The energy and carbon footprint of the ICT and E&M sector in Sweden 1990-2015 and beyond

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Abstract

“Decoupling” has stricken the ICT and E&M sector in Sweden! Despite exponentially increasing data volumes and usage, CO2 emissions and energy consumption decreases (2010 – 2015)!

The trend of decreasing energy and carbon footprints is estimated to continue until 2020. Further on its not possible to estimate.

Sweden is among the leading ICT countries globally (good reference). It can be expected that development will follow a similar path in other ICT mature countries.
"When you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely in your thoughts advanced to the stage of science."

(William Thomson, Lord Kelvin, 1824-1927)

In short: What get’s measured gets done”
The importance of knowledge

- 2002: ”The 3G mobile network in Sweden will require a new nuclear reactor”
  - We responded 2003 it will likely be 20 times less, it turned out to be 50 times less (2010)
- 2005: ”Internet (ICT sector) emits as much CO$_2$ as the aviation industry”
  - No, the aviation industry emits 2-5 times as much depending on how we evaluate all effects
- 2007: ”An SL-avatar consumes as much energy as a Brazilian per year”
  - The average player back then in Second Life (SL) consumed at least 30 times less
- 2009: ”Two Google searches = one cup of tea (7 g CO$_2$)”
  - Google reply: One search is about 0.2 g CO$_2$ (17.5 times less)
- 2012: ”Your iPhone consumes as much energy as two US fridges”
  - With network, data centers and all manufacturing included it’s about 10 times less
Scope

ICT sector

User equipment
- Older phones
- Fixed cordless phones
- Mobile phones, smartphones and tablets
- Routers, modems
- CPE (customer premises equipment)
- Desktop and laptop PCs
- IPTV (TV + STB)

Access networks

Operator activities
- Including the operator’s data centers
- Control and core nodes
- Offices and stores travel and vehicles

Data transmission and IP core network

Enterprise networks and data centers

ICT service providers

User equipment
- Business PCs and office equipment
Scope

ICT sector

Access networks

Operator activities
Including the operator's data centers

Data transmission and IP core network

Control and core nodes

Offices and stores
Travel and vehicles

Global Internet

Enterprise networks and data centers

ICT service providers

User equipment and office equipment

E&M sector

TVs, TV peripherals, TV networks

Other consumer electronics

Paper media

ICT services and E&M content production

User equipment
Older phones, fixed cordless phones

Mobile phones, smartphones and tablets

Routers, modems
CPE (customer premises equipment)

Desktop and laptop PCs

IPTV (TV + STB)
A typical Swede possess in average...

1 PC
(most PCs are laptops used in homes)

1.5 mobile phone
(mainly smartphones)

0.5 Tablet

...and have the highest data traffic in the world

0.7 TVs
Swedish key data and trends

- Telephone lines: 5M in 2010, decreasing to 5M in 2015, of which 5M is VoIP.
- Fixed broadband: 5M in 2010, increasing to 5M in 2015, of which 5M is fiber.
- Mobile phone sales: 5M in 2010, increasing to 5M in 2015, of which 5M is Smartphones.
- PC sales: 5M in 2010, decreasing to 5M in 2015.
- TV sales: 5M in 2010, increasing to 5M in 2015.
Swedish key data and trends

Data traffic

ICT sector use - energy consumption

Facebook data center

Other operators

Telia, measured

Primary energy footprint

Data centers

User equipment

Other operators

Data centers

ICT sector use - energy consumption

Facebook data center

Access networks

Operator activities

Including the operator's data centers

Control and
with rights

Offices and other
travel and vehicles

Enterprise networks

and data centers

Data transmission

and IP core network

ICT service

providers

User equipment

Business PCs

and office equipment
Use behavior and trends

› Usage “moves” to smaller and more energy efficient devices/platforms
  – from desktop PCs to laptop PCs
  – from TVs and PCs to tablets and smartphones

› The PSTN or “POTS (Plain Old Telephony System)”
  – Are being decommissioned but more energy can be saved

› Amount of ICT and E&M scrap is now decreasing
  (Sweden has the highest recycling rate of electronics)
Life cycle impact, based on LCA

› Devices/platforms energy consumption and embodied footprints are improving constantly – Kaizen!
Results: Total carbon footprint

[Graph showing the total carbon footprint from 1990 to 2020, with separate segments for ICT sector, E&M sector, and ICT services and E&M content.]
Results: Total carbon footprint

Scenario with global electricity mix instead of Swedish mix

Data traffic
Results: Carbon footprint per Swede...

Total carbon footprint
- ...in Sweden: ~6 tonne
- ...from abroad (imports): ~7.5 tonne

Mobile (personal)
- ~40 kg

Fixed / Household (/person)
- ~140 kg

Work, content, services (/p)
- ~80 kg

ICT sector: 1.2%
E&M sector: 0.7%
Services/content: 0.4%
Results: Carbon footprint per Swede...

Total carbon footprint:
- ~6 tonne (in Sweden)
- ~7.5 tonne (from abroad (imports))
- ~7.6 tonne (if Swedish electricity was not "green")

Mobile (personal):
- ~40 kg / 80 kg

Fixed / Household (/person):
- ~140 kg / 390 kg

Work, content, services (/person):
- ~80 kg / 180 kg

ICT sector: 1.2%, -7% from 2010
E&M sector: 0.7%, -20% from 2010
Services/content: 0.4%, -10% from 2010
Current trends
Not taken into account fully in new global ICT studies (yet)

- Global PC sales has decreased 2010-2015, from 350 to 290 million (-17%)
- Global TV sales has also decreased 2010-2015, from 250 to 225 million (-10%)
- Usage moves from PCs and TVs with large screens to more energy efficient small screen tablets and smartphones, other consumer electronic sales decrease fast
- New studies from US and Germany report a decreased energy consumption for ICT/E&M
- Global server sales in revenue and numbers are more or less flat 2010-2015
  - New US study on data centers report the energy increase is only 4% since 2010
- Large improvement projects ongoing and network and data center operators also purchase and invest in more and more green electricity

- **Energy consumption do not increase when data traffic increases**
  - Data traffic increases as new equipment/networks enables it and new equipment usually consume less energy due to better energy performance despite having a far greater capacity
Is ICT just energy and GHG from a LCA perspective?

If so, how to quantify?
Summary

› “Decoupling” has stricken the ICT and E&M sector in Sweden! We see an exponentially increasing data volume and usage, still a CO2 emission and energy consumption decreases (2010 – 2015)!

› The trend of decreasing energy and carbon footprints is estimated to continue until 2020. Further on its not possible to estimate. The added footprints related to IoT is estimated to be rather small in the near by future.

› Sweden is among the leading ICT countries globally (good reference). It can be expected that development will follow a similar path in other ICT mature countries.
That’s all folks!

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