DIGITAL ACTION
CLIMATE ACTION

8 ideas to accelerate the twin transition

DIGITALEUROPE

FOREWORD

Together, Europe has set an ambitious target of reducing our emissions by 55% compared to 1990 levels. If we are serious about reaching that goal, we governments, businesses and citizens need to think digital.

It is clearer than ever that we urgently need to take bold actions to counter the global existential threat of climate change and to promote a green economic recovery!

Together, Europe has set an ambitious target of reducing our emissions by 55% compared to 1990 levels. If we are serious about reaching that goal, we governments, businesses and citizens need to think digital.

Studies have found that by 2030, **digital technologies have the potential to help other industries save 20% of global CO_2 emissions.**[1]

For example, a smart city project in the City of Vienna was realised by a combination of innovative digital solutions and data analytics, enabling, amongst other environmental benefits, a reduction of 71% of CO_2 emissions in a large residential building. The project plays a key role in the ambition of the City of Vienna to reduce its environmental footprint.

In the Port of Rotterdam, a combination of innovative digital technologies including artificial intelligence optimise route planning and berthing of the ships, meaning that they are on track to cut 50% of their carbon emissions by 2030.

Renewable energy is crucial to the overall climate goals, but the amount of renewable production that can be injected into the energy grid depends on range of factors and fluctuates. Digital solutions play a key role. An AI-based tool developed and deployed in a Belgian windfarm increased the amount of renewable energy injected on the grid by 5-6%.

These are just a few examples of the many ways that digital technologies can help other sectors of the economy – like construction, transport, and energy – to become greener. You can read more in our paper.

Digital action is climate action

To realise this green potential, digital technologies need investment and enabling legislation that encourages them to flourish. Europe therefore needs to step up its digitalisation efforts – such as boosting connectivity, facilitating data access, and increasing funding to research and development.

And by investing in skills and education, we can ensure that these societal transitions are inclusive. We need to make sure that we empower citizens to succeed in this greener, more digital world.

Our DIGITALEUROPE vision is for Europe to embrace digital in climate action and, in doing this, bring benefits to society at large and to continue its global leadership by collaborating with our international partners.

We strongly believe that we must look at digital and climate action together, rather than separate policy areas. We cannot achieve one without the other.

We also recommend setting ambitious goals for the adoption of new technologies across our most polluting sectors. This KPI-led approach comes from our 2019 manifesto for a stronger digital Europe[2] and was adopted by the European Commission in its Digital Decade targets.

Natural disasters and resource scarcity, like limited access to clean water and agricultural land, will lead to security risks and unrest. These challenges are not national but international by nature. It is our common responsibility towards future generations to do what it takes to protect the environment. It is also our common duty to create a strong and competitive European economy, where people have the means to develop and put into practice innovative solutions that we need.

Cecilia Bonefeld-Dahl
Director-General,
DIGITALEUROPE

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[1] GeSI (2015), *#SMARTer2030 ICT Solutions for 21st Century Challenges*, **https://smarter2030.gesi.org/downloads/Full_report.pdf**
[2] DIGITALEUROPE manifesto (2019), **https://www.digitaleurope.org/policies/strongerdigitaleurope/**

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Introduction

The United Nations Intergovernmental Panel on Climate Change (IPCC) warned in its latest report that global warming will exceed 1.5°C and 2°C during the 21st century unless deep reductions in CO_2 and other greenhouse gas emissions occur in the coming decades.[3] To achieve the goals of the Paris Agreement and limit global warming to well below 2°C and pursuing efforts to limit it to 1.5°C, significant reductions in CO_2 and other greenhouse gas emissions are needed.

For years, DIGITALEUROPE has been advocating for Europe to accelerate the digital transformation of its most energy-intensive sectors. Sustainable digitalisation was a key pillar of our 2019 manifesto.[4] We therefore welcome the strategic direction and ambitious leadership of the von der Leyen Commission, putting the green and digital transitions, the so-called 'twin transition', on top of the political agenda as the two trends that will shape Europe and its future.

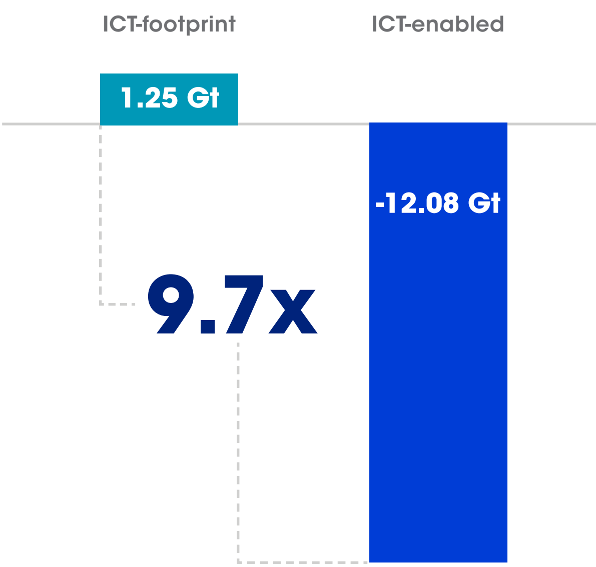
Aside from the 20% of potential carbon savings from digitalisation,[5] a recent study shows that European companies that accelerate both their digital and green transitions are likely to recover faster and emerge stronger from the crisis.[6] Europe's post COVID-19 recovery strategy therefore rightly includes ambitious investment targets for green and digital.

If we are serious about reaching our climate goals, while driving Europe's industrial competitiveness agenda in a global world, we need to accelerate the twin transition. The question is not *if*, but *how*.

While much progress is being made, in reality we see that these two goals are too often considered in isolation. For example, in the recent "Fit for 55" package, the EU Taxonomy, and the investment plans at national level, the connection between digital action and climate action is underdeveloped. This is a missed opportunity.

In this paper we raise awareness about the critical role of digital technologies in the green transition, focusing in particular on addressing climate action.

DIGITAL TECHNOLOGIES CAN SAVE 9.7x MORE EMISSIONS THAN THEY PRODUCE



expected Gt of CO_2 emissions saved by ICT technology by 2030

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[3] IPCC AR6 Climate Change (2021), *The Physical Science Basis*, **https://www.ipcc.ch/report/ar6/wg1/**

[4] DIGITALEUROPE manifesto (2019), **https://www.digitaleurope.org/policies/strongerdigitaleurope/**; DIGITALEUROPE (2019), *Digitalisation as Key for a Sustainable Europe* **https://www.digitaleurope.org/wp/wp-content/uploads/2019/06/Narrative_Sustainability_0620_WEB.pdf**

[5] The figures used in our report are based on the methodology of the GeSI Smarter 2030 study, which Accenture conducted in 2015. In view of various ongoing assessments and discussions on calculation methodologies, the aim of our report is not to present new figures on the saving potential of digital.

[6] **https://www.accenture.com/us-en/insights/strategy/european-double-up**

In **Part 1**, we identify current barriers and present recommendations on how to accelerate the needed shift. We recommend eight actions that Europe and its Member States should prioritise right now.

In **Part 2**, we present 22 case studies from our members to illustrate how digitalisation can cut emissions in five of Europe's most polluting sectors. These five areas – construction, manufacturing, energy, transport, and agriculture – have been identified as having the biggest CO_2 reduction potential enabled by digital technologies.[7]

We want to inspire not only key stakeholders at European level but also stimulate the dialogue at national level to show the opportunities and how to seize them. We hope this will serve as a useful basis for further discussions on concrete actions.

We want to encourage political leaders at European and national levels to fully realise the potential of the twin transition. To do so, we show evidence of what is possible, and what needs to be done to maximise its impact. All these solutions are already possible – we just need to scale them up!

[7] GeSI (2015), *#SMARTer2030 ICT Solutions for 21st Century Challenges*

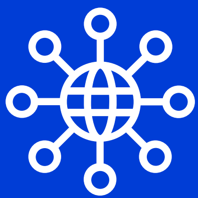
8 ideas to accelerate the twin transition

Set ambitious KPIs to measure Europe's success in accelerating the twin transition

The EU should set concrete targets, similar to those in the Digital Decade post-COVID strategy, and measure the uptake of digital technologies to support our climate goals. These should be both horizontal and sector-specific.

Promote data cooperation to enhance access to and use of sustainability data

In order to make intelligent decisions and cut our energy usage, technologies like AI and the Internet of Things (IoT) rely on access to high-quality and interoperable data. The EU's plan for common European data spaces is a unique opportunity to promote the pooling of sustainability data.



Boost connectivity and infrastructure

Again, strategic digital solutions like AI and IoT rely on high speed and high-quality connectivity. The EU and Member States should increase funding for available and affordable high-quality network infrastructure, such as fibre and 5G, and speed up rollout.

Develop international standards for measuring digital's enablement and carbon footprint

There already exist methodologies and international standards for how to measure the direct environmental footprint of ICT products. However, this is not the case for their enabling effect, that is, the ability for ICT solutions to reduce emissions across other sectors.

The understanding of ICT's impact is therefore limited, and this has an impact on the investments made and ultimately the deployment of solutions. To boost the uptake of digital technologies for the green transition, we need consistent and comparable assessment methods.

Increase access to funding for R&D and innovation spending in green technologies

Europe is lagging behind other major economies in research and innovation spending. Achieving climate neutrality by 2050 means a dramatic scale-up of climate-driven ICT solutions, as well as technological breakthroughs we have not seen yet.

Both EU and national funding programmes should therefore allocate greater resources to help boost clean tech initiatives, notably from start-ups, small and medium-sized enterprises (SMEs), and to create public-private partnerships among industry and academia to fuel technological innovation.

Launch a continent-wide drive for green tech skills

ICT skills such as data literacy, computational thinking, and critical thinking are at the core of Europe's quest to meet its climate neutrality goals. Specific skills are also needed to translate applications of digital solutions to business and industrial uses.

The EU should use its full toolbox of investments and policy to make sure citizens have the skills they need to thrive in a digital and green economy, and that industry has the digital talent it needs to take bold climate action.

Strengthen the link between digital and green policies

Despite the ambitions there are still too many recent examples of legislative proposals that failed to recognise the horizontal and enabling nature of digital. We need to recognise the complementary nature of policy interventions and embed digital transformation into sectoral strategies such as the Renovation Wave, the Common Agricultural Policy, and the "Fit for 55" package, to name just a few.

Create sector-specific action plans to facilitate the uptake of digital technologies across Europe's most energy-intensive sectors

The horizontal actions above should be reinforced by sector-specific action plans at EU and national levels. Each major industry should aim to have a plan in place identifying specific targets for digital uptake; the key technologies they will need to achieve them; what data, research, and skills they need; and an assessment of the regulatory environment and public procurement market.

The role of digital in climate action

While the primary focus of this report is on the role of digital technologies in supporting Europe's key economic sectors to reduce CO_2 emissions, it is important to also acknowledge the broader role of digital in climate action.

Digital technologies and data offer not only solutions to mitigate the impact of climate change, but also to monitor and adapt. The ICT sector is also aware of its own footprint and takes responsibility in becoming greener and more efficient itself, thereby lowering negative environmental impact.

Strengthening climate awareness and monitoring activities

In order to better understand climate change, its short and long-term effects and necessary actions, it is important for scientific organizations as well as government bodies to collect and evaluate a vast amount of data (for example, data about climate, weather, atmosphere, soil, forests, natural resources, pollution etc.).

Digital technologies support in these important monitoring activities. Smart sensors generate data, for instance, on air quality, temperature, and soil. Satellites take millions of images of deforestation, changes in sea level, pollution, spread of atmospheric pollutants and greenhouse gases, and much more. With increasing amounts of data becoming available, technology industry players are launching innovative solutions to enhance the collection, processing, and analysis of the large datasets. This helps to generate actionable sustainability insights.

Supporting smarter climate adaptation actions and crisis management

Even with ambitious climate goals and far-reaching actions to mitigate and cut emissions to zero by 2050, we are already witnessing the impact of climate-related extremes. The devastating floods, heatwaves, and fires across Europe this summer are just recent examples. As the latest IPCC report concluded, human-induced climate change is already affecting extreme weather and climate events in every region across the globe.[8] Evidence of the observed changes in extremes, and their attribution to human influence, has strengthened in the past years.[9]

These climate-related risks require action to prepare and adjust to both the current effects as well as predicted climate change impact in the future. Digital technologies are essential for such adaptation actions. They support government agencies, humanitarian organizations and citizens in making smart decisions by providing timely and effective information. Real-time monitoring, efficient communication links, and digital twin systems, using machine learning, can for instance provide great benefits in the assessment and management of flood risks.[10] There are also promising new projects utilising AI and drones to analyse flood damage. Digital innovation presents opportunities for effective early warning and enhanced disaster management.

[8] IPCC AR6 Climate Change (2021), *The Physical Science Basis,* **https://www.ipcc.ch/report/ar6/wg1/**

[9] *Ibid.*

[10] An example of a project is IJkdijk. This is one of the first projects where, thanks to remote sensor technology, all kinds of measurements and analyzes are performed, in this case on dikes. TNO is the initiator and co-founder of FloodControl IJkdijk together with partners Deltares, STOWA and NOM. The aim is to investigate the possibilities of monitoring dikes by means of sensors in order to eventually arrive at a system for digital dike monitoring. A number of dikes have already been equipped with these sensors. **http://www.ijkdijk.nl/en/**

Taking the initiative to reduce the ICT sector's own footprint

While digital can support most sectors of the economy to become greener, it is also important to look at the footprint of the ICT sector itself and the significant steps that have already been taken to support the greening of ICT. The footprint of digital infrastructure is based on ICT devices, computing centres and communication networks.

Similar studies come to different forecasts on the share of global electricity use by the ICT industry until 2030, due to different scopes, different modelling specificities, lower baselines etc. Despite these differences, it is important to highlight the significant energy efficiency savings which, together with increasingly decarbonised electricity generation, lead to the overall reduction of ICT-related CO_2 emissions.

The International Telecoms Union (ITU) has published a comprehensive standard on the projected greenhouse gas emissions for the ICT industry, and a long-term goal of reaching net-zero carbon emissions by 2050. It predicts that the share of global electricity use by the ICT industry remains stable at 3.3% until 2030.[11]

A recent study estimates that the ICT electricity demand will grow by 50% by 2030, reaching 3,200TWh.[12] Despite this, from 2015 to 2020, we have seen huge efficiency savings. This has been notably visible in data centres and mobile networks (such as 4G). According to the study, 75% of the growth to 2030 is expected to come from data centres and networks, particularly from the steep increase in cloud usage and data storage for big data applications and AI, as well as mobile communications (including the switch to 5G).

As ICT energy demand is essentially electricity-based, any impact of its growth on carbon emissions is primarily related to the carbon intensity of electricity generation. The study suggests that the share of global ICT versus electricity demand is expected to grow from 8.2% in 2020 to 10.2% in 2030. However, looking at CO_2 figures, the share of global ICT energy related emissions would be expected to decrease from 2.8% to 2.6%, because electricity generation will become increasingly decarbonised.

The case of data centres

As our society becomes more digitalised, the amount of data is growing at an exponential rate. This leads to a strong growth in demand for data centre services. Data centres power digital technologies that can help various sectors become more sustainable – including many of the case studies in this paper – which makes them critical to Europe's green transition.

Data centres account for around 1% of global electricity use.[13] Recent years have seen a remarkable decoupling between increasing data use and internet traffic from electricity consumption. This is due to efficiency gains in computing and infrastructure as well as a shift towards greater use of cloud and hyperscale data centres.

The data centre industry is now one of the most advanced sectors in terms of energy efficiency and decarbonisation. If current trends in the efficiency of hardware and infrastructure are maintained, global data centre energy demand can remain flat through 2022, despite a projected 60% increase in service demand.[14]

[11] ITU standard L.1470, **https://www.itu.int/rec/T-REC-L.1470**

[12] Schneider Electric (2021), *Digital Economy and Climate Impact*, **https://perspectives.se.com/research/digital-economy-climate-impact**

[13] International Energy Agency (2020), *Data Centres and Data Transmission Networks*, **https://www.iea.org/reports/data-centres-and-data-transmission-networks**

[14] *Ibid.*

Most data centre owners and operators not only seek to minimise their consumption through optimisation and energy efficiency, but also meet their electricity requirements with energy from renewable sources. Reducing the CO_2 footprint of the digital infrastructure heavily relies on the enhanced use of renewable energy and a next-generation grid infrastructure.

European data centre owners and operators have made commitments to achieve climate neutrality by 2030, setting ambitious targets for energy efficiency, use of clean energy, water conservation and the circular economy. Various industry initiatives, such as the Climate Neutral Data Centre Pact in 2020, also set bold objectives for their members to become climate neutral by 2030.

Virtualisation technology – whereby physical digital infrastructure is moved into the cloud and therefore handled by larger, more energy efficient data centres – can also greatly contribute to reduce the environmental footprint of ICT operations. A recent study, focused on Europe, found that increased deployment of, and continued improvements in virtualisation technology — allowing for much more computing to be done with less energy — could reduce potential future computing emissions by 55% by 2040.[15] This would see computing emissions represent between 2% and 5.5% of total European power sector emissions.[16] The continuous adoption of virtualisation technology by industry should be encouraged and supported to help meeting energy efficiency and CO_2 emission reduction targets.

Supporting the renewable energy transition

While digital technologies can help to significantly reduce CO_2 emissions, even the most efficient economic activities will still use energy. This energy should be increasingly, and ultimately completely, sourced by renewable sources to reach climate neutrality. The renewable sources are weather dependent and variable, which challenges the current energy grids. Digital solutions can empower grids to absorb more power from intermittent energy sources, and they can also help to better balance supply and demand. Smart energy grids are essential to enable the renewable energy sourcing.

ICT device lifecycle and public procurement

The lifecycle of ICT devices is subject to a comprehensive set of different pieces of EU legislation that has expanded over the years.[17,18] Beyond the legislative framework, industry has implemented several successful initiatives (such as the I4R platform[19] and the European Partnership for Responsible Minerals) which are important complementary actions to support the greening of ICT. ICT re-manufacturing, refurbishment and re-use activities also contribute to the circular economy and material and energy efficient use of resources.[20]

DIGITALEUROPE believes in the tremendous potential of sustainable ICT public procurement as a supporting instrument in attaining the goals of the European Green Deal and driving the transition to a low-carbon circular economy. Instruments such as EU Green Public Procurement have their strength in rewarding environmental leadership with positive incentives.[21]

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[15] Aurora Energy Research (2020), *Digital Transformation and a Net Zero Emissions Europe - The role of cloud computing and data centres in achieving power sector emissions reductions in Europe*, **https://www.vmware.com/learn/800033_REG.html**

[16] Virtualization has also been identified as a viable solution for reduction in energy use in a recent European Commission Study (2020), *Energy-efficient Cloud Computing Technologies and Policies for an Eco-friendly Cloud Market*, **ec.europa.eu/digital-single-market/en/news/energy-efficient-cloud-computing-technologies-and-policies-eco-friendly-cloud-market**

[17] The Ecodesign Directive, the RoHS Directive, the REACH Regulation, the WEEE Directive, conflict minerals legislation, etc.

[18] DIGITALEUROPE (2019), *Digitalisation as Key for a Sustainable Europe*, **https://www.digitaleurope.org/wp/wp-content/uploads/2019/06/Narrative_Sustainability_0620_WEB.pdf**

[19] The I4R platform provides treatment and recycling facilities and preparation for re-use operators with access to Waste Electrical and Electronic Equipment (WEEE) recycling information, **https://i4r-platform.eu/**

[20] DIGITALEUROPE (2017), *The Contribution of the Digital Industry in a Circular Economy*, **https://www.digitaleurope.org/resources/the-contribution-of-the-digital-industry-in-a-circular-economy/**

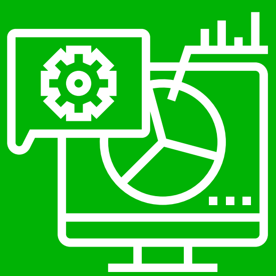
[21] DIGITALEUROPE (2020), *Procurement for a Sustainable Future*, **https://www.digitaleurope.org/resources/procurement-for-a-sustainable-future/**

PART 1

8 IDEAS TO ACCELERATE EUROPE'S TWIN TRANSITION

While many of the necessary and enabling digital innovations for the green transition already exist, there are a number of common barriers identified by solution providers and users. At DIGITALEUROPE we believe these barriers can be overcome with the right policy choices and investments, and we suggest eight ways to do so.

1. Set ambitious key performance indicators for the twin transition



DIGITALEUROPE believes in the importance of key performance indicators (KPIs) and metrics to monitor the implementation of European policies and investments. Back in 2019, we released a set of 22 success indicators that Europe should aim to achieve by 2025.[22] Inspired by our KPIs, the EU's Digital Decade strategy sets digital targets for 2030.[23] Unfortunately, none of these EU targets focus on digital's enabling role in the green transition.

Aligned with our vision and building on the Digital Decade, **we call on the EU to set specific objectives for the green and digital transition, to ensure the EU is on track to meet its decarbonisation objectives.** For that, we need baseline data and clear KPIs to measure.

The process to set the KPIs should involve a wide range of voices, for example through the Industrial Forum and European Green Digital Coalition. It should identify the statistics that are currently missing and aspects that need to be monitored to keep track of Europe's progress in making the twin transition a reality. As well as horizontal KPIs, we should also look at setting KPIs per sector, for example on the uptake of new technologies that are essential to cutting emissions.

The process to set the KPIs should involve a wide range of voices, for example through the Industrial Forum and European Green Digital Coalition.

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[22] DIGITALEUROPE Manifesto (2019), **https://www.digitaleurope.org/policies/strongerdigitaleurope/**

[23] Europe's Digital Decade: digital targets for 2030, **https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/europes-digital-decade-digital-targets-2030_en**

2. Promote data cooperation on sustainability

Data is essential to harness the power of digital across different economic sectors, supporting them to become more efficient and greener. This can vary from data on rainfall patterns to enable farmers to make smart decisions on water and fertilizer usage, to real-time data in production processes that help optimise energy input, to data from sensors in buildings that make it possible to monitor performance levels and help identify energy saving opportunities. We have outlined these and more examples in Part 2.

Meaningful information exchange and taking smart decisions depend on access to quality and reliable data, supported by common interoperable data standards. This is particularly true for AI, as many AI applications depend on the availability of high-quality data to train and develop algorithms, as well as machine and deep learning models.

We should create common data spaces to promote the pooling of data for sustainability and between the key sectors outlined in this report.

However, often high-quality data is either not available or it is not interoperable, and data holders might be unaware of the sharing and collaboration opportunities. These barriers mean that, even where data might in principle be *accessible*, it might not be *usable* enough to enable organisations to derive value from it.

Clear, practical guidance on these issues will give European businesses greater confidence that they can share and use data without risk of liability. Regulatory sandboxing is also a useful tool to experiment with innovative technologies in a controlled environment, under regulatory supervision. Accelerating the twin transition requires advancing the European data economy and creating a truly single market for data that fosters innovation and growth.

We should create common data spaces to promote the pooling of data for sustainability and between the key sectors outlined in this report.[24] These data spaces and the development of industry-driven standards are very important as they allow industry players to compile, curate, share, sell and trade and access quality datasets at a larger scale. Although mandatory standards should be avoided as they risk freezing innovation and impeding market growth, policymakers should support ongoing industry efforts to develop voluntary standards for data sharing, data quality, descriptions of datasets etc.

To boost uptake and to provide actual value for the participating businesses, it is essential to ensure that the data spaces are developed with a bottom-up approach – starting with the use case to assess the data needs and how to standardise – and with non-discriminatory, voluntary participation. We also need to work with researchers and international partners to be able to access state-of-the-art technologies and make the data spaces work in practice. This is particularly important for common challenges like climate change.

In addition, organisations will share their data only if they trust that it will be handled securely and responsibly. Privacy-enhancing technologies should be used to enable organisations to derive value from datasets that contain personal data in ways that do not put data protection at risk.

To encourage the creation of new business models based on business-to-business (B2B) and business-to-government (B2G) data-driven services, we need to promote a data partnership and collaboration culture. Data sharing between companies should be based on the principle of contractual freedom and should therefore be the result of individual negotiations between market participants. Further building blocks of a data partnership culture lie in strong data literacy skills and industry-driven standardisation aligned with global initiatives and fora.

While data spaces can be developed at national and sectorial level, they should ultimately be interoperable. We need cross-border and cross-sectorial approaches, even beyond the EU. Gaia-X, a pioneering industry-led initiative aiming to develop a European cloud and data infrastructure, has the potential to boost data sharing and use in key sectors and among companies of all sizes, as well as paving the way towards the creation of common European data spaces.

Finally, safeguarding global cross-border data flows is crucial. Restrictions to international data transfers could have significant negative impact on European organisations' efforts to become more competitive, digital and greener but also on research, development and innovation projects that rely on exchanging data between partners.[25]

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[24] In the European Data Strategy, the European Commission announced the establishment of nine common European data spaces: industrial (manufacturing), Green Deal, mobility, health, financial, energy, agriculture, public administration, and skills.

[25] DIGITALEUROPE, Frontier Economics (2021), **https://www.digitaleurope.org/resources/the-value-of-cross-border-data-flows-to-europe-risks-and-opportunities**

3. Boost infrastructure & connectivity

5G offers unique ways for industry players to accelerate their green and digital transitions. Research shows that, overall, 5G is expected to reduce CO_2 emissions by 85% (per unit of data transmitted) compared to current 2G – 4G networks.

Connectivity is a fundamental requirement for the twin transition, since many strategic digital solutions like AI and IoT rely on it. However, 40% of people in rural areas still do not have access to fast broadband connections.[26] This does not only have an impact on the digital divide from a social perspective, shutting people out of the digital economy, but it also creates serious barriers for key traditional sectors (such as agriculture, manufacturing, and transport) to accelerate their green and digital transition.

The Internet of Things (IoT)

Connectivity is essential for IoT. IoT products empowered by digital platforms and cloud-based solutions play a key role in collecting, transferring, and analysing a vast amount of data in near real time for increased sustainability. IoT was named in an official analysis of the European Commission[27] as a key enabler for the green transition. This is because of the potential to synchronise devices to optimise energy flows and reduce emissions. IoT has earlier been projected to reduce global carbon emissions by around 15%, through improving process and energy efficiency across a wide range of sectors.[28] It also allows the development of new business models via the sharing and dissemination of information. We need to promote and accelerate the use and development of IoT to grasp the benefit of digitalisation in key energy intensive sectors that require urgent decarbonisation efforts.

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[26] State of the Union Address by President von der Leyen at the European Parliament Plenary (2020), **https://ec.europa.eu/commission/presscorner/detail/en/SPEECH_20_1655**

[27] PwC for the European Commission (2018, *Cross-cutting business models for Internet of Things (IoT)* **https://digital-strategy.ec.europa.eu/en/library/cross-cutting-business-models-internet-things-iot**

[28] Ericsson (2015), **https://www.ericsson.com/res/docs/2015/mobility-report/emr-nov-2015-ict-and-the-low-carbon-economy.pdf**

5G and fibre infrastructure

5G offers unique ways for industry players to accelerate their green and digital transitions. Research shows that, overall, 5G is expected to reduce CO_2 emissions by 85% (per unit of data transmitted) compared to current 2G-4G networks.[29]

High-speed 5G connectivity is critical to enable smart factories, connected vehicles and precision farming due to its ultra-low latency (that is, the time it takes for the data to be transferred), the possibility for real-time communication among connected devices simultaneously, its high reliability for remote control of processes, and high bandwidth enabling high-volume data traffic for surveillance and monitoring of machinery. Together with virtualisation, edge computing, AI-enabled analytics and cloud, 5G can help industries to implement new processes that support a more efficient and flexible allocation of resources.

5G technologies can greatly contribute to the reduction of environmental footprint when moved to the cloud. The power efficiency of 5G networks can benefit from the power optimisation trends of data centres, as big increases in the workloads of data centres translate into very slight increases in power consumption.[30] Therefore, the excellent energy efficiency of the cloud means that 5G networks built in the cloud also benefit.

To date, 5G roll-out is too slow in Europe. Together, we need to address the European and country-specific barriers to the optimal deployment of 5G and other key technologies.[31] 5G spectrums should be made available in all Member States and there is a need to incentivise build-out in industrial locations including remote manufacturing plants or agricultural regions, as set out in DIGITALEUROPE's KPIs for 2025.[32]

The EU and Member States should increase funding for available and affordable high-quality network infrastructure, such as fibre and 5G, in areas where the market conditions are such that private investments will not be able to deliver such networks on their own. Most countries today already have some level of public funds available for broadband deployment projects in rural areas, but these funding levels remain significantly lower than those for other key infrastructure such as roads.

Besides the crucial role of 5G in enabling the green transition in key sectors, it is important to also address its footprint. Research shows that energy consumption is set to increase dramatically if 5G is deployed in the same way as previous generations of wireless were.[33] 5G therefore needs to be deployed in an intelligent way. Industry is taking important steps to reduce the energy consumption. For instance, by modernising the network with the latest technology and replacing old equipment, it is possible to realise new business opportunities and, at the same time, create significant energy savings. There are also advanced energy saving features in the software that can be activated.

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[29] **https://plus.empa.ch/images/5G%20climate%20protection_University%20of%20Zurich_Empa.pdf**

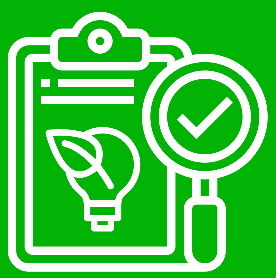
[30] Since 2010, the amount of compute in data centres has increased by 550%, while power consumption only by 6%. **https://www.datacenters.com/news/data-center-power-optimization-increase-efficiency-with-a-data-center-audit**

[31] For some countries such as Belgium, a new emission norm should be adopted and taxes on antennas should be removed.

[32] DIGITALEUROPE, *Key indicators for a stronger Digital Europe*, **https://www.digitaleurope.org/key-indicators-for-a-stronger-digital-europe/**

[33] Ericsson (2020), *Breaking the energy curve*, **https://www.ericsson.com/495d5c/assets/local/about-ericsson/sustainability-and-corporate-responsibility/documents/2020/breaking-the-energy-curve-report.pdf**

4. Develop international standards for measuring digital enablement and carbon footprint



Methodologies for the assessment of the direct environmental footprint of ICT products are already common and subject to international standards, including from standardisation bodies like ETSI, ITU, ISO, CEN-CENELEC and others. There are however no agreed methodology and standard for measuring the positive indirect environmental impact (the enabling effect), including possible rebound effects,[34] of digital solutions and the carbon emissions across industrial sectors. The standards are not yet complete, or inconsistently applied.

The twin transition is hampered by this lack of a standardised framework for measuring the decarbonisation and sustainability potential enabled by digital technologies. Among public as well as private sector players across Europe, the general understanding of the role of digital technologies in greening other industrial sectors is still limited. This limited understanding has an impact on the investments made and ultimately the deployment of the solutions.

The twin transition is hampered by this lack of a standardised framework for measuring the decarbonisation and sustainability potential enabled by digital technologies.

[34] Rebound effects can occur if digitalisation increases consumption or triggers growth effects. As a recent study by Bitkom study also concluded, rebound effects are country, sector- and technology-specific. An exact calculation is therefore very difficult to frame and findings from different studies are very heterogeneous (studies identify a range of 4-37% for the reduction in efficiency potential caused by rebound effects). **https://www.bitkom.org/climate-protection**

In order to boost the uptake of digital technologies for the green transition, for instance via key instruments such as the EU Taxonomy Regulation, there is a need for consistent and comparable assessment methods. This would help public and private investors in making the right decisions and enhance the overall understanding of the enabling potential of digital.

The European Green Digital Coalition (EGDC), an industry-led initiative launched by the European Commission in March 2021 at the request of the European Parliament,[35] has the potential to play a key role. Amongst other goals, one of the primary tasks of the Coalition is to develop methods and tools for measuring the net impact of green digital technologies on the environment and climate.

To ensure global competitiveness and allow industry to scale up world-wide, the work of the EGDC should contribute to the ongoing standardisation efforts by relevant European and international standards development organisations, including CEN, CENELEC, ETSI at European level, ISO, IEC, ITU at global level as well as other industry consortia. Enhanced transatlantic collaboration would bring many mutually beneficial opportunities in this area. The "Climate and Clean Tech" working group, created within the EU-US Trade and Technology Council, should play a key role in fostering this collaboration.

There is also a need for a common way of accurately and consistently measuring carbon emissions across industrial sectors to understand organisations' progress and to enable any necessary actions. Digital technologies can play an important role in supporting and enabling organisations in this recording, reporting, and taking informed decisions. However, there is a need for a harmonised global standard for carbon measurement, accounting, and reporting. It is an area where the EU can show its strong leadership, also in view of the discussions on the Carbon Border Adjustment Mechanism.

[35] The European Green Digital Coalition (EGDC) was formed by 26 CEOs of ICT companies who signed a Declaration to support the Green and Digital Transformation of the EU on Digital Day 2021. **https://digital-strategy.ec.europa.eu/en/policies/european-green-digital-coalition**

5. Increase access to funding for research, development and innovation spending in green technologies

There is no twin transition without innovation. A more holistic approach to investments into R&D and innovation is therefore needed to promote projects combining digital and green innovation. At European level, the European Recovery and Resilience Facility[36] has rightly introduced clear targets with 37% spending on green and 20% on digital. While these ambitious targets are important, many European governments have separate spending plans for digitalisation and decarbonisation in their national recovery plans. If we want to boost the twin transition, we should not look at these two as separate investment areas.

Europe is lagging behind other major economies in research and innovation spending[37], and should be channelling more resources towards improving and leveraging green technologies. Achieving climate neutrality by 2050 means a dramatic scale-up of climate-driven ICT solutions, as well as technological breakthroughs we have not seen yet. At EU level, this means ensuring that programmes such as Horizon Europe, Digital Europe, but also the Just Transition Fund, support innovative tech projects with sustainability at their core.

Currently, about 20%-25% of the patents developed by ICT companies are in green technologies, mainly in energy and greenhouse gas emission reduction.

[36] The RRF is the centrepiece of NextGenerationEU, a temporary recovery instrument that allows the Commission to raise funds to help repair the immediate economic and social damage brought about by the COVID-19 pandemic.

[37] European Investment Bank (2020), *Building a smart and green Europe in the COVID-19 era,* **https://www.eib.org/attachments/efs/economic_investment_report_2020_2021_en.pdf, p.231 (239)**

Currently, about 20% to 25% of the patents developed by ICT companies are in green technologies, mainly in energy and greenhouse gas emission reduction.[38] These figures can be improved further. Both EU and national funding programmes should allocate greater resources to help boost clean tech initiatives, notably from start-ups and SMEs, and to create public-private partnerships among industry and academia to fuel technological innovation. Innovative digital products and services for the green transition should be supported and celebrated.

To support companies to innovate and kickstart their digitally-enabled sustainability journey, there is a need for more funding and financial incentives. Beyond horizontal investment areas, there is a need to identify specific investment needs per industrial sector and capture them in sector-specific action plans *(see point 8).*

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[38] *Ibid.*, p.246 (254).

6. Launch a continent-wide drive for green tech skills

Skills are one of the main drivers to ensure that the twin transition is just and inclusive, leaving no one behind. A lack of green digital skills is also a major obstacle in accelerating this transition. No digital green technology can be implemented without workers with the right training. A lack of green digital skills also impacts the potential for R&D and future innovation in green tech in Europe.

ICT skills that can contribute to green skills,[39] such as data literacy, computational thinking, and critical thinking, are at the core of Europe's quest to meet climate neutrality goals. Specific skills are also needed to translate applications of digital solutions to business and industrial uses. Unleashing their potential requires strong digital upskilling at a basic and advanced level, as well as bold educational reforms to school and university curricula. With Europe embarking upon its Digital Decade, it is crucial that the workforce of tomorrow is given the right skills to keep up with these rapid changes and, most importantly, be part of the digital and green transition.

EU initiatives such as the European Skills Agenda and the Digital Education Action Plan will go a long way in ensuring that people across Europe are able to make the most of digital opportunities. This also includes gaining the right qualifications to do so via initiatives like the Pact for Skills, which several companies and organisations have joined in November 2020 to engage in concrete commitments on upskilling and reskilling.

Building renovations, upgraded infrastructures, smart energy, and waste management will all create a new wave of green jobs in Europe.

[39] UNIDO defines green skills as "the knowledge, abilities, values and attitudes needed to live in, develop and support a sustainable and resource-efficient society". **https://www.unido.org/stories/what-are-green-skills**

The good news is that there are already funding and policy tools in the EU's arsenal.

Firstly, initiatives like the Digital Skills and Jobs Coalition, the Just Transition Fund and the Social Climate Fund have a key responsibility in ensuring strong digital upskilling and reskilling, not least because these efforts will guarantee access to more qualified and better paid jobs in the future. Building renovations, upgraded infrastructure, smart energy, and waste management will all create a new wave of green jobs in Europe. But they will require the necessary skills. Funding is a powerful tool to enable this.

Secondly, EU recommendations to encourage the recognition and validation of micro-credentials – meaning qualifications acquired through a short, transparently-assessed course or module – will be crucial.

We should also ensure that training entitlements can be transferred between jobs, as well as increasing the general level of knowledge around environmental sustainability. Encouraging the development of digital green skills, from pupils to experienced workers, will be essential to enable socio-economic integration, and encourage the technology creators of the future.

For example, new trainings on digital for climate action should be part of national education systems and businesses alike. Several companies have already launched online trainings supporting businesses on how to adopt smart sustainability practices, create sustainable products and services or improve environmental, social and governance practices.

7. Strengthen the link between digital and green policies

We need to recognise the complementary nature of policy interventions and embed digital transformation into sectorial strategies.

For the twin transition to succeed and flourish, sustainability and digital policies need to be considered by policymakers in an integrated way and should reinforce each other.

While we welcome the overall strategic direction and recognise the efforts of the current European Commission to accelerate the twin transition, there are still many recent examples of legislative proposals that failed to recognise the horizontal and enabling nature of digital.[40,41]

We need to recognise the complementary nature of policy interventions and embed digital transformation into sectorial strategies such as the Renovation Wave, the Common Agricultural Policy, and the "Fit for 55" package. This includes their social aspects too, such as the increasing importance of digital upskilling and reskilling in the Just Transition and the Social Climate Funds.

A recent study by Bitkom[42] found that the speed of digital transformation is the primary factor determining the contribution of digital technologies to climate protection. It suggests that digital technologies could support Germany getting halfway towards its 2030 climate goals. The faster the digital transformation across a number of sectors, the quicker they will reach their climate goals.

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[40] The most recent example being Europe's ambitious "Fit for 55" package (July 2021) setting out the measures to reach reduce its net greenhouse gas emissions by at least 55 percent by 2030 which fails to recognize and leverage the enabling potential of digital technologies.

[41] Similarly, the draft EU Taxonomy Climate Delegated Acts initially failed to recognize and leverage the enabling potential of digital technologies. DIGITALEUROPE (2020), **https://www.digitaleurope.org/resources/the-eu-taxonomy-a-missed-opportunity-to-grasp-the-potential-of-the-ict-sector/**

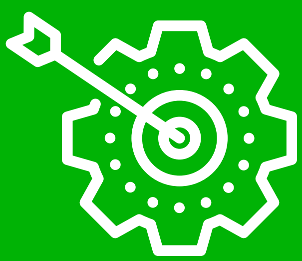
[42] Bitkom study, conducted by Accenture, (2020), *The digital economy's impact on the climate*, **https://www.bitkom.org/climate-protection**

We must also further promote industry-led initiatives for self-regulation or co-regulation. The Climate Neutral Data Centre Pact is an example that commits data centre operators to ambitious actions to make data centres climate neutral by 2030. Another good example of such an initiative is the Data Centres Energy Efficiency Code of Conduct (CoC).[43] The aim is to inform and stimulate data centre operators and owners to reduce energy consumption in a cost-effective manner without hampering the mission-critical function of data centres. The CoC is a voluntary initiative which brings a range of different players together.

To achieve the overall climate goals, it is important to strive for common, harmonised European approaches that can also be an example for global regulation. With the current ambitious strategic direction and actions taken so far on the climate agenda, Europe has the potential to be the global champion and show international leadership. With the focus on the twin transition, Europe has the potential to also step up its leadership on digital. Europe should promote policy instruments that spur environmental innovation, encourage competition, and mobilise sustainable finance and investment. Driving the global agenda and strengthening international regulatory alignment and sharing of best practices will be crucial for the green and digital transitions to happen and succeed.

[43] More about the JRC Data Centres Code of Conduct: **https://e3p.jrc.ec.europa.eu/communities/data-centres-code-conduct**

8. Create sector-specific action plans to facilitate uptake of digital across Europe's most energy intensive sectors



Following our overall assessment of the various barriers and opportunities identified across key sectors, there is a clear need for horizontal actions to accelerate the twin transition. These horizontal actions should however be complemented by sector-specific action plans.

Sector-specific action plans are needed to maximise the environmental benefits made possible by digital technologies and to address any specific challenges to the uptake of digital. These action plans should be developed at European level in the context of the European Industrial Strategy, but we should also require national equivalents to address any specific challenges and make sure we take advantage of local opportunities. The action plans should be based on thorough analysis and stakeholder feedback within the Industrial Forum and European Green Digital Coalition and be regularly reviewed and updated.

These horizontal actions should however be complemented by sector-specific action plans.

Sector specific action plans should include at least the following key elements:

- **KPIs:** to set ambitious goals to measure the twin transition and uptake of digital.
- **Key technologies:** identification of key green digital solutions, understanding specific obstacles (e.g., connectivity, funding etc.) and providing deployment guidance.
- **Data:** identify the data needs and gaps in standards for data sharing.
- **R&D:** investments to mobilise more research and support for projects.
- **Skills:** understanding the skills gap and key actions to address this.
- **Regulatory environment and public procurement:** assessment of relevant horizontal and sector-specific legislation at European and national level and their impact on the sector, including specific needs on implementation, issues with fragmentation or overlaps, lack of green-digital synergies etc. as well as the role of public tenders in deployment of digital technologies.

PART 2

TWIN TRANSITION IN ACTION: CASE STUDIES

Construction

The construction sector is a pillar of the European economy, providing 18 million direct jobs and contributing to about 9% of the EU's GDP.[44] Yet buildings generate about 40% of the EU's energy consumption and 36% of its greenhouse gas emissions.[45]

Digital technologies such as IoT and AI will radically change how we manage and maintain the building stock. Around three quarters of greenhouse gases emitted by buildings are caused by their heating and cooling systems. Through a network of sensors, smart meters, edge computing and energy management solutions, these systems can be optimised to ensure maximum efficiency.

Yet, despite these promising benefits, the sector has been slow in technological adoption.

According to statistics,[46] construction is the least digitised sector in the EU. Globally, the EU construction market only ranks fifth in the use of Building Information Modelling (BIM), one of the most critical tools to digitise the building sector. The building value chain (construction, technology, services, utilities, software etc.) include several global leaders but actors are still very much working in silos which hampers interaction, efficiency, and innovation.

[44] More information: **https://ec.europa.eu/growth/sectors/construction_en**

[45] More information: **https://ec.europa.eu/energy/topics/energy-efficiency/energy-efficient-buildings/energy-performance-buildings-directive_en#energy-performance-of-buildings-standards**

[46] Euractiv, *Construction: The least digitised sector in Europe*, **https://www.euractiv.com/section/digital/news/construction-the-least-digitised-sector-in-europe/**

Member: Autodesk
Location: Oslo, Norway

Advanced digital construction technologies for sustainable buildings

Challenge:
Oslo's historic Bjørvika district is going through major transformation as part of the biggest urban regeneration project in Norway's history, called the "Fjord City" (Fjordbyen). The project seeks to replace old port-lands infrastructure with a new arts and culture precinct. From the get-go, the city of Oslo set sustainability objectives for every component of the Bjørvika regeneration. The challenge was not only to ensure energy-efficient buildings, but also to minimise the embodied carbon stemming from the construction process and the material used. Both were made possible due to the use of advanced digital construction technologies by lead engineering firm Multiconsult.

Solution:
The new Deichman Library has a semi-transparent tiled facade and a rooftop seemingly constructed from car-size shards of triangular glass. These elements were realised with the help of BIM (Building Information Modelling) technology and the power of 3D modelling. The building's exterior combines windowpanes and translucent walls buttressed by insulation and sun protection. The insulation means there is little heat loss: the estimated net energy demand of the total building for the year is only **75-kilowatt hours per square meter.** The reduction is telling – the average consumption of non-residential buildings is 250kWh per square meter.[47] The library is architecturally designed for low energy consumption and **greenhouse gas emissions reduction by 50%** compared to standard buildings. More than 50 3D models created using BIM technology simulated different ways of meeting the building's sustainability targets. BIM allowed Multiconsult to work faster, with less errors and for a lower cost, owing to the use of performant 3D design software. Moreover, the software integrates a lot of information that allows to simulate a broad range of projects based on the sustainability criteria set.

Main technologies:
Building information modelling (BIM)

Partners:
Autodesk solutions were used by Multiconsult, a Norwegian engineering firm, which designed the building with sustainability in mind from the beginning.

[47] European Commission (2013), *Energy consumption per m^2*, **https://ec.europa.eu/energy/content/energy-consumption-m%C2%B2-2_en**

A digitally-enabled, net-zero, ultra-efficient building

Member:
Schneider Electric
Location: Grenoble, France

Challenge:
Schneider Electric planned to build a new, ultra-efficient, zero-carbon office building for its employees in Grenoble. The new building – IntenCity – had to be compliant with the new stringent French Environmental Regulation RE2020. IntenCity also set a target for itself of only **37 kWh/m^2/year**, about a ninth of the average energy efficiency of large office buildings in the world.

Solution:
Schneider Electric's digital solutions allowed IntenCity to be built for this type of performance. Owing to 4,000m^2 of solar panel, local electricity generation largely compensates for consumption, namely **0,9 GWh/year**. More than **1,000 IoT measuring or sensing devices** were deployed in the building to allow for granular and timely energy optimisation strategies. The operational control of all the building's energy systems, provided by the Ecostruxure Building Operation (EBO) software, allows for monitoring and controlling the states of any energy system in the building every minute. Data inputs from all sensors and meters are further aggregated and analysed by the Ecostruxure Power Monitoring Expert (PME) tool. The building manager can rapidly create indicators relative to one or several energy systems and analyse data. On top of EBO, the Ecostruxure Microgrid Advisor (EMA) leverages flexibility pathways to optimise the electricity bill of the building and provide services to the grid.

Main technologies:
Field devices, IoT sensing devices, energy/power meters, Building Management System, Energy/Microgrid management system, Cloud-based Optimization software.

Partners:
Schneider Electric is the tenant of the building, having partnered with Bouygues Immobilier as the owner of the building.

Digital, decentralised, and decarbonised city infrastructure

Member: Siemens
Location: Vienna, Austria

Challenge:
Heading the list of the "Top 10 Smart Cities on the Planet" in 2019,[48] the City of Vienna was determined to reduce its environmental footprint even further.

Solution:
Siemens launched a large smart city project in Vienna. A living laboratory has been running since 2013 in the waterside district of Aspern, one of the largest urban development projects in Europe. Information and communication technologies played an important role in the project, as did data evaluation. Power management in buildings, smart low voltage grid solutions (the electrical distribution system from transformers down to individual buildings and apartments), and Smart Data Solutions for managing "big data", including a city data centre have all been used in running the project. The new IT solutions could detect faults in the system, recognise inefficient consumption patterns and identify potential opportunities for savings. The benefits of the project included an **annual heat recovery of around 195 MWh** e.g., from appliances, **71% reduction in CO_2 emissions** in a residential building with 300 rental apartments, and 1,400 MWh/a energy requirements of a thermal autonomous residential building with **300 units generated entirely from renewable sources.**

Main technologies:
Data analytics, Smart Grid/Edge technologies, BIM, Digital Building Twin, Grid Twin and City Twin, including the transportation grid and the electricity grid.

Partners:
Siemens partnered with the City of Vienna and the city's utility company, Wien Energie.

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[48] City of Vienna (2019), *Vienna is the world's smartest city*, https://www.wien.gv.at/english/politics/international/comparison/smart-city-index.html

A cloud-based monitoring system for saving energy in buildings

Member:
Dell Technologies
Location: United Kingdom

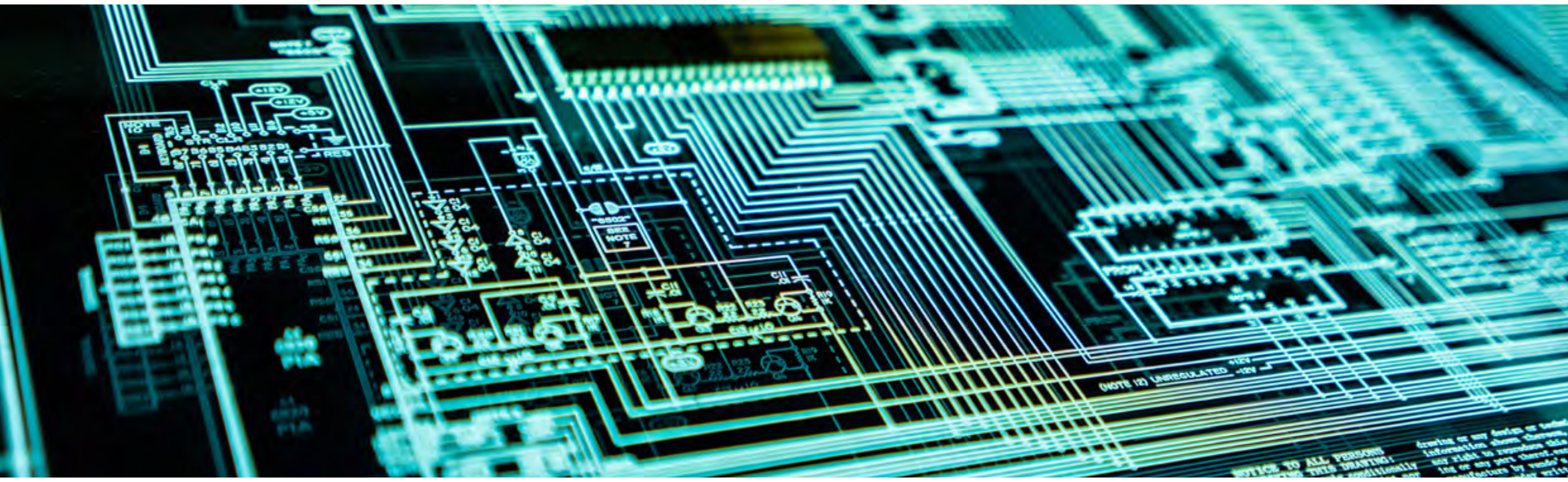
Challenge:
Buildings generate nearly 40% of energy-related carbon emissions worldwide. To achieve global net-zero emissions by 2050, organisations need technologies that make it easier to manage heating, cooling, ventilation, and air conditioning (HVAC) systems. Today, most HVAC systems must be managed manually on-site, making it difficult for businesses to generate live data insights for monitoring and optimising their energy use. A lack of communication between customers' industrial systems, and the absence of a centralised point of insight and control in the cloud are barriers for organisations in reducing their buildings' carbon footprint.

Solution:
Hark Systems, a UK-based energy analytics and industrial IoT company, partnered with Dell Technologies to deploy the Hark Platform, an all-in-one, cloud-based monitoring system, which aggregates data on energy use from existing infrastructures, including HVAC, power, and lighting assets. The Hark Platform turns legacy assets into smart devices by retrieving, analysing, and consolidating sensor data.

The Hark Platform connects modern technology with back-room assets, which are often left out of digitisation programmes. For example, in Sainsbury's stores, the Hark Platform has detected anomalies that have saved **4.5% of lighting costs** by detecting problems and alerting the relevant people in real-time. The Hark Platform saved another customer £1 million (€1.17 million) in energy and asset costs over one year, whilst enabling another to save enough energy in **1 month to power the equivalent of 800 homes for a year**. By providing smart energy controls and partnering with Dell Technologies OEM Solutions, Hark helps more companies understand how their buildings operate so that they can reduce their energy footprint and take an important step toward achieving their net-zero goals.

Main technologies:
Cloud-based IoT

Partners:
Hark Systems, a UK-based energy analytics and industrial IoT company, partnered with Dell Technologies to reduce the energy footprint of buildings.[49]



[49] Hark Systems, **https://harksys.com/**

Partner: Knauf Energy Solutions
Location: Halle, Belgium

Greening buildings with the help of digital technologies

Challenge:
Residential buildings are one of the most important sources of CO_2 emissions. Buildings in the EU are responsible for 36% of all CO_2 emissions[50], and residential houses account for the majority of the building stock. Currently, it is almost impossible to know the real energy and CO_2 savings delivered by energy efficiency renovations in the residential building sector. The sector has had to rely on estimations of the energy efficiency gains which can be wildly inaccurate. The asymmetry of information has led to a market failure ("Market for Lemons" Akerof's 2001 Nobel Prize for Economics). Symptoms of the market failure include, for example, that on the demand side there are no real guarantees of the delivered results of a costly renovation; on the supply side, there are no real incentives to deliver quality, as the construction sector is often paid by the time and material spent. These spin greater distrust in renovation as a reliable source of energy demand reductions, diverting investments from the sector. KES technology solves the fundamental information asymmetry that underpins this market failure.

Solution:
Knauf Energy Solutions (KES) provides an innovative technology that makes it possible to accurately measure and therefore correctly manage the renovation of buildings. The Virtual Energy Infrastructure (VEI) gives both homeowners and governments the confidence to fully leverage the energy saving potential in the built environment.

KES worked with the social housing company in Halle to renovate a neighbourhood of 185 dwellings.
As a first step, each building was continuously assessed by sensors and machine learning algorithms to deliver real performance view of their pre-retrofit energy efficiency level.
As a one-stop-shop, KES controls works and delivery of the retrofit through a comprehensive on-site quality assurance regime, as well as customised training programmes that certify contractors. Finally, the sensors allow KES to properly benchmark the energy performance of the building fabric after the retrofit, giving accurate overview of the delivered energy efficiency savings. Across their different projects, they have different levels of renovation depth but even for simple and cost-effective measures such as loft and cavity renovation works done correctly, they have reported **energy efficiency improvements of 40% on average.**

Main technology:
IoT, AI, Building Physics

Partners:
Knauf Energy Solutions has partnered with a number of social housing companies in Belgium and the UK to deliver Smart Retrofit projects.

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[50] European Commission 2017, *In focus: Energy efficiency in buildings*, **https://ec.europa.eu/info/news/focus-energy-efficiency-buildings-2020-feb-17_en**

Manufacturing

The digital transformation of manufacturing is enabling decarbonization and material efficiency, helping Europe to reinforce its global leadership position in this sector.

Digital technologies, such as IoT, remote monitoring, industrial robots, 3D printing, big data analysis and AI are changing the nature of traditional manufacturing companies and helping them in becoming safer, more productive, more accurate, more sustainable, and more cost-effective.

High-speed 5G connectivity is critical to enable smart and green factories,[51] where wireless communications and industrial IoT are transforming manufacturing through hybrid cyber-physical systems. In a smart factory, almost every asset is connected: this allows for a more efficient production system through a range of sustainability advantages, from machinery monitoring for predictive maintenance and remote-control to real-time supply chain visibility.

A challenge that needs to be overcome is how industry can adopt digital technologies to transform their operations, e.g. transforming supply networks and industrial footprints to reduce logistics activity/emissions, transforming manufacturing model/layout to reduce the required activity levels, less physical space, reduced power consumption etc., transforming the design-sourcing-production chain to create new products with lower environmental impact and more compatibility with a circular economy, transforming production planning and execution to eliminate scarp, waste, and over-production and transforming packaging.

[51] A study commissioned by the German Federal Ministry for Economic Affairs and Energy has shown that manufacturers can save at least 11% (€594m) of material costs and 10% of energy costs (€344m) thanks to digitalization. An average of further 7% reduction in the current use of resources could be achieved through a nationwide broadband expansion and 5G roll-out:
https://www.iwkoeln.de/fileadmin/user_upload/Studien/Gutachten/PDF/2021/Ressourceneffizienz_4.0_Hauptbericht_final.pdf

Member: Rockwell Automation
Location: Ghent, Belgium

Digital technologies transform steel plant carbon emissions into usable fuels and plastics

Challenge:
ArcelorMittal, Europe's largest steel manufacturer, has been seeking to improve standards around a specific part of its operations – the carbon emanating from its blast furnaces, with an overarching goal of reducing carbon emissions across the company's European operations by **30% compared to 2018 figures.**

Solution:
LanzaTech used Rockwell Automation's digital technologies to help ArcelorMittal convert carbon from its plant in Ghent, Belgium, into ethanol. The process uses the PlantPAx distributed control systems (DCS) that allows the company to capture the carbon in the steel off-gases and convert it to ethanol. As a result, the carbon is recycled into a valuable commodity that enables economic routes to sustainable fuels, including sustainable aviation fuel, and chemicals that can serve as building blocks for everyday consumer products, such as plastics and synthetic fibres that can be used in CarbonSmartTM packaging and textiles applications. The PlantPAx® system provides a modern approach to distributed control. The system shares common technology with all other automation disciplines in the plant. This approach creates a seamless information flow across the plant for optimisation opportunities and enables a Connected Enterprise.

Main technologies:
Advanced Process Control technology with specially adapted control loops for this technology.

Partners:
Rockwell Automation partnered with LanzaTech to make carbon from emissions a sellable by-product.

Edge computing leading to energy savings in factories across Europe

Member: Mitsubishi Electric
Location: Poland, United Kingdom, France, and Germany

Challenge:
Manufacturing companies collect large amounts of data. These data can be used to save energy, for instance in terms of consumption and production volume. However, there is a limit to how much data an average engineer can grasp, analyse, and use to improve various internal systems. The power of human cognition can be improved and empowered by the right tools where AI technology is implemented. Such tools need to be based on a large experience and expertise in manufacturing.

Solution:
Mitsubishi Electric developed e-F@ctory, an integration solution that can be employed cross-industries. e-F@actory is an advanced technology that utilises AI to collect data from the production shop floor and analyses it in real-time, thereby improving production. Using edge computing, e-F@ctory achieves data connectivity with optimal efficiency, leading to energy savings. The entry-level e-Factory package can achieve annual **energy savings of 15,000 kWh** (10%) for an SME operation consuming 150,000 kWh per annum. Calculated at €0.11/kWh this amounts to an annual cost saving of €1,600. With a capital cost of €2,256, the return on investment is achieved as a result of energy savings in 17 months.

Main technologies:
IoT, AI, data analytics

Partners:
Mitsubishi Electric are partnering with factories in Poland, United Kingdom, France, and Germany in order to achieve further optimisation and higher efficiency.

Member:
Arcelik A.Ş.
Location: Ulmi, Romania

Digital solutions for lower energy consumption in products

Challenge:
As a global manufacturing company, Arcelik has many processes in place in various locations across the world. The company needed high automation processes, measuring, and analysing infrastructure as part of their digital factories.

Solution:
The Arctic Washing Machine plant in Ulmi, Romania, has implemented advanced measuring and data acquisition system: 245 energy analysers, 9 natural gas meters, 42 water meters, 68 calorimeters, 62 compressed air flow meters and various sensors (daylight, temperature, CO_2 etc.). Equally, machine-wise production quantities, the status information for machinery/equipment (Run/Idle/Setup/Off) and process information such as bushing temperatures, crank angles, hydraulic system temperatures and flowrates etc. are transferred to the databases via Manufacturing Execution System (MES). Connecting these different databases, energy consumption of each single machine/equipment can be tracked with production quantities and status information, helping to decrease the energy consumption per product.

Main technology:
Data analytics, data visualisation, smart algorithms, IoT

Partners:
Arçelik A.Ş. partnered with Accenture and Siemens to reduce the energy consumption per product, whilst implementing an environmentally friendly production.

Data for recycling copper

Challenge:
Aurubis produces copper wire rod that its customers later process into copper wire and cable. Production scraps resulting from these applications consists of high-quality copper. However, this copper might not always be immediately reused and often needs refining, which leads to high environmental and economic impact.

Solution:
Aurubis developed a data modelling technique to recycle the high-grade copper scrap directly into the melting furnace, to make wire rod without compromising its quality in any way. If multiple smelting and refining steps can be avoided, significant energy saving can be achieved.

This real-time modelling technique is based on a wide range of available data, such as orders from customers with the required quality and delivery times, estimates of the returned production scrap's quality, and various sensor measurements in the production process. The outcome is then integrated in the process control to allow the operator to recycle optimally customer's production scrap into the melting furnace and still reach the quality requirements for wire rod. In addition, the generated data is reintroduced into the modelling tool during the process, enabling a learning effect and leading to process improvements overtime.

Main technologies: IoT, data analytics

Member: Aurubis (Agoria member)
Location: Olen, Belgium

Member: SAP
Location: Germany

Cloud application enabling calculation of product carbon footprint

Challenge:
Companies are experiencing difficulties in gathering relevant CO_2 data across the product lifecycle. Businesses need to aggregate their existing transactional and master data together with sustainability data, to achieve regulatory compliance, operational excellence, and innovation and growth. Data from environmental assessments are challenging to interpret and consistent reporting on environmental information poses a challenge. Businesses need well-defined, flexible governance models to establish baselines for measuring and reporting progress on reducing product footprint.

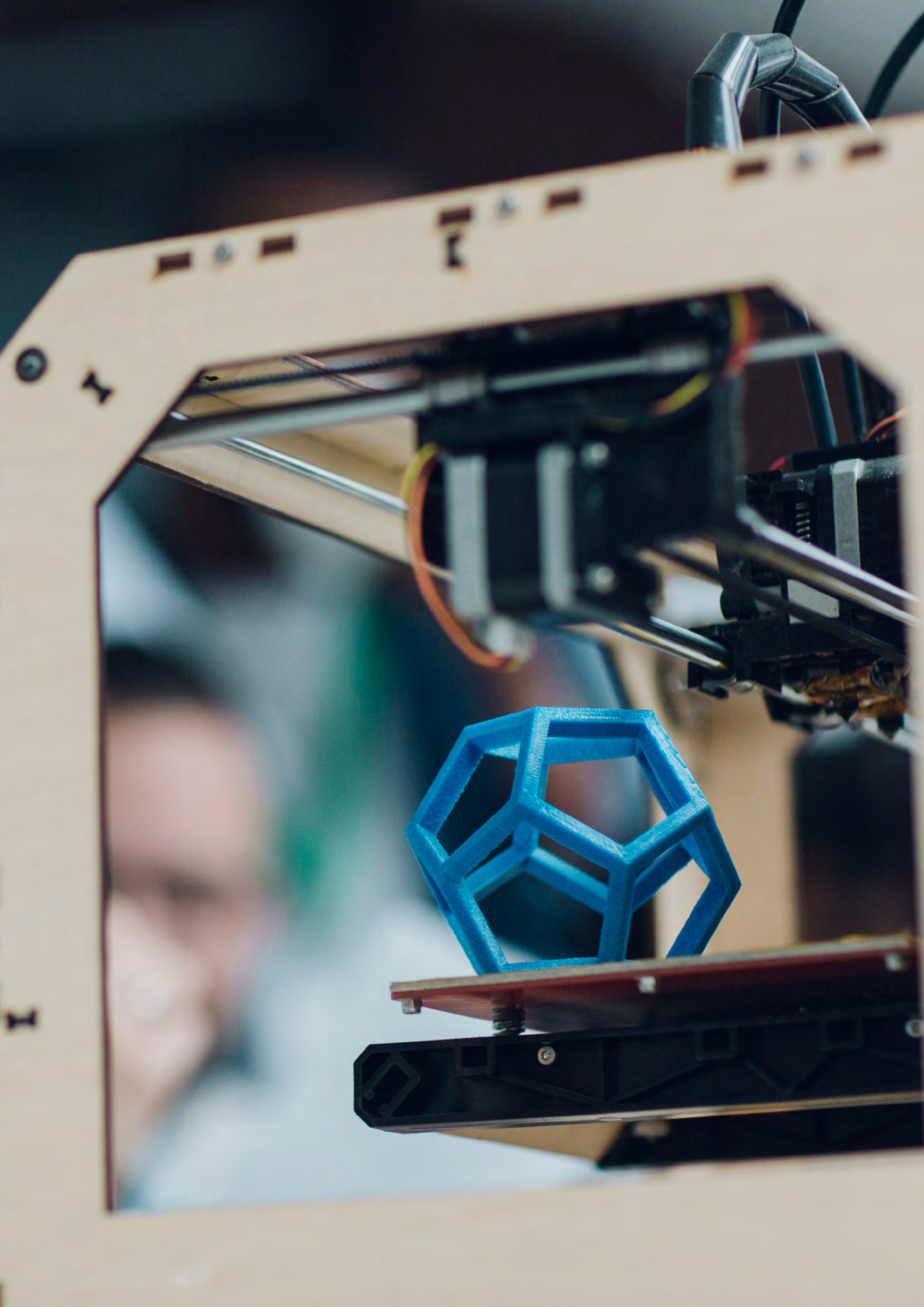
Solution:
SAP Product Footprint Management is enabling calculation of product footprints periodically and at scale across the entire product lifecycle and supply chain, allowing companies to lower their carbon emissions and make their products more sustainable. Those footprints provide customers insights regarding the environmental impact of their products for disclosure to business partners, regulators and for internal product and process optimization. By integrating emissions data across all solutions that govern production processes with master data from business applications such as SAP S/4HANA, SAP Product Footprint Management can calculate the environmental impact of various production scenarios, and is embedded into SAP's Chasing Zero strategy to create a sustainable future through zero emissions, zero waste and zero inequality.

Main technology:
Cloud application

Partners:
Together with WBCSD,[52] SAP is finding new ways to collect and share product carbon footprint data with their customers and consumers, which will give them a real competitive advantage while accelerating global decarbonisation efforts. By working through the Climate 21 co-innovation Council, they are also building an ecosystem around the Climate 21 programme[53] to help companies understand, minimise and disclose the full carbon footprints of their products and services.

[52] WBCSD 2021, *SAP Joins the World Business Council for Sustainable Development to innovate in global decarbonization effort*, **https://www.wbcsd.org/Overview/News-Insights/General/News/SAP-Joins-the-World-Business-Council-for-Sustainable-Development-to-innovate-in-global-decarbonization-effort**

[53] SAP 2020, *SAP Delivers Innovations That Tackle Supply Chain and Industry Challenges; Embedding Sustainability for the Post-Pandemic Era*, **https://news.sap.com/2020/06/sapphire-now-innovations-supply-chain-industry-sustainability/**



Energy

The energy sector has been an early adopter of digital technologies. Digital technologies enable "intelligent" electricity networks and support more efficient and resilient grids with sustainable integration of renewable generation, and a more reliable power system with reduced operations, maintenance costs and outages. Such a fully modern electricity smart grid takes advantage of remote and virtual digital control and data analytical models and systems.

Digital tools will allow intermittent renewables and energy storage assets to be used at scale and to maximise their potential, reducing CO_2 emissions that would be otherwise generated when relying on traditional energy grid management.

Digitalisation can help integrate variable renewables by enabling grids to better match energy demand to times when the sun is shining, and the wind is blowing. In the EU alone, increased storage and digitally-enabled demand response could reduce curtailment of solar photovoltaics (PV) and wind power from 7% to 1.6% in 2040, avoiding 30 million tonnes of CO_2 emissions in 2040.[54]

[54] International Energy Agency (2017), *Digitalisation and Energy*, **https://www.iea.org/reports/digitalisation-and-energy**

Digitalisation platforms boost wind farm productivity

Member:
Nokia
Location: Belgian North Sea

Challenge:
Renewable energy is crucial to the overall climate goals. Wind farms are a valuable source of renewable energy. However, for them to be profitable, the processes need to be as efficient as possible. This is no easy task when operating in remote locations and when so much data needs to be collected to accurately monitor turbines and optimise repair schedules.

Solution:
Private Long-term Evolution (LTE) networks allow for a comprehensive IoT system, connecting teams both onshore and offshore with data reported from sensors installed in the wind turbine, including temperature, vibrations, humidity and current. Nokia's Digital Automation Cloud platform offers unmetered private wireless connectivity and edge computing capabilities.

In collaboration with nCentric, this 5G ready Nokia private LTE network solution has already successfully been installed at several offshore wind farms, improving connectivity, and decreasing costs compared to 3G and VSAT. According to nCentric, a private LTE network can offer 30 times more bandwidth than VSAT, enabling live HD video streaming, video conferencing, file synchronisation, and seamless communication between offshore platforms and teams on land. Data can be monitored in real-time or stored in the cloud for analysis.

Main technologies: IoT, edge cloud computing, artificial intelligence

Partners: Nokia partnered with nCentric to streamline operations in remote locations for wind farms.

Optimising wind energy distribution with the help of artificial intelligence

Member:
Haulogy (Agoria member)
Location:
Braine-le-Comte, Belgium

Challenge:
The amount of renewable production that can be injected into the electrical distribution grid depends on numerous factors and can fluctuate greatly over time. Imposing a static limit on distributed generation, such as wind turbines, requires a conservative approach and is a waste of renewable energy.

Solution:
SANO is an AI-based tool for enhancing the injection of wind energy in the distribution grid and reducing congestions. The AI-based solution developed by Haulogy enables active management of distribution grids and aims to prevent congestion on the network. It allows as much generation as possible and limits the output of wind farms and other distributed generators only when there is a congestion risk to avoid grid disconnections. The O-One project tested the tool on a distribution grid of ORES, hosting a windfarm of Luminus, and showed that it can increase the amount of renewable energy injected on the grid by **5-6%**.[55]

Main technology: Machine learning, artificial intelligence, power systems modelling, software engineering

Partners: Haulogy partnered with ORES and Luminus to improve the integration of renewable energy.

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[55] La Libre (2021) *L'intelligence artificielle au secours des éoliennes*, **https://www.lalibre.be/economie/digital/2021/07/01/lintelligence-artificielle-au-secours-des-eoliennes-DYZALDXMMVFINFEGOVMUMNLXI4/**

Transport

Across the various modes of transport, digital technologies do not only play a key role in enhancing safety but are also helping to reduce emissions. This can lead to the improvement of energy efficiency and reduce maintenance costs.

The Dutch research institute TNO studied the environmental benefits of cellular-based Vehicle-to-Everything (C-V2X) technology and provided evidence of the emission reduction potential of various use cases. Effect sizes per use case has been found high potential to reduce emissions between 5 to 20%. Integrated into corridors and smart cities it will have the true potential to make transport safer.

Therefore, applied digital technologies can significantly reduce CO_2 emissions in the transport sector, for instance through speed and trip planning optimisation, enabling driverless and connected cars as well as Mobility-as-a-Service (MaaS) solutions.

One of the hardest-to-abate sectors is air transport. Reducing its environmental impact is one of the goals of the European Green Deal. Sensors on aircrafts generate data which, through big data analytics, help optimise route planning and enable pilots to make smart decisions and reduce fuel use. A modernised air traffic management system based on digitalisation and automation can further improve current operations and procedures efficiency. The European airspace can become the most efficient and environmentally friendly sky to fly in the world if it is further digitised.

In road transport, connectivity among vehicles and road users presents a great potential to reduce greenhouse gas emissions by making driving behaviour more efficient and minimising unnecessary fuel consumption. For example, tweaks to how traffic signaling operates can ensure that vehicles keep moving whenever possible, preventing unnecessary braking, or stopping, which increases fuel consumption.

Member:
Cisco
Location:
Rotterdam, the Netherlands

Digital technologies for a smart port

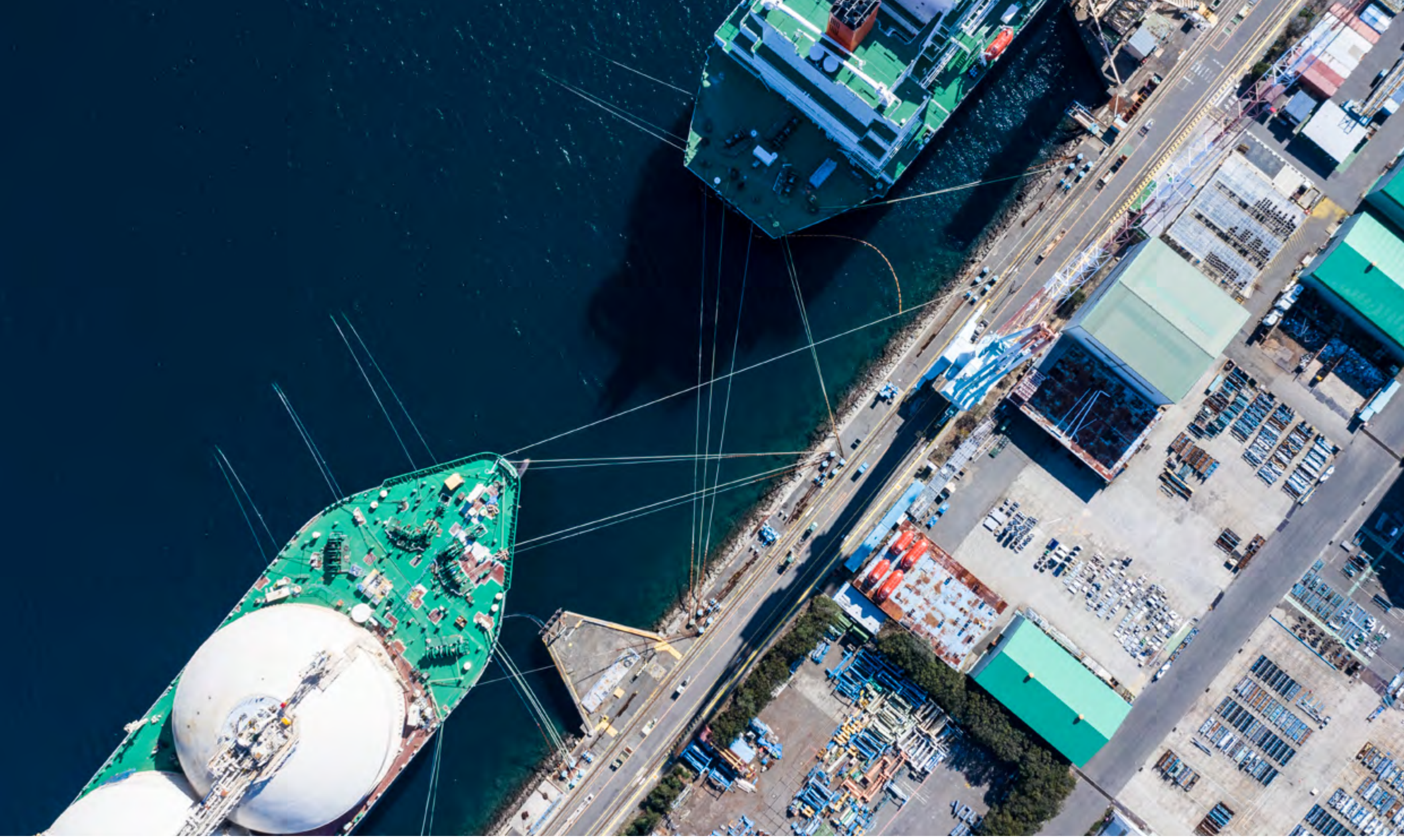
Challenge:
Rotterdam is Europe's biggest and busiest port, stretching 42 kilometres, with 3,000 businesses that employ over 180,000 people. Its economic value is roughly €21 billion or about 3.5% of the Netherlands' GDP. The Port of Rotterdam has been growing at a steady pace; however, growth comes with some challenges. With no more physical room to expand, whilst also seeking to reduce their environmental footprint by up to 95% in 2050, the operations of the port needed streamlining.

Solution:
With the help of Cisco's IoT solution Edge Intelligence, the port is now able to optimise route planning and berthing of the ships, which increases fuel efficiency, saves money, reduces carbon emissions, and improves air quality.

With the Smart Infrastructure program, Rotterdam is currently transforming from a physical to a digital port. As a matter of fact, due to digital solutions such as Edge Intelligence, the port is on track to **reduce its carbon emissions by 50% in 2030**. Cisco's Edge Intelligence is a plug-and-play IoT software solution tightly integrated with Cisco Edge Gateways. It greatly simplifies IoT data extraction, transformation, and delivery to multi destinations with granular data policies for governance.

Main technologies:
IoT, data analysis, artificial intelligence

Partners:
Cisco and the Port of Rotterdam partnered up to optimise fuel efficiency, reduce emissions and improve air quality.



Enabling sustainable growth in ports with 5G

Challenge:
Today, over 30 million tons of cargo, 7,000 ships and 2.5 million tourists travel through the Port of Livorno every year, making it one of the largest ports in the Mediterranean Sea and an important employer in the area, with over 15,000 employees. There is a need to increase efficiency and sustainability in the port's operations, to minimise its carbon impact and ensure its long-term value.

Solution:
Ericsson is exploring how sensors, cameras and devices can connect to a network infrastructure, creating a digitally connected harbour. Utilising 5G connectivity, the project developed a model which allowed for remote communications along the port's supply chain and automated remote control of unmanned ground vehicles for loading and unloading operations in the port area. In this way, the many different departments operating at the seaport – including coastguards, customs, the police, the transport authorities, and other institutional bodies – can share data on common functions and promote a smarter, safer and more efficient working environment. The project cut annual costs by €2.5 million, increased productivity by 20 to 25%, and **reduced CO_2 emissions by 8.2% per container terminal**.

Main technologies:
5G, IoT.

Partners:
Ericsson partnered with telecommunications companies, national authorities, and research bodies, namely TIM, Livorno Port Authority, the National Inter-University Consortium for Telecommunications and Fondazione Eni Enrico Mattei.

Member:
Ericsson
Location: Livorno, Italy

Member: Airbus
Location: European airspace (Benelux, France, Germany, UK, Central & Eastern Europe)

Digitally-predicted trajectory, an enabler of aviation decarbonisation

Challenge:
Aviation decarbonisation is a major challenge globally and reversing the CO_2 emissions' impact of aviation is the number one priority of the whole ecosystem. All stakeholders are working hand in hand on short- and longer-term concrete solutions to decarbonise the air transport sector. One such short-term action is to make the European airspace more efficient and environmentally friendly through network-centric, digitalised air traffic management system. Allowing optimised aircraft operations is indeed a crucial pillar to reduce CO_2 emissions. This needs innovative technology solutions and the political willingness to implement them.

Solution:
Digital technologies allow aircraft to exchange real-time trajectory information with the Air Traffic Controller. A more accurately predicted flight trajectory helps reduce fuel consumption and, therefore, CO_2 emissions. The latest in these developments is through the Trajectory Based Operations (TBO) in 4 Dimensions project, where the trajectory is defined by the three geometrical dimensions (latitude, longitude, and altitude), plus the time.

The expected time at each waypoint along the trajectory is estimated with high accuracy and reliability. Beyond enhanced safety, 4D modelling improves aircraft operations, leading to fewer delays, less fuel burn, and optimised flight patterns, and thus saving CO_2 emissions in the short to medium term, estimated at **5% to 6% by 2035**. For instance, during a four-minute holding while awaiting clearance, an aircraft can consume up to 100 kg of fuel. 4D trajectory-based operations can lead to fuel savings of 10 kg (the equivalent of approximately 32 kg of CO_2), if an aircraft descends from its optimum Top of Descent. When calculated for a European jet fleet of about 5,500 aircraft over an entire year, the savings could be as high as **65,000 tons of fuel**. More can be done: with Air Traffic Control improvements benefits could reach 10% and more in terms of efficiency.[56]

Main technologies:
Data modelling, data processing

Partners:
Air navigation service providers (e.g., DSNA, DFS, ENAIRE, ENAV, Bulatsa, Eurocontrol, Hungarocontrol, NATS, PANSA, ANS CR, Skyguide), systems suppliers (e.g., INDRA, Leonardo, Airtel, Honeywell), government agencies (e.g., CAAC ATMB).

[56] Eurocontrol (2021), *Flying the 'perfect green flight': How can we make every journey as environmentally friendly as possible?*, **https://www.eurocontrol.int/sites/default/files/2021-04/eurocontrol-think-paper-10-perfect-green-flight.pdf**

5G-enabled corridor spurring green driving

Member:
Qualcomm
Location: CAM corridor between Munich and Bologna

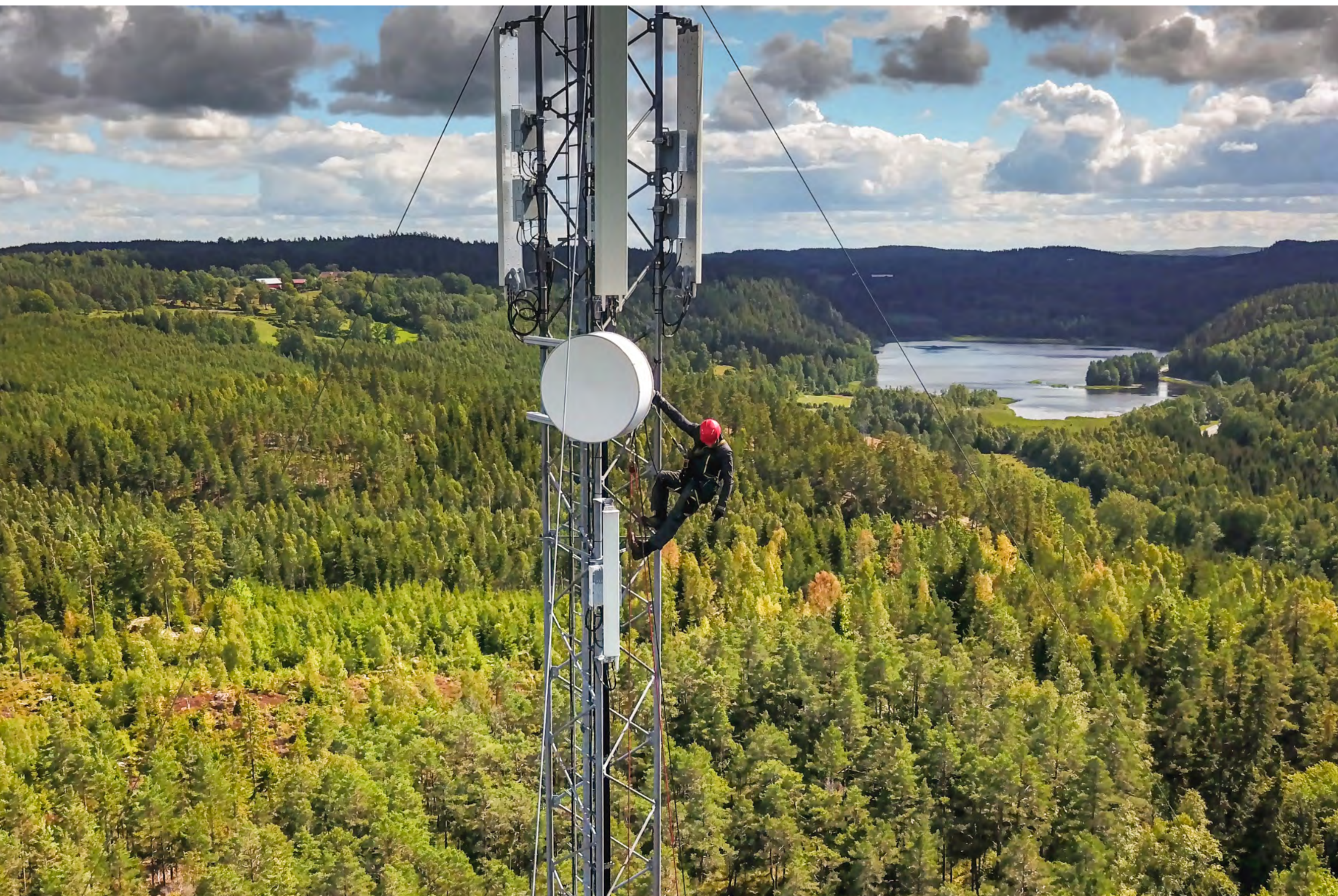
Challenge:
The mobility landscape is drastically changing and facing challenges with growing urbanisation, environmental aspects, and safety. Road infrastructures and vehicles are becoming always-connected, automated and intelligent, delivering optimal comfort and addressing societal goals as emission and accident reduction. Therefore, large-scale collaborative cross-border transport corridors are the basis to master the challenges.

Solution:
5G-CARMEN addresses these challenges by bringing industries, academics, and SMEs together by conducting trials by spanning a 600km corridor between Munich and Bologna (Bavaria, Tirol, and Trentino/South-Tirol).

Vehicle manoeuvre negotiation, infotainment, and emission control in sensitive areas are the cross-border use cases targeted by 5G-CARMEN to maximise the project commercial, societal, end environmental impacts. The project builds a 5G-enabled corridor to conduct cross-border trials and will deploy a mixture of 5G micro- and macro-cells for ubiquitous C-V2X connectivity.

Main technology:
5G

Partners:
Qualcomm partnered with various car manufacturers, such as BMW, to provide solutions geared towards the promotion of greener driving styles, therefore leading to significant improvements in air quality.



Agriculture

Advanced monitoring of livestock health and growth enables dedicated administering of fertilisers or food supplements, optimising and conservation of water resources, avoiding spillage and pollution, achieving energy savings.

The global population is projected to reach 10 billion by 2050. We need to feed more people more sustainably. One of the ways to do that is by increasing the efficiency of our food production through smart agriculture. One element of that is precision farming, using technology such as wireless remote monitoring private networks, digital sensors, and AI-based analytics to minimise pesticide fertiliser and water usage and maximise yields. Studies have found that IoT can help drive higher[58] yields (2%-13% improvements) in crop agriculture.

The World Economic Forum estimates that, if 15-25% of farms adopted precision agriculture, global yield could be increased by 10-15% by 2030, while greenhouse gas emissions and water use could be reduced by 10% and 20%, respectively[59]. While these are small steps in a global scale, food systems are currently responsible for 20 to 30% of global greenhouse gas emissions and 70% of biodiversity loss. Smart agriculture could kickstart the digital transformation of the entire food industry.

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[58] Microsoft (2021), *Sustainability. Good for Business: Executive Playbook - 2021 and beyond,* **https://info.microsoft.com/rs/157-GQE-382/images/EN-CNTNT-Other-ExecutivePlaybook.pdf p.173**

[59] World Economic Forum (2018), *Innovation with a Purpose*, **https://www3.weforum.org/docs/WEF_Innovation_with_a_Purpose_VF-reduced.pdf**

Iot and data analytics for higher crop yields and lower environmental footprint

Member:
Microsoft
Location: Aragón, Magallón, Alfamén, Spain

Challenge:
The global food system has a large environmental footprint; agriculture occupies nearly 40% of the earth's surface, and accounts directly for approximately 11% of global greenhouse gas emissions, whilst crop irrigation comprises 70% of global water use.[60] Inefficient processes and natural resource use must retire; to produce more with less land and fewer natural resources, efficiency is key. Therefore, new and smart agricultural practices need to substitute conventional ways of doing things.

Solution:
Integra's agriculture solution SmartEye demonstrates how the use of IoT and analytics is helping farmers achieve higher crop yields and reduce environmental footprint. Based on intelligent sensors installed in fields, SmartEye monitors and collects data points on a multitude of variables that affect crops such as temperature, humidity, atmospheric pressure, rain, wind, and soil temperature. The real-time insights on the different variables that affect crop yields enable farmers to act with more precision and capture benefits. For example, reduction in the use of pesticides, reduction of water consumption used for crop irrigation, remote control of the crops, and even the use of renewable energies for the weather stations installed in the field. All these benefits significantly reduce the environmental impact. In addition, the solution enables farmers to share data insights, much like an open platform.

Main technologies:
IoT, data analytics, artificial intelligence

Partners:
Microsoft, in collaboration with Integra, a Spanish consulting firm, developed a smart agriculture solution that helps achieve greater efficiency in agricultural exploitations.

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[60] OECD (2019), *Three key challenges facing agriculture and how to start solving them*, **https://www.oecd.org/agriculture/key-challenges-agriculture-how-solve/**

Soil sensor data in the cloud optimising resource use

Member: Amazon Web Services
Location: Germany, Italy, Spain, Romania, and Finland

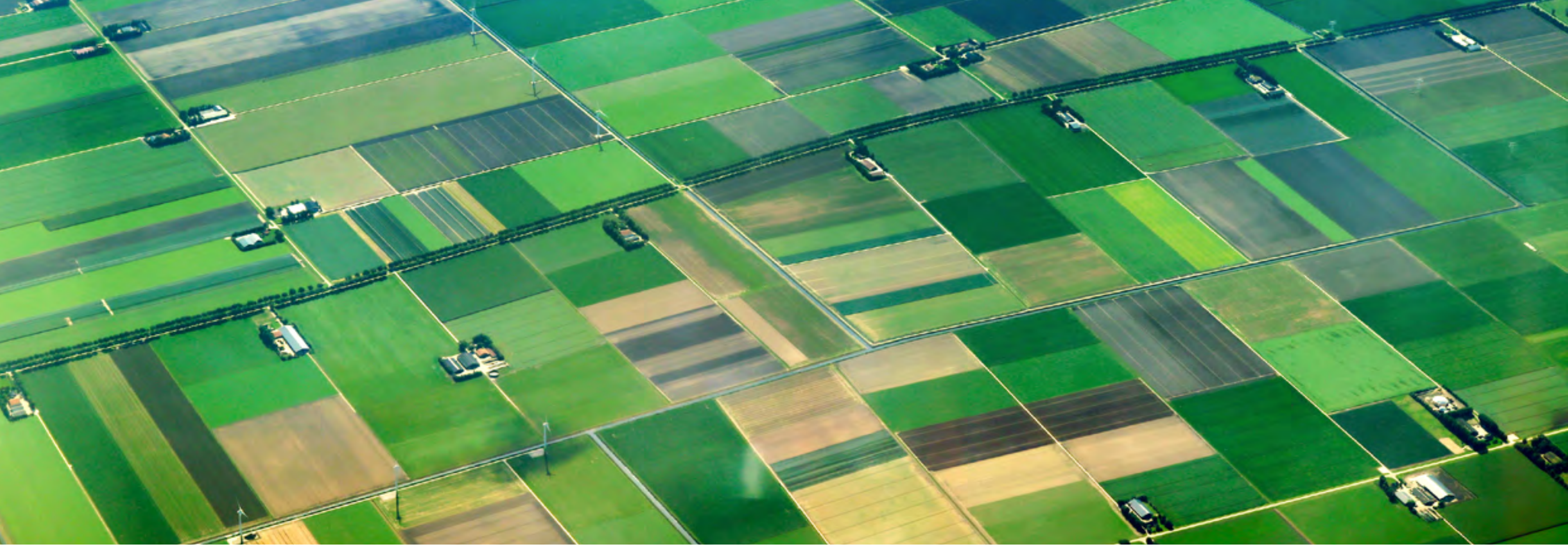
Challenge:
Most agricultural companies rely on above-ground data such as satellite imagery, and less than 10% of companies get data from within the soil, which is where the most valuable data is. Lacking accurate irrigation and fertilisation management capabilities, many farmers do not have comprehensive insight into soil conditions. As a result, farmers often provide either too much irrigation and fertiliser or too little, which wastes valuable resources and does not maximise yield potential.

Solution:
CropX, an agricultural analytics company, is addressing this challenge by helping farmers integrate soil data with numerous above-ground data layers. By providing real-time data on soil moisture, salinity, and temperature, farmers can determine whether a plant has received enough fertiliser even before the plant knows. To collect raw data, process it in real time, and provide real-time recommendations that are specific to the crops, the geography, and the soil. CropX runs its in-soil sensor data solution on AWS Cloud.[61] This allows them to analyse vast amounts of data through AI-based algorithms, integrating in-soil and above-ground datasets with imaging, weather, topography, and soil data, as well as crop models, hydraulic models, and user inputs. Farmers, breeding companies, agrochemical companies, crop insurers, and irrigation system manufacturers are then able to see these insights through the CropX app and receive irrigation and crop nutrition recommendations for their crops. During irrigation experiments using its technology, CropX has demonstrated more than **40% water savings across different crop types**, with a **10% yield increase**. CropX has systems deployed in Germany, Italy, Spain, Romania, and Finland. In the EU only, there are ~197M hectares of utilised agricultural area.

Main technologies:
Cloud computing and storage, data analytics, artificial intelligence

Partners:
AWS partnered with CropX to boost crop yields by focusing on saving water and energy.

[58] AWS (2020), *CropX Runs Soil Sensor Application on AWS to Help Global Farmers Enable Sustainability*, https://aws.amazon.com/solutions/case-studies/cropx-case-study/



Remote monitoring and verification tools to scale sustainable agriculture

Member: Hummingbird Technologies (TechUK member)
Location: London, UK

Challenge:
Agriculture, forestry and land use together contribute 24% of global GHG emissions. At the same time, terrestrial ecosystems are also a substantial carbon sink, sequestering around the same amount from the atmosphere. Reducing emissions and simultaneously increasing sequestration offers a significant opportunity to make a material difference to overall GHG emissions and thereby mitigate climate change. Soil restoration across the world's farmland offers the largest scope opportunity to implement such a change and has low opportunity cost and many co-benefits for wildlife, biodiversity, farmers' economic security and resilience to flooding and drought. The challenge is how to implement incentive mechanisms and structures to effect change across the highly fragmented global food production system, which comprises over 500 million farmers.

Solution:
The key to creating and scaling incentive structures for regenerative agriculture is robust, reliable, and low-cost monitoring, reporting and verification (MRV) tools. Hummingbird Technologies is an imagery analytics company. It uses machine learning techniques to develop reliable monitoring and verification models for key farm management practices such as reduced tillage, cover cropping practices and optimal crop rotations. Regeneratively managed farmland can sequester around **2-3 tonnes of CO_2e per hectare per year**, so scaling up regenerative practices has vast potential; in the EU alone, there are roughly 100m hectares of arable farmland which could sequester around **10% of the EU's 2.5 billion tCO_2e annual emissions** under optimal management practices. Hummingbird Technologies has detection models for key management practices, which it is piloting with key partners in Europe and elsewhere today and aims to apply these MRV tools on land sequestering **1 billion tonnes of CO_2 by 2030**.

Main technologies:
Machine learning; computer vision; remote sensing and geospatial imagery analytics

Partners:
Hummingbird Technologies is working with Rabobank, one of the largest agricultural banks in the world, in the development of its own carbon bank, together with partners such as the Danish agri-carbon programme Agreena.

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