## CANS Part B Sustainability: Internet Emissions Life Cycle Analysis

The purpose of this tutorial is to illustrate by example the emissions arising from the use of networked systems.

Let's consider a mobile device (e.g. an iPad) that communicates with a server in the cloud. Ten million users watch a TV show for half an hour on such a device, e.g. on the Apple TV app. Assume that it requires a thousand servers in a cloud data centre to serve the video streams. Assume the tablet is used for 15,000 hours over its whole life; the server is used for 40,000 hours. Given the following figures:

Tablet embodied carbon: 120 kgCO2e
Server embodied carbon: 1400 kgCO2e

• Data center PUE: 1.4 (\*)

Tablet electricity consumption: 0.002 kWh/h
Server electricity consumption: 0.2 kWh/h

• Carbon intensity: 0.2 kgCO2e/kWh

(\*) PUE = Power Usage Effectiveness. It expresses the overhead of cooling, lighting etc for every unit of energy spent on compute. So ideally, this should be 1 (no overhead), but in reality, overheads are often 50% or more. If all servers in a data centre together consume servers\_total kWh, then the entire data centre consumes servers\_total\*PUE kWh.

- 1. What is the total carbon footprint of this activity (i.e. cloud + all end users)? Work out the calculation first in general, then using the specific values from above.
- 2. How do the contributions to the emissions (embodied/from use; cloud/end user) compare in this case? Can you think of a case where it would be very different?
- 3. Discuss the contributions from the network between the cloud and the tablet to the emissions. How could they be included in the total carbon footprint calculation?