# Networking and Environmental Sustainability

## – *an operational perspective*

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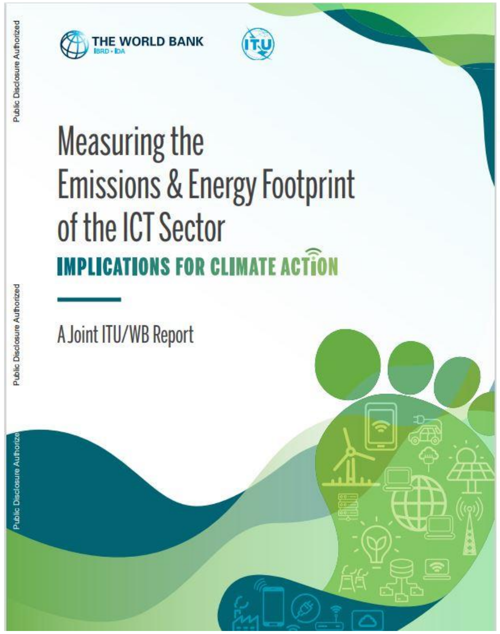
IEPG Meeting @ IETF 120

21 July 2024, Vancouver

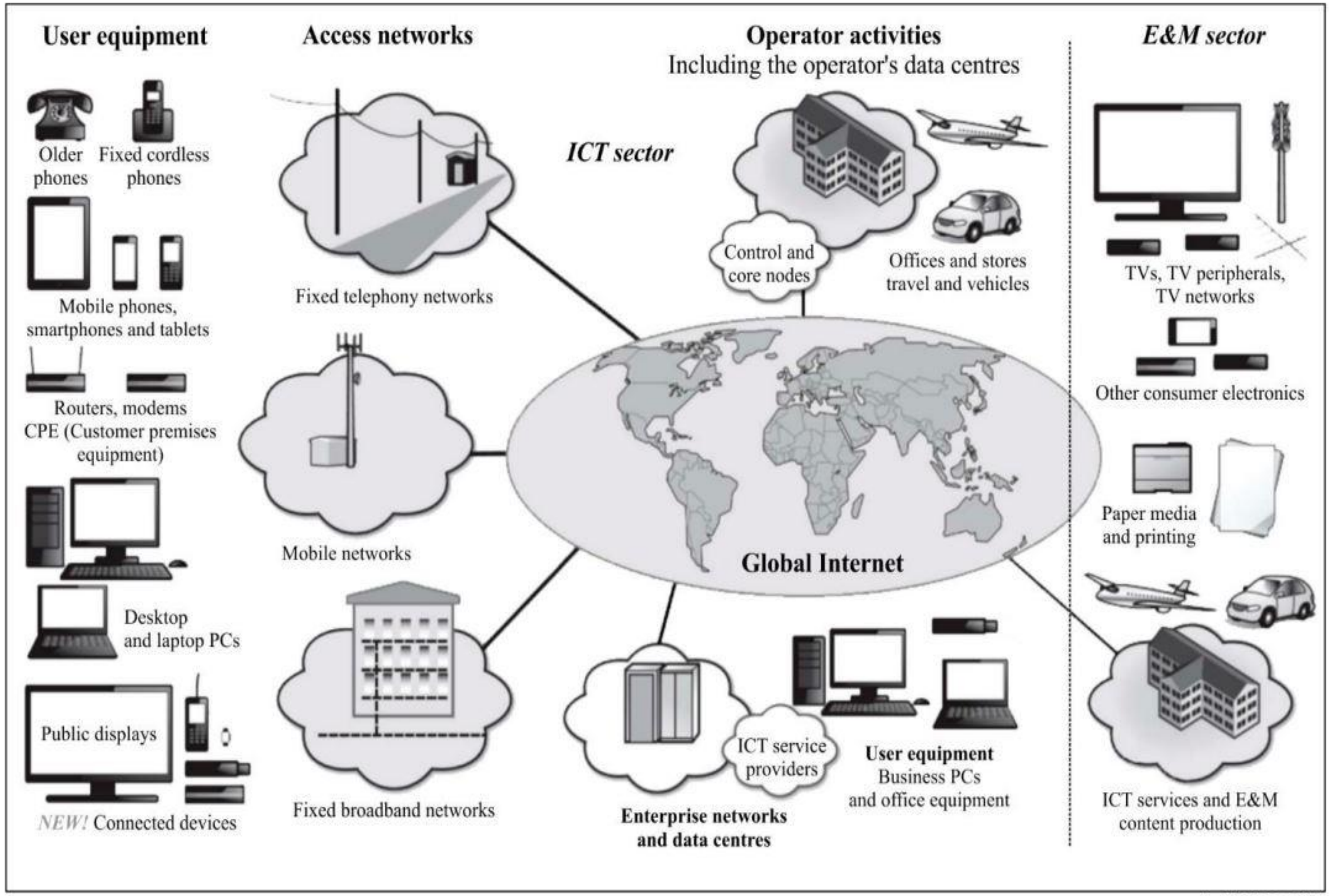
# ICT sector energy consumption & GHG emissions

- In 2020, ICT sector used ~4% of global electricity and emitted ~1.4% of GHGs.
- ICT sector emissions (%) tend to follow the global trend, somewhat increasing, not decreasing.
- ICT sector has a relatively good renewable energy use.
- Electricity consumption and GHG emissions are not aligned with data growth rates, which are much higher.
- Per subscriber energy consumption is stable while emissions tend to decrease due to renewable energy use.




# Different ICT domains have differentiated impact

- User devices take up ~57 % of sector GHG emissions with 50-50 split in use phase and embodied emissions.
- Networks, mobile & fixed (including core), take up ~24 %, with ~83 % in use phase and ~17 % in embodied emissions.
- Data centers and enterprise networks take ~18 %, with ~78 % in use phase and ~22 % in embodied emissions.



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Share of networking operations in global GHG emissions is rather small:

*Why then, should we still care?*

# Why should we care?

- We are seriously off-course to meet the GHG emission reduction targets to meet the Paris Agreement goals: ICT Sector must halve its emissions by 2030 (ITU-T) !
- Most operators & vendors have net-zero pledges, and we are expected (soon required) to report on them.
- Renewable energy transition is not projected to make up for the delta in emissions trajectories.
- One-third of the world population (2.6 billion people) remain unconnected to the Internet. Bridging this divide sustainably, while subscriber numbers rise, is a priority.
- Networks enable new trends like digital twins, metaverse and pervasive AI which would increase digitalization impacts dramatically.

# What should the networking industry do then?

# We must not let the bathtub in our own house overflow!

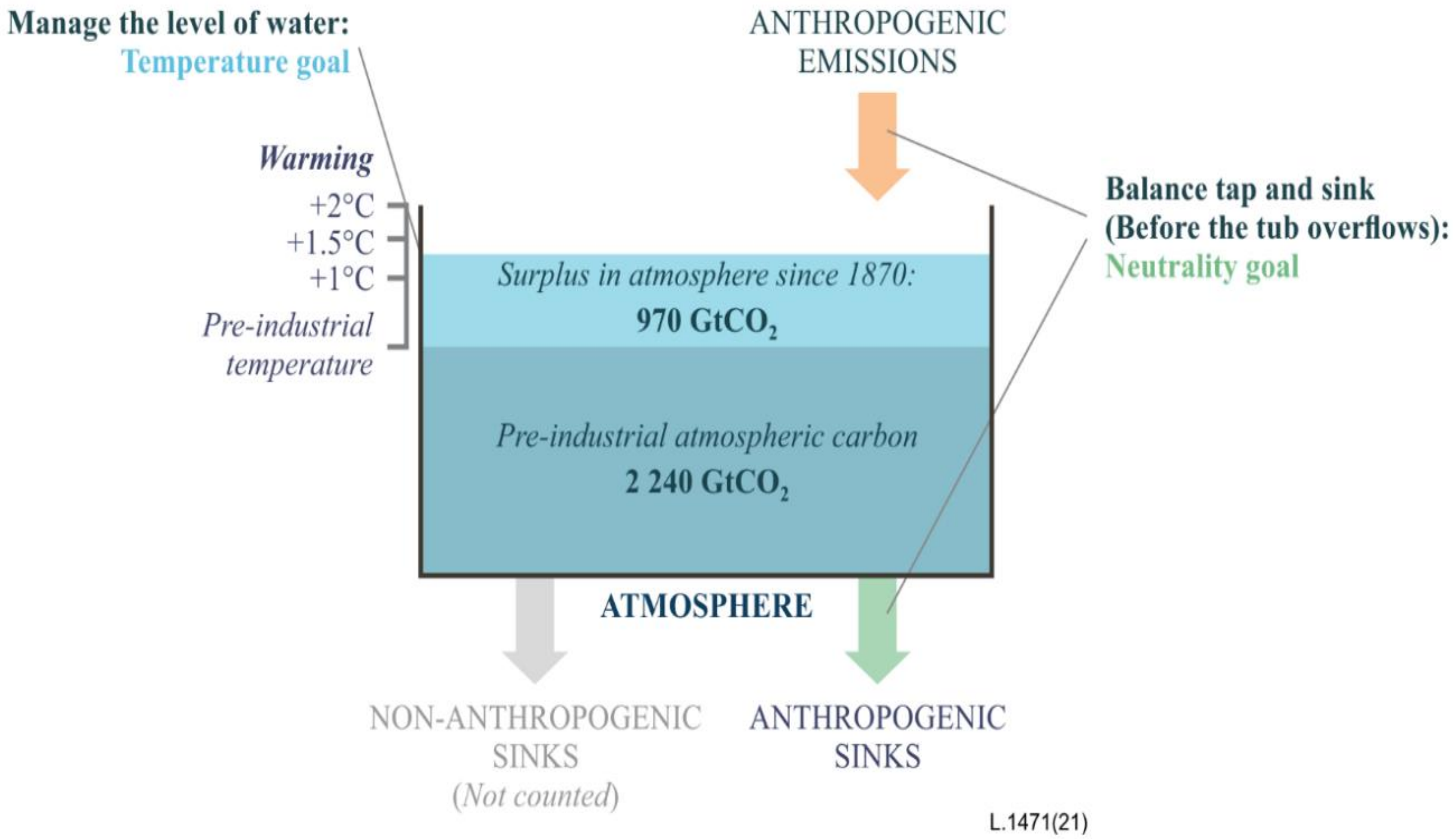


**Figure 1 – The bathtub metaphor related to Net Zero targeting at planetary level**
source: [b-NZI Framework]

Networking industry is currently pursuing a cost reduction-oriented trajectory for its energy efficiency and energy savings optimizations.

*While necessary, this might not be sufficient for GHG emissions targets being reached!*

# From energy savings to GHG emissions reductions

- The path from energy efficiency & savings to GHG emissions reductions must be established.
- Renewable energy use must increase, tracked through carbon intensity of energy.
- Traffic load / capacity needs to not increase disproportionately (rebound).
- Infrastructure expansion needs to be managed for GHG emissions reductions as well as for circularity.

| Category of action | Direction of change | Key actions |
|---|---|---|
| Energy consumption | ↘ | Energy efficiency, energy savings, energy proportionality. |
| Carbon intensity of used energy | ↘ | Decarbonization of the energy supply, enabling user and supply side carbon awareness |
| Traffic load | ↘ | Managing the rebound effect through network protocol, architecture and user & supply side actions |
| Infrastructure expansion | ↘ | Managing embedded (manufacturing) emissions, infrastructure sharing |

# Energy related actions for network operations

- Establishing energy and GHG emissions related metrics: at what granularity, scope, domain, for network operations?
  - *Metrics and measurements should help decision making for energy use / GHG emissions optimizations: how often, how fast? Or only for reporting?*
- Energy proportionality through reduced idle power as well as dynamic decision making based on utilization.
  - *Are all the required utilization metrics & measurements and control protocols in place? Are end-to-end impacts of local port/node shut-down clear?*
  - *Are new use cases and technologies (AI, IoTs & sensing) encouraging an always-on mode of operation and how to deal with them?*
- Can we establish caps & limits on energy consumption, based on energy carbon intensity as well as utilization profiles?
  - *Energy and carbon budgets.*
- What other operator requirements and sensitivities exist?

# GHG related actions for network operations

- What can be done for networks to use low carbon-intensity energy?
  - *Prioritizing locally generated renewable energy use in network operations: cost-effective & carbon-effective choices!*
  - *Interconnections / APIs and protocols between energy grids and networks for better scheduling, planning and resilience,*
  - *Carbon-aware routing and traffic steering,*
  - *Robust networking protocols for intermittent energy supplies?*
- Enabling user and supply side carbon awareness
  - *How can networks help users and content providers make carbon-aware decisions?*
- What other operator requirements and sensitivities exist?

# Traffic related actions for network operations - questions

- How can the rebound effect be managed effectively?
  - *When something becomes more affordable (cost & GHGs), it gets used more!*
  - *What would it take for users and content providers to limit usage and what should these limits be?*
- Network architecture and protocol considerations:
  - *Multicast vs. unicast traffic & can we live with lower QoE?*
  - *Distributed vs. centralized architectures and hierarchy: do they help?*
  - *Impact of cloudification on network traffic,*
  - *Are non-blocking architectures needed everywhere? Multiplexing is a fundamental telecommunications technology along with QoS (when implemented fairly).*
- How can we ensure that new use cases and innovations take network traffic impact into account and not only the other way around?
- What other operator requirements and sensitivities exist?

# Infrastructure related actions for network operations

- Although smaller, compared to the use phase emissions, embedded (embodied) emissions are part of the network GHG emissions impact.
  - *Every infrastructure expansion has cost and GHG impact as well as material (circularity) impact.*
- Can infrastructure sharing be a viable strategy?
  - *Use case / context specific pros&cons analyses would be needed.*
- Longer lifespan for products and services reduces impact.
  - *Circularity principles provide dual benefits (maintainability, repairability, observability, reuse, reduce,…)*
  - *What are the implications for network protocols?*
- Is cloudification the answer? *Not really, but why not?*
- What other operator requirements and sensitivities exist?

# Additional considerations

- Network footprint covers more than GHG emissions: land, water and materials use as well as biodiversity loss are also pushing the planet to its limits and have feedback loops to climate change.
- That means materials efficiency and circularity matter, as well as how these materials are sourced (land/water use, pollution, species extinction and eco-system degradation).
- It is harder to frame the impact of network operations on these elements of environmental sustainability as compared to GHGs.
- In addition to the environmental aspects of sustainability, social and economic aspects also play a key role, enabling or hindering the adoption of environmental sustainability initiatives.

# Thanks!

# Questions / feedback?

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