

LCA of multifunctional devices, networks and digital services - an industry perspective

73rd Discussion Forum on Life Cycle Assessment
21st Nov 2019, Wädenswil, Switzerland





**Forget all figures you have
seen about streaming!**
Streaming is extremely
efficient and net
positive!

73rd Discussion Forum on Life Cycle Assessment
21st Nov 2019, Wädenswil, Switzerland

Global warming



Law of nature:

More CO₂e

=

More heat

It gets hotter...

Global carbon footprint



billion ton CO₂e / year



1988

James Hansen in US Congress
CO₂ level in atmosphere passed
350 ppm, labeled as *safe*
noting *it may be less*

2019:

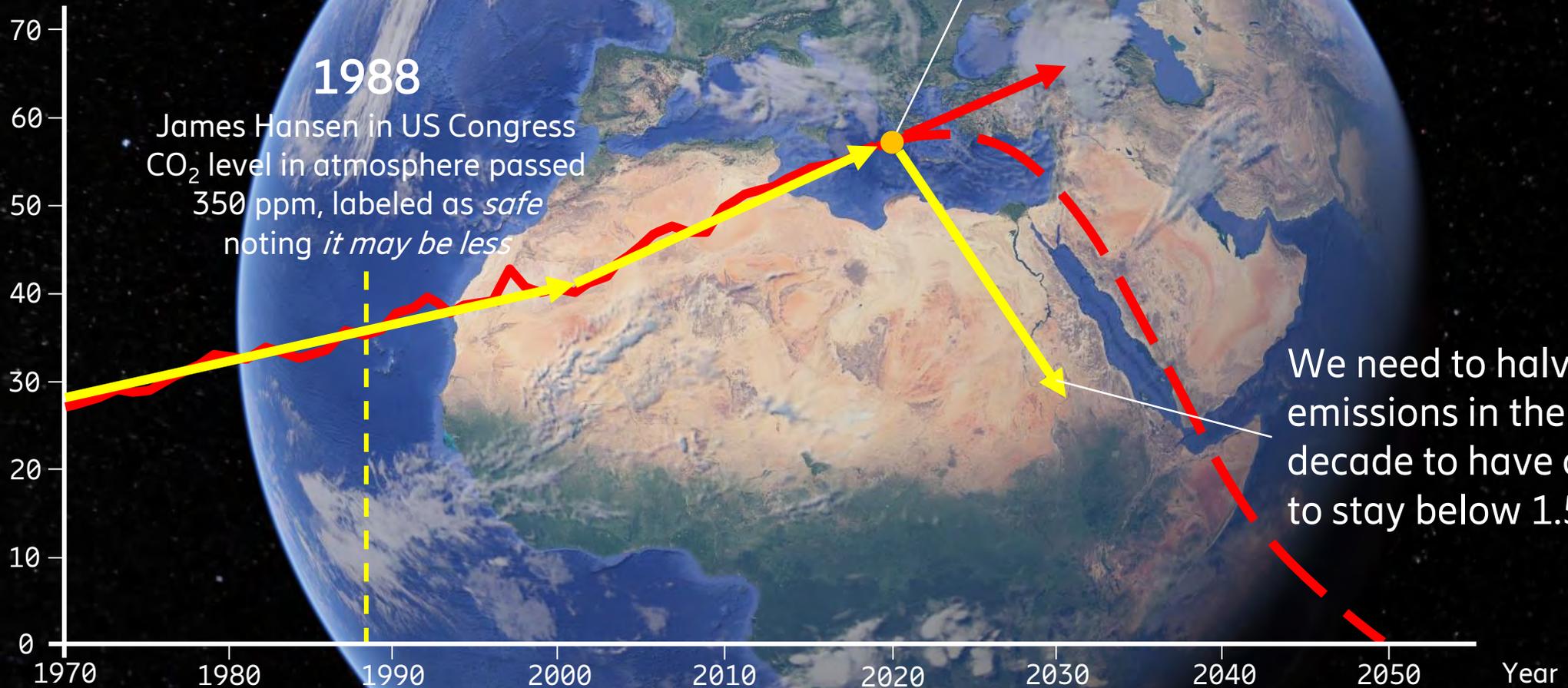
~ 56 billion ton CO₂e / year
~ 410 ppm (~ 470 ppm for all GHG's)

We need to halve
emissions in the next
decade to have a chance
to stay below 1.5°C

Global carbon footprint



billion ton CO₂e / year



How do we define "ICT"?



ICT

Information (IT) and
Communication (telecom)
Technology

Mobile devices



Networks



PCs



Data centers



E&M

Entertainment (music, film)
and Media (TV, paper)



Other EEE

Other electrical and
electronics equipemnt

Buildings/HVAC

Home appliances

Vehicles

Health care

Industry (motors)

Tools

Security

Finance

Aerospace

Military

How do we define "ICT"?



ICT

Information (IT) and
Communication (telecom)
Technology

Mobile devices



Networks



PCs



Data centers



Trend 1



E&M

Entertainment (music, film)
and Media (TV, paper)



Trend 2



Other EEE

Other electrical and
electronics equipemnt

Buildings/HVAC

Home appliances

Vehicles

Health care

Industry (motors)

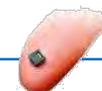
Tools

Security

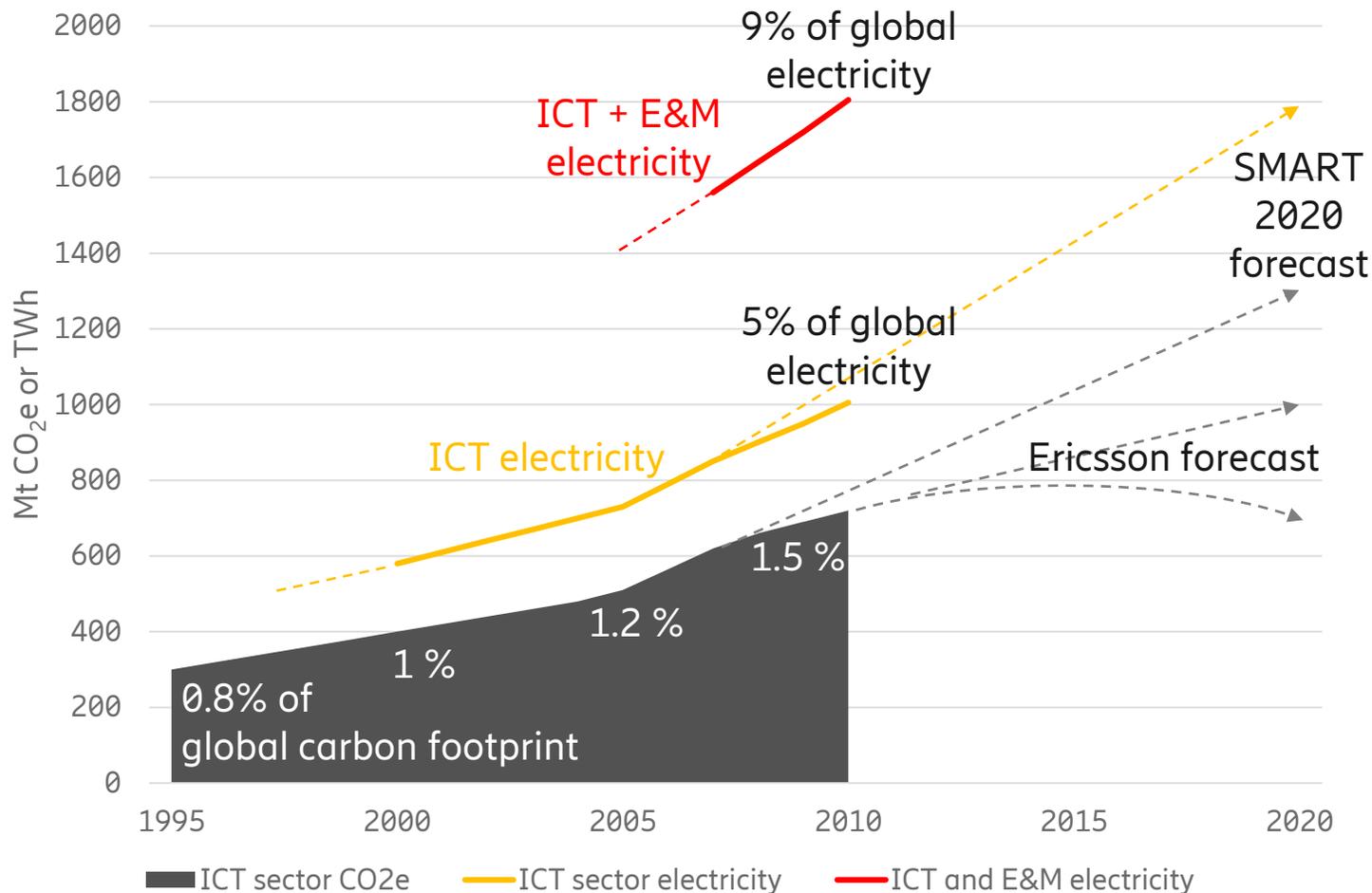
Finance

Aerospace

Military

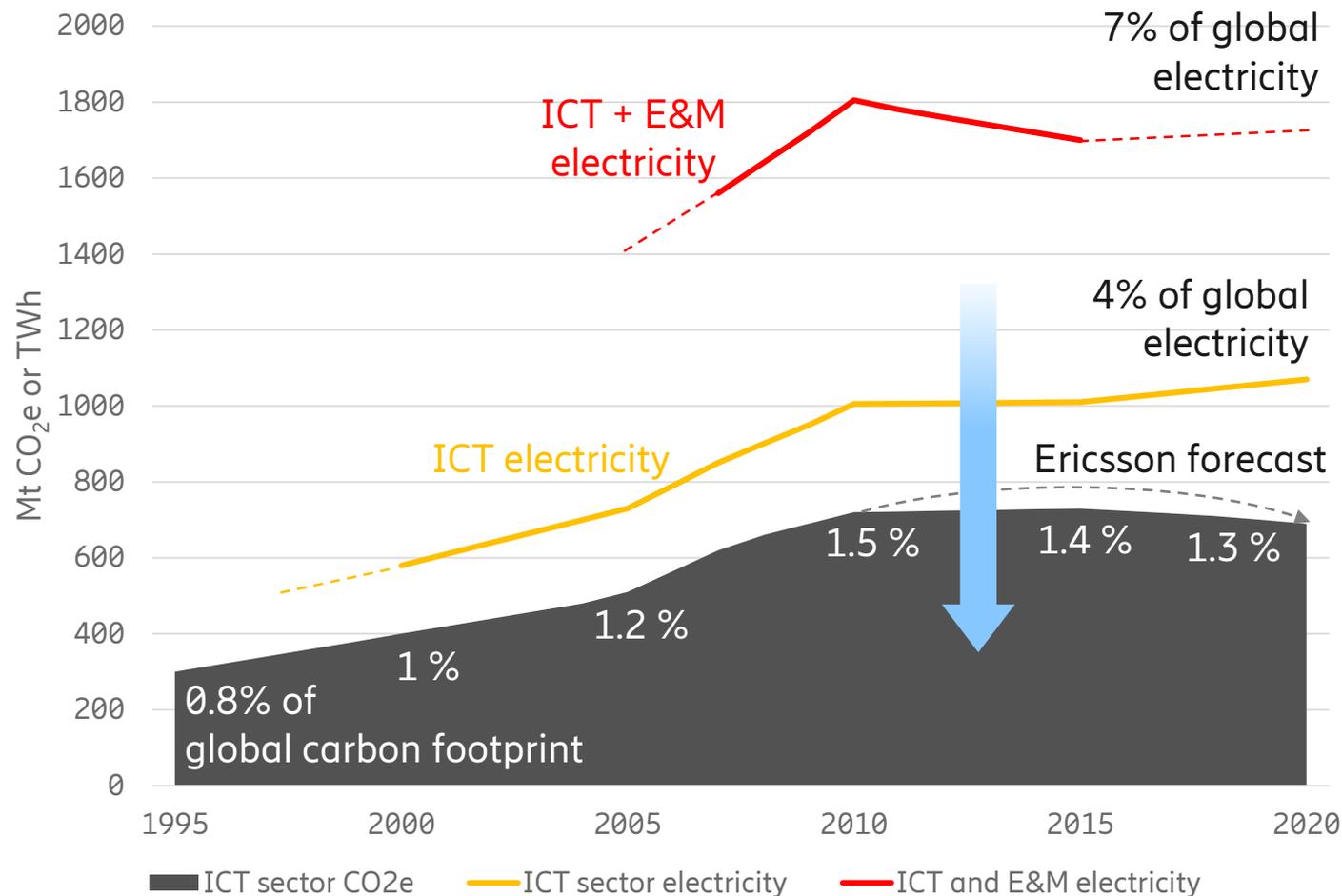


ICT and E&M sector "footprints" to 2010



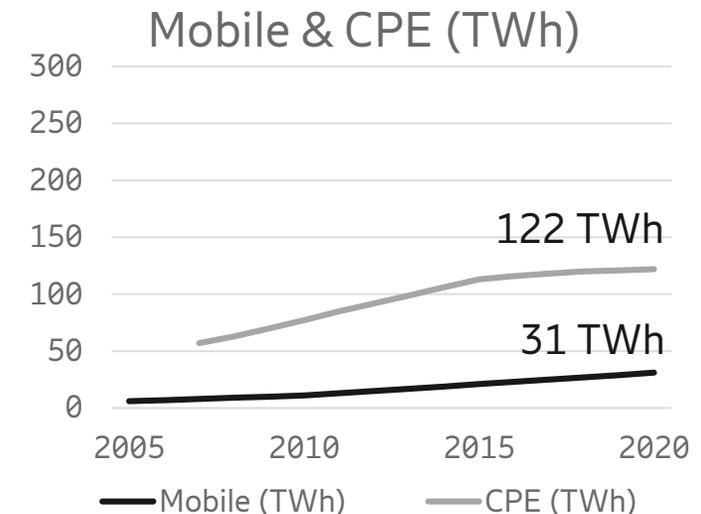
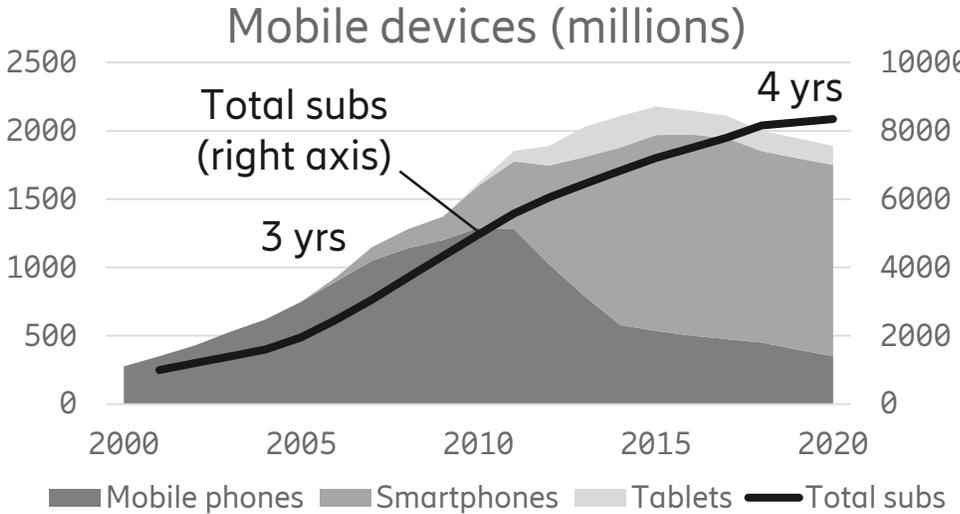
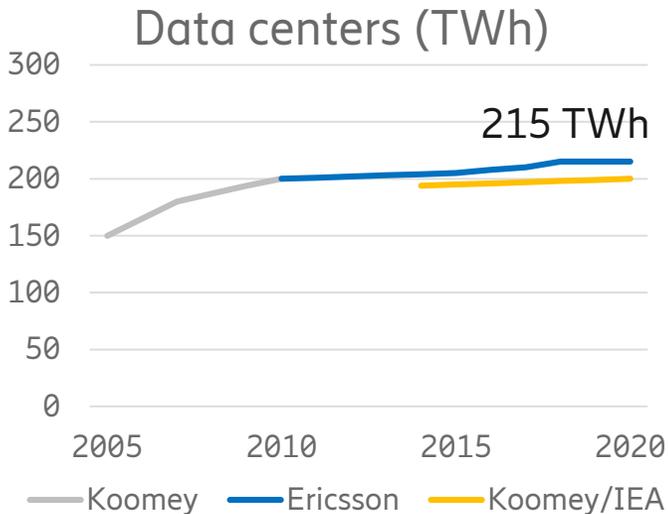
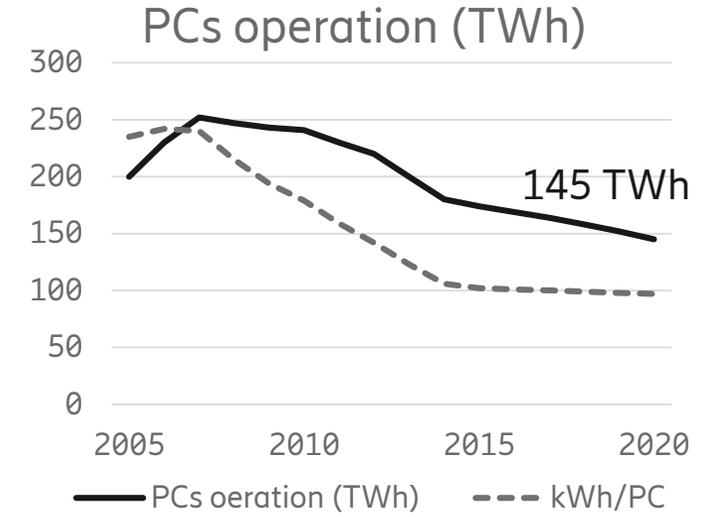
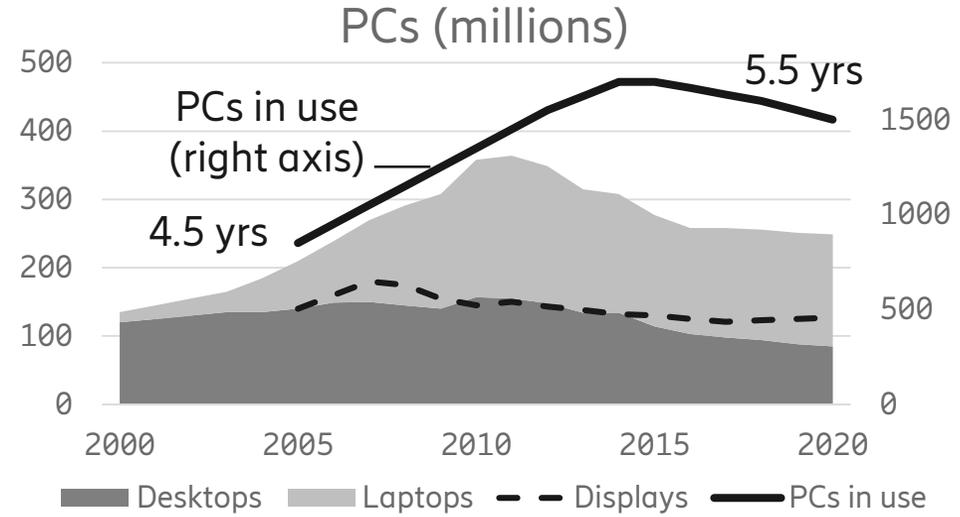
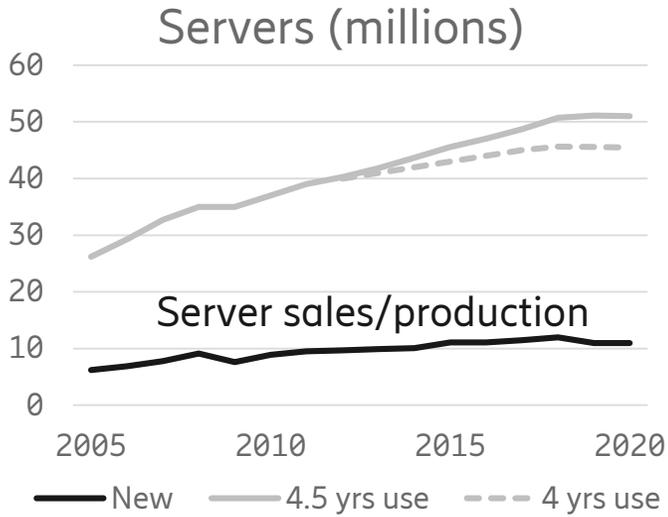
- Relative fast growth to 2010, especially 2005-2010 due to growth of PCs
- ICT sector's carbon footprint 2010: 720 Mt CO₂e 1.5% of the global total (including all manufacturing)
- Nearly all forecasts estimated a continuing growth to 2020
- ...but not this one: "All households can have laptop PCs and all people mobile devices in 2020 with the same footprint as today" - Ericsson @OECD 2008

ICT and E&M sector "footprints" to 2020



- Major trend shift!
- PC and TV sales peaked around 2010 and has decreased since
- Nearly all forecasts made before was wrong by a large margin (not all...)
- New energy efficient display technologies played a key role
- Use and sales "moved" from E&M to ICT and within ICT to smaller energy efficient mobile devices - Dematerialization!
- Added M2M/IoT has a very small footprint
- Renewable electricity!

Our proof



Our proof 2: Data from 100+ companies



Data centers:

- Google: 10.1 TWh
- Amazon: 9.5 TWh
- Microsoft: 7.6 TWh
- Facebook: 3.4 TWh
- Apple: 2.2 TWh
- Oracle: 1.3 TWh

Alibaba, Tencent, Baidu,
JD.com, Ant FSG: no data...

34+10+X = 230 TWh

(incl. 15 TWh offices, stores etc.)
+25 TWh for Enterprise networks

19% primary data

Networks:

- China Mobile: 24.5 TWh
- China Telecom: 17.1 TWh
- AT&T: 14.3 TWh
- China Unicom: 14.2 TWh
- Verizon: 9 TWh
- NTT: 8.3 TWh
- DT: 7.9 TWh
- Telefonica: 6.7 TWh
- America Móvil: 6 TWh

108+56+Y = 245 TWh

(incl. 20 TWh offices, stores etc.)

67% primary data

User devices (manufacturing):

- Samsung: 20.6 TWh
- TSMC: 12 TWh
- Foxconn: 8.9 TWh
- LG Display: 8.3 TWh
- SK Hynix: 8.2 TWh
- Intel: 6.7 TWh
- Micron: 5.6 TWh
- Innolux: 5.5 TWh
- AUO: 5.1 TWh

81+37+Z = 217 TWh

54% primary data
+ 340 TWh operation

This is a more than 10 year old figure...



Calculator



Media player



Stereos



TV



Radio



GPS



Camera(s)



Games!



Clock



Personal post box



Wallet



...can dematerialize...



Keys



...even PCs

Your mobile device...

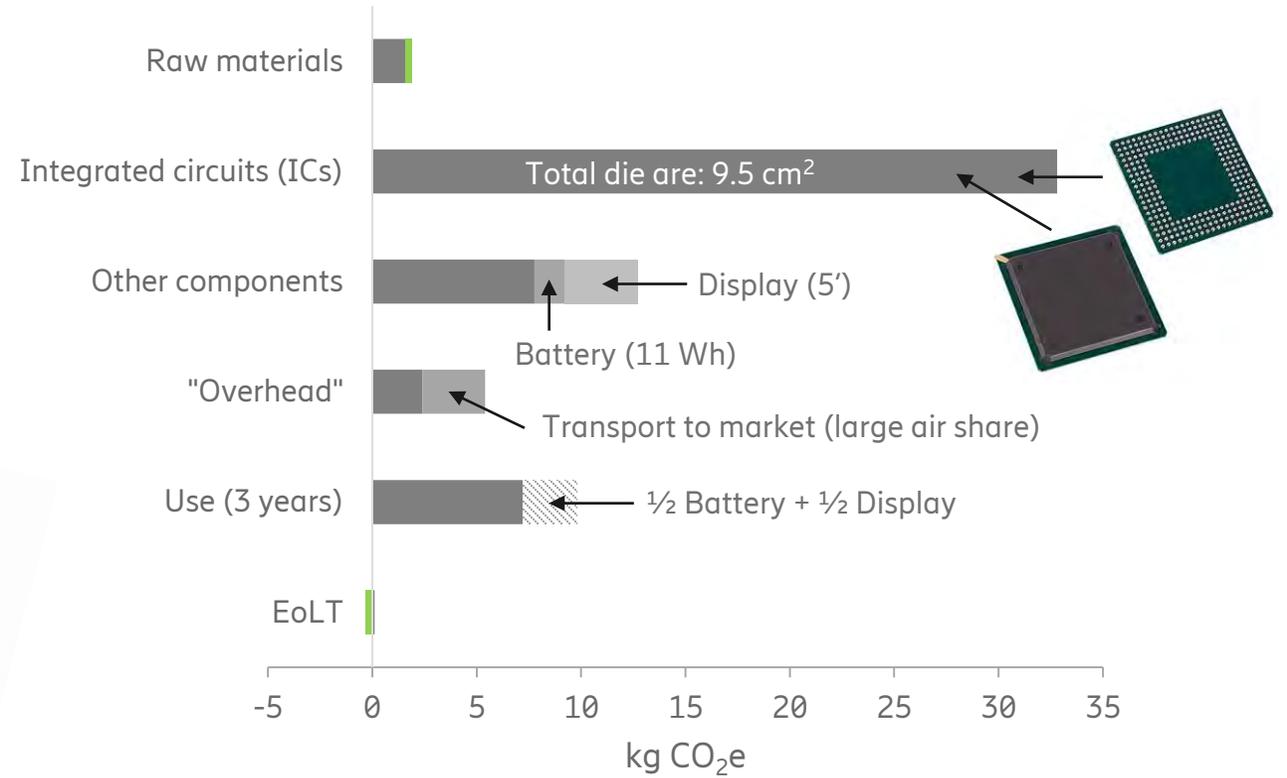
This is a more than 10 year old figure...



LCA of a smartphone



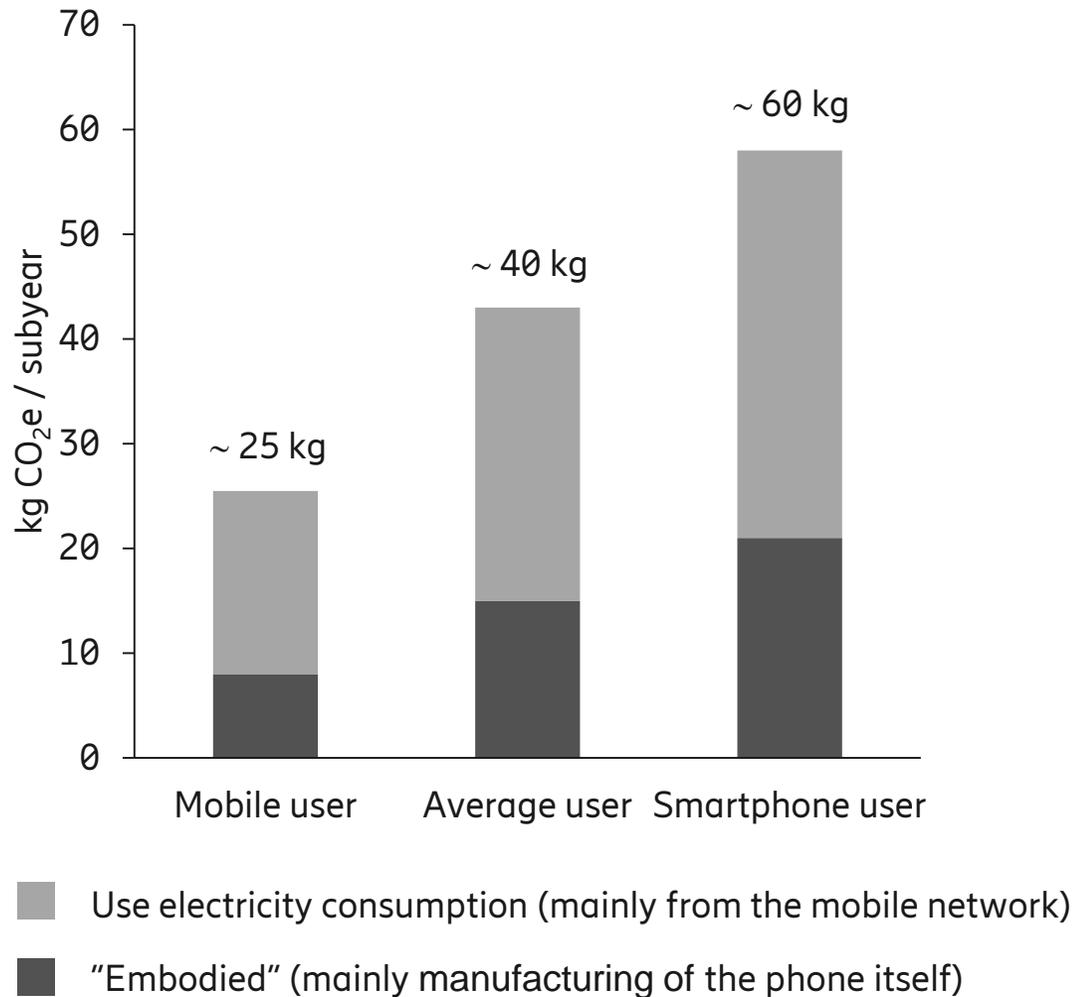
Global Warming Potential (GWP)



Total "embodied" CO₂e: ~50 kg

Use CO₂e: 2.4 kg/year

Carbon footprint of the mobile sector

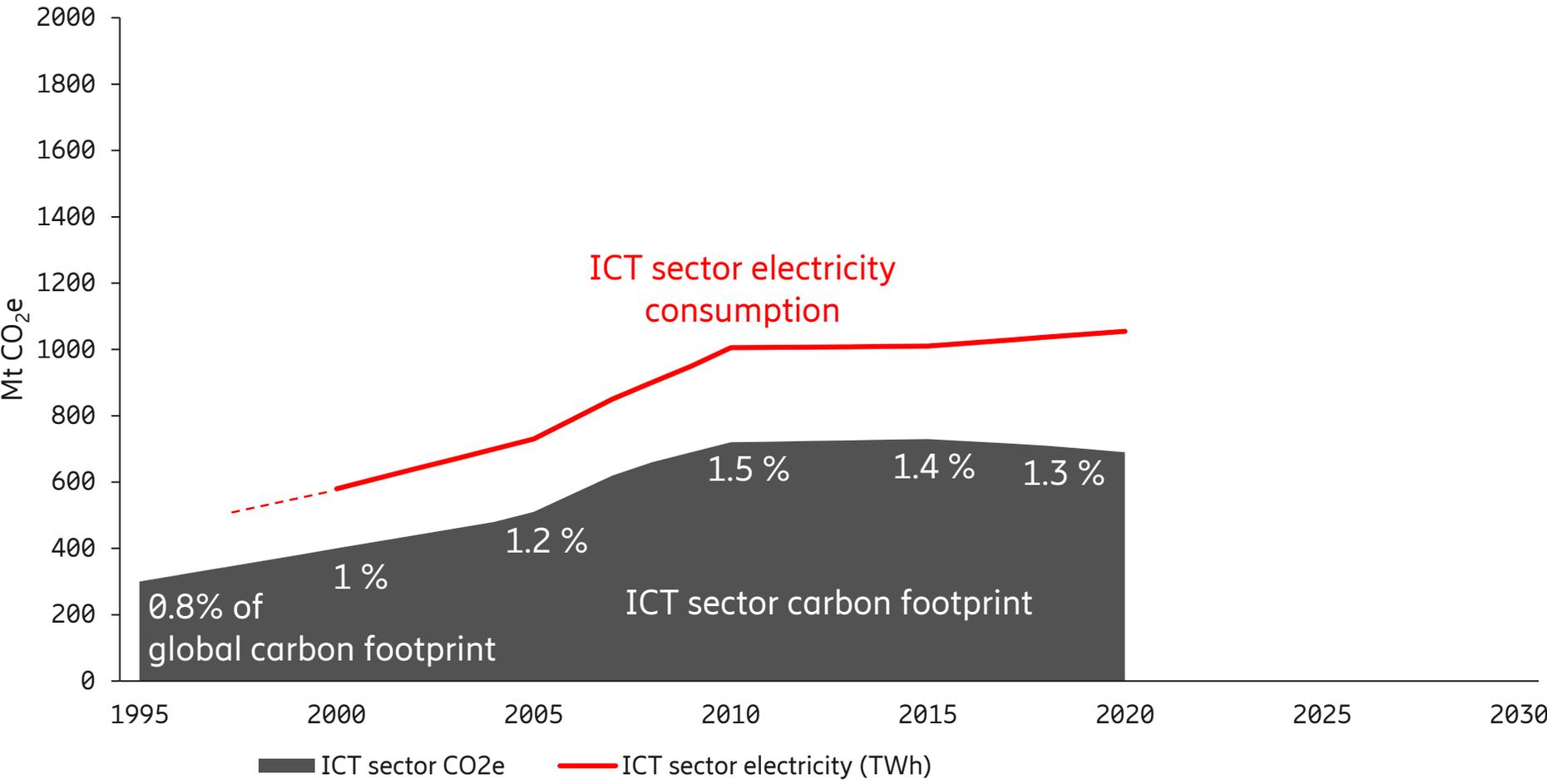


50 years use = 1 transatlantic flight

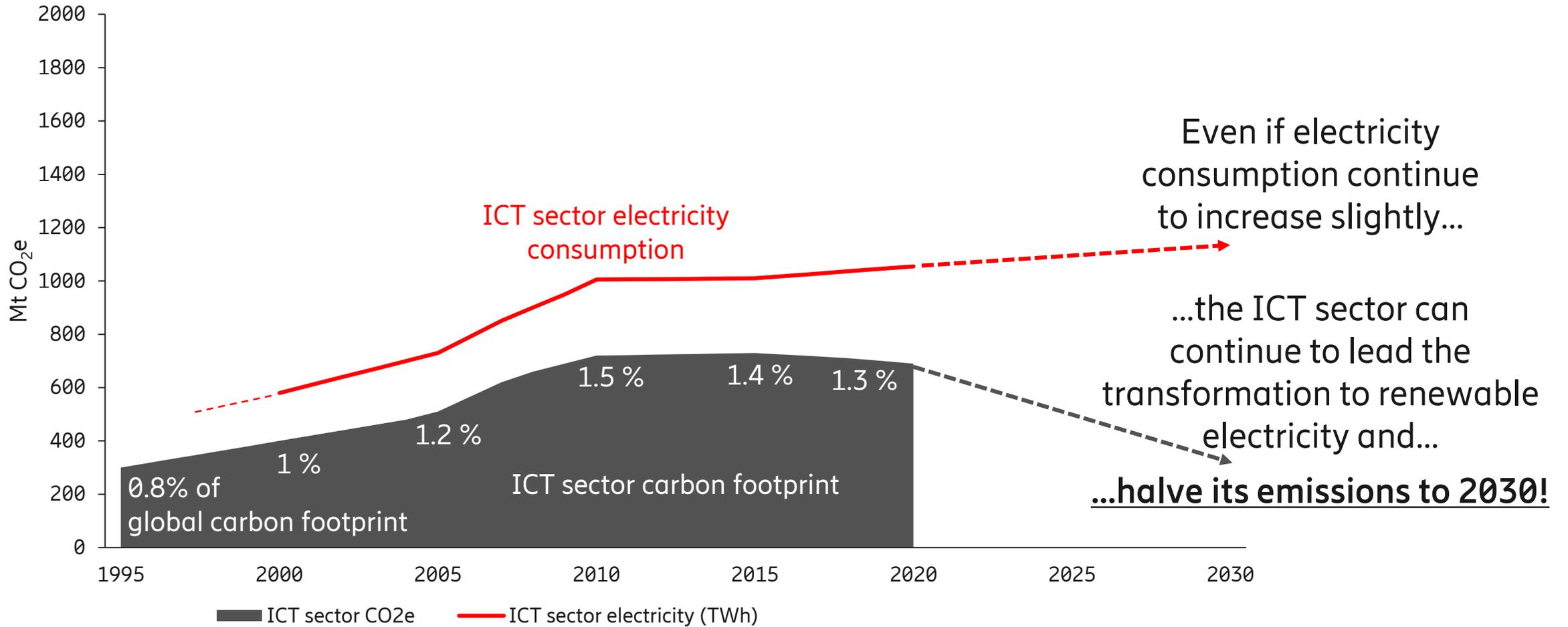
1 year use = 1 ½ hour on the highway

- 50 years of average smartphone and mobile phone use globally in 2018 has an equal carbon footprint to only one transatlantic flight (round trip ~ 2 ton CO₂e)
- The same use for one year has an equal carbon footprint to only about 1 ½ hour with a car on the highway (~ 40 kg CO₂e)

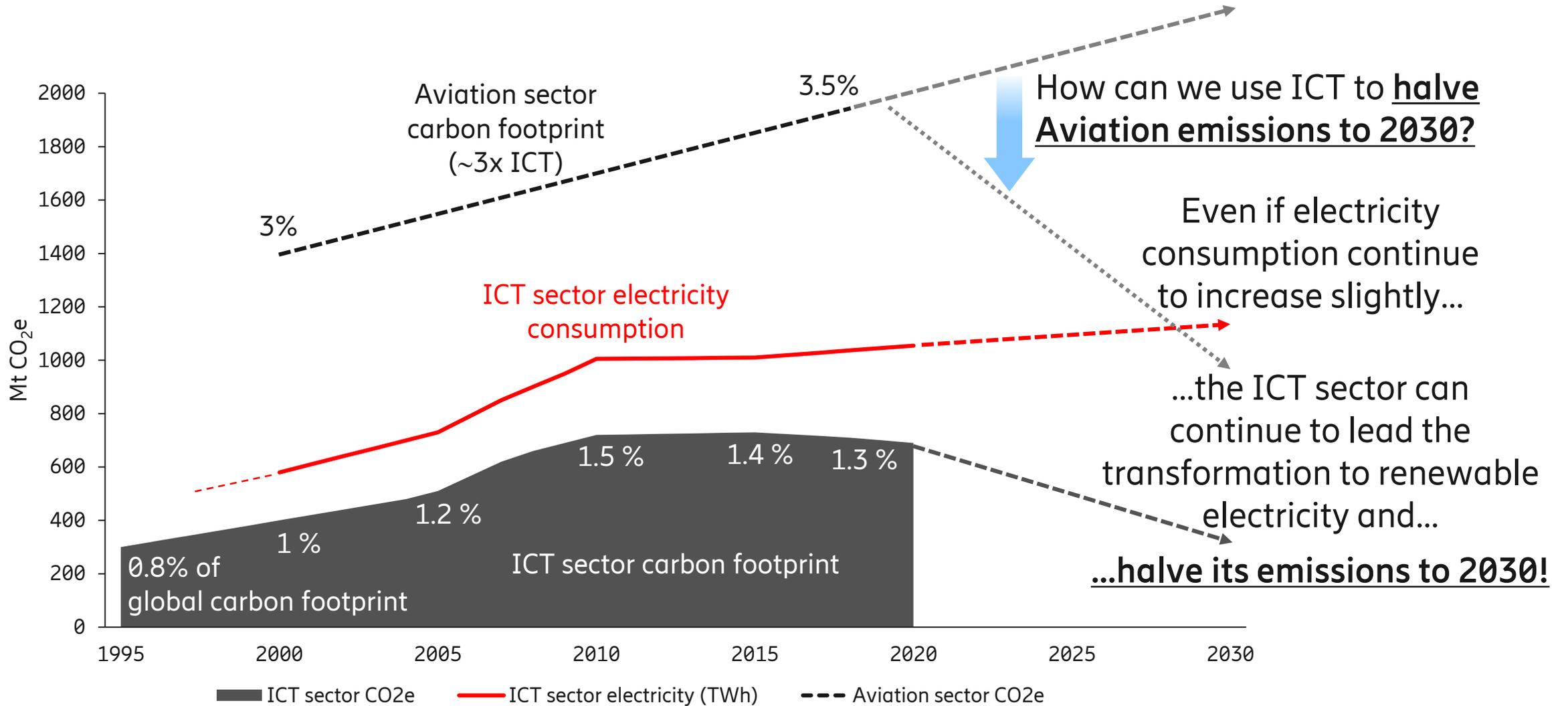
Carbon footprint of the ICT sector



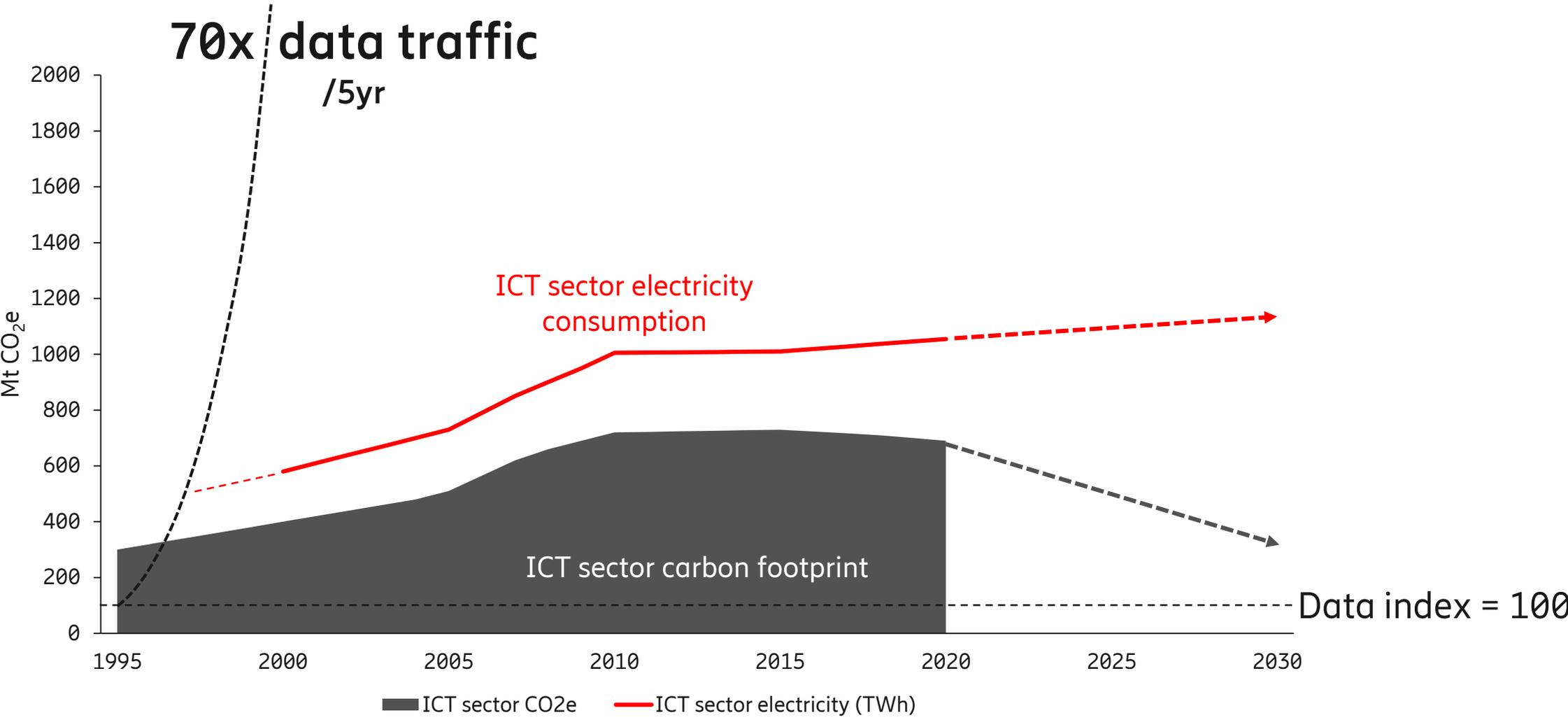
Carbon footprint of the ICT sector



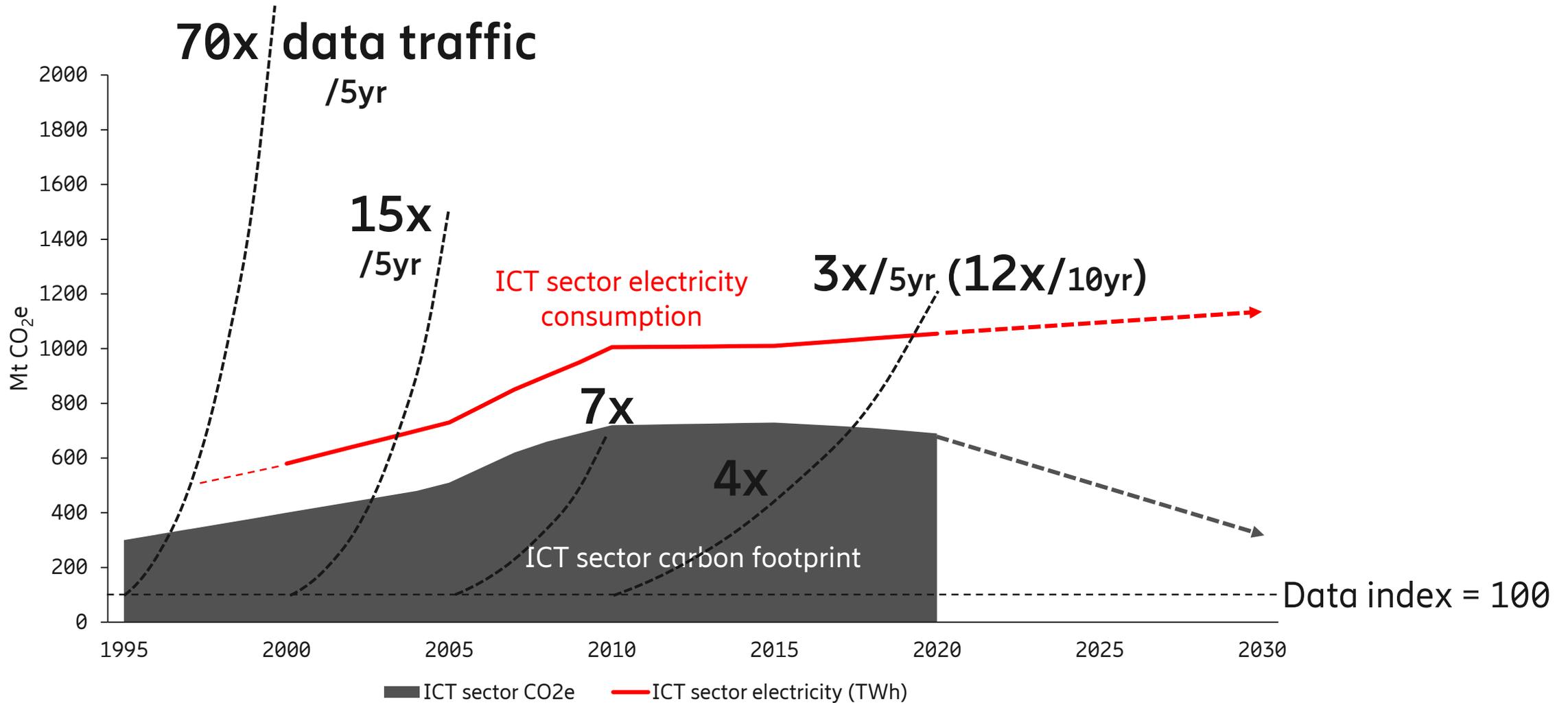
Carbon footprint of the ICT sector



ICT sector footprint and data traffic



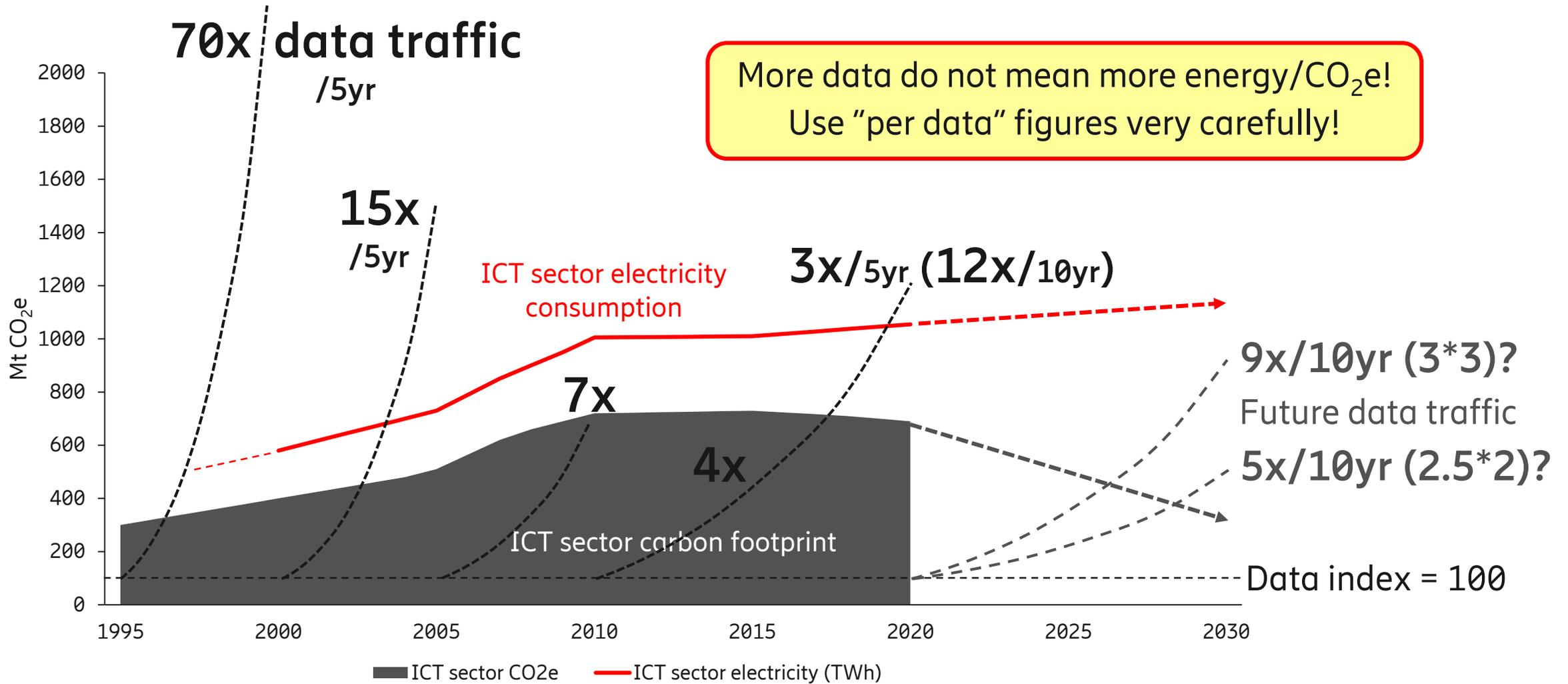
ICT sector footprint and data traffic



ICT sector footprint and data traffic



More data do not mean more energy/CO₂e!
Use "per data" figures very carefully!



What they (shouldn't) say in media



Environment ▶ Climate change Wildlife Energy Pollution

Guardian Environment Network

BBC Sign in News Sport Weather Shop Reel Travel Mo

NEWS

Home Video World UK Business Tech Science Stories Entertainment & Arts

Technology

Climate change: Is your Netflix habit bad for the environment?

By Reality Check team
BBC News

© 12 October 2018

Reality Check

nature
International journal of science

Subscribe Search Login

NEWS FEATURE · 12 SEPTEMBER 2018 · CORRECTION 13 SEPTEMBER 2018

How to stop data centres from gobbling up the world's electricity

The energy-efficiency drive at the information factories that serve us Facebook, Google and Bitcoin.

DAGENS NYHETER. S: DN ARKIVET KUNDERSERVICE KUNSKRÖD QUIZ KUNDERBUJDANDEN

Nyheter Ekonomi Kultur Sthlm Gbg Sport Ledare DN Debatt DN Åsikt Mer

Böcker Kulturdebatt Film Konst Musik Scen Familj Serier

| Kultur

Så påverkar ditt strömmande klimatet

UPPDATERAD 2019-01-30 PUBLICERAD 2019-01-30

'Tsunami of data' could consume one fifth of global electricity by 2025

This article is more than 1 year old

Billions of internet-connected devices could produce 3.5% of global emissions within 10 years and 14% by 2040, according to new research, reports **Climate Home News**



▲ A Google data centre. US researchers expect power consumption to triple in the next five years as one billion more people come online in developing countries. Photograph: Google/Rex



GETTY IMAGES

Data centers
future electricity use:
It's now <1% and stable

“This is how streaming impact the climate” (Swedish news DN 2019-01-30)



- 5 billion downloads of “Despacito” consumed as much electricity as 5 countries (~ 1 TWh)

- 1 hour streaming per week consume as much electricity as 2 fridges

- Downloading a 2 hour film consumes 1.13 kWh

“This is how streaming impact the climate” (Swedish news DN 2019-01-30)



- 5 billion downloads of “Despacito” consumed as much electricity as 5 countries (~ 1 TWh)
- **Translates to 2600 Watt for “whole” video**
As much as ~5000 Watt as viewers only see parts
- 1 hour streaming per week consume as much electricity as 2 fridges
- **Translates to >4000 Watt (modern fridges)**
- Downloading a 2 hour film consumes 1.13 kWh
- **Now we are down to “only” 565 Watt**

"This is how streaming impact the climate" (Swedish news DN 2019-01-30)



- 5 billion downloads of "Despacito" consumed as much electricity as 5 countries (~ 1 TWh)
- **Translates to 2600 Watt for "whole" video**
As much as ~5000 Watt as viewers only see parts
- 1 hour streaming per week consume as much electricity as 2 fridges
- **Translates to >4000 Watt (modern fridges)**
- Downloading a 2 hour film consumes 1.13 kWh
- **Now we are down to "only" 565 Watt**

TV 100 W



Smartphone < 3 W

“This is how streaming impact the climate” (Swedish news DN 2019-01-30)



- 5 billion downloads of “Despacito” consumed as much electricity as 5 countries (~ 1 TWh)
- **Translates to 2600 Watt for “whole” video**
As much as ~5000 Watt as viewers only see parts
- 1 hour streaming per week consume as much electricity as 2 fridges
- **Translates to >4000 Watt (modern fridges)**
- Downloading a 2 hour film consumes 1.13 kWh
- **Now we are down to “only” 565 Watt**

TV 100 W



Netflix < 5 W



Smartphone < 3 W

"This is how streaming impact the climate" (Swedish news DN 2019-01-30)



- 5 billion downloads of "Despacito" consumed as much electricity as 5 countries (~ 1 TWh)
- Translates to 2600 Watt for "whole" video
As much as ~5000 Watt as viewers only see parts
- 1 hour streaming per week consume as much electricity as 2 fridges
- Translates to >4000 Watt (modern fridges)
- Downloading a 2 hour film consumes 1.13 kWh
- Now we are down to "only" 565 Watt

TV 100 W



Netflix < 5 W



Smartphone < 3 W



Network < 10 W

(fixed a little bit worse than mobile)



"This is how streaming impact the climate" (Swedish news DN 2019-01-30)



- 5 billion downloads of "Despacito" consumed as much electricity as 5 countries (~ 1 TWh)
- Translates to 2600 Watt for "whole" video
As much as ~5000 Watt as viewers only see parts **>130 times too high**
- 1 hour streaming per week consume as much electricity as 2 fridges **>200 times too high**
- Translates to >4000 Watt (modern fridges)
- Downloading a 2 hour film consumes 1.13 kWh
- Now we are down to "only" 565 Watt **>25 times too high**

TV 100 W



Netflix < 5 W



With smartphone
Total < 20 W



Smartphone < 3 W

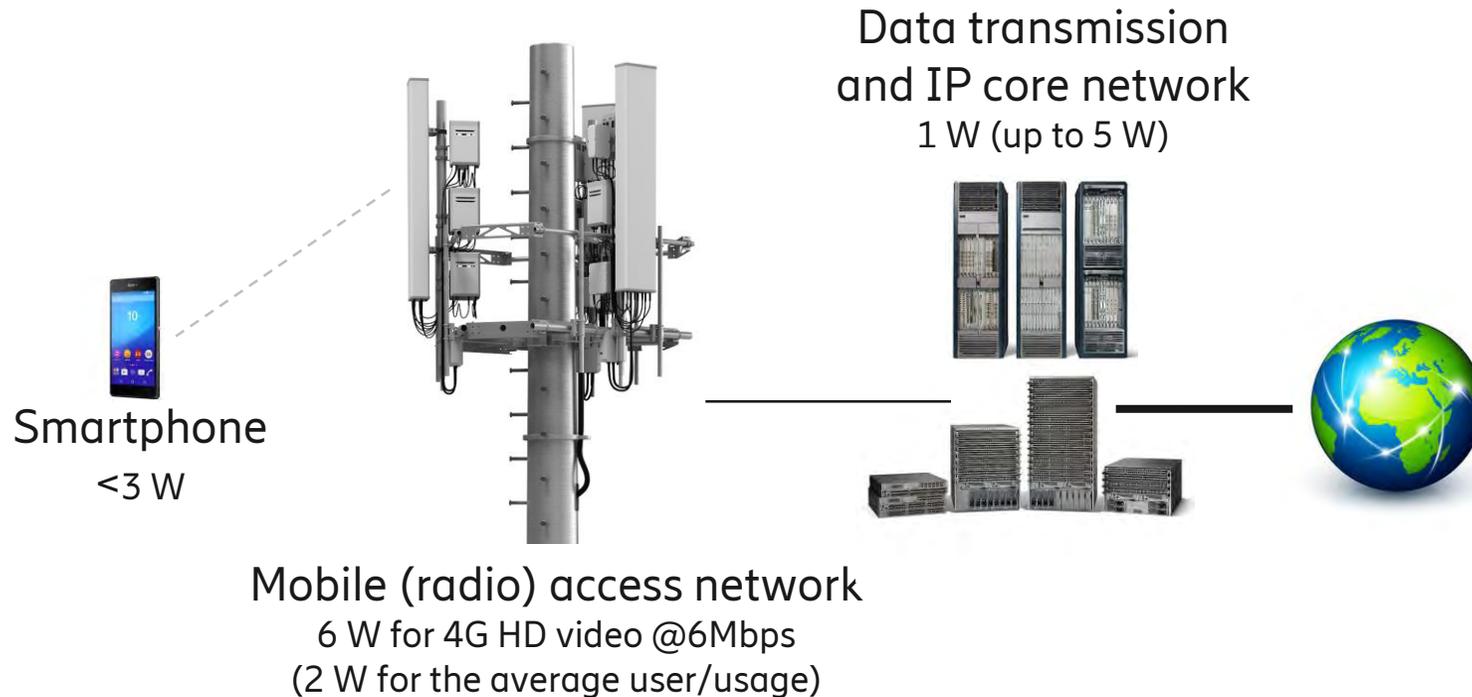


Network < 10 W

(fixed a little bit worse than mobile)



Streaming HD video over mobile (4G)

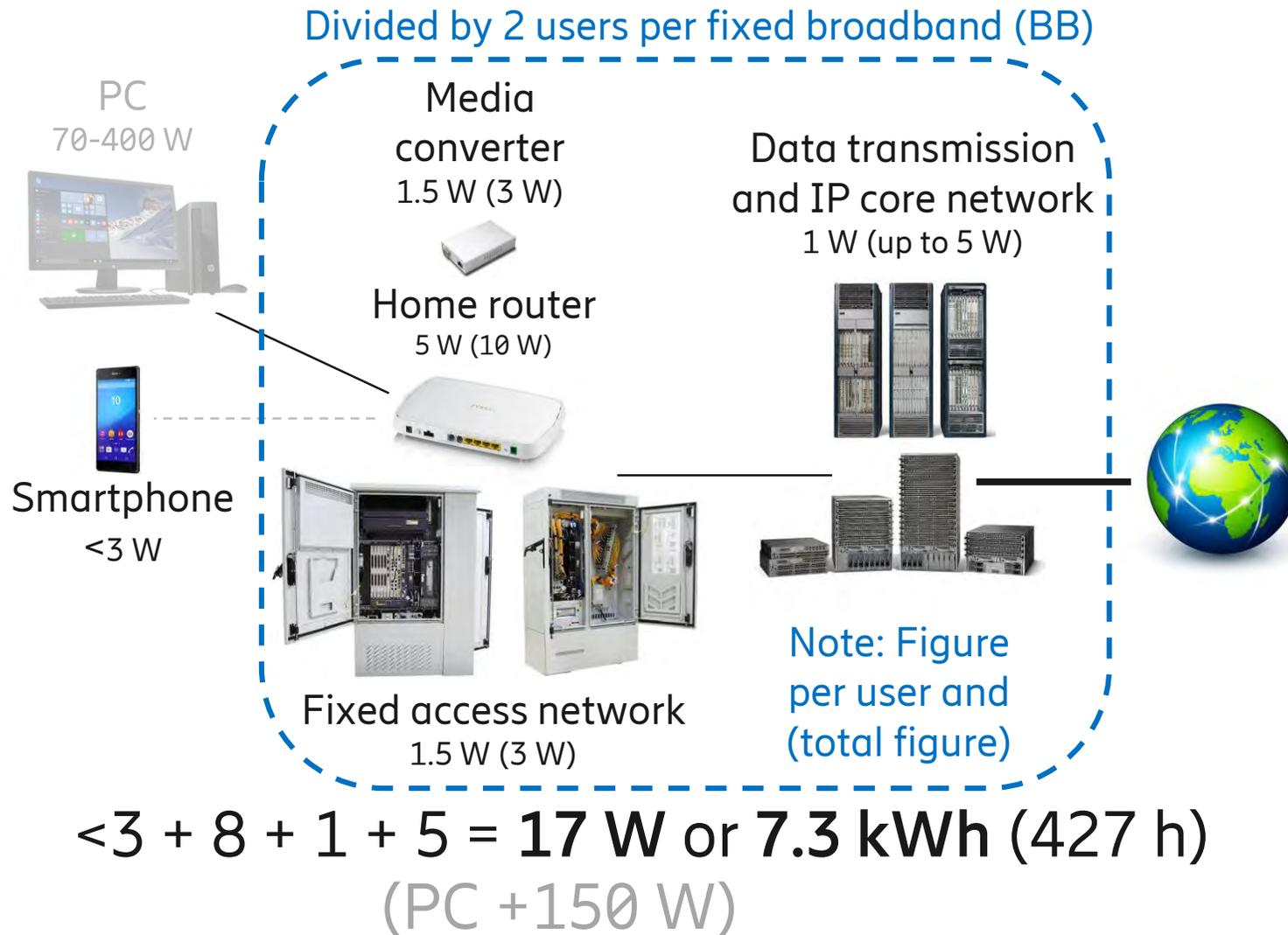


Netflix (HD video streaming):

- 0.3 TWh (100% green)
- 140 million users
- 2.1 kWh (0.24 W) per user
- 1 h 10 min per day
- 4.9 W/user (when active)
(<1 W "in theory")
- 15% of global Internet data

$$<3 + 6 + 1 + 5 = 15 \text{ W or } 6.4 \text{ kWh (427 h)}$$

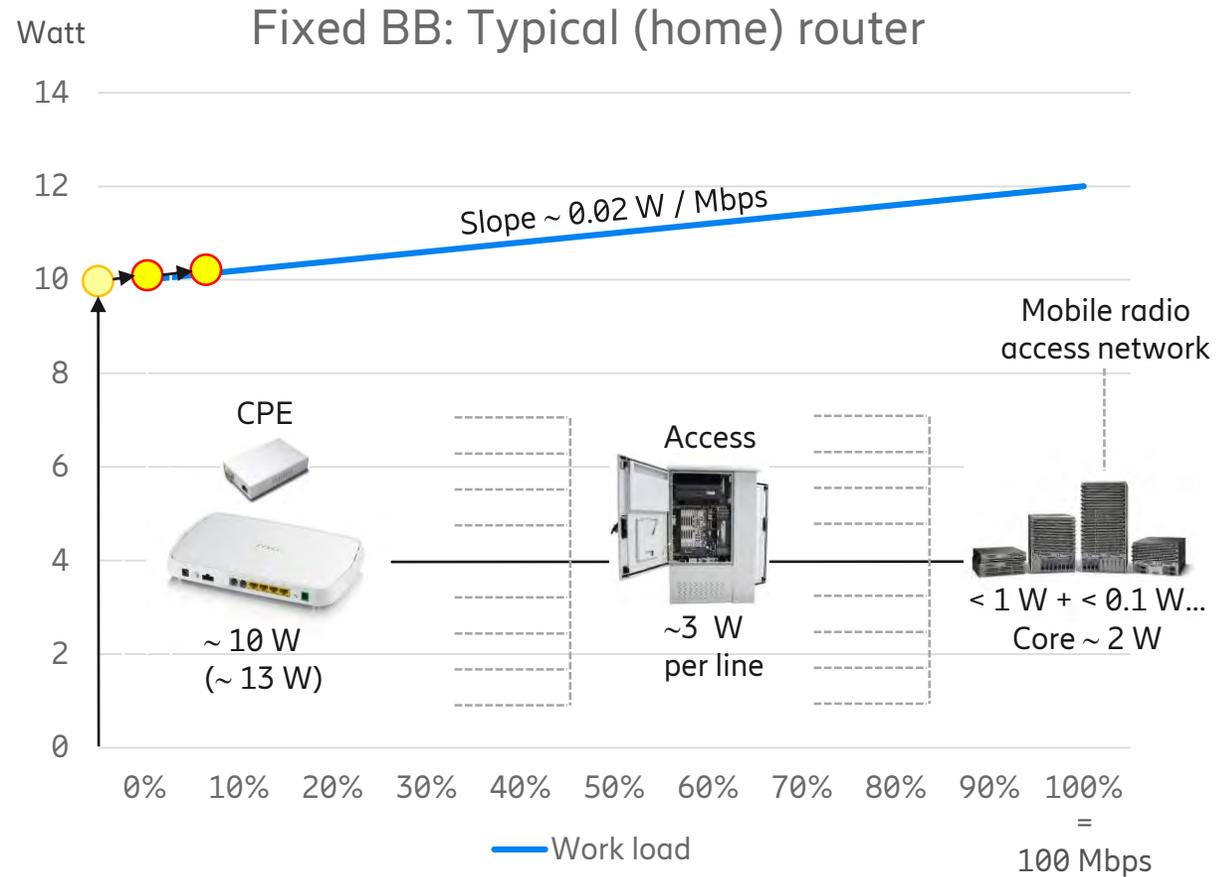
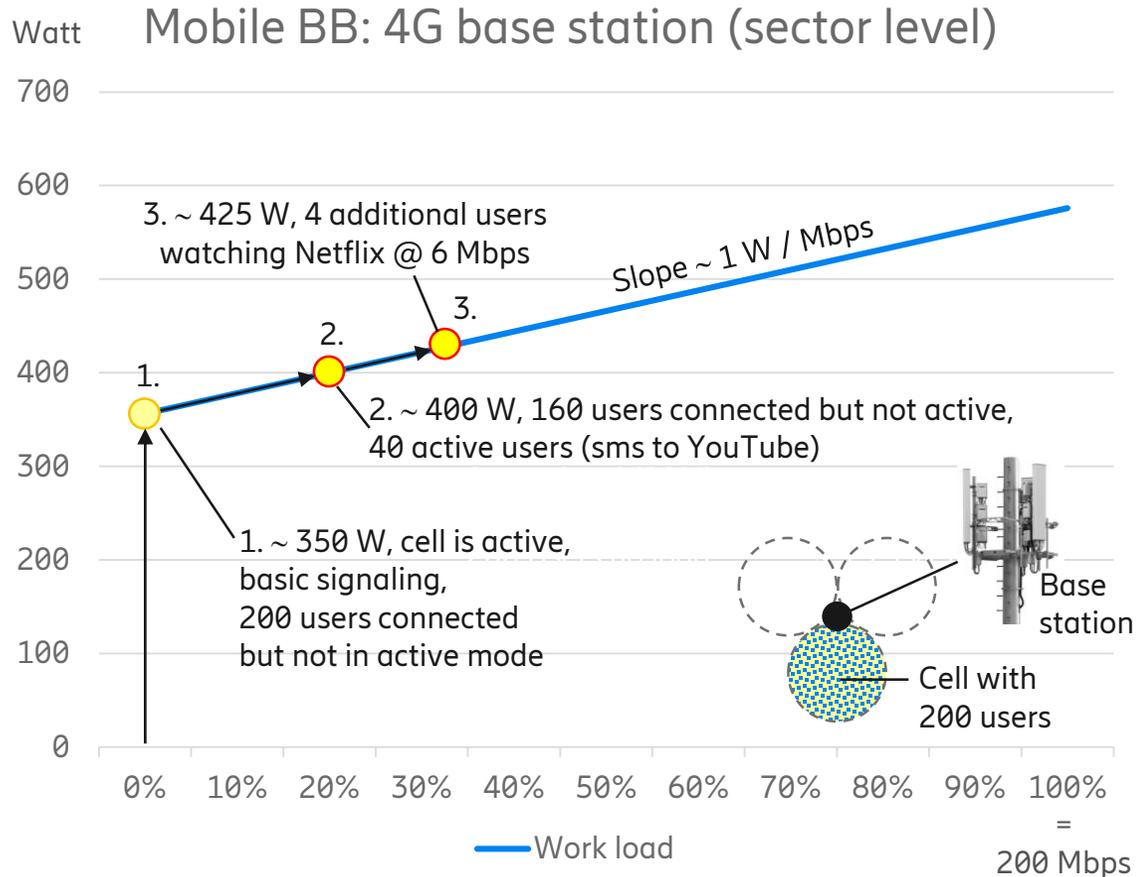
Streaming HD video over fixed



Netflix (HD video streaming):

- 0.3 TWh (100% green)
- 140 million users
- 2.1 kWh (0.24 W) per user
- 1 h 10 min per day
- 4.9 W/user (when active)
(<1 W "in theory")
- 15% of global Internet data

How IT (net) works



Mobile: $< 10 \text{ W}$ incl. core (up to 6-8 Mbps)
 File download: 100 GB $\sim 0.15 \text{ kWh}$ (@ 50 Mbps)
 (Add $\sim 7 \text{ W}$ for a FWA router with 4xLAN+WiFi, but $< 8 \text{ W}$ per user if 2 users)

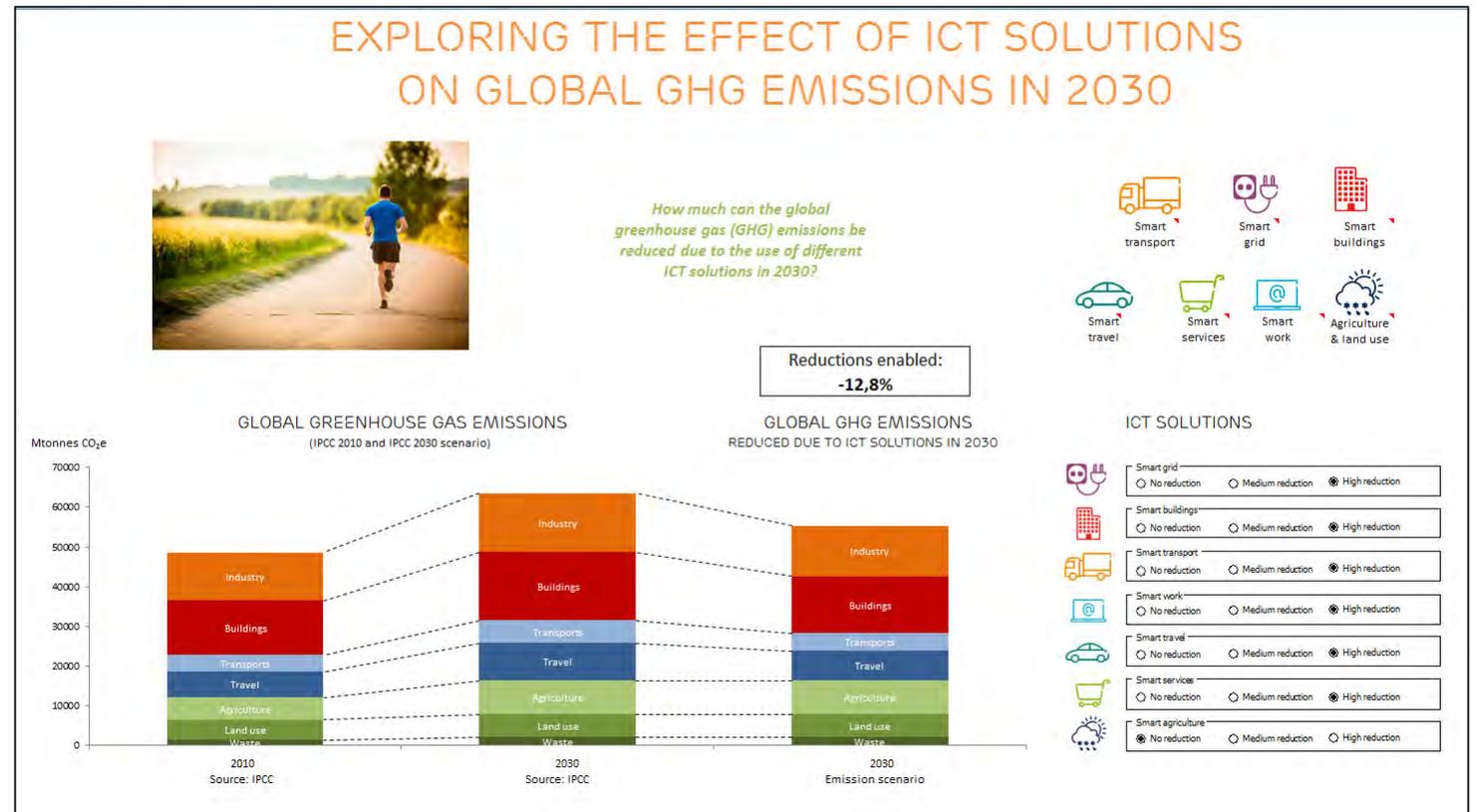
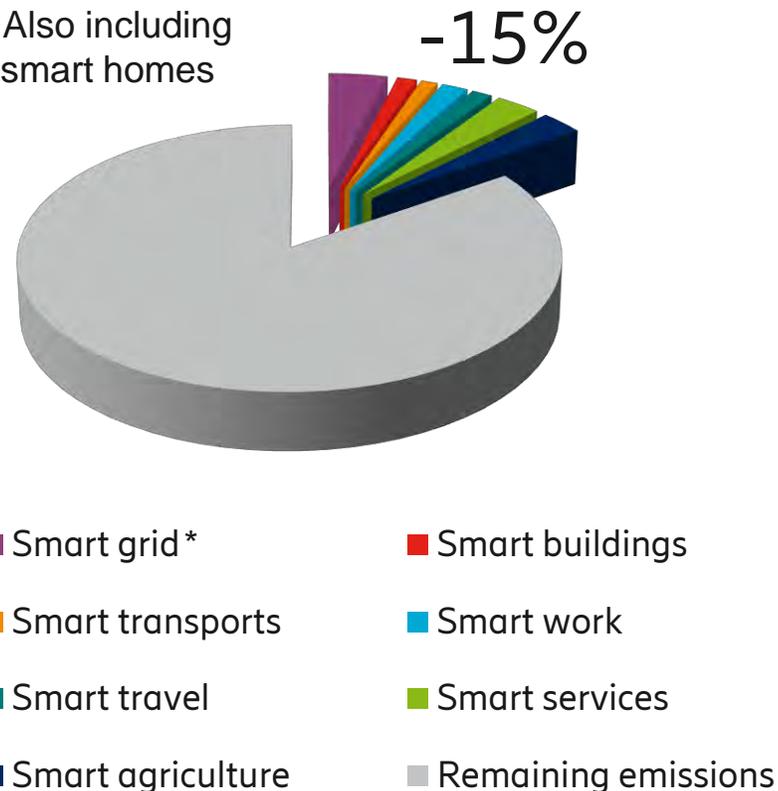
Fixed (split by 2 users): $< 10 \text{ W}$ (up to 100 Mbps)
 File download: 100 GB $\sim 0.03 \text{ kWh}$ (@ 50 Mbps)
 (Multiply above figures by 2 for only 1 user per fixed BB)

How can ICT help society reduce CO2e?

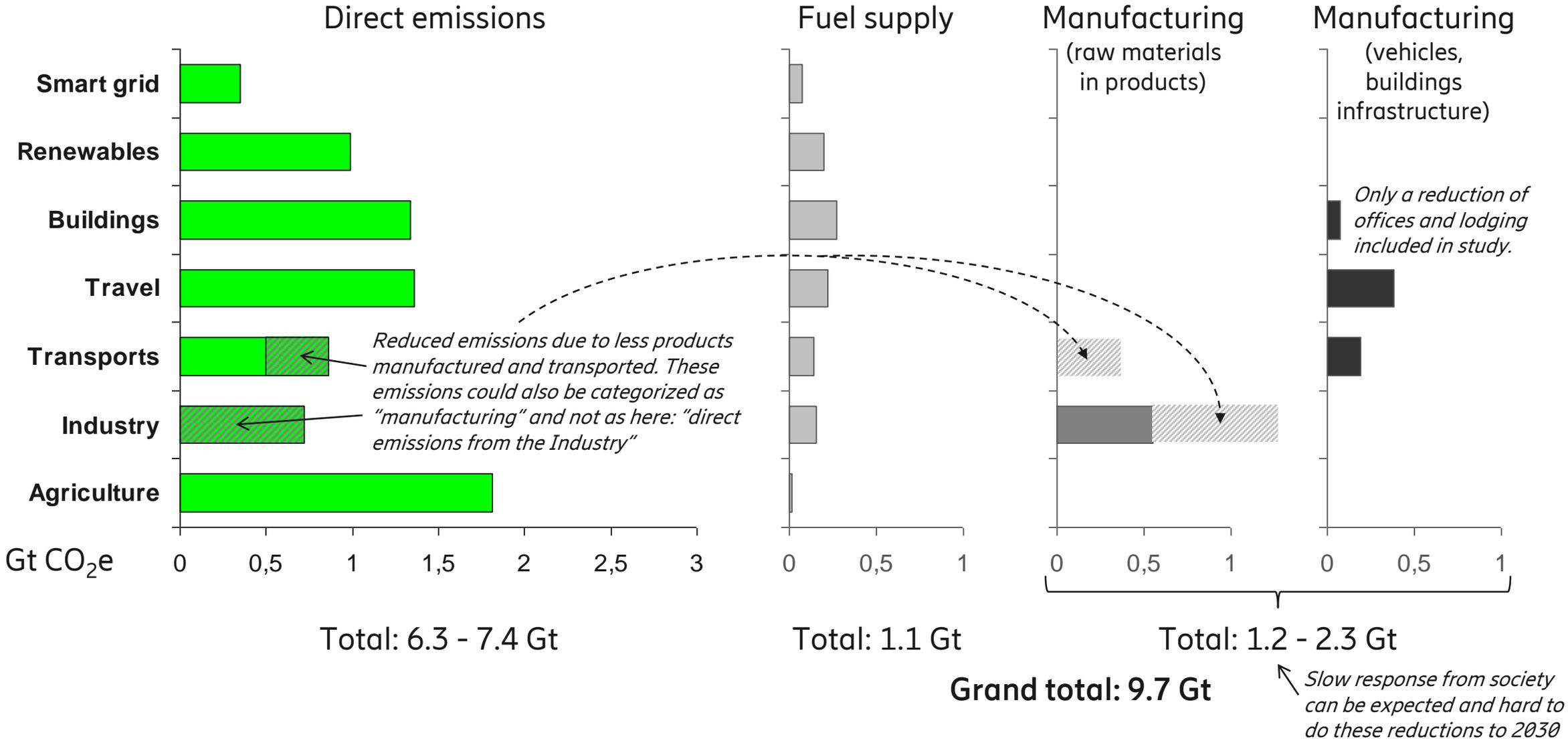


Scale proven emission reductions by ICT solutions to a global level

* Also including smart homes



How can ICT help society reduce CO2e?



exponentialroadmap.org



On 19 September we published two reports. The 2019 Exponential Roadmap covers how to accelerate the 36 solutions required to slash greenhouse gas emissions 50% by 2030. The Meeting the 1.5°C Climate Ambition report makes the case for action sooner rather than later

EXPONENTIAL ROADMAP
SCALING 36 SOLUTIONS TO HALVE EMISSIONS BY 2030
VERSION 1.0, 2019

MEETING THE 1.5°C CLIMATE AMBITION
MOVING FROM INCREMENTAL TO ESSENTIAL ACTION
EXPONENTIAL ROADMAP

Roadmap Provides 36 Solutions to Cut Greenhouse Gas Emissions 50% by 2030 Worldwide



Thank you!

A few things to remember:

- The ICT sector's GHG emissions has peaked and now decreases, a halving of the sector's emissions to 2030 is possible
- Streaming video and music is good for the climate!
- ICT can be used in so many more ways besides streaming, we just need to be better at finding the ways that help us reduce our emissions
Unfortunately, so far we have not been so good at reducing emissions...

For more information, see these papers and web sites:



The effects of ICT solutions on GHG emissions in 2030 (2015)

<https://www.slideshare.net/Ericsson/conference-paper-exploring-the-effects-of-ict-solutions-on-ghg-emissions-in-2030>

(also available through ICT4S proceedings <http://ict4s.org/conference-proceedings/>)

The electricity consumption and operational carbon emissions of ICT network operators 2010-2015 (2018)

<http://kth.diva-portal.org/smash/record.jsf?pid=diva2%3A1177210&dswid=-2471>

The energy and carbon footprint of the global ICT and E&M sectors 2010-2015 (2018)

<https://easychair.org/publications/download/MRdh>

- note that the link ends up in the middle of the document so you need to scroll for the first page

A high-level estimate of the material footprints of the ICT and the E&M sector (2018)

<https://easychair.org/publications/open/XvgV>

- note that the link ends up in the middle of the document so you need to scroll for the first page

Life-cycle assessment of a smartphone (2016)

<https://www.atlantis-press.com/proceedings/ict4s-16/25860375>

Life Cycle Assessment of ICT (2014)

<https://onlinelibrary.wiley.com/doi/full/10.1111/jiec.12145#support-information-section>

The future carbon footprint of ICT and E&M sectors (2013)

<https://pdfs.semanticscholar.org/2d24/59dbf04c61b5bc1aa296b07419a9d9db00d3.pdf>

<https://exponentialroadmap.org/>

