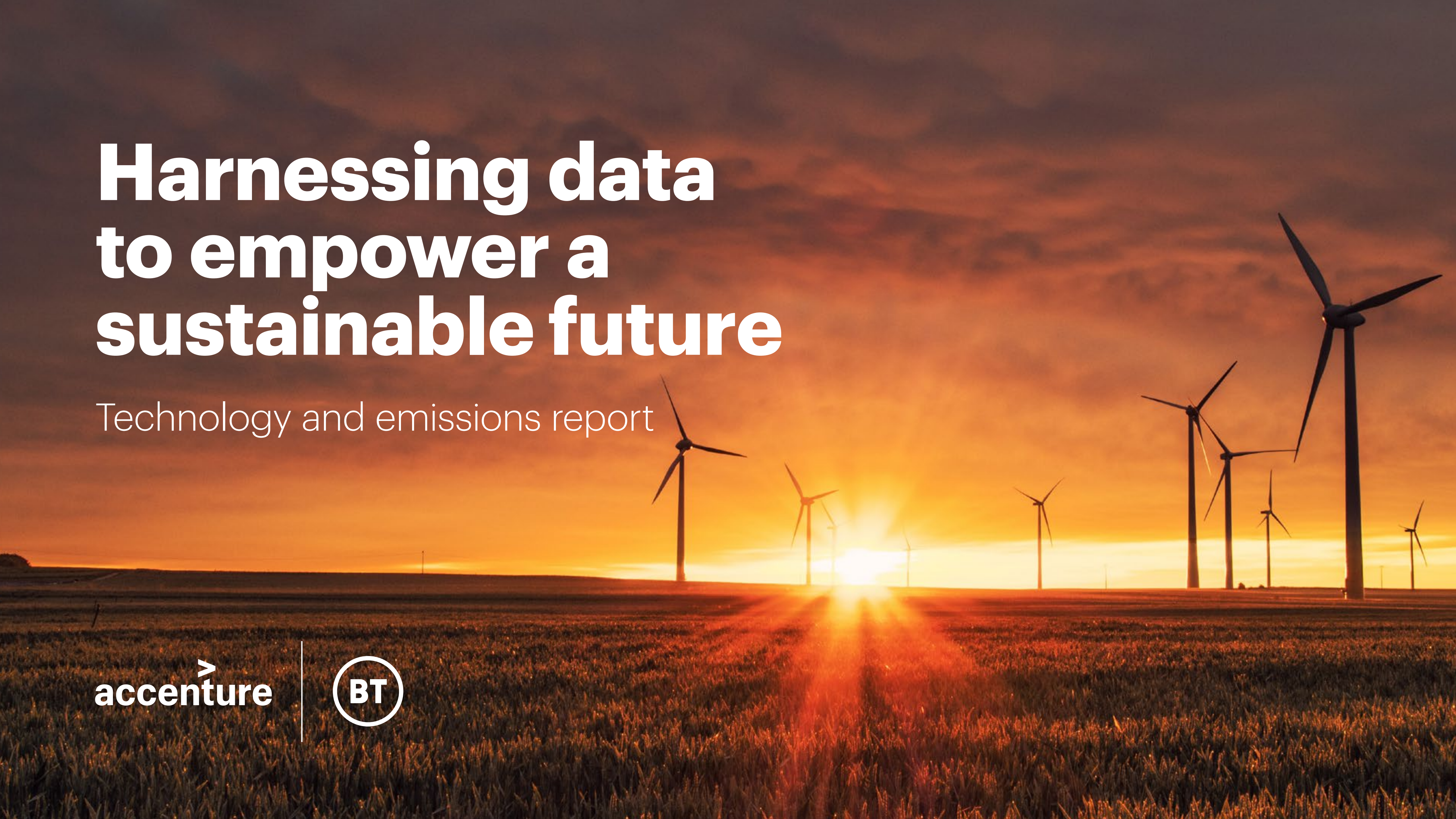


Harnessing data to empower a sustainable future

Technology and emissions report

accenture | BT

Contents

Foreword

At BT, our purpose is to connect for good. Our ambition is to be the world's most trusted connector of people, devices and machines by 2030. We will only get there if we help our customers build the bright sustainable future we all aspire to – and that means dramatically reducing emissions.

We've been a leader on climate and sustainability action for almost 30 years and we've pledged to be a net zero emissions business by 2030 for our own operations, and 2040 for our supply chain and customer emissions. BT reduced its emissions intensity by 80% between 2010 and 2016.

Five years ago, we pledged to further reduce the carbon emissions intensity of our business by 87% by March 2031, launching one of the world's first Paris-aligned science based targets. Since setting the target, we have:

- Reduced the carbon intensity of our operations by 57%
- Cut supplier emissions by 19%, against a target of 42% by March 2031
- Linked 10% of our annual bonus to goals on digital skills and carbon reduction
- Completed the switch to 100% renewable electricity worldwide
- Outlined plans to transition most of our fleet to electric vehicles by 2030

As the world looks to recover from the Covid-19 crisis, we have an opportunity to use our tech, innovation and influence to put climate action at the heart of the economic recovery.

Never before has connectivity been so integral to so much of our lives. BT's full fibre broadband and 5G mobile networks will underpin many of the innovative solutions needed to achieve a net zero carbon economy - supporting everything from home-working through to the development of smart cities and enabling the Internet of Things.

As data traffic grows significantly over the next decade, we expect the energy profile supporting that growth to stay broadly flat. This is a trend we have seen over the last ten years and it is expected to continue.

Our work with Accenture looks at how carbon emissions can be decoupled from growth in data traffic. It also studies how the ICT industry is leading the way in terms of emissions reductions through net zero targets and renewable energy consumption, as well as driving significant abatement in other sectors.

With a customer base of 30 million households and over a million SME customers, BT is well placed to help them and others cut their carbon footprint. Working with partners like Accenture, we're also able to set the record straight around the ICT sector and the emissions it's responsible for, as well as the saving it enables. Together, we can help to build back better by creating a fairer, more resilient and low carbon society.

Philip Jansen
Chief Executive BT Group

Foreword

At Accenture, we believe sustainability is the new digital. It is perhaps the most powerful force of change in our generation, transforming how we live and work, driving new value and growth and permeating everything we do.

Sustainability is also a promise. As a company, we see it as one of our greatest responsibilities, embedding sustainability—by design—into every aspect of what we do for ourselves and for everyone we work with. It is our Accenture Sustainability Value Promise. This includes the ambitious environmental goals and commitments we have made to the future:

- We have pledged to do our part to keep global warming below 1.5˚ through the UN Global Compact's Business Ambition Pledge.
- By 2025, we will achieve net-zero emissions, focusing on actual reductions in our emissions and investing in nature-based solutions that will remove carbon from the atmosphere.
- By 2025, we will reuse or recycle 100% of our e-waste are committed to eliminating single-use plastics.
- By 2025, we will develop plans to reduce the impact of flooding, drought and water scarcity on our business and our people in high-risk areas.
- We are the largest professional services company to date to have a science-based target approved by the Science Based Targets initiative.

Underpinning these commitments, and the transformation we all must make as industry leaders, governments, and communities, are digital technologies—particularly 5G, fibre and the cloud—which we examine in this report. These technologies are key to unlocking the innovation needed to achieve the UN Sustainable Development Goals and to unleash growth as we reimagine our industries and our world to build back better.

That is why we are so proud of our ongoing work with BT, helping the company accelerate and achieve their Net Zero ambitions, including finding ways to improve energy consumption so data traffic can continue to grow without harming the planet. We have put our 360º value framework at the heart of our relationship—which means thinking about and delivering value to all of BT's stakeholders—so we can raise the bar for what we can accomplish together toward a better world for all.

Julie Sweet
Chair & CEO Accenture

The power to change – the role of the ICT sector

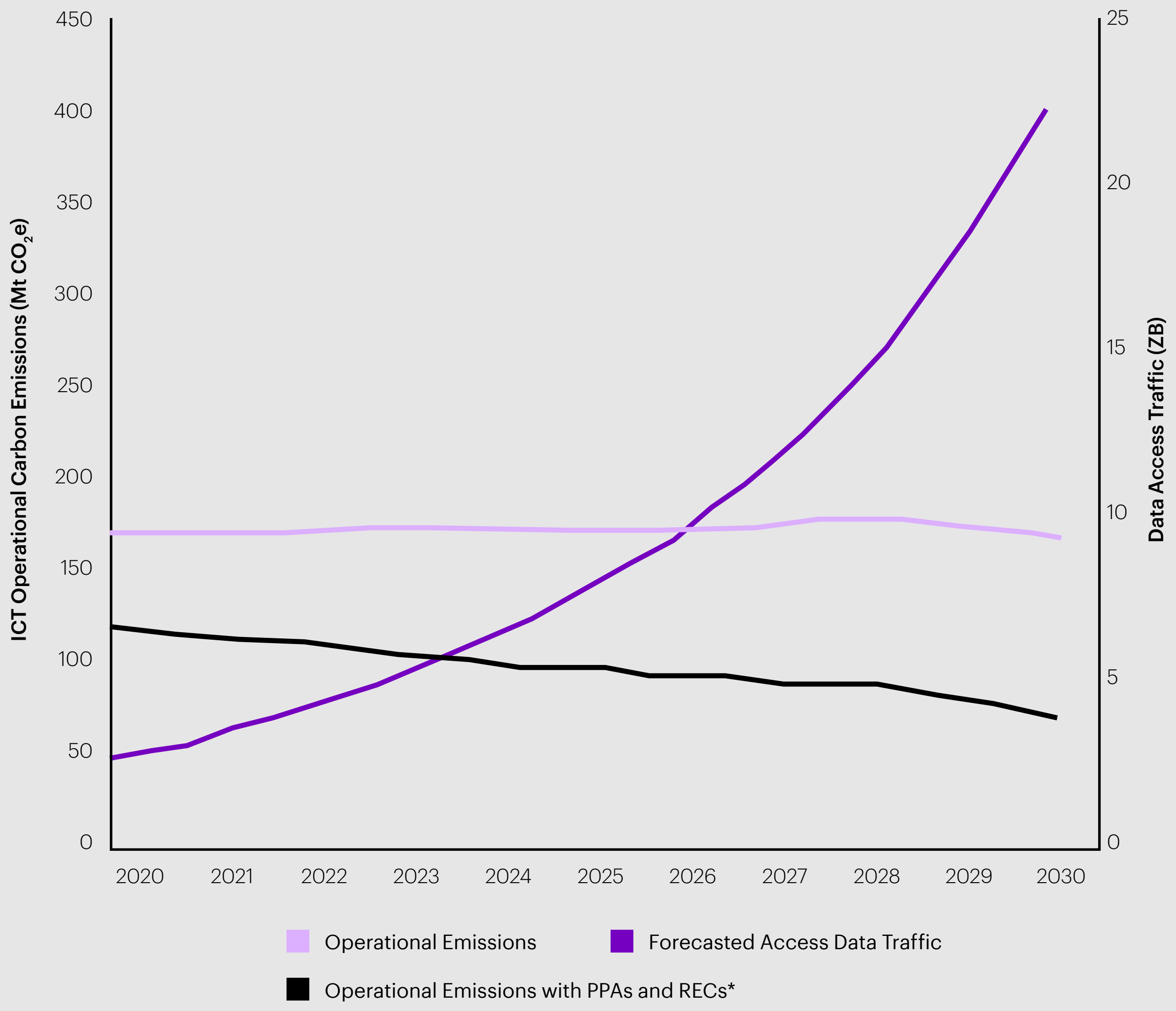
We live in a world more connected than ever, with 70% of individuals worldwide forecasted to be using the internet by 2023[1], as part of the United Nation's efforts for universal connectivity by 2030[2].

The COVID-19 pandemic accelerated the move to more remote work and the need for always-on connectivity, as the home became the office. By 2030, we can expect to see 50 billion connected devices, twice the number in 2018.[3] Mobile data usage will be 10-14 times higher by 2030, given growing data intensity with high-quality streaming and similar services.[4]

No surprise, then, that data traffic is predicted to grow eight-fold by 2030 (see Figure 1).

This appetite for more data could have a significant carbon footprint depending on the source of energy that is fuelling that data. There is good news, however. The Information Communications and Technology (ICT) sector is already acting to reduce its carbon emissions by purchasing renewable energy, setting science-based targets and by making data more

Figure 1: Forecasted ICT Operational Carbon Emissions and Access Data Traffic.



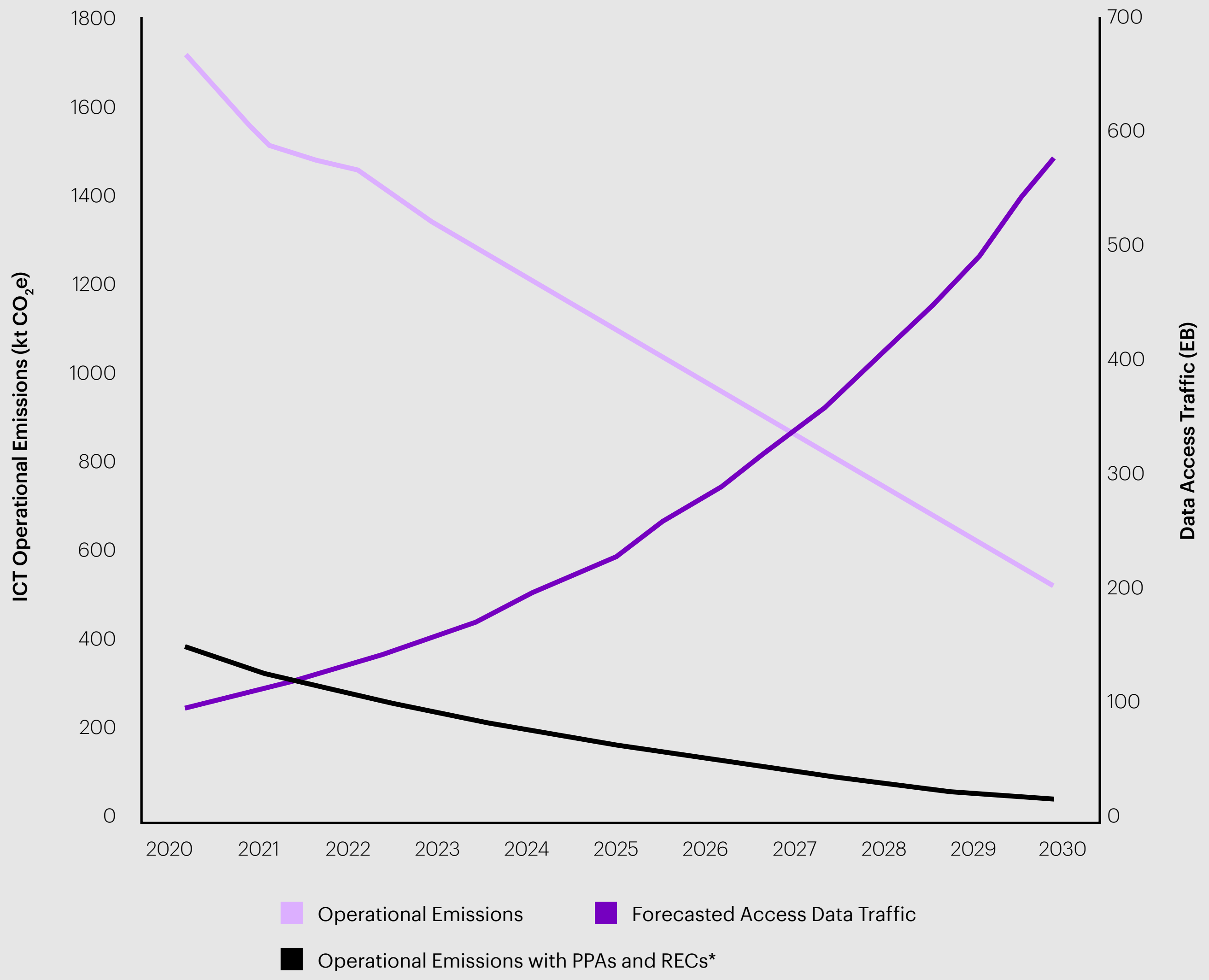
*Company Power Purchasing Agreements and Renewable Energy Certificates taken into account

energy efficient. So, even as demand for data rises exponentially, the amount of energy used to run that data will not rise in the same incremental way.

In fact, carbon emissions from the ICT sector are expected to drop by as much as 40 percent by 2030 (see Figure 1), due to significant actions being taken by the sector to improve energy efficiencies across three technology groups: mobile networks, fixed networks and data centres. This picture is also mirrored in the UK, where carbon emissions could decrease by up to 68% over the next decade (see Figure 2).

What's more, these three technologies have implications far beyond reducing the ICT sector's carbon footprint. If adopted at scale, they can go a long way in reducing carbon emissions from other sectors as well—substantially higher than the operational emissions from the sector itself.

Figure 2: UK ICT Operational Emissions and Data Access Traffic Growth.



*Company Power Purchasing Agreements and Renewable Energy Certificates taken into account

As we demonstrate in this report, by harnessing these same technologies, global carbon emissions could decrease by 17% in the next decade across four emissions-intensive sectors: electricity and heat; agriculture; manufacturing; and smart living, including transportation and buildings.

To seize the full potential impact of these technologies to decarbonise the economy, the ICT sector can take a number of steps. That includes meeting ambitious carbon reduction targets, continuing to prioritise energy efficiency across networks and operations, migrating to the most energy-efficient mobile networks and taking advantage of new technologies such as 5G and cloud. At the same time, sustainable technologies can significantly reduce other sectors' carbon footprint, which will be more critical than ever in the next decade.

Section 1

Deep dive:
The ICT sector carbon footprint

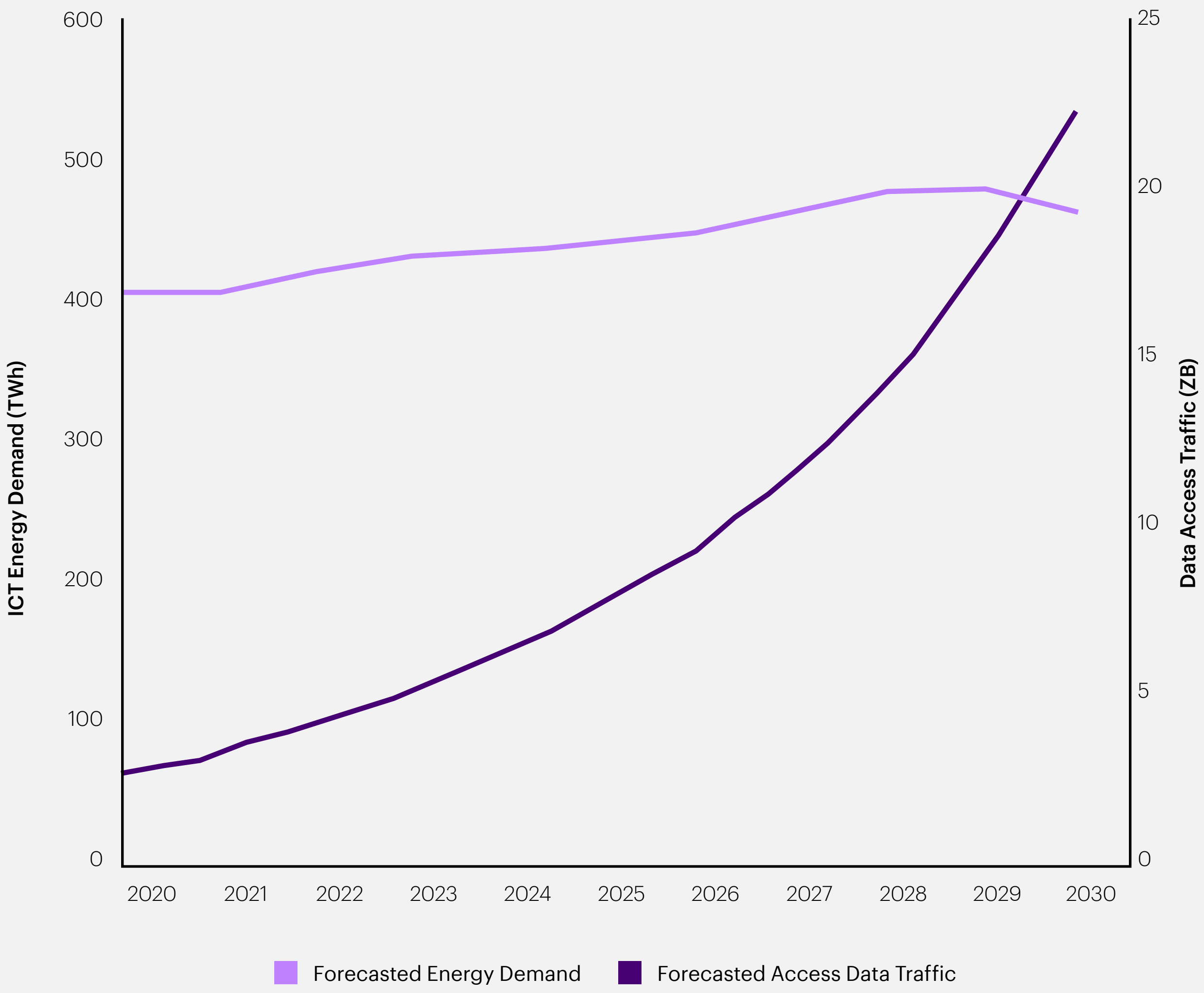
To understand the carbon impact of our increasingly digital world, and the role of the ICT sector to slow that pace, in its own sector and others, let's look at some key facts on data access traffic growth, ICT energy demand and ICT carbon emissions.

Data Access Traffic Growth

By 2030, we predict global access data traffic, representing the amount of data consumed by individuals moving across the fixed and mobile access networks (i.e.: the data traffic over wifi or ethernet connections, and over mobile radio connections), will reach over 22 ZB, growing over eightfold between 2020 and 2030 (see Figure 3).

This is largely driven by growth in the number of connections and devices, in addition to increases in high-quality data volume.

Figure 3: ICT Energy Demand and Access Data Traffic.



ICT Energy Demand

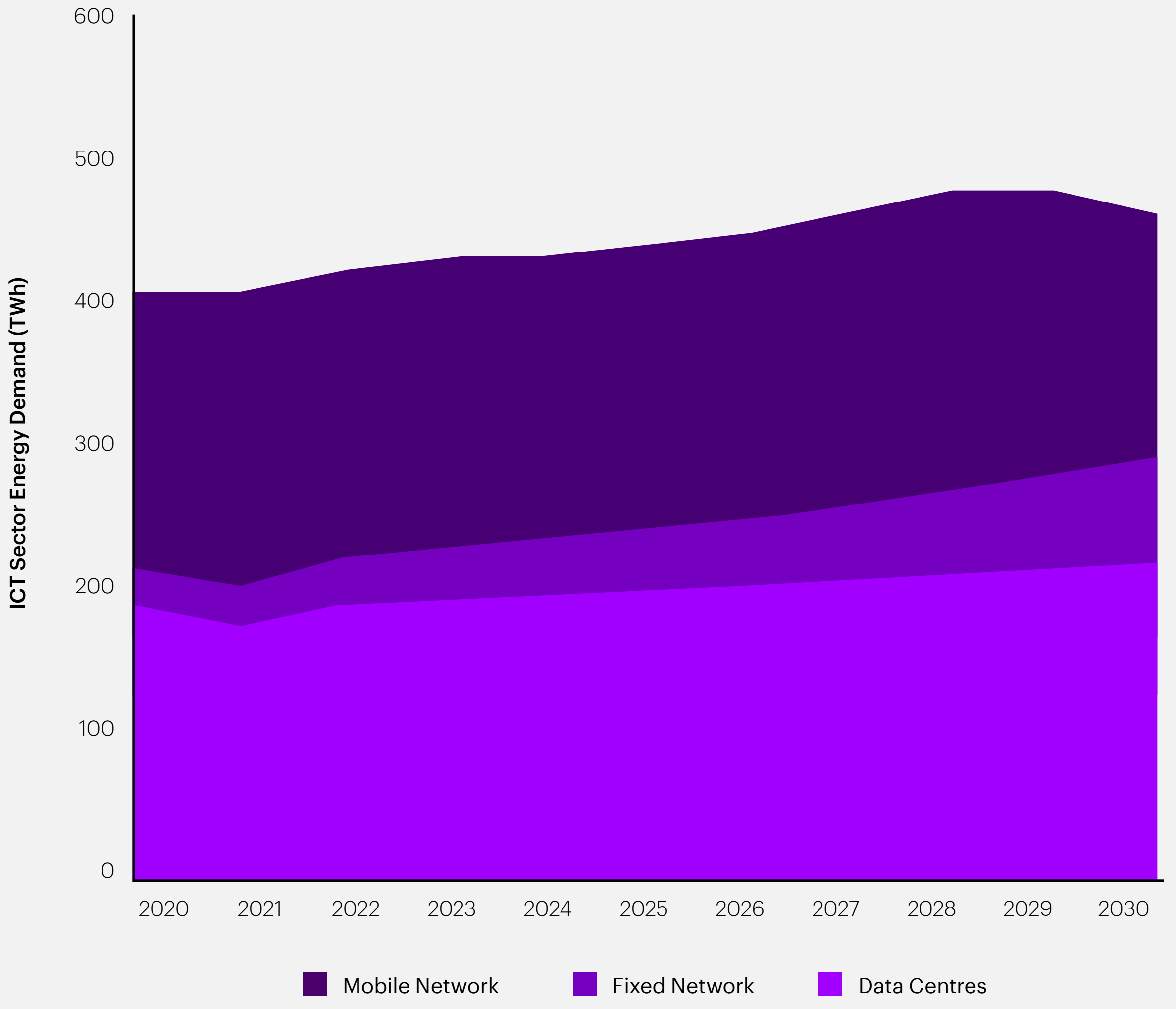
Despite the growth in data traffic, energy demand is expected to only grow at a 1.3% CAGR over the next decade (see Figure 4), due to improvements in network and data processing efficiencies. This is a significant step for the sector, as energy demand – in the form of electricity – is currently responsible for the majority of ICT operational emissions.[1]

What growth we do see in energy demand is largely driven by the fixed network and data centres, which combined are expected to make up 63% of total energy demand by 2030 (see Figure 4).

For fixed networks, the growth in energy demand stems from the dual running of multiple networks at once, creating redundancies and limiting how the network can be optimised for the anticipated growth in data. While fixed networks represent only 6% of ICT operational energy demand, dual running networks could potentially triple their energy demand over the decade.

Yet transitioning fixed access data away from Fibre to the Cabinet (FTTC) to Fibre to the Home (FTTH), along with closing less-efficient legacy technology, could lead to a potential seven-fold improvement in energy efficiency. Historically, fixed network efficiency gains double every two years.[5]

Figure 4: Forecasted ICT Operational Energy Demand.



In fact, our analysis shows that starting in 2029, retiring legacy 3G mobile networks and migrating onto 5G will decrease energy demand of mobile networks, adding to the overall decrease in energy demand of 10% between 2020 and 2030.

Data centres represent 47% of energy demand in 2020 and are expected to grow by 14% over the decade, a clear opportunity for efficiencies. Already over 90% of data flows through cloud data centres.[6] Efficiencies in power and cooling, hardware, compute utilisation and sustainable software engineering are contributing to that lower energy demand.[7] Initiatives like Equinix's Energy Efficiency Centre of Excellence has helped drive continued improvements in data centre power usage efficiency (PUE), bringing down their global benchmark below 1.45, achieving an annual incremental improvement of 8-10%.[8]

Hardware also continues to advance, with some projections estimating a 35% annual improvement in hardware energy efficiency.[9] However, the cloud still leads the charge: migrating to the cloud can improve compute carbon intensity (CO_2 emissions produced per kilowatt hour of electricity consumed) by 60-80%[10] alone.

UK Data Access Growth and Operational Energy Demand

In line with global trends, both data traffic and energy demand are predicted to grow in the UK. Between 2020 and 2030, the UK is forecasted to experience an anticipated 6-fold increase in data traffic, however energy demand is anticipated to actually decrease over the decade by 4%. This is due to strong national efforts to transition onto full fibre and 5G networking. These efforts are highlighted by the closure of the legacy PSTN (public switched telephone network) by 2025[11,12] and migration onto VoIP services (Voice over Internet Protocol), ideally delivered through a growing FTTH (Fibre to the Home) network.

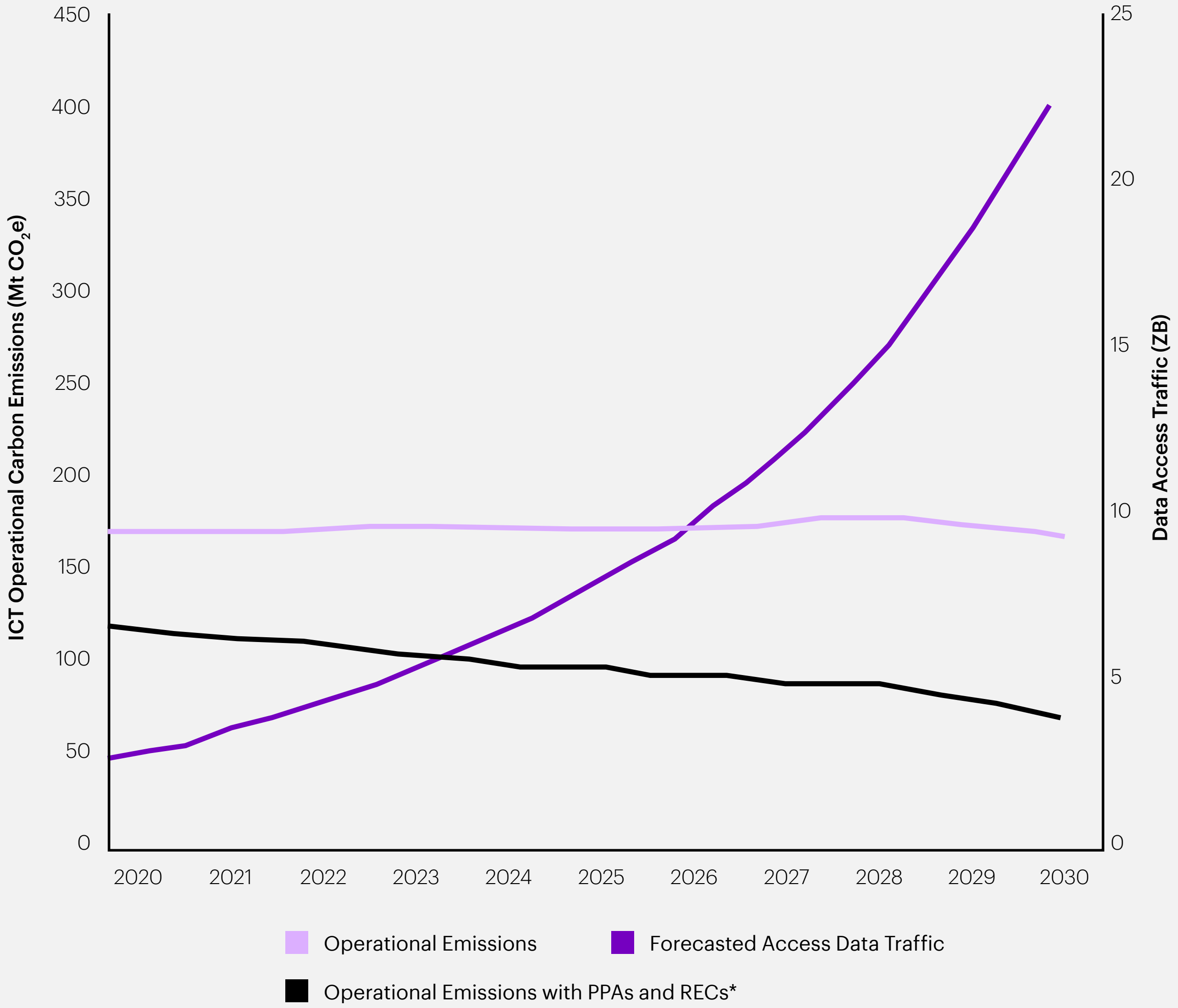
ICT Carbon Emissions

Significant commitments to renewables and science-based emissions reduction targets across the sector will contribute to decreasing carbon intensity. Targets are considered 'science-based' if they are in line with the conclusions of the latest climate science on what is necessary to meet the goals of the Paris Agreement – limiting global warming to well-below 2°C above pre-industrial levels and pursuing efforts to limit warming to 1.5°C.[13]

Over the next decade, carbon emissions from the ICT sector are forecasted to remain flat. That's because as data traffic continues to grow, energy efficiencies and the decarbonisation of the energy grid are likely to be sufficient in order to maintain 2020 ICT operational emission levels.

However, to further this analysis, and take the actions, commitments, and targets of the ICT sector into account (using a market-based approach rather than a locations-based approach – see the Methodology section for more information), we could actually see these emissions be 53 Mt CO_2e lower in 2020, and decrease by 40% over the same time period. In this way, carbon emissions do not follow the same incremental path as increasing data traffic (see Figure 5).

Figure 5: Forecasted ICT Operational Carbon Emissions and Access Data Traffic.



*Company Power Purchasing Agreements and Renewable Energy Certificates taken into account

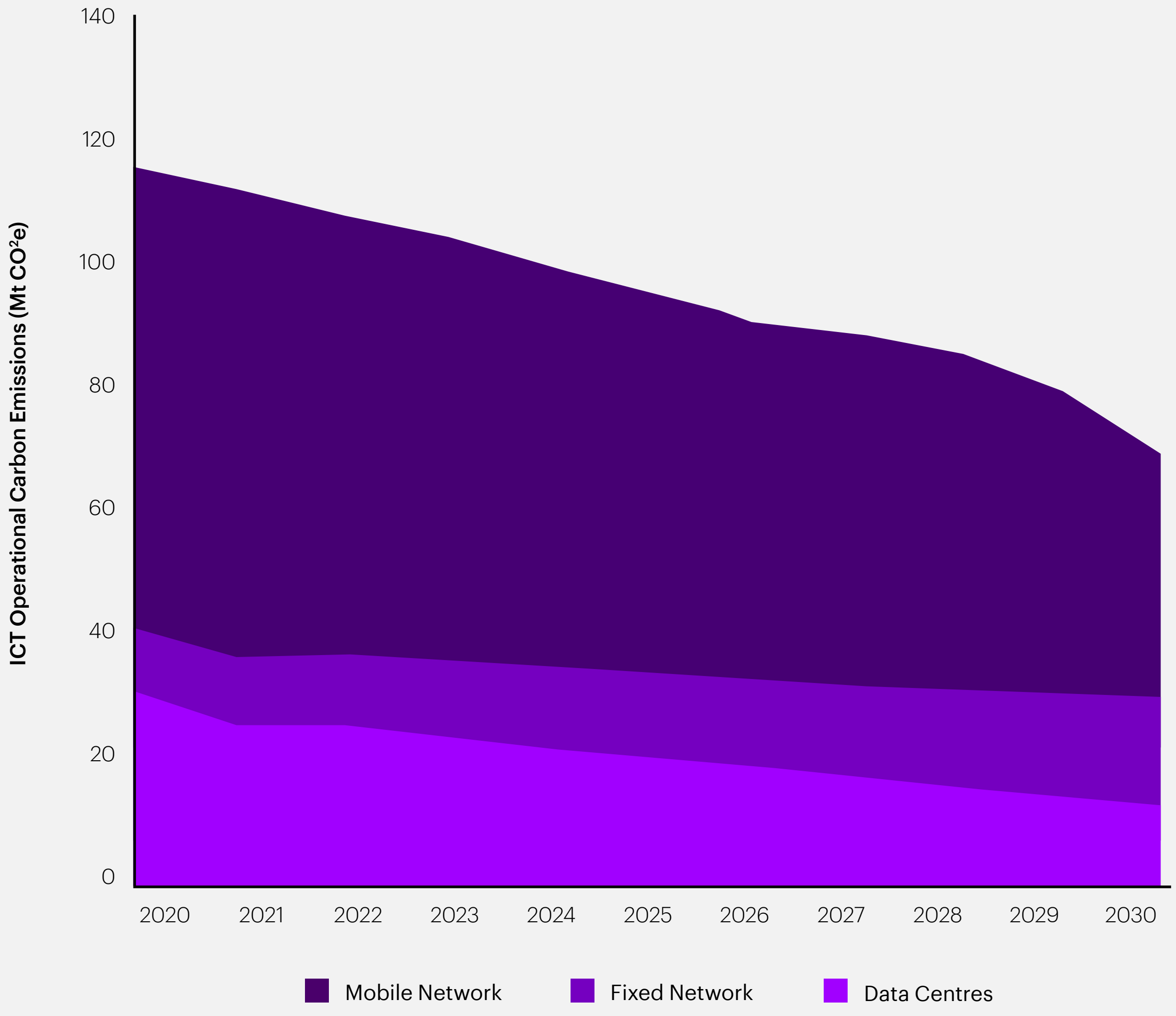
Consider that over a third of mobile operators have aligned to the United Nations "Race to Zero" campaign, and 65% of the industry has already committed to reaching their science-based emissions reductions target over the next ten years.[14]

Further, 13 of the top 15 cloud providers have publicly committed to being carbon neutral by or before 2035, and already operating 82% of cloud data centres (based on provider revenue) on renewable energy sources.[15]

These pledges have not only drastically reduced the carbon footprint of the ICT sector, but have also incentivised further progress on developing a renewable grid. Technology providers are leading the charge in global Power Purchase Agreement (PPA) volumes[16], and renewable microgrids have additionally begun to appear[17], with investments from major players such as Microsoft and Facebook.[18] This shows a potential step away from traditional energy suppliers, along with detailed investigations to meet hourly renewable energy demand.[19]

Breaking down ICT emissions by our three technology groupings (see Figure 6) we begin to see further trends come to light:

Figure 6: Forecasted ICT Operational Carbon Emissions by Technology.



- **Mobile Networks:** 64% of emissions will be generated from mobile networks, decreasing over the decade to 56%, largely due to transitioning from a lower-efficiency legacy network to an increasingly energy-efficient 5G network. Fully retiring legacy 3G networks will be critical to reaching our carbon emission targets where energy is not sourced renewably.

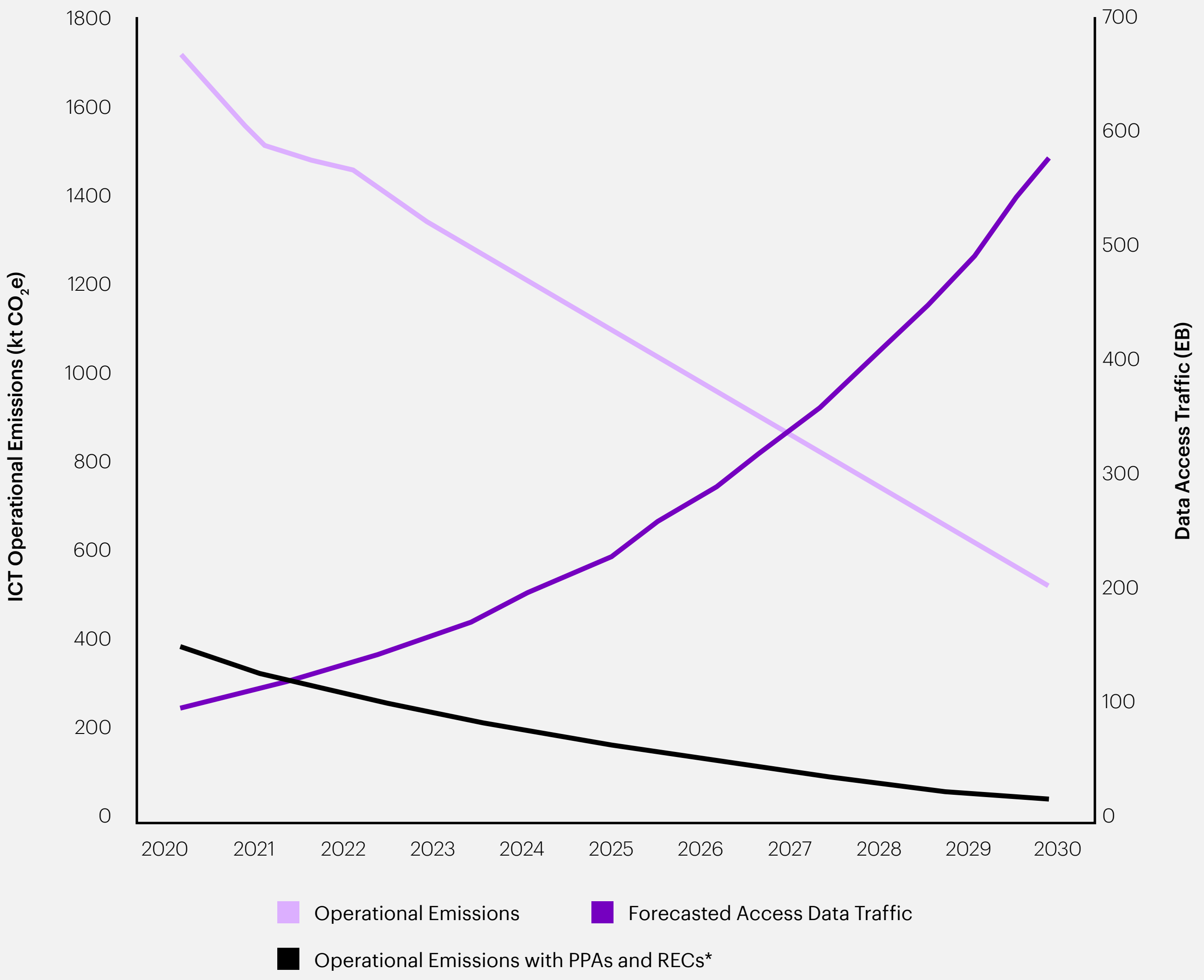
- **Fixed Networks:** Only 9% of emissions will be through fixed networks, increasing to 25% over the next decade, largely due to the limited global rollout of fibre, limiting the adoption of the technology, in addition to conservative efficiency improvements across the decade.

- **Data Centres:** 27% of emissions will be generated by data centres, decreasing to 20% in 2030 due to the significant efforts from the sector to reach 100% renewable electricity for their cloud platforms and drive continued efficiencies in their data centres. Notably, leaders in the space including Amazon[20], Google[21], Microsoft[22], and Salesforce[23] already run their cloud data centres on 100% renewable electricity, setting a market standard which others are quickly adopting[24,25].

UK ICT companies are leading global trends in PPAs and RECs

Similar to the global landscape, UK ICT operational carbon emissions are forecasted to decrease by 68% over the next decade due to both improvements and efforts in reducing energy consumption, as well as a forecasted 67% improvement in the carbon intensity of the UK's energy grid (see Figure 7). UK ICT operational emissions however will decline even further with renewable investments being made by UK ICT companies. Compared to the global average, a higher proportion of UK ICT companies are committed to renewable PPAs and Renewable Energy Certificates (RECs) over the decade. For example, BT as a leader in the space, already source 100% of their electricity through renewables and have been investing in renewables since 2002.[26] While many global players are taking measurable steps in the right direction[27], more ambitious and wide-spread commitments around the globe are needed to avert the climate crisis.

Figure 7: UK ICT Operational Emissions and Data Access Traffic Growth.



*Company Power Purchasing Agreements and Renewable Energy Certificates taken into account

Future Scenarios

Although the ICT sector was recently declared a "breakthrough"[28] industry by the GSM Association (GSMA) following the strong investment in renewables and due to their ambitious net zero targets, more can still be done to further reduce the sector's operational footprint.

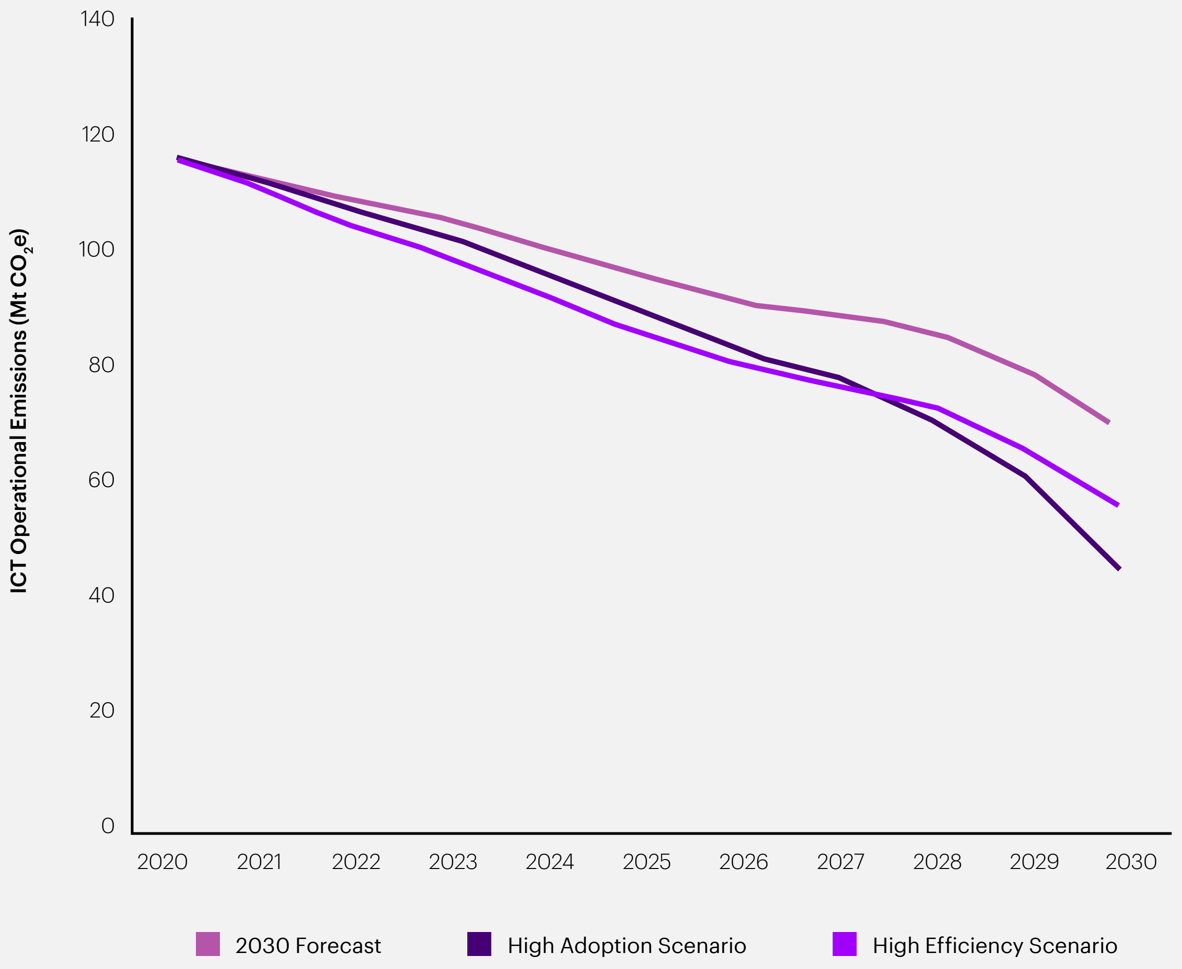
Overall, there is further opportunity to drive an additional 50% in carbon savings through improved efficiencies and greater adoption of the three technologies over the next 10 years. This equates to approximately 35 Mt in CO_2e savings from the sector, or the equivalent of taking over 13 thousand cars off the road.

Greater adoption of these technologies alone may lead to a reduction of 24 Mt CO_2e (34%) from forecasted emissions, in large part driven by the sensitivities in the mobile network to new, more efficient technologies – in particular the adoption of more efficient 5G. Greater adoption could be driven by increased efforts from the public or private sector to roll out at scale use cases to encourage 5G adoption, or from an improved articulation of the value of these new technologies for users. This reduction over the ten-year period can be seen in Figure 8 "High Adoption Scenario" trend line.

On the other hand, greater efficiencies in ICT technology could also further reduce emissions by up to 13 Mt CO_2e (or 19%), enabled predominantly by data centres' sensitivity to expected annual efficiency improvements – an outcome of an already mature migration to cloud. This is also seen in Figure 8 "High Efficiency Scenario" trend line.

We explore the nuances of each technology further in the Appendix, though it is important to note that there is no silver bullet to reducing emissions. These stretch targets represent the possible room to improve beyond current expectations to further minimise ICT's impact on our environment.

Figure 8: Forecasted ICT Operational Emissions Scenarios.



Section 2

Harnessing ICT to help other sectors reduce their carbon footprint

There is significant potential for the ICT sector to help other sectors on their path to reducing their carbon emissions, particularly in the highest emitting sectors globally – energy, manufacturing, agriculture and transport and buildings.

In total, by 2030, we estimate ICT can help enable an additional 8.5 Gt CO_2e in carbon savings, through resource and material savings, increased energy efficiencies, and improvements in renewable energy adoption. These savings represent a reduction in global carbon emissions by 17% (based on 2030 forecasts), a significant potential for the sector.

Additionally, there are significant further positive re-bound effects of these ICT use cases (meaning that human behavior considerations are taken into effect). This includes fuel savings, increased time savings and greater social outcomes through improved access to healthcare and other social services. In short, the benefits of ICT are much greater than carbon savings alone.

In the UK alone, there is the potential to abate up to 61 Mt CO_2e by 2030

Within the UK, there is also significant potential for ICT to lead to substantial carbon abatement across these four sectors. While each of the four sectors represents a proportionally different opportunity size based on the UK landscape, by 2030 ICT could help these sectors reduce carbon emissions up to 61 Mt CO_2e, demonstrating the sizeable opportunity at hand.

Electricity and Heat

ICT can help reduce emissions from the energy sector by up to 9% by 2030, driven by improvements in grid efficiencies

Understanding the Challenge

In 2020, the electricity and heat sector represented between 25-31% of global GHG emissions.[29] With nearly 770 million people globally who lack access to electricity, the sector needs to simultaneously meet rising demand and cut its emissions.[30] With vastly inefficient transmission and distribution, estimates suggest about 70% of electricity is wasted before it reaches the end-user.[31] On-grid electricity losses are often coupled with inefficient, time-consuming and costly manual inspections and delays.

ICT Opportunity & Abatement Potential

How can ICT help the electricity and heat sector deal with these challenges? The primary opportunity is in two areas: 1) improved grid optimisation and 2) improved demand management efficiencies. Solutions such as smart grids, smart appliances, energy storage, predictive analytics, sensors and demand response technologies all contribute to improvements in these areas.[32]

Focusing on these two areas, ICT can help reduce emissions in the heat and electricity sector by up to 9% by 2030, or 1.1 Gt CO_2e.

Let's look first at grid optimisation, in which energy supply is better balanced with existing demand to prevent any losses on the grid. In one solution, 5G-enabled real-time monitoring, coupled with the use of sensors and drones, can help reduce emissions and predict faults before they happen. Consider French distribution network operator Enedis, which previously used helicopter aerial photographs to monitor its 100,000 km of overhead lines.[33] After installing improved sensing and actuation technologies across their network, the company saved approximately 19 tCO_2e annually in reduced fuel consumption and improved the visibility and predictive fault detection across their grid.

Within demand management, use cases can change the role of electricity and heat consumers, moving them from passive to active participants in the energy value chain. By using sensors, smart meters and mobile applications to track electricity and heat use, industrial, commercial and residential consumers can reduce energy demand by up to 20%.[34]

1.1 Gt CO_2e

Up to 9% of global electricity and heat emissions saved

Agriculture

ICT can help reduce global carbon emissions from the agriculture sector by 13% by 2030, driven by reduced energy and fertilizer use

Understanding the Challenge

The agriculture sector is one of the highest emitting sectors globally, responsible for 11 - 24% of global GHG emissions.[35] In addition to carbon emissions, the sector also produces several other GHGs, due to the sector's use of fertilizers and enteric fermentation, including nitrous oxide (N_2O) and methane (CH_4), which has a 25 times higher global warming potential for a 100-year timescale than CO_2.[36] Additionally, the sector is also vastly inefficient across its value chain, as up to 50% of water used for irrigation is wasted and up to 25% of global food production lost.[37]

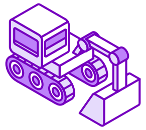
Given these challenges, and our dependence on the sector, it is clear we must ensure the sustainable growth of the agricultural sector, helping us grow more food whilst decreasing the emissions for the sector overall.

ICT Opportunity & Abatement Potential

Within the sector, ICT has the potential to reduce sector emissions by 1.5 Gt CO_2e, or 13% globally, by 2030. For example, ICT can be used to help farmers reduce their fertilizer use through improved soil knowledge and understanding. And by better monitoring food quantity and quality for livestock, it can reduce emissions from enteric fermentation.

The use of sensors, alongside real-time monitoring solutions enabled by 5G connectivity and automation, are crucial ICT solutions for limiting agriculture's impact on the environment. Soil sensors can help reduce the level of fertilizers and manure used, by helping farmers better understand the condition of their soils and crops, and improve growing conditions accordingly. Sensors can also help reduce emissions from rice cultivation, as farmers can control the concentration of methanotrophs (microorganisms that are able to metabolize methane as their only source of carbon and energy) in the waterbed needed for rice cultivation. Finally, real-time monitoring of livestock can also decrease enteric fermentation, helping provide animals with the precise amount of nutrition they need, reducing waste and improving overall efficiencies.

Today, these technologies are already being used within some innovative partnerships across the sector. For example, within the frozen food industry, ICT is being used to reduce carbon emissions through improved monitoring and data collection, more efficient energy and cooling usage and decreasing peak energy demand. Lineage, a food cold chain company partnered with AT&T and Ndustrial.io to decrease its carbon footprint using ICT-based solutions. Lineage monitors its energy use and collects energy demand data to automate processes to supercool produce when energy demand and prices are low. It also uses a customised dashboard for its blast freezing process, reducing freezing time from 100 to 40 hours with energy savings up to 50%.[38]



1.5 Gt CO_2e

Up to 13% of global agriculture emissions could be saved

Manufacturing

ICT can help reduce carbon emissions from the sector by 13% by 2030, driven by process optimisation and innovation

Understanding the Challenge

In 2020, the manufacturing sector was responsible for between 8.8 – 13.5 Gt CO_2e or between 18 – 28% of global GHG emissions.[39]

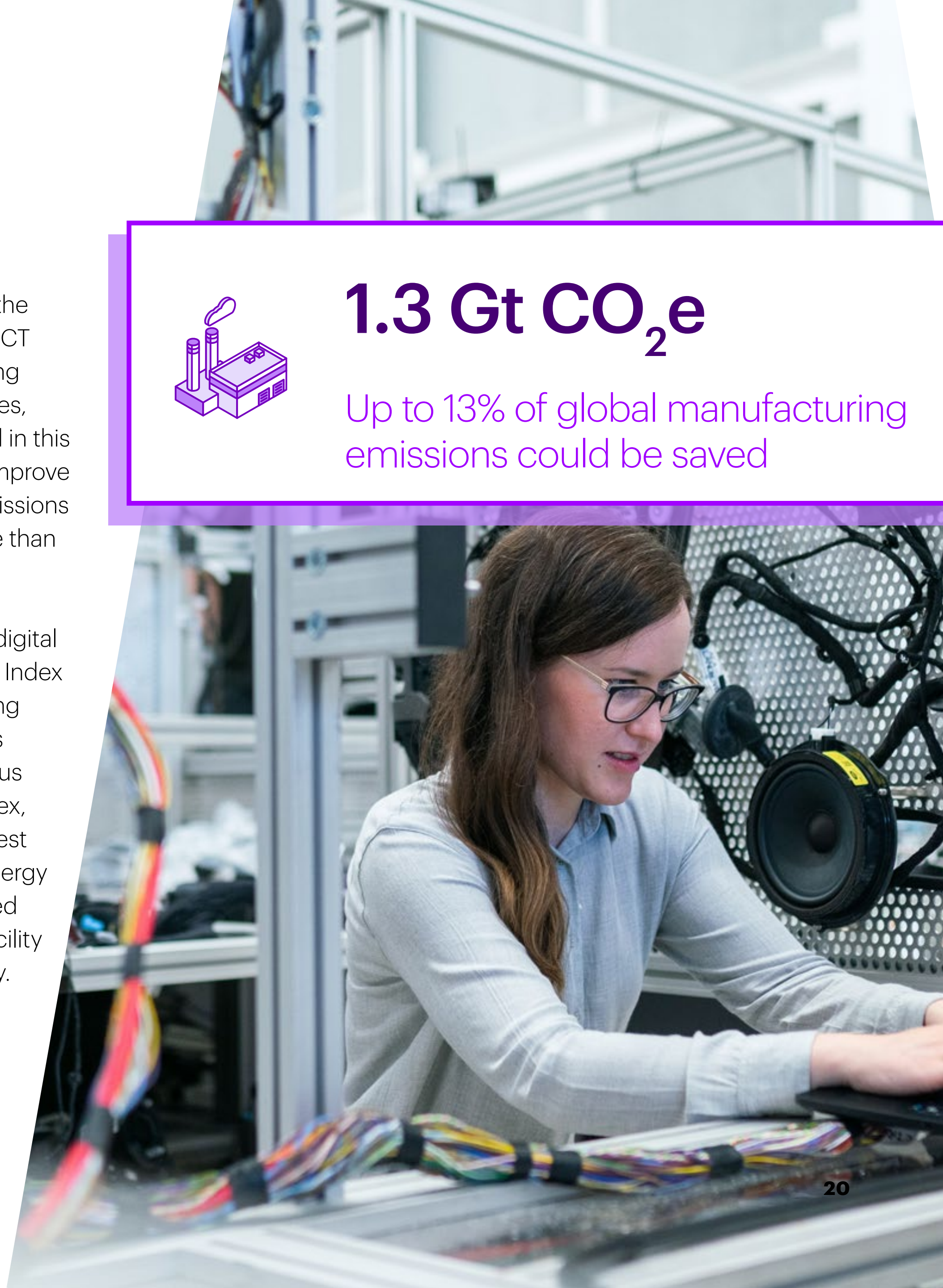
This sector was one of the early adopters of some digital technologies, however, it is still well positioned to drive even greater energy savings through automation, machine learning and digital twins enabled by 5G, fibre and the cloud. These solutions can be applied across manufacturing sites, supply chains and in R&D testing.

ICT Opportunity & Abatement Potential

By 2030, ICT could enable up to 1.3 Gt CO_2e emissions reductions in the sector, representing 13% of current global emissions from manufacturing.

ICT-based solutions can help drive energy efficiencies, ensure faster and less resource-intensive product development, and decrease the time to market for a new product. In particular, ICT can help improve process automation, improving the automation of heating and cooling processes, reducing up to 50% of the emissions generated in this stage of the value chain. Additionally, ICT can improve engine optimisation, reducing up to 40% of emissions as monitoring systems become less IT intensive than regular processes.[40]

BT's Energy Efficiency Index exemplifies these digital manufacturing solutions. The Energy Efficiency Index enables ICT-based models for the manufacturing sector, yielding quick and significant reductions in power usage. Data on the power use of various equipment is put into the Energy Efficiency Index, so that operations can be adjusted for the highest level of productivity with the lowest possible energy use. Using BT's model, a steel mill operator saved 41,600 tCO_2e annually and a gas production facility reduced its emissions by 41,000 tCO_2e annually.



1.3 Gt CO_2e

Up to 13% of global manufacturing emissions could be saved

Smart Living: Buildings & Transport

ICT can help reduce carbon emissions from transportation by 61% by 2030, and from buildings by 18% by 2030, totalling 4.6 Gt CO_2e in abatement potential

Understanding the Challenge

In 2020, the world's buildings and transportation needs were responsible for 9.5 – 12.9 Gt CO_2e, or between 20 – 27% of global GHG emissions. It is a sector slated for substantial growth. By 2030, there will be about 2 billion vehicles on the road, an increase of 0.6 billion in only 10 years,[41] creating the need for an additional 15 billion km of paved roads.[42] At the same time, urbanisation is projected to increase by about 13% between now and 2050, when 68% of the global population will be living in cities[43], creating increased need for buildings and wider city infrastructure.

ICT Opportunity & Abatement Potential

Buildings: ICT-connected residential and commercial buildings have lower energy demand due to improved energy management, automatic fault detection diagnosis and building supervision and control. Through these use cases, by 2030, ICT could reduce GHG emissions from the building sector by up to 506 Mt CO_2e.

Efficiency as a Service (EaaS) solutions are a promising example of ICT-based services for reducing emissions from buildings, powered by improved sensors and real-time 5G monitoring.[44] Using these technologies, large quantities of data can be sent in real-time for analysis, which can lead to improved decision making, and overall energy reductions. EaaS can reduce electricity use, and thus emissions, by up to 20-50%.[45]

0.5 Gt CO_2e

Up to 18% of global buildings emissions could be saved

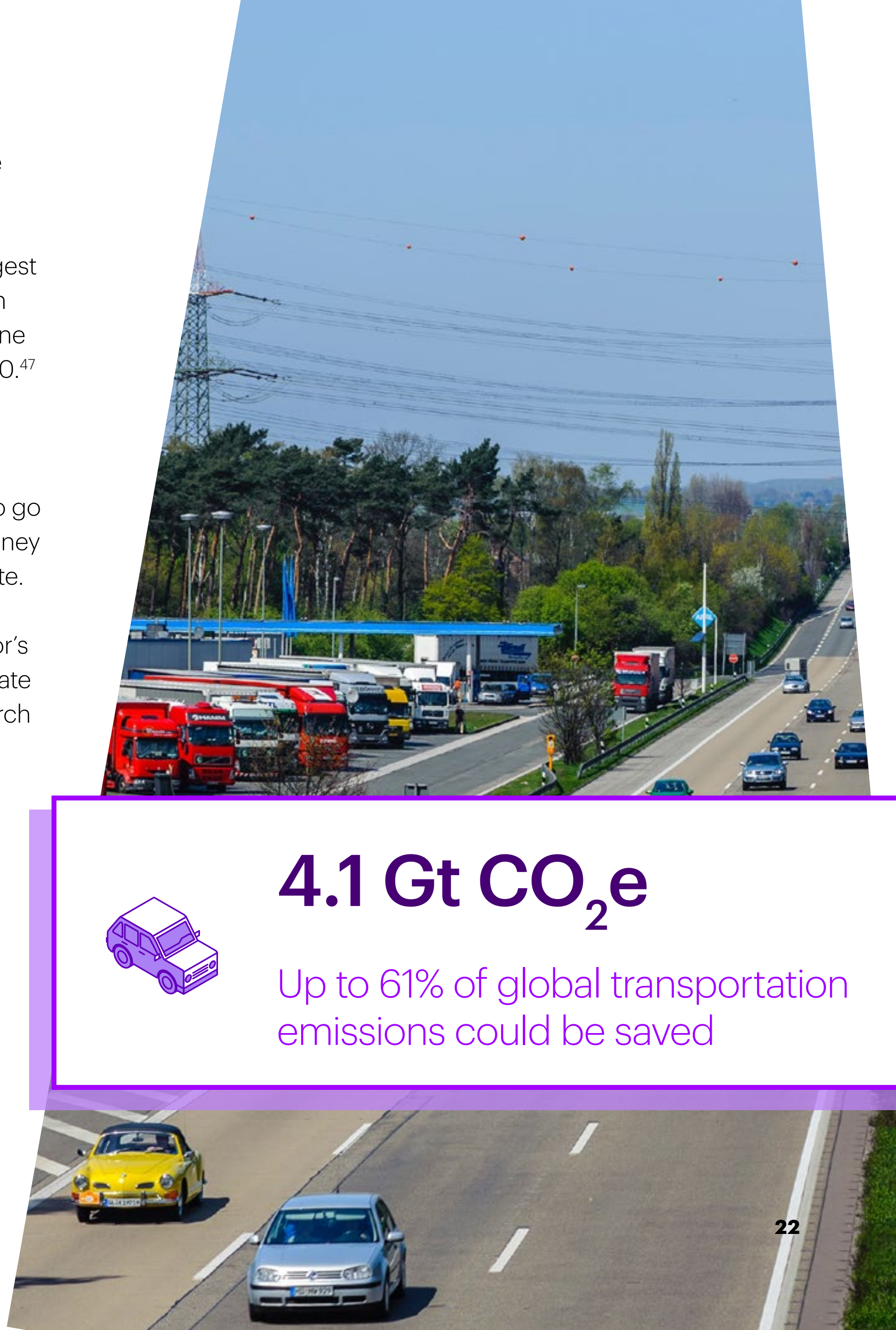
Transportation: Carbon abatement across the transportation sector includes emissions savings due to increases in e-commerce, logistics efficiencies, connected private transportation use cases and improved traffic control and optimisation solutions. Combined, these ICT use cases can abate as much as 4.1 Gt CO_2e by 2030.

Across these use cases, ICT can help reduce the kilometres we travel to purchase goods and services, enable improved route sharing and car-pooling services, and can also provide real time traffic information through low latency connectivity and data storage technologies. These services and technologies are fundamentally transforming the way we travel – whether through Uber, Amazon, or Google Maps, and have the potential to enable significant carbon abatement savings.

For example, using these advancements in technologies, online retailers and logistics companies are increasingly using route optimisation services to reduce kilometres travelled, and provide new services such as using GPS to check if a customer is at home before a parcel is delivered.

Advanced data analytics can help reduce last-mile delivery emissions by between 7 - 9% through improved local order fulfilment and delivery route optimisation.[46] Recent Accenture projections suggest that ICT-enabled efficiencies in last-mile delivery in just three cities (Chicago, London and Sydney) alone could abate 36,960 tCO_2e between 2021 and 2030.[47]

E-Banking: Related to the advancements in transportation and e-commerce, e-Banking has become a staple in our lives. We no longer need to go to our bank's branch to deposit a cheque, take money out of our accounts or review our loan's interest rate. Apart from the comfort and speed of ICT-enabled banking, these services also help reduce the sector's emissions. E-Banking alone has the potential to abate up to 3 Mt CO_2e globally by 2030, based on research in the SMARTer2030 report from the ICT industry body GeSI.[48]



4.1 Gt CO_2e

Up to 61% of global transportation emissions could be saved

Section 3

Conclusion and Recommendations

The ICT sector is making significant progress looking at how it can reduce its carbon footprint and maintain its stable energy footprint despite exponential growth in data traffic over the next ten years. At the same time, the sector is also making significant impacts in other sectors such as manufacturing, energy, agriculture and transport – helping these emissions-intensive sectors reduce their carbon emissions and find new areas for growth.

Looking forward, and to secure the efficiencies and emissions reductions we have identified throughout this report, we have developed five recommendations for the ICT sector to focus on:

1. **Meeting, or exceeding, ambitious carbon reduction targets:** By 2030, Power Purchase Agreement (PPAs) and Renewable Energy Credits (RECs) have the potential to abate over 58% (97 Mt CO_2e) of operational emissions from the ICT sector. However, this potential abatement relies on organisations such as BT, Google and other leaders in the sector reaching their stated net zero ambitions and science-based targets. The sector will need to continue to invest and innovate in this space, through new procurement mechanisms or grid technologies in order to reduce its emissions over the next decade.

2. **Investing in networks and operations to continue to improve energy efficiency:** The sector should look to identify and prioritise where and how it can drive efficiencies. A ripe opportunity is data centres, where continuous and discrete infrastructure updates can be more readily pushed out and implemented, without the nation-wide updates required with mobile and fixed networks. Hardware efficiency, compute utilisation, and sustainable software engineering can all help drive incredible efficiency gains across cloud providers. These efficiencies are a priority, helping cut energy demand despite data access growth.

3. **Retiring legacy technology where possible:** Legacy fixed and mobile networks should be retired where possible to eliminate dual-running and inefficient energy demand. Nearly 90% of energy demand across the fixed network is expected to come from non-fibre sources, despite only 55% of the data being managed by them. Clearly, there is substantial opportunity to drive greater efficiencies by retiring old copper-based networks. Similar benefits can be expected from the retirement of legacy 2G and 3G networks as well.

4. **Incentivising and enabling the adoption of new technologies:** Greater adoption of new technologies will help both encourage the retirement of legacy technologies (such as 3G and Fibre to the Cabinet (FTTC)), whilst also supporting new use cases and business models emerging through 5G and cloud computing. These newer systems are built-for-purpose with sustainability in mind.

5. **Developing and rolling-out cross-industry use cases for carbon enablement at scale:** Considering the sizeable 8.5 Gt CO_2e carbon emissions reductions that can be achieved across just four emissions-intensive sectors, there is huge opportunity to scale ICT solutions amongst other sectors. This will not only help drive greater technology adoption, but also help us meet our climate targets and stay on a 1.5°C path.

Realising these ambitions will take determination and effort, as we look to decrease our carbon emissions and impact on the planet over the next ten years. However, with clear and measurable commitments, investment in our future, and purpose-built technologies, we have a clear path ahead that shows our digital world can thrive in a carbon-constrained future—if we take the necessary steps now.

Appendix Deep Dives

Mobile Networks

Narrowing focus on mobile networks, we look at the trends across modern and legacy mobile networks which include 2G, 3G, 4G, and 5G data networks. For the purposes of simplification and to avoid confusion, we have not included the legacy voice network, which has already been retired in multiple countries.

Specifically within mobile networks, the key technological shift – from legacy tech onto 5G – is driving significant energy demand reductions and reducing carbon emissions for the sector. We have focused on this transition, as mobile data traffic is the most rapidly growing data subset of access data traffic, with 5G sitting at the centre of this growth.

There are three key actions the sector should focus on to manage and reduce the carbon footprint of mobile networks:

1. **Rapidly deploy 5G towers to enable a stand-alone 5G network that helps consumers realise the benefits of 5G.** Current non-standalone 5G networks (i.e. networks which continue to rely on legacy 4G to manage access onto the 5G network) suffer from the inevitable growing pains. While still nascent technology in its deployment, most 5G networks are unable to reach the speeds – and associated data traffic capacities – promised due to the sparsity of 5G towers. Broadly speaking, the most efficient 5G towers operate over high frequency waves which attenuate faster than their longer wavelength counterparts, which require a denser network of sites to maintain signal strength. Real-world studies of 5G sites have shown that through a more mature network, and adoption therein, operational energy efficiencies are upwards of 90% more efficient than in legacy networks.[49]

2. **Drive adoption onto 5G and look to retire redundant legacy 2G and 3G networks where possible.** 5G connectivity will enable higher volumes of data to be shared and processed, and additional optimisations in the programming of 5G networks reduce their energy demand while idle; however, a low utilisation of 5G is still expected to result in lower efficiency per GB of traffic. We will see energy efficiency across 5G networks improve as more users and organisations look to leverage 5G in their business and at home with the result of a more energy and carbon efficient mobile network.

3. **Leverage the capabilities of 5G (ultra-low latency and high-speed data) across industry to reduce industry footprints**. 5G is positioned to drastically change the way we work with its ultra-low latency and high speeds that enable new business models and use cases for how we interact with our environment. We have estimated that the potential of 5G is an indicative 5.9 Gt CO_2e abatement per year based on adoption of mobile solutions in 2030. There are countless high-impact ways to use this technology, not only to make our world greener through the likes of connected and automated farming, intelligent energy grids, and intelligent asset management,[50] but also safer through enhanced vehicle safety and automation, and drastically improved remote healthcare and even surgery.

5G embedded emissions

Expectantly, with the deployment of 5G as with any previous mobile network, there will be anticipated emissions related to both deployment of 5G antennae and the embedded emissions within the towers themselves. While the deployment will likely have minimal emissions due to the lack of any major constructive efforts, embedded emissions of 5G are estimated at 0.75 tCO_2e. Based on a lifetime of over 10 years, these emissions will sit below a +/-5% range of mobile network emissions as a whole, and thus are unlikely to considerably effect the mobile network trends shown in this report.

Fixed Networks

Between 2020 and 2030, fixed network energy demand is expected to increase by almost three-fold. This includes four technology groups: Full Fibre-to-the-home (FTTH), Cable, xDSL, and Other (treated conservatively as xDSL). While in 2020, across OECD countries, we see a roughly even distribution of the three main fixed network methods, there has been an underlying shift off of copper-based networking (cable and xDSL) towards full fibre, given the efficiencies and speed with which fibre is capable of transferring data.

To reduce the emissions from fixed networks, despite the projected growth in energy demand, and almost 6-fold increase in fixed access traffic data, the sector should focus on three areas:

1. **Deploy a full fibre network as efficiently as possible, to achieve faster and less carbon intensive connections.** The deployment and subsequent access to a full-fibre network will mitigate emissions due to an estimated 86% improvement in energy efficiency in comparison with DSL links.[51] Deployment of fibre however constrains the proportion of users that can adopt the network. Our estimates put global adoption at 45% following current deployment trends, however a 93% adoption is what would be needed to see similar energy demand for fixed networks in 2030 as with 2020. This leaves space for progress as we look to shift to a more reliable and energy efficient tech (full fibre) to reduce our long-term environmental footprint.

2. **Retire and consolidate legacy network infrastructure as quickly as possible.** An estimated 89% of the energy consumed across the fixed network is expected to stem from non-fibre sources by 2030, despite only 55% of the data being managed by them. As there are physical limitations to how efficient one can send data over these legacy copper-based network connections, it will be paramount to not only adopt FTTH, but also retire old copper-based networks. This has been the trend, however consolidation efforts and optimised retiring will be critical to minimising dual running of networks.

3. **Emphasize wired (preferably fibre) connection while efficiencies remain.** With the trend of remote working taking-off and increases in the data-intensity of our digital tasks, it is important that we continue to leverage the capacity of wired connections. The core IP network is built on efficient fibre connections and legacy systems have continued to improve[52] over the past decades, resulting in fixed networks being 23 times more energy efficient per GB of data transferred than mobile networks in 2020. This comparative efficiency will change as both fixed and mobile access networks continue to evolve, though it is important to note that from an energy and carbon intensity perspective, fixed networks are more efficient and should thus be prioritised where possible.

Fibre embedded emissions

A potential area of concern for emissions is the rollout of fibre connectivity, which is frequently captured by political headlines.[53] By our conservative estimates, the embedded and deployment emissions for FTTH are expected to reach a maximum of 8.5% of the emissions from the fixed network itself globally (equal to 1.2 Mt CO_2e), however this decreases to less than 1% of fixed network emissions by 2030 (45 kt CO_2e)[54] once the most readily available and data intensive connections have been laid.[55] It is prudent to note that this remains focused on the last mile delivery of FTTH as the core IP network is already fibre based.

Additional to this, fibre is a more robust fixed network connection, reducing the need for maintenance activity by an estimated 20% based on discussions, and with the opportunity to perform network switches digitally, removing the need for on-site technician visits to switch between network providers. These both mitigate fuel consumption and improve the efficiency of network providers, lowering the lifecycle emissions for fibre networks.

Data Centres

For this study, data centres include on-premise centres, cloud data centres (non-hyperscale) and hyperscale data centres (with access through cloud providers such as Google, Amazon, and Microsoft). The reason for these distinctions is to capture the shift in the market towards cloud computing, and more specifically, hyperscale cloud computing. This scale provides additional capacity in the data centres to seek computational efficiencies, helping to drive down emissions.[56,57,58]

Data centres sit behind the access network, doing the legwork of the internet in processing and storing data. Despite the high pressure placed on data centres to manage increasing demand, they have successfully managed to maintain stable operational emissions across the last decade and are operating more efficient than ever.[59] We expect data centre energy demand to grow by only 14% over the decade, an indicator of continued efficiency gains, as we expect cloud adoption rates to slow due to the already deep penetration of cloud data centres.

This leaves two key areas for data centres to maintain their steady emissions profile, and potentially reduce it:

1. **Migrate on-premise computing to the cloud where feasible.** Cloud has moved from "nice to have" to "must have" and has achieved a high level of maturity, already handling over 90% of data centre traffic.[60] However, legacy computing through on-premise data centres still consumed over a quarter of data centre energy demand in 2020. Migrating onto the cloud can reduce this reliance on less efficient legacy systems, while delivering a double helix effect of shareholder and stakeholder value – simultaneously reducing costs and carbon emissions if it is approached from a sustainable perspective.[61] Shifting from on-premise to infrastructure-as-a-service (cloud computing) can reduce carbon emissions by 84%[62] alone.

2. **Focus efforts on improving efficiencies across all data centres.** Hardware efficiency, compute utilisation, and sustainable software engineering, alongside the use of purpose-built facilities and peripherals (cooling) for computing have driven incredible efficiency gains across cloud providers. Google, as a leading example for cloud efficiencies, now has an average PUE (measurement of how efficiently the data centres peripherals operate) across all data centres of 1.1.[63] There is however still room to grow. Historical compute trends show a potential for the doubling of computational energy efficiency every 2.3 years, a CAGR of 35%. However, historical analysis of data centre efficiency improvements lie closer to a 21% CAGR. With hyperscalers, further improvements in network optimisations, clever cooling strategies, and data compression are magnified by economies of scale. It is through these methods that we can look to further reduce the environmental impact of data centres.

Methodology and Assumptions

All data used within the report was sourced from either publicly available data, BT's physical infrastructure, or work produced in association with Accenture. The main methodologies for each section are outlined below.

ICT Operational Emissions Analysis:

Accenture research was conducted across a variety of sources including:

- publicly available data, further referenced and cross checked by Accenture and BT subject matter advisors (SMAs);
- discussion with Accenture and BT SMAs; or
- analysis of Accenture and BT data including work products produced in association with either organisation

to provide input into the formula:

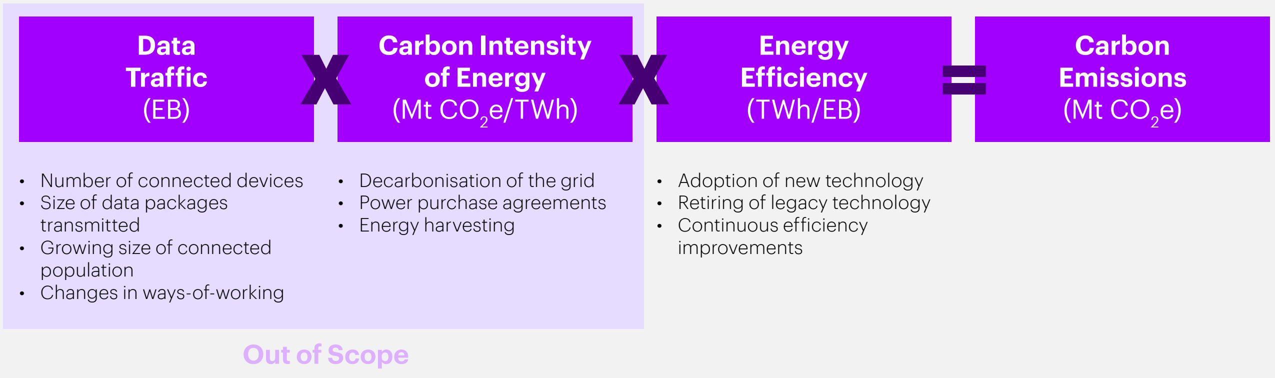
Data Traffic: Figures and trends from publicly available academic and sponsored research projecting data traffic were extended where projections had already been made or projected based on SMA reviewed assumptions.

Carbon Intensity of Energy: Accenture analysis conducted based on expected adherence of national grid decarbonisation commitments across an indicative set of 14 countries, leveraging publicly available carbon intensity of energy data from multiple sources.

Energy Efficiency: Relative and absolute energy efficiencies across technology types were based on academic and sponsored research. Where data was unavailable, historical analysis of technology energy demand and data traffic were used to calculate indicative energy efficiencies which were then projected forward based on trends exhibited from academic and sponsored research as well as Accenture and BT SMA knowledge.

Where data was unavailable, Accenture reviewed assumptions were made and validated against historical trends.

Figure 9: Accenture Analysis Methodology.



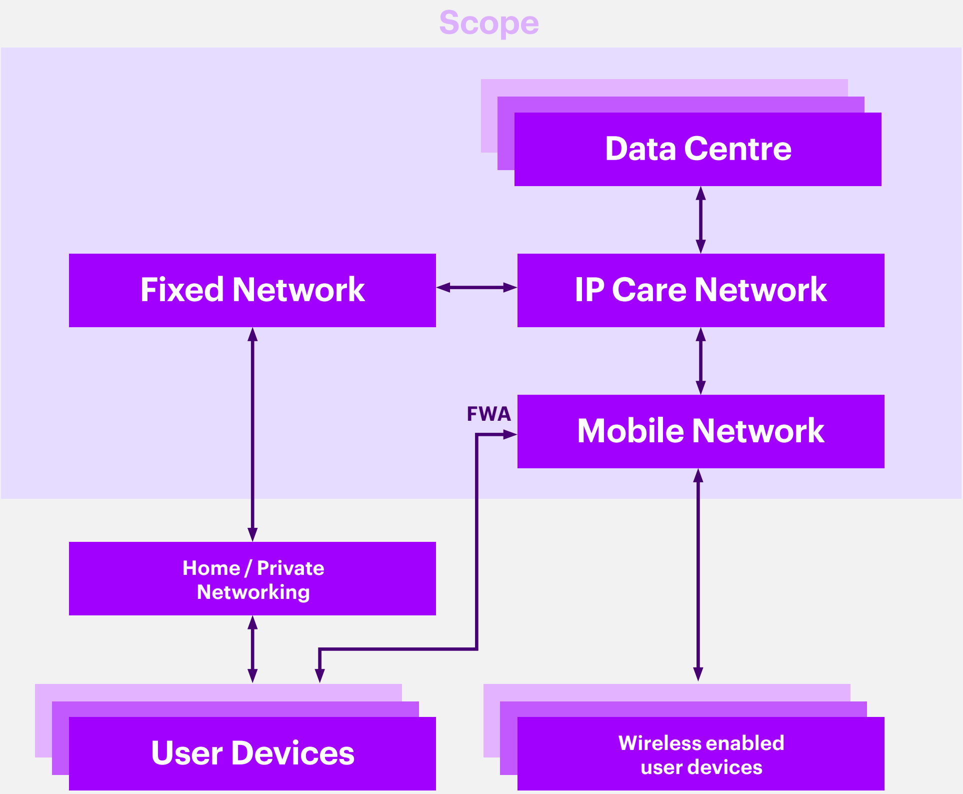
Technologies assessed include data centres, fixed networks, and mobile networks. The IP Core Network was included within the fixed network, however undersea and international fibre network was omitted to focus on data transmission at national levels.

Home / Private Networking, user devices, and wireless enabled user devices were omitted due to their energy demand and subsequent emissions being a function of both data and time use, which generates additional complexities of discerning the relationship between data volume and time use across the multiplicity of future devices now and into 2030. This remains an area for further research and analysis to better understand the impact of user devices on energy demand relative to the growth trends of data.

ICT enabled abatement

Global abatement figures were extrapolated from the SMARTer2030 report which was produced in association with Accenture and the Global eSustainability Initiative. Figures and baseline data within the SMARTer2030 report were updated according to latest publicly available information, and using three indicative countries, extrapolated. For UK specific data, this was updated within the SMARTer2030 model and used directly without further extrapolation.

Figure 10: Scope of the Analysis.



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