The role of ICT in reducing carbon emissions in the EU

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Contents

Executive summary

In 2015, countries set their intended nationally determined contributions (INDCs) to reduce carbon emissions, and help contribute to the global target to limit global warming.

These targets were set in the run up to the Conference of Parties (COP) summit held in Paris. During COP, the Paris Agreement was developed, and once ratified[1], this agreement will commit countries to limit average global temperature rise to "well below 2°C... and pursue efforts to limit the temperature increase to 1.5 °C "[2]. However, the collective national targets are predicted to allow a global average temperature increase of 2.7°C, well above the targets set in Paris. In 2015, the global temperature rise passed 1°C[3], making collective action all the more critical. Government and business leaders will need to take advantage of every method and tool at their disposal to not only meet, but exceed current targets to decrease carbon emissions, while delivering economic growth and prosperity.

Information and Communications Technology (ICT) has the potential to play a significant role in driving carbon reductions, while generating substantial economic and socio-economic benefits. This report builds on the SMARTer2030[4] report which examined the global potential for carbon reductions and economic growth through ICT. This report looks at the potential carbon reductions and associated business opportunity for the European Union (EU), and highlights the following key findings:

- ICT has the potential to reduce EU carbon emissions by over 1.5 Gt CO2e in 2030, 2.7 times larger than the carbon emissions of the entire UK in 2012[5]. This saving is equivalent to almost 19 times the size of the expected footprint of the EU's ICT sector in 2030, or 37% of the EU's total emissions in 2012[6]
- ICT can generate economic and socio-economic value for the ICT sector and other stakeholders:
  - Energy efficiency: 53% of the ICT-enabled carbon reductions are as a direct result of improving energy efficiency, equivalent to a 0.8 Gt CO_2e reduction across the EU
  - Revenue generation and cost savings: €1.3 trillion in additional economic benefits, comprising €678 billion in new revenues and €643 billion in cost savings, attributable to both the ICT sector as well as other stakeholders
  - Socio-economic benefits: e-health could generate over €14 billion in space savings enabled by fewer in-person consultations and over 233 million litres in fuel savings through reduced travel[7]
  - New business models: ICT is enabling new business models and helping the transition from linear to circular value chains, by cutting and eliminating waste and identifying new value streams

1 Ratification will happen once 55 countries sign the agreement. The signing period opened in New York on April 21, 2016
2 Adoption of the Paris Agreement, UNFCCC, 2015. Available online here: https://unfccc.int/resource/docs/2015/cop21/eng/l09.pdf
3 http://www.metoffice.gov.uk/news/release/archive/2015/one-degree
4 http://smarter2030.gesi.org
5 CAIT Climate Data Explorer. 2015. Washington, DC: WRI. Available online at: http://cait.wri.org
6 The EU's total emissions in 2012 were 4.12 Gt CO_2e, including land use and forestry. 2012 figures are the most recent figures available that account for the whole of the EU.
7 Fuel savings are generated from several use cases, and use the average car (diesel & petrol) consumption in L per 100 km in 2030 for OECD countries

	(a)	(b)	(c)	(d)
Report	**Total emissions projected in 2030** (CO_2e)	**Emissions from the ICT sector projected in 2030** (CO_2e)	**Estimated potential ICT-enabled abatement in 2030** (CO_2e)	**Potential ICT-enabled abatement in 2030 as a multiple of footprint** (c÷b)
SMARTer2030	-	1.25 Gt	12.1 Gt (including renewables)	9.7 (including renewables)
			10.3 Gt (excluding renewables)	8.2 (excluding renewables)
BT's EU report	4.11 Gt	0.08 Gt	1.2 Gt (excluding renewables)	14.8 (excluding renewables)
			1.5 Gt (including renewables)	18.6 (including renewables)
BT's UK report	495 Mt	9.75 Mt	121.7 Mt (excluding Smart Energy)	12.5 (excluding Smart Energy)
			176.0 Mt (including Smart Energy)	18.1 (including Smart Energy)

Table 1: Headline findings across three studies. The figures in this table may not add correctly due to rounding up.

- Countries are at different stages of readiness: of the top five carbon emitting EU countries, the UK and Germany are currently best placed to capture these savings due to their strong existing digital capabilities, markets and enabling environment, while Italy lags behind as a result of weaker historical adoption of digital technologies and fewer digital businesses and skills per capita[8].

The analysis conducted for this study followed the same methodology used in BT's similar report, 'The Role of ICT in Reducing Carbon Emissions in the UK', published in December 2015, and the Global e-Sustainability Initiative's (GeSI) earlier report, 'SMARTer2030', with some minor variations based on geography, availability and strength of data, and current strength and clarity of future policy. The headline findings from each report are summarised together in Table 1 above.

Unlike BT's UK report, this report on the EU does not seek to disaggregate the potential carbon benefits from policies that are already in place – rather, it considers the total potential of ICT, across 12 applications. Further supporting information can be found in the Methodology section of this report.

There are several recommendations for policy makers to move the ICT agenda forward and realise these significant benefits in the EU. Policy makers should make clear their intent to support the Paris Agreement through its policies and associated actions. Specifically, they should:

- Develop a robust EU-wide policy framework to drive key elements of success. This framework should focus on:
  - Driving change in those sectors that offer the greatest potential gains with integration of ICT-enabled carbon solutions, e.g. the buildings, manufacturing, and energy sectors offer nearly 74% of the ICT-enabled carbon savings analysed in this report
  - Encouraging long-term investment from both the public and private sector in clean technologies and infrastructure

8 More information can be found in Accenture's Digital Density report online here: https://www.accenture.com/t20150727T213014__w__/us-en/_acnmedia/Accenture/Conversion-Assets/DotCom/Documents/Global/PDF/Dualpub_9/Accenture-Digital-Density-Index-Guiding-Digital-Transformation.pdf#zoom=50

- Encouraging improved technological innovation to drive greater energy efficiency targets and performance
- Encouraging high levels of innovation in business models, job markets, and the wider economy. This level of innovation can help encourage the development of new business models which support the circular economy and
- Targeting the agreed 40% reduction by 2030, whilst including clauses and areas of flexibility to allow for increases in interim or 2030 targets

- Develop a comprehensive yet flexible 'de-carbonisation' roadmap to deliver the EU's carbon reduction and energy efficiency targets, including actions to be taken and a timeline, ultimately designed to work towards carbon neutrality by 2050
- Communicate the framework and roadmap to country-level leadership and targeted industry sectors, and to the population more broadly
- Look for synergistic opportunities to leverage ICT for carbon, economic and socio-economic benefits, e.g. cross-border interconnectors to support distributed renewable energy generation.

National governments should work closely with EU leaders and policy makers, as well as their local constituents, to look to achieve the potential offered by ICT. National governments can use the findings from this report, and other similar pieces of work, to determine which sectors should be the main focus for carbon reduction plans, and ICT-specific interventions to enable significant carbon reductions and economic benefits.

Introduction

There is increasing recognition that climate change is a growing risk not only to the global economy, but also to food security, to public health, to our homes – to our very way of life.

It is an issue that must be addressed with a coordinated and ambitious plan. The United Nations Framework Convention on Climate Change (UNFCCC) has the objective to 'stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system'[9], and has highlighted the importance of limiting the global average temperature rise to below 2°C above pre-industrial levels.

Global action on climate change

In 2015, the UNFCCC's Conference of Parties[10] (COP) came together for their 21st annual meeting at COP21 in Paris. The 'Paris Agreement' marks the first ever global, legally binding agreement for countries to limit their greenhouse gas (GHG) emissions and will frame international climate discussions beyond 2020. The Agreement includes measures to:

- "Hold the increase in the global average temperature to well below 2°C above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5 °C[11]"

  These figures are in line with the Intergovernmental Panel on Climate Change goal to limit global warming to no more than 2°C to avoid serious climatic consequences and events[12]
- Peak GHG emissions as soon as possible, in an effort to work towards a carbon neutrality from 2050 onwards[13]
- Increase the ability of countries to adapt and mitigate against the risks of climate change and to foster climate resilience[14]
- Make finance more readily available to less developed countries to help achieve lower GHG emissions and climate-resilient development. $100 billion a year in climate financing for developing countries by 2020 will be made available, with a commitment to future financing[15].

This milestone in the global fight against climate change means that countries will need to develop clear and ambitious reduction plans to ensure these targets are met. To do so, countries will need to explore every available initiative and technology to establish a strategy for reduction.

9 First steps to a safer future: Introducing the United Nations Framework Convention on Climate Change, United Nations Framework Convention on Climate Change, 2015. Available online here: http://unfccc.int/essential_background/convention/items/6036.php

10 Parties refers to individual countries or groups of countries agreeing to an agreement as one bloc (e.g. the EU, Small-Island Developing States, etc.).

11 Adoption of the Paris Agreement, United Nations Framework Convention on Climate Change, 2015. Available online here: https://unfccc.int/resource/docs/2015/cop21/eng/l09.pdf

12 Why 2°C?, United Nations Conference on Climate Change, 2015. Available online here: http://www.cop21.gouv.fr/en/why-2c/

13 More details about the agreement, United Nations Conference on Climate Change, 2015. Available online here: http://www.cop21.gouv.fr/en/more-details-about-the-agreement/

14 Adoption of the Paris Agreement, United Nations Framework Convention on Climate Change, 2015. Available online here: https://unfccc.int/resource/docs/2015/cop21/eng/l09.pdf

15 One hundred billion dollars, United Nations Conference on Climate Change, 2015. Available online here: http://www.cop21.gouv.fr/en/one-hundred-billion-dollars/

Country commitments

As part of the Paris Agreement, 187 countries (including the EU, representing its 28 member states[16]), committed their Intended Nationally Determined Contributions (INDCs). These submissions account for 95% of global emissions and 98% of the global population[17], demonstrating the sizeable participation and involvement in COP21. Each INDC outlines individual country-level commitments to reduce GHG emissions by 2025-2030. The submitted INDCs are evidence of strong international ambition which demonstrate global action towards meeting the 2°C target and a selection of INDCs have been highlighted in Figure 1 below.

These INDCs will act as a baseline for future carbon mitigation strategies. This means that these action plans provide a firm foundation to achieve the Agreement's targets[18], which countries can exceed but not fail to meet. Countries will then submit updated climate plans – nationally determined contributions (NDCs) – every five years, with the aim to steadily increase their ambition in the long-term to 2050[19].

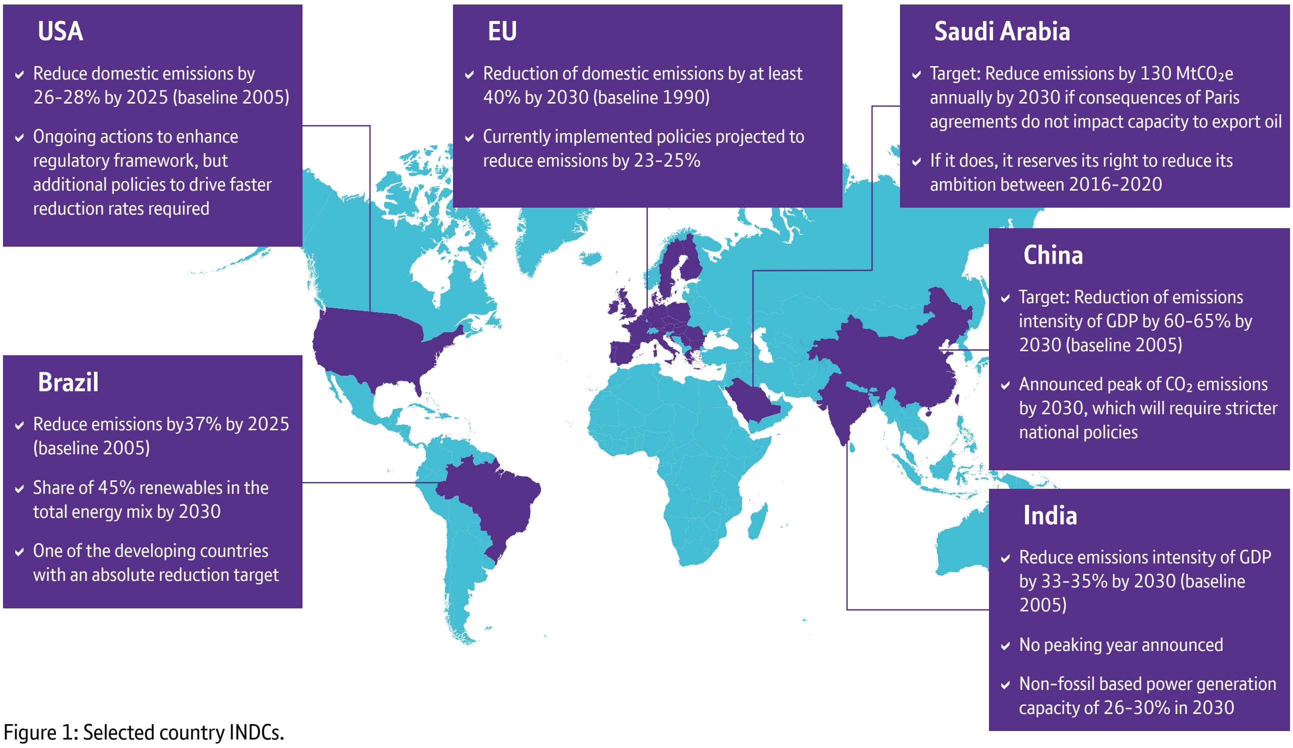

Figure 1: Selected country INDCs.

16 EU28 member states include: Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Germany, Estonia, Ireland, Greece, Spain, France, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Malta, Netherlands, Austria, Poland, Portugal, Romania, Slovenia, Slovakia, Finland, Sweden, United Kingdom (for the purposes of the EU's INDC)

17 http://climateactiontracker.org/indcs.html

18 Historic Paris Agreement on Climate Change, UN Climate Change Newsroom, 2015. Available online here: http://newsroom.unfccc.int/unfccc-newsroom/finale-cop21/

19 Historic Paris Agreement on Climate Change, UN Climate Change Newsroom, 2015. Available online here: http://newsroom.unfccc.int/unfccc-newsroom/finale-cop21/

The need for a broader response

If achieved, the collective INDCs will only limit global average temperature rise to between 2.7°C and 3°C [20] – well above the target and ambitions stated within the Paris Agreement. This gap between the global targets and predicted progress highlights that the collective impact of current contributions will not be enough to meet the global targets.

To help shrink the gap between the stated INDCs and work towards the 1.5°C ambition, global leaders and businesses should continue to show the leadership demonstrated during the Paris Agreement and move the discussion forward. This leadership will be critical if countries are to exceed their current INDCs in order to achieve the stated target and all available initiatives and technologies should be explored.

To date, emissions reduction efforts have tended to focus on infrastructure adjustments, such as higher use of renewable energy, energy efficiency incentives or the elimination of carbon intensive activities or processes. **However, it is clear that policies and actions must move beyond 'traditional' emission reduction measures and integrate new uses of technology and other innovations.** Governments and policy makers should increasingly explore these new technologies and innovations to help address this gap.

The role of technology

Technology can play an increasingly significant role in helping reduce global carbon emissions. Large scale engineering technologies, such as carbon capture and storage, can help drive a decrease in global carbon emissions by removing GHGs from the atmosphere in large power generators, whereas increased renewable generation can help decrease grid intensity.

In addition to these larger scale technologies, ICT has a considerable role to play in driving carbon reductions at scale. ICT can help enable further carbon reductions through improved efficiencies, lower use of resources and behaviour changes. ICT has the power to drive carbon reductions in both a vertical sense – with specific applications in specific industries, and also horizontally – enabling improved decision making, increased access to real-time information and improved automation cross-industry. These benefits are increasingly available as ICT becomes more prevalent, cheaper and faster and its benefits to drive greater inclusivity, decrease costs and create new services and revenues provide a great opportunity to move towards a low carbon economy.

There is a growing basis of evidence which highlights the potential of ICT as an enabler of global carbon reductions. SMARTer2030, a report published by GeSI, in partnership with Accenture Strategy, found that ICT has the potential to enable a 20% reduction in global carbon emissions by 2030, holding emissions at 2015 levels. This reduction in emissions would effectively decouple economic growth from emissions growth.

Building on SMARTer2030, this report looks at the specific potential of ICT in the EU, analysing 12 applications of ICT covering eight economic sectors – mobility & logistics, manufacturing, food, buildings, energy, work & business, health and learning, as the main drivers of EU-wide carbon reductions and economic benefits. The potential role of ICT is described in terms of carbon abatement potential, as well as economic and socio-economic benefits for the whole of the EU, with a further deep dive into the five highest emitting countries: France, Germany, Italy, Spain and the UK.

20 More details about the agreement, United Nations Conference on Climate Change, 2015. Available online here: http://www.cop21.gouv.fr/en/more-details-about-the-agreement/

The role of ICT in reducing carbon emissions in the EU

As part of the Paris Agreement, the EU submitted its INDC on behalf of 28 nation states, exceeding its 2020 targets to develop longer term targets with a view to 2030.

Its INDC committed the EU to achieve the following by 2030:

i. At least 40% reduction in greenhouse gas emissions (from 1990 levels)

ii. At least 27% renewable energy

iii. At least 27% improvement in energy efficiency

ICT can help the EU deliver substantial carbon reductions, and help improve business competitiveness with additional economic benefits and efficiencies, while leveraging existing digital competencies to drive competitiveness and growth. By using ICT to reduce carbon intensive behaviours, improve resource efficiencies and enable the development of new services and products, this report highlights the following key findings:

- ICT can enable a substantial reduction in carbon emissions by over 1.5 Gt in 2030 in the EU. This abatement would be almost 19 times the size of the expected footprint of the EU's ICT sector in the same year, or 37% of the EU's total emissions in 2012[21,22]
- ICT can further generate business value through improved energy efficiency, additional revenues and cost savings and the creation of new business models:

– Improved energy efficiency: 53%, or 0.8 Gt of the total EU ICT-enabled carbon abatement is generated through improvements in energy efficiency[21]

– Additional revenues and cost savings: €1.3 trillion in additional economic benefits to the wider EU society – comprised of €678 billion in additional revenues generated by both the ICT sector and other stakeholders, and €643 billion in total ICT-enabled cost savings

– New business models: ICT is enabling new business models and helping the transition from linear to circular value chains, by cutting and eliminating waste and identifying new value streams. Circular business models re-use and up-cycle key materials, significantly cutting or eliminating waste

- Countries within the EU are at different stages of maturity and readiness in being able to capture these benefits. If successfully adopted, ICT can help improve the competitiveness and growth projections of the largest EU economies moving forward, firmly securing the position of the EU as leader in the global economy.

Each of these benefits is discussed in detail below: the potential ICT-enabled carbon reductions, business imperatives and economic benefits of ICT-enabled carbon reductions, and the readiness and potential improved digital competitiveness of the EU. The nature of these benefits establishes a strong case for greater ICT adoption and deployment throughout the EU, and raises important questions about how ICT could further support synergies between EU members as they pursue these benefits.

21 These numbers are intended to highlight the total potential benefits available – the extent to which ICT-enabled measures are already included in country- or EU-level decarbonisation or energy efficiency strategies was not examined as part of this study

22 The EU's total emissions in 2012 were 4.12 Gt CO2e, including land use and forestry. 2012 figures are the most recent figures available that account for the whole of the EU.

The carbon opportunity

Total potential ICT-enabled carbon reductions were calculated for the 12 ICT applications described below in Figure 2. More information on each application and how each reduces carbon emissions can be found in the Appendix. Each application has been mapped to one of the eight sectors, as shown in Table 2.

Connected Private Transportation

Refers to connecting vehicles to help stimulate car sharing and route sharing, reducing the usage of cars overall. ICT enabled solutions including mobile apps, GPS location based services, RFID/NFC enabled cards for access control for public transport, smartboard computer systems and connected vehicles.

Smart Energy

The connection of energy supply to current demand using more efficient networks encompassing distributed and variable power generation, real-time response to demand changes, predictive analytics and forecasting (supply and demand) and reliable infrastructure resilient to change.

Smart Logistics

Improvements leveraged from ICT that result in an optimisation of distribution activities and a reduction in distance travelled. This will be through dynamic fleet management and route optimisation, increased intermodal transportation, digital warehouses and operational agility and customer centricity.

Traffic Control and Optimisation

Seeks to manage traffic and parking in cities in a smarter, efficient and more fluent way, through intelligent sensors, real-time information gathering and data analytics, traffic management platforms, connected vehicles, driving support technology and information technologies.

Smart Manufacturing

Application of advanced systems to increase knowledge around inefficiencies and enable rapid manufacturing of new products, dynamic response to product demand and real-time optimisation of manufacturing production and supply chain networks. Includes virtual manufacturing, customer-centric production, circular supply chains and smart services.

Smart Agriculture

Efficient farming and agriculture methods (excluding marine agriculture) that involves the use of ICT such as GPS and sensors to increase resource efficiency and higher crop yields and income potential. Includes the use of advanced analytics to develop preventative cautions to environmental shocks.

Smart Buildings

Combination of specific building software and remote controls that lead to intelligent homes and workplaces. Its main pillars are: energy management for households through automatic detection and energy storage, improved buildings efficiencies and the combination of sensors and the Internet of Things.

e-work

Includes the use of cloud platforms, connections and communicating devices to facilitate daily office work between company members that typically operate from different locations. This includes the use of telework facilities/technologies (mobile working) as well as virtual business meetings.

e-commerce

Improvement of current platforms and connections which enable on-line commerce/trading of products or services using internet networks between the retailers and consumers, including integrated multichannel infrastructures and mobile shopping, 3D printing and delivery on demand.

e-health

Transfer of health resources and care using ICT to cover three areas: delivery of information for professionals and consumers, improving provision of public health services (e.g.: education and training of health works) and enabling patients to manage their own health.

e-learning

Use of computerised devices in educational and learning environments, promoting valuable interactive lessons. Its main pillars are: building partnerships with quality training providers and offering wider educational horizons by offering new accessible learning content.

e-banking

Refers to providing banking and products and services through electronic delivery channels, such as internet or mobile banking. Also includes the use of digital wallets (mobile money) through apps and digital currencies (BITCoin).

Figure 2: Description of the 12 ICT applications

Economic Sector	ICT Application
Manufacturing	Smart Manufacturing
Energy	Smart Energy
Buildings	Smart Buildings
Mobility and Logistics	Connected Private Transportation
	Traffic Control and Optimisation
	Smart Logistics
Food	Smart Agriculture
Work and Business	E-work
	E-banking
	E-commerce
Health	E-health
Learning	E-learning

Table 2: Applications of ICT by economic sector.

Based on the current emissions from each sector, predicted ICT adoption rates and the applicability of ICT within each sector, total carbon emissions reductions vary for each. Figure 3 shows the breakdown of the ICT-enabled carbon reductions in 2030 for the whole of the EU – totalling over 1.5 Gt in reductions.

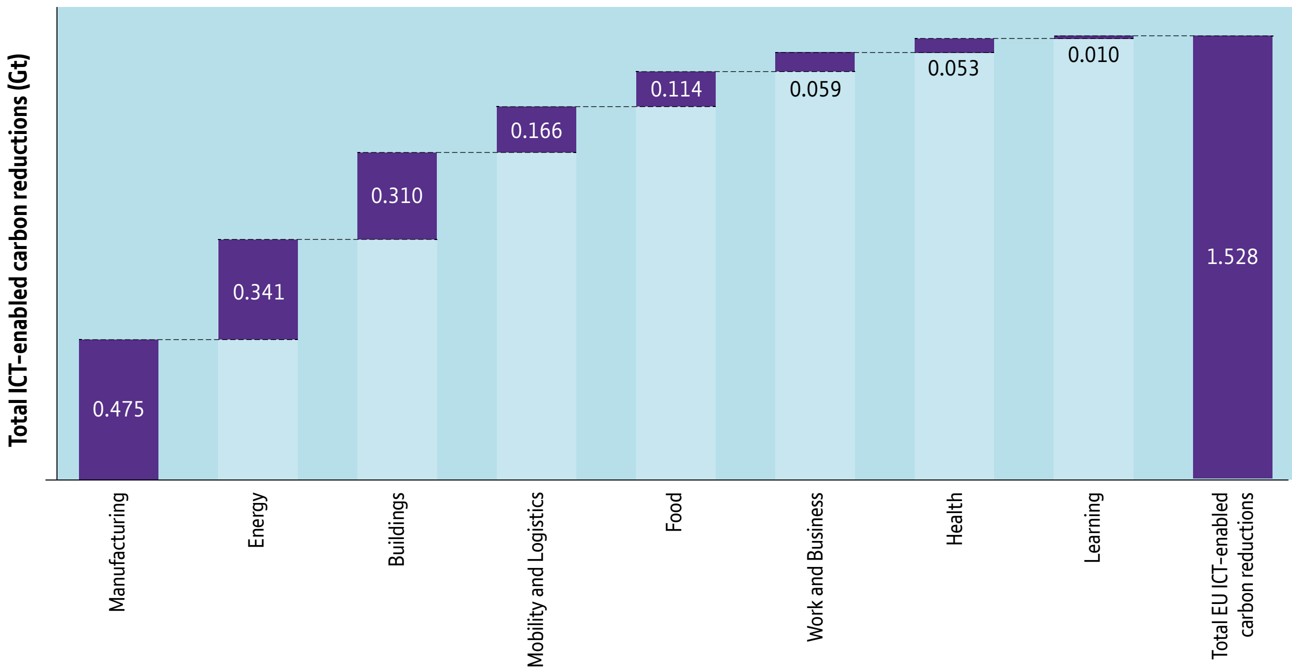

Figure 3: Breakdown of EU ICT-enabled emission reductions[23].

23 The same parameters have been used for this report, as in the UK BT report as well as the GeSI's SMARTer2030 report. Differences in relative carbon abatement potential will be based on existing difference in these geographies such as current emissions profile, population and current industry profiles

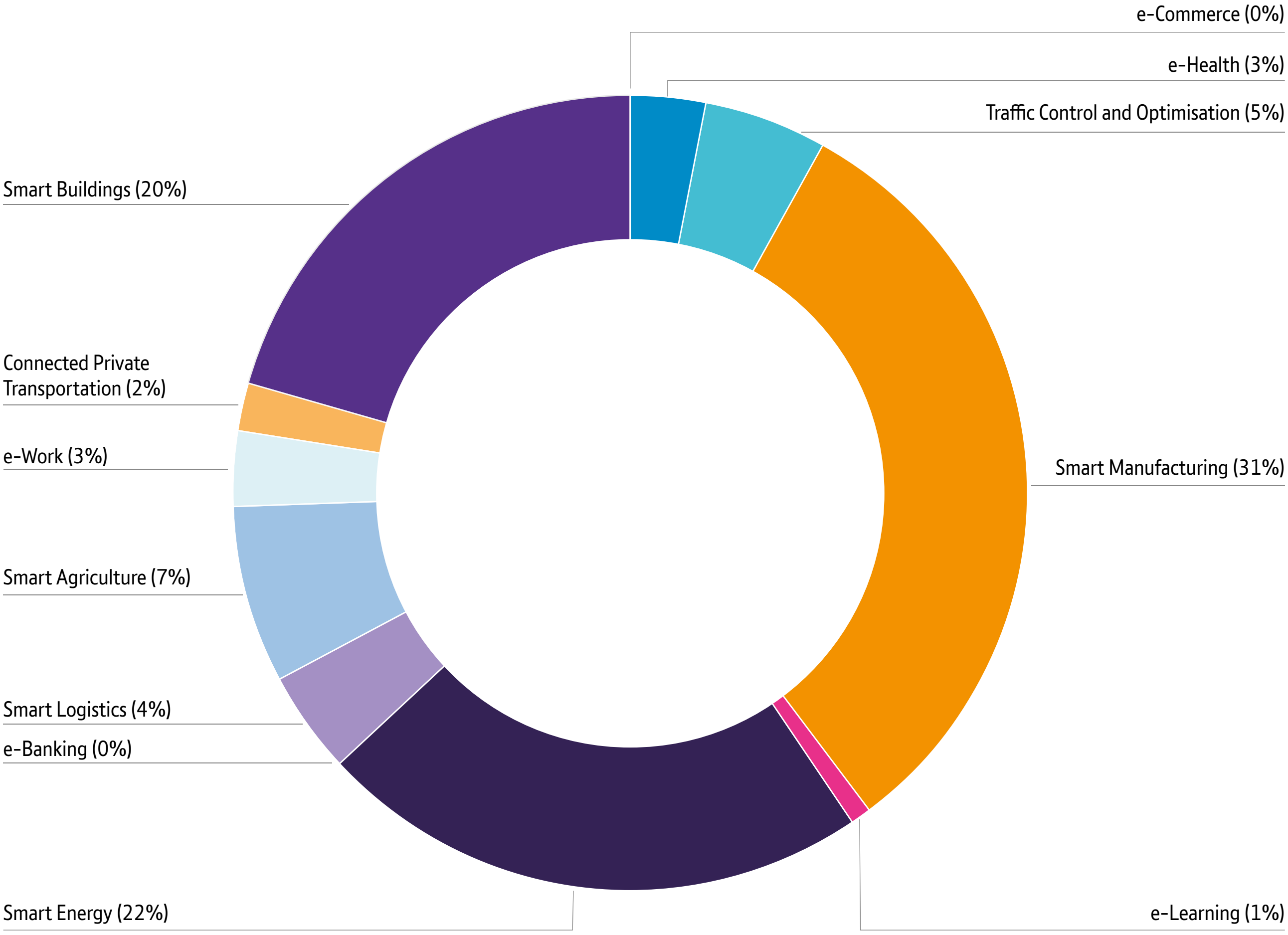

Figure 4: Breakdown of EU ICT-enabled carbon reduction applications.

The ICT-enabled reduction of 1.5 Gt is the equivalent of planting 500m ha of trees, which would cover approximately 65% of the landmass of Australia[24] and is the equivalent to 2.7 times the size of the UK carbon emissions in 2012[25]. To provide further detail, the breakdown of the emissions reductions from each sector, by ICT application, has been listed.

As shown in Figure 4, within the EU, the most substantial ICT-enabled carbon reductions are driven by three specific applications of ICT: smart manufacturing, smart energy and smart buildings. These three applications total nearly 74% of the total EU ICT-enabled carbon reductions. The sources of the reductions in each of these sectors is described below:

- Smart Manufacturing: Carbon reductions can be generated through improved process automation and engine optimisation to significantly reduce emissions
- Smart Energy[26]: Smart grids will be better at balancing energy demand and supply, increase grid efficiencies and will also more easily incorporate renewables
- Smart Buildings: High number and density of older commercial and residential buildings which can be made more energy efficient through smart buildings measures.

24 United States Environmental Protection Agency, 2016. Available online here: http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results; Australian Government, 2016. Available online here: http://www.ga.gov.au/scientific-topics/national-location-information/dimensions/area-of-australia-states-and-territories

25 CAIT Climate Data Explorer. 2015. Washington, DC: WRI. Available online at: http://cait.wri.org

26 Smart Energy abatement is derived from reduced energy production (due to decreased demand), increased renewables and improved grid efficiencies

There are substantial ICT-enabled carbon savings at stake for the EU which could make a significant contribution to helping the EU achieve and exceed its INDC. Importantly, the carbon savings generated from ICT are markedly higher than the emissions generated by the ICT sector. Given the predicted ICT footprint in 2030, the carbon reductions enabled by ICT would be close to 19 times greater than its emissions[27] – a significant net saving, demonstrating the clear role which ICT can play to decrease EU emissions in 2030.

Cloud of Clouds

Sustainable data centres, such as BT's new facilities owned and managed by Ark Data Centres, offer one of the world's lowest total ownership cost, taking into account both financial and carbon costs. Using advanced cooling technology, the data centres use less energy, leveraging free cooling for up to 95% of the year rather than re-circulating and cooling the hot air from the data centre. The facilities also prioritise purchase of renewable energy to match their climate-change agreement to drive energy efficiencies and carbon savings throughout the organisation[28].

The business opportunity

Beyond carbon reductions, ICT has the potential to create a significant business opportunity, in terms of new revenue generation opportunities and significant cost savings, improving energy efficiency, and enabling the creation of new business models. This section discusses each of these business opportunities in turn.

Revenue generation and cost savings

Further to enabling significant carbon reductions, ICT also has the potential to drive additional economic benefits, and enable the development of new business models.

Additional revenues could be generated for both the ICT sector and other stakeholders, while increased use of ICT will also drive significant cost savings.

The breakdown of cost savings and revenues generated is shown below in Figure 5. Costs and revenues vary across sectors, based on the potential for new services and products to be sold, or savings generated, through increased efficiencies (time, resources, or space savings).

Although the manufacturing and energy sectors were the sectors with the largest carbon abatement potential, it is clear in Figure 5 that the Work and Business sector has both the highest cumulative revenues and cost savings, and the highest generation of revenues based on new services and products. Conversely, the Mobility and Logistics sector will experience the highest cost savings due to decreased fuel required for trips, associated cost savings due to fewer cars on the road, and less time spent in traffic.

Overall, in the EU in 2030:

- Revenues generated through the use of ICT for carbon abatement could total as much as €678 billion annually – comprising €442 billion in stakeholder revenues (such as learning centre revenues through e-learning solutions or health service employees working remotely) and €236 billion in additional ICT revenues generated through new products and services and increased use of ICT and related services
- Annual EU-wide cost savings could total €643 billion through improved efficiencies, reduction in resources used (fuel, space, water and others), and other reduced expenditures such as tuition costs displaced by e-learning centres
- Improved energy efficiencies could further help the EU achieve its INDC – ICT can enable energy efficiencies that would deliver 0.8 Gt of carbon abatement. This improvement in energy efficiency would also help cut operational costs.

27 Accenture Strategy analysis
28 http://www.theguardian.com/bt-partner-zone/2015/oct/28/how-cloud-computing-is-becoming-more-sustainable

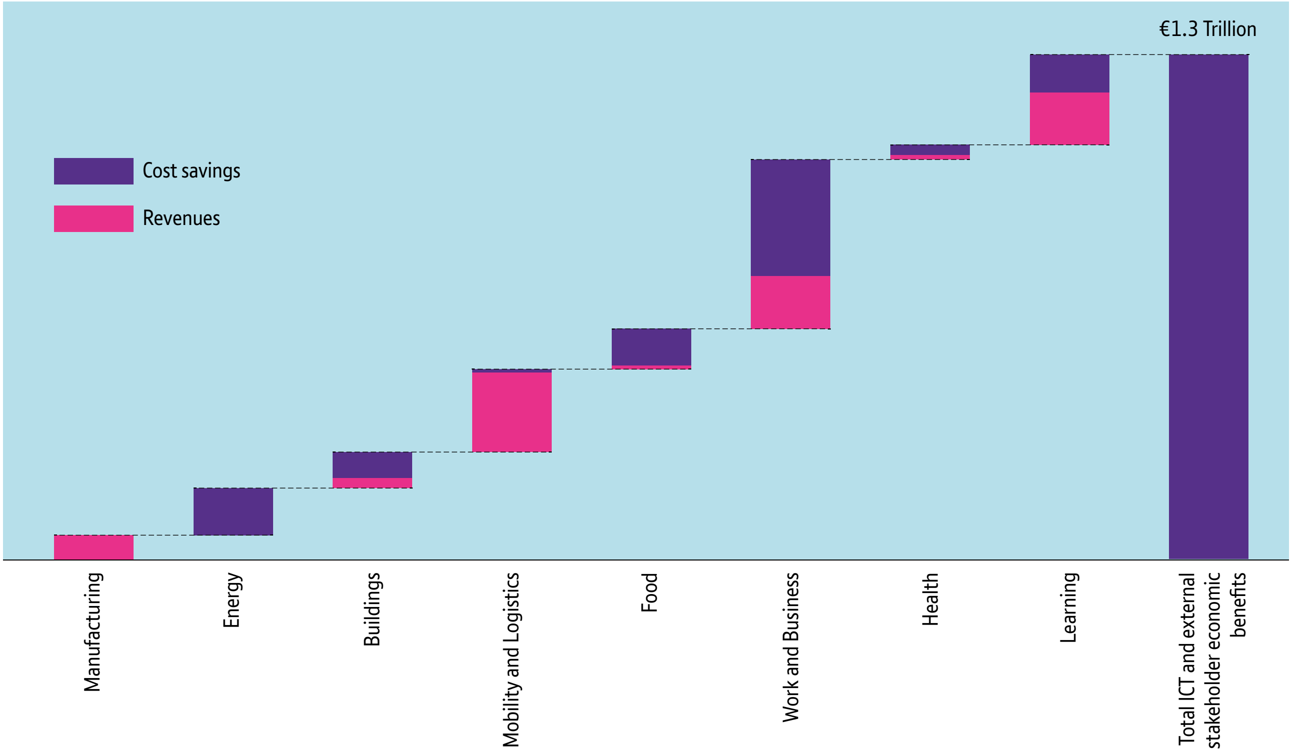

Figure 5: Breakdown of revenues and cost savings by economic sector.

Indesit

Indesit is one of the leading manufacturers and distributors of white goods in Europe in major markets like Italy and the UK, and looked to partner with BT to link its 16,000 employees at 65 sites worldwide including eight manufacturing plants across Italy, Poland, the UK, Russia and Turkey. The BT IP Connect Global network and BT One Collaborate technologies are being used to enable video conferencing across its locations, with high video quality and global support. The video conferencing solution has helped the organisation decrease travel time required and helped cut costs, while fostering collaboration and cooperation amongst colleagues from multiple locations[29].

29 http://www.globalservices.bt.com/uk/en/casestudy/indesit

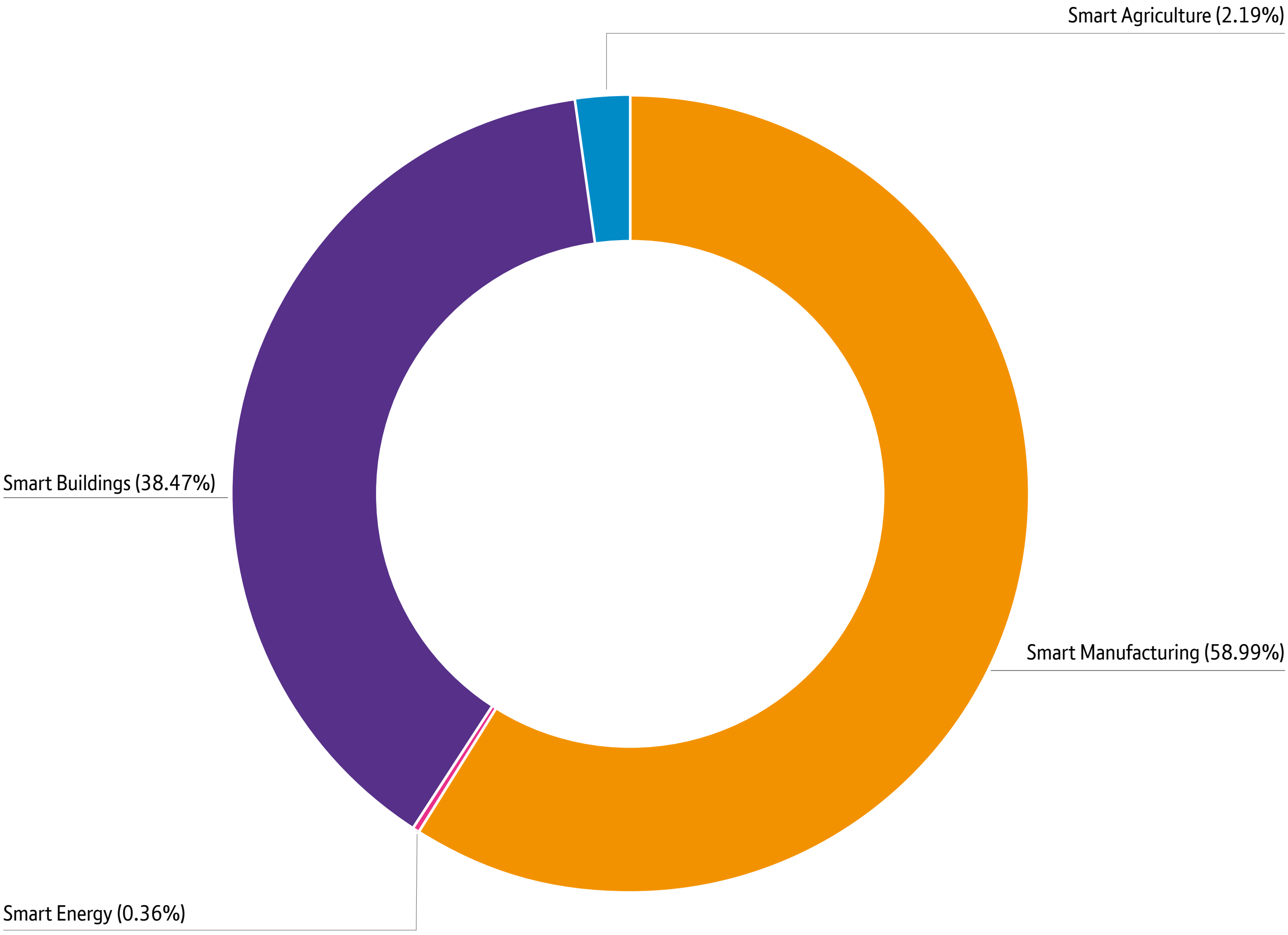

Figure 6: Breakdown of EU-wide energy efficiency improvements[30].

Improved energy efficiency

Improved energy efficiencies could be generated through four applications of ICT: Smart Energy, Smart Manufacturing, Smart Buildings and Smart Agriculture. These applications would drive energy efficiencies through engine optimisation, improvements in process automation, reduced energy loss and decreased use of energy in commercial and residential buildings. Figure 6 shows that the overwhelming majority of these efficiencies are to be gained in Smart Manufacturing and Smart Buildings.

Smart Manufacturing is responsible for over half of the improvements from energy efficiency, based on both the high potential size of ICT-enabled carbon reductions (31% of total ICT-enabled carbon reductions in the EU), and the levers driving the carbon reductions – process automation and engine optimisation (both resulting in improved efficiencies).

30 Smart Energy efficiency savings attributed to decreases in energy production have been re-allocated to Smart Buildings and Smart Manufacturing ICT applications. Decreases in energy production in Smart Energy will be realised through these individual applications, rather than in the Smart Energy application alone.

Smart Buildings

BT Carbon Calculator – www.bt.com/carbon-calculator

The Carbon Calculator for business helps organisations assess the potential carbon savings they could achieve by implementing technology solutions across their organisation. This could include teleconferencing to reduce business travel, virtualising data centres to reduce power consumption, enabling a mobile workforce to reduce daily commutes and overall streamlining their IT operations[31].

Creation of new business models

ICT also has a critical role to play in shaping the digital economy and enabling new business models and sources of growth. New and disruptive business models, such as AirBnB, Uber and others, are underpinned by ICT[32]. ICT is increasingly supporting the creation of these new business models, in particular, enabling eradication of waste or dramatic increases in asset productivity. These are often referred to as circular business models and include circular supply chains, recovery and recycling, product life-extension, sharing platforms and products-as-a-service[33]. All rely on ICT as an enabler. For example, cloud and network infrastructures enable the sharing and virtualisation of capacity and products, while improved visibility of operational information can further help businesses move to more circular value chains. Using ICT as an enabler of these benefits can help accelerate the adoption of the circular economy, and further drive significant carbon reductions at the same time as delivering clear business value.

To underpin these links, Smart Manufacturing is a strong example of how ICT is enabling the adoption of new business models, new revenue streams and the circular economy. ICT can be used within Smart Manufacturing to tag, track and trace products and components throughout their entire life cycle, which can allow them to be more easily and effectively re-manufactured, repaired or refurbished at their end-of-life. This ability allows organisations to reduce their input costs, manage supply chain risks more effectively and therefore become more competitive in their sectors – all linked to all aspects of the business imperatives discussed above.

Smart Manufacturing

Renault's Choisy-le-Roi Factory

Renault has a strong history of using re-manufactured automobile parts since 1949, and has expanded its circular operations to include the use of injection pumps, gearboxes, injectors and recently, turbo compressors. By using this circular supply chain, Renault is driving substantial environmental savings – 80% reduction in energy use, using 88% less water and 92% reduction in chemical products. Overall, this process produces 70% less waste, and enables Renault to send zero waste to landfill[34].

31 BT Carbon calculator for business, BT, 2016. Available online here: http://carbon-calculator.globalservices.bt.com/
32 SMARTer2030, GeSI and Accenture, 2015. Available online here: http://smarter2030.gesi.org/
33 Waste to Wealth, Jakob Rutqvist and Peter Lacy, 2015
34 Renault, JLR, Nissan and Toyota drive car industry towards sustainability, Guardian, 2014. Available online here: http://www.theguardian.com/sustainable-business/renault-jaguar-nissan-toyota-sustainability-circular-economy

The social opportunity

Further to the carbon reduction and economic benefits ICT can enable in 2030, there are also substantial socio-economic benefits to be gained. Across the EU in 2030, ICT could enable:

- Over 20 billion hours in time savings enabled by four ICT applications: e-work, e-commerce, e-banking and Traffic Control and Optimisation. This time could be saved through fewer hours spent commuting to work, more efficient route management when driving and decreased need to travel to stores and banks due to online services. This is equivalent to nearly 40 hours per person per year in the EU in 2030[35]
- Health can enable enhanced health services to be available to over 146 million additional people across the EU through improved ease of access, decreased costs required to travel and improved service delivery. Additional beneficiaries include both those who already have access to health services but will benefit from improved services, as well as those who do not currently have access to any health service
- Smart Agriculture solutions could raise the incomes of EU farmers by almost €6,000 each year per farmer. This income improvement is enabled through improved productivity due to increase access to information and higher yields per farmer
- E-learning solutions could enable a 10% raise in expected income of secondary and higher education students, generating an additional €23 billion in income across the EU in 2030.

These wide-reaching socio-economic benefits have the potential to impact the lives of millions of EU citizens. Communicating the potential value at stake to citizens in a similar way to the above will help citizens understand the value proposition, and "what's in it for them", leading to increased adoption rates and the realisation of these ICT-enabled benefits beyond carbon savings and revenue generation and cost savings.

e-health

Robert Bosch Healthcare

The Bosch Telemedizin system operates in the UK and Germany and uses the Health Buddy system in a patient's home to wirelessly connect devices and wirelessly upload information to healthcare professionals. Each Healthy Buddy enables the assessment of relevant symptoms, providing automatic answers based on the patient's personal condition and medication. This data is then transferred electronically, normally once a day, to medical supervisors, using the traffic light system to help recognise any cause for concern. BT Compute telehousing services is used to support the Bosch Healthcare solution and BT is responsible for hosting the applications and for the safe, and secure storage of such personal data[36].

35 Accenture Analysis; United States Census Bureau, 2016. Available here: http://www.census.gov/population/international/data/idb/region.php?N=%20Results%20
36 http://www.globalservices.bt.com/uk/en/casestudy/robert_bosch_healthcare_gmbh

Country-level results

Total ICT-enabled carbon abatement potential will vary for each country within the EU, with 58% of total abatement potential coming from the UK, Germany, France, Italy and Spain.

The UK, Germany, Spain, Italy and France were selected for detailed analysis. These countries were responsible for 62% of EU carbon emissions in 2012[37], and therefore, have a high potential to realise ICT-enabled carbon reduction benefits while also benefiting from the economic and socio-economic benefits. Figure 7 shows the total carbon emissions from each of these individual countries.

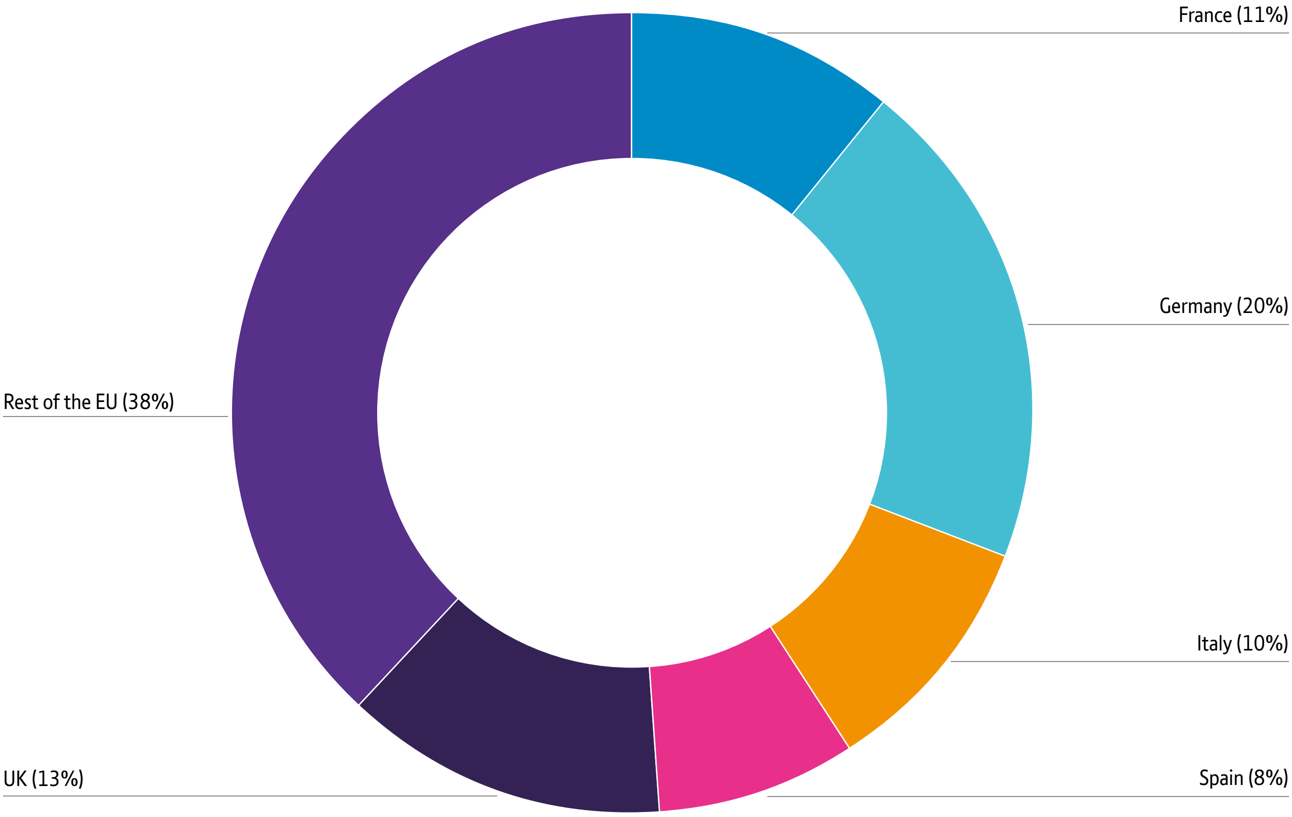

Figure 7: Total carbon emissions from selected countries[38].

37 CAIT Climate Data Explorer. 2015. Washington, DC: WRI. Available online at: http://cait.wri.org
38 CAIT Climate Data Explorer. 2015. Washington, DC: WRI. Available online at: http://cait.wri.org

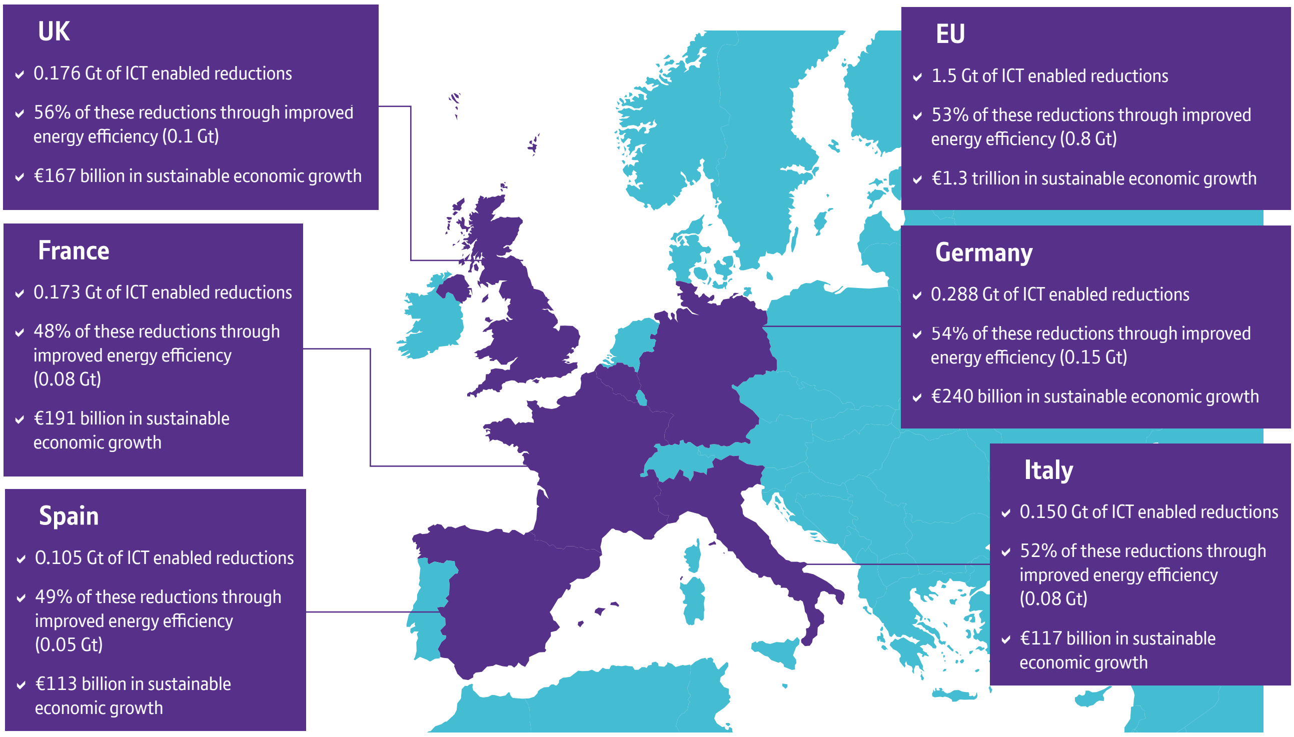

Figure 8: EU overview of ICT-enabled carbon reductions, economic benefits and energy efficiency improvements.

The role of ICT

Figure 8 shows the total potential ICT-enabled carbon reductions, economic benefits (through additional revenues and cost savings), and energy efficiency improvements for each of these countries in 2030. The relationship of each of these countries to the total EU benefits have been further described below, along with key areas highlighted.

Figure 9 shows the breakdown of each key benefit group – carbon reductions, energy efficiency savings, and economic benefits (revenue generation and cost savings) for each of the five selected countries in relation to the total EU benefits. The relative proportion for each of the countries remains roughly the same across the benefit groups.

However, there are a few differences which should be noted:

- The five selected countries for analysis are responsible for a significant proportion of potential ICT-enabled carbon savings in the EU (58%), potential energy efficiency gains (58%), and economic benefits (63%)
- France has a higher proportion of potential ICT-enabled economic benefits – over €191 billion in potential total economic benefits, comprised of:
  - €69 billion in additional stakeholder revenues driven largely by significant e-commerce stakeholder revenues (€23 billion);
  - €35 billion in ICT sector additional ICT revenues, driven by significant e-work ICT revenues of €9 billion; and
  - €86 billion in cost-savings. These cost savings are driven by large energy savings enabled by Smart Agriculture (of €1.6 billion) and Smart Energy (over €5 billion)
- Germany presents a particularly significant opportunity in terms of potential energy efficiency savings and carbon abatement. This is largely driven by:
  - Substantial savings in Smart Manufacturing - 0.09 Gt in carbon abatement alone; and
  - Significant proportion of energy efficiency savings – 0.15 Gt, or 19% of the total EU energy efficiency savings

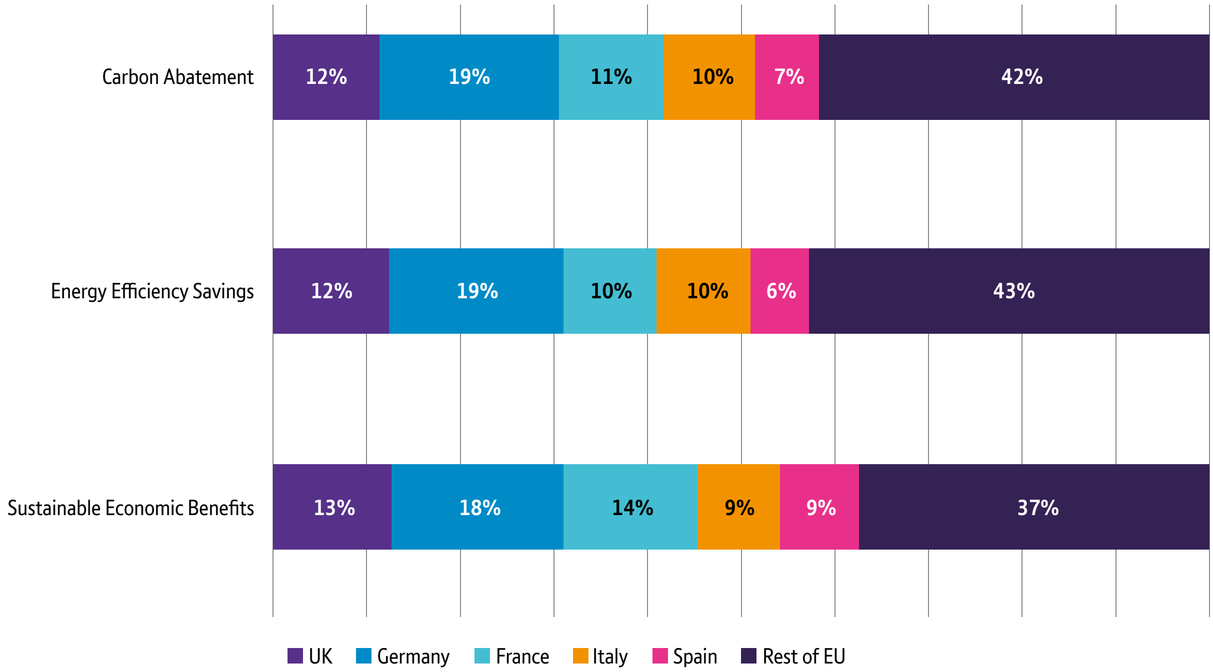

Figure 9: Breakdown of individual country ICT-enabled benefits as a proportion of total EU-wide benefits.

- Spain, by comparison, offers noticeably smaller opportunities in potential carbon abatement and energy efficiency savings. This is in part due to its low carbon footprint (323 Mt, or approximately 8% of total EU emissions), relative to the other four countries, and the lower contribution of Smart Manufacturing carbon savings (0.03 Gt, or less than 7% of total EU potential savings) and low Smart Building carbon savings (only 0.02 Gt, or 6% of total EU potential savings) as a result of low building density and average building age.

Figure 10 shows how the potential carbon abatement of each application in the five countries compares to that in the rest of the EU. Focussing deployment in these countries – particularly in areas of Smart Manufacturing, Smart Energy and Smart Buildings – could make a very significant contribution to the EU's decarbonisation journey.

The readiness of each country is likely to depend on the country's existing strengths and ICT capabilities, which is discussed in the next section.

e-commerce

Superfast Cornwall

Superfast Cornwall was funded by the EU, BT and Cornwall Council and is supported by Broadband Delivery UK, an arm of the UK Department of Culture, Media and Sport. The project delivered fibre broadband to 95% of homes and businesses in Cornwall and the Scilly Isles. The project aims to enable larger carbon reductions at home at the consumer level, enabled by fibre, focusing on e-commerce, cloud services and e-work. Total carbon savings are predicted at over 580,000 tonnes over nine years to 2020, while boosting the economy by more than £186 million[39].

39 http://www.superfastcornwall.org/assets/file/Superfast%20Cornwall%20-%20Our%20Story.pdf

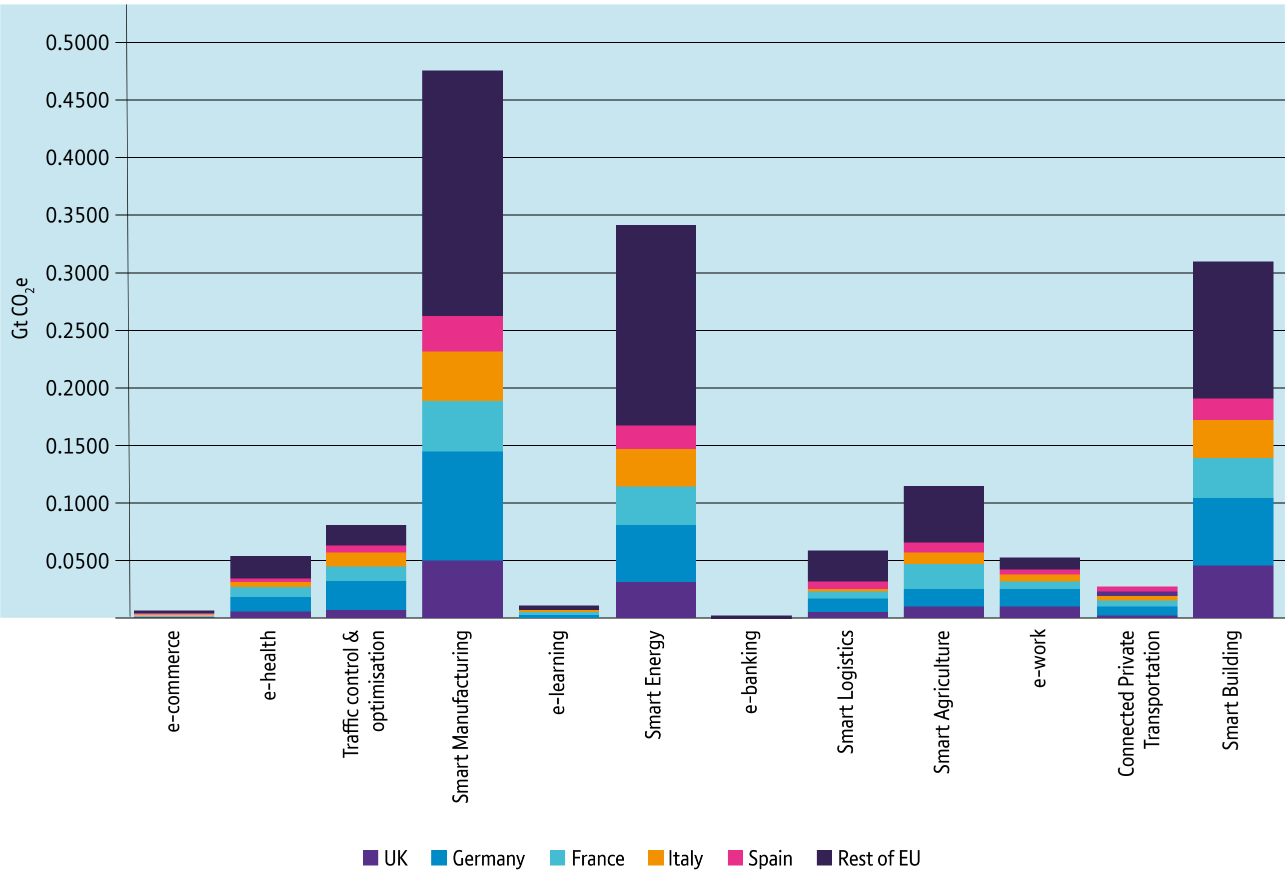

Figure 10: Country breakdown of total EU ICT-enabled carbon reduced, Gt CO2e.

Digital readiness

To determine which of the five countries are best positioned – or 'most ready' – to capture these benefits, this study compared their potential ICT-enabled carbon reductions with their existing digital capabilities (as measured by Accenture's Digital Density Index[40]). This analysis acts as a key input to recommend where attention should focus now on the 'quick wins' and where other countries can learn from current best practice. It is clear that, to best capture and take advantage of the ICT-enabled carbon abatement and business value benefits, the EU and individual countries need to be adequately prepared in terms of their markets, enabling environment and workforce.

Accenture's Digital Density Index[40] has been used to compare each of these countries' current strengths and historical adoption of digital technologies, such as ICT. In doing so, the Index is used here to show readiness to apply ICT in the ways described in this report. The index measures the core inputs into digitally led economic productivity and acts as a scorecard to measure digital adoption globally. A higher score on the Digital Density Index reflects a country's broader and deeper adoption of digital technologies, as well as the skills, ways of working, and regulatory frameworks needed to realise this economic potential. Therefore, a country which has a high Digital Density Index score, whilst also having high ICT-enabled carbon abatement potential, will likely benefit most from a more aggressive application of ICT in this way.

40 Digital Density Index: Guiding digital transformation, Accenture Strategy, 2015. Available here: https://www.accenture.com/us-en/insight-digital-density-index-guiding-digital-transformation.aspx

Figure 11 shows the relationship of the five selected EU countries in terms of their digital readiness and the size of the potential ICT-enabled carbon reductions as analysed and described above. The Digital Density Index helps gauge the current Digital Density of an economy, by providing a scorecard and numerical value to show how digital investments can lead to economic productivity, while the ICT-enabled carbon reduction potential looks to show the potential benefits of ICT in terms of carbon reductions.

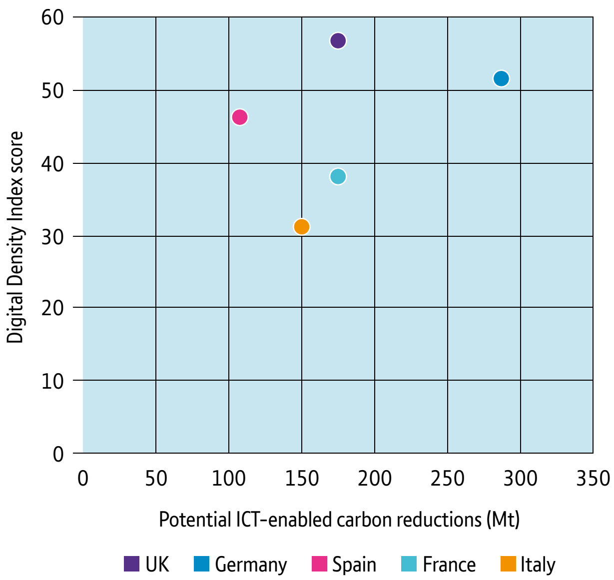

Figure 11: Digital Density Index scores and potential ICT-enabled carbon abatement.

Based on this analysis, the UK and Germany, with the highest ICT-enabled potential abatement and the highest Digital Density scores, are in the best position to take advantage of the ICT opportunity and realise the potential carbon and business value opportunities. This is based on their strong existing digital markets, existing digital supply chains and sourcing methods, strong use of digital within local enterprises, and the current socio-economic environment which helps foster further digital deployment.

Spain, France, and especially Italy (with the lowest Digital Density score), score much lower on the Digital Density Index and should therefore position themselves to more readily leverage the benefits of ICT. Specific recommendations on how to improve digital readiness is included in the Recommendations section below.

By maximising the benefits of ICT, and learning from countries which have done so successfully, governments and business leaders can ensure the maximum extent of the ICT-enabled benefits are leveraged throughout the EU. If the environment is ready and able to adopt these applications of ICT, the benefits will be more quickly realised. Furthermore, as the EU and its individual countries move higher on the Digital Density Index, these economies will become increasingly competitive on a global scale, while becoming increasingly productive and efficient.

Smart Energy

German Smart Meter Roll-Out

In Germany, the federal government is rolling out a large-scale smart meter installation program to help restructure the country's energy system, providing increased grid transparency and supporting the integration of renewables onto the grid. Deutsche Telekom's smart energy solution helps households visualise real-time energy demand, to reduce energy consumption overall – households can reduce their electricity consumption by up to eight percent. Across the country Installing smart meters in the 7.8 million households in Germany by 2020 would reduce carbon emission by up to 1.2 million metric tons annually[41].

41 SMARTer2030, GeSI and Accenture, 2015. Available online here: http://smarter2030.gesi.org/

The way forward

The EU is at a pivotal point in its journey to decarbonisation, and it is clear that ICT has a significant role to play. With the ratification of the Paris Agreement pending until April 2017, now is the time to take a view on what success will look like and which building blocks need to be in place to achieve and exceed the targets agreed.

ICT can enable over a 1.5 Gt reduction in carbon emissions by 2030 and this provides a great opportunity to help transition the EU to a low carbon economy. Furthermore, ICT could deliver €1.3 trillion in additional economic benefits in 2030, split between €678 billion in additional ICT and stakeholder revenue and €643 billion in cost savings. However, to ensure these benefits are realised, it will be important for two key groups of stakeholders to take collective action and move the ICT agenda forward. Policy makers and business leaders have a critical role to play in delivering these results. The recommended actions for each of these groups is discussed below.

Recommendations for policy makers...

Policy makers have the opportunity to set the direction and level of ambition for countries, and the EU more broadly, as the Paris Agreement targets ratification in 2017. This means there is an opportunity to exceed the EU's current INDC, and drive greater levels of decarbonisation through the adoption and use of ICT.

...at the EU level

EU policy makers should continue to demonstrate the leadership shown during COP21 to ensure that the objectives and targets agreed are implemented at pace. Policy makers should make clear their intent to support the Paris Agreement through its policies and associated actions. Specifically, they should:

- Develop a robust EU-wide policy framework to drive key elements of success. This framework should focus on:
  - Driving change in those sectors that offer the greatest potential gains with integration of ICT-enabled carbon solutions, e.g. the buildings, manufacturing, and energy sectors offer nearly 74% of the ICT-enabled carbon savings analysed in this report
  - Encouraging long-term investment from both the public and private sector in clean technologies and infrastructure
  - Encouraging improved technological innovation to drive greater energy efficiency targets and performance
  - Encouraging high levels of innovation in business models, job markets, and the wider economy. This level of innovation can help encourage the development of new business models which support the circular economy; and
  - Targeting the agreed 40% reduction by 2030, whilst including clauses and areas of flexibility to allow for increases in interim or 2030 targets
- Develop a comprehensive yet flexible 'decarbonisation' roadmap to deliver the EU's carbon reduction and energy efficiency targets, including actions to be taken and a timeline, ultimately designed to work towards carbon neutrality by 2050

- Communicate the framework and roadmap to country-level leadership and targeted industry sectors, and to the population more broadly
- Look for synergistic opportunities to leverage ICT for carbon, economic and socio-economic benefits, e.g. cross-border interconnectors to support distributed renewable energy generation.

...at the national level

National governments should work closely with EU leaders and policy makers, as well as their local constituents, to look to achieve the potential offered by ICT. National governments can use the findings from this report, and other similar pieces of work, to determine which sectors should be the main focus for carbon reduction plans, and ICT-specific interventions to enable significant carbon reductions and economic benefits. For example, based on this analysis:

- **Germany:** Germany's manufacturing sector could benefit from significant savings enabled by ICT. Smart Manufacturing could enable a 0.09 Gt reduction in carbon emissions in 2030, and therefore this sector would likely benefit from clear target setting. By using the examples of some of the larger manufacturers in Germany who are already benefiting from best practice (and therefore lower normalised operational carbon emissions), these targets and operational processes could be shared cross-sector to drive improved in-country performance
- **UK:** There are significant Smart Buildings carbon reductions at stake in the UK – 0.05 Gt in 2030. This is due to both the high number and density of buildings in the UK, in addition to the buildings' age and relative potential improvements. By finding ways to use ICT to support the development and monitoring of higher building performance standards, for both new and existing buildings, the UK could benefit from significant reductions in carbon emissions from its building sector. ICT-enabled Smart Buildings savings could be targeted specifically, e.g. advanced energy analytics, in addition to more 'traditional' measures such as insulation and double glazing installation
- **France:** France's agriculture sector could largely benefit from Smart Agriculture practices – saving up to 0.02 Gt in 2030. By targeting this industry, and setting clear guidelines around the use of ICT to enable higher crop yields, targeted resource use and reduced food waste, France could benefit from ICT-enabled carbon reduction and economic benefits. France's government has already started to target the reduction of food waste through specific policies and targets[42], and this encouraging behaviour should continue to enable the realisation of the benefits enabled by Smart Agriculture
- **Smart Energy:** Smart Energy savings (0.3 Gt for the entire EU, and up to 0.05 Gt in Germany alone) are significant, and span multiple sectors and ICT applications, such as Smart Buildings and Smart Manufacturing. It is therefore important for individual governments to encourage Smart Energy initiatives – increasing renewables, improving grid efficiencies and reducing energy production outright – and target these savings through policies and legislations appropriately

In addition, it is likely that nations within the EU will need to help each other where targets could otherwise be missed to ensure that the EU as a whole does not fall short. This means that national governments should work closely together to ensure the common goal is met, and be prepared to exceed national targets where required. Close communication of current progress, along with policies which allow for, and encourage, the increase in targets, will help national governments effectively work together.

Where countries, like France and Italy, have the opportunity to position themselves to more readily leverage the benefits of ICT, governments should look at four key aspects:

- Making markets more digital by understanding and supporting digital business models and understanding new ways for governments and businesses to interact and engage

42 French law forbids food waste by supermarkets, Guardian, 2016. Available online here: http://www.theguardian.com/world/2016/feb/04/french-law-forbids-food-waste-by-supermarkets

- Transforming how government and private sector enterprises operate by increasing their use of digital technologies to transform key business processes and generate substantial efficiency and productivity gains – as mentioned in the business opportunity section above
- Thinking how ICT will increasingly disrupt supply chains and better understand the industrial Internet of Things; and
- Looking beyond digital infrastructure and foster the enabling environment to make using digital easier.

By learning from economies which have embraced digital technologies to drive economic benefits and competitiveness and are more ready for greater ICT adoption, the EU and its individual countries can continue to advance the digital agenda and position themselves for success. Countries like France and Italy can therefore learn from strong performers to begin to embrace digital and more readily prepare for greater adoption rates and benefits.

Finally, although this report has focused on individual sector benefits, there will be interlocks and interdependencies cross-sector where benefits may be greater, and should be realised at scale. For example, Smart Energy carbon reductions enable reduction in energy use in the buildings and manufacturing sector, and will therefore target both industries. To do this effectively, national governments should work cross-sector themselves, involving multiple national and municipal departments to establish targets and policies. Smart City policies and thinking, where governments have authority over multiple sectors (such as energy and building legislation) can apply here, and should be leveraged to drive the greatest cross-sector benefits.

Recommendations for business leaders

Business leaders and the private sector will be critical to encouraging and adopting greater levels of ICT and pushing forward the decarbonisation agenda to help the EU meet and exceeds its targets. Consumers are increasingly demanding the need for businesses to be environmentally conscious and innovative, whilst delivering economic benefits[43], and the use of ICT can help ensure these needs are met. Business leaders from both the ICT sector and beyond have roles to play in generating and driving these benefits.

Businesses should work to understand how national and international policies and targets will affect their core business and how changing climates globally may increase operational risks. By developing a quantified business case and modelling scenario to define how these policies will impact operations, organisations can ensure they are making informed decisions and engage decision makers and secure investment to limit organisational risk.

Additionally, companies should focus on viewing ICT as an enabler across their value chain, and look to understand, in detail, how ICT can help them to reduce emissions through greater energy efficiency, use of renewables, or operational improvements. Cross-sector collaboration, between ICT and non-ICT companies, will help organisations understand the value and potential of ICT within and across their value chains and operations. This collaboration will be critical in driving the greatest benefits of adoption.

Reduction targets and associated ambition levels can be set using the findings of this report to target specific sectors where abatement potential is high. Specifically, the manufacturing sector, buildings sector and energy sector have the potential to generate the highest savings, and should therefore set themselves ambitious targets to work closely with the ICT sector to generate the savings described within this report.

Finally, business leaders should commit to greater emission reduction targets at a corporate level to help drive greater overall national and international reductions. By setting clear reduction targets and roadmaps, businesses can work together to drive greater carbon reductions, whilst delivering economic and socio-economic benefits.

43 The new bottom line: money is no longer a dirty word in sustainability, Guardian, 2016. Available online here: http://www.theguardian.com/sustainable-business/2016/feb/23/corporate-social-responsibility-sustainability-general-mills-patagonia-ben-and-jerrys

APPENDIX

Use Cases

The use cases identified within this report cover eight sectors: mobility and logistics, manufacturing, food, buildings, energy, work & business, health and learning. Each of these sectors includes more detailed use cases which refer to the application of ICT within each. Details on each use case and how they reduce carbon (and where applicable, help improve energy efficiency) are included below:

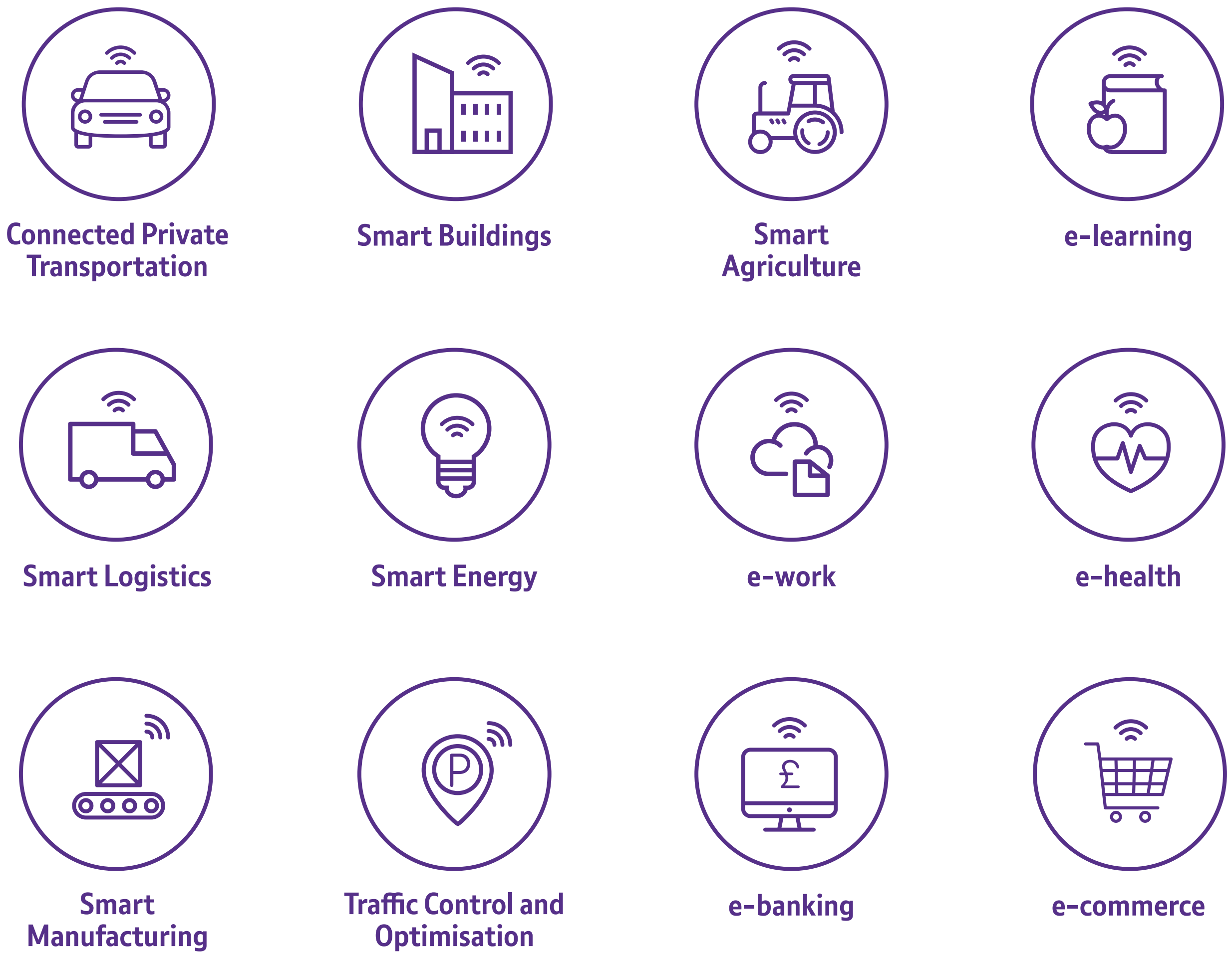

Figure 12: Analysed ICT applications

Connected Private Transportation

Connected Private Transportation:

- WHAT: Refers to connecting vehicles to help stimulate car sharing and route sharing, reducing the usage of cars overall. ICT enabled solutions including mobile apps, GPS location based services, RFID/NFC enabled cards for access control for public transport, smartboard computer systems and connected vehicles
- HOW: Carbon is reduced through increased route sharing, increased car sharing (decrease in travel) and associated reduction in car production
- EXAMPLE: Mobile apps such as Lyft encourage car sharing in major cities, therefore reducing the use of single car trips and overall car usage. This is also a great example of ICT enabling the circular economy through the creation of a sharing platform.

Smart Logistics

Smart Logistics:

- WHAT: The improvements leveraged from ICT that result in an optimisation of distribution activities and a reduction in distance travelled. This will be through dynamic fleet management and route optimisation, increased intermodal transportation, digital warehouses and operational agility and customer centricity
- HOW: Carbon reduced through decrease in air, train, maritime and road freight through maximisation of vehicle capacity and logistics sharing
- EXAMPLE: BLS Trucking uses Verizon's Networkfleet, a wireless fleet management system that combines diagnostic monitoring with GPS-based vehicle location information to monitor and track every vehicle in their fleet while collecting information on location, idle time, odd-hour usage and fuel consumption[44].

Smart Manufacturing

Smart Manufacturing:

- WHAT: Intensified application of advanced systems including ICT to increase knowledge around inefficiencies and enable rapid manufacturing of new products, dynamic response to product demand and real-time optimisation of manufacturing production and supply chain networks. Includes virtual manufacturing, customer-centric production, use of circular supply chains and smart services
- HOW: Carbon reduction through improved process automation and engine optimisation – both energy efficiency
- EXAMPLE: Jaguar Land Rover's REALCAR project sets specific targets – 75% recycled content for every automotive aluminium sheet, 50% of which will be sourced from press sop scarp generated by JLR's own manufacturing operations and primary external stampers, and 25% from post-consumer waste streams. This project helps drive an increase in the value of aluminium scrap and increases the revenues back into JLR, offsetting some of the high initial purchase price of aluminium. JLR is looking to increase their circular economy work, looking for further opportunities in their own supply chain, including end-of-life vehicles[45].

44 SMARTer2030, GeSI and Accenture, 2015. Available online here: http://smarter2030.gesi.org/

45 Renault, JLR, Nissan and Toyota drive car industry towards sustainability, Guardian, 2014. Available online here: http://www.theguardian.com/sustainable-business/renault-jaguar-nissan-toyota-sustainability-circular-economy

Smart Buildings

Smart Buildings:

- WHAT: Combination of specific building software and remote controls that lead to intelligent homes and workplaces. Its main pillars are: energy management for households through automatic detection and energy storage, improved buildings efficiencies and the combination of sensors and the Internet of Things
- HOW: Carbon reduction through decreased energy consumption in households and commercial buildings – both energy efficiency levers
- EXAMPLE: Use of advanced buildings management systems in commercial buildings can lead to a significant decrease in energy use through automatic fault detection, predictive maintenance scheduling and automated programming.

Smart Energy

Smart Energy:

- WHAT: The connection of the energy supply to current demand using more efficient networks encompassing distributed and variable power generation, real-time response to demand changes, predictive analytics and forecasting (supply and demand) and reliable infrastructure resilient to change
- HOW: Carbon reduction through decrease in energy production due to decreased demand (energy efficiency), increase in renewable energy, and improved grid efficiencies (energy efficiency)
- EXAMPLE: Microsoft eSmart Systems is a cloud-based energy management system using sensors, smart meters, and software to forecast consumption, reduce outages and monitor assets. By managing data and information, eSmart System allows utility companies to optimise their grids for efficiencies, allowing for predictive maintenance, and cost savings[46].

Traffic Control and Optimisation

Traffic Control and Optimisation:

- WHAT: Seeks to manage traffic and parking in cities in a smarter, efficient and more fluent way, through intelligent sensors, real-time information gathering and data analytics, traffic management platforms, connected vehicles, driving support technology (high quality navigation systems) and information technologies (driver fatigue systems)
- HOW: Carbon is reduced through the increased use of efficient routes (reduced distance driven), increased efficiency of personal vehicles, and increased attractiveness of public transport
- EXAMPLE: BT and the Open University are working with Milton Keynes Council to accelerate the development of Milton Keynes into a Smart City by piloting a project aimed at citywide parking space optimisation. Hosted by BT, the established Milton Keynes' Data Hub collects and analyses parking sensor data to help drivers identify free parking spaces via roadside displays and a smartphone app. Fully deploying this solution could provide savings of at least £105 million to the city, while contributing to a reduction in traffic congestion of 50%[47].

46 SMARTer2030, GeSI and Accenture, 2015. Available online here: http://smarter2030.gesi.org/
47 The Role of ICT in Reducing Carbon Emissions in the UK, Accenture Strategy and BT, 2015.

Smart Agriculture

Smart Agriculture:

- WHAT: Efficient farming and agriculture methods (excluding marine agriculture) that involves the use of ICT such as GPS and sensors to increase resource efficiency and higher crop yields and income potential. Includes the use of advanced analytics to develop preventative cautions to environmental shocks
- HOW: Carbon reduction enabled through energy efficiency measures (reduction in energy use emissions), reduction in fertilizers used, improved manure management (resource efficiencies) and reduction in food waste
- EXAMPLE: Mobile Information Platforms can be used to share farming information such as local weather forecasts, real-time market prices and technical advice. This improved provision of information can increase yields while reducing overall pesticide and water use[48]

e-work

E-work:

- WHAT: Includes the use of cloud platforms, connections and communicating devices to facilitate daily office work between company members that typically operate from different locations. This includes the use of telework facilities/technologies (mobile working) as well as virtual business meetings
- HOW: Carbon is reduced through lower levels of daily and frequent commuting (less use of personal transport) and decrease in business trips by car and airplane
- EXAMPLE: Yazaki Corporation is a leading supplier of wire harnesses and components, primarily for the automotive industry. From its Tokyo headquarters, Yazaki runs 421 sites in 39 countries, and over 90% of its workforce work outside Japan. Yazaki chose BT's video conferencing solution to enable effective meetings to take place without the inefficiency, cost and inconvenience of travel. BT's managed video conferencing solution allows for meetings to be scheduled from a PC using a simple portal, the network connection is set up automatically and the system is ready to use straight away at the appointed time[49].

e-banking

E-commerce:

- WHAT: Improvement of current platforms and connections which enable on-line commerce/ trading of products or services using internet networks between the retailers and consumers. Includes integrated multichannel infrastructures and mobile shopping, 3D printing and delivery on demand
- HOW: Carbon is reduced through increased online shopping which in turn creates less of a requirement for trips to shops and associated lower fuel consumption
- EXAMPLE: Nearly every retailer has a presence online, enabling consumers to browse, shop, and return products from their homes. This dramatically decreases travel costs and emissions, while reducing the time input required.

48 Connected Agriculture: The role of mobile in driving efficiency and sustainability in the food and agriculture value chain, Accenture and Vodafone, 2011. Available online here: https://www.vodafone.com/content/dam/vodafone/about/sustainability/2011/pdf/connected_agriculture.pdf

49 https://www.globalservices.bt.com/uk/en/casestudy/yazaki

e-learning

E-learning:

- WHAT: Use of computerised devices in educational and learning environments, promoting valuable interactive lessons. Its main pillars are: building partnerships with quality training providers; and offering wider educational horizons by offering new accessible learning content
- HOW: Carbon is reduced through reduction in transport required in secondary and higher education as well as reduction in company travel
- EXAMPLE: The Open University is one of the world's largest universities, offering flexible learning opportunities to nearly 2 million students. It is the biggest academic institution in the UK, with over 173,000 students, however offers courses mainly over online and collaborative environments[50].

e-health

E-health:

- WHAT: Transfer of health resources and care using ICT to cover three areas: delivery of information for professionals and consumers, improving provision of public health services (e.g. education and training of health works) and enabling patients to manage their own health
- HOW: Carbon is reduced through a fall in patient transport used (through decreased requirement for travel by healthcare professionals), as well as a reduction in space used in hospitals and clinics
- EXAMPLE: A mobile solution for the Humber NHS Foundation Trusts, contracted from BT, helps transform patient care and the working patterns of clinicians while driving time savings at the Trust. The solution enables staff to provide a range of mental health, community, learning disability, and addiction services. Staff are able to access patient records, view schedules and update notes on their rounds via the mobile solution on any mobile device[51].

e-commerce

E-banking:

- WHAT: Refers to providing banking products and services through electronic delivery channels, such as internet or mobile banking. Also includes the use of digital wallets (mobile money) through apps and digital currencies (e.g. Bitcoin)
- How: Carbon is reduced through fewer consumer trips required to the bank and reduction in the required banking infrastructure and facilities (through space savings)
- EXAMPLE: Mobile banking apps are increasingly common, enabling users to track spending, transfer sums and pay bills online. Most high street banks have an online or mobile app available to consumers which can help decrease trips to the bank, and decrease the required space for high street banks.

50 The Open University, 2016. Available online here: http://www.open.ac.uk/about/main/strategy/facts-and-figures
51 SMARTer2030, GeSI and Accenture, 2015. Available online here: http://smarter2030.gesi.org/

Methodology

All data used within the report was sourced from either publicly available data or directly from the GeSI SMARTer2030 report, produced in association with Accenture Strategy. The main methodologies for each section are outlined below.

Global extrapolated figures from the SMARTer2030 report were used for the ICT enabled global carbon abatement enabled figures, as well as revenues and cost savings. For EU and country specific data, this was directly pulled out of the SMARTer2030 model (in the case of the UK and Germany), or was researched using publicly available EU-wide and country-specific data (for Italy, France and Spain).

All detailed carbon abatement figures, adoption rates and methodologies, where applicable, have been taken directly from SMARTer2030 and the associated models. Please refer directly to the SMARTer2030 report and its assumptions/methodology for any clarifications required.

Each key finding has been estimated for the geographic area covered in the associated report:

- SMARTer2030 – global potential using 9 countries to extrapolate global figures
- BT's UK report – the United Kingdom of Great Britain and Northern Ireland; and
- BT's EU report – all member countries currently members of the European Union[52].

SMARTer2030

a) Total emissions projected in 2030 – not given in the report.

b) Emissions from the ICT sector projected in 2030 – calculated based on the assumption that ICT emissions are predicted to be approximately 2% of total emissions in 2030[53], equivalent to 1.25 Gt CO2e in 2030.

c) Total estimated potential ICT-enabled abatement in 2030 – 12.08 Gt CO2e in total, including renewable energy (10.31 Gt CO2e not including renewables); renewable energy was included in this report, since the global potential for renewables is well-understood, as is the associated business proposition for how ICT could support this infrastructure.

d) Potential ICT-enabled abatement in 2030 as a multiple of footprint – if renewable energy were excluded, the global ICT potential abatement would be 8.2 times larger the emissions generated by deploying it (=10.31/1.25).

EU

a) Total emissions projected in 2030 – calculated based on the following assumptions:

- Current policy trend: 2030 emissions are predicted to be 73% of 1990 levels[54];
- EU 1990 emissions: 5.626 Gt[55]; and
- Therefore, 2030 emissions predicted to reach 4.11 Gt CO2e[56,57].

b) Emissions from the ICT sector projected in 2030 – calculated based on the assumption that ICT emissions are predicted to be approximately 2% of total emissions in 2030[58], equivalent to 0.08 Gt CO2e in 2030.

c) Estimated potential ICT-enabled abatement in 2030 – 1.53 Gt CO2e, including the renewables element of Smart Energy, as it is in this report (1.19 Gt CO2e if renewables were to be excluded).

d) Potential ICT-enabled abatement in 2030 as a multiple of footprint – the value of 18.6 (=1.53/0.08) was rounded to 19 for the purpose of the report (if renewable energy were excluded (to like for like compare with the UK value), the global ICT potential abatement would be 14.8 times the emissions generated by deploying it (=1.19/0.08).

52 EU28 member states include: Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Germany, Estonia, Ireland, Greece, Spain, France, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Malta, Netherlands, Austria, Poland, Portugal, Romania, Slovenia, Slovakia, Finland, Sweden, United Kingdom (for the purposes of the EU's INDC)

53 SMARTer2030 found that ICT emissions are predicted to be 1.97% of total emissions in 2030. This is also supported by data points from Gartner here: http://www.gartner.com/newsroom/id/503867

54 http://ec.europa.eu/clima/policies/strategies/2050/index_en.htm

55 http://www.eea.europa.eu/data-and-maps/indicators/greenhouse-gas-emission-trends-5/assessment

56 Renewable energy and the wider Smart Energy use case were included in this calculation based on specificity of data available, and the fact that emissions projections for 2030 (at current policies) are clearer about what they include - if renewable energy were not included, the total carbon abatement would be 1.45Gt

57 This calculation was compared against EEA trends and projections for EU 2030 emissions, which stated EU 2030 emissions of 4.03 Gt (source here)

58 SMARTer2030 found that ICT emissions are predicted to be 1.97% of total emissions in 2030. This is also supported by data points from Gartner here: http://www.gartner.com/newsroom/id/503867

UK

In the UK report, the Smart Energy use case was not considered as contributing to the total, additional carbon abatement potential, as this use case was already included in the current UK policies for future emissions reductions.

a) Total emissions projected in 2030 – UK 2030 emissions are predicted to reach 495 Mt CO2e, based on analysis by the Committee on Climate Change given in the fourth carbon budget, and extrapolated to 2030[59] by assuming that:

- All "at risk" and "low risk" policies would cease, and would therefore not have a material impact on expected carbon emissions; and
- Smart Energy policies already in place would remain, i.e. the 495 Mt CO2e accounts for the emissions reductions expected as a result of Smart Energy policies.

b) Emissions from the ICT sector projected in 2030 – calculated based on the assumption that ICT emissions are predicted to be approximately 2% of total emissions in 2030[60]), equivalent to 9.75 Mt CO2e in 2030.

c) Estimated potential ICT-enabled abatement in 2030 – given the 'Smart Energy' application was largely covered by UK policies, the predicted ICT abatement was adjusted to 121.7 Mt CO2e (if the Smart Energy use case were included, the total UK ICT abatement would be predicted to be 176 Mt CO2e).

d) Potential ICT-enabled abatement in 2030 as a multiple of footprint – the value of 12.48 (=121.7/9.75) was rounded to 12 for the purpose of the report (including Smart Energy, UK ICT potential abatement would be just over 18 times larger than the emissions generated by deploying it.

All sources used for analysis have been appropriately referenced within the report, or are considered "Accenture Analysis" completed by Accenture Strategy for BT.

Finally, throughout the report, final figures in USD were translated into EUR using the same exchange rate from 23 February 2016 of $1 USD = €0.91 EUR. These figures were extracted from the SMARTer2030 report and put into an EU- and country-specific context for this paper.

59 The fourth carbon budget provides projections through 2027
60 SMARTer2030 found that ICT emissions are predicted to be 1.97% of total emissions in 2030. This is also supported by data points from Gartner here: http://www.gartner.com/newsroom/id/503867

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