

# The Internet and environmental sustainability: (r)evolutionary?

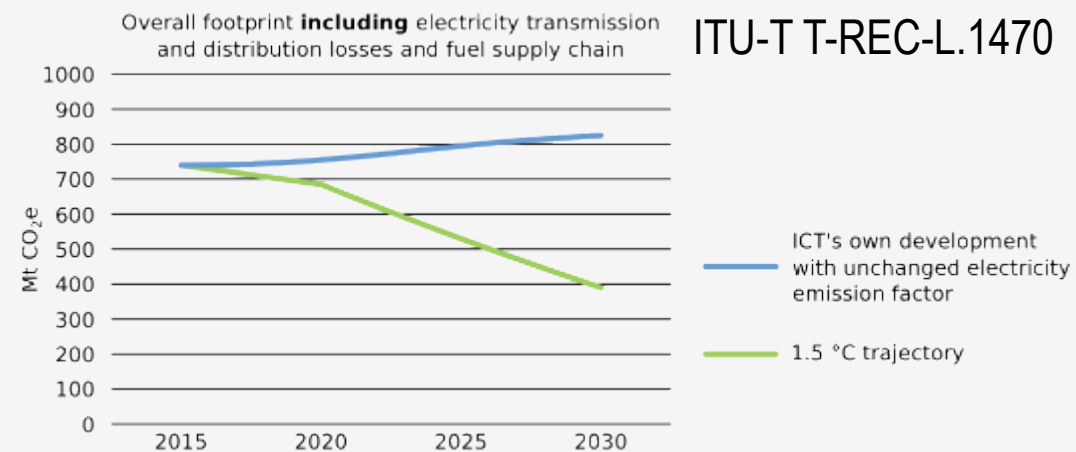
(July 2020)

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# Situation

- More than 6 billion new ICT goods are sold annually worldwide, and beyond 28 billion are expected in 2025
- Can we afford the growth of ICT devices for more people (*everyone*), more devices per person (*mobiles, laptops, desktops, servers, cloud providers, the internet, mobile networks*), more IoT (*everything*)
- ... and the energy spent in all we do on the Internet?
- **Climate change and environmental degradation are an existential threat to the world**
- **Decarbonisation: reduction of green-house gas (GHG) emissions: (r)evolution!**

# Goals?



- Reduction of environmental impact of **about 50%** by 2030 to align with the IPCC 1.5°C trajectory, [ITU-T L.1470] or severe effects for 2°C or ...

- **Keep warming at 1.5°C implies global emissions must peak by 2025** → *in 9-10 IETF meetings*

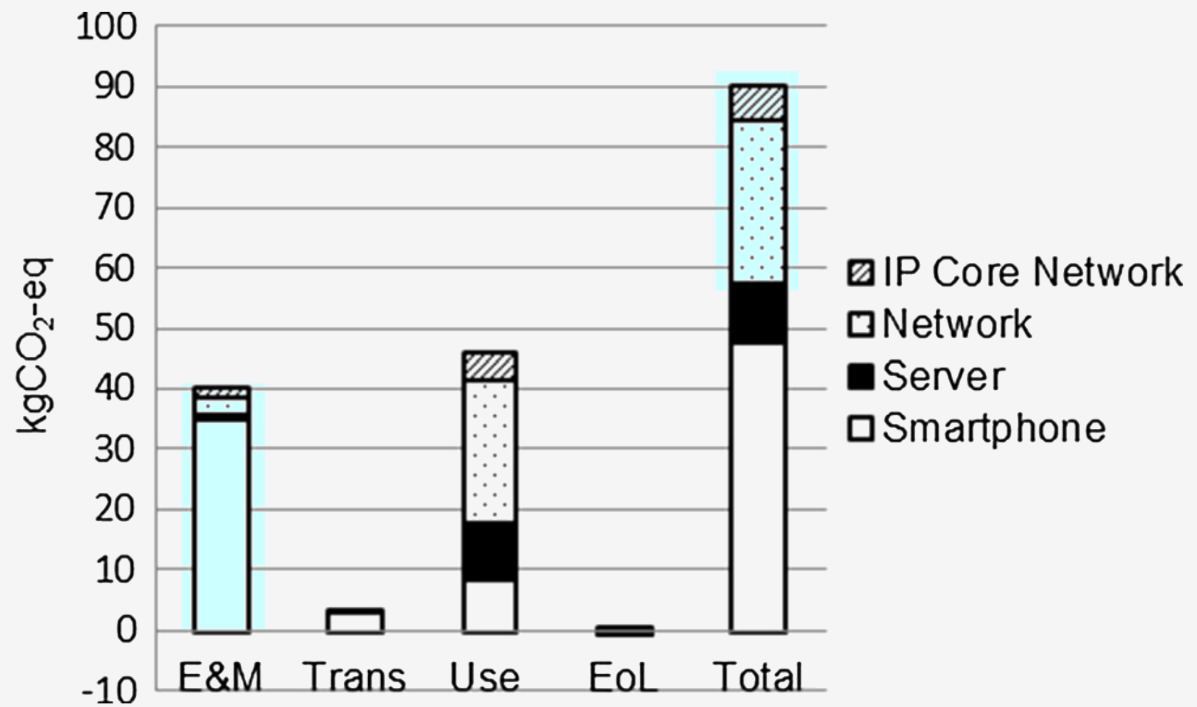
<https://theconversation.com/ipcc-report-global-emissions-must-peak-by-2025-to-keep-warming-at-1-5-c-we-need-deeds-not-words-165598>

- Contribution of ICT in electricity usage is a major green-house gases factor:
  - By **2030** it could use up to 51% of global electricity, and contribute up to 23% of globally released GHG emissions

A. Andrae, T. Edler. *On Global Electricity Usage of Communication Technology: Trends to 2030*. Challenges 2015

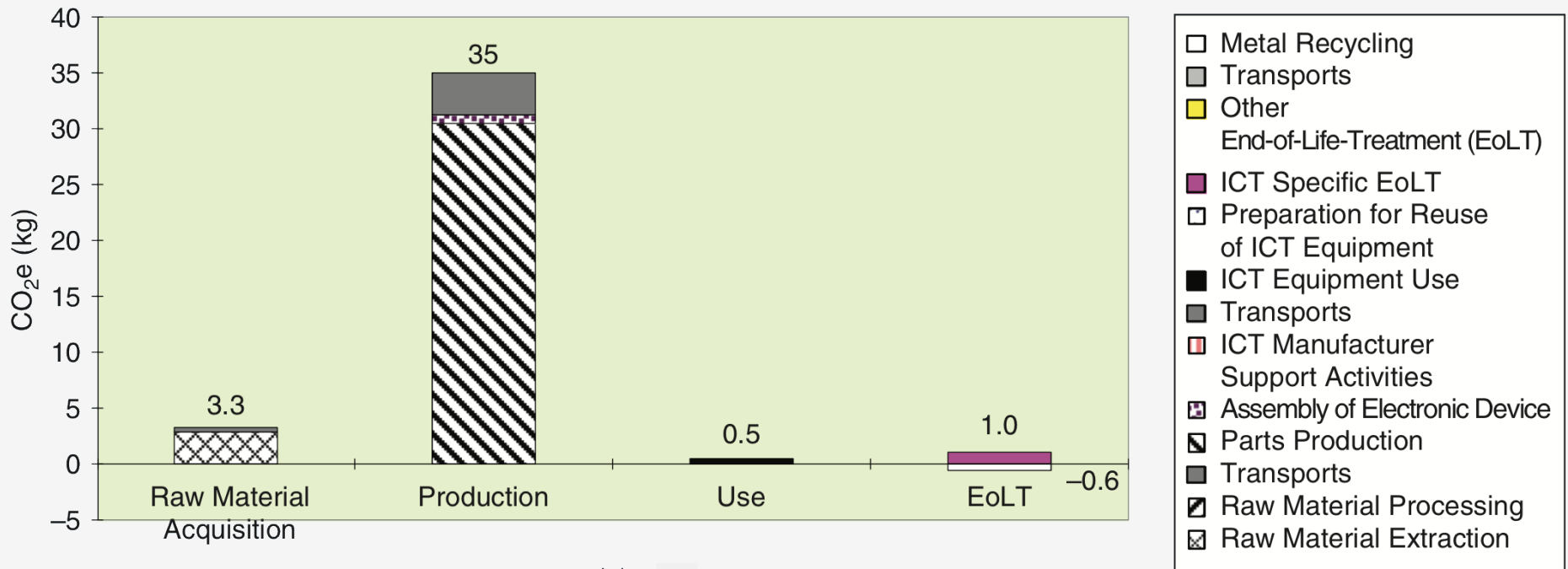
## GHG emissions across the life cycle of a smartphone

J. Suckling, J. Lee. *Redefining Scope: The True Environmental Impact of Smart-phones?* International Journal of Life Cycle Assessment, 2015



## The global warming potential for a mobile phone with two year usage life-cycle

A. Andrae, *Life-Cycle Assessment of Consumer Electronics: A review of methodological approaches*, IEEE Consumer Electronics Magazine, 2016





# Questions

- **What to do now to prepare for the 2025, 2030 deadline? Can we?**
- How to achieve a desirable scenario?
  - Evolutionary: reduce energy & materials in protocols
  - R-ev: FidoNetv6? IPv7, SCION, etc?
- Need for changes on how the Internet works?
  - Architecture: caching, replication, locality, asynchrony, slower
  - Protocols: format, overhead reduction, slowdown
  - Formats: less verbose, compression, binary
  - Parameters: timers, negotiation

# Environmental protocol considerations: energy

<a href="#">RFC 6464</a>	<a href="#">ASCII</a> , <a href="#">PDF</a> , <a href="#">HTML</a>	<b>A Real-time Transport Protocol (RTP) Header Extension for Client-to-Mixer Audio Level Indication</b>	J. Lennox, Ed., E. Iovov, E. Marocco	December 2011	Proposed Standard
<a href="#">RFC 6465</a>	<a href="#">ASCII</a> , <a href="#">PDF</a> , <a href="#">HTML</a>	<b>A Real-time Transport Protocol (RTP) Header Extension for Mixer-to-Client Audio Level Indication</b>	E. Iovov, Ed., E. Marocco, Ed., J. Lennox	December 2011	Proposed Standard
<a href="#">RFC 6988</a>	<a href="#">ASCII</a> , <a href="#">PDF</a> , <a href="#">HTML</a>	<b>Requirements for Energy Management</b>	J. Quittek, Ed., M. Chandramouli, R. Winter, T. Dietz, B. Claise	September 2013	Informational
<a href="#">RFC 7228</a>	<a href="#">ASCII</a> , <a href="#">PDF</a> , <a href="#">HTML</a>	<b>Terminology for Constrained-Node Networks</b>	C. Bormann, M. Ersue, A. Keranen	May 2014	Informational
<a href="#">RFC 7326</a>	<a href="#">ASCII</a> , <a href="#">PDF</a> , <a href="#">HTML</a>	<b>Energy Management Framework</b>	J. Parello, B. Claise, B. Schoening, J. Quittek	September 2014	Informational
<a href="#">RFC 7460</a>	<a href="#">ASCII</a> , <a href="#">PDF</a> , <a href="#">HTML</a>	<b>Monitoring and Control MIB for Power and Energy</b>	M. Chandramouli, B. Claise, B. Schoening, J. Quittek, T. Dietz	March 2015	Proposed Standard
<a href="#">RFC 7461</a>	<a href="#">ASCII</a> , <a href="#">PDF</a> , <a href="#">HTML</a>	<b>Energy Object Context MIB</b>	J. Parello, B. Claise, M. Chandramouli	March 2015	Proposed Standard
<a href="#">RFC 7577</a>	<a href="#">ASCII</a> , <a href="#">PDF</a> , <a href="#">HTML</a>	<b>Definition of Managed Objects for Battery Monitoring</b>	J. Quittek, R. Winter, T. Dietz	July 2015	Proposed Standard
<a href="#">RFC 7603</a>	<a href="#">ASCII</a> , <a href="#">PDF</a> , <a href="#">HTML</a>	<b>Energy Management (EMAN) Applicability Statement</b>	B. Schoening, M. Chandramouli, B. Nordman	August 2015	Proposed Standard
<a href="#">RFC 7668</a>	<a href="#">ASCII</a> , <a href="#">PDF</a> , <a href="#">HTML</a>	<b>IPv6 over BLUETOOTH(R) Low Energy</b>	J. Nieminen, T. Savolainen, M. Isomaki, B. Patil, Z. Shelby, C. Gomez	October 2015	Proposed Standard
<a href="#">RFC 7772</a> a.k.a. <a href="#">BCP 202</a>	<a href="#">ASCII</a> , <a href="#">PDF</a> , <a href="#">HTML</a>	<b>Reducing Energy Consumption of Router Advertisements</b>	A. Yourtchenko, L. Colitti	February 2016	Best Current Practice
<a href="#">RFC 8036</a>	<a href="#">ASCII</a> , <a href="#">PDF</a> , <a href="#">HTML</a>	<b>Applicability Statement for the Routing Protocol for Low-Power and Lossy Networks (RPL) in Advanced Metering Infrastructure (AMI) Networks</b>	N. Cam-Winget, Ed., J. Hui, D. Popa	January 2017	Proposed Standard
<a href="#">RFC 8105</a>	<a href="#">ASCII</a> , <a href="#">PDF</a> , <a href="#">HTML</a>	<b>Transmission of IPv6 Packets over Digital Enhanced Cordless Telecommunications (DECT) Ultra Low Energy (ULE)</b>	P. Mariager, J. Petersen, Ed., Z. Shelby, M. Van de Logt, D. Barthel	May 2017	Proposed Standard
<a href="#">RFC 8352</a>	<a href="#">ASCII</a> , <a href="#">PDF</a> , <a href="#">HTML</a>	<b>Energy-Efficient Features of Internet of Things Protocols</b>	C. Gomez, M. Kovatsch, H. Tian, Z. Cao, Ed.	April 2018	Informational

# Even more ...

You can: **add new ideas, +1 to ideas you like**  
Ideas can either be **+this or -that**

- Locality of edge/fog computing?
- Servitised user-devices: light clients (xterminal like)
- Env accountability:
  - An impact assessment of the Internet and protocols
  - GHG metering, reporting: per device, per org
  - Environmental limits, env budget? tokens  
Environmental congestion control, caching,  
rate/update limits?

# Lessons, actions

You can: **add new ideas, +1 to ideas you like**  
Ideas can either be **+this** or **-that**



- GAIA! Network + end-hosts + things + environmental limits: **an internet for the people and the planet**
- Sustainability: the Internet adds or subtracts on GHG? Better materials, better energy, more durable, less usage, more connections, more base stations, more people ...
  - Frugality vs bloat, efficiency vs rebound effects
- Evolution: Locality of data and computation, caching, replication, slower (asynchrony), limits ...
- **Shall we give up on this? or revolt?**  
**Avoid** or **plan** future IETF meetings in coast areas ...
- **The IRTF way: research, discussion, documents**