Alliance for IoT and Edge Computing Innovation

AIOTI DAYS 2024

24-25 Sep BRUSSELS

Continuum, digital twins and virtual worlds

Session: Use cases to apply the methodologies for CO2 reduction measurements

AIOTI Examples:

Windfarm using Smart Monitoring

5G and improved sustainability in action – Healthcare

Georgios Karagiannis, Huawei, AIOTI Chair of WG ICT for CO2 reduction Methodology

Sylvie Couronné, Fraunhofer IIS, , AIOTI Co-Chair of WG ICT for CO2 reduction Methodology

Anders Andrae, Huawei

International Standardization Bodies to Drive Sustainable Networks

Joint IEC-ISO-ITU Smart Cities Task Force

ITU-T SG20
ITU Study Group on IoT and Smart Cities and Communities

ITU-T SG5
Environment, climate change and circular economy

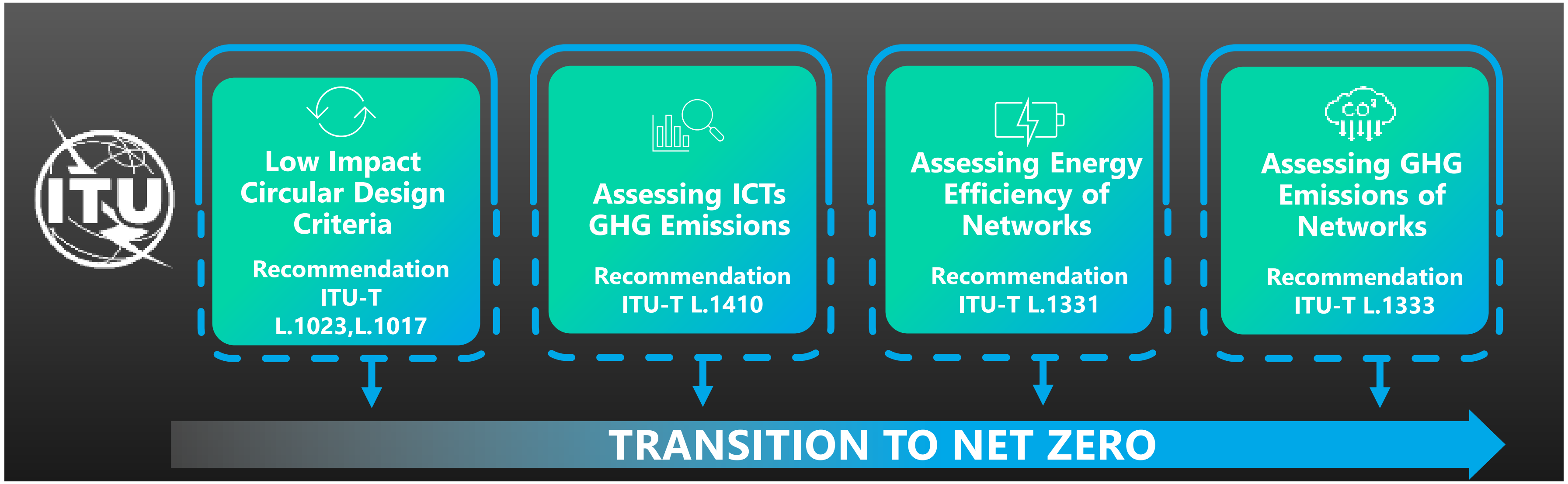
ISO – TC207
Environmental management

ISO/IEC JTC 1
Subcomittee 39 on Sustainability, IT and Data Centres

IEC TC 85
Measuring equipment for electrical and electromagnetic quantities

Ongoing collaboration of ITU-T SG5 with other organizations such as ETSI TC EE and AIOTI to improve and revise L.1480 adding use cases and quantification method

International Standardization Bodies to Drive Sustainable Networks



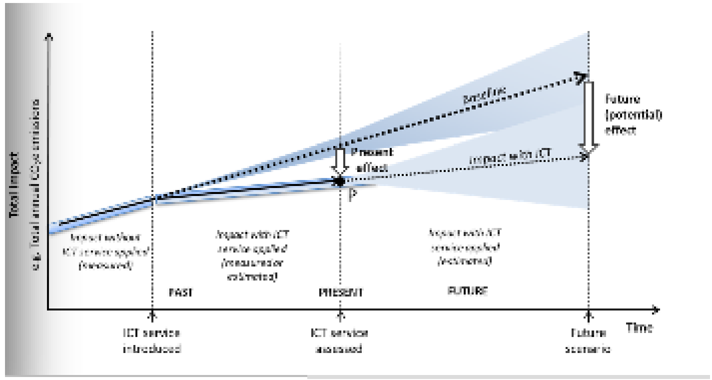
Measuring the impact of ICT and digital technologies solutions on other sector (ITU-T L.1480)

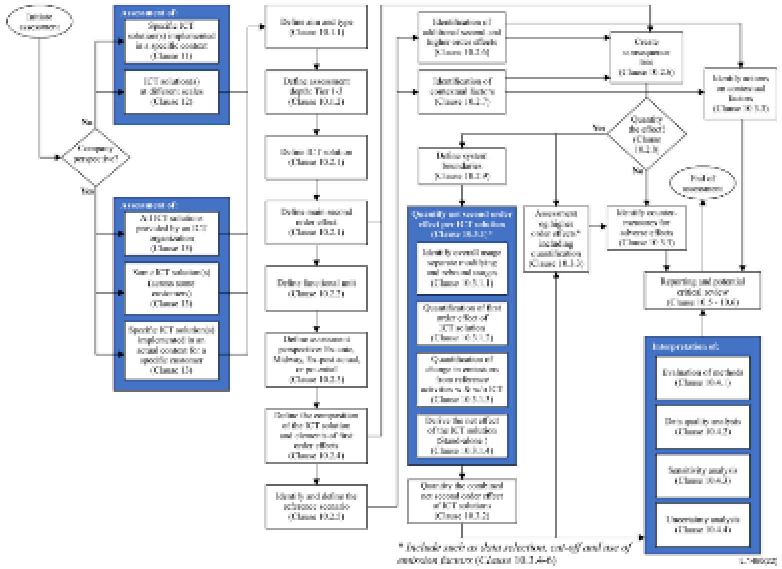
Recommendation
ITU-T L.1480 (12/2022)

SERIES L: Environment and ICTs, climate change, e-waste, energy efficiency; construction, installation and protection of cables and other elements of outside plant

Assessment methodologies of ICTs and CO2 trajectories

Enabling the Net Zero transition: Assessing how the use of information and communication technology solutions impact greenhouse gas emissions of other sectors

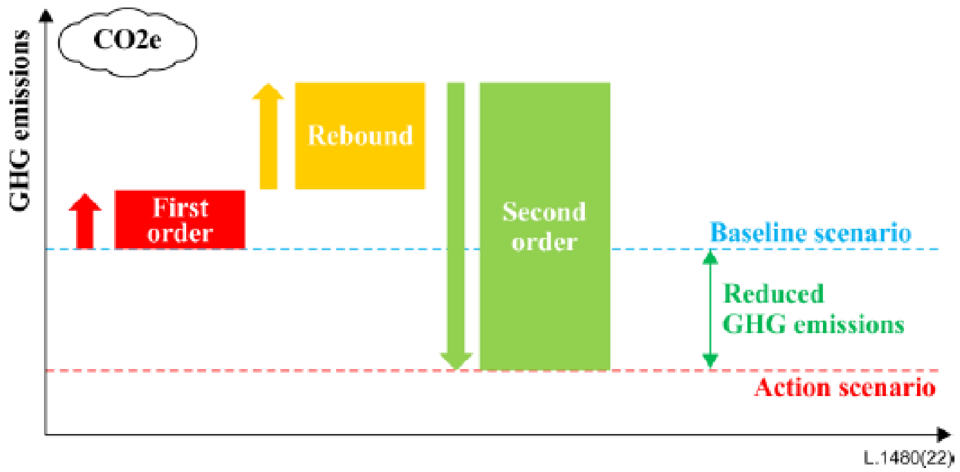


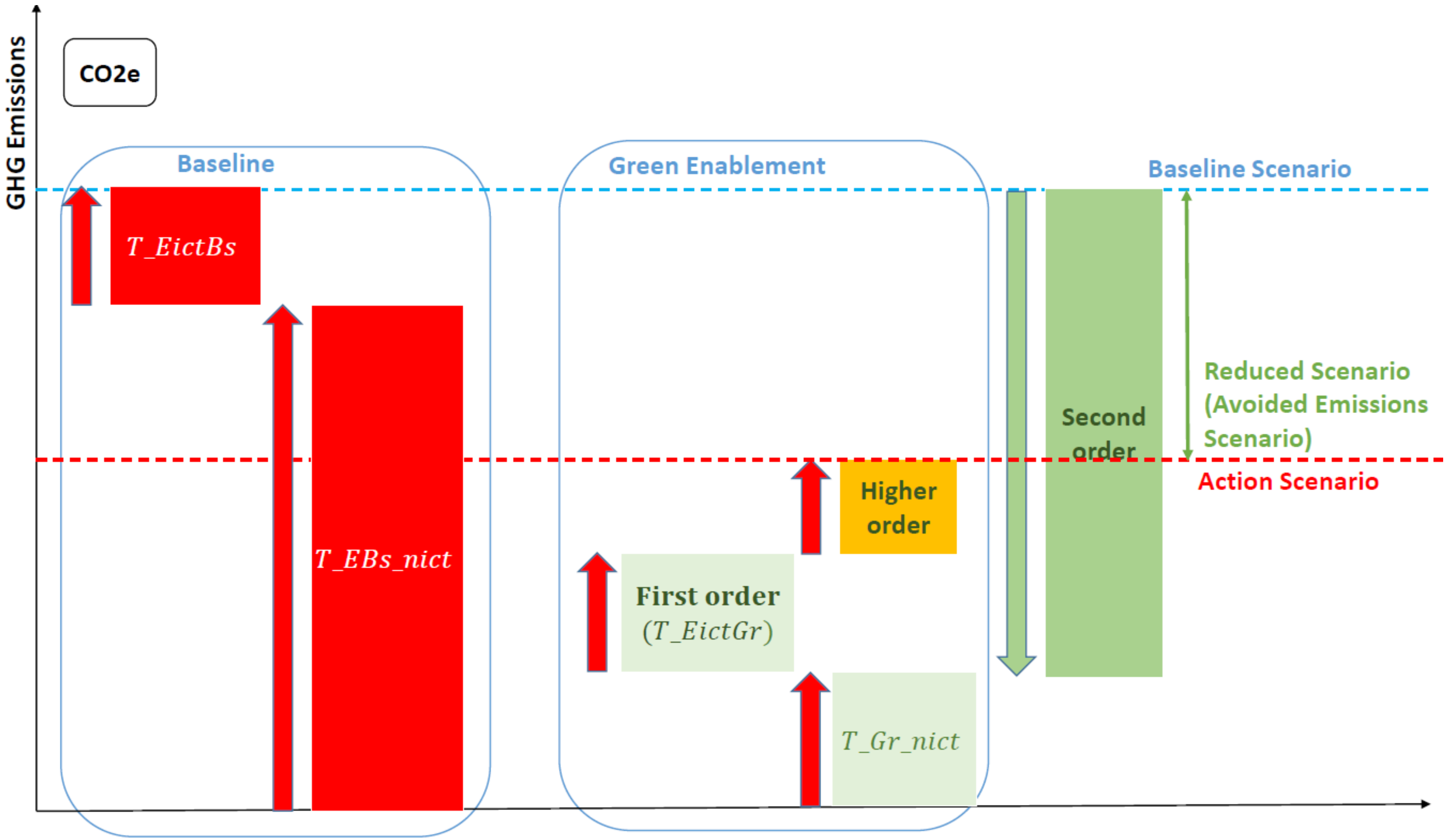


AIOTI

- Ongoing collaboration of ITU-T SG5 with other organizations such a to improve and revise L.1480 adding use cases and quantification method
- AIOTI is based on the ITU-T L.1480 assessment methodology, and it contributes to ITU-T SG5 / ETSI TC EE on introducing a quantification method in an updated version of ITU-T L.1480

AIOTI method of measuring total avoided carbon emissions in vertical sectors, when applying ICT for non-recycled products

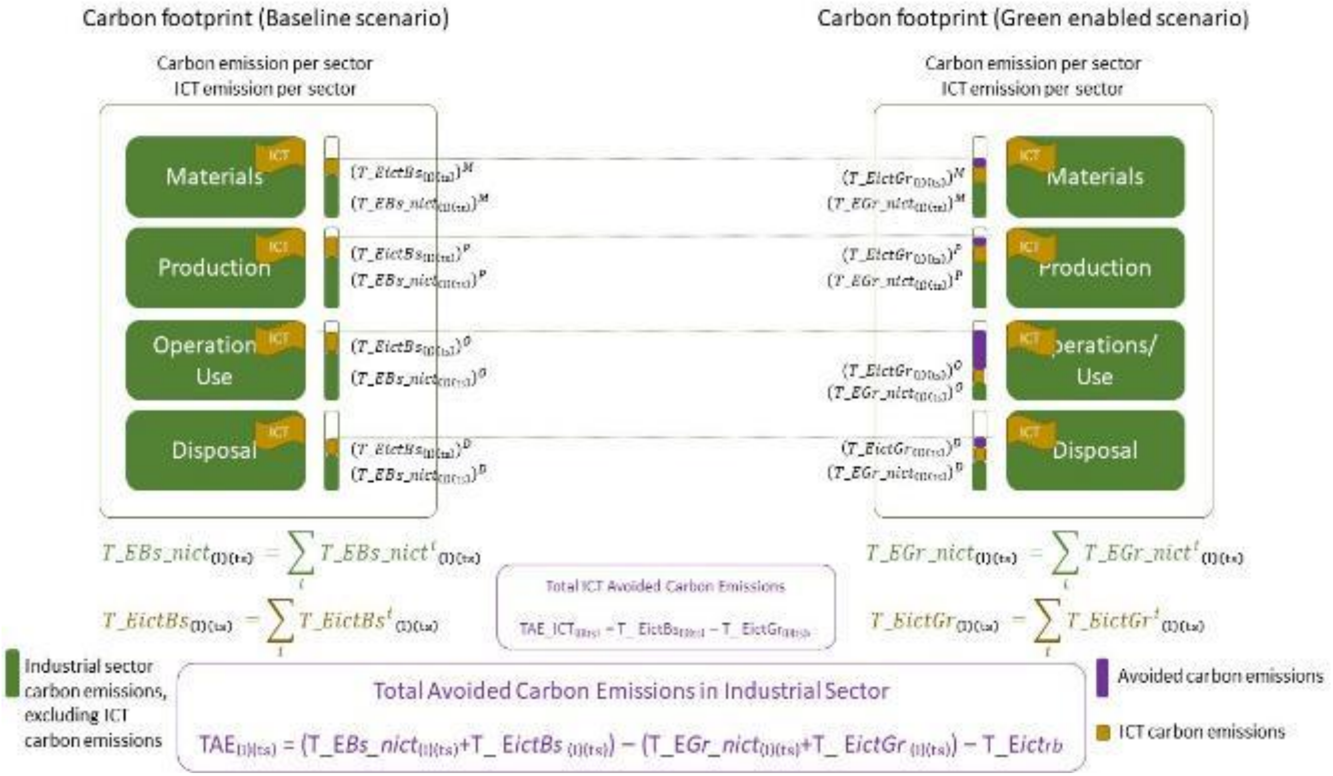




AIOTI Method

AIOTI

AIOTI method of measuring total avoided carbon emissions in vertical sectors, when applying ICT for non-recycled products



- ***LBs_nict**: total number of product/components (m) used in the Baseline scenario, excluding the ICT infrastructure;*
- Superscripts **M**, **P**, **O**, **D**, denote that the carbon emissions calculations are related to the LC phases: Material, Product, Operation, Discard, respectively

$$T\_EBs\_nict^M_{(l)(ts)} = \sum_{m=1}^{LBs\_nict} EBs\_nict^M_{(m)(l)(ts)}$$

$$T\_EBs\_nict^P_{(l)(ts)} = \sum_{m=1}^{LBs\_nict} EBs\_nict^P_{(m)(l)(ts)}$$

$$T\_EBs\_nict^O_{(l)(ts)} = \sum_{m=1}^{LBs\_nict} EBs\_nict^O_{(m)(l)(ts)}$$

$$T\_EBs\_nict^D_{(l)(ts)} = \sum_{m=1}^{LBs\_nict} EBs\_nict^D_{(m)(l)(ts)}$$

- First order effects = $T\_EictGr_{(l)(ts)}$
- Second order effects = $T\_EBs\_nict_{(l)(ts)} + T\_EictBs_{(l)(ts)} - T\_EGr\_nict_{(l)(ts)}$
- Higher order effects = T_Eict_{RB}

Assumptions:

1. When ICT solutions are used, to among other features, reduce carbon emissions in Industrial sectors, it is assumed that in the Use/Operation LC phase the carbon emissions are measured under a certain Load and for a certain type of service;
2. Load = data processed by the network during a unit of time, e.g., 1 week, 1 month, 1 year;
   - "l" index is defined as the "percentage of (average bandwidth ICT infrastructure / total bandwidth that ICT infrastructure can handle)". If "l=1", it means that the applied Load equals the total bandwidth that ICT infrastructure can handle;
3. TS = Type of Service (follow the 5G type of services, e.g., URLLC)
4. LC = Life Cycle, composed by Life Cycle phases Materials, Production, Use/Operation, Disposal;
5. Unit: kgCo2e.

Where:

1. $TAE_{(l)(ts)}$ Total Avoided Carbon Emission Scenario for: (1) the complete LC, excluding the Reuse and Recycle phases, (2) for a certain Load ("l" index) and (3) for a type of service, e.g. follow the classification specified by ITU-T for 5G type of services; Note that the "l" index is defined as the "percentage of (average bandwidth ICT infrastructure / total bandwidth that ICT infrastructure can handle). If "l=1", it means that the applied Load equals the total bandwidth that ICT infrastructure can handle;
2. $T\_EBs\_nict_{(l)(ts)}$ Total Carbon Emission Scenario, for Baseline scenario (Bs), but excluding the carbon emission of the applied ICT infrastructure, i.e., carbon emissions of ictBs, for: (1) the complete LC phases, excluding the Reuse and Recycle phases, (2) for a certain Load ("l" index) and (3) for a type of service, e.g. follow the classification specified by ITU-T for 5G type of services;
3. $T\_EictBs_{(l)(ts)}$ Total ICT Carbon Emission for Baseline Scenario, i.e., ictBs, for: (1) the complete LC, excluding the Reuse and Recycle phases, (2) for a certain Load ("l" index) and (3) for a type of service, e.g. follow the classification specified by ITU-T for 5G type of services;
4. $T\_EGr\_nict_{(l)(ts)}$ Total Carbon Emission Scenario, for Green enabled scenario, but excluding the carbon emission of the applied ICT infrastructure, i.e., carbon emissions of ictGr, for: (1) the complete LC, excluding the Reuse and Recycle phases, (2) for a certain Load ("l" index) and (3) for a type of service, e.g. follow the classification specified by ITU-T for 5G type of services;
5. $T\_EictGr_{(l)(ts)}$ Total Carbon Emission for Green enabled Scenario, i.e., ictGr, for: (1) the complete LC, excluding the Reuse and Recycle phases, (2) for a certain Load ("l" index) and (3) for a type of service, e.g. follow the classification specified by ITU-T for 5G type of services;
6. T_Eict_{RB} Total Carbon Emissions from studied product system for the ictGr applied solution due to higher order effects including rebound effects.

AIOTI

Source: AIOTI: https://aioti.eu/wp-content/uploads/AIOTI-Carbon-Footprint-Methodology-Report-R3-Final.pdf

Example: “Smart Monitoring System in a Windfarm”

Source: AIOTI report “IoT and Edge Computing Carbon Footprint Measurement Methodology, R3” **– Use case: “Smart Monitoring System in a Windfarm, to decrease manual maintenance time in windfarms, and enabling windfarms to generate more renewable energy, based on Fraunhofer IIS - Q-Bo® Technology”**

- Reduction to half of the maintenances days on site and continuous monitoring of the screw

Goal of the case study:

- **reduce maintenance efforts**
- **reduce the loss of wind energy production because of maintenance works**

⇨ define the adequate ICT enabling system for this purpose

Maintenance of wind turbines in Europe	Reference scenario	*ICT Solution scenario*
Parameters		
Maintenances on site over the lifetime of 10 years	20	10
Not produced energy during maintenance to be replaced by local mixed Energy sources	160 hours	80 hours
Transport for maintenance (not included in this analysis)	Car, boot, helicopter	Car, boot, helicopter (1/2 from the reference scenario avoided)
Smart screw monitoring system	No	Yes

Avoided emissions: $TAE_{(t)(w)} = T\_EBs\_nict_{(t)(w)} - (T\_EGr\_nict_{(t)(w)} + T\_EsmartIoTGr_{(t)(w)}) - T\_Eict_{RB}$

$TAE_{(t)(w)}$ = 11.520.000 – (5.760.000 + 14.510) – (-727) = **5.746.217 tCO_2e**

or 574.622 tCO_2e/year

AIOTI

Example: "5G and improved sustainability in action – Healthcare"

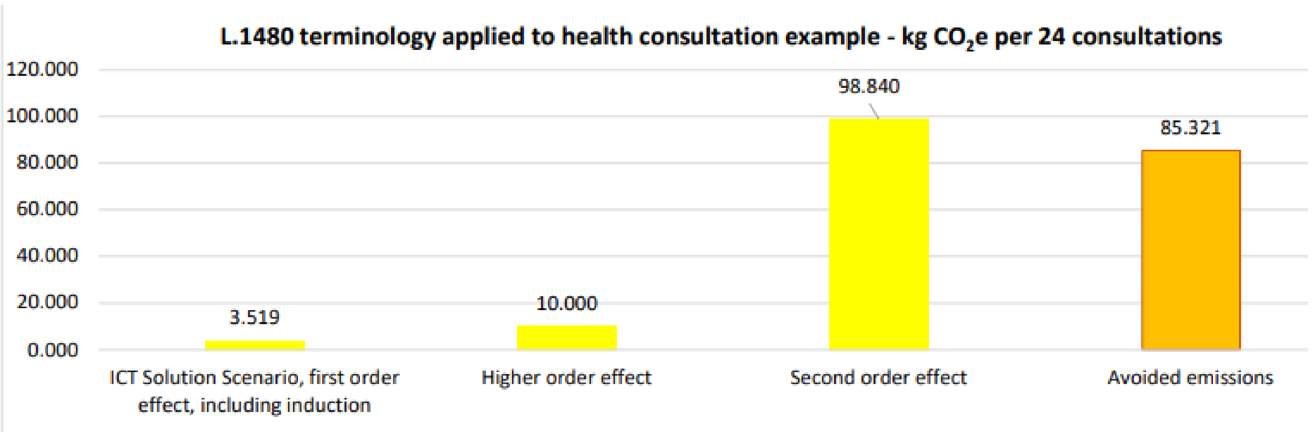
Goal: Health Consultation Technology comparison, effect of digitalization on Co2 emissions, using 5G-enabled CT consultations

Result: Since the middle of 2019, hospitals in less-affluent tier-three cities in China have replaced on-site CT consultations with 5G-enabed remote CT consultations

- 5G-enabled CT consultations can achieve environmental benefits compared to face-to-face consultations, as the GHG emissions of vehicles and aircrafts previously used by the medical experts are completely eliminated, at the cost of additional monitors to display CT scans and high-throughput

Source**: Use case provided by Anders Andrae (Huawei), which is included in AIOTI report **"IoT and Edge Computing Carbon Footprint Measurement Methodology, R3"

Parameters	Reference scenario	ICT Solution scenario
People	4	4
Cars	4	0
Consultations	24/day	24/day
Work time	8 hours	13 hours
Car travel	320 km	0
Airplane travel (not included in analysis)	8000 km	0
PCs	1	3
Computerized Tomography (CT) Monitors	1	3



Source**: AIOTI report **"IoT and Edge Computing Carbon Footprint Measurement Methodology, R3"

AIOTI