Call to Action
From commitment to action: Implementing standards for a sustainable future

Introduction:

The digital era has brought unprecedented technological advancements, reshaping our lives and societies. However, this rapid digitalization also poses significant environmental challenges, necessitating a concerted effort towards sustainable practices. Reaching the 1.5-degree Celsius target outlined in the Paris Agreement is becoming increasingly challenging.

The window for effective action is closing rapidly, requiring global collaboration and bold action for immediate and substantial reductions in greenhouse gas emissions in order to prevent irreversible damage. Digital technologies can help fight the climate crisis but can also be part of the problem if such challenges as energy consumption and e-waste are not managed.

The Green Digital Action Track recognizes that a sustainable digital future is one where technology advances human capabilities, and preserves and enhances the natural environment. This Call for Action document is a testament to this vision. Recognizing this urgent need, the Green Digital Action has been established to accelerate the ICT sector's commitment to collaborative climate action, put the sector on the forefront of climate action, and inspire other industries to follow suit.

The Green Digital Action objectives are as follows:

- Increase multi-stakeholder collaboration to advance digital-technology-driven climate action.
- Co-create and fast-track practical solutions and to tangibly support the climate agenda.
- Mobilize commitments and strengthen accountability to promote the green and digital transitions among governments, businesses, civil society and others, including through the Partner2Connect Digital Coalition.
- Catalyse opportunities for partnerships and broader coordination with key existing mechanisms like the Marrakech Partnership, the World Standards Cooperation, the Digital with Purpose movement or the UN Early Warning for All initiative.

The core objective of this Call To Action is to identify and promote widely recognized and already adopted green standards within digital technologies. This endeavour is not just about listing existing standards; it delves deeper into understanding the implications of these standards in real-world scenarios and exploring opportunities for improvement or identifying standardization gaps. By identifying gaps in standardization, the document aims to create a roadmap that will guide future work and call on experts to contribute post-COP28. It is also a call to experts to share best practices that are not yet standardized.

Recognized Standards for Green Digital Practice

This section is crucial in setting the stage for a sustainable digital environment. The purpose here is multifaceted: to identify green standards that are relevant and have already been recognized from Standardization organizations. These identified standards are identified and promoted to create a common language and understanding among different stakeholders; and to encourage the adoption of these standards across the ICT sector and beyond.

Recognizing these standards is the first step towards a collective commitment to sustainable digital practices. It is about laying down a foundation upon which future innovations and policies can be built. This section is not just about listing standards; it is about understanding their role in shaping a sustainable digital ecosystem and ensuring these standards are adaptable, relevant, and effectively implemented in a rapidly evolving technological landscape. See Annex.

Identification of Standardization Gaps

This section aims to shed light on those areas that current standards and practices have not yet clearly or completely covered, highlighting the need for new or improved standards. The purpose here is twofold: first, to pinpoint the gaps that hinder the full realization of a sustainable digital environment; and second, to propose potential directions for future standardization efforts. This proactive approach is crucial for staying ahead of emerging challenges and ensuring that our standards evolve in tandem with technological advancements. By identifying these gaps, we provide a roadmap for future research and development, fostering innovation that is not only technologically advanced but also environmentally conscious.

1. **Gap Name:** Energy allocation from hardware to software

Description: While standards exist for measuring carbon in hardware, there are no standards that exist for translating and apportioning a hardware's electricity consumption to application and software consumption.
Potential Solutions or Directions: Define apportionment models from hardware standards into practices that can be used in software
Organizations Involved: Green Software Foundation, Cloud providers, SaaS providers, HSBC is in the process of releasing a methodology
Reference Source: N/A

2. **Gap Name:** Energy Proportionality

Description: In essence this is the rate at which energy is consumed relative to the rate at which useful work is done. The Concept is described well here, with plenty of links to additional information: https://en.m.wikipedia.org/wiki/Energy_proportional_computing
Potential Solutions or Directions: Consolidation of existing efforts into a larger programme that looks at the problem from a systems level rather than from a component level.
Organizations Involved: Here is the Uptime Institute Strategy Guidance that references this gap: https://uptimeinstitute.com/creating-a-sustainability-strategy-report - Note that you will need to provide an e-mail address.
Reference Source: https://www.computer.org/csdl/magazine/co/2007/12/mco2007120033/13rRUxASu79 https://link.springer.com/book/10.1007/978-3-031-01761-2

3. **Gap Name:** Software Carbon Efficiency

Description: Alongside the energy standard for software highlighted above, there is no common methodology agreed for assessing the carbon efficiency of a software product / application / SaaS solution.
Potential Solutions or Directions: Agree a methodology for deriving the carbon intensity scoring for software – and the corresponding Carbon Efficiency – so that a consistent approach can be determined. Interlock this with the software use of hardware energy consumption per above for completeness.
GoCodeGreen has a method and framework for achieving this based on ISO standards, the GHG protocol ICT sector guidance and Product standard. There is complimentary alignment with the SCI scoring per GSF.
Organizations Involved: GoCodeGreen, GSF, WRI, WBCSD, and other software businesses wanting to measure and understand the carbon impact of digital products.
Reference Source: https://www.computer.org/csdl/magazine/co/2007/12/mco2007120033/13rRUxASu79 https://link.springer.com/book/10.1007/978-3-031-01761-2

4. **Gap Name:** Green metrics

Description: From ICT there is a need for clear metrics that need to align to current or future standardization efforts, with a clear objective to simplify implementation, integration, consider accuracy and reduce assumptions.
Potential Solutions or Directions: N/A
Organizations Involved: N/A
Reference Source: N/A

Next Steps after COP28

In this section, we outline the proactive steps to be undertaken following COP28. These steps will be focused on creating and launching a peer-learning Working Group, with the objective of following up on the efforts of the Green Digital Action Alliance. This peer-learning working group is expected to work closely with other GDA pillars, such as the Greenhouse Gas (GHG) pillar, and more. The working group is expected to meet throughout next year until COP29, with the purpose of accelerating the implementation of identified standards, sharing best practices, addressing the gaps, and continuously monitoring and revising our approach to ensuring the effectiveness and relevance of the mentioned efforts. As next steps, we also want emphasize the importance of ongoing collaboration among all stakeholders, highlighting the need for a collective and concerted effort to achieve our sustainability goals.

Conclusion

As we conclude, this Call To Action, it is imperative to reflect upon the significance of our mission. This document is not just a compilation of standards and practices; it is a statement for change in the digital world. The Green Digital Action Track stands committed to leading this change, fostering a digital environment that is not only efficient and innovative but also responsible and sustainable.

The **4.a Green Standards pillar** is pivotal in this journey. It represents a focused effort to bring sustainability to the forefront of digital practices. By setting and adhering to green adopted standards,

we can mitigate the environmental impact of digital technologies, foster eco-friendly innovation, and drive the industry towards more responsible practices.

The journey ahead is challenging but essential. We call upon all stakeholders – governments, businesses, civil society and individuals – to join us in this endeavour. Together, we can pave the way for a digital future that is green, inclusive and sustainable.

_____

Annext to Call to Action - From commitment to action-Recognized Standards for Green Digital Practice							
Number of the standard (acronym)	**Last modified date**	**Standard Name: (e.g., Green Data Transmission Protocol)**	**Issuing Organization(s): ITU, IETF, IEC, ISO, IEEE [Other Organization Name]**	**Abstract: A brief summary of the standard, its key components, and its relevance.**	**Objective: A clear description of the intended outcome or goal of implementing this standard.**	**Comments: Notes or additional information about the standard's relevance, applicability, or any other pertinent details**	**Scope**
IEEE P7800	2022	Recommended Practice for Addressing Sustainability, Environmental Stewardship and Climate Change Challenges in Professional Practice	IEEE	Provides a framework for exercising sound professional judgment, to be applicable to all aspects of professional practice including engineering, technical practice and technological innovation	Assists engineers, scientists, technologists, and other professionals consider the implications of climate change and the need for sustainable development and environmental stewardship, including impacts on societies, in their practice, and to create a clear record of the outcomes of those considerations	This recommended practice provides a framework for exercising sound professional judgement, to be applicable to all aspects of professional practice including engineering, technical practice and technological innovation. This recommended practice encourages and helps engineers, scientists, technologists, and other professionals consider the implications of climate change and the need for sustainable development and environmental stewardship, including impacts on societies, in their practice, and to create a clear record of the outcomes of those considerations	Company
IEEE 1922.2	2019	Standard for a Method to Calculate Near Real-Time Emissions of Information and Communication Technology Infrastructure	IEEE	Specifies rules for the near real-time calculation of pollutant emissions allocated to the use of Information and Communications Technology (ICT) infrastructure (servers, network, etc.). Emissions in this standard are defined as gaseous and particle emissions caused by the generation of electricity	Current calculation of emissions related to electricity consumption by ICT during their use phase is inaccurate due to simplifying assumptions of average emissions. The standard provides a more accurate figure of the environmental footprint of ICT infrastructures in real-time.	This standard specifies rules for the near real-time calculation of pollutant emissions allocated to the use of information and communications technology (ICT) infrastructure (servers, network, etc.). Emissions in this standard are defined as gaseous and particle emissions caused by the generation of electricity consumed during the ICT infrastructure use phase.	Company
IEEE 1924.1	2016	Recommended Practice for Developing Energy-Efficient Power-Proportional Digital Architectures	IEEE	A set of guidelines is presented in this recommended practice for the development of energy-efficient and power-proportional digital architectures so that energy is only consumed when	To provide guidelines for the designers and developers of digital architectures for creating power-proportionality at different levels of the system.	This recommended practice specifies a set of guidelines for the development of power-proportional digital architectures so that energy is only consumed when computations are underway.	Company
IEEE 1926.1	2016	Standard for a Functional Architecture of Distributed Energy Efficient Big Data Processing	IEEE	Specifies a functional architecture that supports the energy-efficient transmission and processing of large volumes of data, starting at processing nodes close to the data source, with	To improve the energy efficiency of data networks involved in the processing and transmission of big data.	This standard specifies a functional architecture that supports the energy-efficient transmission and processing of large volumes of data, starting at processing nodes close to the data source, with significant processing resources provided at centralized	Network
IEEE 1927.1	2016	Standard for Services Provided by the Energy-efficient Orchestration and Management of Virtualized Distributed Data Centers Interconnected by a Virtualized Network	IEEE	Specifies an architecture for a service composed of distributed data centers interconnected by a network. It specifies the interfaces and the dynamic orchestration and management mechanisms for energy-efficient allocation of resources from data centers and networks.	The need is to reduce the energy consumption of virtualized, interconnected data centers. This standard also fills the need for enabling independent network and data center operators to cooperate in the provisioning of energy-efficient networking and processing services.	This standard specifies an architecture for a service composed of distributed data centers interconnected by a network. It specifies the interfaces and the dynamic orchestration and management mechanisms for energy-efficient allocation of resources from data centers and network.	Network
IEEE 1928.1	2016	Standard for a Mechanism for Energy Efficient Virtual Machine Placement	IEEE	Specifies an algorithm for energy-efficient virtual machine placement strategies considering network and computational power consumption. It also considers the geographic distribution of user demand.	Information processing is becoming more centralized in large data centers that are distributed across geographic areas. Therefore there is a need to establish mechanisms for energy efficient virtual machine placement.	This standard specifies an algorithm for energy-efficient virtual machine placement strategies considering network and computational power consumption. It also considers the geographic distribution of user demand.	Nework, Equipment
IEEE 1929.1	2016	An Architectural Framework for Energy Efficient Content Distribution	IEEE	Specifies a framework for designing energy efficient content distribution services, such as migration, placement, and replication, over networks.	Creates a framework for design of energy-efficient content distribution mechanisms for various service and networking scenarios	This standard creates a framework for design of energy-efficient content distribution mechanisms for various service and networking scenarios.	Network
IEEE P3224	2022	Standard for Blockchain-based Green Power Identification Application	IEEE	Specifies requirements and specifications for using blockchain for green power identification applications. It describes a technical framework for the planning, design, construction and operation of green power identification systems.	The purpose of this standard is to support the use of green power identification whole process data, by enabling authenticity and uniqueness of "green power identification". The standard enables tracking, traceability and rights conformation throughout the life cycle, while avoiding repeated measurement and accounting. Use of this standard supports increased green power consumption in society to further enable low-carbon energy transformation	This standard defines an application model and technical framework for green power identification based on blockchain. This standard also specifies the technical and operation management requirements of green power identification based on blockchain.	Company, services

IEEE 1888.3	2013	Standard for Ubiquitous Green Community Control Network: Security	IEEE	The enhanced security management function for the protocol defined in IEEE 1888(TM), “Ubiquitous Green Community Control Network Protocol,” is described in this standard. Security requirements, system security architecture definitions, and a standardized description of authentication and authorization, along with security procedures and protocols, are specified.	This standard can help avoid unintended data disclosure to the public and unauthorized access to resources, while providing enhanced integrity and confidentiality of transmitted data in the ubiquitous green community control network.	This standard provides security services enhancements for the protocol defined in IEEE 1888 "Ubiquitous Green Community Control Network Protocol". This standard describes security requirements for the ubiquitous green community control network and specifies the system security architecture along with security procedures and protocols.	Services
IEEE 1680.1	2013	Standard for Environmental and Social Responsibility Assessment of Computers and Displays	IEEE	The environmental and social responsibility performance criteria of this standard are intended to define a measure of environmental and social responsibility attributes controlled or influenced by the manufacturer throughout the product life cycle in: the design and manufacture of the product; the delivery of specified services that are associated with the product; and in associated corporate performance characteristics	This standard is part of the IEEE 1680 family of standards that provides a clear and consistent set of performance criteria aimed to reduce the environmental impact and improve social responsibility associated with electronic products, and provides an opportunity to secure market recognition for conformant products	The purpose of this standard is to define a security management function in the ubiquitous green community control network that provides an interoperable, high quality and secure applications operation platform. Use of this standard avoids unintended data disclosure to the public and unauthorized access to resources, while providing enhanced integrity and confidentiality of transmitted data in the ubiquitous green community control network.	Network
IEEE 1680.2	2017	Standard for Environmental Assessment of Imaging Equipment	IEEE	Defines environmental performance standards for imaging equipment (as defined by the U.S. ENERGY STAR(R) Imaging Equipment Specification1) including copiers, digital duplicators, facsimile machines, multifunction devices, printers, mailing machines, and scanners, relating to reduction or elimination of environmentally sensitive materials, materials selection, design for end of life, life-cycle extension, energy conservation, end-of-life management, corporate performance, packaging, consumables, and indoor air quality.	Used primarily by manufacturers, purchasers and regulatory bodies to assess and certify the environmental performance of imaging equipment. Establishes criteria for envionmental labling of imaging equipment and provides requirements for energy-efficient operation--encouraging manufacturers to design equipment that consumes less power during sue and standby.	This standard defines environmental performance standards for imaging equipment (as defined by the U.S. ENERGY STAR(R) Imaging Equipment Specification1) including copiers, digital duplicators, facsimile machines, multifunction devices, printers, mailing machines, and scanners, relating to reduction or elimination of environmentally sensitive materials, materials selection, design for end of life, life-cycle extension, energy conservation, end-of-life management, corporate performance, packaging, consumables, and indoor air quality.	Equipment
IEEE 1680.3	2017	Standard for Environmental Assessment of Televisions	IEEE	Defines environmental performance for televisions, television combination units, and component television units, relating to reduction or elimination of environmentally sensitive materials, materials selection, design for end of life, lifecycle extension, energy conservation, end of life management, corporate performance, and packaging	The environmental performance criteria of this Standard are intended to define a measure of environmental leadership in: the design and manufacture of televisions; the delivery of specified services that are associated with the sale of the product; and in associated corporate performance characteristics. This Standard is defined with the intention that the criteria are technically feasible to achieve, but that only products demonstrating the leading environmental performance currently available in the marketplace would meet them at the time of their adoption. As the environmental performance of products that are available in the marketplace improves, it is intended that the criteria will be updated and revised to set a higher performance standard for leadership products.	This standard defines environmental performance for televisions, television combination units, and component television units, relating to reduction or elimination of environmentally sensitive materials, materials selection, design for end of life, life-cycle extension, energy conservation, end-of-life management, corporate performance, and packaging. This standard applies to products that are primarily marketed as televisions, and does not cover computer displays as defined by IEEE 1680.1	Equipment

IEEE P1680.4	2018	Standard for Environmental Leadership and Corporate Social Responsibility Assessment of Servers	IEEE	Defines environmental performance criteria for computer servers as defined in the Energy Star Server specifications, including managed servers and blade servers, relating to reduction or elimination of environmentally sensitive materials, materials selection, design for end of life, lifecycle extension, energy conservation, end of life management, corporate performance, and packaging. A limited set of criteria that utilize existing corporate social responsibility standards and programs are included.	The environmental performance criteria of this standard are intended to define a measure of environmental leadership in: the design and manufacture of servers; the delivery of specified services that are associated with the sale of the product; and associated corporate performance characteristics. This standard is defined with the intention that the criteria are technically feasible to achieve, but that only products demonstrating the leading environmental performance currently available in the marketplace would meet them at the time of their adoption.	This standard establishes criteria for multiple levels of environmental leadership and corporate social responsibility performance throughout the product life cycle, relating to energy efficiency; management of substances; preferable materials use; product packaging; design for repair, reuse and recycling; product longevity; responsible end-of-life management; and corporate responsibility.	Company
IEEE P1680.6	2017	Draft Standard for Environmental Assessment of Complex Set Top Boxes	IEEE	Defines environmental performance criteria for complex set top boxes including energy efficiency, reduction or elimination of environmentally sensitive materials, materials selection, design for end of life, lifecycle extension, end of life management, corporate performance, and packaging.	Environmental performance criteria of this standard are intended to define a measure of environmental leadership in: the design and manufacture of complex set top boxes; the delivery of specified services that are associated with the sale of the product; and associated corporate performance characteristics. This standard is defined with the intention that the criteria are technically feasible to achieve, but that only products demonstrating the leading environmental performance currently available in the marketplace would meet them at the time of their adoption	This standard defines environmental performance criteria for complex set top boxes including energy efficiency, reduction or elimination of environmentally sensitive materials, materials selection, design for end of life, lifecycle extension, end of life management, corporate performance, and packaging.	Company, services
IEEE 802.3bt	2018	Standard for Ethernet Amendment 2: Physical Layer and Management Parameters for Power over Ethernet over 4 pairs	IEEE	The maximum Powered Device (PD) power available is increased by this amendment to IEEE 802.3-2018 by utilizing all four pairs in the specified structured wiring plant. This represents a substantial change to the capabilities of Ethernet with standardized power. The power classification information exchanged during negotiation is extended to allow meaningful power management capability. These enhancements solve the problem of higher power and more efficient standardized Power over Ethernet (PoE) delivery systems.	Since the publication of IEEE Std 802.3at-2009, significant market demand has emerged for more efficient power delivery and for applications with power levels greater than those defined in the standard. Example applications include thin clients, multi-radio wireless access points, pan / tilt / zoom cameras, digital signage, building automation, industrial sensors / actuators etc.	This standard defines Ethernet local area, access and metropolitan area networks. Ethernet is specified at selected speeds of operation; and uses a common media access control (MAC) specification and management information base (MIB). The Carrier Sense Multiple Access with Collision Detection (CSMA/CD) MAC protocol specifies shared medium (half duplex) operation, as well as full duplex operation. Speed specific Media Independent Interfaces (MIIs) provide an architectural and optional implementation interface to selected Physical Layer entities (PHY). The Physical Layer encodes frames for transmission and decodes received frames with the modulation specified for the speed of operation,	Network
IEEE 1889	2018	Guide for Evaluating and Testing the Electrical Performance of Energy Saving Devices	IEEE	Described in this guide are methods to evaluate and test the electrical performance of energy saving devices (ESDs). Measurement methods that focus on monitoring the power consumed or generated by the observed load or generator without the ESD connected into the circuit and with the ESD connected and energized into the circuit are described. Detailed protocols describe step-by-step the testing circuits, the type and accuracy of evaluation instrumentation, and the order of the test measurements. Special emphasis is given to sources of measurement errors due to incorrect connection of instrumentation, inadequate instrumentation, or incorrect interpretation of results. Contained in Annex B are practical examples and explanations of the physical mechanisms of phenomena that may cause errors. This guide applies to any electrically connected ESD controlling electrical power delivered from a source and powering an electrical load. While an independent, certified testing	The need of the project is to provide instructions for the measurement protocol of all the electrical quantities that are needed in determining the performance characteristics of Energy Saving Devices (ESD).	This standard describes methods to evaluate and test the electrical performance of Energy Saving Devices (ESD). It describes measurement methods that focus on monitoring the power absorbed or generated by the observed load or generator without the ESD connected and with the ESD energized. Detailed protocols describe step-by-step the testing circuits to be used, the type and accuracy of needed instrumentation, what particular measurements and in what order are to be taken. Special emphasis is given to sources of measurement errors due to incorrect connection of instrumentation, inadequate instrumentation, or incorrect interpretation of results. The appendix contains practical examples and explains the physical mechanisms of phenomena that may cause errors.	Equipment

IEEE 18880	2015	ISO/IEC/IEEE Information technology- Ubiquitous green community control network protocol	IEEE, ISO, IEC	Identifies gateways for field-bus networks, data storage for archiving and developing data sharing platforms, and application units as important system components for developing digital communities, i.e., building-scale and city-wide ubiquitous facility networking infrastructure. The standard defines a data exchange protocol that generalizes and interconnects these components (gateways, storage, application units) over the IPv4/v6-based networks. This enables integration of multiple facilities, data storage, application services such as central management, energy saving, environmental monitoring, and alarm notification systems	The standard develops green communities whose energy-usage are well-managed and highly-efficient by allowing the interconnection of facilities of multiple buildings including small and medium-sized on different converged networks, data sharing platforms and application units. The products based on the standard implement the functions of sensing, archiving, sharing and presenting of ubiquitous information such as power usage and generation, environmental status and signals, human behaviour, Heating, Ventilating and Air Conditioning (HVAC) working status, lighting systems, weather, warnings, analyzed data, forecasted data, and so on. With the capability of interoperable integrating these system components, the standard aims to provide and share rich data platform including the cooperation with control-oriented systems	This standard describes methods to evaluate and test the electrical performance of Energy Saving Devices (ESD). It describes measurement methods that focus on monitoring the power absorbed or generated by the observed load or generator without the ESD connected and with the ESD energized. Detailed protocols describe step-by-step the testing circuits to be used, the type and accuracy of needed instrumentation, what particular measurements and in what order are to be taken. Special emphasis is given to sources of measurement errors due to incorrect connection of instrumentation, inadequate instrumentation, or incorrect interpretation of results. The appendix contains practical examples and explains the physical mechanisms of phenomena that may cause errors.	Equipment
IEEE 18881	2016	ISO/IEC/IEEE Information technology -- Ubiquitous green community control network -- Control and management	IEEE, ISO, IEC	Describes network gateway access, control, and management; specifies control and management requirements; defines the system architecture, communication sequences, and enhanced functions for the protocols defined in IEEE 1888(TM), “Ubiquitous Green Community Control Network Protocol”; and extends the protocols and interfaces based on the requirements. This standard shall provide enhanced protocols, workflows, and message formats for the network gateway under control and management, such as registration, access, control, event handling, configuration, status querying, etc	For ubiquitous community applications and energy informatization services, lack of an open and standardized interface protocol to manage and control the numerous diverse sensors, actuators and gateways is a common problem for service providers, system integrators, and network operators, etc. This standard provides a solution to this problem and improves both operational management and user awareness.	Based on the protocols desribed in IEEE 1888 entitled "Ubiquitous Green Community Control Network Protocol", this standard describes the network gateway central access control and management policy through the extension of the existing interface protocol, message format and interactive processing in an ubiquitous green community network. This standard extends the standard definition of the IEEE 1888 interface protocol and message format. This standard mainly specifies the network gateway signal flow for access control, registration management, state querying, event reporting, and remote management.	Network
IEEE 18883	2013	ISO/IEC/IEEE Information technology -- Ubiquitous green community control network – Security	IEEE, ISO, IEC	The enhanced security management function for the protocol defined in IEEE 1888(TM), “Ubiquitous Green Community Control Network Protocol,” is described in this standard. Security requirements, system security architecture definitions, and a standardized description of authentication and authorization, along with security procedures and protocols, are specified. This standard can help avoid unintended data disclosure to the public and unauthorized access to resources, while providing enhanced integrity and confidentiality of transmitted data in the ubiquitous green community control network.	As an open system, ubiquitous green community control network assumes multi-domain operation and public access from other system components. In this context, security considerations are needed for operation of IEEE 1888 protocol. The main goal of this standard would include: defining the hierarchical architecture design and communication procedures for the authentication and authorization for users and components, describing standard methods for the protection mechanism implementations for resources, the integrity and confidentiality of transmitted data, etc.	This standard provides security services enhancements for the protocol defined in IEEE 1888 "Ubiquitous Green Community Control Network Protocol". This standard describes security requirements for the ubiquitous green community control network and specifies the system security architecture along with security procedures and protocols	This standard provides security services enhancements for the protocol defined in IEEE 1888 "Ubiquitous Green Community Control Network Protocol". This standard describes security requirements for the ubiquitous green community control network and specifies the system security architecture along with security procedures and protocols.

IEEE 1901	2020	Standard for Broadband over Power Line Networks: Medium Access Control and Physical Layer Specifications	IEEE	A standard for high-speed communication devices via electric power lines, so called broadband over power line (BPL) devices, is defined. Transmission frequencies below 100 MHz are used. All classes of BPL devices can use this standard, including BPL devices used for the first-mile/last-mile connection to broadband services as well as BPL devices used in buildings for local area networks (LANs), Smart Energy applications, transportation platforms (vehicle) applications, and other data distribution. The balanced and efficient use of the power line communications channel by all classes of BPL devices is the main focus of this standard, defining detailed mechanisms for coexistence and interoperability between different BPL devices, and ensuring that desired bandwidth and quality of service may be delivered. The necessary security questions are addressed to ensure the privacy of communications between users and to allow the use of BPL for security sensitive services.	Coexistence of the BPL devices on the same power lines is a basic need of the BPL market. Devices from different vendors should continue to operate properly while using the same power lines. Interoperability will support the growth of the emerging BPL market. It will benefit the consumer market, enabling consumers to use devices from different vendors and warranting the availability of lower cost equipment. Interoperability will also benefit the access market, allowing low cost extensions of the services in the houses. It also will benefit the electric utility industry, enabling power companies to improve the efficiency and reliability of electricity distribution by creating low-cost, real-time connections across the distribution system, a capability rarely deployed today.	The scope of this standard is to define medium access co	The scope of this standard is to define medium access control (MAC) and physical layer (PHY) specifications for high-speed (>100 Mbps at the physical layer) communication devices via electric power lines, so-called broadband over power line (BPL) devices as well as lower speed Internet of Things communication devices. This standard uses transmission frequencies below 100 MHz. It is usable by all classes of BPL devices, including BPL devices used for the first-mile/last-mile connection (<1500 m to the premise) to broadband services as well as BPL devices used in buildings for local area networks (LANs), Smart Energy / Smart Grid applications, transportation platform (vehicle) applications, Internet of Things applications and other data distribution (<100 m between devices). This standard focuses on the balanced and efficient use of the power line communications channel by all
IEEE P2061	2018	Standard for Architecture for Low Mobility Energy Efficient Network for Affordable Broadband Access	IEEE	Specifies an architecture for a low mobility and energy efficient network for affordable broadband access. This network is referred to as the Frugal 5G network. The network comprises of a wireless middle-mile network, an access network and the associated control and management functions. The architecture also specifies the major interfaces in the network.	Despite a tremendous growth in the field of communication technology, half of the world's population is still not connected to the Internet. Majority of these unconnected population belongs to the developing countries. The situation is even worse in rural areas of these countries. The most viable method to avail broadband connectivity is via ubiquitous fiber deployment. Since a pervasive fiber network is unavailable in developing countries, the primary way to access broadband is via cellular connectivity. Even the cellular coverage is limited to urban/semi-urban areas leaving the rural areas essentially unserved. It is important to note that the cellular systems are highly optimized to address the mobility challenges. This leads to an energy inefficient network and also increases the operational cost for a network that caters essentially to those users which are either nomadic or moving at very low speed. Hence, there is a need to design a reference architecture which can be adopted to develop a network for a low mobility scenario and aims at providing energy efficient and affordable	This standard specifies an architecture for a low mobility and energy efficient network for affordable broadband access. This network is referred to as the Frugal 5G network. The network comprises of a wireless middle-mile network, an access network and the associated control and management functions. The architecture also specifies the major interfaces in the network.	Network
ITU-T L.1000	07/2019	Universal power adapter and charger solution for mobile terminals and other hand-held ICT devices	ITU	Recommendation ITU-T L.1000 provides high level requirements for a universal power adapter and charger solution that will reduce the number of power adapters and chargers produced and recycled by widening their application to more devices and increasing their lifetime. The solution also aims to reduce energy consumption. The longer life cycle and possibility of avoiding device duplication reduces the demand on raw materials and waste. The universal power adapter and charger solution is designed to serve the vast majority of mobile terminals and other ICT devices.	This Recommendation describes the general requirements for a universal power adapter and charger solution for mobile terminals (any terminal able to connect to a mobile network) and other hand-held ICT devices (e.g., camera, wireless earphone, smartwatch and wearables) compliant with the electrical current limits set out in Annex A. This Recommendation includes basic configurations and general requirements for the power adapter and charger interface, energy efficiency, safety, electromagnetic compatibility, resistibility, and eco environmental specifications.		Equipment

ITU-T L.1001	11/2012	External universal power adapter solutions for stationary information and communication technology devices	ITU	Recommendation ITU-T L.1001 provides requirements for a universal power adapter solution (UPA) for stationary information and communication technology (ICT) devices that will reduce the number of power adapters that are produced by widening their application by more devices, thus enabling their reuse and increasing their life expectancy. The solution also aims to reduce energy consumption. The longer the life cycle and possibility of avoiding device duplication reduces the demand on raw materials and limits the amount of e-waste. The universal power adapter solution for stationary ICT equipment is designed to serve the vast majority of ICT devices.	This Recommendation defines the requirements for a universal power adapter (UPA) solution designed for ICT devices for stationary (non-portable) use. This Recommendation takes into consideration improvements in energy efficiency, greenhouse gas (GHG) emission reductions, and optimization in the use of scarce and raw materials. The UPA is an external power adapter that interfaces to the low-voltage input of an ICT device by converting the AC mains voltage to a low DC voltage output. A UPA is applicable to stationary ICT devices at home, where normal operation requires a permanent connection to a household AC power source. Stationary means that the ICT device does not have an integral battery as the primary power source and would not be expected to be transported by the user on an everyday basis in normal operation. However, it includes ICT devices with battery backup in case of power supply failure. UPA does not provide any charge control for rechargeable batteries. This Recommendation is complementary to [ITU-T L.1000] and aims to cover the widest		Equipment
ITU-T L.1002	10/2016	External universal power adapter solutions for portable information and communication technology devices	ITU	Recommendation ITU-T L.1002 defines the requirements, and provides guidelines on the environmental aspects, of universal power adapter solutions (UPA) designed for use with portable information and communication technology (ICT) devices. It is complementary to Recommendations ITU-T L.1000 and ITU-T L.1001 and aims to cover the widest possible range of ICT devices for portable use within identified voltage and power ranges. It firstly describes basic configurations of UPAs, consisting of a power adapter block with a detachable input cable and a detachable output cable to the ICT device. Then, it defines different general recommendations for UPAs and their interfaces, including cables, connectors, voltage, current, ripple noise, energy efficiency, no-load power, safety, electromagnetic compatibility, resistibility and eco-environmental specifications. All the recommendations have been set with the aim to reduce e-waste and increase usability.	This Recommendation defines the requirements, and provides guidelines on the environmental aspects, of universal power adapter solutions (UPA) designed for use with portable information and communication technology ICT (ICT) devices. UPAs covered by this Recommendation are those that are used with the devices with voltage and power levels identified in clause 7.1.1. This Recommendation does not cover UPAs defined in [ITU-T L.1000] and [ITU-T L.1001]. This Recommendation provides requirements and guidelines for energy efficiency and no load power. It aims to reduce greenhouse gas (GHG) emissions to optimize the use of scarce and raw materials and to enable a long product lifetime to reduce e-waste generation. The considered UPA does not provide any charge control for rechargeable batteries. The load full charging function in the portable device, if present, is not within the scope of this Recommendation. This Recommendation describes basic configurations and general requirements for UPAs and their interfaces, including cables, connectors, voltage, current, ripple, noise, energy efficiency, safety, electromagnetic		Equipment
ITU-T L.1005	02/2014	Test suites for assessment of the universal charger solution	ITU	Recommendation ITU-T L.1005 considers the creation of specific test suites to assess certain functional aspects of the: energy efficiency, interworking, safety and electromagnetic compatibility (EMC) of the universal charger solution (UCS). Such testing is required to guarantee a minimum quality level of the UCS in conformance with the target basic configuration of the UCS and charger described in Recommendation ITU-T L.1000.	This Recommendation describes the general test suites applicable to the universal charger solution (UCS) defined in [ITU-T L.1000]. It establishes a test list necessary to assess the UCS with respect to the requirements described in [ITU-T L.1000]. With regard to electromagnetic compatibility (EMC) and safety aspects, additional requirements to those listed in [ITU-T L.1000] shall necessary for a product to be available for use by the general public.		Equipment

ITU-T L.1006	12/2016	Test suites for assessment of the external universal power adapter solutions for stationary information and communication technology devices	ITU	Recommendation ITU-T L.1006 describes the general test suites applicable to the universal power adapter solution (UPA) designed for ICT devices for stationary (non-portable) use defined in Recommendation ITU-T L.1001. It considers the creation of specific test suites to assess certain functional aspects of the energy efficiency, interworking, safety and electromagnetic compatibility (EMC) of universal power adapter solution (UPA) designed for ICT devices for stationary (non portable) use. Such testing is required to guarantee a minimum quality level of the universal charging solution (UCS) in conformance with the target basic configuration of UPA described in Recommendation ITU-T L.1001. With regard to electromagnetic compatibility (EMC) and safety aspects, additional requirements to those listed in Recommendation ITU-T L.1001 are necessary for a product to be available for use by the general public.	This Recommendation describes the general test suites applicable to the universal power adapter solution (UPA) designed for ICT devices for stationary (non-portable) use defined in [ITU T L.1001]. It establishes a test list necessary to assess the universal power adapter solution (UPA) designed for ICT devices for stationary (non-portable) use in [ITU-T L.1001]. With regard to electromagnetic compatibility (EMC) and safety aspects, additional requirements to those listed in [ITU-T L.1001] are necessary for a product to be available for use by the general public.		Equipment
ITU-T L.1007	12/2016	Test suites for assessment of the external universal power adapter solutions for portable information and communication technology devices	ITU	Recommendation ITU-T L.1007 considers the creation of specific test suites to assess certain functional aspects of the: energy efficiency, interworking, safety and electromagnetic compatibility (EMC) of the universal power adapter (UPA) solution designed for information and communication technology (ICT) devices for portable use. Such testing is required to guarantee a minimum quality level of the UPA in conformance with the target basic configuration of the UPA described in Recommendation ITU-T L.1002.	This Recommendation describes the general test suites applicable to the universal power adapter (UPA) solution designed for information and communication technology (ICT) devices for portable use specified in [ITU-T L.1002]. This Recommendation establishes a test list necessary to assess the universal power adapter (UPA) solution designed for ICT devices for portable use in [ITU-T L.1002] With regard to electromagnetic compatibility (EMC) and safety aspects, additional requirements to those listed in [ITU-T L.1002] are necessary for a product to be available for use by the general public.		Equipment
ITU-T L.1010	02/2014	Green battery solutions for mobile phones and other hand-held information and communication technology devices	ITU	Recommendation ITU-T L.1010 defines a minimum set of parameters necessary to identify green battery solutions that should be considered by developers/manufacturers to reduce the future environmental impact of battery use. The provision of so-called green batteries is to extend the lifetime of handsets, reduce global resources consumption and preserve the environment. The compliance in terms of supporting green information and communication technology (ICT) efforts will be considered including the use of scarce resources, recycling and reuse. The existing environmental schemes available in different regions and international standards will be considered.	This Recommendation describes the general requirements for green battery solutions for mobile phones, and other terminals able to connect to a mobile network and other hand-held information and communication technology (ICT) devices. This Recommendation applies to all battery chemistries utilised within the product described. This Recommendation aims at identifying green battery solutions. Some of the aspects considered include: environmental compliance, safety and reliability, lifetime, and ecodesign. Physical characteristics definitions are outside the scope of this Recommendation.		Equipment

ITU-T L.1015	05/2019	Criteria for evaluation of the environmental impact of mobile phones	ITU	Recommendation ITU-T L.1015 focuses on the criteria to be used for evaluation of the environmental impact of mobile phones. It considers all life cycle stages of mobile phones such as the design, production, use and end-of-life management. The Recommendation also defines a minimum level of environmental performance. Within the constraints of technology and affordability, sustainability should be considered for: materials; energy use; durability, upgrade and repair operations; end of life management; packaging, corporate practice; manufacturing and operations.	This Recommendation proposes criteria to be used when evaluating the environmental impact of mobile phones. The Recommendation provides a reference for manufacturers to enhance environmental performance at a global level. It does not include eco-rating, scoring, eco-labelling or a life cycle assessment (LCA) methodology. Appendix I describes three scenarios using simplified LCA methodologies to support clause 6.4.2, but does not provide a LCA methodology in itself. The Recommendation establishes the criteria to be used for the evaluation of the environmental impact of mobile phones considering all life cycle stages such as the design, production, use and end of user management of mobile phones. Within the constraints of technology and affordability, sustainability should be considered for: materials; energy use; durability, upgrade, refurbish ("aesthetical" maintenance) and repair operations ("corrective" maintenance); end of life management; packaging; corporate practice; manufacturing and operations.		Equipment
ITU-T L.1016	02/2022	Method for evaluation of the environmental health and safety performance of true wireless stereo headphones	ITU	In recent years, more and more headphones belonging to the group of true wireless stereo (TWS) products have become commercially available. In 2019, sales of TWS earbuds surpassed the sales of (non-TWS) wireless earphones. The advent of true wireless stereo headphones raises the question on their performance in terms of health and safety of the user. There is a close link between the health/safety of the user and substances used in true wireless stereo headphones. The concept of products with minimal substances of concern and the phasing out of harmful substances for non-essential uses is one of the key aspects in the European Sustainable Chemicals Strategy, which is an important building block towards the goal of zero-pollution, essential for a circular economy. While the idea of non-essential uses is somewhat new in EU legislative initiatives, it originates from the 1978 US Toxic Substances Control Act and was taken up by other countries such as Canada. The	The objective of this Recommendation is to provide a standardized method to evaluate the performance of true wireless stereo headphones with regards to compliance with existing environment, health and safety regulations and standards. Furthermore, this Recommendation suggests a method to evaluate an aggregate score, reflecting the overall performance and compliance. This Recommendation evaluates the following attributes: – Substance health risk – Hearing health risk – Ergonomics – Radio frequency (RF) radiation safety – Battery safety This Recommendation is applicable to true wireless stereo (TWS) headphones such as smart earphones, including headphones and necklace headphones.		Equipment

ITU-T L.1020	01/2018	Circular economy: Guide for operators and suppliers on approaches to migrate towards circular ICT goods and networks	ITU	Recommendation ITU-T L.1020 suggests approaches of circular economy (CE) for information and communication technology (ICT) goods and networks. It focuses particularly on the next steps in improving circularity in the operators' supply chain. The Recommendation provides a guide on how operators could work with their supply chain to improve CE aspects for ICT goods and networks but it does not provide metrics. The objective of the guide is to provide options to improve circularity and to enable operators and their suppliers to create business models for the promotion of circular networks for an optimum solution that uses all the loops of circularity – from sharing to recycling.	This Recommendation suggests approaches of circular economy (CE) for the information and communication technology (ICT) goods. It focuses particularly on the next steps in improving circularity in the operators' supply chain. The Recommendation provides a guide on how operators could work with their supply chain to improve CE aspects for ICT goods and networks through a manifesto intended to improve the circularity of products through supply chain actions. The objective of the guide is to provide options to improve circularity and to enable operators and their suppliers to create business-models for the promotion of circular networks for an optimum solution using all the loops from sharing to recycling. Thus the proposed manifesto can be used by operators and their suppliers to improve the circularity of all ICT goods and networks, both for infrastructure and end-user goods. This Recommendation does not outline metrics, but is intended to be used as a guide for operators to work jointly with suppliers to improve circularity. This Recommendation builds upon Supplement 28 to the ITU-T L-series of		Company
ITU-T L.1021	04/2018	Extended producer responsibility - Guidelines for sustainable e-waste management	ITU	Recommendation ITU-T L.1021 offers a description of the extended producer responsibility (EPR) system in dealing with e-waste. It expands on the different existing forms of EPR globally, not only in theoretical terms, but also with a practical view on their feasibility, challenges and prerequisites. It presents the definition of the EPR system, in addition to the roles and responsibilities of the different stakeholders and the different types of EPR, as well as how and why they could be used in certain contexts and not in others. The funding mechanism behind every mode and the organizational structure expected to be in place are also presented. Recommendation ITU-T L.1021 concludes with many best practices from the international arena, including developed, developing and emerging economies, as well as the challenges faced in some cases.	This Recommendation establishes guidelines and presents recommendations for the development of extended producer responsibility (EPR) polices for sustainable e-waste management. This Recommendation suggests some supplementary measures and points that support the adoption of EPR polices. It also presents different models of EPR polices adopted by Europe and other developed countries that could be used as a basis for developing countries to build upon.		Country

ITU-T L.1022	10/2019	Circular economy: Definitions and concepts for material efficiency for information and communication technology	ITU	Recommendation ITU-T L.1022 contains a guide to the circular economy (CE) aspects, parameters, metrics and indicators for information and communication technology (ICT) based on current approaches, concepts and metrics of the CE as defined in existing standards, while considering their applicability for ICT. In this Recommendation ICT is defined based on the definition given by the Organisation for Economic Co-operation and Development (OECD) (See [b-ISIC] in the Bibliography). This Recommendation discusses the special considerations and challenges in a broader and more in-depth context for all ICT defining parameters, metrics and indicators with the intention to guide the vertical standardization of material efficiency for ICT. The guidelines aim to examine the kinds of standards that are available and to assess their relevance for ICT product groups citing examples of interrelated relevance throughout the text of the Recommendation.	This Recommendation provides a guide to the aspects of circular economy (CE), parameters, metrics, indicators for ICT based on current approaches, concepts and metrics of the CE as defined in existing standards, while considering their applicability for ICT. It is necessary to distinguish between CE concepts for product design and maintenance and general concepts aiming at the corporate practices of ICT companies. The scope of the Recommendation, in addition to the above context, includes the following aspects: • reparability • durability • reusability • recyclability • recoverability • refurbish ability • remanufacture ability • upgradeability. The following parameters, indicators and metrics are related: • recycled and renewable content • use of critical raw materials • ability to reuse parts/components/materials • quality of recycling. This Recommendation is a framework		Company
ITU-T L.1023	08/2023	Assessment method for circular scoring	ITU	Recommendation ITU-T L.1023 outlines an assessment method for circularity scoring of information and communication technology (ICT) goods. The assessment method consists of three steps: 1) Setting the relevance and applicability (R) of each circularity indicator for the ICT goods at hand. 2) Assess the margin of improvement (MI) of each circularity indicator. 3) Calculating the circularity score (score) from 0 to 100% for the ICT good at hand for all three circularity aspects. This includes: – Using a predefined value matrix to identify the % score from 0 to 100 for each combination of R×MI. – Calculating the average of the included circularity indicators for the ICT good at hand separately for all three circularity aspects: product durability, ability to recycle, repair, reuse, and ability to upgrade from equipment and manufacturer level.	Realization of the circular economy requires incorporating elements in product design that support the reduction of material use, reuse, recycling and recovery of products, product parts, components and materials to circulate them in the value chain for as long as possible. This Recommendation contains a three-step methodology to identify an information and communication technology (ICT) good's circularity in three dimensions via three circularity aspects: first, the ICT good durability; second, the ICT good ability to be recycled, repaired, reused and upgraded; and third, the manufacturers ability to recycle, repair, reuse and upgrade the ICT good put into the market. The three aspects are then divided into indicators for circular product design. The circularity indicators are then assessed at four levels, both from how well circularity has been achieved, the margin of improvement, and the relevance and applicability of each indicator for the ICT good at hand. The margin of improvement (MI) score and relevance score are then combined and translated into a score for each indicator. The average of applicable indicators for each circularity aspect are calculated as the total circularity score for each circularity aspect.	This Recommendation is intended for the circularity assessment of a single product (like phones, computers, servers, chassis, boards, modules, etc.) at a time. Whereas circularity assessment of whole equipment systems – and of organizations' overall circularity performance based on e.g., shipped products per year – are out of scope of this Recommendation.	Equipmernt

ITU-T L.1024	01/2021	The potential impact of selling services instead of equipment on waste creation and the environment – Effects on global information and communication technology	ITU	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	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		Services
ITU-T L.1027	08/2023	Assessment of material efficiency of ICT network infrastructure goods (circular economy) – Server and data storage product disassembly and disassembly instruction	ITU	Recommendation ITU-T L.1027 contains methods to assess the ability to disassemble certain key components of servers and data storage products, and the provision of information on these disassembly operations. It places a special emphasis on aspects relevant to the circular economy, such as fostering durability and reparability, in particular by third parties.	This Recommendation specifies methods to measure the ability of the following products to be disassembled: 1) Servers; 2) Data storage equipment. The Recommendation covers demonstration of compliance with the following requirements of EU Regulation 2019/424: i) The ability to disassemble, with particular regard to assessing that joining, fastening or sealing techniques do not prevent disassembly for repair or reuse purposes. ii) The provision of instructions on disassembly operations, including the type of operation, the type and number of fastening technique(s) to be unlocked and the tool(s) required. The following products are out of scope of this Recommendation: • Servers that are used in means of transport for persons or goods; • Servers intended for embedded applications; • Servers classified as small scale servers in terms of [b-EC 617/2013]; • Servers with more than four processor sockets; • Server appliances;		Equipment
ITU-T L.1030	06/2018	E-waste management framework for countries	ITU	Recommendation ITU-T L.1030 provides an e-waste management framework for countries. It summarizes the different steps that countries need to adopt in order to put in place an e-waste management system. The different steps of the e-waste management system described in this Recommendation will be further elaborated in future Recommendations. In addition, the Recommendation provides highlights concerning the environmental impact of improper handling of e-waste as well as the economic opportunities that could emerge from the sustainable management of e-waste.	This Recommendation provides a set of guidelines that countries can refer to when designing or adjusting their e-waste management systems. It provides guidance on policy/legal frameworks, resource mobilisation, collection mechanisms, financial mechanisms and engagement with all relevant stakeholders.		Country

ITU-T L.1031	12/2020	Guideline for achieving the e-waste targets of the Connect 2030 Agenda	ITU	Recommendation ITU-T L.1031 describes a three-step approach to achieve the e-waste targets set in the Connect 2030 Agenda. These steps consist of guidance on developing an e-waste inventory, approaches to design e-waste prevention and reduction programmes and the supportive measures required for successfully implementing the Connect 2030 e-waste targets. This Recommendation is intended to be utilized by relevant stakeholders to take their first step in addressing Target 3.2 of the Connect 2030 Agenda that is to increase the global e-waste recycling rate to 30% and Target 3.3 that is to raise the percentage of countries with e-waste legislation to 50%.	Recommendation ITU-T L.1031 describes a three-step approach for implementing the e-waste reduction target set-forth in the Connect 2030 Agenda. Step one details guidance on developing an e-waste inventory based on techniques developed by the Basel Convention and the Swiss Federal Laboratories for Materials Science and Technology (EMPA). Step two contains information on designing e-waste prevention and reduction programmes based on strategies developed by ITU-T and other international organizations. Finally step three outlines the supportive measures required for successfully reaching the Connect 2030 e-waste targets. The three-step approach described in this Recommendation forms a holistic guideline to reach the e waste reduction target in the Connect 2030 Agenda. An e-waste inventory establishes the baseline scenario for evaluation and assessment. It classifies e-waste based on existing standards, estimates the amount of e-waste using related metrics and key performance indicators (KPIs) and identifies the role of key stakeholders as well as the flow of e-waste among them. This information allows the relevant		Country
ITU-T L.1032	08/2019	Guidelines and certification schemes for e-waste recyclers	ITU	Recommendation ITU-T L.1032 is part of a series of ITU-T Recommendations that considers requirements for recyclers of waste information and communication technology (ICT). This Recommendation addresses, in particular, the informal sector that is involved in waste electrical and electronic equipment (WEEE) collection and dismantling. This Recommendations must be read in conjunction with national legislation and technical requirements for WEEE recyclers at the national level. A number of standards on WEEE, related to the present series of Recommendations, are published on the ITU-T website at: https://www.itu.int/en/ITU-T/Pages/default.aspx . Updates on the regional and international conventions and legislation presented can be found at: www.Basel.int (for the Basel Convention), also at: http://ec.europa.eu/environment/waste/shipments/legis.htm (for the EU waste shipment regulations), and at:	This Recommendation considers requirements for recyclers of waste information and communication technology (ICT) addressing in particular the informal sector that is involved in WEEE collection and dismantling. By working on the guidelines and certification schemes for WEEE recyclers, this Recommendation aims to support the WEEE informal sector with a view to developing and formalizing its working practices, while recommending interventions that may boost the sector's activities towards being environmentally friendly and protect workers in the sector as well as identifying the steps, needs and methodology required to transform this sector into a formal one.		Country

ITU-T L.1033	10/2021	Guidance for institutions of higher learning to contribute in the effective life cycle management of e-equipment and e-waste	ITU	Managing e-waste has been a major problem in many countries. Emerging economies still face a multitude of challenges that hinder the effective management of e-equipment and e-waste. Many of them do not have suitable facilities to handle e-equipment and e-waste and have inadequate implementation frameworks and structures due to the lack of quantifiable data and statistics on e equipment and e-waste, inadequate policies, regulations, standards and enforcement strategies, low stakeholder engagement/collaboration and limited expertise. Institutions of higher learning have a crucial role in leading society through its influence and the development of individuals. As societal issues become more complex and the boundaries between academia, industry, and the government become unclear, institutions of higher learning must remain the cornerstone of development. Universities among other higher learning institutions are better placed to ensure that the circularity of	This Recommendation establishes guidance for institutions of higher learning to collaboratively contribute on key aspects of managing e-resources and e-waste. It explores how institutions of higher learning can engage in EEE circularity by checking its effective involvement in every EEE and WEEE process.		Country
ITU-T L.1034	08/2022	Adequate assessment and sensitization on counterfeit information and communication technology products and their environmental impact	ITU	Recommendation ITU-T L.1034 provides awareness and guidance on the health and environmental impacts of counterfeit information and communication technology products. The intention is to create awareness and sensitization on human health and environmental risks, as well as measures implemented in different countries for risk mitigation.	This Recommendation provides awareness and guidance on what consumers and retailers should consider about counterfeit information and communication technology (ICT) products regarding environmental and health (EH) risks. The Recommendation describes counterfeit ICT products in this context to guide the assessment of the risks and potential adverse effects, sensitization of the public, and management of counterfeit goods in an environmentally sound manner. The main challenge in the management of counterfeit products is that they misrepresent legitimate ones, do not exist formally and therefore no assumptions about safety can be made. Consequently, counterfeit products can be considered to be potentially hazardous.		Country
ITU-T L.1035	02/2022	Sustainable management of batteries	ITU	Recommendation ITU-T L.1035 provides guidance on the sustainable management of used batteries from information and communication technology (ICT) equipment and their environmentally responsible management, including waste prevention, minimization, recycling, recovery and final disposal. This Recommendation also provides information on best practices in recycling batteries for dissemination. Batteries are crucial for the functioning of ICTs. Improving their design, prolonging their lifespan, improving their recyclability and preventing the dumping of waste batteries can lower their overall energy consumption, reduce exposure of humans and the environment to hazardous substances, as well as reducing global greenhouse gas emissions.	This Recommendation focuses on managing used and waste batteries in information and communication technology (ICT). The main objectives include the following: – criteria for the recyclability of different types of batteries. – identification of hazardous substances in batteries; – safe handling of batteries by recyclers and workers; – best practices for battery recycling and final disposal; – minimization of the environmental impact generated by heavy metals and other hazardous chemicals in used and waste batteries that are disposed of both as municipal solid waste and as hazardous waste and during battery recycling. This Recommendation examines methods for recycling of batteries effectively. This Recommendation also includes proposals for worker safety in the management of waste batteries, as well as policies, legislation and management plans for batteries.		Equipment

ITU-T L.1036	02/2022	Scheduled waste management for a base station (inclusive of e-waste)	ITU	Recommendation ITU-T L.1036 has been developed following the general environment quality act of a member country. As the 5G era proceeds, a huge global discharge of telecommunication equipment and upgrading of equipment are expected at each base station (BS) globally. Recommendation ITU-T L.1036 is an extension to any requirement stipulated in national environment quality or protection acts, a technical requirement for the telecommunication industry to adopt as a practice to reduce scheduled waste including e-waste at a (BS. In addition, Recommendation ITU-T L.1036 provides guidance on how to dispose of e-waste from a BS including the shared responsibility of owners and third parties involved.	This Recommendation finalizes a previously proposed technical code to manage e-waste or waste electrical and electronic equipment (WEEE) in a systematic and zero waste approach. There will be continued efforts to minimize the pollution of waste disposal at a base station (BS), and subsequently enhance the sustainability of the telecommunication industry. Further management quality improvements in accordance with this Recommendation are expected to lead to zero waste disposal to BS, landfill, and incinerator.		Services
ITU-T L.1040	08/2022	Effects of information and communication technology-enabled autonomy on vehicles longevity and waste creation	ITU	Recommendation ITU-T L.1040 establishes guidelines and requirements for information and communication technology original equipment manufacturer vendors providing equipment to autonomous vehicles aiming to reduce the amount of future e-waste. Recommendation ITU-T L.1040 analyses the e-waste risks and other sustainability indicators of autonomous vehicles and proposes how these potential challenges can be mitigated. Recommendation ITU-T L.1040 utilizes information compiled from stakeholders that can provide good insights into the specified potential challenge.	This Recommendation establishes guidelines and requirements for information and communication technology original equipment manufacturer vendors providing equipment to autonomous vehicles aiming to reduce the amount of future e-waste. This Recommendation analyses the e-waste risks and other sustainability indicators of autonomous vehicles and proposes how these potential challenges can be mitigated. This Recommendation utilises information compiled from stakeholders that can provide good insights into the specified potential challenge. This Recommendation contains an analysis of the longevity of autonomous vehicle (AVs). It is plausible that the lifetime of information and communication technology (ICT) components inside AVs could be shorter than manually driven internal combustion engine vehicles (ICEVs). If so, additional e waste – and other waste – may be created. The Recommendation also considers the possible solutions to the problems arising from waste creation caused by ICT enabled AVs. The Recommendation contains a guide for best practice design for longevity of AVs at a global level.		Company

ITU-T L.1050	01/2022	Methodology to identify key equipment for environmental impact and e- waste generation assessment of network architectures	ITU	While a framework for assessing the environmental impacts of the ICT sector exists (developed by the ITU in, for example, Recommendation ITU-T L.1410 on environmental life cycle assessments of information and communication technology goods, networks and services), best practices for equipment identification, developed specifically to assess the environmental impacts of network architecture, are lacking. In this Recommendation, key equipment in networks are identified for smoother life cycle assessment (LCA) calculations. Different types of network architecture employ different goods which entail differences in terms of energy usage, e-waste generation and environmental footprints. This Recommendation will examine three types of network architectures and will suggest an appropriate set of equipment to be considered for each. This Recommendation will begin to support network designers in determining the environmental and circular	The objective of this Recommendation is to provide best practices for equipment identification for ICT service architecture designers to be able to evaluate the environmental performance of different network architectures. The Recommendation will specify the necessary requirements for identifying equipment types used in network life cycle assessments (LCAs). The proposed set of equipment can be used to evaluate the following dimensions of network architecture: – Energy efficiency – E-waste amounts – LCA impacts – Circularity indicators [ITU-T L.1023] NOTE – Applying [ITU-T L.1023] to a network (in order to achieve a single 0% to 100% score for the network) requires allocation (e.g., based on share of cost, share of environmental impact, share of mass, share of functional performance) of the individual [ITU-T L.1023] scores of the equipment composing the network. This not an exhaustive list. While it does not give network architect designers environmental impact values for each equipment, for the environmental		Network
ITU-T L.1060	07/2021	General principles for the green supply chain management of information and communication technology manufacturing industry	ITU	Recommendation ITU-T L.1060 focuses on establishing general principles for the green supply chain (GSC) management of information and communication technology (ICT) manufacturing industry. It mainly gives the general principles for the green properties including upstream and downstream suppliers, logistics, recycling and utilization based on the product whole life cycle. General requirements such as the green supply chain management strategy, implementation, green production, recycling, and green information disclosure will be proposed as well.	This Recommendation specifies the general principles for the green supply chain (GSC) management of information and communication technology (ICT) manufacturing industry and also the requirements for planning, implementation and control, performance evaluation, management review and continuous improvement of the product life cycle. This Recommendation applies to the GSC management of ICT products manufacturing enterprises, covering the entire life cycle of ICT products, including green design, green procurement, green logistics and warehousing, green sales and after-sales service, and green recycling and integration. It also could be used by upstream and downstream suppliers (e.g., suppliers, logistics providers, distributors, after-sales service providers, recyclers, and enterprises from other industries.)		Company

ITU-T L.1061	03/2023	Circular public procurement of information and communication technologies	ITU	Green procurement policies, which focus on purchasing durable information and communication technology (ICT) equipment and recycling e-waste, can help reduce emissions and resource extractions and influence the market by increasing demand and stimulating research and product development. Recommendation ITU-T L.1061 provides technical guidance to public sector organizations on improving their procurement practices to purchase more circular ICT goods and services. The Recommendation covers the purchase of ICT equipment such as personal computers, terminals, network equipment and servers, and imaging equipment, and recommends specific requirements in procurement to (1) minimize the generation of e-waste and its adverse effects; (2) maximize the use of energy-efficient equipment; (3) maximize the useful life of equipment; and (4) maximize recyclability. It also covers design for e waste prevention and procurement recommendations which are relevant	This Recommendation provides a set of principles that provides a basis for circular public procurement of ICT equipment to: – Maximize usable life, – Maximize the use of energy-efficient equipment, – Minimize any resulting amount of e-waste produced, and the adverse effects of e-waste, and – Increase recyclability, thereby contributing to circular economy realization. This set of recommendations defines standards to help the public sector in deciding the ICT products to be procured that will not only be cost-effective but also to minimize e-waste during and after a product's end of use. It means purchase preference shall be given to those products that are environmentally sustainable and that already contain sustainability as a criterion. The decisions of the public sector shall reward the manufacturers of ICT products to move towards more environmentally sustainable ICT products in the medium to long term. This Recommendation covers the purchase of ICT equipment and including: – Personal computer (PC) products including desktops, laptops, servers, displays, docks		Company
ITU-T L.1100	02/2012	Procedure for recycling rare metals in information and communication technology goods	ITU	Recommendation ITU-T L.1100 provides information on the recycling procedures of rare metals in information and communication technology (ICT) goods. It also defines a communication format for providing recycling information of rare metals contained in ICT goods.	This Recommendation explains the necessity and importance of rare metal recycling and describes the following: – the recycling procedure for rare metals; and – the communication method with examples of communication formats that may be used when providing recycling information of rare metals contained in ICT goods.		Country
ITU-T L.1101	03/2014	Measurement methods to characterize rare metals in information and communication technology goods	ITU	Information and communication technology (ICT) goods, which consist of many parts and modules, are comprised of relatively small quantities of rare metals and larger quantities of major materials (e.g., iron, nonferrous metals, plastics, glasses, and engineering ceramics). They are usually produced through complex production procedures. To achieve successful recycling systems, the rare metals information provided by manufacturers should be accurate. However, many measurement and characterization methods may be used to obtain information on rare metals for elements of ICT goods. Each method has its own intrinsic advantages and disadvantages in the analysis of the information of such elements. The element separation capabilities and quantitative resolutions differ according to the measurement methods used and there are no standardized measurement methods to define the quantities and qualities of rare metals. However, IEC 62321 provides some guidelines for X-ray	This Recommendation explains the measurement methods for rare metals contained in Information and Communication Technology (ICT) goods. The measurement method may affect the interpretation of the results. This Recommendation specifies measurement methods to determine types and associated quantities of the rare metals of ICT goods. This Recommendation covers: • an overview of rare metals measurements; • the reference rare metals recycling procedure; and • recommended measurement methods of rare metals of ICT goods.		Company

ITU-T L.1102	07/2016	Use of printed labels for communicating information on rare metals in information and communication technology goods	ITU	Recommendation ITU-T L.1102 describes printed label methods to provide information on rare metals contained in information and communication technology (ICT) goods, and includes requirements specified in Recommendations ITU-T L.1100 and ITU-T L.1101 on the disclosure of rare metals information to consumers and recyclers.	This Recommendation explains printed label methods for communicating information on rare metals contained in information and communication technology (ICT) goods, and describes requirements from [ITU-T L.1100] and [ITU-T L.1101] specifying the disclosure of information on contained rare metals to consumers and recyclers. This Recommendation recommends appropriate label printing methods for rare metals, provides a standard way of obtaining information on rare metals in ICT goods and specifies how to encode rare metals information, as defined in [ITU-T L.1100], into a printed label. This Recommendation covers: • an overview of printed label symbology methods • recommendations for printed label methods for rare metals in ICT goods • a communication process for printed labels providing information on rare metals in ICT goods.		Company
ITU-T L.1200	05/2012	Direct current power feeding interface up to 400 V at the input to telecommunication and ICT equipment	ITU	Recommendation ITU-T L.1200 specifies the direct current (DC) interface between the power feeding system and ICT equipment connected to it. It also describes normal and abnormal voltage ranges, and immunity test levels for ICT equipment to maintain the stability of telecommunication and data communication services. The specified interface is operated from a DC power source of up to 400 V to allow increased power consumption and equipment power density, in order to obtain higher energy efficiency and reliability with less material usage than using a lower voltage such as -48 VDC or AC UPS power feeding solutions.	This Recommendation is aimed at providing compatibility between the power feeding system and ICT equipment installed at telecommunication centres, data centres and customer premises. This Recommendation deals with the requirements for an up to 400 VDC interface between power feeding system and ICT equipment. This Recommendation covers the following main items: • The identification of a power feeding system with the same characteristics for all ICT equipment defined in any location where an up to 400 VDC interface is used, e.g., telecommunication centres, radio base stations, data centres and customer premises. • The 'up to 400 VDC' voltage range in normal and abnormal service conditions at the interface defined in this Recommendation. • Behaviour during voltage variation, dips, short interruptions, transients, inrush current, grounding, etc. The general requirements for safety and earthing and bonding are out of the scope of this Recommendation unless specific requirements are not defined in current standards.		telecom site

ITU-T L.1201	03/2014	Architecture of power feeding systems of up to 400 VDC	ITU	Recommendation ITU-T L.1201 describes the architecture of power feeding systems of up to 400 VDC for information and communication technology (ICT) equipment in telecommunication centres, data centres and customer premises. It describes aspects such as configuration, redundancy, power distribution and monitoring, in order to construct safe, reliable and manageable power feeding systems. It can be used also as an architecture reference model for further Recommendations e.g., on the performance of DC power feeding systems.	This Recommendation specifies a power feeding architecture for power feeding systems of up to 400 VDC at telecommunications centres, datacentres and customer premises [ITU-T L.1200]. This Recommendation aims at providing an architecture reference for an up to 400 VDC power feeding system with high reliability, safety and manageability. This Recommendation covers the following items for power feeding systems of up to 400 VDC: 1) configuration of power feeding systems of up to 400 VDC; 2) requirements of the main basic elements for power feeding systems of up to 400 VDC (rectifiers, power distribution units (PDUs), batteries and distribution power lines); 3) monitoring and management functions. This Recommendation ensures a safe, operable, electromagnetic compatibility (EMC)-compliant and reliable cohabitation of power feeding systems of up to 400 VDC with AC and –48 VDC [EN 300 132-2] systems in sites combining these power feeding interfaces. The full description of a battery, grid AC supply, backup generator and power supply units (PSU) in ICT equipment and renewable or distributed energy sources are out of the		telecom site
ITU-T L.1202	04/2015	Methodologies for evaluating the performance of an up to 400 VDC power feeding system and its environmental impact	ITU	Recommendation ITU-T L.1202 is provided as a complement to Recommendation ITU-T L.1201, which describes the architecture of direct current (DC) power systems with an up to 400 VDC information and communication technology (ICT) equipment interface. The up to 400 VDC ICT equipment interface is described in Recommendation ITU-T L.1200. Recommendation ITU-T L.1202 provides a framework for assessing performances of up to 400 VDC power feeding systems and the savings incurred when compared to other power feeding systems such as the −48 VDC power system and the AC uninterruptable power system (UPS) commonly used in information and communication technology (ICT) sites. This Recommendation deals with performance factors such as efficiency, reliability/availability and environmental impact.	This Recommendation provides a comparative performance assessment of the up to 400 VDC power feeding system using the interface described in [ITU-T L.1200] and installed in telecommunications centres, data centres and customer premises, to determine the environmental savings of the new power feeding architectures defined in [ITU-T L.1201]. The performances evaluated include efficiency performance, reliability performance and environmental impact over life cycle, based on ITU-T Recommendations on metrics and assessment methodologies. Other issues such as electrical disturbances, EMC, scalability and maintenance performance are partially covered.		telecom site

ITU-T L.1203	02/2016	Colour and marking identification of up to 400 VDC power distribution for information and communication technology systems	ITU	Recommendation ITU-T L.1203 defines the requirements and guidelines for DC power distribution identification by colour and marking in Telecom/ICT installations (wire, cables, electric distribution boards, interconnections, etc.). It avoids confusion and errors between the different AC and DC power interfaces and distributions used in buildings and inside Telecom/ICT systems, as 400 VDC power feeding interfaces standardized in Recommendation ITU-T L.1200 is used more, increasing power density of ICT equipment, energy efficiency, simplified reliable power feeding architecture, costs optimisation, etc. Recommendation ITU-T L.1203 supports the progressive introduction of up to 400 VDC installations in cohabitation with the existing −48 V and AC distribution.	The scope of this Recommendation is to define common practice for identification of cabling or parts of the DC electric distribution inside buildings and rooms and inside telecom, ICT and facilities equipment (power plant, cooling, building access, monitoring, etc.). This applies to 400 VDC cabling for telecom, ICT equipment and environment equipment using interface defined in [b-EN 300 132-3-1] or [ITU-T L.1200] and avoids confusion between the DC colour and marking of up to 400 VDC distribution and the other power interfaces identification: −48 VDC distribution for A interface, AC and uninterrupted AC given by inverters or UPS used in the building. The Recommendation defines: – requirements for the colour and identification of separate wires used in DC distribution systems and installations and as much as possible inside equipment between A or P interface and end use; – marking and identification of DC multiwire cables, connectors and any associated equipment for DC power distribution; – marking identification for sub-distribution boards and interconnection boxes. For DC wires in multiwire cables.		telecom Site
ITU-T L.1204	06/2016	Extended architecture of power feeding systems of up to 400 VDC	ITU	Recommendation ITU-T L.1204 describes the extended architecture of power feeding systems of up to 400 V direct current (VDC) for information and communication technology (ICT) equipment in telecommunication centres, data centres and customer premises. It describes aspects such as configuration, redundancy, power distribution and monitoring, in order to construct safe, reliable and manageable power feeding systems. This Recommendation can be used also as an architecture reference model for future Recommendations e.g., on the performance of DC power feeding systems. This Recommendation describes extended power feeding architectures using up to 400 VDC e.g., hybrid redundant DC and alternating current (AC) power feeding based on Recommendation ITU T L.1201.	This Recommendation specifies a power feeding architecture for power feeding systems of up to 400 V direct current (VDC) at telecommunications centres, datacentres and customer premises [ITU T L.1200]. This Recommendation aims to provide a reference of power feeding architecture for an up to 400 VDC power feeding system with high reliability, safety and manageability. This Recommendation covers the following items for power feeding systems of up to 400 VDC: 1) configuration of power feeding systems of pure up to 400 VDC and hybrid power feeding systems with up to 400 VDC and alternating current (AC) power feeding systems; 2) requirements of the main basic elements for power feeding systems of up to 400 VDC, such as rectifiers, power distribution units (PDUs), batteries and distribution power lines; 3) monitoring and management functions. This Recommendation ensures a safe, operable, electromagnetic compatibility-(EMC)-compliant and reliable cohabitation of power feeding systems of up to 400 VDC with AC and −48 VDC [ETSI EN 300 132-2] systems in sites combining these power feeding interfaces. The full description of a battery, grid AC		telecom site

ITU-T L.1205	12/2016	Interfacing of renewable energy or distributed power sources to up to 400 VDC power feeding systems	ITU	The up to 400 volt DC (VDC) power solutions feeding the power interface of ICT/telecom equipment as defined by the ITU-T L.1200 series, are well adapted to the straightforward use of renewable energy or distributed power sources through new simple direct current (DC) nano or micro grids. Recommendation ITU-T L.1205 defines the coupling of local or remote renewable energy into an up to 400 VDC power system without reducing DC performances defined in Recommendation ITU-T L.1202 mainly for efficiency and reliability. The main advantages are saving of fossil fuel (as a source of primary energy consumption), reduction of greenhouse gas (GHG) emissions and increased resilience. Additional site interconnection by a DC grid can even bring more optimization. One other big benefit is that compared to alternating current (AC), with 400 VDC there is no synchronization required between the various inputs, which keeps the architecture simple.	This Recommendation defines the interconnection of the site power installation feeding an up to 400 VDC interface, to site renewable energy or to distributed DC power sources. The aspects covered include: – general power architectures for: – connection of a site renewable energy source (PV, wind generator, fuel cells, etc.) to a site power plant and especially to a DC power system, (the site sources being on the buildings or around) – exchange of power to and from a DC nano or micro grid for use and production outside of the site (this includes dedicated remote powering networks built for telecom/ICT access equipment but also more general purpose DC electric grids) – conditions required to maintain the specified performance for the up to 400V power system: – electrical stability – reliability and maintainability – proper battery charge and management – lightning protection coordination – electromagnetic compatibility (EMC) and transient limits – specification of proper power sizing (requirements for control-monitoring and		telecom site
ITU-T L.1206	07/2017	Impact on ICT equipment architecture of multiple AC, -48VDC or up to 400 VDC power inputs	ITU	Recommendation ITU-T L.1206 discusses multiple power supply interfaces to information and communication technology (ICT) equipment operated by dual power input feeds with combinations of standardized −48 V direct current (DC) or alternating current (AC) sources, or DC source up to 400 V interfaces. Operational voltage and interface characteristics are detailed in ITU-T Recommendations and European Telecommunications Standards Institute (ETSI) relevant standards. This Recommendation also includes some details on the power architecture within the ICT equipment between the ICT power interface and the ICT end load.	This Recommendation is applicable to the case of multiple power feeding configurations at the input of information and communication technology (ICT) equipment in ICT systems. It defines the requirements for the power inputs combination of the three power interfaces: A (−48 V), P or A3 (up to 400 Volt DC (VDC)) and A3ac (AC) that could potentially be used for each input. This Recommendation also provides details of the power structure within ICT equipment, between ICT equipment interfaces, and ICT equipment system loads that is inclusive of system power converters. The input power configurations are categorized to allow for a better understanding, identification, impacts, and benefits of adopting each power feeding solution. The consequence on battery test function with the different dual power inputs combinations are indicated. Requirements are given for avoiding the potential risk of voltage backfeeding from one input to the other and for general isolation requirements.		telecom site

ITU-T L.1207	05/2018	Progressive migration of a telecommunication/information and communication technology site to 400 VDC sources and distribution	ITU	Recommendation ITU-T L.1207 gives explanation, requirements and guidance for boosting the spread of up to 400 V direct current (400 VDC) power systems and the distribution to information and communication technology (ICT) equipment. It includes 400 VDC remote powering up to 400 VDC of distributed ICT equipment, the option of interconnection of local renewable energy sources and their connection to DC power nanogrids and other users, extending the resilience capability of the telecommunication network and ICT sites to grid failures and climate change.	This Recommendation defines solutions for progressive migration of information and communication technology (ICT) sites (telecommunication and data centres) to up to 400 V direct current (400 VDC) distribution and direct use of up to 400 VDC powering ICT equipment from 400 VDC sources. The Recommendation also defines different major use case options and migration scenarios, such as: – migration to an up to 400 VDC of telecommunication site power solution; – migration to an up to 400 VDC of data centre power solution; – migration with up to 400 VDC power transfer between existing −48 V centralized sources to high power density −48 V equipment, such as routers; – integration of up to 400 VDC remote powering; – combined architecture with up to 400 VDC and AC sources and distributions possibly using hybrid power interfaces on ICT equipment. For each of these, this Recommendation describes many possible options and characteristics, such as: – migration architecture with up to 400		telecom site
ITU-T L.1210	12/2019	Sustainable power-feeding solutions for 5G networks	ITU	Recommendation ITU-T L.1210 defines power-feeding solutions for 5G, converged wireless and wireline access equipment and networks, taking into consideration their enhanced requirements on service availability and reliability and new deployment scenarios, along with the environmental impact of the proposed solutions. The minimum requirements of different solutions, including power-feeding structures, components, backup, safety requirements and environmental conditions, are also defined. This Recommendation is applicable to the powering of both mobile and fixed access network elements, in particular equipment that have similar configurations and needs.	This Recommendation defines power-feeding solutions for 5G, converged wireless and wireline access equipment and networks, while taking into consideration their enhanced requirements on service availability and reliability, new deployment scenarios, together with the environmental impact of the proposed solutions. Also defined are the minimum requirements of different solutions, including power-feeding structures, components, backup, safety requirements and environmental conditions. This Recommendation is applicable to the powering of both mobile and fixed access network elements, in particular to equipment with similar configurations and needs. The future development of 5G networks will create a new scenario in which the density of radio cells will increase considerably, together with the increase of wireline network equipment, that are going to be installed in the vicinity of the users; thereby, this creates the need to define new solutions for powering that will be environmentally friendly, sustainable, dependable, smart and visible remotely. The –48 VDC, up to 400 VDC local and remote power solutions defined respectively in [ETSI EN 300 132-2], [b-ETSI EN 302 099]		telecom radio site

ITU-T L.1220	08/2017	Innovative energy storage technology for stationary use - Part 1: Overview of energy storage	ITU	Recommendation ITU-T L.1220 introduces an open series of documents for different families of technologies (e.g., battery systems, super-capacitor systems) that will be enriched progressively as new technologies emerge that may significantly impact the field of energy storage. With the increase of new technologies in energy storage there is need for a global overview of an energy storage system for use in stationary information and communication technology (ICT) installations in networks, data centres and customer premises equipment (CPE), and simple evaluation of acceptable duration and characterization methods for this specific purpose. Identified parts of this Recommendation series, Innovative energy storage technology for stationary use, are: – Part 1: Overview of energy storage; – Part 2: Battery systems; – Part 3: Supercapacitor technology.	This Recommendation identifies the main needs and applications of stationary electrical energy storage for information and communication technology (ICT) sites such as back-up on different grid quality and cyclic use of renewable energy systems. It also provides possible selection criteria for the correct choice for the end system. The topics considered are: – families of electrical energy storage, such as batteries or supercapacitors; – technologies types and their main properties; – adaptation to requirements (e.g., functionalities, technology availability, electrical characteristics, environmental adaptation, maintenance type, cost); – national or regional rules and regulations. The Recommendation highlights the need for evaluation methods that are complementary to existing battery standards as they allow different time-frames including shorter tests compared to common energy storage industry tests. This Recommendation is Part 1 of a series of Recommendations that cover energy storage technologies (e.g., battery, supercapacitor) applicable to stationary telecom/ICT		telecom site
ITU-T L.1221	11/2018	Innovative energy storage technology for stationary use - Part 2: Battery	ITU	Recommendation ITU-T L.1221 is a subpart (Part 2: Battery), of a series of Recommendations (the other Recommendations in the series being Recommendation ITU-T L.1220 and Recommendation ITU-T L.1222) on innovative energy storage systems for stationary power systems of telecom/information and communication technology (ICT) equipment used in telecom networks, data centres and customer premises equipment (CPE). This subpart introduces technologies and methods for evaluating, selecting and testing battery systems for defined applications.	The present Recommendation contains the main requirements for evaluating appropriate innovative batteries for stationary use for powering ICT equipment in telecom sites, active network units and data centres or customer premises with standardized power interfaces in –48V, up to 400 VDC or 12V. Based on the general selection and evaluation method proposed in [ITU-T L.1220], the present Recommendation introduces the main battery technologies, characteristics and the method to select, evaluate and test battery products adapted to a defined application. This Recommendation describes the selection criteria and possible tests for making the appropriate or optimal choice of battery technology for an ICT stationary application. This includes mechanical performance, electrical performance, (voltage, current, power and capacity ratings, efficiency and self-discharge, etc.), environmental performance (temperature range), lifetime performance (cycling and calendar life, tolerance of partial charge and depth of discharge), installation, operation and maintenance complexity (parallel operation), safety (risk to and protection of humans and environment, error		telecom site
ITU-T L.1222	05/2018	Innovative energy storage technology for stationary use - Part 3: Supercapacitor technology	ITU	Recommendation ITU-T L.1222 is based on Recommendation ITU-T L.1220 and is the part related to supercapacitors. Recommendation ITU-T L.1222 contains selection criteria for telecommunication application based on main performance parameters and the methods for proper use. In addition, some use cases and examples are given in an Appendix to help users.	This Recommendation provides an overview of available supercapacitor (SC) technology, with details of SC characteristics (electrical, mechanical, thermal) and applicability in the telecommunication/information and communication technology (TLC/ICT) domain [b ETSI TR 102 532]. A general overview of the evolution of energy storage technologies is provided in [ITU L.1220]. The adoption of SC technology is recommended for coverage of micro-interruptions of the public grid for indoor and outdoor applications. Examples of sizing and essential tests used in the network are described.		telecom site

ITU-T L.1230	08/2022	Specifications of 10 kVAC input and up to 400 VDC output integrated power system in data centre and telecommunication room	ITU	With the development of big data and cloud computing technology, the quantity and total capacity of the data centre and telecommunication room as well as information and communication technology (ICT) equipment power density is increasing rapidly. Furthermore, it has been found that the traditional power systems had the disadvantages of low energy efficiency, high energy consumption and maintenance difficulties in existing data centre and telecommunication rooms. It is therefore necessary to develop a new structure of the whole power system which integrates the traditional 10 kVAC voltage distribution equipment, transformer, low voltage distribution equipment and up to 400 VDC equipment. In the new structure the distribution system of each voltage level is simplified, so that the maintenance work is reduced, and the reliability of the whole power system is improved. Recommendation ITU-T L.1230 includes system composition, general requirements, and monitoring system, etc. of 10 kVAC input and up	This Recommendation specifies the structure of the 10 kVAC input and up to 400 VDC output integrated power system in the data centre and telecommunication room. This Recommendation covers the following items: 1) System composition of 10 kVAC input and up to 400 VDC output integrated power system. 2) General requirements including output voltage range, safety requirement, electromagnetic compatibility (EMC) requirement, resistibility. 3) Monitoring system function of power system.		Equipment
ITU-T L.1240	08/2022	Evaluation method of safety operations and energy saving for power supply systems in telecommunication rooms or buildings	ITU	Recommendation ITU-T L.1240 specifies, for telecommunication rooms or buildings, the overall evaluation framework, classification, reliability grading, evaluation items and evaluation methods for power supply systems. Recommendation ITU-T L.1240 applies to the evaluation of power supply systems, maintenance capability, safety operations and energy saving of various telecommunication rooms or buildings.	This Recommendation establishes evaluation methods of safety operations and energy saving for power supply systems in telecommunication rooms or buildings. This Recommendation specifies: • overall safety operations evaluation; • energy-saving evaluation; • classification of telecommunication rooms or buildings; • reliability grading; • evaluation methods for power supply system in telecommunication rooms or buildings. This Recommendation applies to the evaluation of power supply systems, maintenance capability, safety operations and energy saving of various telecommunication room or building configurations.		telecom site
ITU-T L.1241	09/2023	Methodologies for evaluating the functionality and performance of power supply units configured for servers	ITU	This Recommendation provides comprehensive evaluation methods of power supply unit configured for servers to evaluate the electrical performances, functionalities and safety aspect.	This Recommendation provides comprehensive evaluation methods of power supply unit configured for servers to evaluate the electrical performances, functionalities and safety aspect. The functional features and performances evaluated mainly include input voltage range and rated frequency, THD of voltage and current, no-load power consumption, power factor, energy efficiency, load distribution management, telemetry, telecommunication, telecontrol, safety and protection.		Equipment

ITU-T L.1300	06/2014	Best practices for green data centres	ITU	Recommendation ITU-T L.1300 describes best practices aimed at reducing the negative impact of data centres on the climate. It is commonly recognized that data centres will have an ever-increasing impact on the environment in the future. The application of the best practices defined in this Recommendation can help owners and managers to build future data centres, or improve existing ones, to operate in an environmentally responsible manner. Such considerations will strongly contribute to a reduction in the impact of the information and communication technology (ICT) sector on climate change.	This Recommendation specifies best practices aimed at developing green data centres. A green data centre can be defined as a repository for the storage, management, and dissemination of data in which the mechanical, lighting, electrical and computer systems are designed for maximum energy efficiency and minimum environmental impact. The construction and operation of a green data centre includes advanced technologies and strategies. The Recommendation provides a set of rules to be referred to when undertaking improvement of existing data centres, or when planning, designing or constructing new ones. The proposed best practices cover: • data centre utilization, management and planning; • ICT equipment and services; • cooling; • data centre power equipment; • data centre building; • monitoring. The environmental impact of a data centre should be assessed in line with [ITU T L.1400], [ITU T L.1410] and [ITU T L.1420].		Data center
ITU-T L.1301	05/2015	Minimum data set and communication interface requirements for data centre energy management	ITU	Recommendation ITU-T L.1301 establishes a minimum data set necessary to manage data centres and telecommunication rooms in an environmentally responsible manner. The Recommendation specifies the communication interface and defines the parameters to be communicated depending on the equipment used in data centres, such as power systems (alternating current (AC)/direct current (DC) and uninterruptible power supply (UPS) and energy distribution), cooling systems and information and communication technology (ICT) equipment.	This Recommendation aims to: – establish a minimum data set necessary to manage data centres in an environmentally responsible manner; – establish high-level interface requirements for information and communication technology (ICT) and facility equipment communication that contribute to energy saving, energy management and energy-saving evaluation.		Data center
ITU-T L.1302	11/2015	Assessment of energy efficiency on infrastructure in data centres and telecom centres	ITU	Recommendation ITU-T L.1302 specifies an energy efficiency assessment methodology for data centres and telecom centres, test equipment accuracy requirements, assessment period, assessment conditions and calculation methods. Concerning the data centres and telecom centres, the Recommendation considers assessment methods for the efficiency of the whole data centre/telecom centre and of a part of the data centre/telecom centre. As the main energy-consuming infrastructure in data centres and telecom centres are the power feeding system (power supply system) and the cooling system, this Recommendation covers energy efficiency measurement methodologies for both types of systems. The Recommendation takes into account methodologies and best practices currently in use or under development in networks, and data centres and telecom centres. This Recommendation is aimed at reducing the negative impact of data	This Recommendation specifies an energy efficiency assessment methodology of the infrastructure of data centres and telecom centres under running conditions. The assessment methodology includes an assessment methodology of the energy efficiency for the whole data centre/telecom centre infrastructure (or facility), for a partial data centre/telecom centre infrastructure (or facility), for the power feeding system and for the cooling system.		Data center

ITU-T L.1303	11/2018	Functional requirements and framework of green data centre energy-saving management system	ITU	Recommendation ITU-T L.1303 describes the functional requirements and framework of an energy-saving management system for green data centres. Functional requirements of energy-saving management include requirements for measuring energy consumption and environmental conditions data, collecting and storing data, reporting data and conducting energy-saving. The energy-saving management system consists of the following functional blocks: data collecting block; data storing block; data process and analysis block; external system interfacing block; user interface block; control block. The operational flow of the energy-saving management system is also included.	This Recommendation describes the functional requirements and framework of a green data centres energy-saving management system. The energy-saving will be achieved by increasing the energy efficiency of data centres. The scope of this Recommendation includes: – Characteristics and operation flow of a green data centre energy-saving management system – Functionality requirements of a green data centre energy-saving management system (e.g., energy consumption data acquisition; energy consumption data analysis and chart show; energy consumption data query; energy consumption monitoring and early warning.) – Framework of a green data centre energy-saving management system including functional blocks such as data collecting, data storing, data process and analysis, external system interface, user interface and control block. Sensor definition, interface and protocol are not included in the scope of this Recommendation.		Data center
ITU-T L.1304	12/2020	Procurement criteria for sustainable data centres	ITU	Recommendation ITU-T L.1304 aims to support public authorities in purchasing data centres related products, services and items with reduced environmental impacts through establishing a set of procurement criteria.	This Recommendation aims to support public authorities in purchasing data centre related solution while taking in consideration a set of sustainable criteria. This Recommendation considers energy efficiency solution for equipment and facilities. Different physical construction solutions are considered.		Data center
ITU-T L.1305	11/2019	Data centre infrastructure management system based on big data and artificial intelligence technology	ITU	ITU-T L.1305 contains technical specifications of a data centre infrastructure management (DCIM) system, with the following aspects being covered: principles, management objects, management system schemes, data collection function requirements, operational function requirements, energy saving management, capacity management for information and communication technology (ICT) and facilities, other operational function requirements and intelligent controlling on systems to maximize green energy use. Other aspects such as maintenance function requirements, early alarm and protection based on big data analysis and intelligent controlling on systems to decrease the cost for maintenance are also considered.	Objective: This Recommendation describes specifications of a data centre infrastructure management (DCIM) system based on big data and artificial intelligence (AI) technology. The system will manage all infrastructure in the data centre at the same time through a comprehensive platform.	The scope of this Recommendation includes: – network infrastructure of management systems; – standardization of data collection of the installed module; – interconnection among various kinds of monitoring sub-systems; – requirements for different functions in a DCIM.	Data center
ITU-T L.1306	02/2023	Specification of an edge data centre infrastructure	ITU	Recommendation ITU-T L.1306 defines systematic requirements for infrastructure equipment utilized in the edge data centre including information and communications technology (ICT) equipment, power feeding system, cooling system, monitoring system, etc. to get green, safe, reliable, smart energy saving.	This Recommendation focuses on the specification of edge data centre infrastructure, such as principles, basic components, technical specification of power feeding systems, cooling systems (design, maintenance, operation and energy consumption), monitoring systems and others.		Data center

ITU-T L.1310	09/2020	Energy efficiency metrics and measurement methods for telecommunication equipment	ITU	Recommendation ITU-T L.1310 contains the definition of energy efficiency metrics test procedures, methodologies and measurement profiles required to assess the energy efficiency of telecommunication equipment. Energy efficiency metrics and measurement methods are defined for telecommunication network equipment and small networking equipment. These metrics allow for the comparison of equipment within the same class, e.g., equipment using the same technologies. The comparison of equipment in different classes is out of the scope of this Recommendation.	This Recommendation specifies the principles and concepts of energy efficiency metrics and measurement methods for telecommunication network equipment. This Recommendation also specifies the principles and concepts of energy efficiency metrics and measurement methods for small networking equipment used in the home and small enterprise locations.		Equipment
ITU-T L.1315	05/2017	Standardization terms and trends in energy efficiency	ITU	Recommendation ITU-T L.1315 provides a high-level definition of energy efficiency, energy management requirement to increase the energy efficiency of information and communication technology (ICT) goods, networks and services.	This Recommendation specifies terminology, principles and concepts for energy efficiency and energy management. The Recommendation establishes a common understanding on measurement methodology used to determine the energy efficiency of a good, service and network. It is a framework for other ITU-T standards and other standard development organization (SDO) document for energy efficiency thematic.		Equipment, Country, Company
ITU-T L.1316	11/2019	Energy efficiency framework	ITU	Recommendation ITU-T L.1316 contains a framework of documents for collecting standards on energy efficiency metrics/key performance indicators (KPIs), measurement methodologies and energy management solutions for information and communication technology (ICT) equipment. The Recommendation suggests the selection of the appropriate document to reference when determining energy efficiency.	The Recommendations are a framework of existing standards, from ITU-T, ETSI and ATIS, covering various aspects of energy efficiency (EE) and energy management. This Recommendation covers energy efficiency of: – information and communication technology (ICT) goods; – telecom networks; – services. Standards from other organizations not covered in this Recommendation will be added in future versions.		Equipment, Country, Company
ITU-T L.1317	11/2021	Guidelines on energy efficient blockchain systems	ITU	Several models have been introduced to calculate the urban energy system and to demonstrate the variants that calibrate the local energy efficiency. Recommendation ITU-T L.1317 focuses on the impact of blockchain in energy efficiency. A literature analysis is performed with regard to the understanding of the blockchain energy demands and how these can be optimized. The aim of this Recommendation is to explain the energy demand of blockchain, to define the blockchain energy model and to describe the energy efficiency parameters that can be calibrated in order to enhance the corresponding energy efficiency.	This Recommendation contains a literature analysis to understand the blockchain energy demands and how these can be optimized. The aim of this Recommendation is to: • explain the energy demands of blockchain, • define the blockchain energy model, • describe the energy efficiency parameters that can be calibrated in order to enhance the corresponding energy efficiency.		Country; Company

ITU-T L.1318	08/2022	Q factor: A fundamental metric expressing integrated circuit energy efficiency	ITU	Recommendation ITU-T L.1318 outlines a method and fundamental metric for expressing integrated circuit energy efficiency, the Q factor. The Q factor could be applied to measure and improve the integrated circuit technology behind information and communication technology itself. The method consists of two separate parts: 1) Method and metric development; 2) Examples of Q factor scores for different integrated circuits and energy and carbon saving potentials in relation to Q factors.	This Recommendation defines the integrated circuit metric for energy efficiency (TIME) as the Q factor (also known as "quality factor" or "Q"). Q factor provides a key means to accurately express energy efficiency at the integrated circuit (IC) level. This Recommendation defines Q factor as a metric for IC energy efficiency; This Recommendation is applicable to all ICs and differentiates ICs with Q ≥ 1000 (highly energy efficient) from those ICs with Q = 1 (current ICs).		Country; Company
ITU-T L.1320	03/2014	Energy efficiency metrics and measurement for power and cooling equipment for telecommunications and data centres	ITU	Recommendation ITU-T L.1320 contains the general definition of metrics, test procedures, methodologies and measurement profiles required to assess the energy efficiency of power and cooling equipment for telecommunications and data centres. More detailed measurement procedures and specifications can be developed in future related ITU-T Recommendations. Metrics and measurement methods are defined for power equipment, alternating current (AC) power feeding equipment (such as AC uninterruptible power supply (UPS), direct current (DC/AC) inverters), DC power feeding equipment (such as AC/DC rectifiers, DC/DC converters), solar equipment, wind turbine equipment and fuel cell equipment. In addition, metrics and measurement methods are defined for cooling equipment such as air conditioning equipment, outdoor air cooling equipment and heat exchanging cooling equipment.	This Recommendation specifies principles and concepts of energy efficiency metrics and measurement methods for power feeding equipment and cooling equipment in telecommunications rooms and data centres. The methodologies defined in this Recommendation are applied at single equipment level. The efficiency of power conversion and cooling in the data centre or telecommunication facility is only partially attributed to the equipment. The architecture and organization of the space and equipment to deliver the power or cooling to the systems is as equal, if not a more significant factor in energy efficiency. Another general factor is the interoperability, management and response of these systems across the demand and operational range. NOTE – Cooling equipment: In general, data centre level systems should be referred (or normalized) with respect to a full year, in order to take into account the yearly variability of environmental conditions and the consequent possible use of various cooling methods. The reference to a whole year helps to establish a power usage effectiveness (PUE) comparison, especially with respect to an individual data centre.		data center/telecom site
ITU-T L.1321	03/2015	Reference operational model and interface for improving energy efficiency of ICT network hosts	ITU	Recommendation ITU-T L.1321 describes a reference operational model and interface for improving energy efficiency of ICT network hosts. The operational model and interface specify network proxy operation to support IPv4 ARP and DHCP in order to promote the deployment of network proxy.	This Recommendation specifies a reference model for improving energy efficiency of wired network hosts so that network hosts can reduce energy consumption by entering an energy saving sleep state. This Recommendation describes the specification for improving energy efficiency by defining a reference operational model of a network proxy to handle mandatory protocols for network hosts in the sleep state.		Services

ITU-T L.1325	12/2016	Green ICT solutions for telecom network facilities	ITU	Recommendation ITU-T L.1325 has been developed to introduce highly-efficient infrastructure solutions, including highly-efficient power solutions, renewable energy solutions, air conditioning energy-saving solutions and free and economical cooling solutions. With the development of information and communication technologies, and especially high power-density equipment, the energy consumption of communication industry is increasing. Therefore, we must pay attention to energy conservation, and protection of the environment. This Recommendation specifies Green ICT solutions for telecom network facilities.	This Recommendation specifies Green ICT solutions for telecom network facilities and aims to increase the energy efficiency of the whole telecom network and to reduce carbon emissions. ICT infrastructure can be defined as a repository for the telecom equipment, management system, power system and cooling system. It is designed for maximum energy efficiency and minimum environmental impact. The construction and operation of telecom network infrastructures includes advanced technologies and strategies. This Recommendation provides a set of rules to be referred to when undertaking improvement of existing telecom network infrastructure, or when planning, designing or constructing new ones.	Not every solution mentioned in this Recommendation is fit for everywhere. When operators choose the solution, it should be selected according to local situations.	telecom site
ITU-T L.1326	08/2023	Requirements and use cases of liquid cooling solutions and high energy efficiency solutions for 5G BBU in centralized-RAN mode	ITU	Liquid cooling systems are mainly used for processing high thermal power density which exceeds the physical limits of air-cooling methods, to support application scenarios where manufacturers are creating competitive advantages. Liquid cooling can provide heat transfer capabilities several orders of magnitude higher than those of air cooling, and applications dealing with high heat density in the core and in edge computing as well as in access networks will increasingly require the support of liquid cooling technology. Recommendation ITU-T L.1326 identifies the requirements for liquid cooling and high energy efficiency solutions for 5G BBU in centralized-RAN mode, including requirements of immersion and spray liquid cooling technology, key indicators of immersion and spray liquid, safety requirements of immersion and spray liquid cooling system, management procedure and an energy efficiency measurement method, and use cases of liquid cooling solutions. In this Recommendation, a complete	This Recommendation provides requirements for liquid cooling and high energy efficiency solutions for 5G BBU in centralized-RAN mode, including requirements of immersion and spray liquid cooling technology, key indicators of immersion and spray liquid, safety requirements of immersion and spray liquid cooling system, management procedure and an energy efficiency measurement method, and use cases of cooling solutions.		Equipment, telecom site

ITU-T L.1330	03/2015	Energy efficiency measurement and metrics for telecommunication networks	ITU	Recommendation ITU-T L.1330 provides a set of metrics for the assessment of energy efficiency (EE) of telecommunication (TLC) mobile networks, together with proper measurement methods. Such metrics are of extremely high importance to operators, given that the optimization of the energy performance of a single piece of equipment does not guarantee the overall maximum energy efficiency of a complex network formed by several interconnected equipments. Hence, through the metrics reported in this Recommendation, a better comprehension of network energy efficiency will be gained, not only for "total" networks, but also for "partial" networks, definable through either geographic or demographic boundaries. In a future step, energy efficiency of TLC fixed networks will be provided.	This Recommendation aims to define the topology and level of analysis necessary to assess the energy efficiency (EE) of mobile networks. Within the scope of this Recommendation are the radio access parts of the mobile network, namely: radio base stations, backhauling systems, radio controllers and other infrastructure radio site equipment. The technologies covered are: global system for mobile communications (GSM), universal mobile telecommunications communications (UMTS) and long-term evolution (LTE) (including LTE advanced (LTE-A)). In particular, this Recommendation defines metrics for mobile network energy efficiency and methods for assessing (and measuring) energy efficiency in operational networks. The purpose of this specification is to allow better comprehension of network energy efficiency. This Recommendation deals with both homogeneous and heterogeneous "networks" and considers networks whose size and scale could be defined by topologic, geographic or demographic boundaries. For networks defined by topologic boundaries, a possible example of a network consists of a control node (whenever applicable), its supported		Company
ITU-T L.1331	01/2022	Assessment of mobile network energy efficiency	ITU	Recommendation ITU-T L.1331 aims to provide a better understanding of the energy efficiency of mobile networks. The focus of this Recommendation is on the metrics and methods of assessing energy efficiency in operational networks. The networks considered are those whose size and scale could be defined by topologic, geographic or demographic boundaries.	This Recommendation aims to provide a better understanding of the energy efficiency of mobile networks in particular considering the networks' evolution in different periods of time. The focus of this Recommendation is on metrics for energy efficiency and methods of assessing (and measuring) energy efficiency in operational networks. This Recommendation defines the topology and level of analysis needed to assess energy efficiency. The analysis includes radio base stations, backhauling systems, radio controllers (RCs) and other infrastructure radio site equipment. The technologies involved are global system for mobile communication (GSM), universal mobile telecommunications service (UMTS), long term evolution (LTE) and 5G New Radio (NR).	This Recommendation explains how to extrapolate the measurements made on partial networks to the level of the total network. Such a simplified approach is proposed as a way of making approximate energy efficiency evaluations at the level of network elements and cannot therefore be considered sufficient for the entire network operation including, for example, transport.	Company
ITU-T L.1332	01/2018	Total network infrastructure energy efficiency metrics	ITU	Recommendation ITU-T L.1332 contains the basic definition of energy efficiency metrics and measurement methods required to evaluate the energy efficiency of a total network, including the energy consumption for: – all telecommunication (TLC)/information and communications technology (ICT) equipment in the network; – all facilities equipment (e.g., cooling systems, site monitoring systems, fire protection and lighting systems; – energy losses in DC power station or AC UPS and in the power distribution; – maintenance activities and site-visit energy used for transportation (e.g., by car); – diesel generators used for emergency purposes.	This Recommendation specifies principles and concepts of energy efficiency metrics and measurement methods to evaluate the energy efficiency of an entire network consisting of telecommunication equipment and infrastructure equipment. This Recommendation also develops the methodology to consider the influence on total energy consumption including maintenance activities; by establishing methodologies which consider the energy necessary for the transport activities embedded in the maintenance phase. Energy sources of different natures are taken into account in this Recommendation. For concepts of energy efficiency, see [ITU-T L.1315].		Company

ITU-T L.1333	09/2022	Carbon data intensity for network energy performance monitoring	ITU	To meet the targets of the Paris Agreement, telecom operators, like other industries, need to set targets for emission reduction to arrive at a net zero situation as reported in Recommendation ITU-T L.1470. For a situation in which network traffic will increase, this Recommendation defines a key performance indicator (KPI) useful to evaluate network emission and give an indication on how a network can reduce its emission due to energy usage. Recommendation ITU-T L.1333 defines a KPI called network carbon intensity energy (NCIe); it also defines how to apply the Recommendation: which part of the network is covered and how to calculate the metric continuously in network evolution. This Recommendation also defines the correlation between the carbon intensity indicator and energy efficiency metric.	This Recommendation defines a KPI for the carbon emission intensity of a network focused on network energy consumption in relation to data traffic. It includes the KPI definition and describes the KPI calculation and methods of measurement of the quantities necessary to calculate the KPI. The network carbon intensity energy KPI is applicable to a complete network greenness assessment. It does not only encourage the reduction of network electricity consumption, but also the use of low-carbon energy supply and the improvement of energy utilization efficiency. This Recommendation considers only the network operation phase, i.e., network energy consumption. The Recommendation is applicable to the public telecom network (PTN), non-public network (NPN) and enterprise network.	This first edition of this Recommendation refers to data traffic intensities; however, future editions may include other metrics to describe services, such as the number of user connections	Company
ITU-T L.1340	02/2014	Informative values on the energy efficiency of telecommunication equipment	ITU	Recommendation ITU-T L.1340 provides informative values on the energy efficiency of different types of telecommunication network equipment and small networking equipment in use in both the fixed and mobile networks. These values are related to energy efficiency metrics, test procedures, methodologies and measurement profiles that have been defined in Recommendation ITU-T L.1310. These informative values are intended to be a valued reference resource for those in the process of choosing the most energy-efficient technologies for network upgrade and deployment and, in so doing, reducing the carbon footprint of the Information and Communication Technology (ICT) sector.	This Recommendation defines a set of informative values for telecommunication network equipment and small networking equipment used in the home and small enterprise locations. The goal is to provide useful information to support a fast deployment of energy-efficient broadband and ultra-broadband networks. Such informative values refer to the metrics, test procedures, methodologies and measurement profiles that have been defined in [ITU-T L.1310].		Equipment

ITU-T L.1350	10/2016	Energy efficiency metrics of a base station site	ITU	Recommendation ITU-T L.1350 contains basic definitions of energy efficiency metrics, to evaluate the energy efficiency of a base station site including the energy consumption for: • the telecom equipment inside the base station site e.g., backhaul and base station equipment; • the entire infrastructure, including cooling systems, monitoring systems (for power consumption, equipment running status, environment parameters, etc.), fire protection and lighting systems for all the sites; • energy losses due to AC/DC rectifiers, generator and cable losses. The following energy factors will be considered for the evaluation: • electric energy from a public grid; • electric energy generated by generators such as diesel generators for emergency or normal operation purposes; • renewable energy. Measurement methodologies for the parameters considered in the metrics proposed are contained in other ITU-T Recommendations of the same series.	This Recommendation specifies principles and concepts of energy efficiency metrics used to evaluate the energy efficiency of a base station site considering the energy consumption for: • the telecom equipment inside the base station site e.g., backhaul and base station equipment; • the entire infrastructure, including cooling systems, monitoring systems (for power consumption, equipment running status, environment parameters, etc.), fire protection and lighting systems for all the sites; • energy losses due to AC/DC rectifiers, generators and cable losses. This Recommendation shall not be used to evaluate the energy efficiency of equipment that are covered by other Recommendations such as [ITU-T L.1310] and [ITU-T L.1320].		radio site
ITU-T L.1351	08/2018	Energy efficiency measurement methodology for base station sites	ITU	Recommendation ITU-T L.1351 describes and establishes requirements for energy efficiency measurements applicable to base station sites. This Recommendation describes: – Measurement points definitions – Conditions of measurement – Instrumentation requirement – Reporting requirement – Use of a monitoring system. This Recommendation can be used as a conformity assessment standard for Recommendation ITU T L.1350.	This Recommendation is applicable to base station site energy efficiency parameter measurement in line with the metric established by [ITU-T L.1350]. This Recommendation describes how to realize measurement of parameters establishing requirements on: – measurement points, – measurement conditions, and – instrumentation. This Recommendation also considers continuous monitoring of the site energy efficiency parameters. It does not specify metrics, but refers to the metric defined in [ITU-T L.1350]. The concepts of energy efficiency are covered by [ITU-T L.1315].		radio site
ITU-T L.1360	12/2016	Energy control for the software-defined networking architecture	ITU	Energy efficiency has become one of the most important aspects for both current and future telecommunications infrastructures. Taking energy into account induces a new constraint when managing a network. To tackle the integration of the energy constraint into the networks, the European Telecommunications Standards Institute (ETSI) has recently standardized the green abstraction layer (ETSI ES 203 237) which is an interface between the resource and the control planes of a network that enables control plane processes to manage the power management capabilities of fixed network nodes to effectively adapt the energy consumption of the network nodes with respect to the load variations. Recommendation ITU-T L.1360 defines the integration of the green abstraction layer into a software defined networking (SDN) architecture (see Recommendation ITU-T Y.3302) in which the connections between a set of network resources are on demand and are managed by one or more	This Recommendation defines the integration of green abstraction layer [ETSI ES 203 237] into a software-defined networking (SDN) architecture [ITU-T Y.3302]. Four basic SDN elements are defined within the SDN architecture [ITU-T Y.3302]: the SDN application layer, the SDN control layer, the northbound interface between the SDN application layer and the SDN control layer and the southbound interface between the SDN control layer and the SDN resource layer. The green abstraction layer adds a further dimension which requires integration and is the subject of this Recommendation. Since the green abstraction layer allows applications to access to the power management capabilities of network nodes in the resource layer to effectively adapt the energy consumption of the network nodes with respect to the load variations, it can be said that all the SDN elements are impacted. In this respect, this Recommendation focuses on: – The definition of an energy-efficient SDN general architecture; – The definition of an energy states model. Appendix I provides an example of an energy-efficient SDN based on the Open Networking		Company

ITU-T L.1361	11/2018	Measurement method for energy efficiency of network functions virtualization	ITU	Recommendation ITU-T L.1361 is intended to define common energy efficiency measurement methods for network functions virtualization (NFV) environments, it does not try to cover all of the different types of VNFs (e.g., firewall, gateway, etc.), but it provides the basis to make an extensible definition.	This Recommendation defines the metrics and measurement methods for the evaluation of the energy efficiency of functional components of a network functions virtualization (NFV) environment. Figure 1 shows the NFV function components in the scope of this Recommendation. The NFV functional components include virtual network functions (VNFs) and NFV infrastructure (NFVI) defined in the NFV architecture framework as described in [b-ETSI GS NFV 002]. Management and orchestration (MANO) is not included in the system under test, but will be eventually used as a test environment. The measurement method described in the present Recommendation is intend to be used to assess and compare the energy efficiency of single functional components independently in both laboratory testing and pre-deployment testing. Energy efficiency of co-located VNFs sharing same platform resources cannot be compared by using the method defined in the present Recommendation. The scope of this Recommendation is not to define the measurement method in an operational NFV environment. The present Recommendation is intended to define common energy efficiency		Company
ITU-T L.1362	08/2019	Interface for power management in network function virtualization environments – Green abstraction Layer version 2	ITU	Recommendation ITU-T L.1362 specifies a data model for energy discrete states within virtualized networks, and operations to interact on this model. In virtualized networks, establishing a mapping between the energy discrete states of logical entities (e.g., virtualized network functions) and the energy consumption of the hardware hosting the virtual machines that execute these logical entities is a challenging task. Recommendation ITU-T L.1362 adapts the green abstraction layer specification (GALv1) to virtualized networks.	This Recommendation specifies a data model for energy discrete states within virtualized networks, and operations to interact on this model.		Network
ITU-T L.1370	11/2018	Sustainable and intelligent building services	ITU	The concept of sustainable intelligent building (SIB) is closely related to efficiency and environmentally-aware practices. The concept is therefore the key enabler of the sustainability of the building itself, and of the city as a whole. Recommendation ITU-T L.1370 sets the minimal requirements for the efficient and sustainable management of the building as a unit. The sustainability of human activities in urban areas cannot be addressed without taking into consideration the building, which is the most basic unit that cities are composed of. This Recommendation also defines the services enabled by the SIB concept, the way it contributes to the aforementioned goals of sustainability, its features, its different possible functioning modes, or its internal architecture and requirements with the Internet of things (IoT) node at its core. Interoperability deserves a special mention among these requirements and specifications, as most of the added-value that the SIB provides comes into action when it interacts with	This Recommendation sets out the services and data required for a sustainable and intelligent building to improve the quality of life of citizens, as well as the specification of its functional features and the technical requirements to be met by the device that provides these services and data.		Services

ITU-T L.1371	06/2020	A methodology for assessing and scoring the sustainability performance of office buildings	ITU	Recommendation ITU-T L.1371 provides a consistent framework for building owners, managers and operators to critically assess, score and improve the sustainability performance of office buildings in 10 key areas: energy; water; air; comfort; health and wellness; purchasing; custodial; waste; site; and stakeholders. The framework described in Recommendation ITU-T L.1371 provides a set of concrete and measurable steps to reduce environmental impacts, and specifically greenhouse gas emissions, of existing office buildings, thus contributing to the achievement of Sustainable Development Goal 11 "Sustainable cities and communities –s Make cities inclusive, safe, resilient and sustainable". The annex to Recommendation ITU-T L.1371 specifies an assessment scoring methodology to allow owners and managers to undertake a self-assessment to evaluate their building's current status and track progress going	This Recommendation specifies a methodology for assessing and scoring, and subsequently improving, the sustainability performance of existing office buildings. The methodology described in this Recommendation provides building owners, managers and operators with a consistent framework to critically assess the sustainability performance and management of office buildings in 10 key areas: energy; water; air; comfort; health and wellness; purchasing; custodial; waste; site; and stakeholders. It should be noted that the methodology proposed in this Recommendation applies only to existing office buildings and not to the construction of new buildings. NOTE – This Recommendation is based on the BOMA BEST Sustainable Buildings assessment programme [b-BOMA].		Company
ITU-T L.1380	11/2019	Smart energy solution for telecom sites	ITU	Recommendation ITU-T L.1380 focuses on smart energy solutions for telecom sites, mainly on the performance, safety, energy efficiency and environmental impact, when the system is fed by various types of energy such as photovoltaic (PV) energy, wind energy, fuel cells and the grid. The Recommendation also considers smart energy control. For example, if the grid is off, how can the energy flows be managed to achieve higher energy efficiency, how to get green energy, etc.	The level with which photovoltaic (PV) systems are powered by solar energy depend on the level of sunshine. When specific special areas lose power grid supply, remote power supplies or diesel generators can be used as stand-by power supplies. This type of system can save operating costs, thereby reducing the gasoline or grid energy consumption and ensure the availability of power supply. Peak load shifting is a solution that is based on the smart energy concept. When the energy consumption is higher, the storage battery is used in priority to provide electric power. When the charge is lower, the mains are used in priority to supply power to the load and to charge the storage battery. In this way, the cost of electric power of the base station can be reduced. When a smart cooling energy system is used, the air-conditioning system used by the base station can naturally adjust the temperature and relative humidity of the base station according to the different indoor and outdoor environmental conditions. It is much more energy efficient to replace air-conditioning refrigeration under most conditions all year round and avoid the power waste caused by		telecom site

ITU-T L.1381	06/2020	Smart energy solutions for data centres	ITU	Recommendation ITU-T L.1381 considers a smart control strategy for the entire energy system, including power-feeding and cooling solutions, of data centres to achieve higher energy efficiency and to decrease overall energy consumption. Firstly, for a multiple energy input system, including photovoltaic (PV) solar panels, wind, fuel cells, the electrical grid, power generators and batteries, can be connected to a system. Recommendation ITU-T L.1381 considers how to control these different energy inputs in a smart way to increase energy efficiency and to decrease carbon emissions. In addition, for smart cooling systems, Recommendation ITU-T L.1381 considers how to use outside cool air and maximize utilization of information and communication technology (ICT) side cooling, e.g., ICT rack cooling, row cooling methods and liquid cooling. Recommendation ITU-T L.1381 focuses on smart energy solutions for data centres to achieve green and	This Recommendation establishes requirements for data centre smart energy solutions, including those for smart power feeding, cooling and safety. This Recommendation considers energy efficiency and environmental impacts for all solutions, including combined cooling heat and power (CCHP) systems, direct grid supply, green energy system, liquid cooling, evaporative cooling and smart control of environmental parameters.		Data center
ITU-T L.1382	06/2020	Smart energy solution for telecommunication rooms	ITU	Recommendation ITU-T L.1382 specifies requirements for the power supply mode of the three-layer architecture of telecommunication rooms. Recommendation ITU-T L.1382 aims to drive future-oriented network deployment for the information and communication technology (ICT) industry, as well as maximizing energy efficiency, the use of renewable resources and social resources in the digital era, and reducing energy and resource consumption. while ensuring network performance and user experience. Innovative ICTs are used to promote network energy saving, emission reduction and circular economy development, as well as continuously driving all parties in the industry chain to jointly build green networks and low-carbon societies. In addition, Recommendation ITU-T L.1382 provides suggestions and requirements on the deployment of three types of telecommunication rooms, which can be used as a reference for operators to build the target network evolution strategies for	This Recommendation specifies a smart energy solution for telecommunication rooms. It provides design requirements for the power supply and backup systems for telecommunication rooms of the integrated access, aggregation and core types, based on the trend of fifth generation (5G), edge computing sinking and content delivery network (CDN) sinking.		telecom site

ITU-T L.1383	10/2021	Smart energy solutions for city and home applications	ITU	Recommendation ITU-T L.1383 focuses on smart energy solutions in different application scenarios facilitating energy saving and carbon emission reduction. Besides their application in the field of ICT, such as in base stations, data centres and telecom centres, smart energy solutions have been applied in cities and homes as an advanced update to ICTs. Cities play a different role in different parts of the world. With the development of smart energy technologies, it is becoming possible to answer key issues in cities worldwide, prompted by the urgent necessity of GHG emissions reduction. This Recommendation includes specific smart energy applications in cities and homes, such as energy sources and energy management functions.	This Recommendation provides smart energy solutions that boost energy efficiency and reduce carbon emissions in different cities and home applications, namely: – City applications, including those in the business district, community, industrial park, transportation network and municipal area. – Home applications including household appliances, electric vehicle charging, power dual-way trading and habit training of energy use.		City
ITU-T L.1390	08/2022	Energy saving technologies and best practices for 5G radio access network (RAN) equipment	ITU	The rapid development and commercialization of 5G radio communication technology is further accelerating 5G network construction. While it is an important enabler for the digitalization of other industries and thereby contributes to significant energy savings and emission reductions, it is also important to consider the energy consumption of the 5G network infrastructure itself. Recommendation ITU-T L.1390 identifies energy saving potentials, describes energy saving principles and technologies for 5G RAN and related equipment, and provides best practice recommendations on when and how these technologies should be used and controlled, thereby reducing 5G RAN energy consumption, saving operational costs and making 5G RAN a green and high-efficiency network.	This Recommendation identifies energy saving potentials, describes energy saving principles and technologies for 5G RAN and related equipment, and provides best practice recommendations on when and how these technologies should be used and controlled to reduce 5G RAN energy consumption.		Equipment/ network

ITU-T L.1410	12/2014	Methodology for environmental life cycle assessments of information and communication technology goods, networks and services	ITU	This Recommendation provides a methodology for evaluating the environmental impact of ICTs objectively and transparently and is based upon the life cycle assessment (LCA) methodology standardized in ISO 14040 and ISO 14044. It describes environmental assessments through a life cycle assessment (LCA) which is a systematic analytical method and model by which the potential environmental effects related to ICT goods, networks and services can be estimated. This Recommendation also gives guidance on the assessment of software. LCAs have a cradle-to-grave scope where the life cycle stages, i.e., raw material acquisition, production, use, and end-of-life are included. Moreover, transport and energy supplies are included at each life cycle stage. The standard is divided into two parts: • Part I: ICT life cycle assessment - framework and guidance. This part deals with the LCA methodology applied to ICT goods, networks and services.	Objective: Describes details about processes and actions to be included in life cycle assessment to get environmental impact of a ICT product, network, or service. Comparative part describes how to set system boundaries for proper comparative assessment. Comparative assessment is useful, e.g. in assessing improvement gained by a specific change.		Equipment/network/services
ITU-T L.1420	02/2012	Methodology for energy consumption and greenhouse gas emissions impact assessment of information and communication technologies in organizations	ITU	Recommendation ITU-T L.1420 presents the methodology to be followed if an organization intends to claim compliance with this Recommendation when assessing its information and communication technology (ICT) related energy consumption and/or greenhouse gas (GHG) emissions. This Recommendation can be used to assess energy consumption and GHG emissions generated over a defined period of time for the following purposes: for assessment of related impact from ICT organizations or for assessment of impact from ICT related activities within non-ICT organizations.	The increasing proliferation of information and communications technology (ICT) has led to concerns regarding its environmental impact. Taking into consideration the ongoing efforts within the United Nations Framework Convention on Climate Change (UNFCCC) to combat climate change, ITU-T decided to develop an internationally agreed upon methodology to help the ICT Sector to make an inventory of the environmental impact, including greenhouse gas emissions and energy consumption, of ICTs in organizations. This Recommendation can be used to assess the energy consumption and GHG emissions of ICT related to organizations for two different purposes. • Firstly, it can be used to assess the life cycle GHG emissions (first and second order effects) emerging from the use of ICT in non-ICT organizations, based on the Recommendation ITU-T L.1410. • Secondly, it can be used as a supplement to [ISO 14064-1] and to [b-GHG Protocol] for ICT organizations intending to assess their own organizational energy consumption and GHG related impact. This Recommendation is intended to allow organizations to assess their direct GHG		Company

ITU-T L.1430	12/2013	Methodology for assessment of the environmental impact of information and communication technology greenhouse gas and energy projects	ITU	Recommendation ITU-T L.1430 is intended as a complement to ISO standard ISO 14064-2 and the Project Protocol of the Greenhouse Gas Protocol (GHG Protocol). This Recommendation provides guidance for the application of a specific methodology to assess the environmental impact of information and communication technology (ICT) greenhouse gas (GHG) and energy projects. This assessment methodology is specifically directed at quantifying and reporting GHG emission reductions, GHG removal enhancements, energy consumption reductions, and enhancement of energy generation and storage in ICT GHG and energy projects. An ICT GHG project uses mainly ICT goods, networks and services (GNS) and is designed to reduce GHG emissions or increase GHG removals that are quantified by comparison between the environmental impact of a project activity and a corresponding baseline scenario. An ICT energy project uses mainly	This Recommendation describes principles, concepts, requirements and methods to provide specific guidance for assessment of the environmental impact of information and communication technology (ICT) greenhouse gas (GHG) projects and ICT energy projects. The methodology has been developed from the ICT perspective and is intended to assist in quantifying, monitoring and reporting GHG emission reductions or removal enhancements, energy consumption reductions, and enhancements of energy generation and storage in ICT GHG and ICT energy projects. This Recommendation is a complement to [ISO 14064-2] and [b-Project Protocol] and provides additional requirements and guidance to complement [ITU-T L.1410] in: • identifying GHG sources, sinks and storage systems relevant to ICT GHG projects • identifying energy consumers, generators and storage systems relevant to ICT energy projects • determining the baseline scenario • identifying GHG sources, sinks and storage systems relevant to the baseline scenario • identifying energy consumers, generators and storage systems relevant to the baseline		Company
ITU-T L.1440	10/2015	Methodology for environmental impact assessment of information and communication technologies at city level	ITU	Recommendation ITU-T L.1440 gives general guidance on city-level environmental assessments related to information and communication technologies (ICT) and provides a description of the methodologies to be used for the assessment of the environmental impact of ICT in cities. In this first edition of this Recommendation, the assessment is limited to energy consumption and greenhouse gas (GHG) emissions. This Recommendation is divided into two parts. 1) Part I relates to the first order effects from the use of ICT goods and networks in a city's organizations and households. 2) Part II relates to the first and second order effects from ICT projects and services applied in the city. This Recommendation provides specific guidance on setting city boundaries, preparing and performing the assessment of ICT-related GHG emissions and energy consumption at city level.	Based on other ITU-T L.14xx-series of Recommendations, this Recommendation aims at providing guidance for the assessment of ICT-related greenhouse gas (GHG) emissions and energy consumption at city level. This Recommendation provides a framework for the quantitative assessment at city level of first and second order effects of ICT. It also gives some guidance on how to qualitatively assess other effects. More specifically, this Recommendation can be used to assess the first order effects of the use of ICT in organizations and households, as well as its first and second order effects when applied to different industrial sectors such as transport, buildings, utilities and waste management. For the second order effects, it is not expected that the overall second order effects of all ICT at city level is assessed. Rather, this Recommendation provides guidance on how to assess the second order impact of one or more ICT projects or ICT services at the scale of the city. This Recommendation, in line with [ITU-T L.1400], is focused on energy consumption and GHG emissions. This Recommendation is intended for city		City

ITU-T L.1450	09/2018	Methodologies for the assessment of the environmental impact of the information and communication technology sector	ITU	Recommendation ITU-T L.1450, which forms part of the ITU-T L.1400 series, consists of two parts: 1) Part I: The methodology for calculating the information and communication technology (ICT) sector footprint with respect to life cycle greenhouse gas (GHG) emissions; 2) Part II: The methodology for defining GHG emissions budget for the ICT sector considering a 2 C or lower trajectory. Appendix IV gives an example of a partial ICT sector footprint derived in line with Part I of the Recommendation.	This Recommendation specifies methodologies for assessing the environmental impact of information and communication technology (ICT) at a sector level including its future development. It consists of two parts: 1) Part I: The methodology for calculating the footprint of the ICT sector with respect to life cycle greenhouse gas (GHG) emissions; 2) Part II: The methodology for defining a GHG emissions budget for the ICT sector considering a 2ºC or lower trajectory. It also applies the methodology of Part I and gives an example of a partial ICT sector footprint derived in line with this Recommendation (Appendix IV). A GHG emissions budget for the ICT sector could either take an organizational approach or be derived from the perspectives of the goods, networks and services of a sector. Each approach has its own challenges, although the latter has been more commonly adopted in the past. For this reason, in this edition of the Recommendation, the methodology focus is on the second approach – a footprint and budget related to ICT goods, networks and services. However, some observations and ideas for an organizational		Country
ITU-T L.1451	11/2019	Methodology for assessing the aggregated positive sector-level impacts of ICT in other sectors	ITU	To date no international comprehensive methodology exists to assess the environmental impact of information and communication technology (ICT) at sector level, or to assess the aggregated positive effects of the ICT sector on other sectors of the economy. Without a standard methodology evaluating the positive impacts of ICT, the role of ICTs in the fight against global warming will be only partially perceived. Recommendation ITU-T L.1451 addresses the need to contribute to achieve the targets and goals of the 2030 Agenda for Sustainable Development, especially its Sustainable Development Goal 13 (SDG13), the Connect 2030 Agenda and the Paris Agreement from a global perspective. This Recommendation addresses the opportunity to use a computable general equilibrium (CGE) model as a possible methodology for simultaneously assessing the environmental and economic impacts	This Recommendation uses a computable general equilibrium (CGE) model as a possible methodology for simultaneously assessing the environmental and economic impacts of information and communication technologies (ICTs) at the sectoral level. The CGE model adopts a top-down economic approach using economic input-output tables. Compared to a bottom up assessment method, it provides a model of the overall environmental impacts at the sectoral level without collecting complex sets of data. Since it uses a macroeconomic approach, the proposed method makes an attempt to capture the economy-wide rebound effects in addition to the primary and secondary effects of ICTs. As a principle, the CGE model calculates the pricing effects of using ICT services and derives the positive effects of this ICT usage. However, the introduction of ICT services leads to effects which are not directly measurable in terms of costs considering the externalities of environmental effects in the price mechanism. These effects (not measurable in terms of costs) are not evaluated in this version of the Recommendation.		Company
ITU-T L.1460	08/2018	Connect 2020 greenhouse gases emissions - Guidelines	ITU	Recommendation ITU-T L.1460 provides guidelines to address the Connect 2020 greenhouse gas (GHG) emissions target. It is intended to be utilized by relevant stakeholders to address the Connect 2020 ambitions, while considering the sustainable development goal (SDG) 13 and the objectives of the Paris Agreement. It also presents examples of actions taken in order to limit the GHG emissions in the information and communication technology (ICT) sector.	This Recommendation provides guidelines to address the Connect 2020 greenhouse gas (GHG) emissions target. This Recommendation is intended to be utilized by relevant stakeholders to address the Connect 2020 ambitions, while considering the SDG 13 goal and the objectives of the Paris Agreement.		Country; Company

ITU-T L.1470	01/2020	Greenhouse gas emissions trajectories for the information and communication technology sector compatible with the UNFCCC Paris Agreement	ITU	Recommendation ITU-T L.1470 provides detailed trajectories of greenhouse gas (GHG) emissions for the global information and communication technology (ICT) sector and sub-sectors that are quantified for the year 2015 and estimated for 2020, 2025 and 2030. In addition, Recommendation ITU-T L.1470 establishes a long-term ambition for 2050. The trajectories, the long-term ambition and the 2015 baseline have been derived in accordance with Recommendation ITU-T L.1450 and through complementary methods in support of the 1.5°C objective described by the IPCC in its Special report: Global warming of 1.5°C and in support of the Science-based Targets (SBT) initiative.	This Recommendation provides detailed trajectories of greenhouse gas (GHG) emissions for the global information and communication technology (ICT) sector and sub-sectors that are quantified for the year 2015 and estimated for 2020, 2025 and 2030. In addition, it defines a long-term ambition for 2050. The trajectories, the long-term ambition and the 2015 baseline have been derived in accordance with [ITU-T L.1450] and through complementary methods in support of the 1.5°C objective described by the IPCC in its Special report: Global warming of 1.5°C [b IPCC 1.5] and in support of the Science Based Targets (SBT) initiative. This edition of this Recommendation includes mobile networks, fixed networks, data centres, enterprise networks and end-user devices, but excludes ICT services. The 1.5°C trajectories are developed from two different perspectives as follows. – A life cycle-based carbon footprint of the ICT sector to help ITU as the United Nations (UN) agency concerned with ICT to establish a clear view regarding ICT´s potential climate impacts in a 1.5°C scenario. – An ICT sector trajectory in support of the SBT initiative to help ICT companies to set		Country; Company
ITU-T L.1471	08/2023	Guidance and criteria for information and communication technology organizations on setting Net Zero targets and strategies	ITU	Currently, the definitions of Net Zero and related concepts such as carbon neutrality and climate neutrality for organizations remain under development. Several initiatives, including, inter alia, the Science Based Target Initiative, the United Nations Framework Convention on Climate Change (UNFCCC) Race to Zero, the UN High-level Expert Group on Credibility and Accountability of Net Zero Emissions Commitments of Non-State Entities (HLEG), ISO IWA42, ISO TC 207, and the Net Zero Initiative are working on defining or aligning the different views of these concepts to avoid confusion and reduce risks for green washing. Recommendation ITU-T L.1471 seeks to guide information and communication technology (ICT) organizations in clarifying the meaning of Net Zero in the context of the ICT sector and setting Net Zero targets and strategies. It also identifies actions that would lead the sector towards Net Zero according to the trajectories described in Recommendation ITU-T L.1470.	This Recommendation provides guidance and criteria to information and communication technology (ICT) organizations on setting Net Zero targets and strategies based on approaches put forward by major Net Zero initiatives. It also describes actions that should be undertaken in moving the sector towards Net Zero. In particular, this Recommendation provides guidance to achieve the decarbonisation of the sector in line with the trajectory outlined in [ITU-T L.1470] that is a prerequisite for the subsequent steps towards Net Zero.		Company

ITU-T L.1480	12/2022	Enabling the Net Zero transition: Assessing how the use of information and communication technology solutions impact greenhouse gas emissions of other sectors	ITU	Recommendation ITU-T L.1480 provides a methodology for assessing how the use of information and communication technology (ICT) solutions impacts greenhouse gas (GHG) emissions of other sectors. More specifically, the methodology provides guidance on the assessment of the use of ICT solutions covering the net second order effect (i.e., the resulting second order effect after accounting for emissions due to the first order effects of the ICT solution), and the higher order effects such as rebound. By providing a structured methodological approach, it aims to improve the consistency, transparency and comprehensiveness of assessments of how the use of ICT solutions impacts GHG emissions over time. Guidance is provided to assess the net second order effect and higher order effects of the following cases: – ICT solution(s) implemented in a specific context by the user of the ICT solution(s). – ICT solution(s) implemented at	This Recommendation provides guidance for assessing how the use of ICT solutions impacts GHG emissions of other sectors, using a robust and sound methodology. The guidance is agnostic to the outcome of the assessment, whether it be an addition or an avoidance of GHG emissions, and addresses both positive and negative effects. Specifically, the methodology provides guidance on the assessment of the use of ICT solutions covering the net second order effect (i.e., the resulting second order effect after accounting for emissions due to the first order effects of the ICT solution), and the higher order effects. Moreover, the methodology also distinguishes between effects associated with actual reductions of GHG emissions and lesser increases in GHG emissions, as well as between immediate and mid-term/long-term effects. Comments: Effects associated with increases of GHG sinks are not included in the present version of this Recommendation.		Company
ITU-T L.1481	12/2022	Guidance on how to address the Connect 2030 targets on net greenhouse gas abatement	ITU	Recommendation ITU-T L.1481 provides guidelines on how to address the Connect 2030 target on net telecommunication/ICT-enabled greenhouse gas (GHG) abatement. It is intended to be utilized by relevant stakeholders of the Connect 2030 ambitions, while considering the sustainable development goal (SDG) 13 and the objectives of the Paris Agreement and the Glasgow Climate Pact. It also presents examples of information and communication technology (ICT) solutions associated with a potential reduction of GHG emissions in other sectors.	This Recommendation provides guidelines on how to address the Connect 2030 sustainability target 3.4, which states: "By 2023, net telecommunication/ICT-enabled greenhouse gas abatement should have increased by 30% compared to the 2015 baseline". Such effects are referred to as second order effects in [ITU-T L.1410] and [ITU-T L.1480]. This Recommendation aims to complement [ITU-T L.1410] and [ITU-T L.1480] by providing guidance on how to address target 3.4, which deals with aggregated second order effects. Hence, this Recommendation aims to propose a way forward towards a deeper understanding of how to increase and quantify ICT's second order effects. This Recommendation is intended to be utilized by relevant stakeholders to address the Connect 2030 ambitions, while considering the SDG 13 goal and the objectives of the Paris Agreement.		Country; Company

ITU-T L.1500	06/2014	Framework for information and communication technologies and adaptation to the effects of climate change	ITU	Recommendation ITU-T L.1500 describes a framework for information and communication technologies (ICTs) and adaptation to the effects of climate change. This framework identifies and defines the basis for development of the following Recommendations: • Recommendation ITU-T L.1501 on how countries can utilize ICTs to adapt to the effects of climate change. It will also provide a framework and a checklist for countries to integrate ICTs into their national strategies for adaptation to climate change. Examples of checklists, use cases, best practices, guidelines, consideration points, etc. will be added when appropriate. • A future Recommendation on how to adapt the ICT infrastructure to the effects of climate change. It will provide a set of guidelines, requirements and best practices to be referred to during operation, maintenance, upgrade and improvement of existing ICT infrastructure and when planning, designing and constructing ICT	This Recommendation describes the framework for using ICTs in adaptation to the effects of climate change. This Recommendation will define the scope of the subsequent three Recommendations to be published within this framework. This Recommendation does not provide strategies or best practices for climate change adaptation as these will be provided in the Recommendations developed within this framework.		Country
ITU-T L.1501	12/2014	Best practices on how countries can utilize ICTs to adapt to the effects of climate change	ITU	Recommendation ITU-T L.1501 provides guidance on how information and communication technologies (ICTs) can help countries to adapt to the effect of climate change. It also provides a framework and a checklist for countries to integrate ICTs in their national climate change adaptation strategies. The recommendation is part of the ITU T L.1500 series Recommendations on adaptation to the effects of climate change. It is designed to assist countries in integrating ICTs into their national climate change adaptation strategies. The Recommendation describes the complexity of climate change and explains why countries need to adapt. It also describes the role of ICTs in helping countries respond to the effects of climate change by looking at how various sectors use ICTs; including the ICT sector. It is designed to be a guide for regulators and policymakers to minimize the impact of climate change and provides a 'multi-level framework for ICTs integration in climate change adaption' to assist	This Recommendation considers how countries can utilize ICTs to adapt to the effects of climate change. It provides a framework for countries on how to integrate ICTs into their national strategies for adaptation to climate change. A checklist is provided as an instrument for policymakers to ensure that they have the necessary pre requisites to adapt the suggested framework in their national legislations, and enabling them to assess the adoption and implementation of the framework.		Country

ITU-T L.1502	11/2015	Adapting information and communication technology infrastructure to the effects of climate change	ITU	Information and communication technologies (ICTs) can be part of the solution to climate change by, for example, helping countries adapt to the effects of climate change. At the same time, ICT equipment and infrastructure are themselves exposed to the effects of climate change and therefore need to be both robust and resilient. Recommendation ITU-T L.1502 identifies direct and indirect threats of climate change on ICT services and provides options for adaptation and mitigation. These threats include extreme rainfall, flooding, landslides, extreme wind, lightning, extreme humidity, drought, ice storms and heavy snowfall. This Recommendation was developed within the framework of Recommendation ITU-T L.1500. It focuses on telecommunication networks and infrastructure.	This Recommendation describes how information and communication technology (ICT) can adapt to or may be adapted to cope with the effects of climate change. It provides a set of requirements and it is to be referred to when planning or upgrading ICT infrastructure to adapt to the effects of climate change. The term "ICT infrastructure" includes the telecommunication network and its elements such as terrestrial cables, submarine cables, wireless antennas, satellite networks, towers, telecom offices, data centres and customer premises equipment.		Country
ITU-T L.1503	06/2016	Use of information and communication technology for climate change adaptation in cities	ITU	This Recommendation is aimed at a broad audience of stakeholders interested in information and communication technologies (ICTs), climate change adaptation, and smart sustainable cities (SSCs), including city decision-makers and planners. Urban stakeholders, including mayors and city planners, are invited to consider novel approaches to sustainability by integrating the use of ICTs in their climate change adaptation strategies and policies. The following are the key steps: • assess climate change risks and vulnerabilities: • develop an action plan; • identify the role of ICTs and infrastructure in the adaptation plan; • implement adaptation actions; • monitor and evaluate adaptation actions using ICT. Climate change may negatively impact urban ICT infrastructure and the provision of key public services (e.g., health, water supply and sanitation, energy provision, waste management, mobility, urban planning and food	This Recommendation identifies the impacts of climate change in cities and explains why cities need to adapt to its harmful effects. The roles ICTs can play in helping cities to adapt to climate change are presented. An ICT-based framework for climate change adaptation is included to assist policy makers in developing effective adaptation strategies and building resilient cities. Key stakeholders involved in urban climate change adaptation strategies are identified. A checklist is included to assess the integration of ICTs into an urban climate change adaptation plan, and to identify aspects that could be strengthened in local adaptation planning and response.		City
ITU-T L.1504	12/2016	ICT and adaptation of agriculture to the effects of climate change	ITU	Recommendation ITU-T L.1504 provides a description of how the use of information and communication technology (ICT) can help sustain the agricultural sector in the event of poor yields or disasters triggered by climate change. The possible impacts of climate change on agriculture and farming communities are described. This is followed by an outline of what measures are needed to adapt the sector and how ICT can play a role in this. The Appendices share some examples of best practices in different countries with details of specific ICT implementations.	This Recommendation includes a review of the effects of climate change on agriculture and agricultural communities. It recognizes the need for adaptation and the use and dissemination of relevant innovative techniques. It explores adaptation plans and the potential of ICT in supporting the adaptation of the agricultural sector to cope with the effects of climate change with reference to [ITU T L.1500]: Framework for information and communication technologies and adaptation to the effects of climate change, and [ITU-T L.1501]: Best practices on how countries can utilize ICTs to adapt to the effects of climate change. Examples are given from different countries of best practices on the use of ICT systems and tools to adapt the agricultural sector.		Country

ITU-T L.1505	01/2018	Information and communication technology and adaptation of the fisheries sector to the effects of climate change	ITU	Climate change will affect both fish stocks and their habitats. Rising or falling temperatures will influence the abundance, migratory patterns and mortality rates of wild fish stocks and determine what species can be farmed in specific regions. Climate change can lead to changes in the volume of water in rivers and lakes. The composition of water bodies can affect the species and quantities of fish stocks. These climatic effects on fish stocks will have social and economic consequences for people dependent on fisheries and aquaculture ranging from fisheries workers to coastal communities as well as to the consumers of fish. Recommendation ITU-T L.1505 includes a review of the effects of climate change on fisheries and fishing communities. It recognizes the need for adaptation and for the use and dissemination of relevant innovative techniques. It explores adaptation plans and the potential role of information and communication technologies (ICTs) in supporting the adaptation of the fisheries sector to	This Recommendation includes a review of the effects of climate change on fisheries and fisheries communities. It recognizes the need for adaptation and for the use and dissemination of relevant innovative techniques. It explores adaptation plans and the potential of ICTs in supporting the adaptation of the fisheries sector to cope with the effects of climate change with reference to [ITU T L.1500] and [ITU-T L.1501]. Examples of best practices from different countries on the use of ICT systems and tools to adapt the fisheries sector are also provided in this Recommendation.		Country
ITU-T L.1506	01/2018	Framework of climate change risk assessment for telecommunication and electrical facilities	ITU	Recommendation ITU-T L.1506 describes the framework for assessing climate change risk to telecommunication and electrical facilities. The framework consists of a risk assessment methodology and considerations for applying the defined methodology. The methodology specified in this Recommendation provides a climate change risk assessment that integrates multiple climate change risk factors into a single metric and shows the assessment result from an overall perspective.	This Recommendation describes a framework for assessing climate change risks to telecommunication and electrical facilities. This Recommendation includes an overview of climate change-related risks, requirements for climate change risk assessment methodology, risk assessment methodology and considerations for using the defined methodology. Development of climate change risk factors or of a weighting scheme for an individual risk factor is outside the scope of this Recommendation, as is the development of interpretation criteria for assessment results. It should be noted that the methodology defined in this Recommendation is not intended for comparison among different organizations, but is mainly targeted at self-assessment purposes.		Country

ITU-T L.1507	07/2019	Use of ICT sites to support environmental sensing	ITU	Mitigating and adapting to climate change are global issues, and developing solutions to enable effective adaptation and early warning becomes important. One of the key aspects for developing the innovative solutions is the availability of highly stable environmental monitoring data. The meteorological organizations work on realizing the stable and fine grained collection of the global environmental conditions. To achieve this goal, it is necessary to deploy a large number of environmental sensing stations, which requires large amount of efforts. Information and communication technology (ICT) sites are good candidates to resolve such an issue due to their global distribution, reliable power, network communications, and maintenance as well as the availability of poles and towers to host various environmental sensors. Recommendation ITU-T L.1507 presents a set of rules for installing the environmental sensing system on ICT sites to utilize the ICT sites as environmental sensing stations.	This Recommendation focuses on collecting the environmental data utilizing ICT sites and infrastructure. It investigates the present challenges of the meteorological sector to improve the stable and fine grain sensing of environmental conditions. These challenges require an increased number of stable environmental sensing stations. This Recommendation presents a set of rules for installing the environmental sensing system on ICT sites in order to utilize the ICT sites as environmental sensing stations. This Recommendation covers the following: – General architecture of environmental sensing system; – Requirements for installing environmental sensing system on ICT sites; – Deployment use cases.		Country
ISO 50001		Energy Management	ISO				
ISO/IEC 22237	2021	Information Technology - Data Centre Facilities and Infrastructure	ISO, IEC	This document: - describes the general principles for data centres upon which the requirements of the ISO/IEC22237 series are based; - defines the common aspects of data centres including terminology, parameters and reference models (functional elements and their accommodation) addressing both the size and complexity of their intended purpose; - describes general aspects of the facilities and infrastructures required to support data centres; and more.	Amongst other things, the document specifies a classification system, based upon the key criteria of “availability”, “security” and “energy-efficiency” over the planned lifetime of the data centre, for the provision of effective facilities and infrastructure.		International; data centre
ISO/IEC 23544	2021	Information Technology - Data Centres - Application Platform Energy Effectivenesss (APEE)	ISO, IEC	This document specifies application platform energy effectiveness (APEE) as a Key Performance Indicator (KPI) which quantifies the energy effectiveness of an application platform for an IT service in data centres. This KPI evaluates the energy consumption of an application platform prior to deployment.	The purpose of this KPI is to measure the energy effectiveness of a set of target IT equipment, operating systems and middleware, to enable the selection of an energy effective IT stack.		International; data centre

ISO/IEC 25010	2023	Systems and software engineering - Systems and software quality requirements and evaluation (SQuaRE) - System and software quality models	ISO, IEC	ISO/IEC 25010:2011 defines: -A quality in use model composed of five characteristics (some of which are further subdivided into subcharacteristics) that relate to the outcome of interaction when a product is used in a particular context of use. This system model is applicable to the complete human-computer system, including both computer systems in use and software products in use. -A product quality model composed of eight characteristics (which are further subdivided into subcharacteristics) that relate to static properties of software and dynamic properties of the computer system. The model is applicable to both computer systems and software products.	The scope of application of the quality models includes supporting specification and evaluation of software and software-intensive computer systems from different perspectives by those associated with their acquisition, requirements, development, use, evaluation, support, maintenance, quality assurance and control, and audit.	International; systems and software
ISO/IEC 15067-3	2019	Information technology - Home electronic system (HES) application model - Part 3: Model of a demand-response energy management system for HES	ISO, IEC	The standard specifies a high-level architecture and a set of models for a demand-response energy management system with multiple interacting EMAs in a home or community housing (such as one or more apartment buildings or a campus of houses) Note: This document builds upon ISO/IEC 15067-3	This document specifies a high-level model of interacting energy management agents (EMAs). Interacting EMAs provide coordination among EMAs to offer improved energy management and overall efficiency. The intent of these models is to accommodate flexible and efficient energy management.	International; system (energy management system)
ISO/IEC 23001-11	2023	Information technology - MPEG systems technologies - Part 11: Energy-efficient media consumption (green metadata)	ISO, IEC	This document specifies metadata for energy-efficient decoding, encoding, presentation, and selection of media.	The metadata for energy-efficient encoding specifies quality metrics that are used by a decoder to reduce the quality loss from low-power encoding. The client in an adaptive streaming session uses this metadata to determine decoder and display power-saving characteristics of available video representations and to select the representation with the optimal quality for a given power-saving.	International; metadata
ISO/IEC 30134	2016	Information Technology - Data Centres - Key Performance Indicators (+ ammendment AMD 1:2018)	ISO, IEC	The standard defines common requirements for a holistic suite of KPIs for data centre resource efficiency.	Within the ISO/IEC 30134 series, the term “resource usage effectiveness” is more generally used for KPIs in preference to “resource usage efficiency”, which is restricted to situations where the input and output parameters used to define the KPI have the same units. The ISO/IEC 30134 series is intended to accelerate the provision of operational infrastructures with improved resource usage effectiveness. The common objective of the KPIs is the effective or efficient use of resources.	International; data centre
ISO/IEC 30134-4	2017	Information technology - Data centres - Key performance indicators - Part 4: IT Equipment Energy Efficiency for servers (ITEEsv)	ISO, IEC	The standard specifies Information Technology Equipment Energy Efficiency for servers (ITEEsv), a key performance indicator (KPI) which quantifies the energy efficiency characteristics of servers in a data centre.	The ISO/IEC 30134 series is intended to accelerate the provision of operational infrastructures with improved resource usage effectiveness.	International; data centre (servers)
ISO/IEC 30134-8	2022	Information technology - Data centres key performance indicators - Part 8: Carbon usage effectiveness (CUE)	ISO,IEC	The standard presents specific rules on the Carbon Usage Effectiveness (CUE) metric, along with its theoretical and mathematical development _ in the context for a data centre.	The ISO/IEC 30134 series is intended to accelerate the provision of operational infrastructures with improved resource usage effectiveness.	International; data centre

ISO/IEC 21836	2020	Information technology - Data centres - Server energy effectiveness metric	ISO,IEC	This document specifies a measurement method to assess and report the energy effectiveness of a computer server. This document does not set any pass/fail criteria for servers.	To specify a measurement method to assess and report the energy effectiveness of a computer server.		International; data centre
ISO/IEC 19395	2015	Information technology -- Sustainability for and by information technology -- Smart data centre resource monitoring and control	ISO,IEC	The standard provides Messages that facilitate integrated or "smart" monitoring and control of Resources (which may also be composed of other resources; for instance, a rack may contain servers, ventilators etc.). As an example, those servers may be viewed from their computing, energy consumption or dissipation aspects which ISO/IEC 19395:2015 models as Resource Components and groups into IT, power and fluid Domains, respectively.	Operation of data centres requires management of storage, computation, communication, electrical energy and temperature to achieve the required quality of service and efficiency parameters. Often, however, the separate management of Information Technology (IT), electrical energy (or power) and cooling Resource islands yields a sub-optimal result. This International Standard provides Messages that facilitate integrated or “smart” monitoring and control of Resources in those islands.		International; data centre
ISO/IEC 24771	2014	Information technology -- Telecommunications and information exchange between systems -- MAC/PHY standard for ad hoc wireless network to support QoS in an industrial work environment	ISO,IEC	The standard defines a protocol for the physical layer (PHY) and the data link layer in order to construct a reliable and high-speed data transmission network between devices on industrial sites such as factories and plants.	This network specification provides a standardized protocol to provide a framework for various industrial devices to establish a simple, low-cost, energy-efficient, and high-speed network between them.		International; network
ISO/IEC 29142-3	2013	Information technology -- Print cartridge characterization -- Part 3: Environment	ISO,IEC	The standard establishes environmental terms, definitions, attributes and test methods in accordance with the terms, symbols, notations and framework of ISO/IEC 29142-1 and ISO Guide 64.	The objective is to standardize treatment of environmental interactions and impacts throughout the cartridge life-cycle, and the standard promotes harmonization of environmental standards, environmental labels, and green procurement criteria pertaining to ink and toner cartridges, thereby reducing impact on the environment and informing and benefiting the cartridge customer.		International; equipment
IEC 62075	2012	Audio/video, information and communication technology equipment - Environmentally conscious design	IEC	IEC 62075:2012 applies to all audio/video, information and communication technology equipment marketed as final products. This standard specifies requirements and recommendations for the design of environmentally sound products regarding: - life cycle thinking aspects, - material efficiency, - energy efficiency, - consumables and batteries, - chemical and noise emissions, - end of life, - hazardous substances/preparations, - and product packaging.	The standard focuses on the Environmentally conscious design for Audio/video, information and communication technology equipment. - Although this standard does not explicitly apply to individual components and subassemblies to be incorporated into final products, component manufacturers also should consider this standard, to enable manufacturers using such components to meet the requirements herein. - Only the intended use of products as defined by the manufacturer is within the scope of this standard.		International; equipment
IEC 62087	2015	Audio, video, and related equipment - Determination of power consumption - Part 1: General	IEC	IEC 62087-1:2015 specifies the general requirements for the determination of power consumption of audio, video, and related equipment.	Methods of measurement for the power consumption of audio, video and related equipment. With these standards, the course is set for more eco-design and more energy efficiency.		International; equipment
IEC 63376	2023	Industrial facility energy management system (FEMS) - Functions and information flows	IEC	IEC 63376:2023 specifies the functions and the information flows of industrial Facility Energy Management System (FEMS).	Generic functions are defined for the FEMS, to enable upgrading traditional Energy Management System (EMS) from visualization of the status of energy consumption to automation of energy management defining a closer relation with other management and control systems		International; system (energy management system)

IEC 62872-2	2022	Industrial-process measurement, control and automation - Part 2: Internet of Things (IoT) - Application framework for industrial facility demand response energy management	IEC	This document specifies: - an overview of the price-based demand response program that serves as basic knowledge backbone of the IoT application framework; - a IoT-based energy management framework which describes involved functional components, as well as their relationships; - detailed information exchange flows that are indispensable between functional components; - existing IoT protocols that need to be identified for each protocol layer to support this kind of information exchange; - communication requirements that guarantee reliable data exchange services for the application framework.	The document presents an IoT application framework for industrial facility demand response energy management (FDREM) for the smart grid, thereby enabling efficient information exchange between industrial facilities using IoT related communication technologies.		International; system (energy management system)
IEC 63474	2023	Electrical and electronic household and office equipment - Measurement of networked standby power consumption of edge equipment	IEC	IEC 63474:2023 specifies methods of measurement of electrical power consumption in networked standby and the reporting of the results for edge equipment.	The standard can have a potentially bigger impact, by allowing measurement of power consumption and hence ultimately enable power monitoring and subsequently help in its efficient management.		International; power management
IEC 63318	2022	Specifications for SELV DC systems conforming to the ESMAP multi-tier framework tier 2 and tier 3 requirements for household electricity supply	IEC	Specifications for SELV DC systems conforming to the ESMAP multi-tier framework tier 2 and tier 3 requirements for household electricity supply	In developed economies, the use of low voltage direct power (LVDC) will help improve energy efficiency and reduce global carbon footprint. It can power data centres, office buildings or hospitals. In developing countries LVDC provides affordable and sustainable electricity access to people who would otherwise have to wait many years for a connection to the main electricity grid. IEC is leading efforts to make LVDC technology safe for use everywhere, where DC power can be used directly without losses in energy conversion.		International; electrical supply
IEC 60364-5-52	2009	Low-voltage electrical installations - Part 5-52: Selection and erection of electrical equipment - Wiring systems	IEC	Selection and erection of electrical equipment - Wiring systems- introduces additional requirements with regard to proximity of underground power and telecommunication cables.	[Same as above]		International; electrical supply
IEC 60364-8-1	2019	Low-voltage electrical installations - Part 8-1: Functional aspects - Energy efficiency	IEC	IEC 60364-8-1:2019 provides additional requirements, measures and recommendations for the design, erection and verification of all types of low-voltage electrical installation including local production and storage of energy for optimizing the overall efficient use of electricity.	[Same as above]		International; electrical supply
IEC 62309	2004	Dependability of products containing reused parts - Requirements for functionality and tests	IEC	Introduces the concept to check the reliability and functionality of reused parts and their usage within new products. Also provides information and criteria about the tests/analysis required for products containing such reused parts, which are declared "qualified-as-good-as-new" relative to the designed life of the product.	The purpose of this standard is to ensure by tests and analysis that the reliability and functionality of a new product containing reused parts is comparable to a product with only new parts. In doing so, the objective is to contribute towards a circular economy.		International; equipment/products

IEC 63077	2019	Good refurbishment practices for medical imaging equipment	IEC	The standard describes and defines the process of refurbishment of used medical imaging equipment and applies to the restoring of used medical imaging equipment to a condition of safety and performance comparable to that of new medical imaging equipment.This restoration includes actions such as repair, rework, software/hardware updates, and the replacement of worn parts with original parts.	The intention is to define a process for ensuring the performance and safety of refurbished medical imaging equipment. In doing so, the objective is to contribute towards a circular economy.		International; equipment (medical imaging)
IEC 62430	2019	Environmentally conscious design (ECD) - Principles, requirements and guidance	IEC	The standard describes principles, specifies requirements and provides guidance for organizations intending to integrate environmental aspects into the design and development in order to minimize the adverse environmental impacts of their products. This document applies to processes on how ECD (environmentally conscious design) are integrated into the design and development. This document applies to any organization, regardless of its size, type or sector.	The standard is aimed at organizations intending to integrate environmental aspects into design and development in order to minimize the adverse environmental impacts of their products throughout their lifecycle, from raw material extraction to disposal.		International; Eco-design
IEC 62474	2018; Ammend ment 2020	Material declaration for products of and for the electrotechnical industry	IEC	IEC 62474:2018+A1:2020 specifies the procedure, content, and form relating to material declarations for products of companies operating in and supplying the electrotechnical industry.	It aims to contribute to optimizing material efficiency, and thus promote a circular economy model.		International; equipment/products
IEC 63333	2023	General method for assessing the proportion of reused components in products	IEC	IEC 63333:2023 deals with the assessment of the proportion of reused components in products on a horizontal level, which can be applied at any point in the life of the product. This document applies to electrical and electronic products. It can also be applied to other product types.	By providing a method to assess a proportion of reused components in products, the standard aims to contribute towards a circular economy.		International; equipment/products
ISO/IEC TR 15067-3-8:2020	2020	Information technology - Home electronic system (HES) application model - Part 3-8: GridWise transactive energy framework	ISO,IEC	Technical Report: provides a conceptual framework for developing architectures and designing solutions related to transactive energy (TE). Transactive energy allows electricity generated locally by consumers using wind, solar, storage, etc., at homes or buildings to be sold into a competitive market. This document provides guidance for enhancing interoperability among distributed energy resources involved in energy management systems at homes and buildings.	Transactive energy allows electricity generated locally by consumers using wind, solar, storage, etc., at homes or buildings to be sold into a competitive market. The document addresses gaps identified as problematic for the industry by providing definitions of terms, architectural principles and guidelines, and other descriptive elements that present a common ground for all interested parties to discuss and advance TE	non normative	International

ISO/IEC TR 21897:2022	2022	Information technology - Data centres - Impact of the ISO 52000 series on energy performance of buildings	ISO,IEC	Technical Report: This document: — provides the main definitions and concepts from the ISO 52000 series needed to make a primary energy assessment for data centres; — provides approaches for discriminating true sources of energy used by a given data centre; — compares, where relevant, the terms used in both the ISO/IEC 30134 series and ISO 52000 series and provides explanations on the use of factors for converting final or delivered energy to primary energy which take a different approach in each series (and how to move from one to the other); — illustrates the impact of using the EPB approach on data-centre-energy-related key performance indicators (KPIs), both in general and by the provision of examples; — provides known sources of weighting or conversion factors to be		non normative	International; data centre
ISO/IEC TR 30132-1:2016	2016	Information technology - Information technology sustainability - Energy efficient computing models - Part 1: Guidelines for energy effectiveness evaluation	ISO,IEC	Technical Report:establishes guidelines for improving the energy effectiveness for computing models.		non normative	International; energy
ISO/IEC TR 30133:2023	2023	Practices for resource-efficient data centres	ISO,IEC	Technical Report:This document describes generally applicable practices for improving the resource efficiency of data centres, independent of their application(s).		non normative	International; data centre
IEC TR 62725:2013	2013	Analysis of quantification methodologies of greenhouse gas emissions for electrical and electronic products and systems	IEC	Technical Report: IEC/TR 62725:2013(E) is intended to provide users with guidance to understand methodologies and to evaluate carbon footprint of products (hereinafter referred to as CFP), by quantifying the greenhouse gases (GHG) emissions (hereinafter referred to as CFP study) for Electrical and Electronic products (hereinafter referred to as EE products) based on life-cycle thinking. It is applicable to any type of EE products, which are new or modified (e.g. reconditioned, upgraded, etc.) and is based on the result of a comparative study on existing methodologies published or under discussion in representative international organizations.		non normative	International; equipment/products ; systems
IEC TR 62726:2014	2014	Guidance on quantifying greenhouse gas emission reductions from the baseline for electrical and electronic products and systems	IEC	Technical Report:IEC TR 62726:2014 describes principles and guidance on quantifying greenhouse gas emission (CO2e) reductions compared to a baseline (which includes "business as usual") for electrical and electronic products and systems (hereinafter referred as EE products). It is based on the result of a comparative study on existing methodologies published or under discussion in international organizations.		non normative	International; equipment/products ; systems

IEC TR 63212:2020	2020	Harmonization of environmental performance criteria for electrical and electronic products – Feasibility study	IEC	Technical Report: provides a feasibility assessment to determine if harmonization of environmental performance criteria is possible and would benefit the electrotechnical industry.	This document is intended as a feasibility study report rather than a standard. It reports the possibility/opportunity to harmonize environmental performance criteria and, with it, the feasibility for future development of an international standard on environmental performance criteria. It is intended as a vision of how such a standard would be structured and how it could be implemented to meet the specific requirements that were identified in the study.	non normative	International; equipment/products ; systems
IEC TR 62921:2016	2016	Quantification methodology for greenhouse gas emissions for computers and monitors	IEC	Technical Report: for quantification methodology for greenhouse gas emissions for computers and monitors	The aim is continuous improvement processes, designs and guidelines that prioritize resource efficiency.	non normative	International; equipment