TECH INDUSTRY
challenges and efforts

DIGITALISATION & TECH
as enablers

9 POLICY PROPOSALS
for sustainable development

A REPORT FROM TECHSVERIGE

Sustainable Tech & Tech for the Climate

Tech industry challenges and efforts

TechSverige

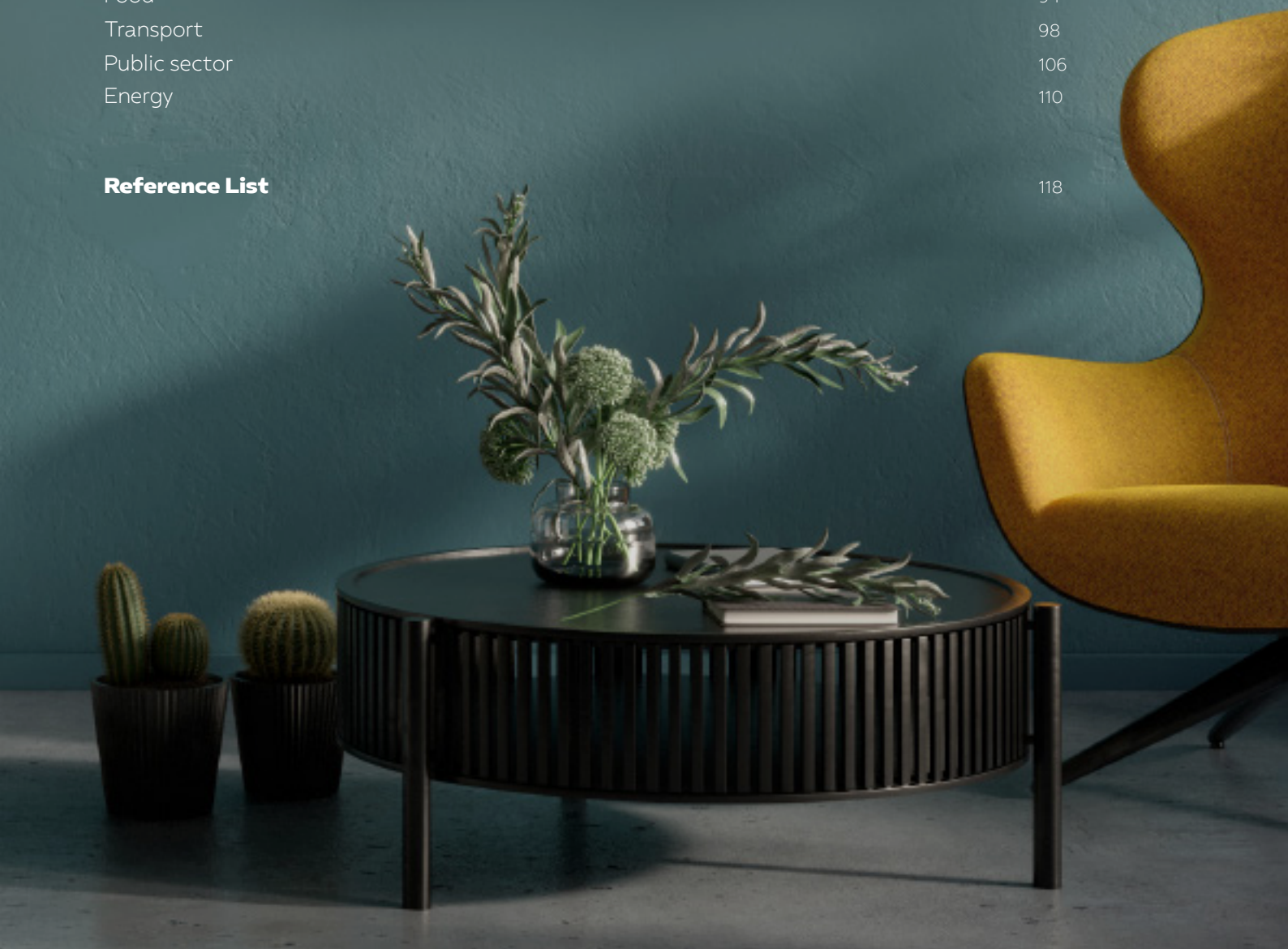
PART 1

Sustainable Tech

TechSverige

PART 2

Tech for the Climate



Summary

Sustainability is one of the most important issues of our time that affects us all. The tech industry works every day to develop solutions that facilitate the transition of companies and industries towards more sustainable products, services, and processes – as well as the transition of society as a whole. But while tech companies are enablers for increased sustainability, the industry has its own sustainability challenges.

The industry needs to constantly become more energy efficient in order to prevent energy consumption from increasing at the same rate as the amount of data, reduce emissions from its own operations, and, above all, work to reduce emissions and environmental impact at the stages of the supply chains where they occur the most. Unwanted chemicals need to be phased out, and products must be designed – from the onset – to allow for reuse, upgrading, and circularity in order to maximise the use of product materials and minimise their climate impact. Increasing social sustainability of the industry's supply chains, both nationally and globally, is also of great importance. During the pandemic, the industry has shown how tech can contribute to increased inclusion and a more resilient society, even though there are still challenges to address going forward.

TechSverige has mapped out the industry's main sustainability challenges related to the climate, environment, and social areas. Within the scope of the report, six member companies with great commitment to sustainability have been interviewed, and a survey among TechSverige member companies has been conducted. The picture is clear: The industry has several sustainability challenges, but there is a strong commitment and drive to address them and contribute to the tech industry both becoming more sustainable itself and being able to help other industries as well as society as a whole become more sustainable. The report also presents nine concrete policy proposals that can make it easier for tech and the tech industry to become more sustainable and thereby further contribute to achieving Sweden's climate and environmental objectives as well as the 2030 Agenda and its Sustainable Development Goals.

“We are proud to be a new Swedish basic industry – but with that comes a special responsibility to contribute to positive and sustainable societal development."

Åsa Zetterberg

PREFACE

The tech industry – a key actor for sustainable development

Sustainability is one of the main challenges of our time, one that is redefining the conditions for society as well as businesses and private citizens. How well we tackle this challenge today will affect not only developments in the near future, but also the quality of life and conditions for future generations. Sustainability is a high priority issue for TechSverige and our member companies.

Every day, the tech industry contributes to a more sustainable society by increasing the sustainability of its own operations and developing a more sustainable production of goods and services to reduce climate footprint at the supplier stage. At the same time, through its development of smart products and services, the industry also contributes to the entire society's ability to become more sustainable – both environmentally and socially.

According to the World Economic Forum, 70% of the Sustainable Development Goals (SDGs) of the 2030 Agenda can be supported using already existing technology and technical solutions, such as the Internet of Things (IoT), Artificial Intelligence (AI), and robotics.[1] Sustainability is also about our future competitiveness. Companies that don't take the work with sustainability seriously will fall behind its competitors.

The message in the latest report from the Intergovernmental Panel on Climate Change (IPCC) and from the COP26 is clear.[2] If we don't take resolute action, we will not reach the goal of keeping global warming below 1.5 degrees Celsius. Reaching the goals of the Paris Agreement and the 2030 Agenda requires innovative capability throughout society, and digitalisation has a key role in achieving that.

The establishment of the tech sector as a new base for the Swedish economy is evident from its contribution to GDP. Since 1981, the sector's contribution has grown by 1,300%, totalling SEK 281 billion in 2020. In absolute numbers, this contribution to GDP is almost as large as the contribution from the traditional Swedish basic industries combined.[3] We are proud to be a new Swedish basic industry – but with that comes a special responsibility to contribute to positive and sustainable societal development.

The tech industry, just like all other industries, has clear sustainability challenges that need to be addressed. The industry needs to reduce emissions in its own operations as well as emissions in the supply chains. Unwanted chemicals need to be phased out, and products must be designed – from the onset – to allow for reuse, upgrading, and circularity. Social sustainability is also important for the industry.

Around 70% of Sweden's tech-related emissions come from the manufacture and use of personal devices, such as computers, mobile phones, and tablets.[4] As an industry, we need to move from linear business models to circular ones, and for that information to reach the consumers, we need a targeted approach. We can see that many of our member companies are moving from selling physical products towards business models based on the "as-a-service" and sharing economy approach, where you sell a function and service rather than a product. The shift to selling a function has great potential to reduce the industry's climate footprint by allowing products to be used by more people, to be upgraded and updated, and thereby live longer.

The best way to break unsustainable habits is to make the more sustainable option more appealing. The tech industry therefore needs to work purposefully to help customers and consumers understand the value of using products longer and buying products with a longer lifespan. Increased circularity of products also creates a larger market for used goods. This, in turn, means that people with smaller financial means have greater opportunities to gain access to modern technology, which contributes to increased inclusion and social cohesion.

The digital and the green transition go hand in hand and are interdependent. A world-leading tech industry that takes responsibility for sustainable development is a vital key, not just for the green transition of Sweden, but for the green transition of the world. The tech industry in Sweden should be a pioneer and a key player in the global transition.

With this report, we want to show the massive benefits of digitalisation for our ability to change into a more sustainable society, but also point out the sustainability challenges that the tech industry itself needs to address and take responsibility for. In addition, the report highlights policy proposals that enable the tech industry to become more sustainable, while strengthening its ability to further contribute to Sweden reaching its climate and environmental objectives as well as the SDGs.

Åsa Zetterberg
Managing Director
TechSverige

June 2022

[1] Herwijer, Celine. "How technology can fast-track the global goals", *World Economic Forum*.
[2] IPCC. *AR6 Climate Change 2021: The Physical Science Basis*.
[3] Swedish IT & Telecom Industries. Tech – Sweden's new basic industry.
[4] Huber, Bernhard. "Svenska it-sektorns klimatpåverkan kartlagd" [Climate impact of the Swedish IT sector mapped

Global and national sustainability goals

There are a number of important international resolutions and agreements that form the basis for Sweden's and the tech industry's work with sustainability. The most important ones are:

- **The Sustainable Development Goals of the UN 2030 Agenda**
- **The Paris Agreement**
- **The European Green Deal**
- **Sweden's climate and environmental objectives**

In addition to these, there are national initiatives of particular relevance, such as Fossil Free Sweden.

The Sustainable Development Goals

In 2015, the UN member states adopted the 2030 Agenda. This universal Agenda contains 17 global goals to be achieved by 2030. Among other things, the goals aim to eradicate extreme poverty, solve the climate crisis, and promote peace and justice. The 17 SDGs, in turn, include 169 targets and roughly 230 global indicators for how the work should be carried out and monitored.[5] There are currently a little less than 10 years left to reach the goals of the Agenda. Digitalisation has a key role as a catalyst for several of the goals, and through innovations and technological strides, it can contribute to finding solutions to the challenges of our time.

Sweden's ambition is to be a leader in the implementation of the 2030 Agenda. In the Sustainable Development Report ranking of total progress of the countries, Sweden has topped the list on several occasions since the adoption of the goals in 2015.[6] However, there is still a lot of work that remains to be done, even in Sweden, in order to achieve the goals.

In 2017, when the Delegation for the 2030 Agenda mapped out Sweden's conditions for achieving the goals, six areas of priority were identified.[7]

- Social equality and gender equality
- A sustainable society
- A socially beneficial and circular economy
- A strong business sector with corporate social responsibility
- A sustainable and healthy food chain
- Knowledge and innovation

[5] UNDP. *Sustainable Development Goals.*
[6] Sustainable Development Reports.
[7] Fi 2016:01. *I riktning mot en hållbar välfärd: Agenda 2030-delegationens nulägesbeskrivning och förslag till handlingsplan för genomförandet av Agenda 2030 för hållbar utveckling*


1 INGEN FATTIGDOM
2 INGEN HUNGER
3 GOD HÄLSA OCH VÄLBEFINNANDE
4 GOD UTBILDNING FÖR ALLA
5 JÄMSTÄLLDHET
6 RENT VATTEN OCH SANITET FÖR ALLA
7 HÅLLBAR ENERGI FÖR ALLA
8 ANSTÄNDIGA ARBETSVILLKOR OCH EKONOMISK TILLVÄXT
9 HÅLLBAR INDUSTRI, INNOVATIONER OCH INFRASTRUKTUR
10 MINSKAD OJÄMLIKHET
11 HÅLLBARA STÄDER OCH SAMHÄLLEN
12 HÅLLBAR KONSUMTION OCH PRODUKTION
13 BEKÄMPA KLIMAT-FÖRÄNDRINGARNA
14 HAV OCH MARINA RESURSER
15 EKOSYSTEM OCH BIOLOGISK MÅNGFALD
16 FREDLIGA OCH INKLUDERANDE SAMHÄLLEN
17 GENOMFÖRANDE OCH GLOBALT PARTNERSKAP
GLOBALA MÅLEN
för hållbar utveckling

The Paris Agreement

The Paris Agreement is a legally binding international treaty adopted by 196 parties at the COP21 in 2015 and ratified in 2016.[8] The aim of the agreement is to ensure that a global temperature rise is kept well below 2 degrees Celsius compared to pre-industrial levels, while pursuing efforts to keep it at 1.5 degrees. This is to be accomplished mainly by reducing greenhouse gas emissions. Another part of the agreement involves increasing the ability to adapt to negative effects and manage the damages and losses that occur as a result of climate change. The countries' commitments will gradually be made more ambitious and will be reviewed every five years through a global stocktake.

The European Green Deal

The European Green Deal contains an overall action plan from the European Commission with a number of initiatives and measures that will transition the entire EU economy. The overarching objective is for the EU economy and society to become climate-neutral by 2050. Through the European Climate Law, the goals of the Green Deal are written into law. The law also sets the milestone target to reduce net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels.[9] As part of the work on the updated goals, the European Commission has put forward "Fit for 55", a package of legislative proposals and other policy initiatives, to reach the 55% reduction in climate impact within the Union by 2030.[10]

Among other things, the Green Deal includes a comprehensive action plan for a circular economy.[11] The action plan contains a series of initiatives with focus on product design, promotion of circular business models, sustainable consumption, waste prevention, and efficient use of resources.

Digitalisation and its areas of application are present as intertwined themes throughout the Green Deal. The European Commission states that the EU will need AI, 5G, cloud, edge technology, and IoT in order to maximise and accelerate effects as well as deal with climate issues and protect the environment. It believes that the EU needs a digital sector that puts sustainability at the heart of things.

In 2020, the European Commission presented its Chemical Strategy for Sustainability – Towards a Toxic-Free Environment. Among other things, this strategy aims to simplify EU chemical legislation, substitute and minimise substances that give rise to concerns, and phase out the most harmful chemicals from use that is not essential to society[12] [13]

Sweden's climate and environmental objectives

The Swedish climate targets are part of the environmental objectives system as well as a central component of Sweden's work to live up to the Paris Agreement. Sweden's long-term climate objective is to reach net zero emissions by 2045 and then go on to achieve negative emissions. This target means that GHG emissions from Swedish territory must be at least 85% lower by 2045 compared to emissions in 1990.

The environmental objectives are an important point of departure for Sweden's national implementation of the UN 2030 Agenda and its 17 Sustainable Development Goals. They also connect to other cross-sectoral goals, such as the EU climate and energy goal and the EU climate and energy framework. The environmental objectives system consists of a generational goal to "hand over to the next generation a society in which the major environmental problems have been solved without increasing environmental and health problems outside Sweden's borders", 16 environmental quality objectives, and a number of milestone targets in the areas of waste, biodiversity, hazardous substances, sustainable urban development, air pollution, and climate. Sweden's environmental objective is the national implementation of the environmental dimension of the Sustainable Development Goals.[14]

Sweden's path towards a more circular economy is outlined in "Circular economy – Strategy for the transition in Sweden" and the supplementary action plans. The strategy includes four areas of focus, and digitalisation is clearly highlighted as a key to achieving the goals.[15]

[8] UNFCC. *The Paris Agreement.*
[9] European Commission. *A European Climate Law.*
[10] European Council. *European Green Deal.*
[11] European Commission. *Circular Economy Action Plan.*
[12] European Commission. *Chemicals Strategy.*
[13] European Council. *Council approves conclusions on the EU Chemicals Strategy for Sustainability.*
[14] Sweden's Environmental Objectives.
[15] Sweden's Ministry of the Environment. *Circular economy – Strategy for the transition in Sweden.*

The tech industry's work with sustainability

Every day, the tech industry contributes to a more sustainable society by increasing the sustainability of its own operations and developing a more sustainable production of goods and services to reduce climate footprint at the supplier stage. At the same time, through its development of smart products and services, the industry also contributes to the entire society's ability to become more sustainable – both environmentally and socially.

In addition to a strong commitment among companies, there is a clear – and growing – demand for sustainable technology. More and more customers are requiring some type of account of their supplier's actual impact, regardless of whether it relates to the environment, social responsibility, or economic sustainability. More than half of the respondents in a survey among TechSverige members believe that the demand of customers for social and environmental sustainability has increased in the last five years.[16] Tech companies need to be able to meet this demand and account for what their work with sustainability looks like in order to be nationally and internationally competitive. Potential employees might also find companies and organisations that work with sustainability more attractive to work for. For example, half of the responding members state that their work with sustainability affects their ability to attract new employees.[17] The fact that a majority of the responding member companies have one or several employees with explicit responsibility for environmental and social sustainability efforts emphasises the clear commitment of these members.[18]

The tech industry has an important role in the transition towards a sustainable society. It is a new Swedish basic industry, and with that comes a special responsibility to address the industry's own sustainability challenges in the most important areas. These areas are:[19]

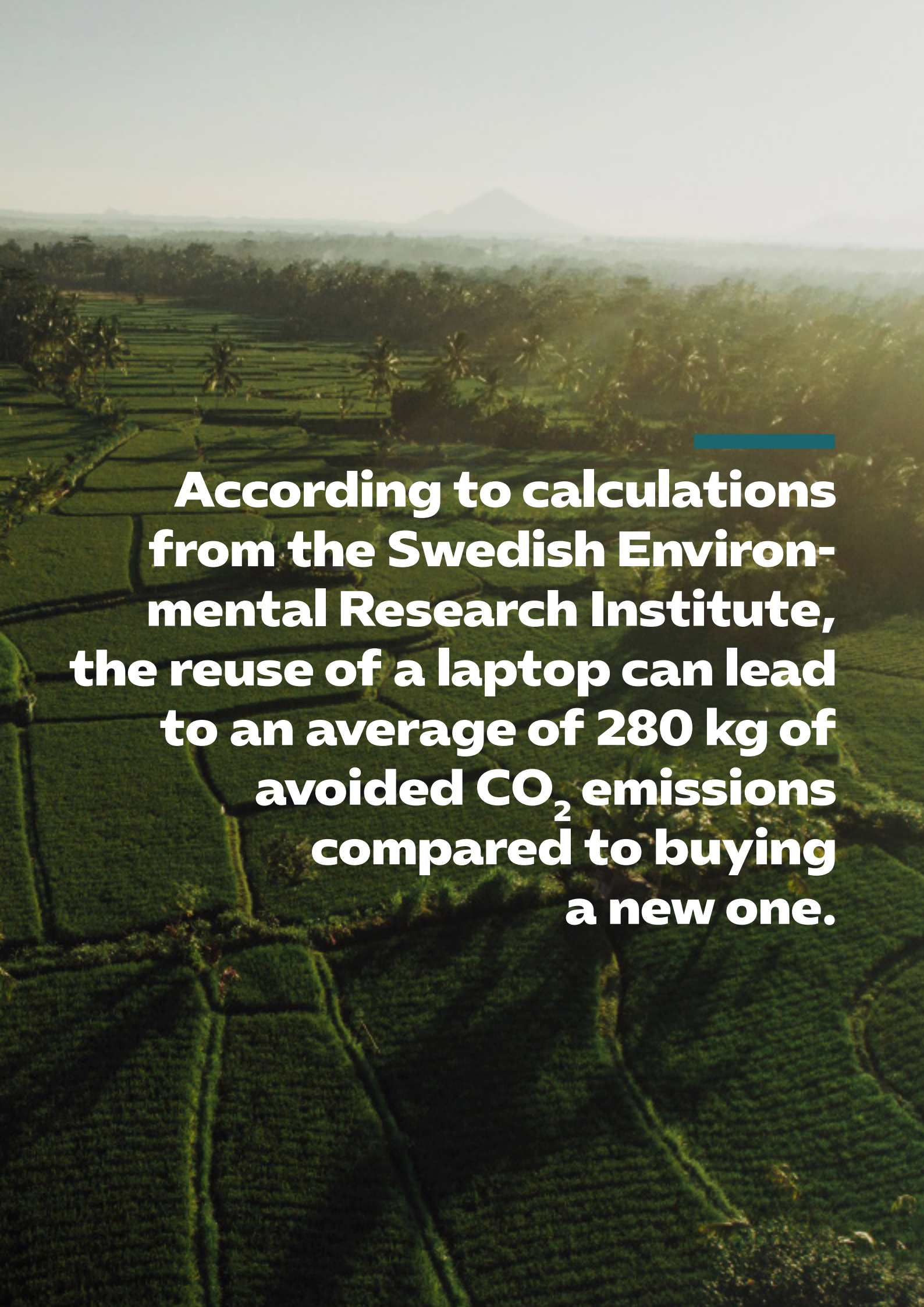
- Climate and environmental impact
- A circular and sustainable value chain
- Social sustainability

For each of the areas, the following chapters will outline the industry's biggest challenges and how it is working to address them.

[16] Survey among members 4–19 October 2021.
[17] Ibid.
[18] Ibid.
[19] There are several other areas linked to sustainability, where TechSverige and our members are involved in separate projects. These are therefore not the focus of this report.

Climate and environmental impact

In connection with the COP26 summit in Glasgow in 2021, the United Nations' Intergovernmental Panel on Climate Change (IPCC) pointed out in a report, once again, that greenhouse gas emissions are not decreasing at the rate required to reach the Paris Agreement goal of limiting the global rise in temperature to 1.5 degrees Celsius. The pace of the global transition needs to be accelerated, and Sweden must ensure that Swedish climate targets are in line with the 1.5-degree goal of the Paris Agreement. The tech industry can contribute by reducing its own emissions – and through products and services that enable other actors to reduce their emissions.



According to calculations from the Swedish Environmental Research Institute, the reuse of a laptop can lead to an average of 280 kg of avoided CO_2 emissions compared to buying a new one.

Challenge – carbon dioxide emissions and electricity use

The European Commission assesses the tech sector's share of carbon dioxide emissions at just over 2%[20], but there are also studies showing that the impact of the tech sector may correspond to as much as 2.1–3.9% of total carbon dioxide emissions.[21] In addition, the European Commission has projected that emissions from the sector, unless efforts are made to reduce them, might increase the world's total carbon dioxide emissions by 2040, as a result of increased digitalisation.[22]

According to a study from KTH Royal Institute of Technology, around 70% of emissions from the tech sector in Sweden comes from the manufacture and use of personal devices, such as computers, mobile phones, and tablets. However, this calculation also includes products manufactured abroad and transported to Sweden.[23] A substantial proportion of these emissions occur in the manufacturing phase, while only a marginal proportion of the emissions are generated when using the devices.

A similar study assesses that emissions from manufacturing and use of personal devices account for 54% of the ICT[24] sector's emissions globally. Of these emissions, the manufacturing phase accounts for nearly half, while the use of equipment during its lifetime generates significantly more emissions on a global level than in Sweden.[25] This is mainly due to the fact that energy production globally consists of a much larger proportion of fossil sources.

There is great potential to reduce the tech sector's footprint, both globally and in Sweden, through increased circularity of collected IT products for repair, upgrade, and reuse.[26] According to calculations from the Swedish Environmental Research Institute, the reuse of a laptop can lead to an average of 280 kilos of avoided emissions compared to buying a new one. Reusing a computer screen saves almost twice as much – 520 kilos of avoided carbon dioxide emissions on average. As much as 95% of the savings come from avoiding the manufacture of new products.

The use of electricity has a major effect on the IT sector's climate impact and emissions, especially from an international perspective. In Sweden, less than 2% of the electricity comes from fossil production, which means that the climate impact from the use of IT sector products is limited compared to the impact globally, where nearly half of the electricity comes from fossil sources. Sweden's electricity use linked to the use of IT sector products and solutions mainly stem from the operation of data centres and the use of personal devices.[27] According to the European Commission, the ICT sector globally accounts for 5–9% of the electricity use, and since the electricity mix in many countries is still predominantly fossil, electricity use is a major source of carbon dioxide emissions.[28] The proportion of fossil electricity production within the EU is estimated at 40% and within the OECD at 50%.[29] There is thus also great potential for the IT sector to reduce its climate impact globally, by ensuring that more of the electricity required for the use of its products and services comes from fossil-free energy production.

The tech sector's total impact on global carbon dioxide emissions depends on the degree to which the sector is able to replace more traditional, carbon-intensive activities and the extent to which it offers or contributes new activities that increase the use of electricity and how such electricity is produced. The former can reduce total emissions, while the latter, in the worst case, can increase them. Long-term projections are always fraught with uncertainty; however, emissions from the sector risk increasing as 5G becomes the rule while the capacity of AI, cloud services, and data centres increases. If this growth takes place while the electricity used to power tech sector solutions still consists of a large proportion of fossil electricity production, the sector's climate impact could become greater than it is today. At the same time, increased digitalisation can result in reduced emissions in other sectors. The roll-out and use of 5G technology, for example, has the potential to reduce global emissions by 15%. There are thus great opportunities for decreased net emissions, even if the industry's own emissions increase. The ongoing transition of the energy sector along with an increased proportion of fossil-free electricity production is important to ensure that increased data use does not lead to increased emissions.

[20] European Commission. *Supporting the Green Transition.*
[21] Widdicks, Kelly et al. *"The climate impact of ICT: A review of estimates, trends and regulations".* Lancaster University.
[22] Publications Office of the European Union. *Supporting the green transition: Shaping Europe's digital future.*
[23] Huber, Bernhard. *Svenska it-sektorns klimatpåverkan kartlagd [Climate impact of the Swedish IT sector mapped out].* KTH Royal Institute of Technology.
[24] Information and Communication Technology
[25] Malmodin, Jens & Lundén, Dag. "The energy and carbon footprint of the Global ICT and E&M sectors 2010-2015".
[26] See more in Chapter 5.
[27] https://www.kth.se/aktuellt/nyheter/svenska-it-sektorns-klimatpaverkan-kartlagd-1.482123 and Life Cycle Assessment of ICT : Carbon Footprint and Operational Electricity Use from the Operator, National, and Subscriber Perspective in Sweden.
[28] Publications Office of the European Union. Supporting the green transition: Shaping Europe's digital future.
[29] Holmström, Christian. "Elproduktion med fossila bränslen – internationellt" [Electricity production with fossil fuels – internationally], Ekonomifakta.

The industry's work for reduced emissions

Many tech companies want to report their climate efforts in a transparent and credible manner. To do so, many of them use the Greenhouse Gas Protocol (GHG Protocol), which is the world's most widely used standard for calculating and reporting greenhouse gas emissions throughout the value chain. Reporting includes three different categories:

Scope 1: All emissions from the company itself that are within its control. This includes, for example, emissions from fuels in factories owned by the company, heating produced by the company, and company cars.

Scope 2: Indirect emissions, for example from the consumption of electricity, district heating, and district cooling.

Scope 3: Indirect greenhouse gas emissions, in addition to purchased energy, that occur outside company boundaries. These emissions are often divided into so-called upstream and downstream emissions, depending on whether they occur prior to the company's own operations in the chain or after (illustrated in Figure 1).

When companies report according to the GHG Protocol, Scope 1 and Scope 2 are the ones that are mandatory to measure and report. Having low levels of Scope 1 and 2 emissions is much easier in Sweden and in the Nordic Region than in many other parts of the world, partly thanks to good access to renewable electricity, partly because much of the component manufacturing is located in other parts of the world.

Most of the Swedish tech companies' greenhouse gas emissions fall under what we call Scope 3. In order to obtain Scope 3 data, companies need to work with their suppliers, employees, and sometimes even customers, which means that the work is more extensive and involves several assumptions. At the same time, proactive work to reduce Scope 3 emissions is what has the greatest overall effect.

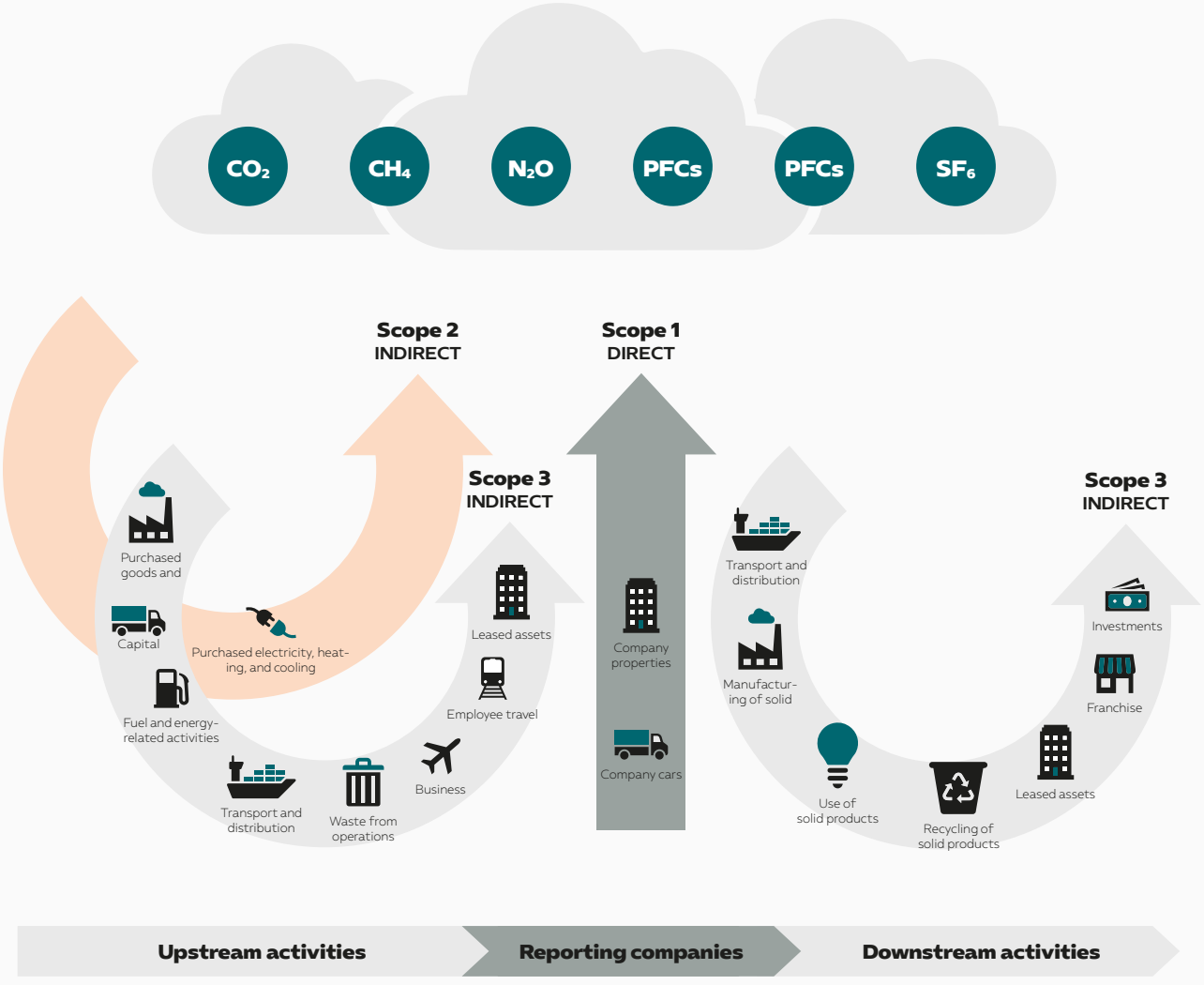
It is also becoming increasingly common for tech companies to work with what is called avoided emissions (sometimes called Scope 4). These calculations highlight the potential of digitalisation to contribute to companies becoming providers of fossil-free solutions. Within the scope of its roadmap for a Fossil Free Sweden, the non-profit association, Digitaliseringskonsulterna[31], works to develop its own framework for reporting the industry's positive and negative contribution within Scope 1–4, including avoided emissions. A similar initiative is also underway in the EU, where a number of tech companies have initiated the European Green Digital Coalition.[32]

While the tech industry is addressing the challenge of reducing its own emissions, it has a unique opportunity to reduce emissions and energy use from other sectors as well, and thereby contribute to an overall lower net, even if the proportion from the tech sector itself increases in the future. The tech sector is estimated to have the potential to reduce total greenhouse gas emissions by up to 15% by 2030 through the digitalisation of other sectors.[33] [34]

[30] Aldrigde, Christian. "You, too, can master value chain emissions", *Greenhouse Gas Protocol*.
[31] Digitaliseringskonsulterna.
[32] European Commission. *European Green Digital Coalition*.
[33] Ericsson. *ICT's potential to reduce greenhouse gas emissions in 2030*.
[34] European Commission. *Supporting the green transition*.

Figure 1

Emissions in different parts of operations[30]



INTERVIEW WITH JAKOB TAPPER,
SUSTAINABILITY DIRECTOR AT IVER

"It's a matter of symbolic to take responsibility for emissions at home; the majority of and the serious emissions occur in the supply chain."

Can you describe the central aspects of Iver's work with sustainability?
Reducing the climate footprint of our operations is central to us. We focus on reducing our climate footprint from our entire service delivery, including our entire supply chain, where we see a clear footprint from hardware. We strive to choose the right hardware from a sustainability perspective, and we also work to extend the life of our products, find opportunities for reuse, and handle recycling in a good way. It's important for us to maintain a close customer dialogue, where we explain the benefits of increased lifespan to our customers.

Other key aspects of our work with sustainability are security and privacy. Issues relating to cyber security and the risk of breach and data loss are constantly of current interest. In order for us to be a sustainable, long-term provider, we must obviously always protect the information of our customers. But we must also give our customers the right advice on where and how data is properly handled, including from a regulatory perspective. Storage in global cloud services is not always right for all businesses and types of information, and we therefore have our own cloud services that are suited to businesses with a high level of regulatory requirements, Jakob Tapper explains.

And how would you describe your contribution to sustainability in society at large?
All businesses have their climate footprint. We, and all other providers like us, make massive amounts of purchases of services and products in order to handle our deliveries to our customers. It's not just about energy and hardware but about everything from fruit bowls in the office to pension provisions for our employees. In 2020, we did a full Scope 3 analysis of the company's climate footprint. We did it by tracking all our purchases and calculating their climate footprint. The analysis showed that as much as 99.8% of our emissions occur in the supply chain.

Today, it's a matter of symbolic to take responsibility for emissions at home, scopes 1 and 2, but the majority of and the serious emissions occur in the supply chain. Analysing the entire supply chain requires extensive data access. We made calculations using templates, but going forward, we will use hard data. This will allow us to gain better knowledge of our climate footprint, make better purchases, and report our climate footprint to our customers. We hope that more actors will follow suit, being transparent about the climate impact of their entire operation, including throughout their supply chain.

What are the greatest environmental challenges facing the industry?
Energy consumption is a major challenge for the industry, and we need to ensure efficient and green energy use. The industry must also continue its efforts for more sustainable production, increased lifespan, and even better recycling of hardware.

What would you like national policymakers to do in order to facilitate the industry's work with sustainability?
It's important that policymakers listen to the industry and really see it as the enabler it is for more sustainable utilisation of resources in general. It is, of course, also important that the public sector pursues relevant and modern procurements that contribute to a more sustainable IT delivery.

Jakob Tapper
Sustainability Director at Iver

Challenge – climate impact of increased data volumes

Data centres are a prerequisite in order for much of what we take for granted in our modern societies to function. A growing demand for processing power and cloud storage is an accelerating trend, and an increasingly large part of our lives contains elements where data must be processed and stored. Simultaneously, data centres account for a large proportion of the tech industry's energy consumption, and considerable gains can be made by planning, building, and operating data centres more efficiently as well as increasingly integrating them into urban planning and utilising the heat created, for example, by heating homes or industrial facilities via district heating networks.

As the digitalisation of society increases, so does the internet traffic and internet use. Global internet traffic alone is expected to reach 4.2 zettabytes per year in 2022, and the number of mobile internet users are expected to increase from 3.8 billion in 2019 to 5 billion in 2025, while the number of connections to IoT is expected to double from 12 to 25 billion. These trends are driving an exponential rise in the demand for data centres and network services, which, unless focus is placed on increased energy efficiency, can create additional demand for energy.[35] At the same time, it can be noted that the energy use in data centres, up to this point, has increased only marginally despite greatly increased internet traffic and workload.

The number of internet users worldwide has more than doubled since 2010.[36] In that same period, global internet traffic has increased fifteenfold, corresponding to a near 30% increase per year. According to the International Data Corporation, an estimated 64.2 zettabytes of data were created, collected, copied, and consumed in 2020.[37] That's an increase of nearly 5,000% in only ten years.[38] As a result, workloads on the world's data centres have increased tenfold.

In 2020, the capacity of Swedish data centres (installed power, which is a "maximum ceiling") was estimated at a total of just over 640 megawatts, 368 megawatts of which belong to the data centre industry. In 2020, the data centres used 2.4 terawatt hours of electricity. The installed power for all Swedish data centres is expected to increase by 13% annually until 2025.[39]

The tech industry is facing a number of challenges in meeting this demand in the most climate and environmentally sustainable way possible. For one, the energy required to power data centres and provide network services needs to be fossil-free, which it largely is in Sweden. Also, the energy efficiency needs to be improved so that less energy is used per data set.

With the greatly increasing volume of data that will need to be handled by data centres and other network services in the future, a major challenge lies in the fact that many existing facilities and systems are located in countries using a fossil electricity mix. To address this, the industry, along with not least international actors, need to work to ensure that the energy supply in these countries causes as little emissions as possible and that new facilities are placed in locations where the energy supply comes from fossil-free sources.[40]

Just like the energy mix, the energy efficiency in data centres varies between different countries. The tech industry has a great responsibility to improve energy efficiency through, among other things, continued technological development, application of various forms of sustainability certifications, and by working even more to ensure that facilities are optimally utilised.

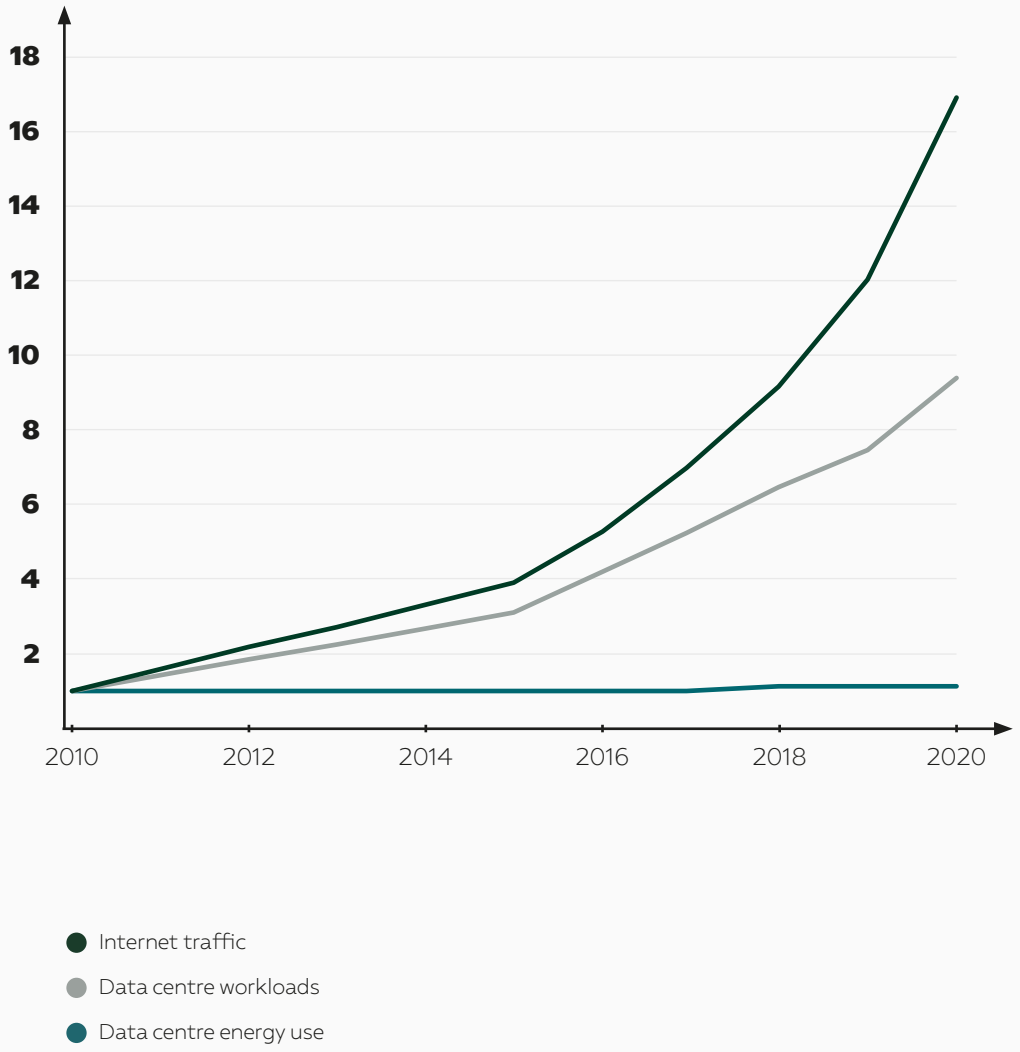
Customer needs and demand have led to data traffic increasingly reaching customers via mobile networks. The energy efficiency of mobile networks is now rapidly increasing. 4G networks are about five times more energy-efficient than 3G networks and 50 times more efficient than 2G. While today's 5G system consumes more energy than a 4G system, it can handle significantly more users with data transfer rates that are multifold. But progress is rapid, and thanks to technological development, 5G can be 10 to 20 times more energy-efficient than 4G as early as 2025–2030.[41] The roll-out of 5G networks in Sweden has begun, but given, among other things, that the 2G and 3G networks are being phased out, improved conditions are required. Partly for the industry, which will be responsible for the roll-out and provide the solutions, partly for the other social actors who will need the ability to test and develop solutions.

[35] GSMA. *The Mobile Economy 2020.*
[36] ITU. *Internet uptake has accelerated during the pandemic.*
[37] IDC.
[38] RISE. *Data in Sweden and the world.*
[39] Radar Ecosystem Specialists – Datacenter i Sverige 2020–2025 [Data centres in Sweden 2020–2025]
[40] Radar Ecosystem Specialists – Datacenter i Sverige 2020–2025 [Data centres in Sweden 2020–2025]
[41] Ibid.

Figure 2

Global trends in internet traffic, data centre workloads, and data centre energy use, 2010–2020 [42]

Index 2010 = 1



[42] IEA. *Data Centres and Data Transmission Network*

The industry's work with energy efficiency

Swedish data centres are some of the most energy-efficient in the world, and many Swedish data centre companies have a clear sustainability focus in their work. They plan, build, and operate data centres efficiently with as little environmental impact as possible. The energy efficiency in data centres is measured through the Power Usage Effectiveness (PUE)[43] calculation method. PUE is determined by dividing the total amount of energy supplied to a data centre by the amount of energy used to power the equipment contained in it. Swedish data centres are far more energy-efficient than the EU average, according to a PUE comparison. Several major actors are also working with commitments to reduce their carbon dioxide emissions to obtain Zero Waste Facility certification, run their business with 100% renewable energy, and power their backup power generators with environmental diesel, which has significantly lower net carbon dioxide emissions than traditional diesel.

The cooling of data centres is a cause of high energy use, and there is a great demand internationally for energy-efficient data centres. Sweden stands out with its cold climate, which reduces the need for cooling, and low climate impact as a result of a near fossil-free electricity mix. Add to this the ability to reuse excess heat for heating via local or regional district heating networks. In addition, Sweden has a lower risk of natural disasters and a stable political climate. By locating data centres in Sweden, the tech sector's international climate footprint is reduced.

The roll-out and use of 5G is an important measure to accelerate climate action and can reduce global emissions by 15%.[44] Along with IoT and AI, the tech sector can increase the rate of change to whole new levels.[45] The roll-out of the 5G network in Sweden is currently underway, and several of TechSverige's member companies are active. However, the process has been delayed as a result of, among other things, the postponed auction of 5G licences and the global challenges concerning logistics and access to components that followed from the pandemic.

The strong surge in demand for data centre services is largely offset by the ongoing work to make servers and data centre infrastructure more energy-efficient as well as by more and more services being located in the cloud or large-scale data centres. A clear trend that offers the potential for more efficient energy use is the fact that companies are increasingly renting data centre space rather than owning and operating their own. This provides economies of scale, such as large-scale use of cooling technology and various customer applications being run from a single machine, which increases the degree of hardware utilisation. Technological development has led to energy efficiency, including in the components used in both servers and storage devices.

Sweden has great opportunities to house the data centres and other network solutions required to respond to the exponentially increasing data handling and internet usage. However, there is a challenge in utilising the capacity of the facilities optimally. Development must be stimulated in order to make more companies and other actors choose to share data centre capacity, for example by renting space in existing ones. The reduced energy tax has made it easier for a number of international companies to locate their data centres here, which is positive from a sustainability perspective. However, the current design of the energy tax does not favour joint, more efficient use of the facilities.

[43] A theoretically overall efficient data centre would have a PUE of 1. Modern so-called "hyperscale" data centres are often built with the ambition of achieving a PUE of below 1.2, and the most efficient ones are at around 1.1. The measured Swedish PUE of 1.56 may seem high in comparison, but it's significantly lower than the EU average of 1.79 (based on 281 data centres).
[44] Ericsson. *Connectivity and climate change.*
[45] Ekholm Börje, Rockström Johan. "Digital technology can cut global emissions by 15%. Here's how", *We Forum.*

Swedish data centres are far more energy-efficient than the EU average.

INTERVIEW WITH NIKLAS LINDQVIST,
HEAD OF TECHNICAL DESIGN AT COROMATIC

"The heat from data centres can heat our homes"

What are the most important aspects of your work with sustainability today – socially and environmentally?
One of our most important initiatives is that we teach people what it would mean for industries and companies if power and communication in society were not to function. Through preventive measures, we reduce the vulnerability of society. We don't operate any data centres of our own, but we do operate others', and we are constantly working to operate them as energy-efficiently as possible, Niklas Lindqvist, Head of Technical Design at Coromatic, says.

As an employer, we work with our policies for travel, use local resources as far as possible, coordinate shipping and the like, and engage in discussions about the workplace of the new age. We also participate in forums and seminars, trying to get companies, municipalities, and regions to understand and use energy-efficient solutions. Our experience is that a lack of sustainable solutions is rooted in a lack of knowledge.

How does your company contribute to social and environmental sustainability in society as a whole?
We work extensively to secure critical infrastructure to ensure full functionality of other services and functions, for example, so that patient data is not lost, that medical records are available 24/7, and that planes can land even during a power outage. Our contribution consists in finding the best solutions and alerting companies to the importance of securing data. In addition, all our solutions are pervaded by an environmental sustainability perspective. Unfortunately, eco-friendly solutions are usually the most expensive ones. Therefore, we help our customers find green installations at a reasonable cost for the customer.

We also try to plan ahead by building data centres where the heat that is produced can be recovered and utilised. Releasing the heat from data centres straight into the air is a pure waste of energy, and we don't want to contribute to that. In Stockholm, for example, as well as in other parts of Sweden, the heat from data centres can be utilised thanks to a well-developed district heating network. Among other things, it can be used for heating our homes. Locating data centres close to the user also allows for faster data transfer, which is something that customers and society are increasingly demanding.

What are the greatest environmental challenges facing the industry?
There is not yet a large market for dismantling and recovery – but there will be. The industry should also agree on methods for comparing how eco-smart data centres are. Today's standards, norms, and certifications are used based on what best suits the particular data centre. In comparison, the real estate industry has comparable figures on a whole different level. The choice of location when establishing a data centre is also an important point of consideration. In Poland, for example, coal energy dominates, which makes the Nordic Region a much better place for data centres.

What can national policymakers do to make it easier for the tech sector to contribute to Sweden's climate transition?
Politicians need more knowledge in order to make demands on the industry that provide clear environmental benefits. They can, for example, introduce conditional tax relief and make it easier for those who want to establish operations with concrete environmental investments, such as district heat recovery from data centres. It's about creating incentives for the industry to build right.

Community and urban planning need to include plans for building smaller data centres located in existing or new neighbourhoods. Data centres must become a natural part of urban planning in the same way as other critical infrastructure. This is a must for developing smart cities.

Coordinating the construction and ownership of data centres is key. Regions should be able to join forces and operate a common data centre instead of several different ones – that would be much more efficient. Nowadays, we also tend to build too big, not creating the efficiency we should and could have.

Niklas Lindqvist
Head of Technical Design, Coromatic

INTERVIEW WITH JOHANNA GIORGI,
SUSTAINABILITY DIRECTOR AT ADDSECURE

"Sweden must get 5G in place"

How does AddSecure work with sustainability issues?
For AddSecure, sustainability is very much about efficient and smart use of resources, both as an offer to the customer and in the development of our business models. We are increasingly moving towards as-a-service models and subscription services. This enables long-term relationships with our customers while also allowing us to better control the way our products are being handled. In addition, cyber security and privacy are obvious sustainability issues of major focus for us as well as something that our customers are increasingly demanding.

How would you say that you contribute to sustainability in society as a whole?
Our IoT solutions are basically about transporting data from A to B in a secure manner. A common denominator is that they enable remote control and remote monitoring of operational systems, which in turn creates energy and emissions savings. Within our various market segments, we offer digital solutions as responses to the challenges contained within the 2030 Agenda, such as safe learning environments, more efficient care solutions, optimisation of transport, and modernisation of power grids. Our point of departure is that the world, in order to cope with the challenges we're facing, needs not only smart solutions but smart **and** secure solutions.

What are the tech industry's environmental challenges?
The world as a whole needs more efficient use of resources with circular resource flows. The tech industry was early to adopt as-a-service business models. With the component shortage currently experienced by the entire industry, the need to improve processes for reuse, upgrading, and material recovery is growing as well.

Energy use is another issue that the industry has to deal with. We know that this is an energy-consuming business, but it's difficult for us to get an accurate picture, as many data centres, especially outside the Nordic Region, do not offer this information to their customers. This makes it difficult to estimate the total benefit from the energy savings enabled by digital solutions.

Finally, as an IoT company with focus on secure communication and secure data, it may not be surprising that we push the issue of cyber security. Digital solutions have enormous potential to provide the answer to many of today's sustainability challenges. But if we can't build robust systems that resist external attacks and protect the privacy of individuals, the digital promise of a greener and more appealing world will be difficult to deliver on.

What can national policymakers do to make it easier for the tech sector to contribute to Sweden's green transition?
In order to enable continued automation and realise the efficiency gains that follow, Sweden must get 5G in place. It is the infrastructure that is needed in order for the tech industry to deliver the best solutions with the greatest effect possible. The energy issue also needs to be resolved. There are many of us requesting energy, and especially renewable energy.

In general, increased insight and knowledge about the opportunities offered by digitalisation are needed. For example, if we look at the roadmaps developed within the framework of Fossil Free Sweden, digital solutions are consistently absent. At the same time, many public investments in digitalisation lack direction in terms of the effects to be achieved. It risks becoming a matter of "digitalisation for the sake of digitalisation" rather than initiatives where digitalisation is truly used as a tool to achieve the necessary change.

Johanna Giorgi
Sustainability Director at AddSecure

Challenge – unwanted chemicals

Chemicals are all around us. They provide a variety of properties and functions that are necessary and that facilitate our everyday lives. Chemicals can occur naturally in the environment or be made synthetically. A natural chemical substance can affect people, animals, and nature negatively, and conversely, synthetic chemicals can have many positive properties. But the use of hazardous chemicals is a problem, both for people and the environment. The fact that IT products contain chemicals means that the tech industry needs to deal with this throughout the lifecycle of a product: in production, during use, and upon recycling or combustion. If handled incorrectly, chemicals risk leaking into the environment. Chemicals that are not tested and approved risk harming the people who handle them, such as workers in component and final assembly plants.

In 2020, there were over 350,000 different chemicals registered for all commercial production and use. The United Nations Environment Programme estimates that the global chemical market will double between 2017 and 2030.[46] Thousands of chemicals are used in tech. While the majority of them are not hazardous, the complexity of the IT industry's global supply chains, with the import and export of chemicals and components, makes it difficult even for manufacturers and retailers to know exactly which chemicals a product contains.[47] New chemicals can be introduced faster than they are tested and regulated, and when they are banned, they are sometimes replaced with new, not yet tested chemicals.[48] It is therefore important that tech industry actors carefully keep track of which chemicals are used in production and that they use chemicals that are proven to be safe.

The absolute majority of chemical substances in IT and telecom products are chemically bound in the various parts of the products. An example of commonly occurring chemicals in IT products is flame retardants. These are used to delay or prevent material from burning. In practice, this means that they pose no risk when used as intended. However, the flame retardants themselves can be hazardous to human health and the environment and persistent. Many IT products also contain various softeners, such as cables, which need to be bendable. In addition, various process chemicals are used in production that can be hazardous to the health of the workers. Other hazardous substances are found inside the electronics and only become a problem when the product becomes waste.

Product and service producers are responsible for complying with all applicable legislation regarding, among other things, chemical content. Information about the content of chemical substances in goods aims to create conditions for reduced risk by providing all production and handling stages with sufficient information to be able to contribute to the development of products in accordance with the Swedish Environmental Code and in line with the environmental quality goal of a "toxic-free environment". There may be risks to human health and the environment if the waste from these products is not handled in accordance with current recycling regulations. It is therefore important to have structures in place for safe recycling of electronic waste.

[46] The United Nations Environment Programme (UNEP), Global Chemicals Outlook (GCO) II Report (2019). p. 13
[47] The United Nations Environment Programme (UNEP), Global Chemicals Outlook (GCO) II Report (2019). pp. 22–23
[48] TCO Development, Impacts & Insights: Navigating the Sustainable IT Revolution (2021).

The industry's work with chemicals

The tech industry has and takes great responsibility for reducing the occurrence of harmful chemicals throughout the product lifecycle. The industry has made great progress in the field of chemicals in recent decades. Since the mid-1990s, it has stopped using flame retardants included in the PBB[49] and PBDE families[50], substances which the EU banned in 2006 through the so-called RoHS Directive[51]. Other harmful substances phased out by the industry are lead, mercury, and cadmium in batteries, as well as certain chlorinated paraffins. In 2010, an active phase-out of mercury in flat screens, laptops, and TVs began, and today, it is completely phased out. Flame retardants containing bromine and chlorine have long been substituted for phosphorous-based substances, among others. The industry is now intensively searching for good alternatives to so-called phthalates, which are used to soften plastics and rubber, for example in electrical cables. Many companies have decided to reduce their use of PVC, a form of plastic, in both products and packaging materials due to its content of phthalates.

For many years, the EU Chemicals Regulation known as REACH and the substances on the so-called Candidate List have governed the industry's work with chemicals.[52] Great caution is required when substituting chemical substances, as the environmental properties of the new substance, the substitute, must have been investigated. Introducing new substances thus requires extensive investigations. Furthermore, the technical properties of the substitutes must be as good as the substances they are replacing. The industry's work with this is constantly ongoing, and the development is also driven by the companies' own climate efforts, which include demands from both corporate and public sector customers. The industry uses various methods to identify safer chemicals that can provide substitutes for chemical content in electronic products.[53] The majority of companies use the GreenScreen Method for assessing alternatives in order to reduce the risk of so-called false substitution.

Already in 2006, the tech industry developed an international and standardised environmental declaration for the content of various products, including chemicals. The declaration is continuously updated to make it easier for buyers to compare the content of different suppliers' products.[54]

In Sweden, the collection and handling of electronics are key aspects of the so-called producer responsibility, which was introduced in 2001. Electronics manufacturers then created a joint service via industry organisations, including TechSverige, to make the recycling process easier: El-Kretsen. The job of El-Kretsen is to help producers fulfil their producer responsibility by offering a nationwide collection system to enable the handling and recycling of electronic products in accordance with current laws and regulations.

Government policy is that Sweden should lead the way and be a driving force in reducing unwanted chemicals in people's home environment. In 2017, it therefore introduced a tax on chemicals in certain electronics sold in or imported into Sweden (the so-called electronics tax or chemicals tax). The purpose of the tax is to encourage manufacturers of the taxed products to use better alternative chemicals, mainly in flame retardants. On behalf of the government, the Swedish Chemicals Agency and the Tax Agency have investigated the effect of the tax and what changes should be implemented in order to make the law more effective. The agencies concluded that the tax does not achieve the environmental aim, as it does not generally change the use of flame retardants in electronics, is not cost-effective, raises the price for consumers, and is an administrative burden for companies.[55] The tax also constitutes an obstacle for the tech industry's ability to reuse products via IT retailers, as the tax can correspond to the value of a used product and thus render it uneconomical to sell.

The tech industry supports the ambition to reduce unwanted chemicals, but the work to reduce these substances should take place at EU level. The Swedish tax on chemicals in certain electronics should be abolished and Sweden should instead be a driving force for common EU rules in the area of chemicals, as was successfully done in the past with the ban on PFAS substances.[56]

[49] Polybrominated biphenyls.
[50] Polybrominated diphenyl ethers.
[51] Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment Text with EEA relevance.
[52] European Chemicals Agency.
[53] Greenscreen Chemicals.
[54] ECMA International. *TED – The ECO declaration.*
[55] Swedish Tax Agency. *Farliga flamskyddsmedel ger högre skatt [Hazardous flame retardants result in higher taxes].*
[56] Highly fluorinated substances.

A circular and sustainable value chain

In order to reach national and global climate targets, both the business community and the public sector must move from linear to circular business models. The tech industry can contribute by increasing circularity in every part of the tech value chain, from extraction and processing of materials, production, and distribution to handling by customers and end users, waste management, and recycling.

The main challenge for the tech industry in increasing circularity in the value chain is extending the life of the products.

Challenge – circularity throughout the value chain

The traditional linear model for electronic products consists of five steps: extraction of materials, manufacturing, distribution, consumption, and finally disposal. In a linear model, the step following consumption and use of a product is often that of recycling or waste. Since a linear economy is based on volume, little consideration is given to the potential life of a product.

In a circular model, the products can take several new paths after the initial consumption step, including being reused by another consumer, upgraded, disassembled and utilised, or, if none of this is possible: material recovery. The ultimate goal of a circular model is to completely eliminate waste. As electronic waste, or e-waste, contains many valuable and rare materials, such as gold, platinum, cobalt, earth metals, aluminium, and tin, it represents a great opportunity for the industry to secure access to raw materials while reducing the amount of waste.

Figure 3

Linear vs. circular model for electronic products

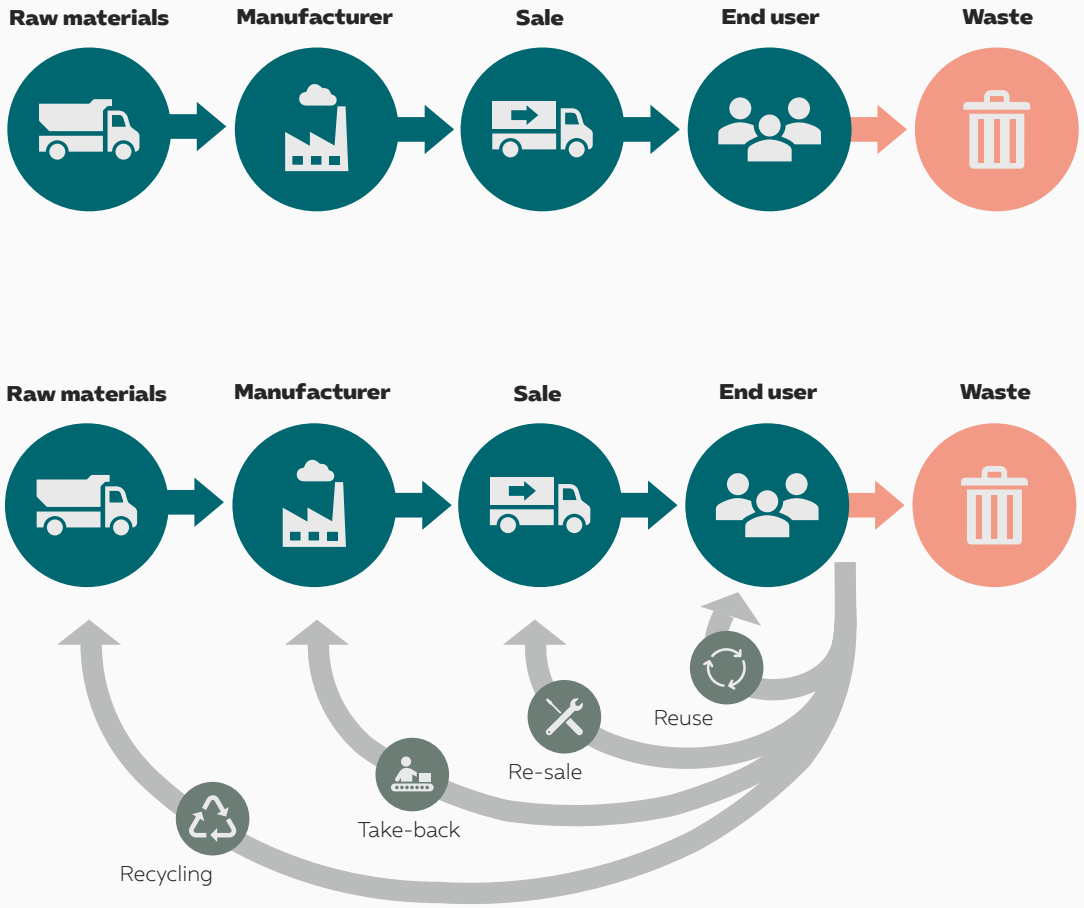
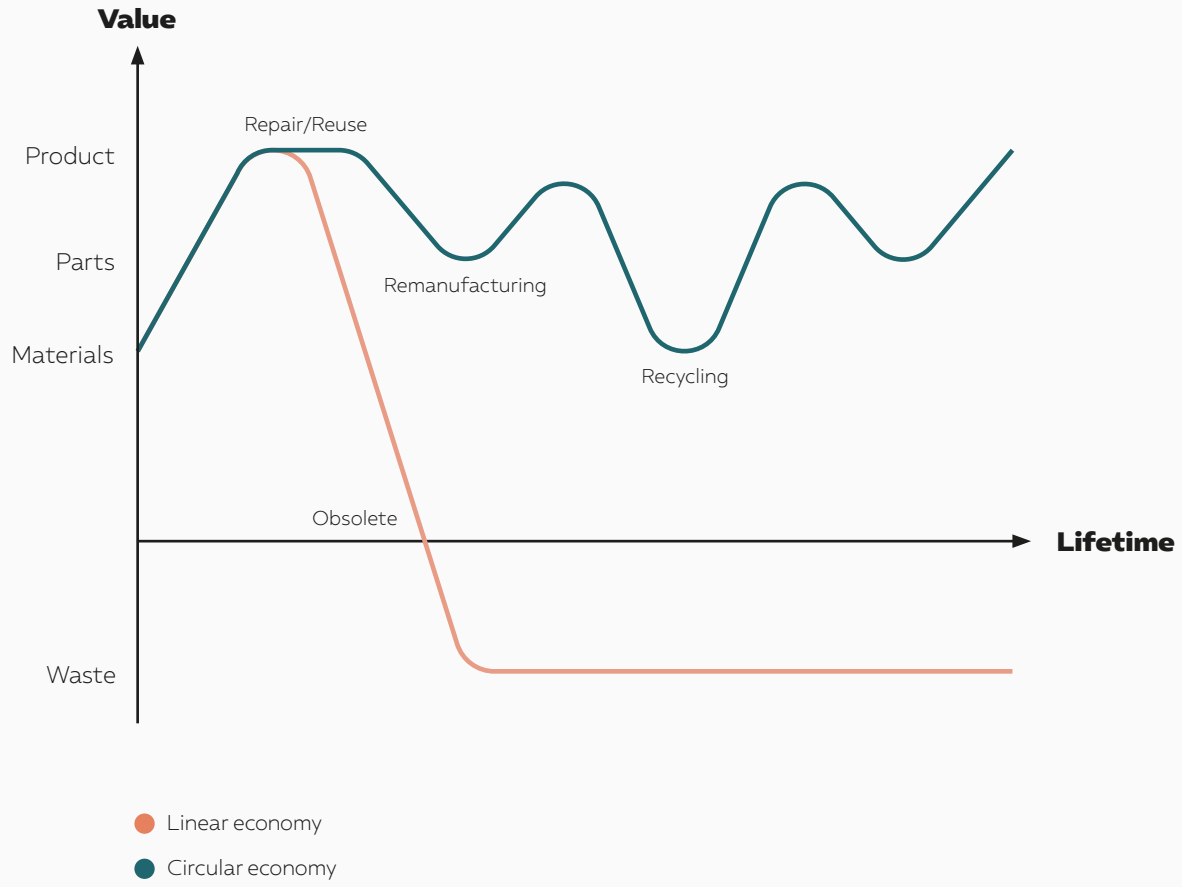


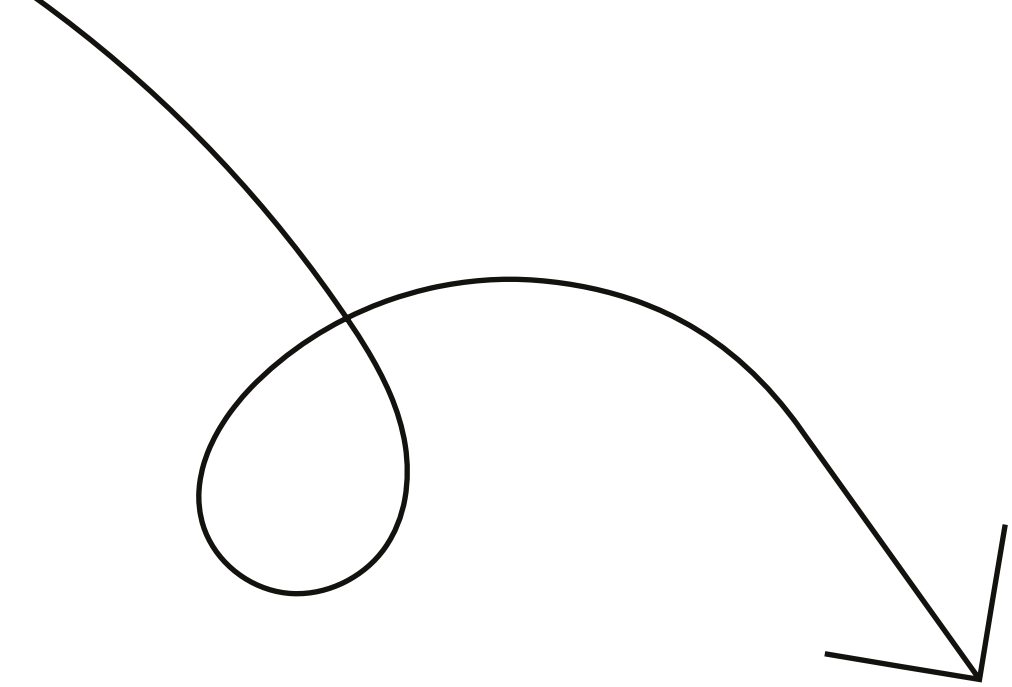
Figure 4

Lifetime value of materials in a circular economy[57]



Increased circularity significantly reduces the climate and environmental impact of electronic products. For example, the European Commission estimates that if the life of all smartphones in the EU was extended by one year, it would save the equivalent of 2.1 million tonnes of CO_2 by 2030.[58] In addition, a circular value chain allows for increased value, as revenue from a product is generated multiple times instead of only when sold (see Figure 4). This also reduces the company's exposure to increased raw material prices and new material shortages that can arise when more and more industries change, and the cost of critical raw materials go up.

[57] Eionet Portal. *ETC/WMGE Report: Electronics and obsolescence in a circular economy.*
[58] Publications Office of the European Union. *Supporting the green transition: Shaping Europe's digital future.*



In addition, tech products contain many precious metals that could be extracted, recovered, and used as recycled raw materials in new products. The value of raw materials in the e-waste generated globally in 2019 alone is estimated at USD 57 billion. Iron, copper, and gold are the main contributors to this value.[59] The challenge is that many electronic products are extremely complex and can contain more than 1,000 different substances.[60]

Globally speaking, tech products today have a low degree of circularity. For example, the life of an average mobile phone in Sweden is around 3–4 years.[61] The main challenge for the tech industry in increasing circularity in the value chain lies in the aspect of extending the life of the products and, not least, in adapting the product for repair, upgrading, and reuse already in the design phase, so-called upstream innovation.

The amount of e-waste and the recycling rate differ significantly between different continents. In Europe, 43% of all e-waste is recycled, while, in Africa, the recycling rate in only 1%. As much as 8% of all e-waste is estimated to be thrown in the bins in high-income countries.[62] Compared to other countries, Sweden is relatively good at recycling old computers, TVs, and mobile phones. According to statistics from El-Kretsen[63], the total collection of electrical and electronic products and batteries in 2020 amounted to 156,000 tonnes. This equals approximately 15 kilos per person, which is a slight increase from 2019.[64] About half of the waste falls in the "miscellaneous electronics" category, in which, among other things, computers and phones are included.

One challenge for the industry is that although products are designed for reuse and recycling, there are no facilities to support their return to the circular economy. Hardware manufacturers, for example, need large flows of high-quality materials, and finding suppliers who can provide these is difficult. There is not yet enough recycled plastic of a high enough quality for use in new IT products, and recycling black plastic remains a challenge.

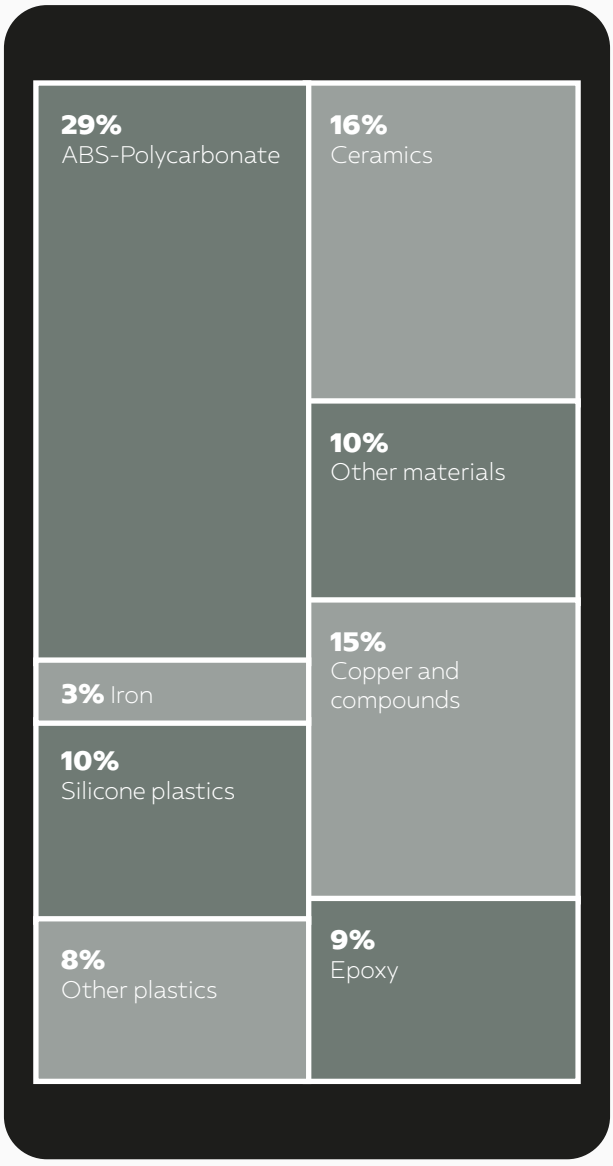
There are still only few recycling plants that can recycle and take apart tech products. However, the tech industry in Sweden already has a number of such actors operating in Sweden as well as in the Nordic Region and the EU. But in order to achieve scale, it also needs to be easier for customers to contribute to increased reuse. At recycling centres today, all electronics are often placed in one and the same container. The content is then shredded, even though there may be, for example, mobile phones with both one and two life cycles left in them.[65] From a sustainability perspective, this is highly counterproductive, so making sure that collection promotes reuse is crucial.

Illegal export of waste is a common problem globally and yet another challenge for the tech industry. In Sweden, however, it is not very common, although a number of illegal cross-border transports of e-waste or batteries are reported every year.[66]

[59] Unitar. *The Global E-waste Monitor 2020.*
[60] Santhanam Needhidasan et al. *Electronic waste – an emerging threat to the environment of urban India.*
[61] Umeå University. *Vad händer med alla elektroniska prylar när vi inte längre vill ha dem? [What happens to all the electronic gadgets when we no longer want them?]*
[62] Unitar. *The Global E-waste Monitor 2020.*
[63] Learn more about El-Kretsen in Section 5.6.
[64] Sustainability Library. *Det här återvinner vi. [What we recycle.]*
[65] TechSverige. *Återvinning måste vara det sista stadiet för en produkt. [Recycling must be the final stage for a product.]*
[66] Swedish Internet Foundation. *Så kan tekniken du redan äger bli grönare. [How the technology you already own can become greener.]*

Figure 5

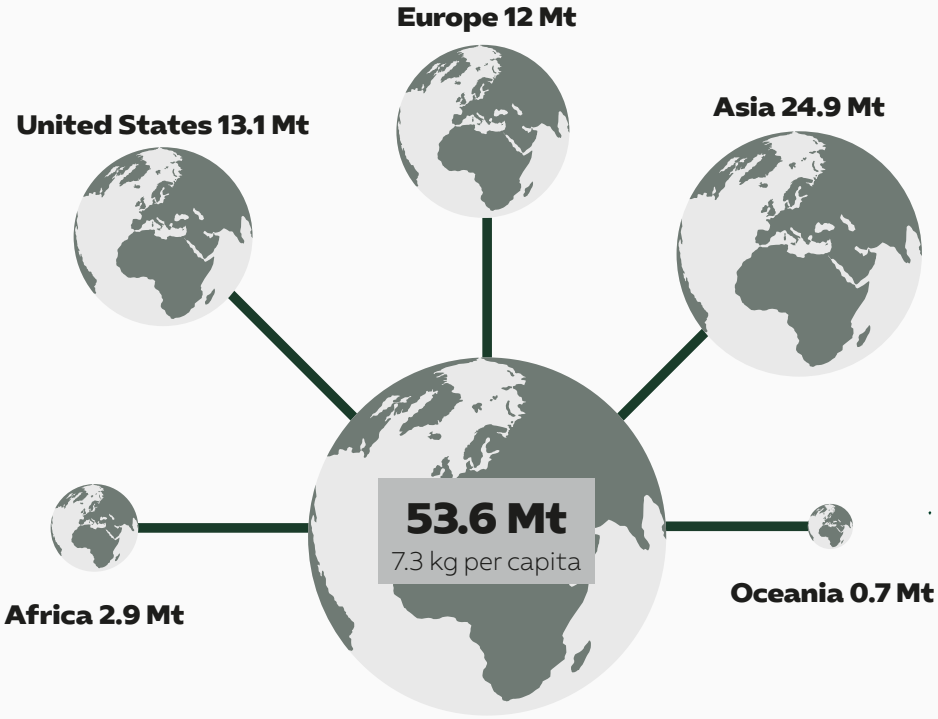
"What does a mobile phone consist of?" [67]



[67] Publications Office of the European Union. Supporting the green transition: Shaping Europe's digital future.

Figure 6

E-waste generated in 2019 per continent[68]



E-waste generated globally 2019

Percentage of e-waste that is recycled[69]

Globally
17.4 %
9.3 Mt
Increase of 1.8 million tonnes since 2014.

Africa 0.9%
United States 9.4%
Europe 42.5%

Oceania 8.8%
Asia 11.7%

[68] Rework of the image on page 13 http://ewastemonitor.info/wp-content/uploads/2020/12/GEM_2020_def_dec_2020-1.pdf
[69] Rework of the image on page 14 http://ewastemonitor.info/wp-content/uploads/2020/12/GEM_2020_def_dec_2020-1.pdf

The industry's work for increased circularity

In the tech industry, more and more companies are shifting to new, more circular business models, where focus is on as-a-service and the sharing economy rather than just the sale of hardware. This transition lays the foundation for a more circular economy by focus no longer solely being on selling a product but creating a more long-term relationship with the buyer, where the company owns and takes responsibility for the product throughout its life cycle. The customer can use the product as long as needed and only pays for the result rather than the entire product. The company, on the other hand, takes responsibility for making a quality product that lasts and is both material- and energy-efficient. The company also takes responsibility for taking the product back and adapting it to the next user. The shift to more circular business models also means that revenues change, from revenue at sale to recurring revenue throughout the life cycle.

Today, all Nordic mobile phone operators offer fully circular models that allow handing in phones, often getting paid for them, and buying used mobile phones with the same warranty and customer experience as for a new mobile phone, only with a lower carbon footprint. This model is also offered by major electronics chains. The transition to new service models and better product tracking and take-back can lead to global, circular value chains.

Producer responsibility is a political instrument for achieving the environmental goals and means that producers are responsible for collecting and taking care of end-of-life products and/or materials. This is meant to motivate producers to develop products that are more resource-efficient, easier to recycle, and free from environmentally hazardous substances. Producer responsibility can be found in several areas linked to IT products.

Sweden introduced producer responsibility for e-waste as early as 2001 as a political instrument for achieving the environmental goals. It means that producers are responsible for collecting and taking care of end-of-life products and/or materials. Producer responsibility can be found in several areas linked to IT products. Also initiated in 2001 was "Elretur", a collaboration between El-Kretsen and the municipalities. The collaboration involves the municipalities arranging for manned receiving terminals, usually located by recycling centres, where households can drop off their electrical waste free of charge. El-Kretsen arranges for the end-of-life electronics to be collected and transported to one of El-Kretsen's contracted recycling companies, where pre-treatment and recycling take place in an environmental manner in accordance with current laws and regulations.

The EU Circular Economy Action Plan (CEAP) specifies a number of key activities for which the European Commission has presented and will present proposals affecting the industry in the coming years. This includes proposals for product passports and the right to repair. Within the scope of the EU's work with sustainability issues, a need has also been identified to improve the recycling rate of used products to ensure future access to raw materials. The tech industry welcomes this development and is generally positive about initiatives such as this one.

In this context, data sharing between companies and other relevant actors in supply chains, within and outside the country, is a key to increasing transparency in the supply chains. The current obstacles to data sharing, such as competition and security aspects, need to be overcome to enable increased circularity in value chains. The industry participates in various development projects on this topic.[70] A shift from virgin (i.e. newly produced) to more recycled raw materials from electronics recycling or raw material marketplaces also drastically reduce the risks and environmental impacts of mineral and material extraction. The use of recycled metals, for example, can reduce greenhouse gas emissions from mobile phone manufacturing by an estimated 50%.[71] Such a shift, in turn, requires expansion of the recycling infrastructure and, most likely, changed customer behaviour as well as increased focus on sustainability in public procurement, which is something the industry is working to create.

Product design solutions, such as those for reducing the use of materials in products (dematerialisation), also have great potential to reduce the environmental impacts of various materials over a life cycle. The tech industry has undergone a natural dematerialisation over the last decade, as large and heavy products, such as screens and computers, have been replaced by lighter and more compact ones. Many digital products that used to come separately can now be found in one and the same product, such as in a mobile phone. Reduced product weights and dimensions lead to reduced emissions from transport.[72]

[70] Vinnova. *Sweden's conditions in the digital structural transformation.*
[71] J. M. Valero Navazo, G. Villalba Méndez, and L. Talens Peiró, "Material flow analysis and energy requirements of mobile phone material recovery processes," Int J Life Cycle Assess, vol. 19, no. 3, pp. 567–579, Mar. 2014, doi: 10.1007/s11367-013-0653-6
[72] Global Electronics Council. *Sustainable use of resources.*

Challenge – sustainable supply chains

Today, the supply and value chain for the tech industry's products is often dependent on a large number of subcontractors in everything from extraction of raw materials and materials, manufacturing, assembly, shipping, and transport to end users. It is not uncommon that the chain spans multiple continents. Each stage of the value chain involves social and ecological sustainability risks and thus challenges that the industry needs to address. Companies need to be transparent and pursue sustainability throughout the value chain. The requirement for companies to report both social and environmental sustainability is increasing, not only in terms of their own operations but also those of their suppliers.

The complexity and comprehensiveness of the IT industry's global supply chains are illustrated in Figure 8. In the computer example, the first step of the supply chain goes from mines (1) and smelters in South America and Africa to component manufacturers (2–3) and final assembly plants (4) in Asia.

Extraction of raw materials and manufacturing

The environmental and social sustainability risks, and the actual impact, are the greatest far down the supply chain, especially in the production of the materials and minerals needed to create the tech industry's products. Metals, plastics, and minerals are important in contributing to the shape, functionality, and finish of hardware products. A smartphone can contain up to 60 elements, i.e. more than half of the elements in the periodic table.[73]

According to the International Energy Agency (IEA), the world's extraction of minerals must increase fourfold by 2040 in order to reach the goals of the Paris Agreement, as many of the technologies considered to be crucial for making the transition use various minerals in production. For example, the world is expected to need 21 times more cobalt compared to today, and 42 times as much lithium.[74]

The production of all the raw materials and materials required in electronics is a major challenge for the industry. Production often takes place in countries with non-existing or very limited environmental legislation and poor working conditions. The unregulated mining of so-called conflict minerals (tantalum, tin, tungsten, and gold) is especially problematic, as it can also be a contributing factor to conflict. Further up the chain, for example in component manufacturing and final assembly, we find social risks such as corruption and poor conditions concerning work environment and workers' rights.[75]

For many tech companies, carbon dioxide emissions are also significantly higher further down the value chain, not least in the extraction of raw materials and manufacturing. Up to 80% of emissions linked to, for example, a laptop, occur at the manufacturing stage.[76]

Transport and end use

Further up the value chain, where products are shipped and transported to end consumers and then used by end consumers, global transport causes major carbon dioxide emissions. Efforts for reduced carbon dioxide emissions and environmental impact and for increased social sustainability in all parts of the supply chains need to be made on an international level in order to be successful, as sustainability risks often occur in countries with weak regulatory pressure for change.

[73] C. Hagelüken and C. W. Corti, "Recycling of gold from electronics: Cost-effective use through 'Design for Recycling,'" Gold Bull, vol. 43, no. 3, pp. 209–220, Sep. 2010, doi: 10.1007/BF03214988

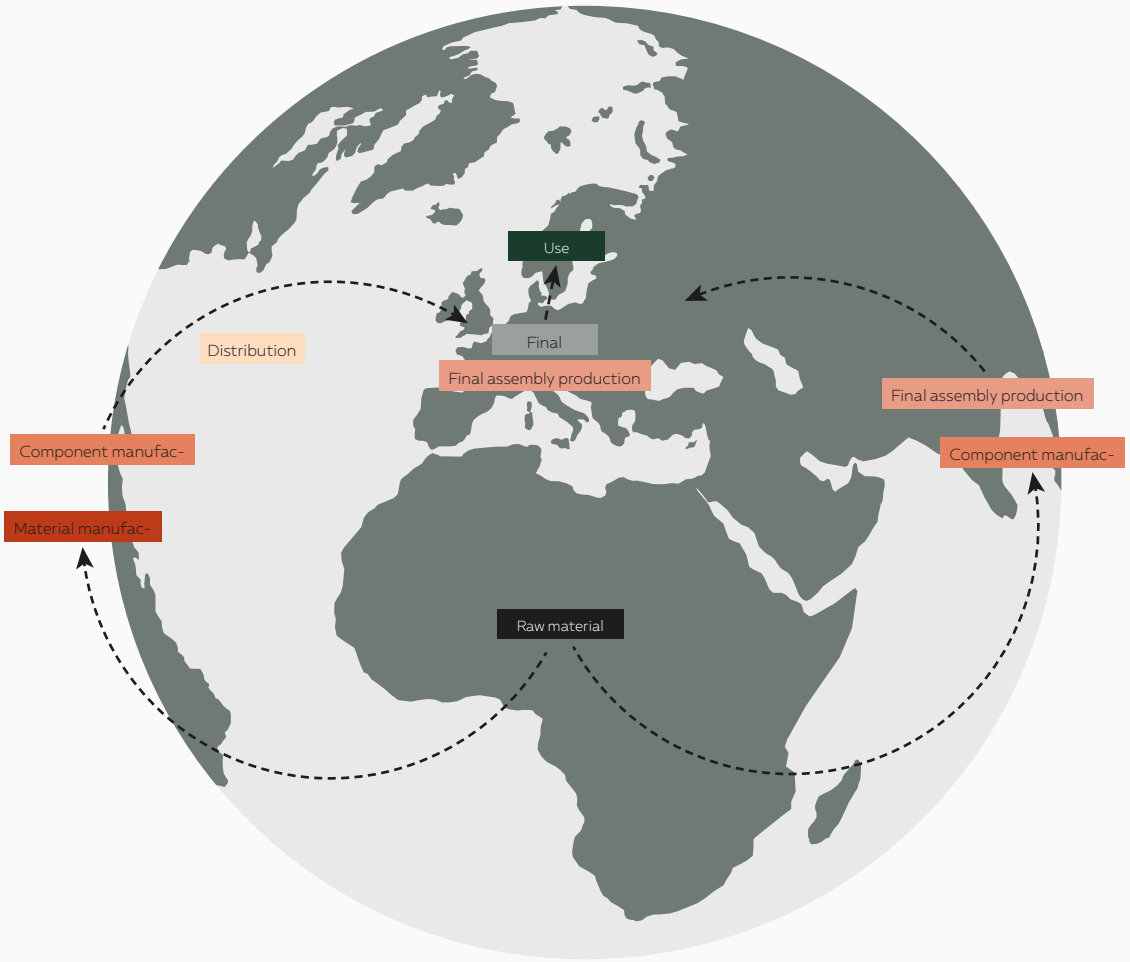
[74] IEA. *The Role of Critical Minerals in Clean Energy Transitions.*

[75] Advania. *I takt med omvärlden: Advanias hållbarhetsarbete [In pace with the world: Advania's work with sustainability].*

[76] TCO Certified. *Impacts and Insights: Circular IT Management in Practice.*

Figure 8

The supply chain of a computer [77]



Example of a supply chain where part of the raw materials comes from Africa. Also, raw material extraction takes place largely in Asia and the United States.

[77] Wieland, Andreas. *The Supply Chain of a Computer, SCM Research.*

A challange for the industry is that even if products are designed to be reused and recycled, it lacks facilities that can support the return of the products to the circular economy.

The industry's work for increased sustainability in supply chains

In its report, Sustainable Supply Chains, TechSverige describes the conditions for working for sustainable supply chains.[78] Ensuring environmental and social responsibility throughout the value chain is a complex and extensive task for companies that may have thousands of suppliers. The challenge is especially great when it comes to imposing requirements on underlying supplier stages, i.e. subcontractors of suppliers, and monitoring those requirements. Companies in the industry work with their own as well as joint efforts to ensure that all stages of the supply chain comply with:

- ILO fundamental conventions covering subjects such as discrimination, child labour, the right to organise, and compulsory labour
- The UN Convention on the Rights of the Child
- The UN Declaration on Human Rights
- The UN Global Compact, consisting of international principles for businesses concerning human rights, labour issues, the environment, and corruption
- High set requirements for health and safety, environment, ethics, anti-corruption, and limited use of so-called conflict minerals

In addition to their own work, companies can choose to join various industry initiatives. Examples of industry initiatives to ensure social corporate responsibility in the supply chain:

- The RBA (Responsible Business Alliance) has produced a common code of conduct that is used primarily by actors in the electronics manufacturing industry. It includes supporting the rights and well-being of workers and societies around the world affected by the global supply chain. As a member, a company also commits to supporting continuous improvements of its social, environmental, and ethical responsibility in its supply chains. The RBA has three suborganisations – RMI (Responsible Mineral Initiative), RLI (Responsible Labor Initiative), and RFI (Responsible Factory Initiative) – which provide tools and resources that enable companies to make responsible choices.
- JEITA (Japan Electronics and Information Technology Industries Association) works with various initiatives related to sustainability.
- GeSI (Global e-Sustainability Initiative/Global Enabling Sustainability Initiative)
- JAC (Joint Audit Cooperation)

TechSverige has conducted a survey among our members on how they work with different sustainability issues throughout the value chain. The companies stated that they want to avoid contributing to conflicts by purchasing minerals from conflict-affected and high-risk areas. Since companies in the tech industry operate in a very long supply chain, there are many stages between the companies and the mining of conflict minerals, which makes setting and monitoring requirements a complex matter. Efforts, on both industry and company level, are therefore mainly focused on improving traceability of mineral origin.[79] Companies also work together with their subcontractors to reduce emissions and waste, including through dialogue and requirements for appropriate certification. Many of the responding companies in the same survey also stated that updated supplier policies are in progress.[80] Hardware has the greatest environmental impact, and 60% of the respondents in the Hardware subindustry stated that they make estimates of the environmental impact of their own operations. In addition, 80% stated that they have a continuous dialogue with subcontractors in order to reduce their emissions and waste.[81]

[78] Swedish IT & Telecom Industries. *Hållbara leverantörskedjor [Sustainable Supply Chains]*.
[79] Examples of initiatives are The Responsible Mineral Initiative (f d CFSI, Conflict-Free Sourcing Initiative), The Conflict Minerals Regulation (regulation 2017/821), and the US Public Law No: 111-203" – part 1502 (Dodd-Frank Wall Street Reform and Consumer Protection Act H.R. 4173).
[80] Survey among members 4–19 October 2021.
[81] Survey among members 4–19 October 2021.

INTERVIEW WITH STEFAN NILSSON,
DIRECTOR OF SUSTAINABILITY AND ESG AT FOXWAY

"The requirements for re-use in the IT industry must be made more stringent"

What are the most important aspects of your work with sustainability?
Today, Foxway's operations have a relatively low climate footprint, with good control over the internal footprint. We have also set a goal to have 100% recycled electronics in-house starting 2022 and to be climate-neutral in scopes 1, 2, and 3 by 2025. The biggest difference is made for our customers and partners; we reduce the industry footprint mainly in Scope 3 through reduced consumption and we have also joined forces with other companies and partners in the EU to create circularity through reuse in several steps. Our turnover is currently 80% circular and 20% linear, while, with other actors, I'd say that the relationship is the other way around.

A central aspect of our work with sustainability is that we have a tech centre that refurbishes, packages, and sells IT products with an extended warranty. If, after the second sale, the products are still in good condition, the process is repeated as many times as possible. The components are then taken apart and used as spare parts. Alternatively, the material is extracted for reuse. The first and second reuse usually take place in the Nordic Region and the EU, while the third takes place in southern and eastern Europe, the Middle East, and Africa. Finally, the raw materials can be recovered to become new products. This ensures circularity in our sales.

Our view is that the whole approach to circularity and reuse needs to be updated and made more stringent. Today, no distinction is made as to how circular IT suppliers are. Regardless of whether all you do is collect and sell to the highest bidder, usually through export without any monitoring, or you responsibly repair, grade, upgrade, and sell with new warranty, "take-back" is seen as one item. We believe that the industry will make a clearer distinction between partners who engage in "trading" and those who actually work to extend the life of IT products.

How does your company contribute to sustainability in society?
We work a lot with teaching others in the industry how to work with reuse professionally. Foxway co-founded the European Refurbishment Association (EUREFAS) to develop the knowledge of and the work with IT repair and circular economy. Getting the entire production chain onboard requires European and global rules for the reuse of IT products. Recycling/reuse must take place with quality and safety, with products that retain their safety qualities in terms electricity and water even in reuse.

Foxway works according to four cornerstones that we believe can have major societal effects. The first involves promoting the sharing economy, where we want customers to rent more and where we work with the supplier regarding the product's entire life cycle. At present, the industry is way too linear. The other cornerstone focuses on circularity and means that we must work together to collect, repair, and upgrade old IT products, such as mobile phones, tablets, and computers. The third is about wanting to encourage consumers to buy things that last longer, ideally 7–8 years. All too often, government agencies and companies focus on price and a life of maybe 3–4 years. Finally, we work with digital inequality. As more and more people acquire sustainable computers and mobile phones, we enable groups that are less well-off to gain access to the Internet, connection, and IT products in the second, third, and fourth life cycles of the product.

We have also reached out to universities to develop knowledge about sustainability in the IT industry, such as more research on the life of IT products. We want to monitor the effects of our model in a professional manner.

Stefan Nilsson
Director of Sustainability and ESG at Foxway

What are the greatest environmental challenges in the industry?
Profitability in the industry is still driven by increased sales. This means that the industry has a linear mindset, ending its relationship with the product once it's sold and the invoice is sent. Instead, we try to have a circular business model. However, if circularity is to become the standard, data and monitoring are a must – we need to know the expected life of IT products in order to make better consumption decisions. Few buyers, for example in the public sector, consider the fact that IT products have different lifespans and what that means for the climate footprint. We see a trend towards climate footprint and carbon dioxide reporting becoming as complex and demanding as financial reporting. We cannot maintain our linear mindset in such a society.

Another challenge is that companies don't calculate according to the same method when preparing their climate reports. We believe it is of utmost importance that the industry uses standardised methods linked to the calculation of avoided emissions. We're looking into such a method within the scope of the collaboration in the non-profit association Digitaliseringskonsulterna, where we use standardised ISO models for calculating Carbon Handprint.

What can national policymakers do to make it easier for the tech sector to contribute to Sweden's climate transition?
The public sector must shift its focus from product price to lifespan and circularity when making purchases. Procurements should contain requirements for expected lifespan reporting. It makes no sense for a product that may last for over 10 years to get the same environmental score as a product that may live only for 3–4 years. Climate footprint must follow life expectancy.

[82] See for example: https://www.vttresearch.com/sites/default/files/pdf/publications/2021/Carbon_handprint_guide_2021.pdf

INTERVIEW WITH OVE JANSSON, ENVIRONMENTAL AND QUALITY MANAGER AT SHARP BUSINESS SYSTEMS SVERIGE AB

"Complex supply chains make control more difficult"

What are the most important aspects of your work with sustainability?
Sharp's main focus is to reduce the climate footprint of our operations. It's a big challenge, as we are part of a major global organisation with headquarters in Japan. Sweden only constitutes a small part of the entire organisation, and we are almost at the far end of the chain. In Sweden, we are subject to strict sustainability-related requirements, imposed by both customers and legislators, but this is not the case globally.

Social sustainability is another key issue that we work with, particularly focusing on the working conditions in our supply chains. My assessment is that we have good control and monitoring when it comes to the manufacturing plants that we own ourselves. However, we also have many complex supply chains, and it's much more difficult for us here in Sweden to check, for example, the work environment and working conditions in the step preceding our own manufacturing plants. We believe that international organisations are needed to regulate and monitor this type of challenges.

How does your company contribute to sustainability in society as a whole?
Sharp Sweden has gone from being a "printer company" to providing document and information management systems for the digital workplace. This shift means a lower climate footprint and greater opportunity for guiding consumers towards more sustainable use of our products and services. Through, for example, increased refurbishment of products as well as reuse and recycling of electronics, we and our customers can do lots of good in the area of sustainability. Globally, Sharp also works with the development and manufacturing of solar energy solutions, which also contribute to sustainable development. I think being an active member of various development projects is incredibly important. For example, Sharp is the referral body for the Swedish Chemicals Agency, the National Agency for Public Procurement, and the Ecodesign work within the EU. In these forums, we can share knowledge and experience for the development of the credible and high sustainability requirements of the future. This is an important contribution to jointly creating a more sustainable world, socially as well as environmentally.

Do you see any obvious challenges in the industry related to sustainability?
The reuse of IT equipment is a central challenge. Today, our products have an estimated life of 10–15 years, and we do what we can to ensure that customers use them as long as possible.

What policy initiatives would you like to see?
Clearer guidelines and directives for public administration in terms of accepting the use of recycled products, as well as for measuring the use. The Swedish National Agency for Public Procurement should be given clearer directives to procure reused products. This could be done in collaboration with the Swedish Chemicals Agency and the Swedish Environmental Protection Agency.

Another key issue for our government agencies and legislators is to look at the difference between consumer and business products in IT and electronics. Companies have both laws and customer requirements to live up to. Consumers, on the other hand, handle their IT and electronics based on legal requirements that are not checked as extensively. Unfortunately, we see that requirements to create sustainable development for private consumers often also lead to legislation on business products, such as the chemicals tax and the deposit law for small electronics. These legislations cause increased costs for business products, which leads to increased costs for procuring government agencies. Regulations and market controls are already in place for business products in order to meet current objectives in the area of sustainability.

Ove Jansson
Environmental and Quality Manager at Sharp

Social sustainability

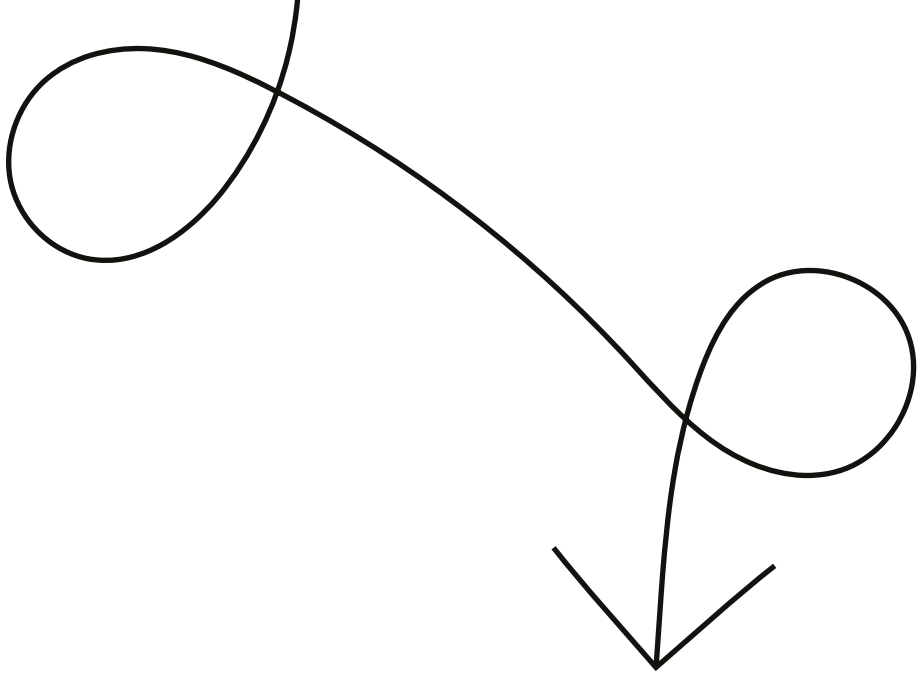
A socially sustainable society is a society with social and gender equality, where people have good health and live good lives without unjust differences. Social sustainability puts the individual in focus and involves our human rights, such as issues of discrimination, work environment, working conditions, gender equality, diversity, and inclusion.

The corona pandemic has drawn attention to the merits of digitalisation for increased social sustainability. Without the digital know-how that characterises Sweden, society's ability to cope with and avoid some of the potential consequences of the pandemic would have been completely different. Telework became a possibility because of great broadband expansion and the fact that most homes have access to internet connection. Even teaching was carried out remotely. But the pandemic also exposed challenges, such as difficulties for people who, for various reasons, do not have e-identification to access health care services or services that all too often are designed in a way that don't make them accessible to everyone. The differences in the opportunities to use digital services became apparent and must be remedied through structured and long-range efforts in which both the government and the business community are involved.

The tech industry has long worked to increase social sustainability in the industry and manage or participate in several initiatives linked to competence supply, diversity, gender equality, and work environment issues. It is of fundamental importance that the industry attracts the very best talent, regardless of gender, age, or ethnicity. In its role as industry and employer organisation, TechSverige wants to contribute to positive societal development by setting an example within its own organisation, while supporting and encouraging our members to proactively pursue increased social sustainability throughout the industry.

Since the tech industry is highly global and thus exposed to international competition, many of the social challenges are basically about societal development progressing differently in different parts of the world, which makes the industry's work for increased sustainability in supply chains vital to increased social sustainability. The fact that legislation and compliance with laws concerning, for example, the environment or labour, do not have the same traditions or are equally established in all countries poses a major challenge for companies that want to operate in these markets without making concessions with respect to their own responsibilities.

A poor work environment, unregulated working hours, violation of working time laws, and low wages are some examples of failures in corporate social responsibility that still occur in many parts of the world, and the tech industry is working with several international initiatives to promote social sustainability in the supply chains. The industry's work with social issues in supply chains and the initiatives and collaborations in which we participate have previously been described in Section 5.4. This section focuses on the industry's challenges and efforts linked to inclusion, privacy, and information security.



Challenge – inclusion and privacy

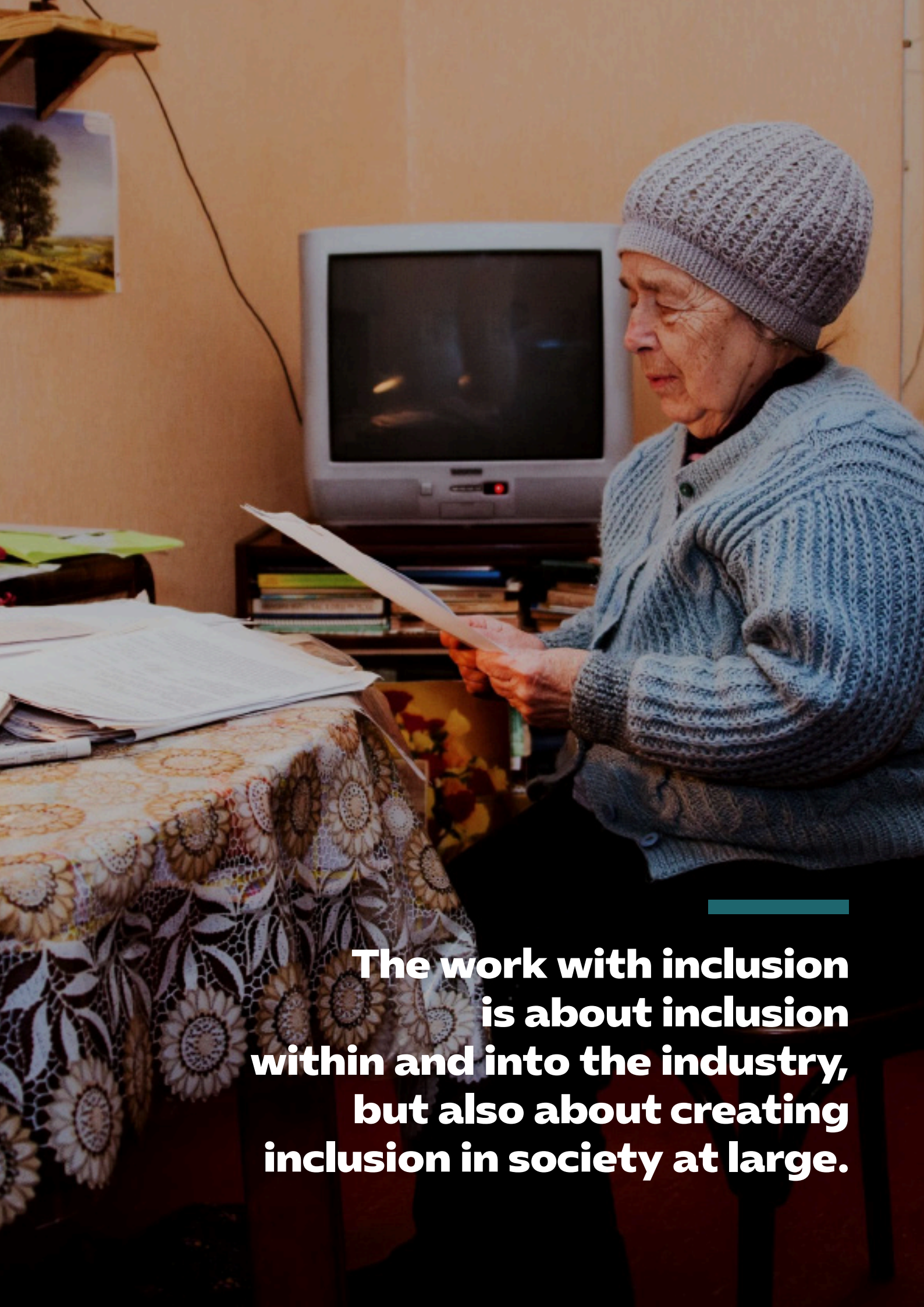
Digital services are becoming an increasingly important part of our daily lives. In Sweden, nine out of ten use various digital public services for their pension, health care, and public transport, etc.[83] Digital transformation simplifies the lives of many, but poses a particular challenge for people and companies who, for various reasons, do not keep up with the rapid technological development. Those excluded – an estimated one million people in Sweden – are often groups that already experience various degrees of exclusion.[84] Through the rapid digitalisation, those who do not use the Internet risk a burden of double exclusion. Those excluded are above all our elderly, many of whom need a great deal of help using digital services. It is therefore important that digitalisation is imbued with a democratic approach and includes a consequence perspective from the individual's point of view in order to be socially sustainable.

Inclusion and diversity are vital components for the tech industry's ability to continue to be competitive and contribute to positive societal development. They are a must in order for the industry to be attractive to as many people as possible and to secure the competency needed. The work with inclusion is about inclusion within and into the industry, but also about creating inclusion in society at large. One challenge for the industry is the continued low proportion of women compared to other industries, presently just over 30%. This proportion is gradually increasing, albeit slowly, and the industry is working to increase gender equality through various initiatives.

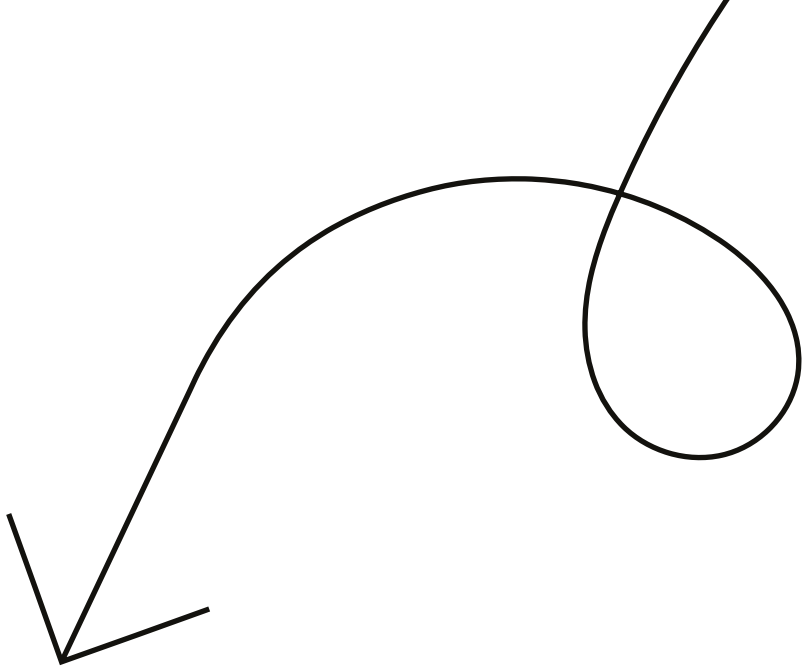
Increased inclusion also involves the need for more foreign-born people to the industry. By 2024, an additional 70,000 people are expected to be needed in the industry, and the competence shortage can be seen in several areas, including systems development, AI, IT security, usability design, game development, and 5G technology.[85] The competence shortage also affects the industry's ability to contribute to green and sustainable societal development using digitalisation. A key initiative to increasing access to competence nationally is to include digitalisation in various ways throughout the education system and across all levels of education, but also to ensure that labour immigration regulations enable easy recruitment of international talent.

More and more people are using digital services and are thus sharing personal information digitally. Protecting data integrity, the right to privacy, and the way personal data are used online is fundamental to social sustainability in the tech industry and throughout society. According to the Swedish Internet Foundation's report, The Swedes and the Internet 2021, half of all internet users feel very concerned about foreign companies collecting data about them, and four out of ten internet users feel very concerned about large companies doing so. Even in people's encounters with the public sector, there is concern linked to privacy. Four out of ten state that they feel very concerned about the risk of their digital medical records being accessed by someone unauthorised.[86] In 2018, the EU General Data Protection Regulation (GDPR) entered into effect, further strengthening protection and imposing greater responsibility on those handling personal data. Sanctions were introduced which mean that non-compliance can result in hefty fines. The legislation has been debated, not least because it's complex and costly; however, its purpose is fundamentally sound. But despite legislation being in place and the tech industry spending plenty of resources protecting user privacy, there is obviously still concern linked to online privacy.

[83] Swedish Internet Foundation. *Inte ens hälften av de äldsta använder digitala samhällstjänster [Not even half of the elderly use digital societal services].*
[84] Swedish Internet Foundation. *Digitalt utanförskap 2020 Q1: Sammanfattning [Digital Exlusion 2020 Q1: Summary].*
[85] Swedish IT & Telecom Industries. *The IT Competence Shortage.*
[86] Swedish Internet Foundation. *Utbredd oro över insamling av personlig data [Widespread concern about the collection of personal data].*



The work with inclusion is about inclusion within and into the industry, but also about creating inclusion in society at large.



The industry's work for increased inclusion and privacy

Everyone should benefit from the opportunities offered by digitalisation, regardless of ability and conditions. An essential measure for increased inclusion is the work to ensure that more people gain access to better and faster internet connection, especially those who live and work in rural areas. In the Swedish Broadband Forum, the industry works with government agencies, organisations, and companies to remove obstacles so that more people have access to better connection and thus greater opportunities to participate in an increasingly digitalised society. The industry works actively to ensure that those furthest away from the digital community will be included, for example through initiatives where young people help seniors improve their digital skills.[87]

Companies in the tech industry also contribute solutions that promote integration and provide easier pathways into society, such as apps aimed at helping refugees and newcomers learn Swedish for a profession.[88] The industry's ability to contribute to reduced exclusion and increased inclusion has been especially evident during the pandemic. Digital solutions and services have allowed seniors and vulnerable groups to receive home deliveries of food and necessities.[89] In addition, digital health care and meetings between seniors, healthcare providers and relatives have been made possible.[90] There are also examples of hardware being refurbished, upgraded, and repaired and then donated to socially vulnerable groups in other countries instead of being recycled.[91]

The tech industry works to broaden recruitment into the industry by getting more women to apply for tech jobs and keeping them in the industry. This involves, among other things, increasing the industry's ability to attract and retain the best talent and increasing the proportion of women both in general and in managerial positions. This proportion is gradually increasing, albeit slowly, and the industry is working to increase gender equality through various initiatives.

There are also ongoing initiatives to increase interest in the tech industry and knowledge of, among other things, programming through the innovation house Changers Hub and its programming course Changers Tech. These initiatives give people who were previously further away from a career in tech, including people in marginalised areas, the opportunity to learn programming and development. Getting more people to increase their knowledge of and interest in tech is crucial for securing the supply of competence, while it also increases diversity in the tech industry.

The tech industry also works proactively to ensure that rules and legislation protect individuals and companies while promoting innovative capability in the industry. The intention is to ensure a high level of confidence in data processing by future-proofing rules and establishing guidelines and codes of conduct for industry companies. Creating and improving products and services that ensure responsible handling of all data generated is one of the keys to the tech industry's work in this area. The industry feels a great responsibility for ensuring that end users, companies, government agencies, and other actors feel confident that this work is ongoing and proactive.

[87] Telia. https://www.telia.se/foretag/bransch/kommun/mer-digital
[88] TechSverige. *Lingio – Utbildning och lärande för att lösa stora samhällsutmaningar [Lingio – Education and learning to solve major societal challenges].*
[89] TechSverige. *Tobias Forngren, CEO, Feelway.*
[90] TechSverige. *Catharina Borgenstierna, CEO, Camanio.*
[91] TechSverige. *Foxway banar väg för den nya generationens hållbara och jämlika It-samhälle [Foxway paves the way for the sustainable and equal IT society of the next generation].*

Challenge – information security

In the tech industry, a high level of information and cyber security is a prerequisite for maximising the opportunities offered by digitalisation and for building trust in the digital development among society, companies, and individuals. Different types of threats and vulnerabilities must be managed in order to protect operational and business benefit, privacy, trust, and security. Information security is about ensuring confidentiality, accuracy, and availability of data belonging to individuals and companies. Cyber security is about protecting hardware and software, such as networks, devices, programmes, systems, data, and servers from illegal access and attacks.

In a world where more and more people are connected and more and more of society's functions are digitalised, the intensity of cyberattacks will increase, as will the vulnerability of businesses and society at large. The threats to our IT systems are changing, becoming increasingly asymmetrical, and the risks are especially tangible considering that our security situation in Europe has greatly deteriorated. Today, everything and everyone is a potential target for cyberattacks and, using only small means, criminals can carry out attacks with major financial consequences for companies and society. For many companies, as much as 80% of their value is in data and information.[92] This implies a significantly increased need for insight, maturity, and competence on the part of clients and suppliers as well as politicians and government agencies, along with increased collaboration between responsible agencies and the business community.

Along with statistics and research, data is a vital key to developing better and more sustainable public services. Access to more and better data on things like traffic, weather, energy, and health care allow us to easily build greater knowledge, which has contributed to a significant increase in new service and business models. As innovation becomes data-driven, the need for information security increases markedly.

In order to maintain or increase people's trust and willingness to use digital services, the services must be secure. The public and private sector both need to work systematically with information and cyber security, even outside IT departments. Management functions have a major responsibility to handle security as a strategic business issue, which requires proper competence, and the competence shortage in information security is significant.

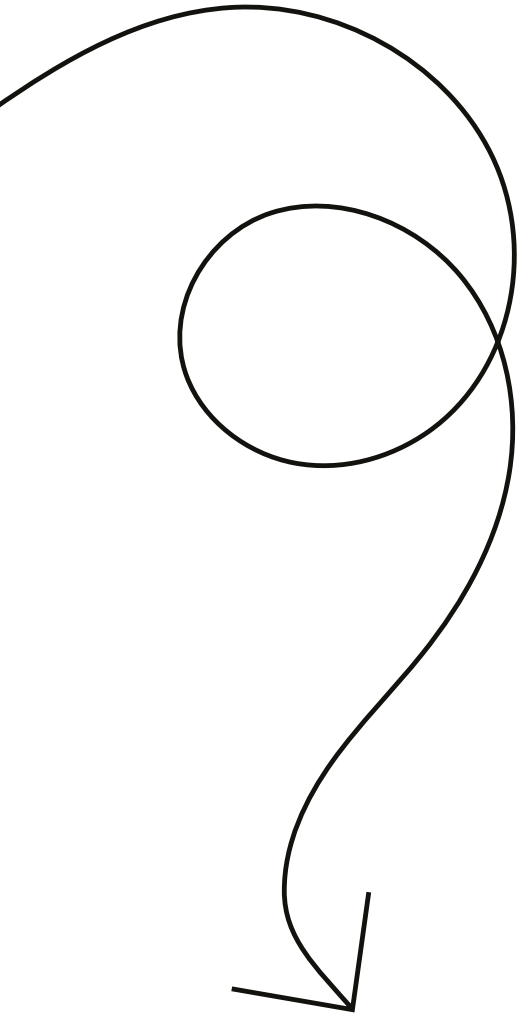
In 2021, nearly half of all Swedish organisations increased their investments in cyber security.[93] However, despite the importance of and increased costs for strengthening cyber security, 44% of Swedish IT decision makers feel that their organisations are underinvested when it comes to cyber security.[94]

The number of cyberattack incidents has increased in Europe during the corona pandemic.[95] The renowned cyberattack on, among others, Coop in[96] 2021 showed just how extensive the consequences can be when technology stops functioning. Criminal hacker groups can lock companies' computer systems or hijack an entire company, demanding large ransoms for returning control to the company. The fact that commerce is affected by computer problems is serious; however, the consequences of attacks on vehicles, waterworks, hospitals, and other vital and socially critical activities can lead to major consequences in society.

Many Swedish SMEs currently have a low level of security maturity, and a lack of investment willingness when it comes to security can constitute a serious risk. A completed cyberattack can cost tens of millions of Swedish kronor. Often, the damage is not proportionate to the number of employees or the turnover of the company, and smaller companies tend to be hit up to ten times harder than large companies.[97] The Swedish National Centre for Cyber Security has been tasked by the government to coordinate the work to prevent, detect, and manage cyberattacks and other IT incidents. The Centre also provides advice and support related to threats, vulnerabilities, and risks. The intention is for the Centre to become a platform for collaboration and information exchange between private and public actors. This will require a deep understanding of the broad use of IT throughout society and extensive collaboration with the business community. Sweden's law enforcement agencies must ensure effective efforts in order to prevent cybercrime and prosecute those who commit such crimes.

[92] Swedish Agency for Economic and Regional Growth. *Report 0339: Informationssäkerhet [Information Security].*
[93] Radar. *Svensk cybersäkerhet 2021 [Swedish Cyber Security 2021].*
[94] Ibid.
[95] Walsh Paton, Nick. "Serious cyberattacks in Europe doubled in the past year, new figures reveal, as criminals exploited the pandemic", *CNN.*
[96] Toresson, Jenny. "It-attacken mot Coop – detta har hänt" ["Cyberattack on Coop – this has happened"], *SVT Nyheter.*
[97] Advania. *IT-trygghet genom proaktivt säkerhetsarbete [IT security through proactive security efforts].*

For many companies, as much as 80% of their value is in data and information.



The industry's work to strengthen information security

In order to strengthen information and cyber security, increased awareness throughout society and a clear distribution of responsibility between different actors are needed. There is no quick or easy fix, and no actor can solve the entire issue on its own. Enhanced information security is also closely linked to the methods used to improve the protection of personal data and privacy. In addition to collaborating with the legal system and other relevant actors, spreading knowledge is a central aspect of the industry's efforts. The tech industry works to increase general awareness of security issues and cyber security as well as provide forums for the exchange of knowledge and experience and the establishment of rules and standards for how companies should act in relation to these issues. The tech industry uses modern and up-to-date tools and methods for protecting information and cyber security in both internal and external operations, while helping customers with the classification of data and information. In addition, the industry attaches great importance to hardware and software having a clearly defined life cycle, where products and solutions – not least from a security perspective – are defined based on how they are to be acquired, maintained, developed, or decommissioned.

Many companies in the industry are noting an increased demand for various digital security solutions. While digitalisation creates opportunities for environmental, economic, and social sustainability, it also involves major risks, not least for knowledge-intensive companies.

In summary, information and cyber security is a priority issue in the industry. Ensuring that the digital products and services contributed by the industry have security functions, and continuously adapting them to address the constantly changing risks and threats are obvious aspects of the ongoing work.

“We need a national knowledge boost regarding the connection between digitalisation and sustainability, within our own industry as well as among politicians and in society at large.”

INTERVIEW WITH HELENA NORDIN, SUSTAINABILITY MANAGER AT ADVANIA

"Privacy and security are central sustainability issues"

What is the focus of your work with sustainability?
Advania's sustainability efforts are aimed at three focus areas: Sustainable Advania, Sustainable Offers, and Sustainable Supply Chain. One of the top priority issues is related to Sustainable Offers and concerns privacy and security, which are central issues of sustainability for our line of business. We need to take responsibility for the protection of our customers' data and help them ensure that the handling of personal data complies with all aspects of the GDPR. One of the key fundamental principles of the GDPR is the right of all people to protection of their personal data.

Other priority areas are sustainable IT and sustainable digitalisation. Sustainable IT is about how we develop our services to reduce the negative environmental impact of the use of IT hardware, while sustainable digitalisation is about the effect of our IT solutions on our customers and society at large. We want to, and can, contribute to digitalisation leading to a more sustainable development in society. Other examples of important issues include how to ensure that we continue to be an attractive employer and how to improve gender balance and diversity, which has become a matter of survival in an industry with an ever-increasing competence shortage.

How do you contribute to sustainability in society?
Digitalisation has enormous potential to make a positive mark both socially and environmentally, but it's not a given that all digitalisation actually leads to sustainable societal development. There are numerous challenges along the way, including increased energy needs, privacy issues, or digital solutions eventually only leading to an acceleration of unsustainable development and increased mass consumption. A concrete example of our potential for positive impact: We are a major provider of IT solutions to the schools, and in the spring of 2020, it became urgent to quickly help the schools in Sweden transition to remote teaching. Although the rapid shift to digitals aids presented many challenges for all teachers and although the evaluation of this is still ongoing, we can already conclude that our industry, in spite of all the challenges, was a key to society continuing to function at all during the pandemic.

What are the greatest sustainability challenges in the industry?
The industry has a long way to go before we can really start talking about circularity, and the progress towards upstream innovation of IT products – designing them for a long life and circular use of materials – is slow. The goal of many retailers today to take back 100% of what they sell means that every product is taken back from the customer for the purposes of being sold and used in another usage cycle. This is still far from being the definition of a circular economy; to eliminate waste altogether. However, the increased focus from the EU and new legislation in combination with the enormous consumption of IT products leading to a global shortage of valuable metals and minerals will hopefully create a much stronger driving force for circularity and for making use of the materials contained in electronic scrap.

The location of hardware production is another major challenge. Today, production takes place in parts of the world where fossil-driven energy is used and where the risk of human rights violations is significant.

Helena Nordin
Sustainability Manager at Advania

What would you like from our policymakers?
We need a national knowledge boost regarding the connection between digitalisation and sustainability, within our own industry as well as among politicians and in society at large. Sustainability does not automatically follow from sustainability. An important part in increasing understanding of the potential of digitalisation is to agree on a common method for measuring so-called avoided emissions, i.e., how the use of digital solutions leads to avoided CO_2 emissions in other parts of operations. We currently have several different ways for calculating this, but as long as there is no common method with clear principles for what is to be included and delimited, comparing different IT solutions and providers are difficult, and calculations of avoided emissions lose both credibility and benefit. Policymakers can contribute by creating a demand for a standardised method for measuring avoided emissions as well as encouraging government agencies or public procurement to require that this be reported. A final concrete recommendation is based on the fact that basically all sectors of society should have a great interest in sustainable digitalisation and thus should assign a clear responsibility for this within each department.

9 proposals to promote digitalisation and tech for sustainable development

The tech industry is a key enabler for the entire society's sustainable development and climate transition by contributing smarter processes and more efficient use of resources in traditional industries. When used properly, technology can also lay the foundation for increased democracy and inclusion in society. While the industry enables others to become more sustainable through digital solutions and new business models, it also has challenges of its own, such as the use of unwanted chemicals and a low degree of circularity. While much of the regulations affecting the tech industry's work with sustainability is based on EU directives or international agreements, national regulations are important as well. Based on the challenges identified in this report, TechSverige has formulated nine national policy proposals that would make it easier for the tech industry to become more sustainable and further contribute to Sweden reaching its climate and environmental objectives as well as the SDGs. In addition to these, the Swedish government needs to proactively push, at both European and international level, for solutions and regulations that facilitate sustainable tech globally.

Accelerate the use of tech in the climate transition.

Digitalisation is an enabler for the entire society's climate transition, and the tech sector has the potential to contribute to smart societal development with reduced energy consumption and less CO_2 emissions in many sectors, such as transport, industry, agriculture, and construction. The government must raise its ambition and accelerate the work for a broad use of tech in the climate transition as well as increase investments in order to achieve Sweden's climate targets through digitalisation.

Ensure stable supply and distribution of electricity throughout the country.

As society becomes increasingly digitalised, with tech industry data centres and solutions allowing for more sustainable solutions in other industries and society at large, the use of connected devices will increase significantly. With more connected products and services comes the need for 24/7 availability, which requires stable and safe supply of electricity. With this in mind, the entire society and business community must have access to a safe and cost-effective supply of energy wherever and whenever needed at a competitive cost. Sweden's energy policy needs to focus on securing supply throughout the country. The government must act promptly to ensure sufficient production and distribution capacity.

Have the courage to procure functionality to promote innovation, and monitor set requirements.

Every year, the public sector spends about SEK 800 billion on procurement and is thus an important player in driving innovation and development forward in many industries, including the tech industry. The public sector needs to focus on setting relevant sustainability requirements in its procurement of IT products and services as well as advancing the efforts to monitor these requirements during the contract period. In order to promote and contribute to the development of sustainable tech solutions, procuring government agencies and functions must have the courage to procure functionality and desired performance in order to give companies the opportunity to propose and develop modern, circular, and innovative sustainable solutions. To realise this, a high level of client expertise, improved digital competence, and increased organisational digital maturity in the public sector must be ensured.

Release the climate potential of 5G through accelerated expansion as well as testbeds and development programmes.

Increased optimisation and efficiency using 5G can provide major climate gains in many sectors and industries. Good coverage, capacity, and open collaboration platforms are needed in order for Sweden to fully utilise the great potential of 5G to contribute to reaching the emission targets by 2030. The government needs to initiate and support the establishment of testbeds and concrete development programmes so that government agencies, academia, and businesses can jointly test solutions for the promotion of sustainable technology solutions and the creation of new innovations in the field. Furthermore, the frequencies identified for 5G must be released to the market, and scheduled frequency allocations must not be delayed.

Promote digital innovation of sustainable solutions through increased access to data.

The need to exchange data will increase, and the work to make open data easily accessible must continue and be intensified in order to promote the tech industry's ability to contribute with smart and sustainable solutions, including using AI. It must become easier to share data between public and private actors, both nationally and internationally, which requires adaption, secure systems, and standards for data exchange. Sweden needs to have a stated ambition to become the best in the Nordic Region in making government data accessible. Contributory requirements imposed on government agencies that currently sell their data to finance activities must be removed. The cost of accessing open data must be set at zero or, at most, cost price.

Implement an initiative to increase digital competence and invest in research and innovation – for the climate.

Computer skills and computational and critical thinking are central to Sweden reaching its goal of climate neutrality by 2045. Without these skills, the tech industry might lose out on opportunities to contribute to climate-smart solutions. In order to strengthen digital competence, it is thus important that the government and education providers ensure that digitalisation pervades education at all levels of the education system. To drive innovation and development of digital services that contribute to the entire society's sustainable transition, the government also needs to invest in research and strong research environments through appropriately targeted grants.

Strengthen the work with information and cyber security for a safe and inclusive society.

The protection of socially critical functions, privacy, and companies' ability to secure business-critical information and systems is of great importance for sustainable development. Tech companies often provide solutions for this, and work to increase information and cyber security in both the private and public sector. The business community's efforts must therefore be matched by the public sector. The Swedish National Centre for Cyber Security and the Swedish Civil Contingencies Agency need to take further steps to support the business community's delivery of secure solutions through increased exchange of information on threats and security between government agencies and the tech industry. Government agencies must be given adequate opportunities, including through legislation, and sufficient resources to meet the private sector's needs for support, information, and collaboration as well.

Effectively phase out unwanted chemicals in electronics.

The Swedish chemicals tax on electronics is a national tax on products for a global market. It is not effective because it does not lead to the desired environmental effects and discourages the reuse of products. The tax should be abolished in favour of voluntary or other legislative initiatives to promote the substitution of unwanted chemicals within the framework of the EU work. If the tax is retained, it should include a zero tax option and the taxation should be on the inherent hazardous properties of the individual substance. A functioning compliance check is also a basic prerequisite.

Steer towards increased reuse of small electronics.

Sweden needs to raise its ambitions for increased circularity of small electronics. The government should implement the inquiry into deposit's proposal for stricter producer responsibility with special focus on information, incentives, and responsibility through, among other things, requirements for the industry to provide collection data and inform customers about the return and erasure of data. This would mean going from traditional collection and recycling to also promote and utilise the opportunities to reuse small electronics.

PART 2

Tech for the Climate

Summary

We are standing at a crossroads – emissions must be reduced more rapidly, and it must happen now. Global greenhouse gas emissions continue to increase. The rate of emission reduction at national and international level therefore needs to accelerate significantly in order to reach the climate targets, especially in the sectors that account for large parts of the emissions.

Digitalisation plays a key role in this pursuit. In its report, Climate Change 2022: Mitigation of Climate Change, the Intergovernmental Panel on Climate Change (IPCC) of the United Nations explains that there are many tools for reducing emissions and that digital changes are becoming an important driving force in societal transformation. The European Green Deal as well as Sweden's Industrial Strategy identify digitalisation and digital solutions as keys for the transition.

Digital solutions can reduce emissions in several ways. The ability of digitalisation to reduce emissions through society-wide transformations, more efficient processes, and new working methods is great. 5G technology, along with IoT and AI, provide the cornerstones of many of the solutions required to reach the climate targets. These technologies are estimated to be able to contribute to reducing global emissions by up to 15%, indirectly contributing to a further reduction of 35% through system transformation and by influencing consumer and business decisions.

The tech industry contributes with solutions that reduce emissions from the business community and the public sector. This reports describes seven examples, where Telia, Atea, Ericsson, TietoEVRY, Prototyp, Microsoft, and Sweco, along with private and public sector partners, have developed solutions that reduce emissions in food production, manufacturing industries, the public sector, energy consumption, construction, real estate, and transport.

The capabilities of tech and digitalisation to contribute to and accelerate the climate transition in society are enormous. Existing digital solutions can be scaled nationally and globally. The message from all the examples highlighted in this report is clear: Digital solutions for reducing emissions can be scaled as well as expanded into more industries.

PREFACE

Tech and digitalisation enable the climate transition here and now

We only have about eight years until 2030, the year when the SDGs as well as Sweden's and the EU's milestone targets for emission reductions are supposed to achieved. As expectations of climate and environmental efforts are increasing both nationally and internationally, so is the commitment of governments, businesses, and consumers. Yet global greenhouse gas emissions continue to rise, and the widespread shutdowns during the COVID-19 pandemic had no noticeable effect on the levels of greenhouse gases in the atmosphere or the rate at which they increase. There was merely a temporary reduction in new emissions. The rate of emission reduction at national and international level therefore needs to accelerate significantly in order to reach the climate targets, especially in the sectors that account for large parts of the emissions.

The Intergovernmental Panel on Climate Change (IPCC) of the United Nations, explains in its report, Climate Change 2022: Mitigation of Change, that there are many tools for reducing emissions and that digital changes are becoming an important driver in societal transformation. Tech and digitalisation are not merely an "instrument" to solve sustainability challenges; they are also a fundamental driver for revolutionary change that affects the direction of development.[1]

Digital solutions are already helping industries and sectors in need of more sustainable processes and production, but their potential is so much greater than that. The technology we need in the form of, for example, AI, blockchain technology, and IoT is available here and now and can help us all make smarter, faster, and more precise decisions. Just like no single actor can stop climate change on its own, finding and implementing solutions is often difficult when going at it alone. It is through collaboration between parties that technology can be put to good use and quickly contribute to achieving the sustainable development goals.

Sweden is a technologically advanced country, and we have unique opportunities to lead the climate transition and create a society with low greenhouse gas emissions. Companies and industries that use smart digital solutions in order to reduce emissions not only contribute to a more sustainable production but also to increased profitability. Digital solutions that contribute to more resource-efficient processes become a competitive edge nationally and internationally. Sweden has a unique capability to develop, use, and export smart digital solutions for the climate transition. The market for solutions in cleantech, proptech, indtech, and mobilitytech, along with the innovations that consider natural resources and promote economic and social development, is growing, and the demand for these solutions globally will only continue to grow. The hunt for smart and sustainable solutions is ongoing all over the world. A number of national strategies have been presented, pointing to digitalisation as a key prerequisite for the green transition, but it's time we make it a reality.

With this report, we want to inspire to greater change and highlight the opportunities offered by tech by providing examples of existing technologies that can contribute to the ability of Sweden's and Europe's most carbon-intensive sectors to reduce their emissions. Our member companies, Telia, Atea, Ericsson, TietoEVRY, Prototyp, Microsoft, and Sweco have, in collaboration with partners, developed solutions that reduce emissions in food production, the manufacturing industry, public sector, energy sector, real estate sector, and transport sector. The Global Enabling Sustainability Initiative (GeSI), which works to promote social and environmental sustainability globally, has also found that several of these sectors have the most potential to reduce carbon dioxide emissions through digital technologies.[2]

The transition potential of all actors in society must be realised. The tech industry is ready to both reduce emissions in its own operations and help companies and society do the same, not least through collaboration with other industries. With future generations in mind, let's level up the work to utilise all the opportunities and innovations available to accelerate the climate transition and reduce emissions. Let's invest in tech for the climate!

Åsa Zetterberg
Managing Director
TechSverige

June 2022

[1] Ellis, Dominic. "Digital technology key to energy efficiency says IPCC",
[2] GeSI (2015), #SMARTer2030 ICT Solutions for 21st Century Challenges. https://smarter2030.gesi.org/downloads/Full_report.pdf

“Sweden has a unique capability to develop, use, and export smart digital solutions for the climate transition.”

Åsa Zetterberg

The climate transition affects everything and everyone

Climate change and its impact on society is becoming increasingly obvious, and the need for accelerated transition – in everything and everyone – is urgent. The main cause of global warming is greenhouse gas emissions, particularly carbon dioxide. The Paris Agreement aims to limit global warming by reducing the emissions of these gases. The global climate agreement, which was adopted by 196 parties in 2015, determines that the global rise in temperature must be kept well below 2 degrees Celsius compared to pre-industrial levels, and the work must focus on limiting this rise to 1.5 degrees.

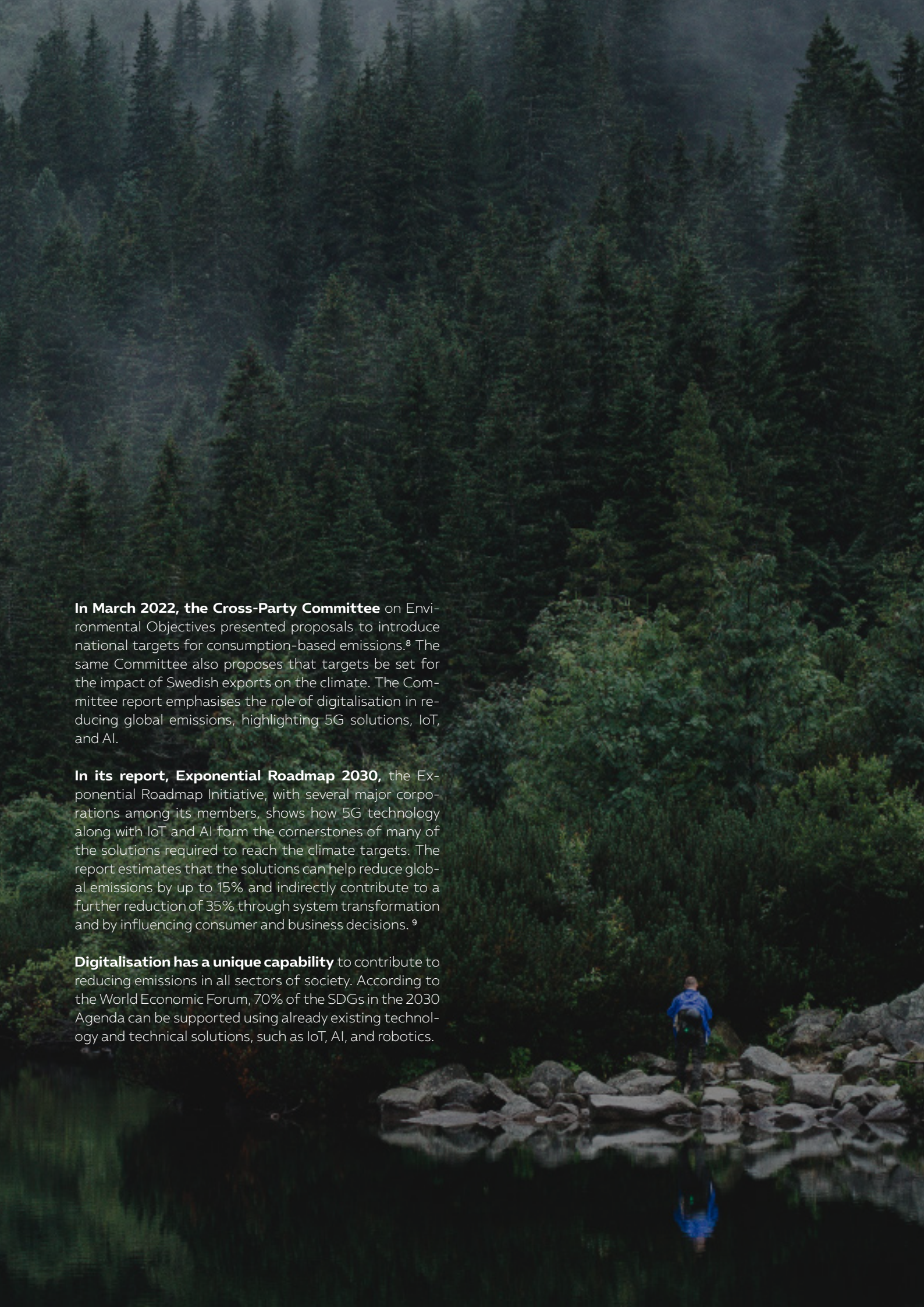
The IPCC Climate Change 2022: Mitigation of Climate Change report is the first report aimed at mitigation that the IPCC has produced since the signing of the Paris Agreement. The report focuses on solutions that can limit average global warming to 1.5 degrees Celsius.

In its report, the IPCC describes how digital technology can contribute to mitigating climate change and achieving several of the SDGs. For example, sensors, IoT, robotics, and AI can improve energy management in all sectors. Digitalisation can promote the use of low-emission technologies, including decentralised renewable energy, while providing economic development at the same time. They also point out the importance of digital technology actually being used in such a way that it reduces greenhouse gas emissions.[4]

Despite global agreements, the message from both the IPCC and the COP26 summit in November 2021 is that the current efforts of the world's countries to reduce emissions are not enough to mitigate climate change in accordance with the goals of the Paris Agreement. Greenhouse gas emissions have increased considerably in recent decades and risk continuing to increase until 2030 unless more is done.[5]

There are three ways to measure emissions: territorial, production-based, and consumption-based. Territorial emissions, which are emissions that occur within a country's borders, is the measure used to follow up the climate targets set for Sweden within the UN, the EU, and nationally. Production- and consumption-based emissions are supplementary measures. Production-based emissions refer to emissions from Swedish companies and people that occur both outside and within a country's borders, while consumption-based emissions refer to emissions that a country's consumption causes in one's own country as well as in other countries.[6] [7]

[3] Swedish Environmental Protection Agency. *Vad är Parisavtalet? [What is the Paris Agreement?]*
[4] Climate Change 2022: *Mitigation of Climate Change. Intergovernmental Panel on Climate Change, IPCC*. p.13
[5] NDC Synthesis Report. *UNFCCC*.
[6] Swedish Environmental Protection Agency. *Tre sätt att beräkna klimatpåverkande utsläpp [Three ways to calculate climate-changing emissions].*
[7] This report focuses on territorial emissions, i.e. emissions that occur within a country's or territory's borders.
[8] SOU 2022:15. Swedish Cross-Party Committee on Environmental Objectives. *Sveriges globala klimatavtryck [Sweden's global climate footprint].*



In March 2022, the Cross-Party Committee on Environmental Objectives presented proposals to introduce national targets for consumption-based emissions.[8] The same Committee also proposes that targets be set for the impact of Swedish exports on the climate. The Committee report emphasises the role of digitalisation in reducing global emissions, highlighting 5G solutions, IoT, and AI.

In its report, Exponential Roadmap 2030, the Exponential Roadmap Initiative, with several major corporations among its members, shows how 5G technology along with IoT and AI form the cornerstones of many of the solutions required to reach the climate targets. The report estimates that the solutions can help reduce global emissions by up to 15% and indirectly contribute to a further reduction of 35% through system transformation and by influencing consumer and business decisions. [9]

Digitalisation has a unique capability to contribute to reducing emissions in all sectors of society. According to the World Economic Forum, 70% of the SDGs in the 2030 Agenda can be supported using already existing technology and technical solutions, such as IoT, AI, and robotics.

We have the tools and the knowledge required to limit global warming, but the tools need to be scaled and applied broadly and fairly in order to support major emission reductions and stimulate innovation worldwide.

Sustainability is also about our future competitiveness. Companies that don't take the work with sustainability seriously risk falling behind its competitors in various ways. In recent years, the government has presented proposals highlighting the role of digitalisation for the climate transition. For example, the government collaboration programme, The Climate Transition of the Business Community, highlights the role of digitalisation for the green transition as a priority area for achieving net zero emissions by 2045.[10] The government's national data strategy states that increased access to data is a priority area for addressing current challenges in society.[11] Among other things, the strategy aims to promote the green transition of the business community by commissioning Swedish government agencies to collect and utilise data.

In Sweden's new industrial strategi, Industry of the Future – A Strategy for Green and Digital Transition, digitalisation is named a prerequisite for our competitiveness, and the development and use of enabling digital technologies, such as 5G, IoT, automation, AI, smart contracts, blockchain technology, cloud solutions, and digital transformation, as keys to reaching the goals to increase the competitiveness of industrial manufacturing and of Sweden.[12]

Digitalisation is also identified at EU level as a key factor in the priorities highlighted in the European Green Deal. The European Commission states that Europe's digital transition goes hand in hand with the green transition, naming them the "twin transitions". This is also reflected in the EU digital strategy, A Europe fit for the digital age, which is considered to be a decisive part of the green transition. The 2022 Commission Work Programme states that an action plan to accelerate the digital transition must be proposed in order to achieve EU climate targets.[13]

The EU data strategy, which was presented in 2020, aims to create a single market for data within the EU and increase data access. The strategy is considered to be of central importance for the climate transition, underlining how digitalisation can enable the climate transition through, among other things, better decision support and data-driven optimisation.[14] Data access and AI are specifically highlighted as two important solutions.[15]

According to the IPCC, the world is standing at an environmental crossroads: We have the tools and the knowledge required to limit global warming, but the tools need to be scaled and applied broadly and fairly in order to support major emission reductions and stimulate innovation worldwide.

[10] Swedish Government Offices. *Samverkansprogrammet Näringslivets klimatomställning [Collaboration programme, The climate transition of the business community].*
[11] Swedish Government Offices. *En nationell datastrategi [A national data strategy]*. 2021
[12] Swedish Government Offices. *Framtidens industri: En strategi om grön och digital omställning [The industry of the future: A strategy for green and digital transition].*
[13] European Commission. *Commission work programme 2022: Making Europe stronger together.*
[14] European Commission. *Digital transition.*
[15] Webb, Hilary. "Commission launches new digital strategy: A Europe fit for the digital age", *ERRIN.*

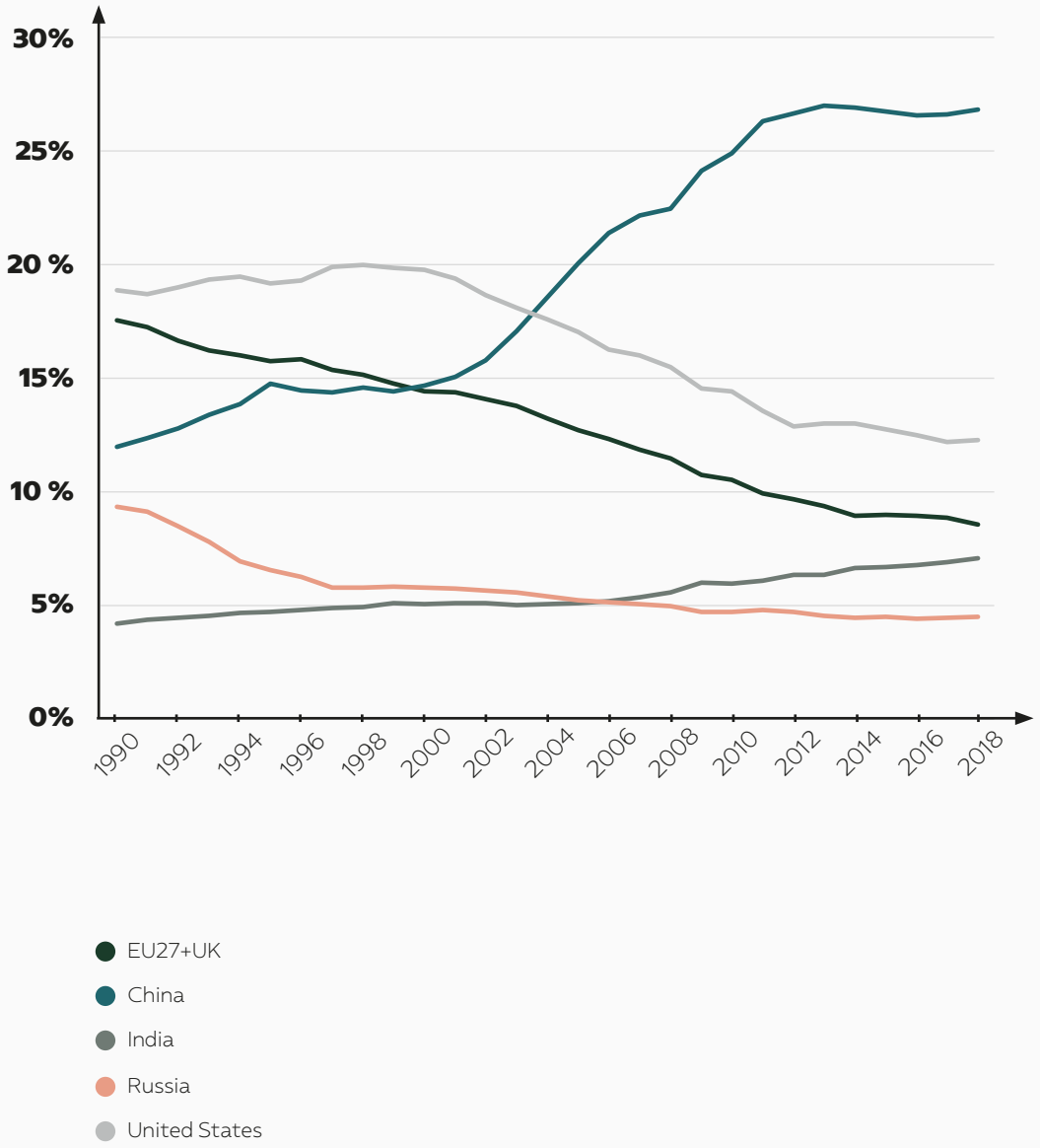
The world needs to pick up the pace

The entire world needs to pick up the pace of the transition, but things are progressing differently in different countries. In some countries, mainly China and India, emissions are increasing, both in terms of total emissions and as share of global emissions. From releasing about 3,900 million tonnes of carbon dioxide equivalents (CO_2e) in 1990, which corresponded to 12% of global emissions at the time, China's emissions have increased by over 250% to almost 14,000 million tonnes of CO_2e in 2018. China is thus currently the single largest emitter, accounting for 27% of global greenhouse gas emissions (hereinafter referred to as "emissions"), as shown in Chart 1. During that same period, India's share of global emissions has increased by over 75%, and today, the country accounts for 7% of the world's total emissions. In the United States, the 27 EU Member States, and the UK on the other hand,[16] emissions in terms of share of total global emissions have decreased significantly compared with 1990.

There are great benefits in uniting the climate challenge and digitalisation when radical and rapid reductions of greenhouse gases must be achieved.

Chart 1

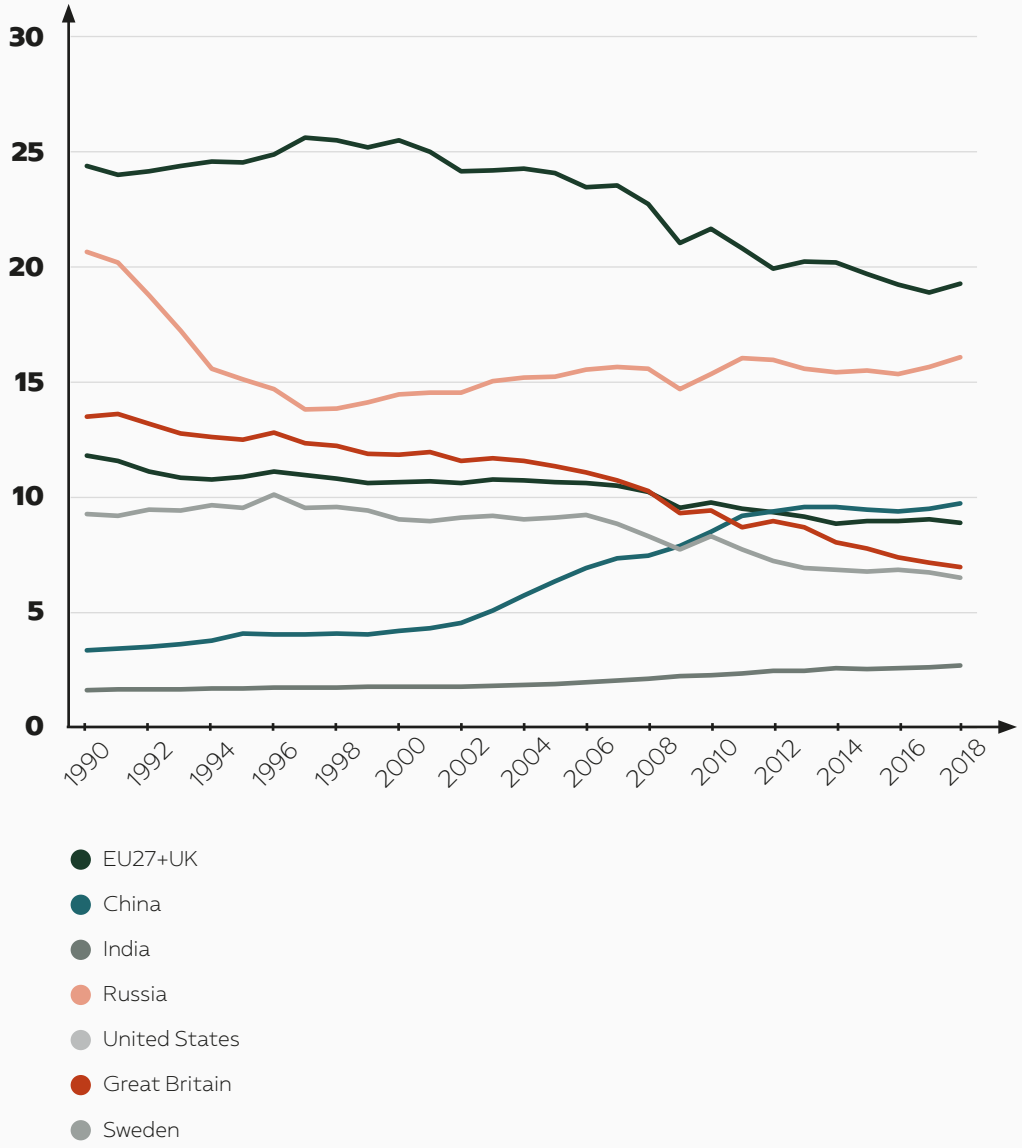
GHG emissions (share of global emissions) for a selection of countries [17]



[16] At the point of measuring in 2018, the UK was still a formal EU Member State.
[17] EDGAR (Emissions Database for Global Atmospheric Research). *GHG emissions of all world countries – 2021 Report*.

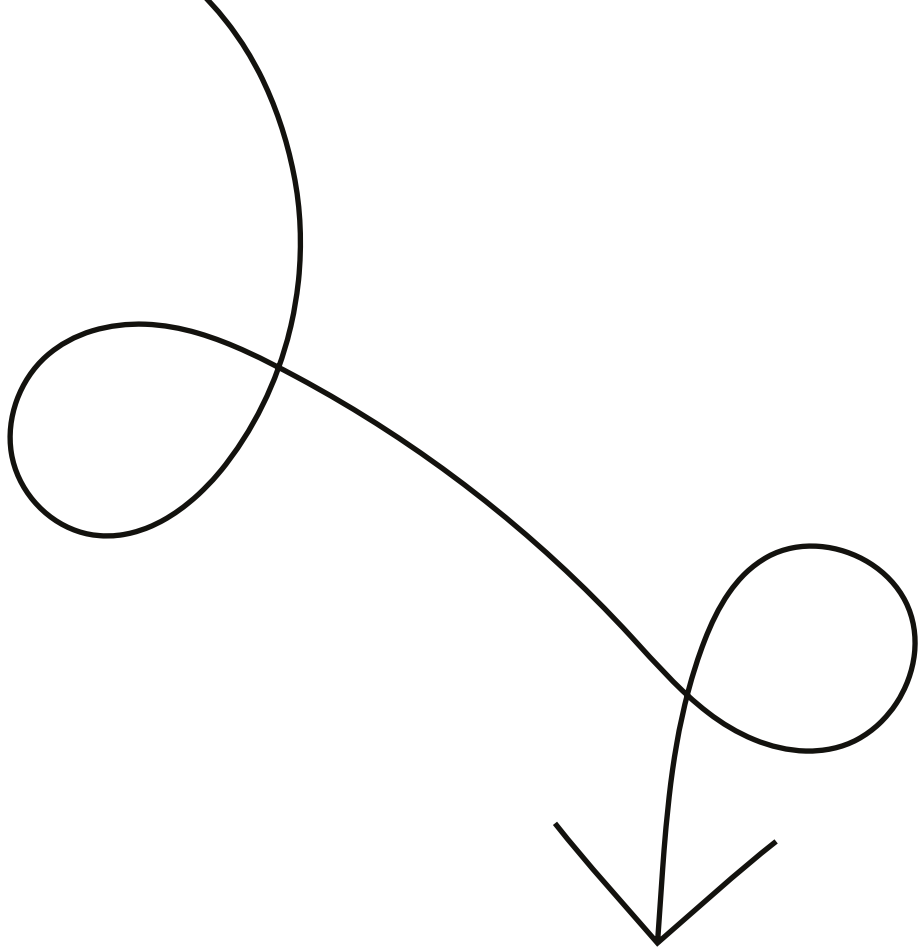
Chart 2

GHG emissions per capita (tonnes of CO^2e) for a selection of countries[18]



A similar trend can be seen when comparing countries based on emissions per capita, as shown in Chart 2. The reduction in emissions by countries such as the United States and the EU Member States is taking place whilst emissions are increasing sharply in other parts of the world. Two of the reasons for this are a delayed industrialisation process compared to many Western countries and the fact that, for many years now, the production of goods has been moved to countries such as China and India for economic reasons. However, the United States, despite the reduction achieved in recent years, still tops the list in terms of emissions per capita.

[18] EDGAR (Emissions Database for Global Atmospheric Research). *GHG emissions of all world countries – 2021 Report*.



Emissions in the EU are clearly decreasing – but more is required

The European Green Deal contains an overall action plan from the European Commission with a number of initiatives and measures that will transition the entire EU economy, including a goal for the EU economy and society to become climate-neutral by 2050. The European Climate Law provides the framework for EU climate-related legislation for the next 30 years and is an important part of the Green Deal. In addition to the 2050 goals, the law also contains milestone targets to reduce net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels. As part of the work on the updated goals, the European Commission has put forward "Fit for 55", a package of legislative proposals and other policy initiatives, to reach the 55% reduction in climate impact within the Union by 2030.

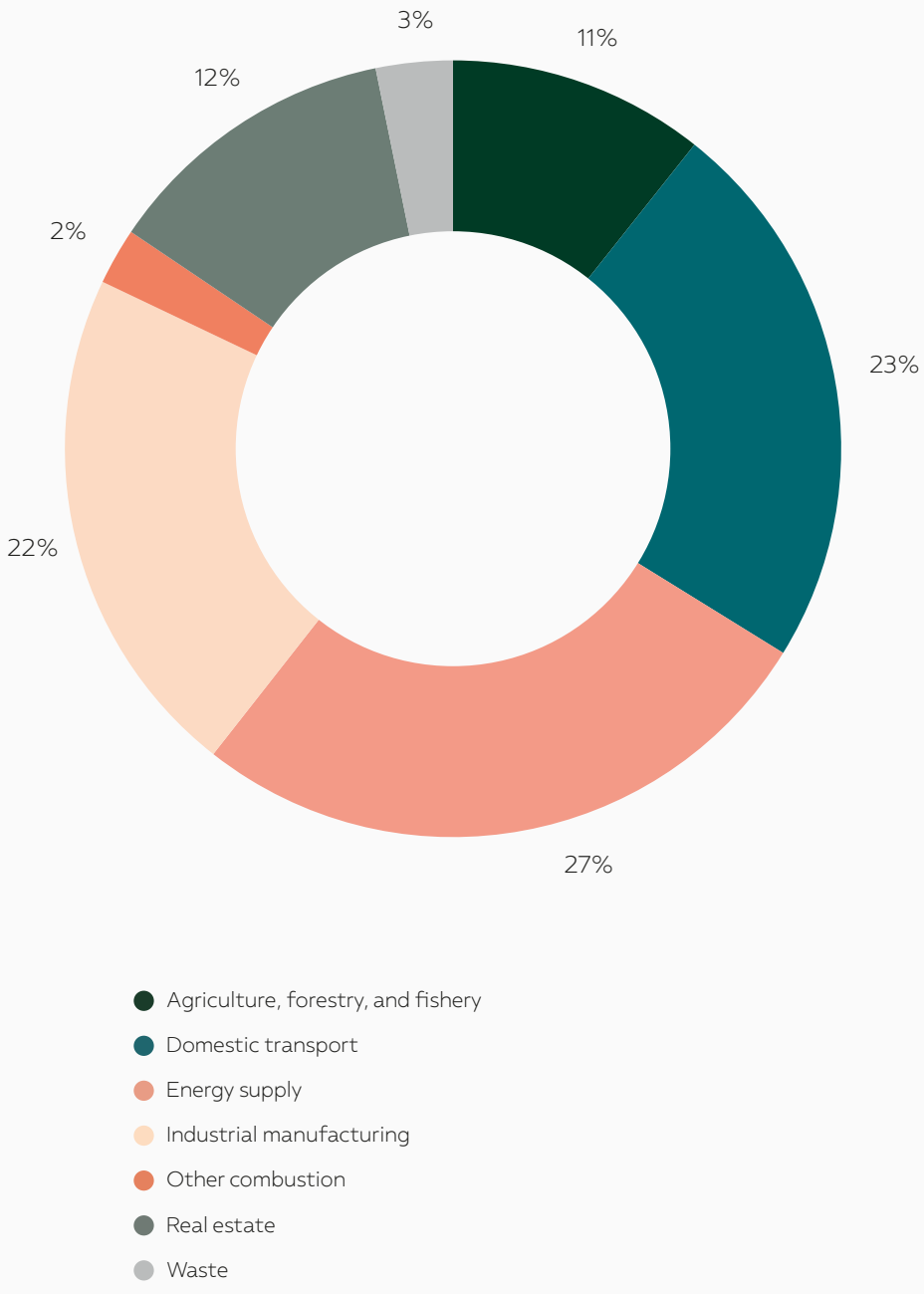
Emissions in the EU have decreased considerably since 1990, from just under 5 billion tonnes of CO_2e to just under 4 billion tonnes in 2018, a reduction of just over 20%. However, the rate of reduction is still far from what is necessary to achieve the objectives of the European Green Deal and the European Climate Law. The European Environment Agency (EEA) estimates that current and planned future efforts to reduce emissions will lead to a reduction in greenhouse gas emissions of just over 40% by 2030.[19] The EEA states that further action is required in order to achieve climate neutrality by 2050 as well as the milestone target of a 55% reduction in emissions by 2030. Among other things, they highlight the necessity of more extensive efforts to increase the share of renewable energy and energy efficiency for all consuming sources in order to reach the targets.

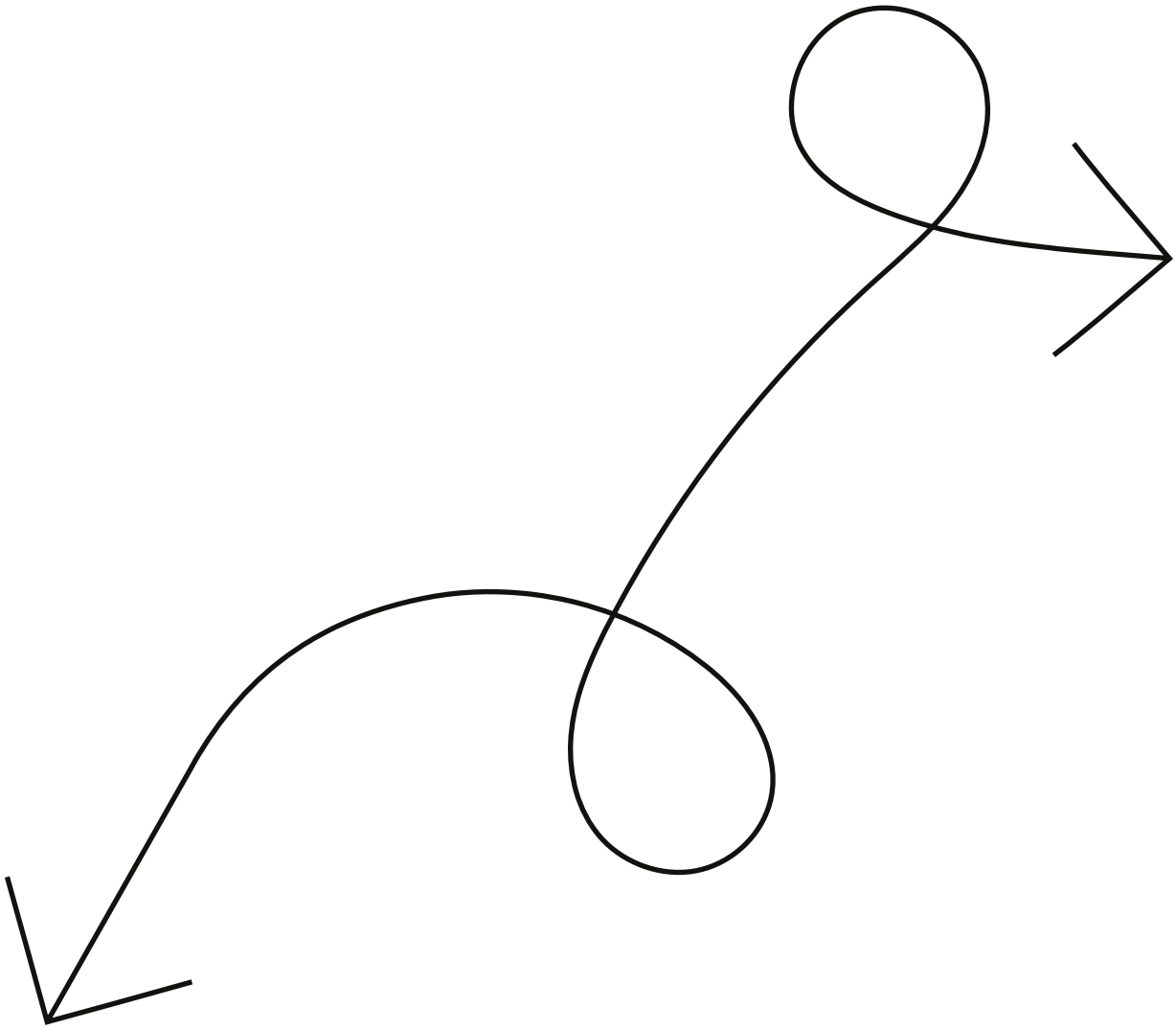
Within the EU, energy supply , domestic transport, and industrial manufacturing account for nearly 75% of total emissions. Energy supply accounts for the largest share, 27%. Unlike countries such as Sweden, energy production in the EU includes a significant proportion of fossil production, such as from gas and coal power plants. Domestic transport accounts for approximately 23% of the emissions, the majority of which consists of emissions from road transport. Heating of commercial and residential real estate accounts for approximately 12% of the emissions, which can be derived from the fact that many countries in the EU use natural gas for heating, while fossil electricity production makes up a significant proportion of the energy mix. In 2019, agriculture, forestry, and fishery as well as waste and other combustion accounted for about 11.3% and 2%, respectively, of total EU emissions.

[19] European Environment Agency. *EU achieves 20-20-20 climate targets, 55% emissions cut by 2030 reachable with more efforts and policies.*
[20] European Environment Agency. *EEA greenhouse gases, 2019*. Does not include international air transport, maritime transport, or emission absorption via LULUCF.

Chart 3

Emissions in the EU27, share per sector in 2019 [20]





Sweden's ambitious targets require accelerated transition

Sweden has high-level targets with respect to the climate. The Swedish climate targets are part of the environmental objectives system as well as a central component of Sweden's work to live up to the Paris Agreement. Sweden's long-term climate objective is to reach net zero emissions by 2045 and then go on to achieve negative emissions. This target means that greenhouse gas emissions from Swedish territory must be at least 85% lower by 2045 compared to emissions in 1990. In addition to the overarching objective, there are milestone targets for 2030 and 2040 to reduce emissions by 63% and 75%, respectively, compared to 1990.

Chart 4 shows figures on Sweden's territorial emissions from two different data sources. The upper graph (blue) shows emissions from the EU database EDGAR, which is based on a calculation method created to calculate all countries' emissions and which is better suited for international comparisons. The lower graph (green) shows the Swedish Environmental Protection Agency's official statistics for Sweden's emissions. The difference is due to the EDGAR database not having access to the Environmental Protection Agency's detailed statistics.

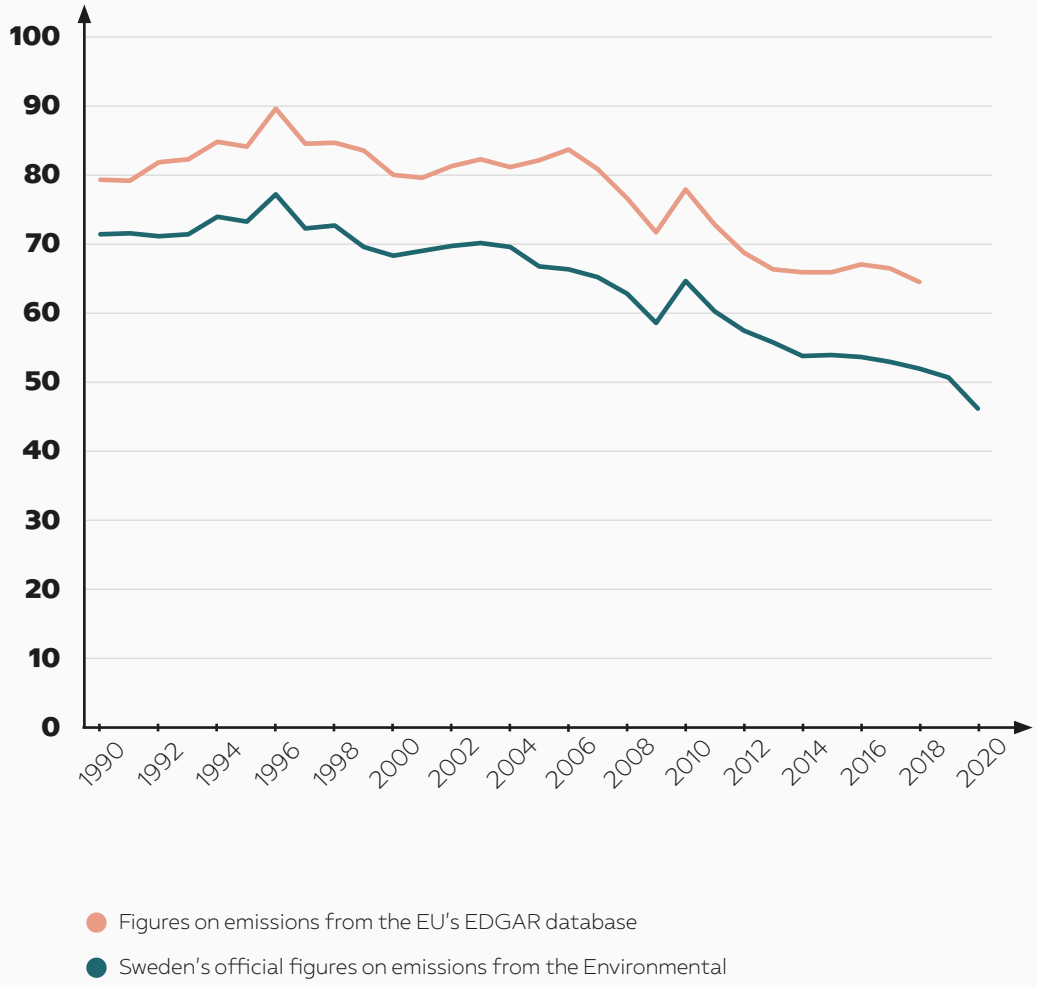
As shown by the graph, Sweden's emissions have decreased considerably since 1990. Territorial greenhouse gas emissions have decreased from just over 70 million tonnes of CO_2e in 1990 to just over 46 million in 2020, which corresponds to a reduction of around 35%.

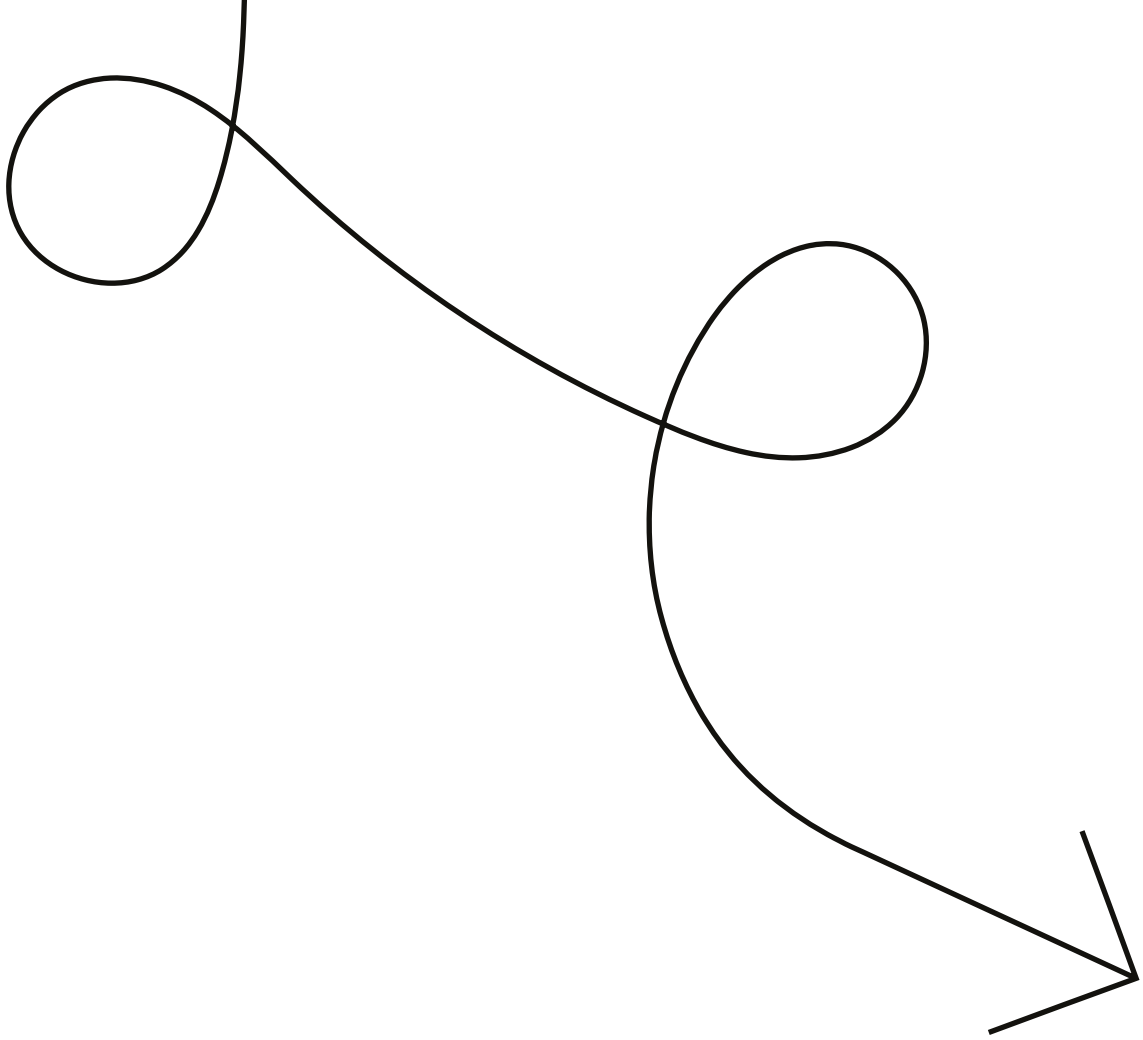
But in order for Sweden to fulfil both national and international climate commitments, the transition must take place significantly faster than today. In the 2022 report from the Swedish Climate Policy Council, the council states that emissions must decrease at a much higher rate than today in order for us to reduce emissions by the two-thirds that remain by 2045, compared to 1990 levels. The report also emphasises that we need to create conditions now for continued decreased emissions after 2030.[23]

[21] EDGAR - Emissions Database for Global Atmospheric Research. *GHG emissions of all world countries - 2021 Report, 2021.*
[22] Swedish Environmental Protection Agency. *Territoriella utsläpp och upptag av växthusgaser, 2020 [Territorial emissions and absorption of greenhouse gases, 2020].*
[23] Swedish Climate Policy Council Report 2022.

Chart 4

Greenhouse gas emissions in Sweden (million tonnes CO_2e)[21] [22]





An important part in reducing emissions is creating opportunities for the business community and the public sector to adjust. Started at the initiative of the Swedish Government ahead of the UN climate conference in Paris in 2015, Fossil Free Sweden brings together stakeholders in the form of companies, municipalities, regions, and organisations that support the declaration of Sweden becoming one of the world's first fossil-free welfare nations.[24] A total of 22 industries have developed roadmaps, several of which mention digitalisation and the use of data as key to becoming fossil-free.[25] A number of digitalisation consulting companies have produced a roadmap with main focus on how digitalisation can enable major emission reductions in all sectors of society.[26]

Climate-changing emissions come from many different parts of society. Practically all products and services used in Sweden contribute to climate-changing emissions at some point. A majority of Sweden's emissions are generated in domestic transport, industrial manufacturing, and agriculture. As shown in Chart 5, they account for approximately 33%, 32%, and 13%, respectively, of Sweden's total territorial emissions.[28] Domestic transport includes transport by passenger car, light and heavy-duty trucks, maritime transport, buses, and domestic flights. Industrial manufacturing consists mainly of traditional basic industries and their production processes. Emissions are generated by the iron and steel industry, mineral industry, refineries, and paper and pulp industry, among others.

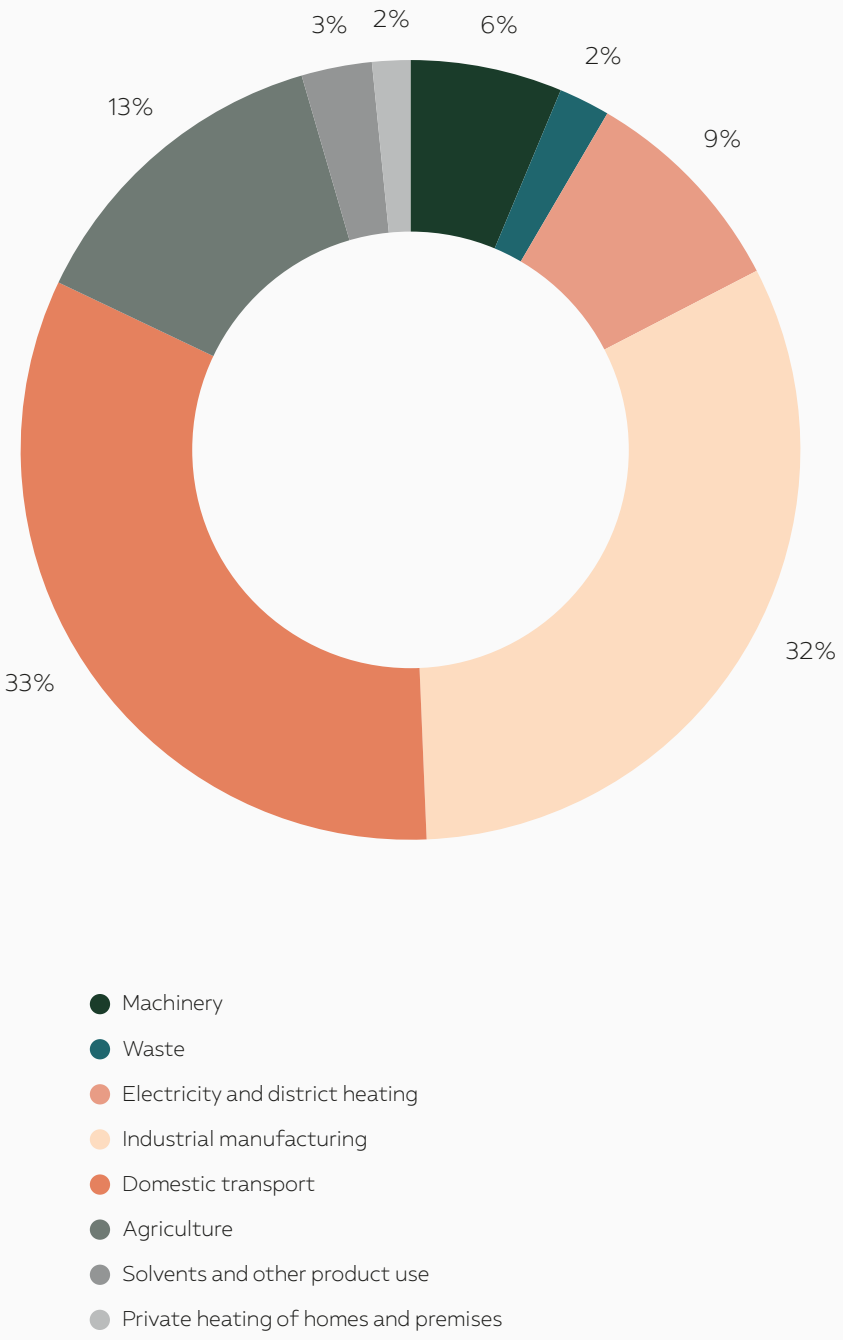
Since electricity production in Sweden mainly comes from fully fossil-free energy, emissions from electricity and district heating account for only about 9%, far below the level of emissions that this sector accounts for globally and otherwise within the EU. Remaining emissions in Sweden come from machinery, solvents and product use, private heating of homes and premises, and waste.

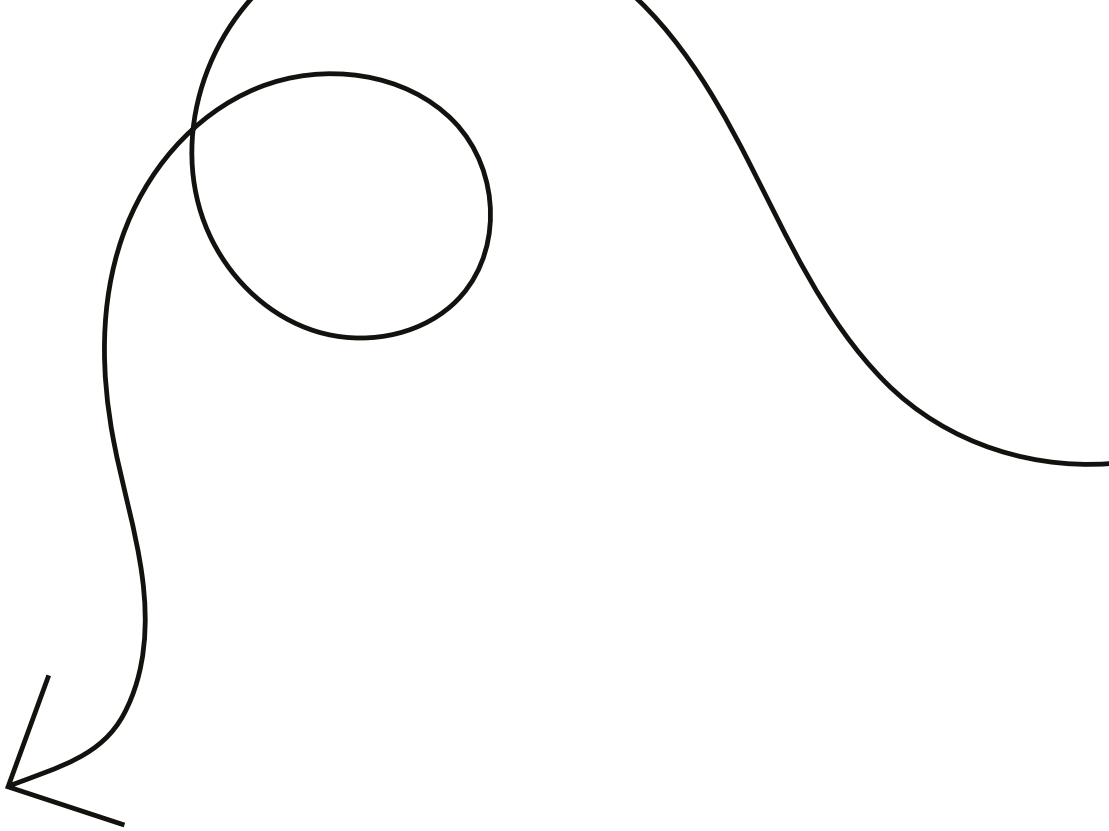
Businesses, the private sector, and consumers all have important roles in reducing emissions nationally. Businesses can move to more efficient and sustainable production methods, consumers can make more conscious choices in their everyday lives, and the public sector can steer towards reduced emissions through public procurement, by clearly including digital opportunities and the tech sector's solutions when, for example, setting requirements.

[24] Fossil Free Sweden.
[25] See, for example, the construction sector, electrical industry, agricultural industry, and road haulage companies.
[26] Fossil Free Sweden. Digitaliseringskonsulterna's roadmap.
[27] Swedish Environmental Protection Agency. Territoriella utsläpp och upptag av växthusgaser, 2020 [Territorial emissions and absorption of greenhouse gases, 2020].
[28] Swedish Environmental Protection Agency, national total, excluding LULUCF, excluding international transport.

Chart 5

Emissions in Sweden, share per sector in 2019[27]





Sweden's ambitious targets require accelerated transition

The purchases and procurements by public actors, such as municipalities, regions, government agencies, and publicly owned housing and real estate companies, generate significant climate emissions every year. In 2019, the climate impact of public procurement amounted to 23.5 million tonnes of CO_2e – approximately 28% of the total climate impact of consumption or 46% of Sweden's total emissions in 2019. Municipalities account for the largest share of public sector emissions, around 45%, while regions, government agencies, and municipal housing and real estate companies account for approximately 24%, 23%, and 9% respectively.[29]

A substantial share, nearly 40%, of the emissions generated by public sector procurement comes from operations relating to general spatial planning – such as buildings, real estate, and land. This involves, for example, procurement of energy, services for sewer system management, construction contracts, and street and property maintenance. Procurement and operation of various activities, such as public transport, hospitals, and other infrastructure also generate a significant share of emissions. Minimising the climate and environmental impact of the services and products procured and purchased is a major challenge for actors in the public sector.

The potential to reduce emissions in the public sector is especially great in community and transport planning, an area in which much of the emissions generated by municipal activities occur. This could, for example, be taken into account in spatial planning and new construction right from the start, by adapting neighbourhoods or transport solutions in overview plans and zoning plans according to climate benefit in order to promote new mobility solutions and solutions to transport goods more efficiently.

The SDGs are just two procurement periods away, and the public sector actors themselves identify both challenges and areas for improvement in the work for the sector's climate transition. Setting higher and clearer requirements in purchases and public procurement is identified as a key component for reducing climate impact. SKR (Sweden's Municipalities and Regions) notes, among other things, that more stringent climate and environmental requirements in procurement are decisive for making Sweden climate-neutral.[30]

As stated above, municipalities account for the largest share of public sector emissions, and there are several areas in which municipalities, regions, and state actors can reduce their climate impact and where digitalisation and tech can contribute with solutions. This can involve, for example, utilising digital solutions for energy efficiency, transport planning, and optimisation, as well as in the procurement of hardware for schools, government agencies, and public operations.

[29] Swedish National Agency for Public Procurement. *De offentliga inköpens klimat- och miljöpåverkan [Climate and environmental impact of public procurement].*
[30] SKR (Swedish Municipalities and Regions). *Klimatsmart upphandling [Climate-smart procurement].*

Examples of how tech contributes with solutions for the climate transition in different sectors

The increasing global emissions can easily lead to despair, but the IPCC makes it clear that emissions can be reduced and that technology has a decisive role in making it happen. Existing technology can make a big difference when used properly. Many industries are therefore working extensively to utilise existing technology and digital solutions that can contribute to the climate transition. In addition, new solutions are constantly being developed.

Digital solutions can accelerate the implementation of sustainable solutions and optimise existing systems. However, minor efficiencies and alterations in consumption patterns only go so far. The changes necessary to achieve the climate targets require transformative changes at societal level – and they need to be made in several different areas. An example of previous transformative change is goods and services taking on entirely new forms, such as streaming instead of physical record trading, sharing services for vehicles and housing, or digital photos replacing photographic film and developers. The effects of transformative changes became especially evident during the pandemic, where phenomena such as remote teaching, teleworking, and digital health care had their breakthroughs.

There are great benefits in uniting the climate challenge and digitalisation when radical and rapid reductions of greenhouse gases must be achieved. Transformative change is achieved when the effects of digitalisation at different levels work together, i.e. when new technical solutions, business models, financial incentives, new legislation, spatial planning, new financing models, evaluation methods, and ways to create transparency are combined.

Digital solutions based on, for example, blockchains, machine learning, artificial intelligence, 5G, sensor technology, digital 3D modelling, emissions calculation, automation, and optimisation all enable different sectors to take action to reduce their emissions. Increased use of digital twins, virtual copies of a building, a vehicle, or even entire neighbourhoods or transport networks provide ground-breaking opportunities to adapt properties, transport systems, and entire cities to what is best for the climate transition.

Even though the development in the rest of the world is slow, there's a very positive development taking place throughout the Swedish business community and public sector. There is also great awareness of the fact that further changes are needed in order to achieve the climate targets. In this section, the member companies of TechSverige – Telia, Atea, Ericsson, TietoEVRY, Prototyp, Microsoft, and Sweco – in close collaboration with companies or actors in high-emission sectors nationally and/or globally, provide concrete examples of how digitalisation contributes to work processes, programmes, and services that reduce emissions in the industrial, construction, food, transport, public, and energy sectors.

But the possibilities with the digital solutions in these examples don't stop at the individual company or sector. They can be both scaled and expanded into other sectors, which creates great opportunities for emission reductions at national and international level. The ability of digitalisation to fundamentally transform our society, with rapid and radical emission reductions as a result, must be given a central role in climate policy going forward.

Industry (IndTech)

Emissions from the industrial sector constitute a major share of total emissions, globally as well as within the EU and Sweden. The International Energy Agency estimates that the industrial sector accounted for approximately 40% of total global emissions in 2019.[31] In the EU, the sector accounted for about a fifth of emissions, and in Sweden, about a third. In the Swedish industrial sector, production processes in the traditional basic industries, such as iron and steel, minerals, refineries, and paper and pulp, are particularly high in emissions. Despite the industrial sector reducing its total emissions between 1990 and 2019, its share of Sweden's total emissions increased from 29% to 32% in the same period.[32]

In the government's industrial strategy from 2022, The Industry of the Future: A Strategy for Green and Digital Transition, the objective is that Swedish industry of the future shall be a world leader in innovation and sustainable industrial production of goods and services. The strategy states, among other things, that the green and digital transition of the industry needs to take place along the entire production chain and throughout the country in order to enable more companies to benefit from the increasing diversification of value chains as well as from digital and circular production and product design.

Example 1: Optimisation and sensor technology provide energy savings in the industrial sector

Challenge: In 2019, the paper and pulp industry in Sweden generated almost 1 million tonnes of CO_2e, which corresponds to 5% of industrial sector emissions and just under 2% of Sweden's total emissions. The Swedish Energy Agency's programme 2021, The Energy and Climate Transition of the Industrial Sector, states that, together, the paper and pulp, steel and metal, and chemical sub-sectors, accounted for 75% of the industrial sector's final energy use in 2018. Among other things, the programme is intended to contribute to the fulfilment of the Agency's vision for industrial research and innovation as well as to reaching the targets of 50% more efficient energy use by 2030 and net zero GHG emissions by 2045. The promotion of energy and resource-efficient production processes is highlighted as a primary area of focus. The forestry sector's roadmap for fossil-free competitiveness – in which the paper and pulp industry is included – also emphasises the need for continued resource and energy efficiency, while underlining the fact that the forestry sector's long-term ability to create climate benefit is determined by the development of industrial production.[33]

Solution: The implementation of technology and digitalisation in the industrial sector has great potential to contribute to the climate transition by streamlining production and manufacturing processes and by reducing the use of energy and resources.

In collaboration with partners, the programming and coding company Prototyp has developed technology solutions to streamline the industrial process at one of Stora Enso's production sites, Skoghall Mill, which produces packaging materials. The purpose is to maximise the use of the facilities and save energy in the long term. Using a large number of sensors in different parts of the manufacturing process, the work of different parts of the system can be read, such as if they're working too hard, too little, or at the wrong intervals. In order to convert the advanced data read by the sensors into information that can be easily interpreted, Prototyp developed a so-called "proof of concept" (PoC) in the form of a web app that visualises how the different components and devices work. The solution enables the identification of which parts of the facility that, for example, are not working efficiently or are consuming too much energy. Based on this information, the different parts of the system can be optimised so that a significantly smaller amount of energy is required to produce Stora Enso's products. With the help of this technology alone, Skoghall Mill is estimated to achieve annual energy savings of between 25 and 50 GWh, which corresponds to about 3–5% of annual consumption. At the same time, the quality variation for certain products produced by the facility is reduced by up to 50%, which results in more efficient and less resource-intensive production.

Technology: Sensor technology and digital data processing

Partners: Prototyp, Stora Enso, and Chalmers University of Technology

[31] International Energy Agency. *Greenhouse Gas Emissions from Energy: Overview: Emissions by sector.*
[32] Swedish Environmental Protection Agency. *Industri, utsläpp av växthusgaser samt Territoriella utsläpp och upptag av växthusgaser [Industry, GHG emissions and Territorial emissions and absorption of greenhouse gases].*

TOBIAS RUNDBOM, CO-FOUNDER & DEVELOPER, PROTOTYP

“We see great potential in this technology, and from our perspective, there are no practical obstacles to scaling it.”

What potential do you see for scaling the technology and use it in other businesses and sectors?

We see great potential in this technology, and from our perspective, there are no practical obstacles to scaling it. The technology and methods are already in place. Because the tool is so flexible, there are great opportunities to reduce the use of energy in the production process while also creating higher quality products. In the Stora Enso case alone, we’re talking energy savings corresponding to the annual electricity use of 2,000–4,000 standard homes – and that’s just for one site.

Tobias Rundbom
Co-Founder & Developer, Prototyp

Construction and Properties (ConTech and PropTech)

The value chain of the construction and property sector in Sweden, in the EU, and globally is extensive and includes several different emission-intensive stages. The United Nations Environment Program (UNEP) estimates that the sector globally accounts for 35% of the final energy use and about 38% of energy-related carbon dioxide emissions – or over 20% of total global emissions – including emissions generated by the energy production required for heating, electricity, and production of building materials.[34] The heating of commercial properties in the EU alone accounts for 12% of the Union's total emissions. Emissions from the construction and property sector at all stages of the life cycle – from construction, use, renovation, and demolition – are estimated to constitute as much as 36% of total emissions.[35] On a global level, as well as within the EU, the sector's high level of emissions are due to a largely fossil energy production.

Swedish emissions from the heating of properties and premises and from the electricity needed to run them are low in an international context, since the Swedish electricity mix includes very few fossil elements. However, the Swedish construction and property sector gives rise to significant emissions in other parts of the value chain. According to the Swedish National Board of Housing, Building, and Planning, total emissions from the sector in 2019 were 11.7 million tonnes of CO_2e – corresponding to 21% of total emissions in Sweden. If emissions from imported products and services linked to the sector are included, such as hazardous chemicals, the sector generated as much as 19.3 million tonnes of CO_2e in the same year – nearly 38% of total territorial emissions.[36]

Example 2: 3D modelling enables reduced climate impact of the construction sector

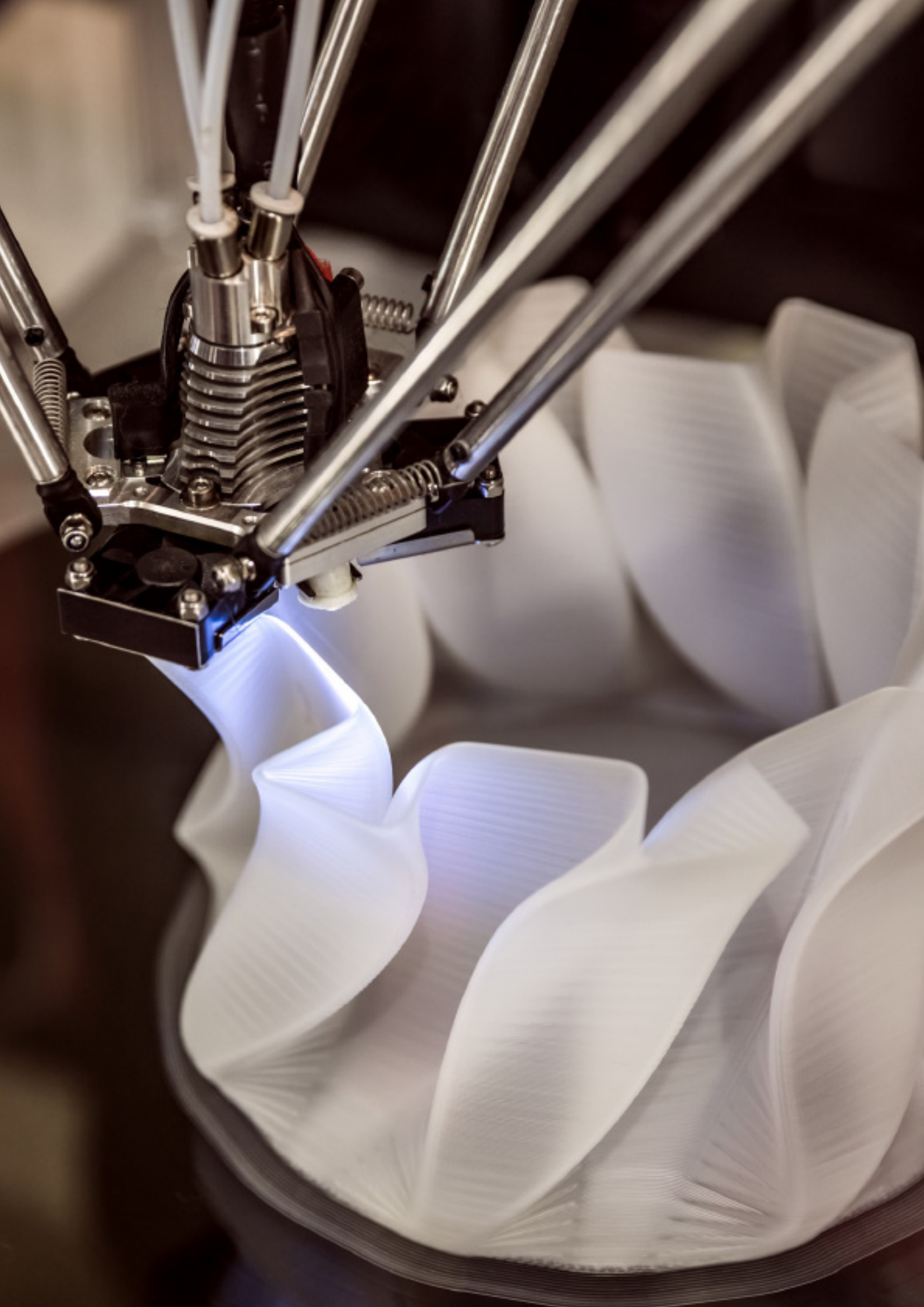
Challenge: A significant share of the emissions generated by a building from a life cycle perspective occurs in the actual construction process. According to figures from the Swedish National Board of Housing, Building, and Planning, new construction activities generated domestic emissions of nearly 5 million tonnes of CO_2e in 2019, and approximately 10 million tonnes of CO_2e if emissions from imported goods and services are included. Among the processes included in these emissions are those linked to the manufacturing of various building materials, such as cement and steel and iron products. In its 2018 roadmap for fossil-free competitiveness, the construction sector concludes that the manufacturing of building materials is the main cause of emissions at the construction stage, and that this stage accounts for around 80% of its climate impact.

Solution: Because a large share of the emissions generated by a building occurs early in the value chain, there is great potential to reduce emissions by making informed material and design choices as early in the construction process as possible. By digitalising the planning and design phase and combining it with data on the emissions generated by different materials, construction industry actors can make choices that reduce the climate impact of buildings even at the drawing table. The architecture and engineering consultancy Sweco has developed the service C3 Carbon Cost Compass, a digital calculation tool with direct connection to a 3D model that makes it possible to see what emissions different material choices and compositions in various construction parts may lead to in a finished building. The tool offers the ability to compare different materials based on climate calculation, cost calculation, relevant comparative data, as well as in accordance with the Swedish National Board of Housing, Building, and Planning's climate declaration requirements. With this solution, actors in the construction sector can see, for example, how the use of wood material instead of steel in certain construction parts can reduce climate impact by an estimated 70% – all with just a few klicks of a button.

Technology: Digital 3D modelling and emissions calculation

Partners: Sweco and ByggVesta

[34] UN Environment Programme. *2020 Global Status Report for Building and Construction: Towards a zero-emissions, efficient and resilient buildings and construction sector.*
[35] European Commission. *In focus: Energy efficiency in buildings.*
[36] Swedish National Board of Housing, Building, and Planning. *Utsläpp av växthusgaser från bygg- och fastighetssektorn [GHG emissions from the construction and property sector].*



KARIN HURTIG, ARCHITECT SAR/MSA, SWECO

“The vision is to be able to obtain a complete picture of the climate impact of more and larger parts of different construction processes – for example at city plan level.”

How does this solution contribute to the climate transition, and what is the potential to broaden the field of application of the technology?

This tool gives actors greater ability to contribute in the climate transition by concretising the climate and cost benefit of different material and design choices, while allowing them to track and evaluate the effects of different choices throughout the project. The solution can be expanded and used in more design platforms and software, and not least in more sectors. The vision is to be able to obtain a complete picture of the climate impact of more and larger parts of different construction processes – for example at city plan level.

In what other sectors can you see this solution being used?

At the moment, we see great potential in the infrastructure and installation industries, among others. There are also major potential climate gains to be made if we develop the tool with calculations based on an energy perspective. We could, for example, include materials with really low u values (which means that less heat and energy is transmitted through the material) and thereby demonstrate how major climate gains can be achieved by making certain choices. Since the technology and method are already in place, the solution can also be used in more countries.

Karin Hurtig
Architect SAR/MSA, Sweco

Food (FoodTech)

By 2050, the world's population is estimated to have grown to 10 billion people, an increase of 25% compared to today. This increase will place great demands on our ability to secure basic necessities, such as food. The world's food production causes major impact on our planet, accounting for nearly 35% of global greenhouse gas emissions, according to the UN. At the same time, almost a third of all the food produced becomes waste.[37] [38] How the food value chain looks, and how it can be improved in order to reduce its climate impact is becoming an increasingly important issue. In order for us to secure the supply of food, we need to become better at circular, climate-smart food production that doesn't require long-distance, high-emissions transport to get the food where it needs to go. At the same time, consumers need to be able to make informed choices to support sustainable food production. Digital technology enables new and innovative solutions to meet the challenges and reduce the food sector's environmental impact, nationally and globally.

Example 3: Blockchain technology makes the food industry traceable and resource-efficient

Challenge: The production and delivery methods used for food, such as fish, cause environmental impact and emissions through, for example, long-distance transport, pollution, overfishing, and unsustainable water use. Today, salmon and cod can be caught in the Arctic Ocean or farmed in cages in Norwegian waters, cleaned in China, and shipped back to the Nordic Region for consumption in the form of fillets. This generates high levels of emissions. And when the stakeholders in the different parts of the production and supply chain of a food product make calculations of the product's climate and environmental impact that differ from each other, it becomes difficult for both the sector and the consumers to gain complete insight into the emissions of a product. This, in turn, makes it more difficult to carry out emission-reducing measures in one's own value chain efficiently, while also reducing consumer and buyer ability to make informed choices.

Solution: Digitalisation and technology solutions provide new opportunities to identify product origin and trace food products throughout the value chain, from production to transport and consumption. With the help of Atea, Helsingborg is the first municipality in Sweden to create a blockchain technology for its purchasing of fish in order to trace purchased products and choose alternatives that lead to lower emissions.

Using blockchain technology, information about the production and supply chain of the fish, which used to be manual, has now been digitalised. The technology assigns a "block" to each step of the chain, such as the breeding of the fish, in which data about, for example, breeding method and emissions generated is entered. This makes all data available to all actors throughout the chain. Every aspect of the value chain of a food product is thus registered in the blockchain, including fishing method, catch area, by-catch, slaughter method, and transport. Using the data in the blockchain, uniform and comparable calculations of emissions for each step of a certain production and supply chain can be made. This makes it possible to obtain the actual emissions of a product from start to finish. Atea has built the platforms that are used, installed digitally connected measuring points along the food chains, and developed an app for QR scanning for end consumers. Atea also carries out necessary development projects and manages the solution.

About 80% of the fish purchased by the City of Helsingborg in 2020 was transported 44,000 kilometres back and forth from the Nordic Region to China to be filleted. Transport is mainly via shipping, and the emissions are extensive. With the help of this technology, people who consume the fish can use the QR code to see the origin of the fish and understand the climate impact of a certain food product, while buyers can choose products that don't have the same climate-negative transport chain. By applying blockchain technology, the City of Helsingborg has reduced its climate impact from the transport of purchased fish by 90% by choosing a supplier that has a value chain that generates much lower levels of emissions.[39]

Technology: Blockchain technology

Partners: Atea and the City of Helsingborg

[37] UN News. *Food systems account for over one-third of global greenhouse gas emissions.*
[38] Swedish Food Agency. *Därför ska vi minska matsvinnet [Why we must reduce food waste].*
[39] Fagerström, Jonas. "Spårade torsken – fick ner utsläppen med 90 procent: "Vi kan se vilken båt och vilket redskap" ["Traced the cod – reduced emissions by 90%: We can see which

MATS HÄLLDAHL, BLOCKCHAIN LEAD AT ATEA

“Using blockchain technology, they can choose products that haven’t travelled an additional 44,000 kilometres.”

How great is the demand for blockchain technology?

We’re seeing a rapid increase in the demand for traceable food in the Nordic Region. Every municipality we talk to wants to be able to know where the food comes from and what climate and environmental impact it has had. The example of the City of Helsingborg says a lot. Using blockchain technology, they can choose products that haven’t travelled an additional 44,000 kilometres. This leads to major emissions savings, which, in turn, contributes to the municipality’s overall goal of reduced climate impact. When used properly, blockchain technology can help the business community and the public sector reach their 2030 targets, increase resource efficiency, and reduce food waste.

In what other industries could this technology be used?

In the forestry industry, the interest in this technology is great. They want to be able to show that the material used doesn’t come from rainforests or from threatened forests. And the steel industry is interested, for example, in being able to show environmental impact. Other industries in which we see the technology being used, or could be used, include mining, health care, transport and logistics, and retail. Having access to all the production and transport data of a particular product in one single blockchain makes it easier to calculate an accurate environmental footprint of the entire supply chain.

Mats Hälldahl
Blockchain Lead at Atea

Transport (MobilityTech and TransportTech)

The transport sector is one the sectors that accounts for the largest share of emissions – globally, in the EU, and in Sweden. Emissions from domestic transport constitute over 32% of total greenhouse gas emissions in Sweden and just over 23% of emissions in the EU. The majority of transport emissions in Sweden comes from road transport, mainly from passenger cars and heavy vehicles.

In its roadmap, The Automotive Industry – Heavy Vehicles, the transport industry identifies the needs for more efficient transport in order for the industry to achieve the same transport benefit with fewer vehicle kilometres.[40] The industry highlights the opportunities provided by increased digitalisation and technology in making this happen, such as shared data on transport needs, transport chains, and transport patterns for goods, as well as how this can lead to efficiencies and reduced driving distances.

Example 4: Autonomous vehicles and 5G can lead to significantly reduced emissions in the transport sector

Challenge: According to the Swedish Transport Administration, the demand for goods transport in Sweden will increase by about 50% by 2040, with a main increase in road transport. The Swedish Parliament's climate target for the transport sector means that greenhouse gas emissions from domestic transport, excluding air traffic, must decrease by 70% by 2030, compared to 2010 levels. In 2019, emissions from domestic transport totalled 16.6 million tonnes of CO_2e, 90% of which came from road transport. Goods transport accounts for about 20% of the emissions from road transport, which corresponds to about 3.2 million tonnes of CO_2e. The strong increase in demand for goods transport, in combination with high-level targets for emission reductions in the transport sector, pose major challenges for the sector in its transition work.

Solution: Technological development and digitalisation have the potential to be central factors in the work with the transport sector's climate transition. The Swedish Transport Administration states that automation, electrification, and digitalisation will be key aspects for creating conditions for more cost-efficient and energy-efficient transport solutions, and that digitalisation and technology can contribute to increased route optimisation and load factor.[41]

Ericsson collaborates with major suppliers of transport solutions, such as Volvo and Scania, as well as new innovation companies, such as the tech company Einride, which, in just a few years, acquired one of Europe's largest fleets of electric lorries, and which recently established itself in the US market. Einride has created a logistics system that, through automation, self-driving lorries, AI, and machine-learning, enables more efficient goods and logistics management, while also reducing vehicle emissions. The first step of Einride's solution is the electrification of transport through the development of electric lorries. The next step is a comprehensive, digital transport system with great capability to streamline transports. The self-driving, electric lorries are controlled by operators who can control several vehicles at the same time. In addition to the efficiency created by having more vehicles per operator, an increased load factor also contributes to more goods being transported using the same number of transports as before. Ericsson supports Einride with the 5G technology needed to ensure a high-efficiency transport system and for the self-driving vehicles to hit the roads in a safe and efficient manner. Ericsson estimates that over 60% of transports today could be replaced by Einride and Ericsson's 5G technology.

Technology: 5G, electrified and autonomous vehicles

Partners: Ericsson, Einride, and Scania

[40] Fossil Free Sweden. *Fordonsindustrin – tunga fordon: Färdplan för fossilfri konkurrenskraft [The automotive industry – heavy vehicles: A roadmap for fossil-free competitiveness].*
[41] Swedish Transport Administration. *Digitaliseringens bidrag till målbild 2030: Tillgänglighet i ett hållbart samhälle [The contribution of digitalisation to the 2030 target: Accessibility*

MATS PELLBÄCK SCHARP, HEAD OF SUSTAINABILITY, ERICSSON

"In addition to reduced emissions, Einride's use of electric vehicles contributes to reduced particle pollution and noise levels, especially in densely populated areas."

What climate benefit has been achieved with Einride?

If Einride were to replace an entire logistics chain in Sweden, given the Swedish energy mix, carbon dioxide emissions from transport would be reduced by over 90%. In addition to electric vehicles being used instead of those powered by fossil fuel, the reduction in emissions is created by the fact that Einride's logistics platform measures, optimises, and coordinates drivers, pallets, loading and unloading sites, and routes. That's an enormous change. Einride has resulted in major changes in other countries as well. The use of Einride's vehicles alone means that annual carbon dioxide emissions, seen over the life of a vehicle, are reduced to approximately 7 tonnes. This is less than one-tenth of the emissions generated by a diesel-powered vehicle during its lifespan. The results are especially notable when it comes to heavy transport. In addition to reduced emissions, Einride's use of electric vehicles contributes to reduced particle pollution and noise levels, especially in densely populated areas.

What is the potential for implementing Einride's system in other countries around the world, and what climate benefit could that result in?

The streamlining that creates climate benefit with Einride is twofold. First of all, the entire logistics system is more efficient and reduces the work required to transport a product. Second, the electrification reduces emissions locally and creates increased efficiency in the use of energy. In Europe, for example, the average load factor for transports is about 60%. Major efficiencies can thus be achieved without even replacing the vehicles, through higher efficiency throughout the logistics chain. Globally, it's about the need to electrify transport at a much higher rate than today. The great benefit of digitalisation from a sustainability perspective is the ability to streamline and create major change in a short period of time.

Mats Pellbäck Scharp
Head of Sustainability, Ericsson

Example 5: Data-driven analysis reduces emissions from the transport sector

Challenge: A central aspect in reducing emissions from the transport sector is creating more transport-efficient societies and smarter spatial planning. This means that we need to shift to more energy-efficient, lower-emission modes of transport for our travels, especially within and between cities and urban areas. At the same time, measures must be taken to stimulate more travel-free (digital) meetings.[42] Understanding where emissions in a sector occur is crucial to understanding which measures must be taken to reduce them. Municipal, regional, and business actors need a comprehensive picture of what transport patterns and flows look like and what emissions they generate in order to make the right operational changes and implement the appropriate spatial planning measures to reduce the climate impact of transport.

Traditional methods for calculating emissions from transport for a particular municipality or region, which often involve travel habit surveys, are time-consuming, and the ability to follow up and evaluate the effects of spatial or transport planning measures is limited.

Solution: With Telia's Travel Emission Insights, anonymised and aggregated data from Telia's mobile network is used to create statistics of movement patterns in society. Statistics are made representative of the entire population through a method developed jointly with Statistics Sweden (SCB). In order to recalculate movement statistics to carbon dioxide emissions, Telia collaborates with the climate expert CERO, utilising their emissions calculation, which was developed by researchers at KTH Royal Institute of Technology.

Based on the statistics, users of the tool can obtain information about the transport patterns of hundreds of thousands of people within and between municipalities, regions, or along a certain route, which modes of transport are used, and what emissions are generated. Furthermore, users can get quantified suggestions for measures to reduce emissions by a certain percentage. For example, this tool can provide information on the number of car journeys that must be substituted for public transport in order to achieve the desired percentage impact on total emissions.

Technology: Data-driven analysis of emissions from the passenger transport sector.

Partners: Telia Company, Järfälla Municipality.

[42] Sveriges Miljömål [Sweden's Environmental Objectives]. *Utsläpp av växthusgaser från inrikes transporter [Greenhouse gas emissions from domestic transport].*


55.04
90.73
55.39
12.78
25.01
58.02
22.82
90.73
55.04

KRISTOFER ÅGREN, HEAD OF DATA INSIGHTS AT TELIA COMPANY

"I think all of Sweden's 290 municipalities could benefit greatly from systematically mapping and optimising transport using data-driven analysis."

How great is the potential of this type of tool nationally?
I think all of Sweden's 290 municipalities could benefit greatly from systematically mapping and optimising transport using data-driven analysis. Traditional methods often differ from one municipality to the next and, in some cases, they're based solely on travel habit surveys. By also including continuous movement statistics, you can work in a truly data-driven manner. In addition, municipalities can compare and report the effect of measures based on the same data set. I think this leads to significantly improved opportunities to actually reduce emissions in society.

And internationally?
Our service is presently available in most countries where Telia operates (Sweden, Finland, Norway, Denmark, and Estonia), and we're already seeing increased interest in the service from telecom operators in other countries. The model can easily be calibrated for new data sets and locations, such as mobile network operators in other countries.

Kristoffer Ågren
Head of Data Insights at Telia Company

Public sector (GovTech)

While the public sector is a source of major emissions in Sweden, Europe, and globally, it also has a significant role in the transition. The purchases and procurements made by municipalities, regions, state agencies, and municipal real estate companies in 2019 generated consumption emissions of over 23 million tonnes of CO^2e in Sweden, corresponding to 40% of Sweden's total territorial emissions that year. Over 9 million tonnes of these emissions, around 40%, occurred in the buildings, real estate, and land category. The Swedish Parliament recently decided that emissions caused by Swedish consumption, both nationally and internationally, shall be included in Sweden's climate calculations. In its report, Sweden's Global Climate Footprint, the Swedish Cross-Party Committee on Environmental Objectives, whose proposal provides the basis for the Parliament's decision, emphasises that the public sector needs to lead the way in the climate transition, for example by choosing more climate-smart alternatives in procurement, which also contributes to creating markets and promoting the development of innovation.[43] They also propose that emissions from publicly procured goods and services be reduced more rapidly than emissions from society in general and that requirements be introduced for national climate targets to be considered in public procurement.[44]

About 80% of public properties in Sweden are owned by the state, a municipality, or a county council, while private actors own the rest. One of the European Commission's goals is for all new public buildings in the EU to be "zero emitters" as early as 2027. This means, among other things, that the energy consumption of the buildings must be limited, that the buildings must not generate any emissions on site, and that the potential of the buildings to reduce global warming from a life cycle perspective must be reported.[45]

The transition in the public sector already is but will become even more important in the future. Digitalisation and automation are central tools for enabling actors in the sector to obtain information about where in operations climate impact occurs, what measures must be taken to reduce it, and what effects the various measures have.

Example 6: Automated collection of emissions data provides a complete picture of the climate impact of public operations

Challenge: More and higher demands are being placed on public administration actors in terms of how to report their climate impact and what measures to take in order to reduce it. There is a great need among society's actors to gain detailed knowledge about where emissions occur. The availability of accurate and up-to-date information on, for example, how much energy and heat are required to run public properties and buildings, and the climate impact this leads to, is central to actors being able to take appropriate action to reduce the impact. Today, the collection and analysis of energy consumption and climate impact data are often carried out manually, which is highly time-consuming. In addition, the work usually only takes place annually or quarterly, which lessens the opportunities to take swift and continuous action.

Solution: Digitalisation and automation of data collection have great potential to provide actors in the public sector with real-time visualisation of where emissions occur in various parts of the value chain, such as how much energy in the form of electricity and heat is consumed by properties and offices, and how much various measures can reduce the climate impact.

Together with several actors in the Nordic Region, including the city of Vaasa in Finland, TietoEVRY has developed digital solutions that automatically collect and visualise data on where emissions from electricity consumption, heating, and transport occur, and what climate effects various measures might have. The technology creates connections between already existing systems, such as electricity meters from an electricity supplier or various application programming interfaces, so-called APIs. The automated data collection is then fed into a platform, where it can be visualised based on, for example, the level of emissions generated by current energy use and what emission reductions various measures can lead to.

The technology provides a complete picture of where emissions occur in the value chain of a business, which factors affect emissions, and the potentially positive climate effects of various measures. Actors who use the tool can start controlling their climate efforts in real time, and not in retrospect, which they used to. TietoEVRY's solutions are helping the city of Vaasa achieve its goal of climate neutrality both easier and faster.

Technology: Automation of data collection and analysis

Partners: TietoEVRY, Vaasa, Vasa Elektriska, Wärtsilä, and Committed.

[43] SOU 2022:15. Swedish Cross-Party Committee on Environmental Objectives. *Sveriges globala klimatavtryck [Sweden's global climate footprint].*
[44] Swedish Government Offices. *Regeringen tar emot förslag om nya klimatmål för konsumtion och export [The government accepts proposals for new climate targets for consumption and exports].*
[45] European Commission. *European Green Deal: Commission proposes to boost renovation and decarbonization of buildings.*

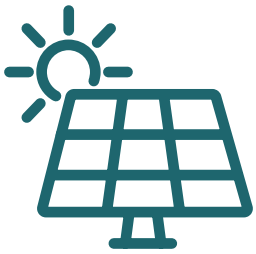
PETER MANKENSKIÖLD, SUSTAINABILITY STRATEGIST & LEAD BUSINESS CONSULTANT, TIETOEVRY

"If data is available in any kind of existing system, it can be used in our solution."

What possibilities are there to scale the solution?
There really is no limit. Since our solution is a tool that can be applied to all forms of data, it's not limited to any particular industry or part of a value chain. If data is available in any kind of existing system, it can be used for our solution. The potential for scaling the application of this tool and expanding the solution into more industries is enormous. We see an especially strong interest in this type of solution in the construction and property sector as well as in banking and insurance, not least because of the increasing demands placed on climate and sustainability reporting and the great need for having an overall picture of climate impact throughout the value chain. We're also speaking with actors in the forestry sector, and we've previously mapped and analysed emissions for postal services in Norway. There are also great opportunities in the manufacturing industry, with the ability to connect to data from factories or the supply chain.

What benefits does this solution provide?
We use these solutions to calculate the climate impact in our own value chain as well. We used to spend around 2,000 working hours per year manually collecting this data from, for example, the parts of operations that account for much of our energy use, such as offices and data centres. By digitalising and automating the collection of data, we obtain more detailed information about our climate impact on a daily or weekly basis, as opposed to annually or quarterly, and we also enable those who used to collect the data to focus on analysing it instead. These digital solutions thus provide us with direct climate benefit as well as major efficiencies.

Peter Mankenskiöld
Sustainability Strategist & Lead Business Consultant, TietoEVRY



Energy (CleanTech)

Globally, the energy sector is one of the largest sources of carbon dioxide emissions. This is because the production of electricity internationally largely uses fossil fuels, such as coal, gas, and oil.[46] Just over two-thirds of the world's electricity is produced using fossil fuels.

Even in the EU, energy supply accounts for the main share of the Union's emissions: 27%. Unlike countries such as Sweden, energy production in the EU still includes a considerable proportion of fossil production, such as from gas and coal power plants. Nearly 40% of the electricity consumed in the EU comes from power plants that burn fossil fuels.[47] In Sweden, only about 2% of the electricity production is fossil.[48] The EU electricity sector is expected to be a key for the Union's ability to achieve net climate neutrality by 2050. In order for this to happen, the sector's greenhouse gas emissions must decrease drastically in this decade.

In 2021, the International Energy Agency (IEA) presented a roadmap for the energy sector's path to net zero emissions globally. In it, the IEA calls on the world to immediately stop investing in new fossil fuel projects. According to the roadmap, solar and wind power needs to be expanded to just over 1,000 GW per year until 2030 (about four times more than what was installed in 2020). By 2050, 90% of the world's electricity production must come from renewable production, with 70% from solar and wind power.[49] The EU has set a binding target for 32% of electricity to be generated by renewable energy sources in the EU's energy mix until 2030.[50]

Example 7: Data analysis enables tracking of renewable electricity

Challenge: The production of electricity and district heat is one of the main sources of carbon dioxide emissions worldwide, and many companies are committing to using 100% renewable energy in order to achieve their sustainability goals. Fulfilling this ambition requires a reliable way to track renewable electricity. Although progress has been made in terms of renewable energy sources and commitments, there is a fundamental lack of monitoring of the source and the amount of energy consumed. The current system has no way to match the supply of renewable energy to the demand for this energy on an hourly basis. The energy may come from renewable sources or be produced from fossil fuels. Without transparency in supply and demand, market forces cannot act to ensure that the demand for renewable energy is met.

Solution: Vattenfall uses Microsoft's Azure services, including Microsoft Azure IoT Central and Microsoft Power BI, to build and deliver a solution that enables matching renewable energy production to demand 24/7, 365 days a year. Energy produced from renewable sources is measured every hour, while consumption is measured using smart meters installed on sites where energy is used. The transparency provided by the solution increases the understanding of energy use and climate impact. With the solution, companies can see if their commitment to 100% renewable energy covers every consumption hour and if they can convert renewable energy purchases to climate impact. This makes it easier for energy suppliers to understand the demand for renewable energy hour-by-hour and take steps to help production meet demand.

By combining the existing Guarantees of Origin system (GOs) for tracking of renewable electricity with a digital solution for matching consumption to renewable electricity production on an hourly basis, Vattenfall can provide its electricity customers with information about the source of their energy – not just on a monthly or annual basis but on an hourly one. This solution contributes to transparency in the climate issue through more detailed tracking of renewable electricity. Using GOs, end consumers can choose electricity from a specific source, which enables them to choose electricity that comes exclusively from renewable energy sources, such as wind, solar, or hydropower.

Technology: IoT, data analysis, smart electricity meters.

Partners: Microsoft and Vattenfall.

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[47] Eurostat. "What is the source of the electricity we consume?". 14 April 2022.
[48] Fossil Free Sweden. Elbranschen: Färdplan för fossilfri konkurrenskraft [The electrica industry – heavy vehicles: A roadmap for fossil-free competitiveness].
[49] Kofod-Hansen, Marie. "Så ska världens energisektor nå nettonollutsläpp" ["How the world's energy sector will reach net zero emission"], *Tidningen Energi*. 2021
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Living Room
HEAT SET TO
75
Home
75
Living Room
Inside Humidity
Outside Temp.

TAYLOR LEYDEN, PROGRAM MANAGER ENERGY AND SUSTAINABILITY, MICROSOFT

"Over time, this storage will enable power grids to deliver 100% carbon-free electricity."

What is the potential of this solution?

This can become a global solution. Because 24/7 adaption of consumption and production is what drives the actual market demand for renewable energy. When products for renewable energy produced 24/7 worldwide are introduced, they will stimulate investments in energy storage, which will enable energy companies to store renewable energy when produced and thereby continue to provide their customers with renewable energy even when it's not being produced. Over time, this storage will enable power grids to deliver 100% carbon-free electricity.

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The basis for this report has been prepared in collaboration with New Republic.

Other sources

Survey among TechSverige's members 4–19 October 2021.

The basis for this report has been prepared in collaboration with New Republic.

A REPORT FROM TECHSVERIGE

Sustainable Tech & Tech for the Climate

TechSverige is an industry and employer organisation for all companies in the tech sector, with the mission to create the best conditions possible for a world-leading tech industry in Sweden together with our members. Our 1,400+ member companies, collectively employing close to 100,000 employees in Sweden, include everything from small start-ups with few employees to major multinational corporations with thousands of employees worldwide.

TechSverige is one of nine collaborative federations in Almega. Our members are also members of the Confederation of Swedish Enterprise. Visit us at techsverige.se

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