



16th ITU Symposium on ICTs, Environment, Climate Change and Circular Economy

Session 3: Assessing the Enabling Effect of ICTs for Climate Action and Biodiversity

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ICT for Green Logistics

Green Transformation by F5G Infrastructure in Logistics Operations

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Introduction

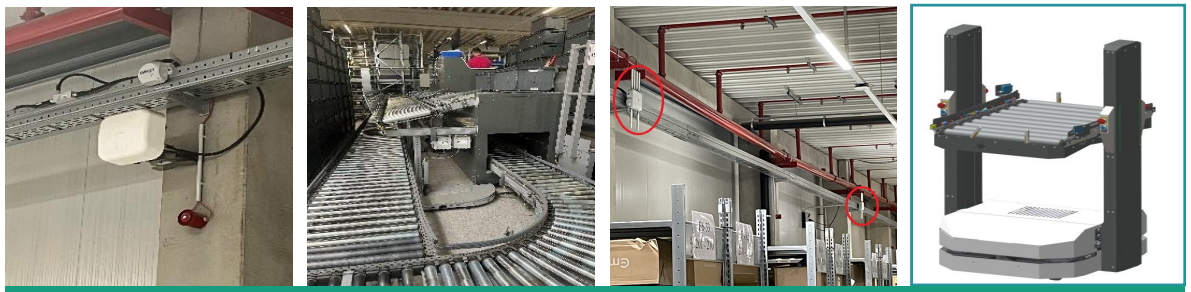
Overview of the Use Case Scenario

Hammer Advanced Logistics Campus - (Hyper-Connectivity Campus)

- Located at Eschweiler, Germany
- Entire Area- 105,000 sqm
- Study scope: Deployment of ICT solution in a controlled area of 720 sqm
- Use Case: ‘Pick and Place’ task for package shifting from storage shelves to conveyor belt
- Baseline scenarios:
  - Manual operation by human labor
  - Partially automated operation by automated guided vehicle (AGV) via legacy Wi-Fi connectivity based on copper cables
- F5G ICT upgrade scenario:
  - Partially automated operation by automated guided vehicle (AGV) via PON solution (XGS-PON / Wi-Fi 7)



Study/Use Case Site



Installed ICT Components and the Automated Guided Vehicle (AGV) for the use case

Objective

- Quantification of potential energy efficiency and greenhouse gas (GHG) emission reductions through upgrading the ICT system

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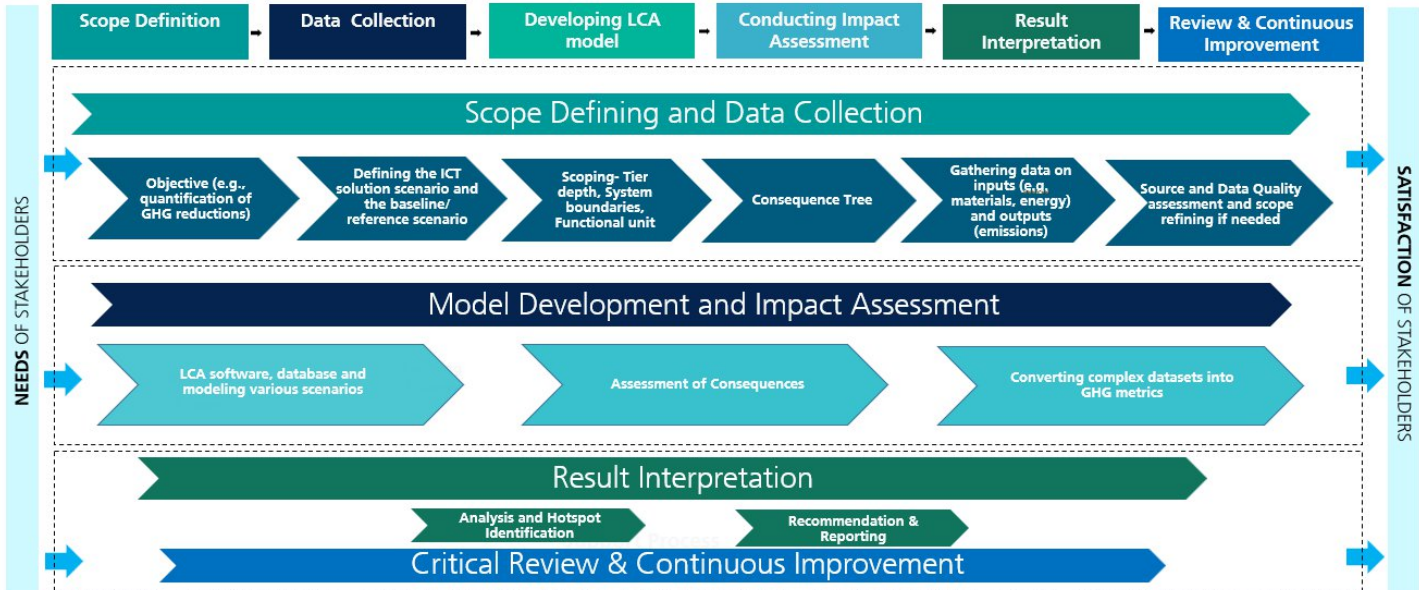
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Assessment Framework

ITU-T L.1480 – A Structured Method to Assess ICT Solutions' GHG Impacts

Targeting Tier 1 (most detailed) assessment including:

- Quantification of direct and indirect (both positive and negative) impacts - first, second, and higher-order / rebound impacts
- Combination of primary and secondary data; proxy data to cover data gaps
- System boundary/ Life Cycle Assessment (LCA) stages cradle to grave
- Functional unit: five-year service of the ICT solution
- Final assessment: Ex-post with extrapolation (measured GHG savings after deployment of ICT solution)



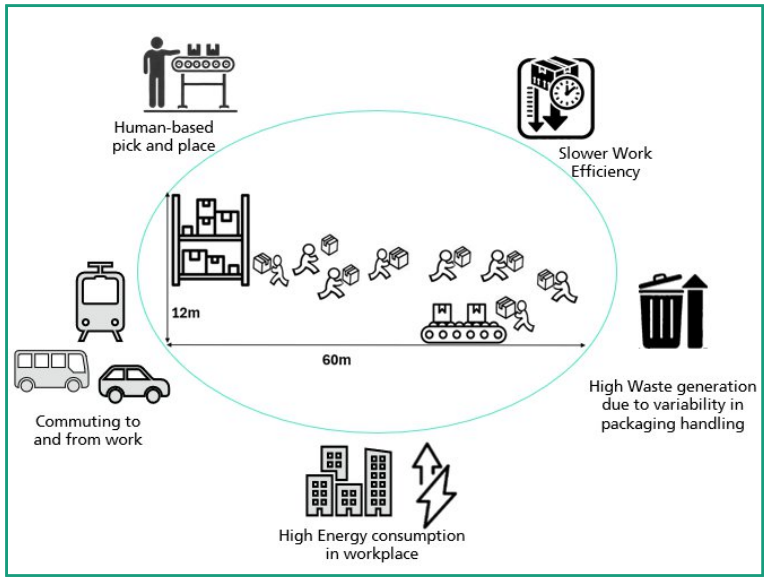
Basic steps of ITU-T L. 1480 standard

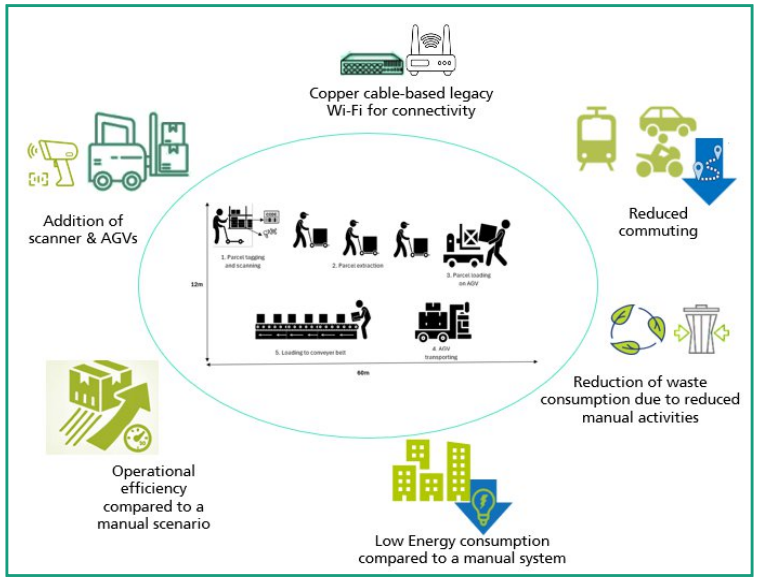
Note: This study is being conducted based on the release of ITU-T L.1480 (07/2025) and data collected from the logistics center, ICT vendors, AGV vendor, literature, online sources and commercial data bases.

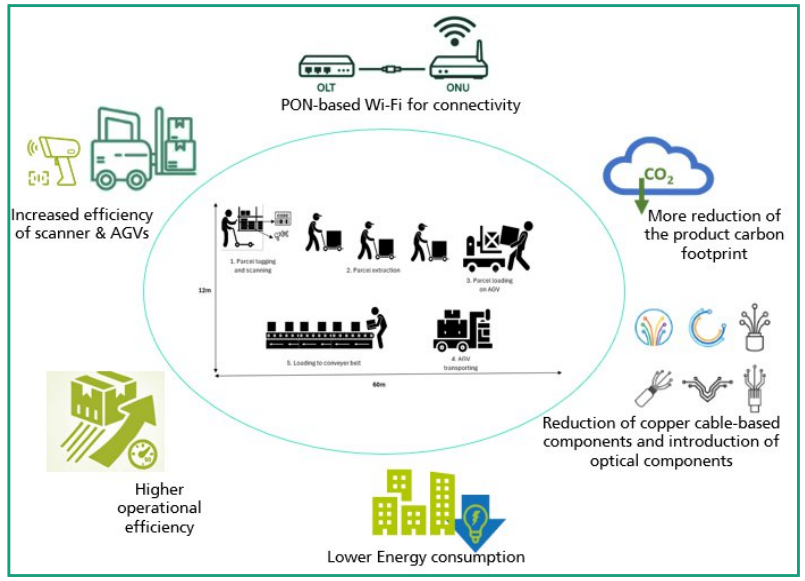
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Three scenarios: Manual vs. Legacy/ Copper Wi-Fi vs. PON Wi-Fi







Baseline: Manual operation

- **Human labor dependent → higher risk of errors and delay**
- **More worker commuting → higher transport-related impacts**
- **May lead to higher facility energy and waste consumption**

Baseline: Legacy/ Copper Wi-Fi-based system

- **Legacy Wi-Fi connectivity enabled through a copper cable–based infrastructure**
- **Introduction of automation through scanners & AGV transportation**
- **Improved workflows, reduced wasted movement and time**

Upgraded ICT use case: PON Wi-Fi-based system

- **Improved connectivity & reliability**
- **Reducing the environmental burden of copper cable-based systems**
- **Real-time monitoring of power consumption to assess actual emissions**

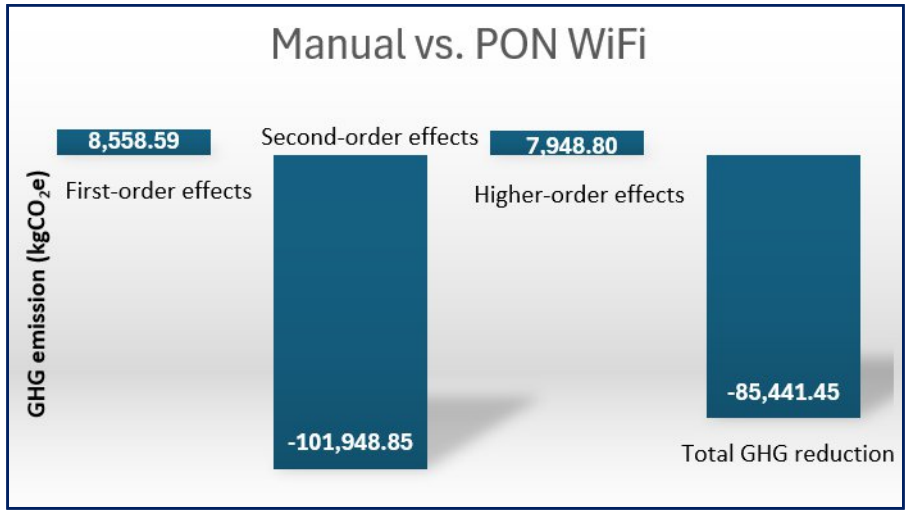
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Preliminary Insights

Consequences - Manual vs. PON Wi-Fi

Effect Criteria	Consequences	Results ($kgCO_2e$)
First order effects	▪ ICT Components used for the ICT solution, e.g., OLT, ONUs etc. (I)	5,243.68
	▪ Emissions from server consumption/ Data center (I)	2,635.59
	▪ Emissions from supporting operations such as cooling/ HVAC (I)	398.95
	▪ Introduction of scanners (I)	10.37
	▪ Maintenance/ Servicing of ICT solution (D)	270
Second order effects	▪ Addition of emission from AGV (I)	1,411.5
	▪ Removal of Human Labor- Direct emissions (I)	-1,128.54
	▪ Evolution of commuting emissions for reducing workers (I)	-66,143.32
	▪ Evolution of workplace Energy consumption for reducing Human labor (I)	-10,497.62
	▪ Removal of scanning paper by introducing scanners (I)	-772.25
	▪ Evolution of workplace waste consumption for reducing Human labor (D)	-26,177.49
Higher order/ Rebound effects	▪ Evolution of financial gains or losses by the solution seller (I)	6,268.22
	▪ Evolution of financial gains or losses by the solution user (I)	1,680.58



Specifications	
Intended Assessment Depth	Tier 1
Operational Use phase duration	5 Years
No. of AGVs for the use case area	1
No. of workers replaced per AGV	2
Primary Database	Ecoinvent 3.12

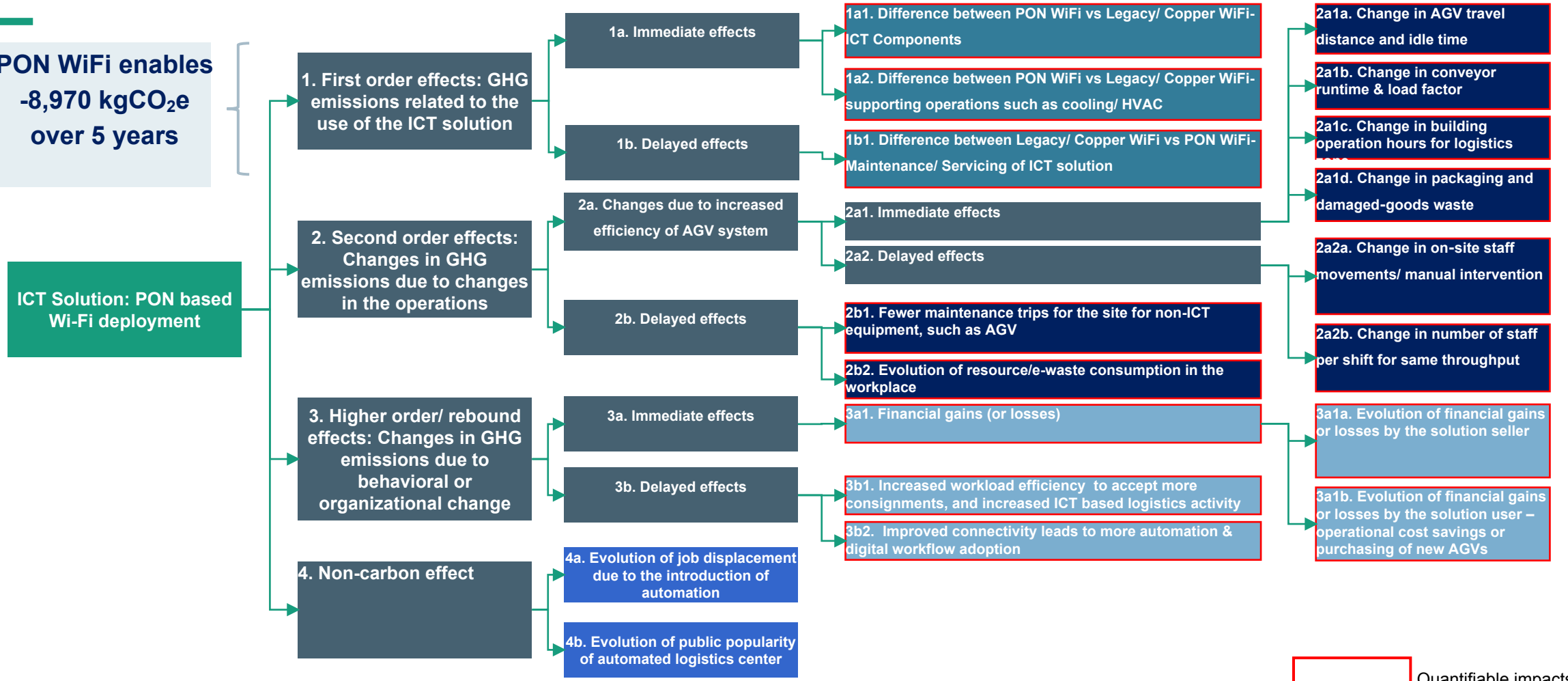
Note: I= Immediate effects, D= Delayed effects

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Preliminary Insights

Consequence Tree - Legacy/Copper WiFi vs. PON WiFi

PON WiFi enables -8,970 $kgCO_2e$ over 5 years



Quantifiable impacts

*Calculation ongoing

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Conclusions and Future Outlook

- **F5G PON Wi-Fi enables net climate benefit of -85.44 TCO_2e over 5 years vs. manual operation.**
- **Commuting of workers is the largest hotspot for Manual vs PON scenarios, making employee transport the primary emissions-reduction priority.**
- **PON cuts direct emissions in components & maintenance — greener solution already at first-order.**
- **Overall, operational emissions dominate over embodied emissions, indicating that improving energy efficiency can offer a significant factor for GHG reduction.**
- **Next steps: refining the assessment with improved data quality & real-time measured site data.**
- **Analysis of second & higher order impacts for legacy copper-based WiFi vs PON Wi-Fi.**
- **Scale-up assessment: model full-site deployment to identify the best mitigation pathways.**

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Thank you for your attention!

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