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SERIES L: ENVIRONMENT AND ICTS, CLIMATE
CHANGE, E-WASTE, ENERGY EFFICIENCY;
CONSTRUCTION, INSTALLATION AND PROTECTION
OF CABLES AND OTHER ELEMENTS OF OUTSIDE
PLANT

The potential impact of selling services instead of equipment on waste creation and the environment – Effects on global information and communication technology

Recommendation ITU-T L.1024

ITU-T L-SERIES RECOMMENDATIONS

**ENVIRONMENT AND ICTS, CLIMATE CHANGE, E-WASTE, ENERGY EFFICIENCY; CONSTRUCTION,
INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT**

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Recommendation ITU-T L.1024

The potential impact of selling services instead of equipment on waste creation and the environment – Effects on global information and communication technology

Summary

Recommendation ITU-T L.1024 utilizes information compiled from stakeholders that provides insights into cases in the information and communication technology (ICT) ecosystem, in which ICT goods are sold as services or subscriptions rather than products. Currently, these cases are not clearly understood from an environmental point of view.

Current estimates are that billions of new ICT goods – smartphones and others – are sold annually and sales are expected to be higher in 2025 than in 2020.

Business models based on servitization which would – most effectively – improve the circularity of these ICT goods are not well understood, e.g., prolonging the lifetime or increasing the e-waste collection rate.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
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Business model, circular economy, environmental footprint, refurbishment, remanufacturing, repair, reuse, servitization.

* To access the Recommendation, type the URL <http://handle.itu.int/> in the address field of your web browser, followed by the Recommendation's unique ID. For example, <http://handle.itu.int/11.1002/1000/11830-en>.

FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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Recommendation ITU-T L.1024

The potential impact of selling services instead of equipment on waste creation and the environment – Effects on global information and communication technology

1 Scope

This Recommendation contains analyses and predictions of the real or potential environmental consequences of a transfer to selling services instead of equipment for the global information and communication technology (ICT) industry.

It is plausible that some economic realities will drive some parts of the ICT ecosystem to be sold as services instead of goods. There are several studies looking at parts of the ecosystem and specific service transformations. However, there is few studies focusing on what this likely trend will mean for overall environmental impact.

The Recommendation considers possible conflicts and solutions regarding the opportunities and problems arising from a potential global service transformation of ICT.

The Recommendation contains a guide to cases where a service transformation makes sense or not from an environmental point of view.

This Recommendation takes into account previous and ongoing appropriate ITU deliverables on life cycle assessment (LCA) and circular economy, e.g., [b-ITU-T L.Suppl.28], [ITU-T L.1015], [ITU-T L.1020], [ITU-T L.1021], [ITU-T L.1022] and [ITU-T L.1023].

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- | | |
|----------------|---|
| [ITU-T L.1015] | Recommendation ITU-T L.1015 (2019), <i>Criteria for evaluation of the environmental impact of mobile phones.</i> |
| [ITU-T L.1020] | Recommendation ITU-T L.1020 (2018), <i>Circular economy: Guide for operators and suppliers on approaches to migrate towards circular ICT goods and networks.</i> |
| [ITU-T L.1021] | Recommendation ITU-T L.1021 (2018), <i>Extended producer responsibility – Guidelines for sustainable e-waste management.</i> |
| [ITU-T L.1022] | Recommendation ITU-T L.1022 (2019), <i>Circular economy: Definitions and concepts for material efficiency for information and communication technology.</i> |
| [ITU-T L.1023] | Recommendation ITU-T L.1023 (2020), <i>Assessment method for circular scoring.</i> |
| [ITU-T L.1410] | Recommendation ITU-T L.1410 (2014), <i>Methodology for environmental life cycle assessments of information and communication technology goods, networks and services.</i> |

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 global warming potential (GWP) [ITU-T L.1410]: Ratio of the warming of the atmosphere caused by one greenhouse gas to that caused by a similar mass of carbon dioxide. GWP is calculated over a specific time frame generally 100 years.

NOTE – See also [b-ITU-T L.Suppl.32].

3.1.2 preparing for reuse [b-Ardente]: Checking, cleaning or repairing recovery operations, by which products or components of products that have become waste are prepared so that they can be reused.

3.1.3 reconditioning; refurbishing [b-Ardente]: Return a used product to a satisfactory working condition by rebuilding or repairing major components that are close to failure, even where there are no reported or apparent faults in those components.

3.1.4 remanufacturing [b-Ardente]: Return a used product [or component] to at least its original performance with a warranty that is equivalent or better than that of the newly manufactured product.

3.1.5 repurposing [b-Ardente]: Utilize a product or its components in a role that it was not originally designed to perform.

3.1.6 reuse [b-EN 45554]: Process by which a product or its parts, having reached the end of their first use, are used for the same purpose for which they were conceived.

3.1.7 second-hand product [b-Ardente]: Tangible movable property that is suitable for further use as it is or after repair.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 abiotic resource depletion potential (ADP): From a functional point of view, is the decrease of availability of the total reserve of potential functions of resources. From the intrinsic value of naturally occurring minerals point of view, is the decrease of the unique natural configurations of elements in resources in the environment. Abiotic refers to natural resources (including energy resources) such as iron ore, crude oil which are regarded as non-living.

NOTE – Paraphrased from [b-van Oers]. See also [b-ITU-T L.Suppl.32].

3.2.2 computational use value: A rating of the usefulness of a computing device for specific computing tasks

3.2.3 cumulative energy demand (CED): A measure of primary energy demand from renewable and non-renewable resources or similar that can be used as representative of primary energy consumption.

NOTE – See [ITU-T L.1410].

3.2.4 energy proportional computing: Energy proportionality is a measure of the relationship between power consumed in a computer system, and the rate at which useful work is done (its utilization, which is one measure of performance). If the overall power consumption is proportional to the computer's utilization, then the machine is said to be energy proportional.

NOTE – Based on [b-Barroso].

3.2.5 recycling use value: A rating of the value of a computing device based on raw material value considering the cost of recycling it.

3.2.6 re-use rate: Degree to which an information and communication technology (ICT) good or its component parts are reused for the same purpose.

3.2.7 servitization: The process of creating value by adding services to products. In more detail 'the offering in terms of "goods or services" through "goods and services" to the marketing of bundles of "goods + services + support + knowledge + self-service".

NOTE – See [b-Kowalkowski].

3.2.8 use value: A rating of the usefulness of a good for a useful purpose, in comparison to the exchange value by which the commodity compares an item to other objects on the market.

NOTE – Based on [b-Franquesa 2018].

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ADP	Abiotic resource Depletion Potential
CED	Cumulative Energy Demand
ED	Energy Depletion
GWP	Global Warming Potential
GWP100	Global Warming Potential at 100 years
HDD	Hard Disc Drive
ICT	Information and Communication Technology
LCA	Life Cycle Assessment
ONT	Optical Network Terminal
PCB	Printed Circuit Board
PCBA	Printed Circuit Board Assembly
PSU	Power Supply Unit
RAM	Random Access Memory
RMD	Raw Material Depletion
SSD	Solid-State Disc
SMART	Self-Monitoring, Analysis, and Reporting Technology
STB	Set-Top Box
WD	Water Depletion
xDSL	any type of Digital Subscriber Line

5 Conventions

None.

6 Business models

Previous methods include [b-Tasaki] and [b-Goldey].

[b-Tasaki] proposes a method in which replacement conditions of products are compared with iso-environmental-load lines to determine the appropriateness of replacement.

A theoretical limit of 50% environmental impact reduction for one remanufacturing cycle for ICT infrastructure goods has been proposed [b-Goldey].

6.1 Desktop computing as a service per hour via different business models

Electronic devices such as desktops, laptops or mobile phones are said to be reused when they have already been manufactured, are used and maintained in good use for a few years by an organization, and then are discarded by the initially envisaged use and user. While most are still operational, they are disposed of or recycled unless they are repaired, remanufactured, refurbished or redistributed to other users. These devices are collected by a second-hand agent or sent to a remanufacturer for processing, sale or rent, and redistributed to other users. The reuse process ends when, after a few years, the device or a component returns to the disposal state, which means its useful value then, even if improvements were made, no longer allows its reuse. That process should end in recycling, a process that transforms computational use value into raw material use value [b-Franquesa 2018]. The eReuse initiative works with social enterprises in Spain that collect and refurbish desktop and laptop devices donated by public and private organizations (numbering over 10 000 in the last 5 years). These computing devices are sold for a price that reflects the cost of refurbishment and carry a guarantee for a 1-2 year period. In the case of a fault, devices are replaced instead of repaired *in situ*. Several recipient organizations like schools prefer to pay a yearly fee or sign a contract for a number of computing units with an agreed performance level (computing as a service). They receive some additional computer units to ensure quick replacement of any that are faulty.

The eReuse field study reported in [b-Franquesa 2019] collects data (public dataset from October 2013 to May 2019) about desktop and laptop devices beyond their first usage (reuse) [b-Franquesa 2020]. In reuse, nearly all devices are refurbished with reused components, except new batteries and hard disc drives (HDDs), when they raise signals of failures (by self-monitoring, analysis, and reporting technology; SMART). The dataset shows durability per manufacturer (90th percentile among devices from the same manufacturer) of the total usage period, up to 46 477 h (5.3 years) and a maximum of 65 332 h (7.5 years), consistent with [b-Ardente]. The concept of energy proportional computing (see clause 3.2.4) is significant for the use stage of servers, although it may have been neglected in the LCA in [b-Ardente], but is less important for personal computers. [b-Franquesa 2019] and the corresponding public dataset [b-Franquesa 2020] found that reuse can contribute to approximately a duplication of lifespan in personal computers, especially in a servitized model with network data storage, where faulty computers can be easily replaced by *in-situ* spares.

The life cycle environmental impacts of a desktop computer can be roughly estimated by creating an environmental intensity per mass for a server [b-Ardente] and multiplying by 5 kg desktops [b-Franquesa 2019]) and assuming that the power consumption of a desktop is one-third of the server. The results for desktops are shown in Table 1.

Table 1 – Summary of approximate life cycle environmental impacts of a desktop without refurbishment

Environmental impact category	Manufacturing	Use	End-of-life
GWP, kg CO ₂ e	154	1 025	–11
ADP, kg Sb-e	0.02	0.000 18	–0.013
CED, MJ	2 288	23 834	–125
CO ₂ e: carbon dioxide equivalent; Sb-e; antimony equivalent			

If the scenario is translated to a computing as a service or servitized model, environmental impacts per device and per hour (of availability and possible usage of a computing device) can be examined and compared. If Table 1 represents the impact of the first usage cycle of a new computer, Table 2 represents the expected potential effect of reuse after refurbishment in comparison to the use of two new devices (as in clause 6.2). Reuse roughly results in doubling of usage hours by a new user, usually