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ERICSSON ENERGY AND CARBON REPORT

INCLUDING RESULTS FROM THE FIRST-EVER NATIONAL ASSESSMENT OF THE ENVIRONMENTAL IMPACT OF ICT

November 2014

CONTENTS

INTRODUCTION

The continued growth of the Information and Communication Technology (ICT) sector brings with it a range of environmental challenges. As an industry leader, we are committed to understanding not only how new technology can transform society but also the environmental impact of ICT itself. We regularly forecast how this impact might change over time and seek to understand the potential of ICT to reduce the environmental impact in other sectors – the so-called enablement effect.

In the November 2014 Ericsson Mobility Report, we forecast that by 2020 the world will have 9,5 billion mobile subscriptions and that more than 90% of the world's population over 6 years old will have a mobile phone. Along with this growth we are witnessing that video is the largest and fastest growing segment of mobile data traffic. We expect it to grow by approximately 45% annually and forecast that around 55% of all global mobile data traffic will come from video in 2020, placing huge capacity demands on tomorrow's networks.[1]

OVER 90% OF THE WORLD'S POPULATION OVER SIX WILL HAVE A MOBILE PHONE

~55%

OF MOBILE DATA TRAFFIC WILL COME FROM VIDEO IN 2020.

So how can we accommodate all of this growth while still enabling a low-carbon economy? One indicator is that even with the continued growth predicted for ICT, the total ICT impact is expected to account for no more than 2% of the total global greenhouse gas (GHG) emissions in 2020.[2] This is largely due to advances in technology and an industry-wide effort to reduce energy consumption. However, in absolute terms the emission levels from ICT are still considerable and must be aggressively addressed. A concerted focus on prioritizing energy performance throughout the entire network will help identify opportunities to dramatically reduce energy consumption and thereby GHG emissions of mobile networks.[3]

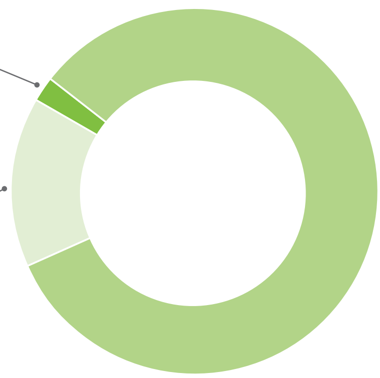
On the other hand, another encouraging factor is the potential of the ICT sector to provide solutions that reduce global GHG emissions in other sectors. For example, with the help of video conferencing and other ICT-enabled technologies, virtual meetings may make it possible to reduce the need for travel. In this respect, ICT can be an enabler for reducing the other 98% of GHG emissions not related to ICT's own impact. Studies show that this potential reduction is in the order of one sixth of global GHG emissions, as illustrated below.[4], [5]

This report focuses on the ICT sector's own environmental impact in terms of electricity use and GHG emissions. It also includes an update of our 2020 forecast for GHG emissions of ICT. In addition, we present the first-ever national assessment of the total GHG emissions attributable to the ICT sector. Finally, we present a detailed study of the life-cycle impact of a smartphone. The results presented here are based on close research collaborations with Swedish telecom operator TeliaSonera, the KTH Royal Institute of Technology in Stockholm and Sony.

World total GHG emissions

<2%

The ICT sector's impact on total global GHG emissions is less than 2%.



Potential reduction of approximately one sixth of the global GHG emissions due to use of ICT.

GLOBAL GHG EMISSIONS FROM ICT

In last year's Ericsson Energy and Carbon Report, we estimated that the total carbon footprint for the ICT sector would be about 1,100 million tonnes by 2020.[2] Our continued research confirms that this figure still holds true. The total ICT sector's share of the global carbon footprint is estimated to increase from 1.3% in 2007 to about 2% in 2020.[6]

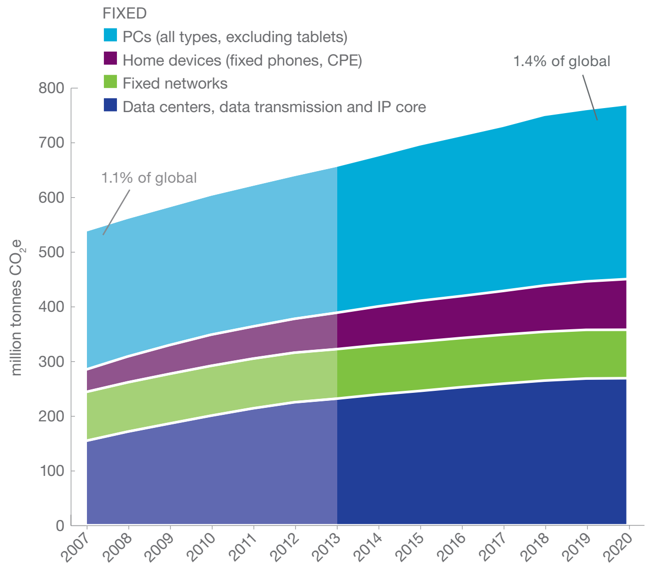
For fixed ICT networks, it is estimated that the share of GHG emissions will be 1.4% in 2020, as shown in the left-hand graph below. The level of GHG emissions is expected to flatten out somewhat towards 2020. This trend is being driven by technological advances and changes in use and operation, particularly as regards PCs and data centers.

Although GHG emissions due to mobile ICT networks are continuously increasing, they remain significantly smaller than those attributable to fixed ICT networks. It is estimated that mobile networks will grow somewhat faster than fixed networks and represent about 0.5% of the global GHG emissions up to 2020, as shown in the right-hand graph below. This increase is primarily due to user equipment such as mobile devices, PCs and other connected devices. GHG emissions due to the mobile access portion of the total mobile ICT network will increase only slightly and are expected to decrease in relative terms through 2020.

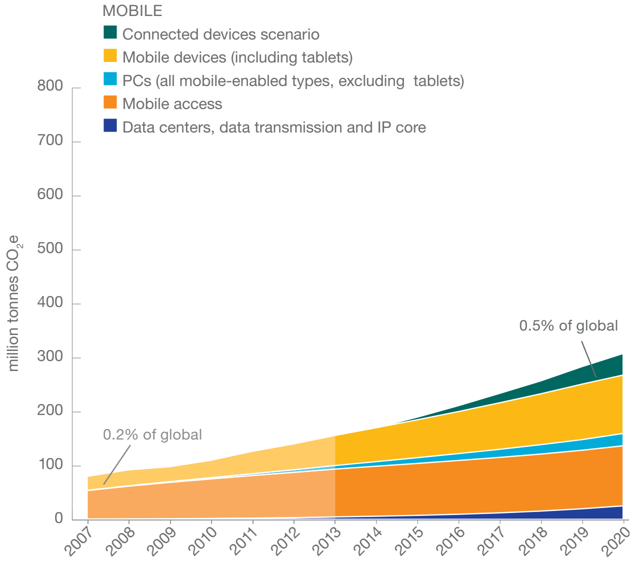
FIXED ICT **1.4%** OF GLOBAL GHG EMISSIONS IN 2020

MOBILE ICT **0.5%** OF GLOBAL GHG EMISSIONS IN 2020

Total GHG emissions from fixed ICT networks



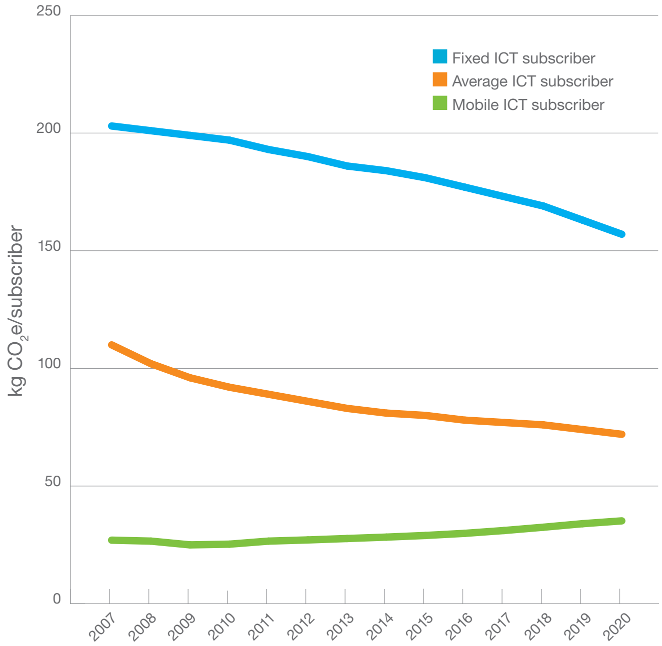
Total GHG emissions from mobile ICT networks



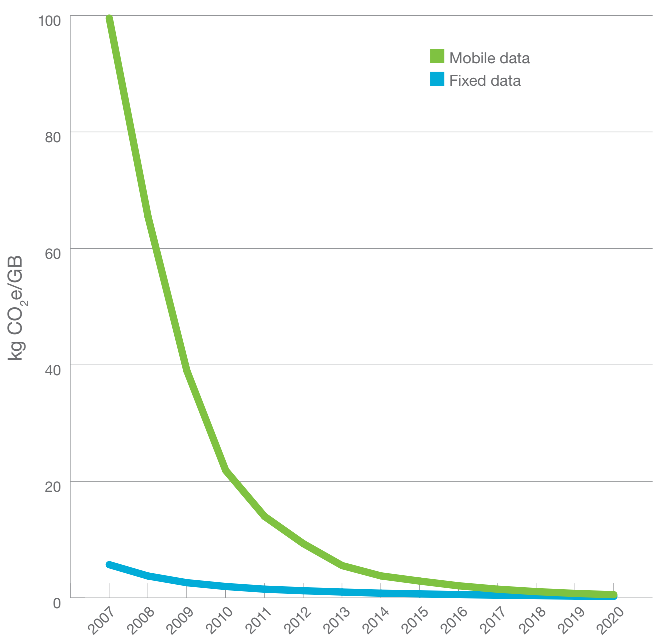
One way to place GHG emissions from ICT into context is to present the results on a per user basis. Since 2007, GHG emissions per average fixed user have declined, while emissions due to mobile usage have increased. For fixed networks, the main driver behind this trend is the smaller user equipment, i.e. moving from desktop PCs to laptops, while for mobile networks, the user equipment gets more advanced, i.e. smartphones and tablets. On a global basis, the GHG emissions per capita for ICT are estimated to increase from 100 kg in 2007 to about 130 kg in 2020, as shown in the left-hand graph below. It is also expected that individual users will have more subscriptions and devices in the future.[6]

Interestingly, the rapid increase in data capacity is not having a significant impact on the overall carbon footprint of the ICT sector. It is estimated that GHG emissions per amount of fixed data transmitted will decrease from nearly 6 kg CO_2e/GB in 2007 to about 0.25 kg CO_2e/GB in 2020, as shown in the right-hand graph below. For mobile data, the estimated decrease is even larger – from about 100 kg CO_2e/GB to about 0.5 kg CO_2e/GB during the same period. The share of data used in mobile ICT networks is estimated to increase from less than 1% in 2007 to about 15% of all data in 2020.[6]

GHG emissions per subscriber



GHG emissions per amount of data



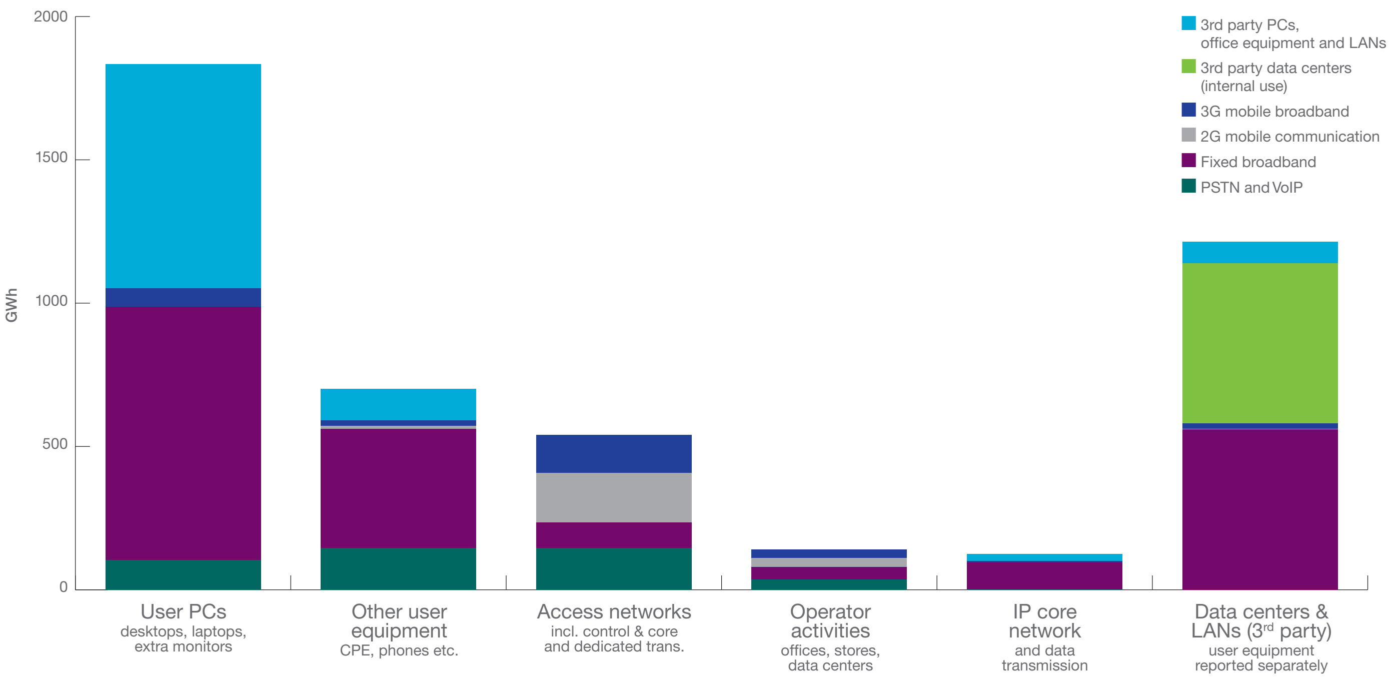
TOTAL IMPACT OF ICT IN SWEDEN

In 2014, a national-level study of the life cycle environmental impact of ICT was published together with TeliaSonera and KTH Royal Institute of Technology in Stockholm. This unique study is based on available statistical data from 2010.

Our results show that the ICT sector in Sweden consumed about 4,600 GWh of electricity in 2010. The main electricity-consuming categories were user PCs, data centers (servers) and other user equipment (customer premises equipment, CPE), as shown in the graph below. These areas also offer the largest potential for reducing electricity consumption.[7]

The ICT sector comprises everything from end-user equipment to the access networks and data centers. Our definition of "ICT network" extends from mobile and fixed-access networks (including broadband) to data transmission and the IP core network. User equipment is defined as everything from fixed and mobile phones to modems, computers and set-top boxes for IPTV. To provide a more complete picture, the enterprise networks as well as operators' own activities in terms of offices, stores, travel and vehicles are included. Life-cycle assessment data were collected for the vast majority of included products.

Total electricity consumption of ICT in Sweden 2010

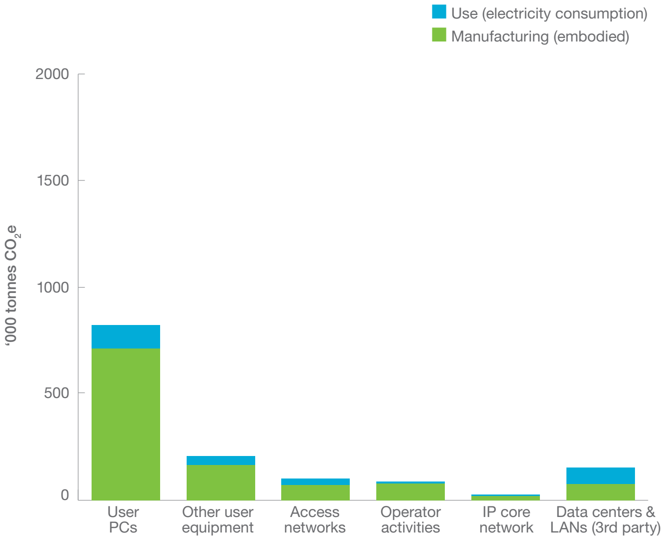


The total GHG emissions due to the ICT sector in Sweden amounted to approximately 1.5 Mtonnes CO_2e in 2010. This corresponds to 1.2% of total Swedish GHG emissions.[7]

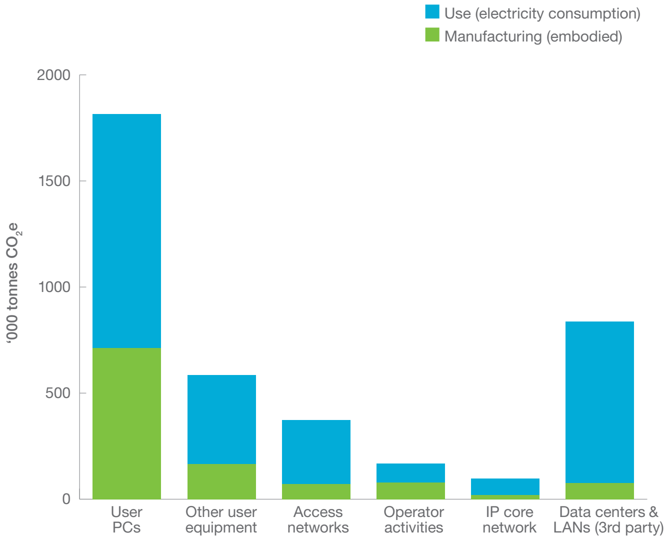
Electricity production in Sweden has about one-tenth of the GHG emissions per kilowatt hour (kWh) compared to the world average. Consequently, to place the results of our national study in a global context it is relevant to replace the Swedish electricity mix, with a global electricity mix.

When applying a global average electricity mix to the ICT model for Sweden, the relationship between the manufacturing and use stage changes considerably for all parts, as shown in the graphs below. The operational electricity consumption contributes to a larger share of the overall emissions, when applying the global electricity mix. For instance, for user PCs, the share of the use stage increases from 13% to 60% of the total impact.[7]

Total GHG emissions of ICT in Sweden 2010 – Swedish electricity mix



Total GHG emissions of ICT in Sweden 2010 – global electricity mix in the use stage

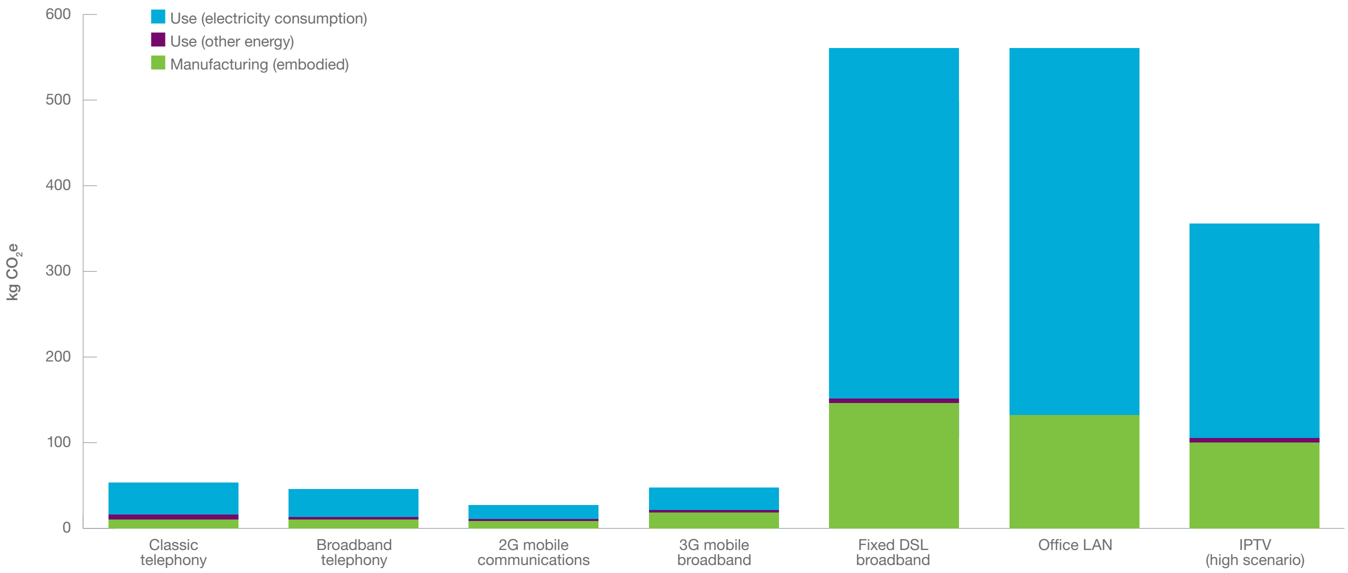


Our experience shows that, with a global electricity mix, the Swedish ICT sector can be used as a proxy for the global impact of ICT per subscriber.

In our study, the annual GHG emissions for an average Swedish subscription, recalculated with global electricity mix, ranges from 34 kg CO_2e for 2G mobile communications up to about 560 kg CO_2e for a fixed (xDSL) broadband subscription or a workplace (LAN) PC, as shown in the graph below.[7]

The main reasons for the relatively large impact for fixed subscription types are that the average subscriber has a greater number of user equipment connected to the fixed network and these devices are, on average, physically larger compared to mobile user equipment. Fixed ICT networks also carry the majority of the transmitted data, resulting in a larger share of GHG emissions being allocated from data centers.[7]

Annual GHG emissions for different average subscriptions in Sweden 2010 – global electricity mix in the use stage



GHG EMISSIONS OF A SMARTPHONE

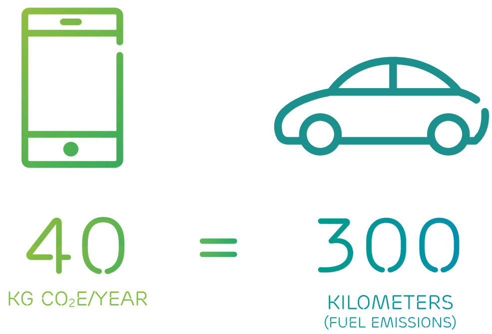
Our assessment of the total impact of ICT in Sweden is built on data collected for many different product types, including end-user equipment like smartphones.

A life cycle assessment (LCA) of a smartphone, concluded recently together with Sony, provides the smartphone model used in the larger study of the total impact of ICT. The smartphone LCA results are presented here using a global electricity mix in the use stage.

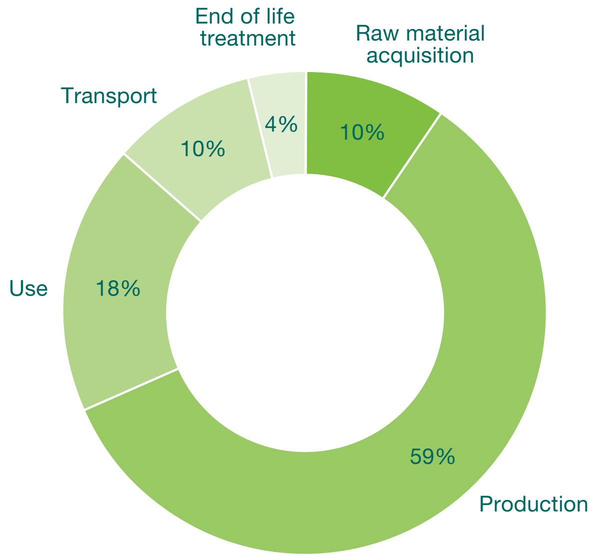
GHG emissions for a smartphone, including accessories and the use of the network, are assessed to be 40 kg CO_2e per year for an average usage scenario over a three-year life time. This is equivalent to the emissions from driving an average car for about 300 km. About 55% of the GHG emissions are attributable to the smartphone itself, whereas 42% are related to the networks and only 3% to the accessories such as the charger and headset.[8]

For the smartphone itself, the majority of the GHG emissions are related to production, as shown in the chart.

LIFE CYCLE IMPACT
(INCLUDING ACCESSORIES & NETWORK)



Total lifetime GHG emissions for one Sony Xperia™ phone



KEY FIGURES

Table A: ICT's share of global GHG emissions.[6]

ICT NETWORK	2007	2020
Fixed ICT	1.1 %	1.4 %
Mobile ICT	0.2 %	0.5 %
TOTAL ICT	1.3 %	1.9 %

Table B: Annual life cycle GHG emissions by subscription type in Sweden for Swedish and global electricity mix in the use stage.[7],[8]

SUBSCRIPTION	DESCRIPTION	ANNUAL GHG EMISSION		
		Swedish electricity	Global electricity	Unit
Classic telephony	1 subscription/line, 1 cordless and 1 analog phone per telephony subscriber	20	51	kg CO_2e
Broadband telephony	1 cordless and 1 analog phone per telephony subscriber (3-play share)	14	48	kg CO_2e
2G mobile subscription	1 subscription, 1 mobile phone	16	34	kg CO_2e
3G mobile subscription – average	1 subscription, 1 average mobile device (incl. PC, phone)	24	50	kg CO_2e
3G smartphone subscription	1 subscription, 1 smartphone[8]	23	40	kg CO_2e
Fixed DSL broadband	1 subscription/line, 1.5 home PCs, 1.5 CPE boxes	216	560	kg CO_2e
Office LAN PC	1 office PC, LAN share including office equipment	180	561	kg CO_2e
IPTV (high use)	1 TV+set-top-box (STB), 0.43 gateway (3-play share)	131	356	kg CO_2e

Table C: Overview of electricity consumption and GHG emissions from production for total ICT sector in Sweden 2010.[7]

ICT SECTOR PART	AMOUNT	ELECTRICITY CONSUMPTION	GHG EMISSIONS FROM PRODUCTION
User equipment			
Fixed phones	~ 11 million	150 GWh	12 ktonnes CO_2e
Mobile phones	~ 10.5 million (one per active subscription)	30 GWh	84 ktonnes CO_2e
PCs	~ 8.5 million	1,850 GWh	790 ktonnes CO_2e
Fixed modems, routers and gateways	~ 4 million	330 GWh	16 ktonnes CO_2e
TVs and set-top-boxes related to IPTV	~ 0.35 million	95 GWh	17 ktonnes CO_2e
Network equipment and operators' operation and maintenance			
Fixed phone network	5.4 million active phone lines, including local and central phone switches	145 GWh	39 ktonnes CO_2e
Mobile network	29,000 base stations, also including central mobile nodes (from 3 national GSM networks and 2 national 3G networks)	306 GWh (172 GWh GSM and 134 GWh 3G)	37 ktonnes CO_2e
Broadband access	2.8 million active lines	90 GWh	3 ktonnes CO_2e
Core networks (IP networks and data transport networks)	Tens of thousands of nodes and hundreds of thousands of direct links	130 GWh	19 ktonnes CO_2e
Operator activities	4 national operators including offices, stores, own data centers, business trips and service cars	140 GWh (+250 GWh other primary energy)	Not included
Data centers & local networks and other ICT office equipment	2.1 million fixed active LAN ports with a connected PC, 330,000 active servers plus projectors and equipment for online conferences	1,300 GWh (of which data centers are 1,130 GWh)	90 ktonnes CO_2e
TOTAL ICT	12.1 million mobile subscriptions, 10.5 million mobile phones, 5.4 million active phone lines, 2.8 million active fixed broadband	4,600 GWh (+250 GWh other primary energy)	1,100 ktonnes CO_2e

DEFINITIONS & REFERENCES

The research presented in this Energy and Carbon Report was conducted at Ericsson Research, in collaboration with internal company experts, customers and partners. Models, system boundaries and data projections used affect the results. Some numbers presented in this report may differ from previous reports and this shall not be seen as a change of position from Ericsson. All details can be found in the references. Latest estimates on market developments will always be found in the Ericsson Mobility Report.[1]

> **Greenhouse gases (GHG).** A greenhouse gas is any of the gases whose absorption of solar radiation is responsible for the so-called greenhouse effect. Earth's natural greenhouse effect makes life as we know it possible. However, human activities, primarily the burning of fossil fuels and clearing of forests, have intensified the natural greenhouse effect, causing global warming. Greenhouse gases include carbon dioxide (CO_2), methane, nitrous oxide and ozone. GHG emissions are measured in CO_2 equivalents (CO_2e). When calculating CO_2e, other emissions and effects are normalized to the global warming potential of CO_2 over 100 years.

> **Carbon footprint.** Carbon footprint is used to denote the total amount of GHG emissions associated with a product or service over its entire lifetime based on a standardized life cycle assessment (LCA) method. It is measured in CO_2e. While carbon footprint is used to estimate the impact of a product or service over its lifetime, this should not be confused with direct energy consumption: the measurement of energy needed to operate the same product or service. The energy consumption for operation of a product may in economic terms be compared to (and have a direct impact on operational costs) OPEX, while a similar economic comparison for an LCA would look at the life-cycle costs, including all investment, running, service, maintenance and disposal costs.

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EXTERNAL LINKS

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Ericsson is the driving force behind the Networked Society – a world leader in communications technology and services. Our long-term relationships with every major telecom operator in the world allow people, businesses and societies to fulfill their potential and create a more sustainable future.

Our services, software and infrastructure – especially in mobility, broadband and the cloud – are enabling the telecom industry and other sectors to do better business, increase efficiency, improve the user experience and capture new opportunities.

With more than 110,000 professionals and customers in 180 countries, we combine global scale with technology and services leadership. We support networks that connect more than 2.5 billion subscribers. Forty percent of the world's mobile traffic is carried over Ericsson networks. And our investments in research and development ensure that our solutions – and our customers – stay in front.

Founded in 1876, Ericsson has its headquarters in Stockholm, Sweden. Net sales in 2013 were SEK 227.4 billion (USD 34.9 billion). Ericsson is listed on NASDAQ OMX stock exchange in Stockholm and the NASDAQ in New York.

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