ERICSSON

Research brief

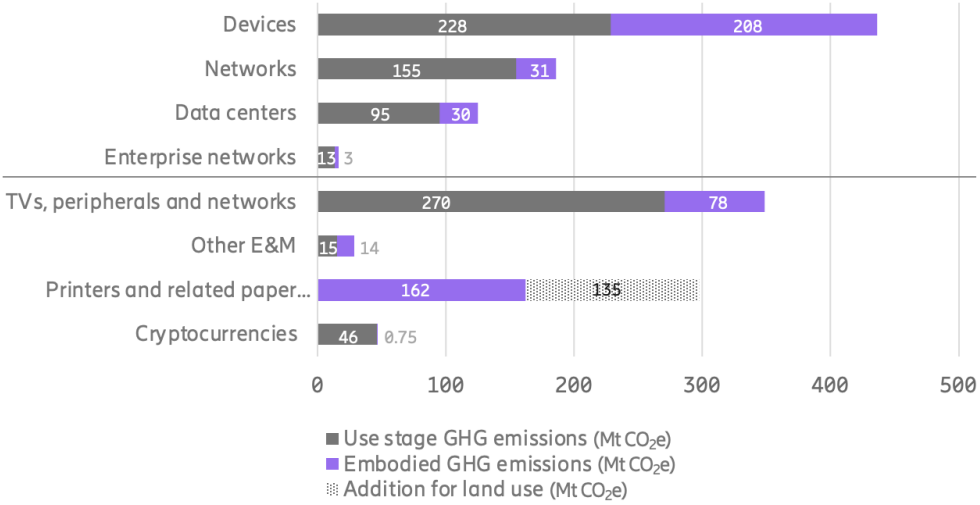
# ICT used about 4% of the global electricity in the use stage while in total representing about 1.4% of the global GHG emissions in 2020

The ICT sector's total greenhouse gas (GHG) emissions were about 5% higher than in 2015. ICT's share of global GHG emissions of 1.4% was about the same as in 2015, while the share of use stage electricity increased somewhat. Use stage GHG emissions relating to electricity use represent the majority of the total GHG emissions. User devices accounted for over half of all GHG emissions in the ICT sector, with equal parts relating to use stage and other lifecycle stages. Networks and data centers are dominated by use stage GHG emissions.

**GHG emissions in the ICT sector: use stage as the dominant contributor**

In 2020, the total greenhouse gas (GHG) emissions from the Information and Communication Technology (ICT) sector were about 764 million metric ton carbon dioxide equivalents (Mt $CO_2e$) which is 5% higher than in 2015. About 64% of ICT's GHG emissions relates to the use stage, mainly the electricity in the operation of the equipment. The remaining 36% relate to the other life cycle stages (raw material acquisition, production and end of life), often referred to as embodied emissions. A large part of the embodied GHG emissions is also related to electricity use from raw material acquisition and production.

The ICT sector is divided into three main parts: user devices including internet-of-things (IoT), networks and data centers. The graphs below show the GHG emissions divided into use stage and embodied emissions for the ICT sector in 2020.




The related entertainment and media (E&M) sector dominated by TVs, TV peripherals, and TV networks is estimated to about 350 Mt $CO_2$e in total – corresponding to 0.65% of global GHG emissions. This is about 12% higher than the combined emissions from ICT networks and data centers.

**User devices responsible for over half of GHG emissions**

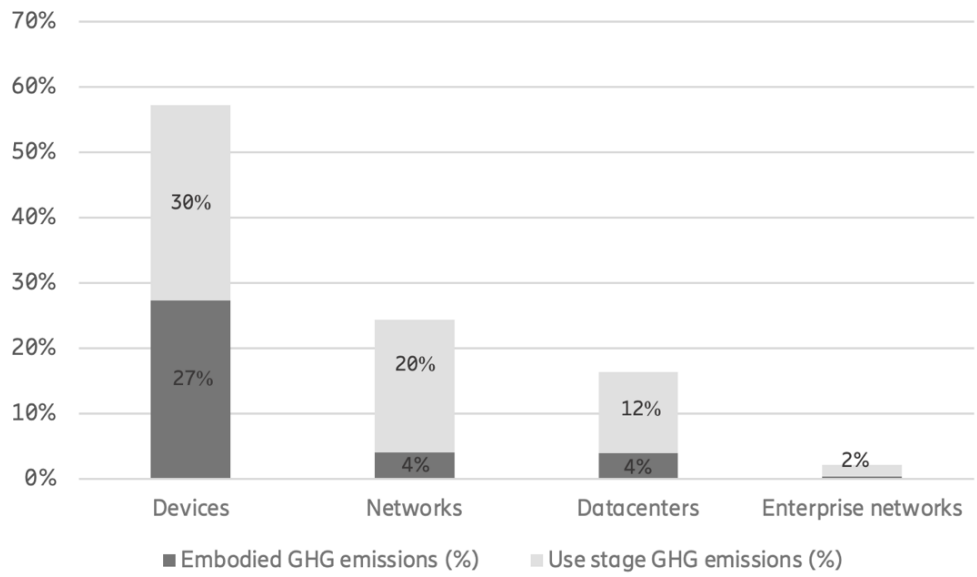
The user devices accounted for over half (about 57%) of all GHG emissions from the ICT sector, with about equal parts relating to use stage and other lifecycle stages.

For the most common user devices for mobile communication – feature phones, smartphones, tablets, laptop and desktop PCs and the related PC displays and customer premises equipment (CPE), the total embodied GHG emissions for 2020 are estimated to about 180 Mt $CO_2$e. The rest of the ICT devices have embodied GHG emissions of about 17 Mt $CO_2$e.

**Mobile networks the dominating contributor to GHG emissions**

For networks, the use stage GHG emissions are dominating with 155 Mt $CO_2$e and stands for about 20% of the ICT sector's total GHG emissions, while the network's embodied emissions stand for about 4% (31 Mt $CO_2$e). Total electricity consumption for network operations in 2020 are estimated to 247 TWh. The majority part, 161 TWh, is consumed by mobile networks, while fixed broadband consumed 60 TWh and fixed telephony consumed 23 TWh. In addition, it is estimated that enterprise networks globally consume 25 TWh per year.

The use stage electricity consumption per subscription in 2020 was in total 24 kWh/subscription (mobile and fixed) and the total GHG emission per subscription was 18 kg $CO_2$e/subscription.




**Most GHG emissions from data centers origin from the use stage**

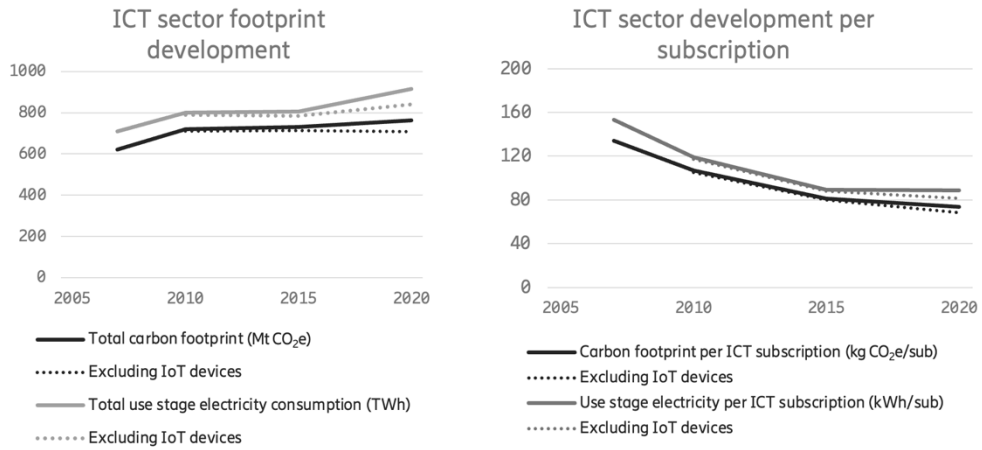
The total electricity consumption for data centers, including support activities, is estimated to 223 TWh for 2020. Combining reported data with extrapolation using the global average electricity grid emission factor result in 95 Mt $CO_2$e for the operation of data centers. The total embodied GHG emissions for data centers in 2020 are estimated to 30 Mt $CO_2$e, which includes 23 Mt $CO_2$e for data center hardware and the rest relates to data center buildings and other non-electronic infrastructure.

**Development over time: the stable carbon footprint of ICT sector**

The ICT sector represents about 1.4% of the global GHG emissions including land use effects presented by UNEP (2022)[1]. The annual GHG emissions per subscription have decreased compared to 2015, from 81 kg $CO_2$e/subscription to 74 kg $CO_2$e/subscription. However, the annual use stage electricity consumption has remained at 89 kWh/subscription between 2015 and 2020. The changes in GHG emissions can be explained by more renewables in the electricity mix overall, and additional renewables used in datacenter operations but also in network operations. This has also helped to keep the sector's total GHG emissions stable.

[1] United Nations Environment Programme. (2022). Emissions gap report 2022: The closing window — climate crisis calls for rapid transformation of societies. Nairobi, Kenya.

The left graph below shows the development of the ICT sector's operational electricity consumption and total life cycle GHG emissions from 2007 until 2020, using also data from an older study[2]. In the same time period, the global data traffic increased about 40 times[3] while the ICT sector's GHG emissions and use stage electricity has stayed almost the same if excluding the IoT devices´ impact (see dotted lines).




An increased number of ICT subscriptions has led to a decrease in electricity consumption and GHG emissions per subscription 2007–2020 (right graph), but the decrease has slowed down and electricity consumption per subscription is similar in 2020 compared to 2015.The main reason for the decrease is the high growth of mobile subscriptions together with the low network and mobile device electricity consumption per subscription. Note that the IoT subscriptions are not included in the number of subscriptions while electricity consumption and GHG emissions related to IoT are included. If excluding the impact related to IoT devices from the total GHG emissions and use stage electricity consumption, the total sector footprint would be lower, as indicated with dotted lines in the figure above.

**Data quality and alignment with ITU**

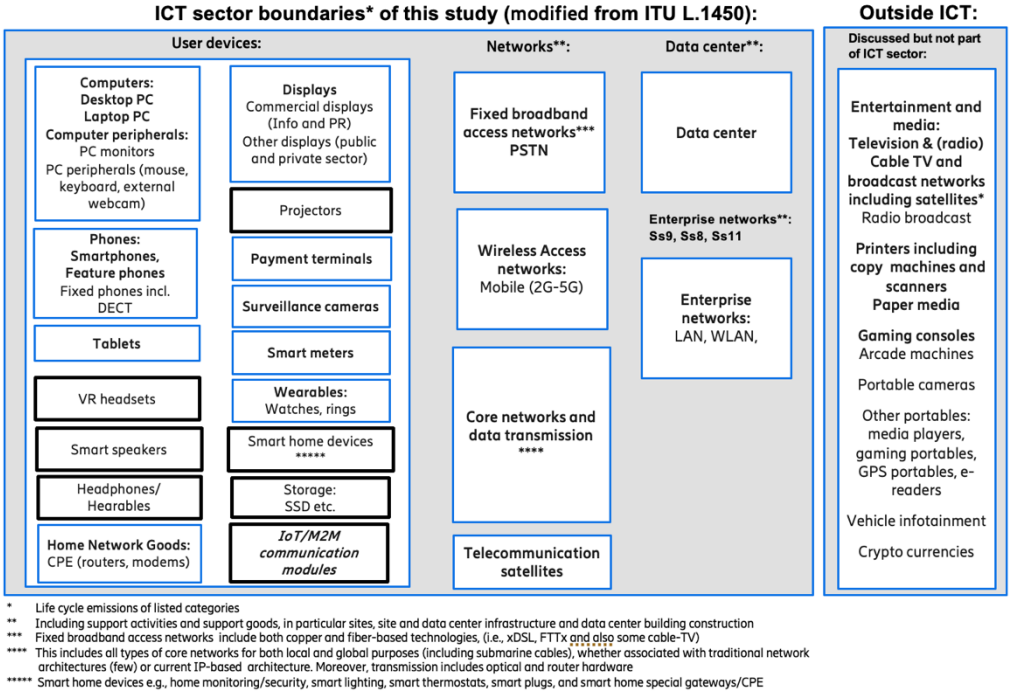
The study has used the standard ITU L.1450[4] as its methodological basis. However, it also includes additional categories and by that expands the scope beyond the standard to also cover emerging categories of equipment such as virtual reality (VR) devices, see figure.

[2] Malmodin, J., & Lundén, D. (2018). The energy and carbon footprint of the global ICT and E&M sectors 2010-2015. Sustainability, 10, 3027.

[3] Cisco. (2015). The history and future of internet traffic. Blog from August 2015.
IEA. (2022). Data centres and data transmission networks. Paris, France.

[4] International Telecommunications Union, (ITU-T). (2018). L.1450 Methodologies for the assessment of the environmental impact of the information and communications technology sector. Geneva, Switzerland, 2018.

The study builds on a high number of data sources including measured and reported data from about 150 companies that is estimated to cover about 80% of network subscriptions, about 55% of data center electricity, and about 35% of the upstream GHG emissions.




**Reference to full paper:**

Malmodin J, Lövehagen N, Bergmark P, Lundén D. (2023). ICT sector electricity consumption and greenhouse gas emissions – 2020 outcome - ScienceDirect. Volume 48, Issue 3, April 2024, 102701.