Alliance for AI, IoT and Edge Continuum Innovation

NetworldEurope and AIOTI joint webinar “How advanced communications can support sustainability goals, 21 January 2025

AIOTI Driven Use Cases that apply Methodologies for GHG Reduction Measurements

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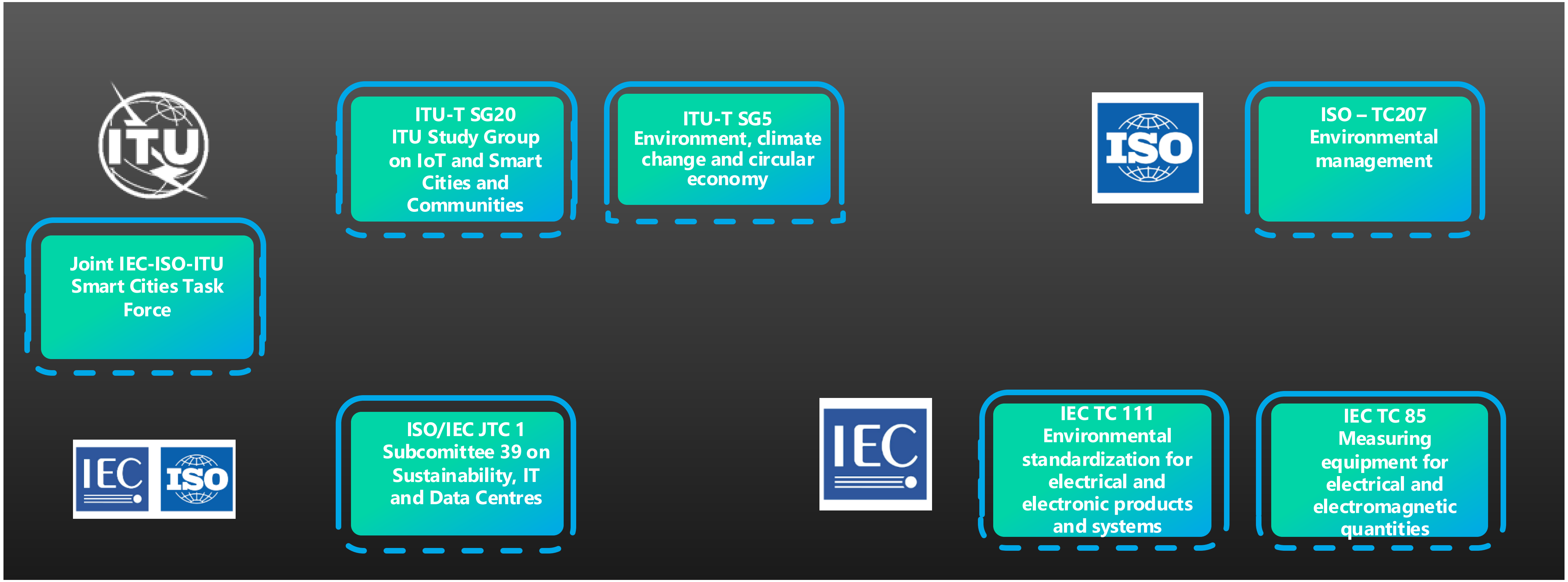
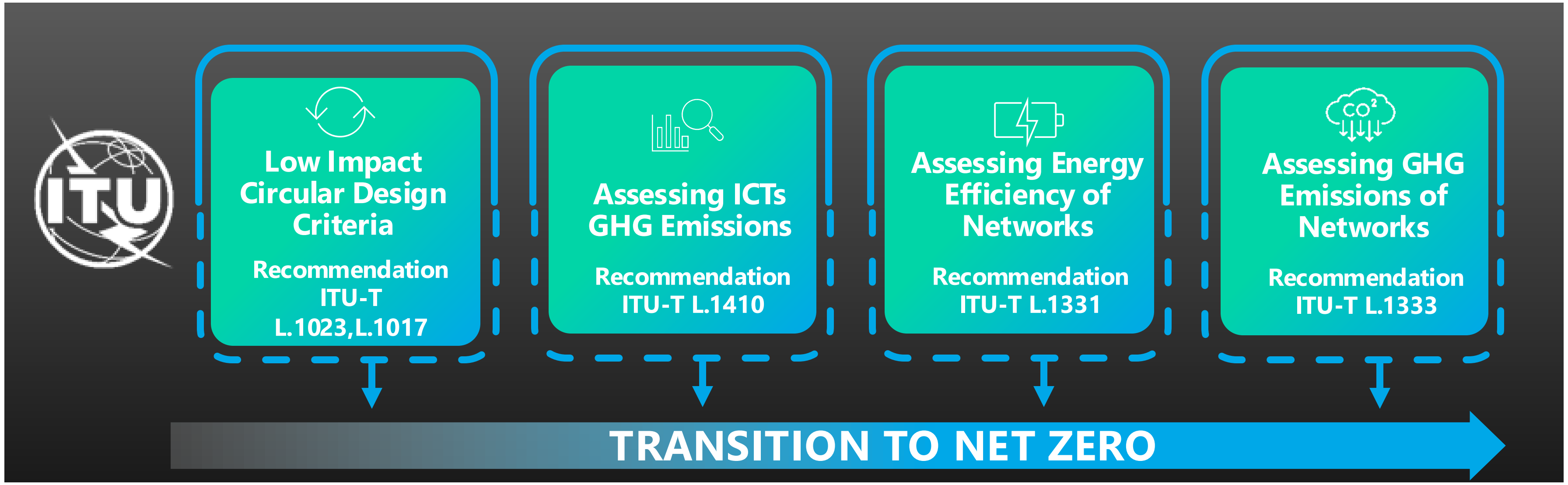
International Standardization Bodies to Drive Sustainable Networks



Ongoing collaboration of ITU-T SG5 with other organizations such as ETSI TC EE and AIOTI to revise L.1480

AIOTI contributes to ITU-T SG5 / ETSI TC EE on introducing representation by a formula and illustrating ITU-T L.1480 with use cases

International Standardization Bodies to Drive Sustainable Networks



Measuring the GHG emissions impact of <u>the use of</u> ICT and digital technologies solutions on other sectors (ITU-T L.1480)

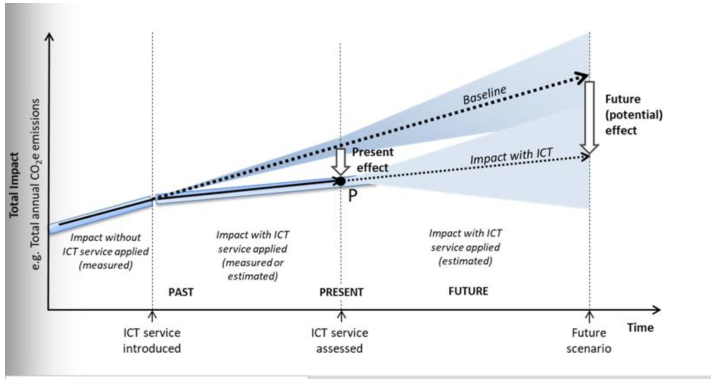
Recommendation

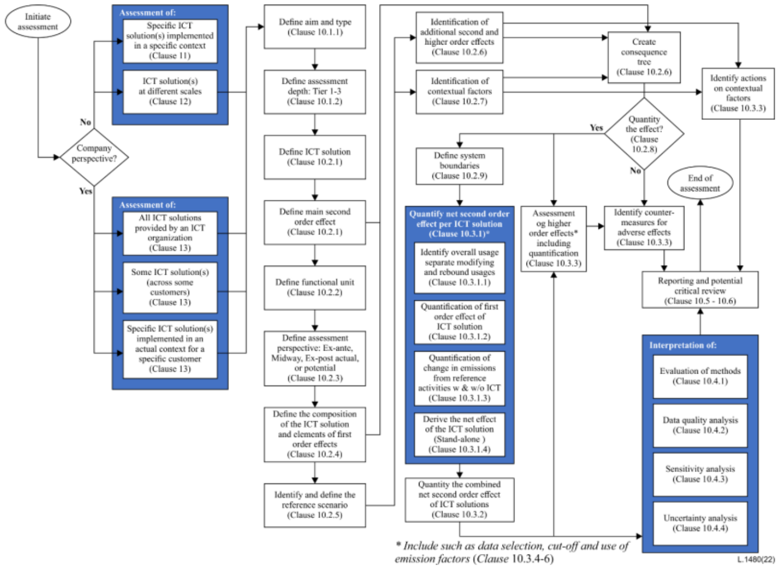
ITU-T L.1480 (12/2022)

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

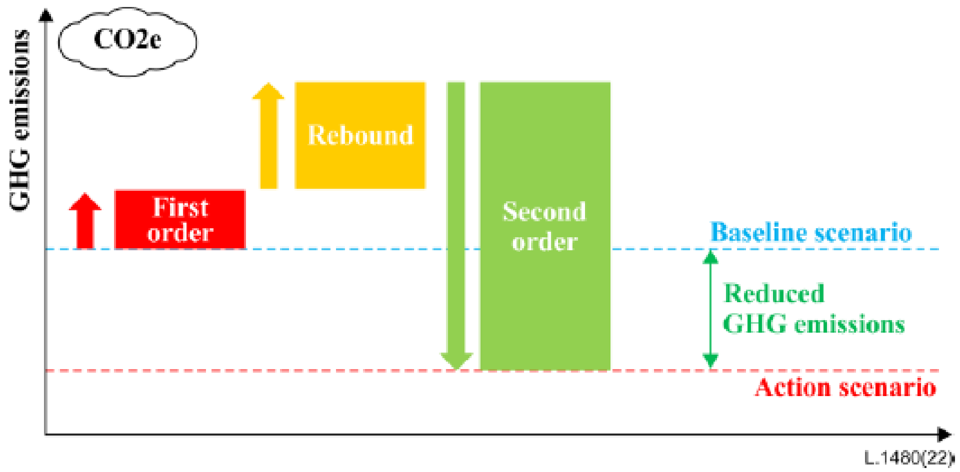
Enabling the Net Zero transition: Assessing how the use of information and communication technology solutions impact greenhouse gas emissions of other sectors



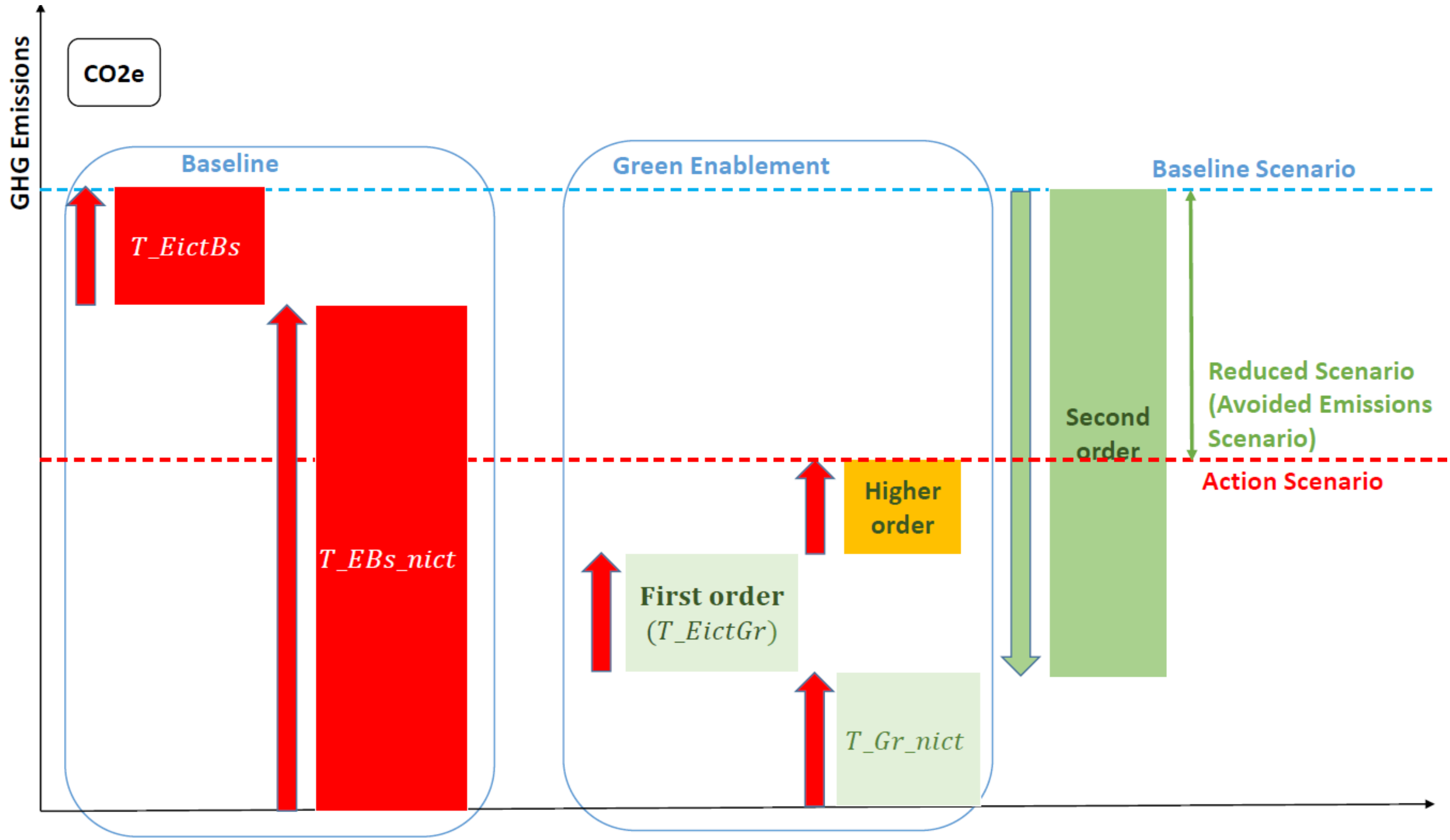


AIOTI

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

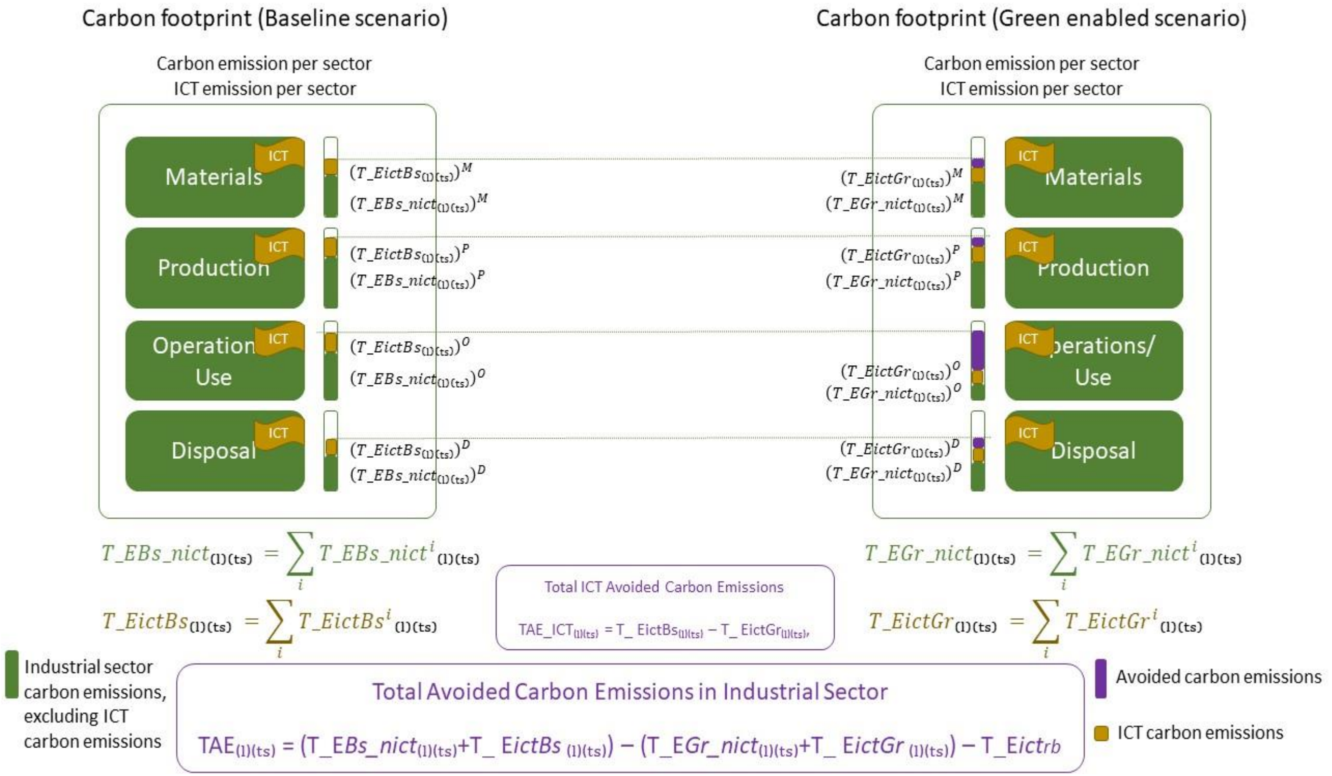


From non normative ITU-T L.1480 Appendix I
« Other methodologies »
Methodological framework derived from ADEME
Figure I.5 - Calculation of reduced GHG emissions as the algebraic sum of negative (first order and rebound) and positive (second order) effects of the action on GHG emissions of a baseline scenario



AIOTI Method

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.

This methodology was updated in a joint Nov 2024 contribution with Orange, Huawei and the Fraunhofer Institute, for inclusion in ongoing ITU-T L.1480 revision process.

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

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

or 574.622 tCO_2e/year

AIOTI

This use case, with support from Orange, is currently being updated to align with the ITU-T L.1480 Recommendation

Example: “5G and improved sustainability in action – Healthcare”

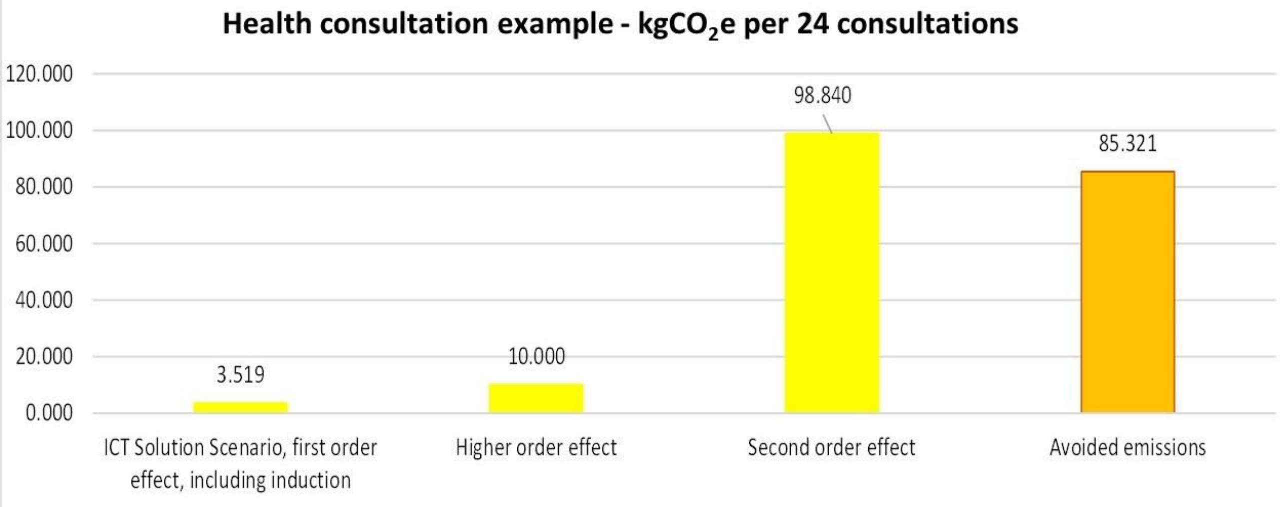
Goal: Health Consultation Technology comparison, effect of digitalization on Co2 emissions, using 5G-enabled CT consultations

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

Example: Green ICT – Optical Infrastructure Reduces Energy Consumption in ICT Infrastructures

F5G OpenLab

Fraunhofer HHI

Enable twin transition
- green and digital -
Through ubiquitous fiber connectivity.

Open Space for Collaboration

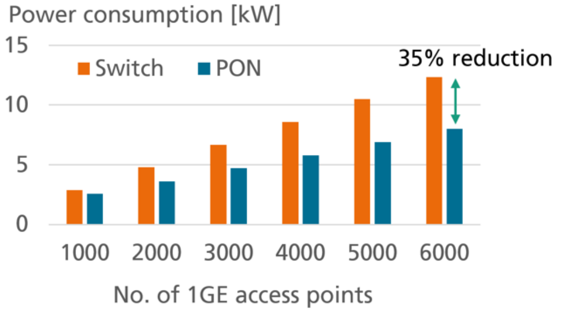
Enable the Green Transition by ICT

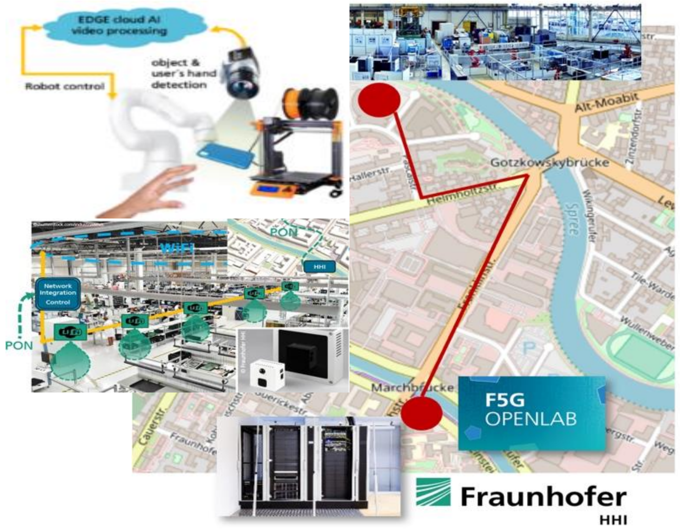
Component/System Vendors
Compare carbon footprint of different component/system versions
Live environment for product use phase testing

Network Operators
Develop and test new networking paradigms
Test technologies for carbon footprint reduction in a sandbox

Vertical Sectors
Relevant use cases of interest
Quantify reduction of carbon footprint
Evaluate/select best suited Green ICT technology

Together, find the best solution for carbon footprint reduction by ICT.





Recap 2023 Progress
Tested F5G in Manufacturing Network EE saved 35%

Advancing 2024 & 2025
Optical can reduce power consumption in industrial scenarios for Manufacturing.
Enable quantification of net benefits (incl. 1st and 2nd order effects according to ITU-T L.1480).

***Source**: based on AIOTI report “IoT and Edge Computing Carbon Footprint Measurement Methodology, R3”*

This use case is not applying explained AIOTI measurement methodology
- ➢ **Applying ITU-T L.1333 methodology to assess the GHG emission of applied networks**

Current status and Next steps

- ITU-T Orange members François Bélorgey and Jérôme Fournier, and AIOTI members worked together on clarifying and updating AIOTI method and make it useful for inclusion in ITU-T L.1480 revision process.
- During joint ITU-T SG5 / ETSI TC EE meeting on 18 November 2024, contribution was provisionally accepted for inclusion in a new Sub-section 10.3.7 of revised ITU-T L.1480 (under discussion).
- **Key changes in AIOTI method:**
  - Adaptation to ITU-T L.1480 methodology, which is based on concept of Consequence and Consequence tree. A Consequence tree represent an analytical basis for identifying the effects induced as result of the deployment and use (with all effects included) of an ICT solution in other sectors.
  - All Consequences (for first order, second order and higher order) in the Consequence tree are summed up:
    - each Consequence assesses GHG values compared to a reference situation,
    - the assessment result for each consequence depends on the actual use of the ICT solution by its user
    - when measuring separately GHG emissions without and with use of the ICT solution under study is not easy or is not practical (which is the most common case), only the differences between each consequence and the reference situation are measured.
  - For first-order Consequences (related to the physical existence of the ICT solution in use), two alternative approaches are proposed for assessing each Consequence:
    - equipment approach, when equipment life-cycle GHG emissions details are known individually,
    - system approach, when the characteristics of each piece of equipment are not available to the practitioner conducting the study, or are too difficult to access (for example, architecture of the network used or all various elements of data center infrastructure). The ICT solution is then considered as the sum of the usage of each piece of equipment and system that makes it up, each usage being defined through an allocation rule in relation to the total impacts of the equipment and systems.
- **Next steps**:
  - ITU-T Orange members and AIOTI members are working together on applying the L.1480 measurement method for the measurement of the GHG emissions related to “Smart Monitoring System in a Windfarm” use case
    - During joint ITU-T SG5 / ETSI TC EE meeting on 16 December 2024, the updated “Smart Monitoring System in a Windfarm” use case contribution that apply the updated AIOTI method was provisionally accepted for inclusion in Supplément ITU-T L.Examples to ITU-T L.1480 Recommandation

Thank you for listening

Any questions?

You can email us at sg@aioti.eu