International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

L.1471

(09/2021)

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

Assessment methodologies of ICTs and CO_2 trajectories

Guidance and criteria for information and communication technology organizations on setting Net Zero targets and strategies

Recommendation ITU-T L.1471

ITU-T L-SERIES RECOMMENDATIONS

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

OPTICAL FIBRE CABLES	
Cable structure and characteristics	L.100–L.124
Cable evaluation	L.125–L.149
Guidance and installation technique	L.150–L.199
OPTICAL INFRASTRUCTURES	
Infrastructure including node elements (except cables)	L.200–L.249
General aspects and network design	L.250–L.299
MAINTENANCE AND OPERATION	
Optical fibre cable maintenance	L.300–L.329
Infrastructure maintenance	L.330–L.349
Operation support and infrastructure management	L.350–L.379
Disaster management	L.380–L.399
PASSIVE OPTICAL DEVICES	L.400–L.429
MARINIZED TERRESTRIAL CABLES	L.430–L.449
E-WASTE AND CIRCULAR ECONOMY	L.1000–L.1199
POWER FEEDING AND ENERGY STORAGE	L.1200–L.1299
ENERGY EFFICIENCY, SMART ENERGY AND GREEN DATA CENTRES	L.1300–L.1399
ASSESSMENT METHODOLOGIES OF ICTS AND CO_2 TRAJECTORIES	**L.1400–L.1499**
ADAPTATION TO CLIMATE CHANGE	L.1500–L.1599
LOW COST SUSTAINABLE INFRASTRUCTURE	L.1700–L.1799

For further details, please refer to the list of ITU-T Recommendations.

Recommendation ITU-T L.1471

Guidance and criteria for information and communication technology organizations on setting Net Zero targets and strategies

Summary

Currently, the definitions of Net Zero and related concepts such as carbon neutrality and climate neutrality for organizations are still under development. Several initiatives, including, inter alia, the Science Based Target Initiative, the United Nations Framework Convention on Climate Change (UNFCCC) Race to Zero, 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.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T L.1471	2021-09-22	5	11.1002/1000/14720

Keywords

Climate, CO_2 emissions, decarbonization, emission reduction, first order effects, footprint, GHG emissions, ICT sector, Net Zero, trajectories, 1.5°C.

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

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

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

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

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

NOTE

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

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents/software copyrights, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the appropriate ITU-T databases available via the ITU-T website at http://www.itu.int/ITU-T/ipr/.

Table of Contents

		Page
1	Scope	1
2	References	1
3	Definitions	1
	3.1 Terms defined elsewhere	1
	3.2 Terms defined in this Recommendation	2
4	Abbreviations and acronyms	2
5	Conventions	3
6	Background information	3
7	Definition and approaches of Net Zero	5
8	Criteria to be followed by an ICT sector organization setting a Net Zero target and strategies	5
9	Reduction of GHG emissions	7
10	Removals of GHG emissions	7
11	Avoidance of GHG emissions	8
Appendix I – IPCC		10
Appendix II – UNFCCC Race to Zero		11
Appendix III – SBTi Net Zero		14
Appendix IV – UNFCCC Climate Neutral Now initiative		19
Appendix V – Net Zero initiative		20
Bibliography		22

Recommendation ITU-T L.1471

Guidance and criteria for information and communication technology organizations on setting Net Zero targets and strategies

1 Scope

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.

2 References

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

[ITU-T L.1410] Recommendation ITU-T L.1410 (2014), *Methodology for environmental life cycle assessments of information and communication technology goods, networks and services*.

[ITU-T L.1420] Recommendation ITU-T L.1420 (2012), *Methodology for energy consumption and greenhouse gas emissions impact assessment of information and communication technologies in organizations*.

[ITU-T L.1430] Recommendation ITU-T L.1430 (2013), *Methodology for assessment of the environmental impact of information and communication technology greenhouse gas and energy projects*.

[ITU-T L.1451] Recommendation ITU-T L.1451 (2019), *Methodology for assessing the aggregated positive sector-level impacts of ICT in other sectors.*

[ITU-T L.1470] Recommendation ITU-T L.1470 (2020), *Greenhouse gas emissions trajectories for the information and communication technology sector compatible with the UNFCCC Paris Agreement.*

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 like-for-like [b-RtZ Lexicon]: When a source of emissions and an emissions sink correspond in terms of their warming impact, and in terms of the timescale and durability of carbon storage. For example, fossil carbon is stable in the lithosphere over millennia if it is not extracted and burned, therefore mitigating measures (e.g., offsets) that aim to neutralize the effect of these emissions must persist for a comparable, geological-timescale. Although all CO_2 once emitted,

whether originally sourced from the lithosphere or biosphere, persists in the active carbon cycle for centuries to millennia, it may be appropriate to balance shorter-duration carbon released from biogenic carbon stocks (e.g., forests and soils) with comparably temporary storage in like stocks. The variable risks of reversal of different carbon stocks must also be considered, for example forests may suffer from unforeseen anthropogenic (e.g., illegal logging), non-anthropogenic (e.g., disease and disaster), or climate change-induced (e.g., warming) reversal risks.

3.1.2 Net Zero (planetary level) [b-IPCC 1.5]: The International Panel on Climate Change (IPCC) defines Net Zero as that point when "anthropogenic emissions of greenhouse gases to the atmosphere are balanced by anthropogenic removals over a specified period".

NOTE – Agreement sets out the need to achieve this balance by the second half of this century and this term is defined at global planetary level.

3.1.3 removals [b-IPCC 1.5]: Anthropogenic removals refer to the withdrawal of greenhouse gases (GHGs) from the atmosphere as a result of deliberate human activities.

3.1.4 scope 1 emissions [b-GHGP]: Direct greenhouse gas (GHG) emissions occur from sources that are owned or controlled by a company, for example, emissions from combustion in owned or controlled boilers, furnaces, vehicles, etc.; emissions from chemical production in owned or controlled process equipment. Direct CO_2 emissions from the combustion of biomass shall not be included in scope 1 but reported separately (see chapter 9). GHG emissions not covered by the Kyoto Protocol, e.g. chlorofluorocarbons (CFCs), NOx, etc. shall not be included in scope 1 but may be reported separately (see chapter 9).

3.1.5 scope 2 emissions [b-GHGP]: Scope 2 emissions account for greenhouse gas (GHG) emissions from the generation of purchased electricity consumed by a company. Purchased electricity is defined as electricity that is purchased or otherwise brought into the organizational boundary of the company. Scope 2 emissions physically occur at the facility where electricity is generated.

3.1.6 scope 3 emissions [b-GHGP]: Scope 3 emissions are a consequence of the activities of the company, but occur from sources not owned or controlled by the company. Some examples of scope 3 activities are extraction and production of purchased materials; transportation of purchased fuels; and use of sold products and services.

NOTE – Relevant Scope 3 categories for ICT companies are listed in [ITU-T L.1420].

3.2 Terms defined in this Recommendation

This Recommendation defines the following term:

3.2.1 Net Zero (organization level): State reached by an organization that has reduced its value chain emissions (scope 1, scope 2 and scope 3 emissions) following science-based pathways, with any remaining residual greenhouse gas (GHG) emissions attributable to that organization being fully neutralized by like-for-like removals (e.g., permanent removals for fossil carbon emissions) exclusively claimed by that organization.

NOTE 1 – The term "residual" refers to residual emissions that remain technically unfeasible to be eliminated. For the ICT sector, such residual emissions shall align with or outperform the level of residual emissions as defined in [ITU-T L.1470].

NOTE 2 – Definition based on [b-RtZ Criteria] and [b-SBTi Net Zero].

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

A/R Afforestation/Reforestation

BECCS Bio-Energy Carbon Capture and Storage

CCS	Carbon Capture and Storage
CDP	Carbon Disclosure Project
CDR	Carbon Dioxide Removal
CER	Certified Emission Reduction
GHG	Greenhouse Gas
GHG Protocol	Greenhouse Gas Protocol
ICT	Information and Communication Technology
IPCC	International Panel on Climate Change
NZI	Net Zero Initiative
SBTi	Science-based Targets Initiative
SDA	Sectoral Decarbonization Approach
UNFCCC	United Nations Framework Convention on Climate Change
VCM	Voluntary Carbon Market
WRI	World Resources Institute

5 Conventions

In this Recommendation, the term "removal" is used instead of the equivalent term "sequestration".

6 Background information

The International Panel on Climate Change (IPCC) defines Net Zero at a global planetary level as that point when "*anthropogenic emissions of greenhouse gases to the atmosphere are balanced by anthropogenic removals over a specified period*".

The Paris Agreement states the need to achieve this balance by the second half of this century. Furthermore, in October 2018, the IPCC confirmed that, in order to limit global warming to 1.5°C, the world needs to halve CO_2 emissions by around 2030 compared to 2015 levels and reaches Net Zero CO_2 emissions by mid-century.

The current situation can be described with the bathtub metaphor summarized in Figure 1 and developed by the Net Zero Initiative [b-NZI Framework]. It illustrates how in order to stabilize the water level in the bathtub at a reasonable level and thus meet the temperature objectives of 2°C or 1.5°C, the incoming carbon flows must correspond to the annual outgoing flows.

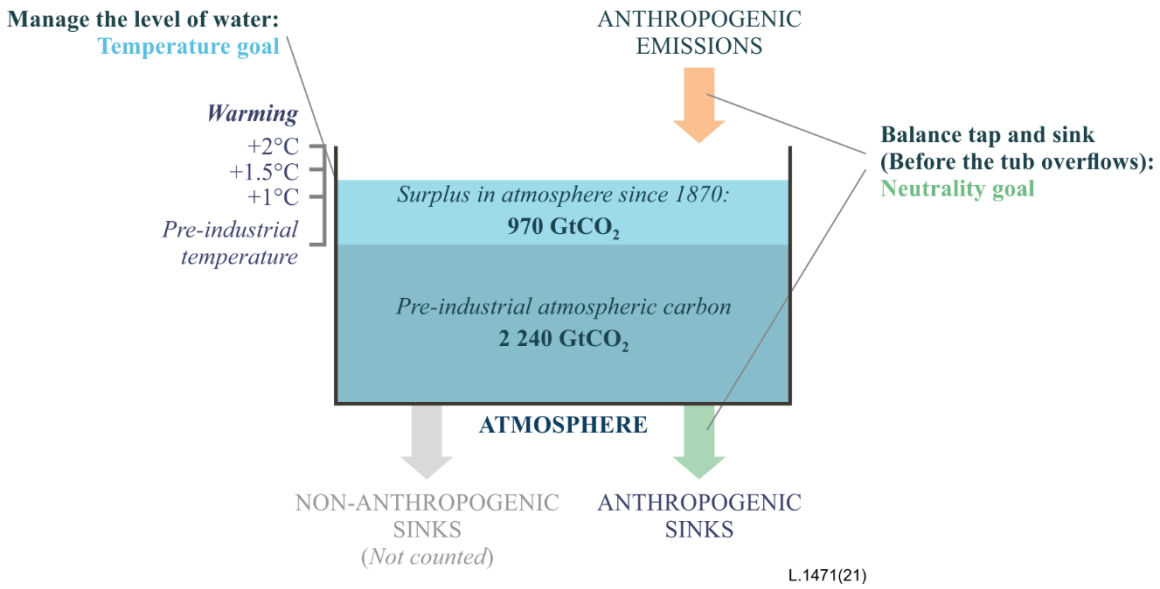


Figure 1 – The bathtub metaphor related to Net Zero targeting at planetary level
source: [b-NZI Framework]

Following this, [ITU-T L.1470] on greenhouse gas emissions trajectories for the information and communication technology sector compatible with the United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement was created.

However, it also outlines the long-term perspectives in relation to its two normative scenarios, making reference to the ambition of reaching net zero in the frame of ICT organizations.

[ITU-T L.1470] states:

"In the longer term, the IPCC P2 trajectory shows a GHG emissions reduction of about 88% in 2050. Remaining emissions should be net zeroed by 2050 with carbon dioxide removals (CDRs), e.g., carbon sinks, BECCS and direct air capture". (clause 9.1)

"It should be noted that offsets cannot be considered in meeting an SBT initiative-approved target. However, a long-term target for the ICT sector would be to achieve net zero emissions by 2050. This is consistent with SBT initiative requirements and is aligned with a 1.5℃ trajectory, while also recognizing the high level of electricity usage by the sector". (clause 9.2)

Several organizations, including, inter alia, the Science Based Target Initiative, the UNFCCC Race to Zero initiative and the Net Zero Initiative are working on guidance on Net Zero approaches to avoid confusion and reduce risks of green washing.

At the same time, the UNFCCC Climate Neutral Now initiative and ISO TC 207 are addressing the related concepts of climate neutrality and carbon neutrality.

To date, three main documents are available providing guiding principles for organizations to set Net Zero targets:

- *Starting Line and Leadership practices 2.0* – In force from 1 June 2021 and released in April 2021 by the UNFCCC Race to Zero initiative [b-RtZ criteria].
- *Foundations for Science-Based Net Zero target setting in the corporate sector*, released by SBTi in September 2020 [b-SBTi Net Zero].
- *Net Zero Initiative, a framework for collective carbon neutrality*, released by the Net Zero Initiative and Carbone 4 in April 2020 [b-NZI framework].

Building on these, the following clauses provide guidance for ICT sector organizations to set net zero targets and strategies that contribute to reaching net zero at planetary level at the pace necessary to comply with the provisions of the Paris Agreement, limiting global warming mean at +1.5°C in 2100 compared to pre-industrial levels.

After presenting existing Net Zero initiatives and the main criteria to be followed by an ICT sector organization setting a Net Zero target, guidance is provided regarding reduction of GHG emissions, removal of GHG emissions and avoidance of GHG emissions.

7 Definition and approaches of Net Zero

The Net Zero concept emerges from IPCC and was originally established as a term at the planetary level. Used in this sense, IPCC defines Net Zero as the point when "anthropogenic emissions of greenhouse gases to the atmosphere are balanced by anthropogenic removals over a specified period".

Further details regarding IPCC definitions are found in Appendix I.

Building on IPCC and seeking to guide companies on how they should contribute to Net Zero several initiatives have been developed.

These initiatives are summarized in Appendices II-V and include:

- UNFCCC Race to Zero
- SBTi Net zero
- UNFCCC Climate Neutral Now
- Net Zero Initiative.

Based on these initiatives, clause 8 define criteria for ICT organizations setting Net Zero targets and strategies.

8 Criteria to be followed by an ICT sector organization setting a Net Zero target and strategies

Taking into account the existing frameworks to date and referring to the Net Zero definition put forward in this Recommendation (see clause 3.2.1), ICT organizations' Net Zero targets and pathways shall follow the following principles/criteria:

General criteria

- Organizations shall reach Net Zero GHG emissions by no later than 2050, 2040 is recommended. While earlier target years are encouraged, a more ambitious timeframe should not come at the expense of the level of abatement (i.e., reduction of own value chain emissions) in the target.
- Net zero shall be seen as a future state with remaining emissions being only those being technically unfeasible to eliminate.
- The main vehicle towards Net Zero shall be reduction of Scope 1, 2 and 3 emissions and reduction efforts shall be the priority.
- All Net Zero strategies shall adhere to robust social and environmental principles, ensuring amongst others, protection and/or restoration of naturally occurring ecosystems, robust social safeguards, and protection of biodiversity, amongst others.

Reductions

- The full value chain including Scope 1, Scope 2 and Scope 3 emissions shall be considered in accordance with the boundaries defined in [ITU-T L.1420].
- All GHG emissions shall be included in the Net Zero target.

- Organizations' pathways towards the state of Net Zero shall follow a science-based pathway aiming towards or beyond a fair share of halving of global emissions by 2030 compared to 2015 levels and must reflect this in an interim target. Thus, ICT sector organizations shall reduce scope 1, 2 and 3 emissions in line with or over-performing the trajectories outlined in [ITU-T L.1470] and [b-ITU-T L-Sup.37] for operators (also available in [b-SBTi ICT]) and [b-ITU-T L-Sup.38] for manufacturers and potential other Supplements to come which are all representative of such a pathway. Organizations shall also make sure that the less prescriptive scope 3 reduction efforts described in the above-mentioned documents, are ambitious enough to stay within this trajectory. This way, organizations maintain consistency with mitigation pathways that limit warming to 1.5°C with zero or limited overshoot.
- Consequently, organizations shall set intermediate GHG emissions reduction objectives for 2030 respecting or over-performing the trajectories defined in [ITU-T L.1470] and its associated guidance Supplements, namely [b-ITU-T L-Sup.37] for operators, [b-ITU-T L-Sup.38] for manufacturers and, potentially other Supplements to come while covering scope 1, 2 and 3 emissions.

Removals

- At the time that Net Zero is reached, GHG emissions that are not feasible for an ICT organization to abate shall be neutralized by GHG removals.
- Organizations shall plan and prepare to implement yearly GHG removals, from the target year of Net Zero at the latest and at least at the level of the remaining emissions while following a like-for-like principle.
- Any removal to balance emissions shall follow like-for-like principles and be permanent when Net Zero is claimed and be uniquely claimed by the organization.
- During an organization transition to Net Zero, removal measures may complement, but not substitute, reducing value chain emissions in line with science. Such measures cannot be used to claim a Net Zero state but shall be seen as a way to further support the global transition to Net Zero.
- Any compensation and neutralization measures shall: (a) ensure additionality, (b) have measures to assure permanence of the mitigation outcomes, (c) address leakage and (d) avoid double-counting.

Avoidance

- In addition to their Net Zero reduction and removal approaches, ICT organizations should also help society to reach a Net Zero state by developing GHG emissions avoidance, in particular through the provision of ICT networks, goods and services, assessing and documenting the benefits brought by these ICT networks, goods and services, according to the principles indicated in [ITU-T L.1410], [ITU-T L.1430] and [ITU-T L.1451].
- During the transition of an organization to Net Zero, avoidance measures may complement, but not substitute, reducing value chain emissions in line with science. Such measures cannot be used to claim a Net Zero state but shall be seen as a way to further support the global transition to Net Zero.

Disclosure

- Organizations shall describe how the organization intends to achieve the Net Zero target.
- Organizations shall be transparent about the sources of emissions included and excluded from the target boundary, the timeframe for achieving Net Zero emissions, the amount of abatement and neutralization planned in reaching Net Zero emissions, and their interim targets or milestones.

- Any use of sinks and credits shall be clearly stated and cannot be used to claim a Net Zero state until only a residual fraction of emissions remain.
- Organizations shall transparently report measures taken and progress made towards reaching the Net zero status, reporting separately reductions, removals and avoidance.
- Any deviations shall be explained, motivated and documented.

At the time of elaboration of this Recommendation, these criteria are considered as being consistent with the Guidelines elaborated by SBTi, the Race to Zero, Climate Neutral Now programmes from the UNFCCC and the Net Zero Initiative.

9 Reduction of GHG emissions

Reduction of emissions is the main strategy towards Net Zero for all sectors, including the ICT sector. In line with clause 8, ICT sector organizations setting Net Zero targets need to respect or over-perform the trajectories defined in [ITU-T L.1470].

Consequently, ICT organizations shall give priority to GHG emissions reductions respecting or over-performing the trajectories defined in [ITU-T L.1470] and its associated guidance Supplements, namely [b-ITU-T L-Sup.37] for operators, [b-ITU-T L-Sup.38] for manufacturers and, potentially other Supplements to come.

In line with [ITU-T L.1470], acknowledging that the majority of the ICT sector emissions are associated with the use of energy, the main strategy to decarbonize the ICT sector, at the pace necessary to align with 1.5°C trajectories, is the implementation of simultaneous, vigorous and urgent actions in the following fields:

- implementation of energy efficiency plans;
- switch to renewable or low carbon electricity supplies;
- encouragement of carbon consciousness among end-users.

Figure 2 shows some examples of categories of supporting actions.

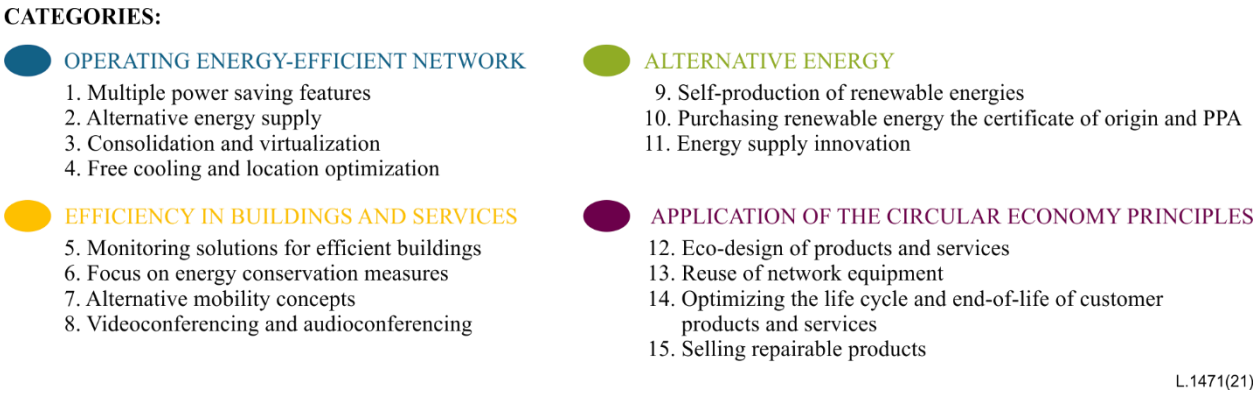


Figure 2 – Decarbonization measures
(source: [ITU-T L.1470])

ICT organizations should also refer to the most recent [b-UNFCCC Pathways] in particular the industry pathway [b-UNFCCC Industry] for applicable measures.

10 Removals of GHG emissions

While the main strategy for achieving Net Zero is associated with actual reduction of emissions, the residual emissions which cannot be reduced, need to be balanced with like-for-like or permanent removals which respect an additionality principle, i.e., the removals cannot be part of another

organization's reduction but can be additional to other measures already accounted for in the carbon budgets.

As stated in clause 8, when setting Net Zero targets, ICT organizations shall plan to implement yearly GHG removals, from the date of the Net Zero status, at least at the level of the residual emissions following a like-for-like principle.

Following the current SBTi guidance on Net Zero, the intended amount of GHG emissions to be removed shall be captured and stored before the equivalent amount is released into the atmosphere.

Whenever possible, removal of carbon emissions for the longest possible periods shall be preferred, such as reforestation, mangroves, plantations for long-living bio-materials such as furniture or harvested wood products, for building purposes for instance, or when adequate technologies will be available, geological removals.

Generally, GHG removal shall be implemented according to the acknowledged and most restrictive frameworks related to assessments and implementation.

NOTE 1 – GHG protocol is currently developing a new greenhouse gas protocol guidance on accounting for land sector activities and CO_2 removals in corporate greenhouse gas inventories. Other organizations also provide guidance in this area such as the Gold Standard and Verra.

In addition, risks of reversal in carbon removal, for instance due to fire, drought and pests, shall be identified and actively managed and fought over the period of removal. The actions undertaken shall be documented.

In all cases, the like-for-like principle shall be followed for removals.

NOTE 2 – ICT services could improve removal efforts.

11 Avoidance of GHG emissions

In addition to their Net Zero reduction and removal approaches, ICT organizations should also help society to reach a Net Zero state by developing GHG emissions avoidance, in particular through the provision of ICT networks, goods and services, and assess and document the benefits brought by these ICT networks, goods and services, according to the principles indicated in [ITU-T L.1410], [ITU-T L.1430], and [ITU-T L.1451] and other relevant ITU-T Recommendations to come.

Thus, beyond working on their transition to a Net Zero state ICT organizations should also support other sectors in their transformation. One important source which outlines the pathways for such transformation is the UNFCCC pathways [b-UNFCCC Pathways] across sectors. For the current decade the exponential roadmap [b-Exp Roadmap] could provide high level guidance on how ICT organizations can support a 1.5°C aligned pathway.

As indicated above, when setting Net Zero targets, ICT organizations shall develop GHG emissions avoidance, in particular through the provision of ICT goods and services, and assess the benefits brought by these ICT goods and services.

[ITU-T L.1430] provides a list of ICT goods and services potentially facilitating GHG emissions avoidance in other sectors.

1) Smart buildings
2) Smart logistics and transport
3) Smart grids
4) Smart motors and manufacturing
5) Dematerialization, including teleworking, virtual conferencing, e-media, e-documents
6) Carbon management software

Figure 3 gives some examples of how different digital technologies could support other sectors.

Key digital technologies	What does it mean	How they help can help limit global warming 1.5°C	How they risk accelerating global warming towards 4°C
Social media	Interactive technologies that facilitate the creation and sharing of information via networks while collecting personal data for behavioural insights	Support democracy. Promote fact-based worldviews. tackle misinformation. Utilize behavioural insights to enable sustainable lifestyles. Enable global climate movements. Help displace the need for physical travel.	Spread misinformation e.g., climate denial. Undermine democratic processes. Encourage unsustainable consumption.
E-commerce	Buying or selling of products and services over the Internet	Support a shift to sustainable, low-carbon products and services through information and nudging.	Simplify high-carbon consumption through low prices, fast delivery and heavy promotion, leading to increased waste of material, energy and transportation.
Internet of things	Connecting devices and everyday objects to each other and online services	Optimise any type of system to save energy, materials and to enable a circular economy. Enable distributed demand response to help balance electricity grids.	Increase efficiency of oil and gas extraction and production of high-carbon products thereby delaying the shift to low-carbon alternatives.
AI, machine and deep learning	The ability of a machine or computer programme to think and learn.	Continuous improvement of energy systems, factories, buildings and vehicles. Drive down costs and carbon footprint, while improving performance and functionality. Linking with social media and other technologies, it can also help people to understand their footprint and nudge them in a sustainable direction.	Accelerate high-carbon consumption, long-distance travel and goods transportation through biased algorithms and profiled online advertising.
5G mobile networks	5th generation cellular network technology providing higher speed connectivity to people, enterprises and objects.	Mass scale, global connection of electric grids, buildings, industries, cities, vehicles and things combined with AI and machine learning enable efficiency of systems. Virtual meetings and virtual and augmented reality reduces need for travelling. Resource-efficient manufacturing flows and autonomous services brings down use of resources.	Enable acceleration of high-carbon intense industries and digital platforms, which drives high-carbon consumption.
Blockchain	An open distributed ledger that can record transactions between two parties efficiently and in a verifiable and permanent way	Allows greater transparency throughout the value chain of goods and services, making it easier to drive decarbonization. Enable distributed coordination of physical energy flows and financial flows.	Current cryptocurrencies using blockchain technologies have a high energy demand - currently equivalent to a small developed country.
Digital twin	A digital replica of a living or non-living physical system	Allows designers and engineers to test and simulate how systems such as cities and grids can be improved, optimized and transformed.	Can be deployed to accelerate fossil-based high-carbon systems.

* These lists are not mutually exclusive

L.1471(21)

Figure 3 – Example of how digital technologies could be used to support the transition to Net Zero (source: [b-Exp Roadmap])

Emissions avoided shall be calculated in accordance with [ITU-T L.1410] and [ITU-T L.1430] and other relevant ITU-T Recommendations to come. [ITU-T L.1451] further provides useful reference on the benefits brought by ICT services in terms of reduced GHG emissions in other sectors of the economy.

Organizations referring to the avoidance they have enabled shall also be transparent regarding any services contributing to decelerating the transition to the Net Zero society.

At this stage, the target-setting corresponding to the avoided emissions for products and services is recommended "as large as possible". This is line with the option 1 of the Guidance from the Net Zero initiative.

In addition, ICT organizations can optionally contribute to GHG emissions avoidance by financing certified or validated carbon reduction projects outside of their value chain, through the purchase of carbon credits or green bonds. As indicated in the Net Zero Initiative guidance, in the cases where a project has not been certified by a standard, it shall be calculated and validated by a third party according to a recognized methodology.

In any case, such financial measures are seen as additional to the measures undertaken to reach Net Zero and shall be stated separately from scope 1, 2 and 3 emission levels and reduction measures. Such financial measures shall not be used by an ICT organization to claim to be Net Zero.

Appendix I

IPCC

(This appendix does not form an integral part of this Recommendation.)

The Net Zero concept emerged from IPCC and was originally established as a term at the planetary level. Used in this sense, IPCC defines Net Zero as the point when "anthropogenic emissions of greenhouse gases to the atmosphere are balanced by anthropogenic removals over a specified period".

NOTE – The Paris Agreement [b-UNFCCC PA] sets out the need to achieve this balance by the second half of this century and this term is defined at global planet Earth level.

IPCC further gives the following definitions at the planetary level [b-IPCC Glossary]:

Carbon neutrality: Net Zero carbon dioxide (CO_2) emissions are achieved when anthropogenic CO_2 emissions are balanced globally by anthropogenic CO_2 removals over a specified period. Net Zero CO_2 emissions are also referred to as carbon neutrality. See also Net Zero emissions and net negative emissions.

Net Zero emissions: Net Zero emissions are achieved when anthropogenic emissions of greenhouse gases to the atmosphere are balanced by anthropogenic removals over a specified period. Where multiple greenhouse gases are involved, the quantification of Net Zero emissions depends on the climate metric chosen to compare emissions of different gases (such as global warming potential, global temperature change potential, and others, as well as the chosen time horizon). See also Net Zero CO_2 emissions, negative emissions and net negative emissions.

Climate neutrality: Concept of a state in which human activities result in no net effect on the climate system. Achieving such a state would require balancing of residual emissions with emission (carbon dioxide) removal as well as accounting for regional or local biogeophysical effects of human activities that, for example, affect surface albedo or local climate. See also Net Zero CO_2 emissions.

Appendix II

UNFCCC Race to Zero

(This appendix does not form an integral part of this Recommendation.)

The UNFCCC Race to Zero campaign gathers 509 cities, 23 regions, 2,162 businesses, 127 of the biggest investors, and 571 higher education institutions (as per 2021-04-27). These actors join 120 countries in the largest ever alliance committed to achieving Net Zero carbon emissions by 2050 at the latest. Collectively these actors now cover nearly 25% global CO_2 emissions and over 50% GDP, see [b-RtZ info].

The UNFCCC campaign, referring to Net Zero as the valid end state for the campaign define Net Zero with the following text:

Referring to the world as a whole, the IPCC defines Net Zero as: When anthropogenic emissions of greenhouse gases to the atmosphere are balanced by anthropogenic removals over a specified period.

Race to Zero considers individual actors to have reached a state of Net Zero when: An actor reduces its emissions following science-based pathways, with any remaining GHG emissions attributable to that actor being fully neutralized by like-for-like removals (e.g., permanent removals for fossil carbon emissions) exclusively claimed by that actor, either within the value chain or through purchase of valid offset credits. [b-RtZ Lexicon].

They further define like-for-like as follows:

When a source of emissions and an emissions sink correspond in terms of their warming impact, and in terms of the timescale and durability of carbon storage. For example, fossil carbon is stable in the lithosphere over millennia if it is not extracted and burned, therefore mitigating measures (e.g., offsets) that aim to neutralize the effect of these emissions must persist for a comparable, geological-timescale. Although all CO_2 once emitted, whether originally sourced from the lithosphere or biosphere, persists in the active carbon cycle for centuries to millennia, it may be appropriate to balance shorter-duration carbon released from biogenic carbon stocks (e.g., forests and soils) with comparably temporary storage in like stocks. The variable risks of reversal of different carbon stocks must also be considered, for example forests may suffer from unforeseen anthropogenic (e.g., illegal logging), non-anthropogenic (e.g., disease and disaster), or climate change-induced (e.g., warming) reversal risks. [b-RtZ Lexicon]

These definitions are then used for the criteria document [b-RtZ Criteria] which outlines their application by the Race to Zero initiative, as shown in Table II.1.

Table II.1 – Race To Zero starting line criteria and leadership practices
source: [b-RtZ Criteria]

Starting line	
Pledge	Pledge at the head-of-organization level to reach (net) zero GHGs as soon as possible, and by mid-century at the latest, in line with global efforts to limit warming to 1.5°C. Set an interim target to achieve in the next decade, which reflects maximum effort toward or beyond a fair share of the 50% global reduction in CO_2 by 2030 identified in the IPCC Special Report on Global Warming of 1.5°C.
Plan	Within 12 months of joining, explain what actions will be taken toward achieving both interim and longer-term pledges, especially in the short-to medium-term.
Proceed	Take immediate action toward achieving (net) zero, consistent with delivering interim targets specified.
Publish	Commit to report publicly both progress against interim and long-term targets, as well as the actions being taken, at least annually. To the extent possible, report via platforms that feed into the UNFCCC Global Climate Action Portal.
Leadership practices	
Scope	Targets must cover all greenhouse gas emissions: 1) Including Scope 3 for businesses and investors where they are material to total emissions and where data availability allows them to be measured sufficiently. 2) Including all territorial emissions for cities and regions Leading targets may also include: 1) Cumulative emissions (for all actors). 2) Consumption emissions (for cities, states, and regions.
Sinks and credits	1) In the transition to (net) zero, prioritize reducing emissions, limiting any residual emissions to those that are not feasible to eliminate. 2) Clearly specify what sinks or credits are used to make what, if any, neutralization claims, clarifying how sinks and credits are used both on the path to (net) zero, and after (net) zero is obtained. Any neutralization of residual emissions must transition to permanent removals by the time (net) zero status is achieved. 3) Encourage immediate contributions to the preservation and restoration of natural sinks, not necessarily linked to neutralization claims. 4) Ensure that any credits achieve robust outcomes for additionality, permanence, and accounting, and do not undermine social justice or harm biodiversity.
Empowerment and equity	Seek to enable all actors to contribute to the global transition toward (net) zero through engagement, information sharing, access to finance, and capacity building. Develop pledges, plans, and actions in consideration of equity, drawing on, inter alia, the sustainable development goals and Articles 2 and 4 of the Paris Agreement.

Together these definitions and criteria set some basic principles:

- Net Zero is a future state with remaining emissions being only those that cannot be reduced.
- The main vehicle towards Net Zero is reduction of own emissions and reduction efforts shall be priority.

- Scope 3 is considered as being own emissions.
- Organizations shall follow a science-based pathway aiming towards and beyond a fair share of halving of global emissions by 2030 compared to 2015 levels and must reflect this in an interim target.
- Any removal to balance residuals shall follow like-for-like principles and be permanent when Net Zero status is claimed.
- Any use of sinks and credits must be clearly explained.

Following UNFCCC's theory of change, having 20% of a sector committing to Net Zero is considered as a tipping point [b-RtZ Mobile operators]. In January, the mobile operators were the first sub-sector to reach this major moment. At this point, 36% of the mobile operators by revenue, and 31% of the mobile operators by connections, are in the Race to Zero. A list of participating mobile operators is given at https://racetozero.unfccc.int/mobile-sector-breakthrough/. Moreover, mobile operators with science-based carbon reduction targets cover 50% of mobile connections and 65% of industry revenues globally.

Closely related to the Race to Zero, the UNFCCC Climate Champions team has worked to develop the climate action pathways which represent a vital part of the Marrakech Partnership for Climate Change toolbox [b-UNFCCC Marrakech] to enhance climate action and ambition towards fully implementing the Paris Agreement [b-UNFCCC PA]. First launched in 2019, these pathways set out sectoral visions for achieving a 1.5°C resilient world in 2050, with overarching transformational milestones, and key impacts that need to be achieved to realize them. The latest publicly available version was produced in 2020 [b-UNFCCC Pathways], and an enhanced version will be available in the summer of 2021. The ICT sector is addressed within the industry pathway [b-UNFCCC Industry].

Appendix III

SBTi Net Zero

(This appendix does not form an integral part of this Recommendation.)

The Science Based Targets initiative (SBTi) is a partnership between the Carbon Disclosure Project (CDP), the United Nations Global Compact, World Resources Institute (WRI) and the World Wide Fund for Nature (WWF). The SBTi call to action is one of the "We Mean Business Coalition" commitments. The initiative drives ambitious climate actions in the private sector by enabling organizations to set science-based emissions reduction targets.

As a start to their Net Zero methodology work, SBTi investigated the current use of the Net Zero concept. They identified that corporate Net Zero targets differed across three important dimensions:

- the range of emission sources and activities included;
- the timeline;
- how organizations are planning to achieve their target.

Moreover, they have included the following decarbonization approaches:

- eliminating sources of emissions within the value chain of the organization (i.e., an organization of scope 1, 2, and 3 emissions);
- removing CO_2 from the atmosphere; and
- compensating for value chain emissions by helping to reduce emissions outside of the value chain (e.g., through the provision of finance).

With this scattered landscape and the difficulties in assessing consistency towards a science-based Net Zero ambition, SBTi developed a document to provide a conceptual foundation for setting and assessing corporate Net Zero targets based on robust climate science in [b-SBTi Net Zero].

In this context, SBTi indicates that "*while the transition to Net Zero will be different for each individual actor, depending on their individual and unique circumstances, it is desirable that all actors converge towards a state that is compatible with reaching Net Zero emissions at the planetary level*".

SBTi presents the need to reach the Net Zero status at a global level as a desired state compared with the current situation, this is illustrated in the Figure III.1.

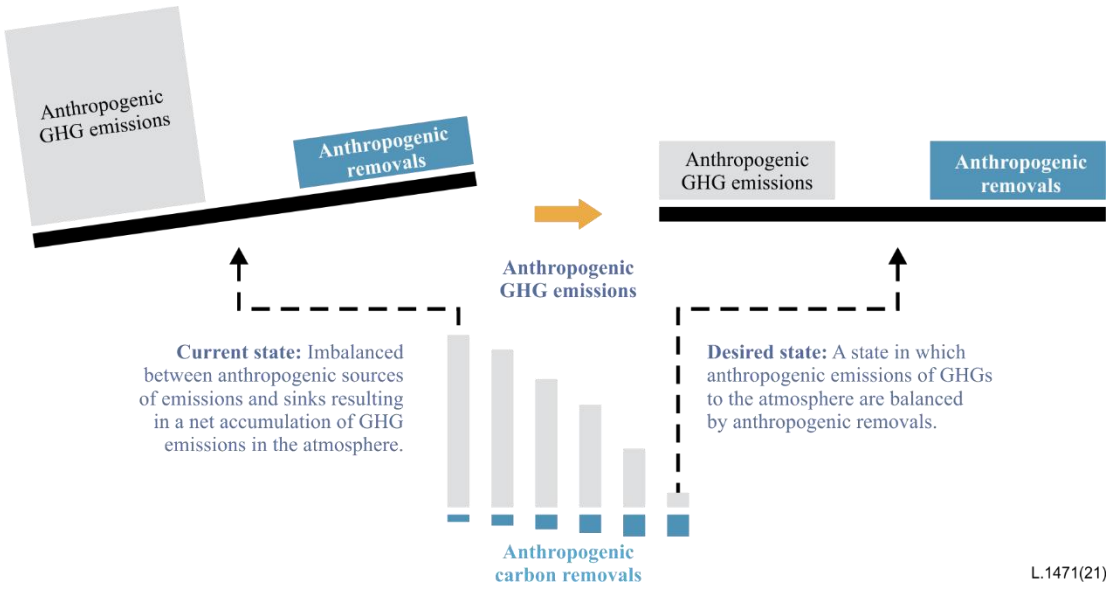


Figure III.1 – The desired state versus current state related to anthropogenic emissions
source: [b-SBTi Net Zero]

This resulted in the following key recommendations:

- **Boundary**: An organization Net Zero target should cover all material sources of GHG emissions within its value chain.
- **Transparency**: Organizations should be transparent about the sources of emissions included and excluded from the target boundary, the timeframe for achieving Net Zero emissions, the amount of abatement and neutralization planned in reaching Net Zero emissions, and any interim targets or milestones.
- **Abatement**: Organizations must aim to eliminate sources of emissions within their value-chain at a pace and scale consistent with mitigation pathways that limit warming to 1.5°C with no or limited overshoot (i.e., this is associated with preventing the release of GHGs at the source). During an organization transition to Net Zero, compensation and neutralization measures may complement, but not substitute, reduction of value chain emissions in line with science. At the time that Net Zero is reached, emissions that are not feasible for society to abate may be neutralized with an equivalent measure of CO_2 removals. This is defined as neutralizing the impact of any source of residual emissions that remain unfeasible to be eliminated by permanently removing an equivalent amount of atmospheric carbon dioxide. It is further stated that 1.5°C-aligned mitigation pathways should be the basis for determining the level of residual emissions for different activities and sectors of the economy at different points in time.
- **Timeframe**: Organizations should reach Net Zero GHG emissions by no later than 2050. While earlier target years are encouraged, a more ambitious timeframe should not come at the expense of the level of abatement in the target.
- **Accountability**: Long-term Net Zero targets should be supported by interim science-based emission reduction targets to drive action within timeframes that are aligned with corporate planning and investment cycles and to ensure emission reductions that are consistent with Paris-aligned mitigation pathways.
- **Neutralization**: Reaching Net Zero emissions requires neutralizing organization residual GHG emissions with an equivalent amount of carbon removals. An effective neutralization strategy involves removing carbon from the atmosphere and storing it for a long-enough period to fully neutralize the impact of any GHG that continues to be released into the atmosphere.

- **Compensation**: While reaching a balance between emissions and removals is the end goal of a Net Zero journey, organizations should consider undertaking efforts to compensate unabated emissions in the transition to Net Zero as a way to contribute to the global transition to Net Zero.
- **Mitigation hierarchy**: Organizations should follow a mitigation hierarchy that prioritizes eliminating sources of emissions within the value chain of the organization over-compensation or neutralization measures. Land-based climate strategies should prioritize interventions that help preserve and enhance existing terrestrial carbon stocks, within and beyond the value chain of the organization.
- **Environmental and social safeguards**: Mitigation strategies should adhere to robust social and environmental principles, ensuring amongst others, protection and/or restoration of naturally occurring ecosystems, robust social safeguards, and protection of biodiversity, amongst others.
- **Robustness**: Compensation and neutralization measures should: (a) ensure additionality, (b) have measures to assure permanence of the mitigation outcomes, (c) address leakage and (d) avoid double-counting.

The SBTi document also distinguishes between the transition towards Net Zero and the Net Zero state.

In particular, SBTi refers to removals and states that organizations may reach a balance between emissions and removals before they reach the depth of decarbonization required to limit warming to 1.5°C. While this represents a transient state of Net Zero emissions, it is expected that organizations will continue their decarbonization journey until reaching a level of abatement that is consistent with 1.5°C pathways.

The SBTi document further distinguishes between actions that organizations take to help society avoid or reduce emissions outside of their value chain (compensation measures) and measures that organizations take to remove carbon from the atmosphere within or beyond the value chain (neutralization measures).

NOTE 1 – SBTi uses the term "neutralization" in the context of removals, explaining that "to neutralize" is to "render something ineffective or harmless by applying an opposite force or effect". Accordingly, the removal and permanent storage of atmospheric carbon is a measure that, theoretically, can neutralize or counterbalance the effect of releasing CO_2 and other GHGs into the atmosphere".

NOTE 2 – SBTi refers to emissions avoidance as "compensation" referring to "measurable GHG emission reductions, resulting from actions outside of the value-chain of an organization that compensate for emissions that remain unabated within the value-chain of an organization". SBTi indicates in its document that "Compensation measures commonly used by organizations include direct investment in emission reduction activities, purchase of carbon credits, and avoided emissions through the use of sold products, amongst others".

SBTi sees two roles for compensation and neutralization related actions:

- In the transition to Net Zero: Organizations may opt to compensate or to neutralize emissions that are still being released into the atmosphere while they transition towards a state of Net Zero emissions;
- At Net Zero: Organizations with residual emissions within their value chain are expected to neutralize those emissions with an equivalent amount of carbon dioxide removals;

While seeing a role for such measures, it is stated that these do not replace the necessity of reducing value chain emissions in line with science.

NOTE 3 – The Swedish Consumer Agency recently published a memorandum regarding environmental statements where they put forward offset claims in the context of Net Zero and other similar concepts as lacking precision and clarity. They also stated that average consumers could not be expected to understand such claims. Even statements that are correct may be considered misleading depending on context and the

impression they create. Though documents from one single market could not be used to make global conclusions this example shows that although offsetting is accepted organizations should be careful in how such activities are referred to [b-SCA].

In particular SBTi summarizes the role of nature-based climate solutions in corporate science-based Net Zero strategies as follows:

- **As part of an organization emissions abatement plan**: Organizations with land-use intensive business models must aim to eliminate deforestation from their supply chains by no later than 2030.
- **As a compensation measure**: Organizations in all sectors can catalyse action that preserves or enhances existing carbon stocks as part of an effort to compensate emissions as they transition toward a state of Net Zero emissions. This should prioritise interventions with strong co-benefits and that contribute to achieving other social and environmental goals.
- **As a neutralization measure**: Organizations with emissions that are not feasible for society to abate can resort to nature-based carbon removal measures to counterbalance the impact of unabated emissions. Interventions that contribute to restoring natural ecosystems are preferred, and organizations should avoid interventions with the potential to create additional land-use pressure.

An overview of mitigation measures is given in Figure III.2.

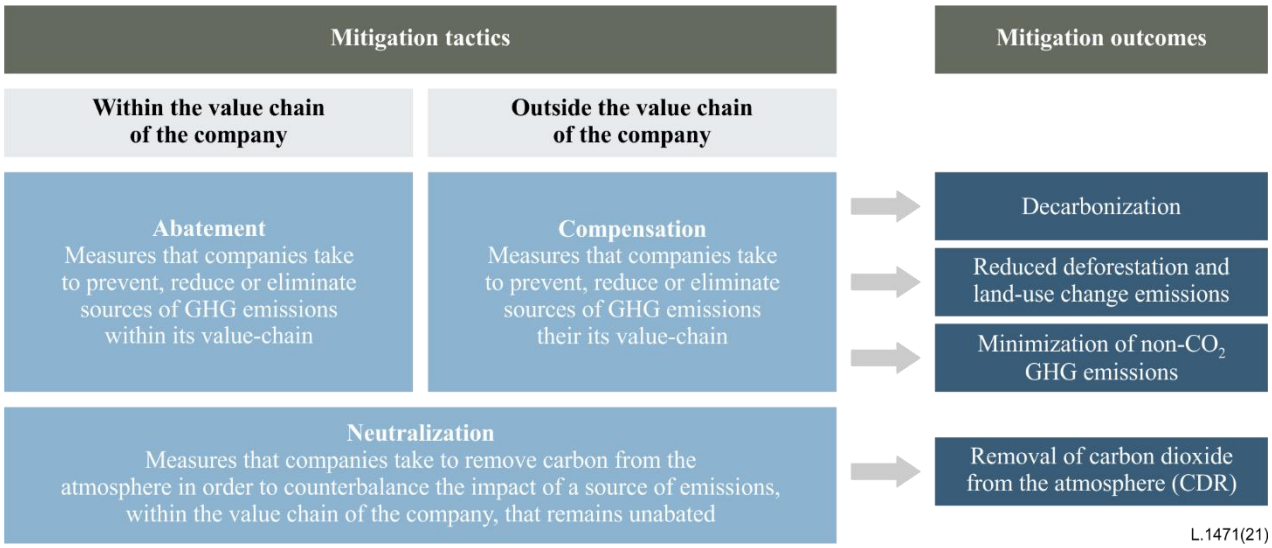
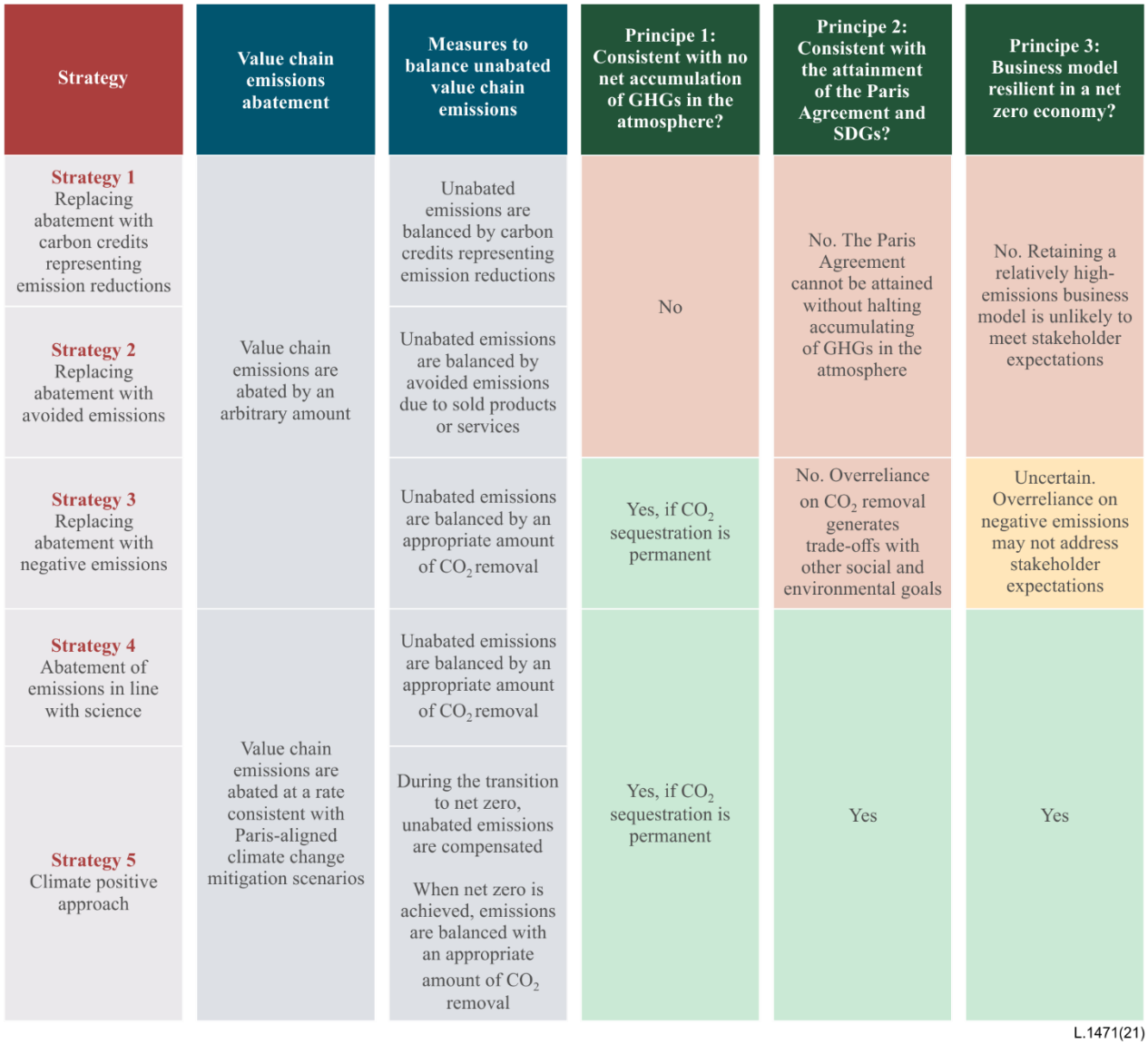


Figure III.2 – Summary of decarbonization strategies and terminology
source: [b-SBTi Net Zero]

SBTi also summarizes priorities and validity of corporate Net Zero claims in Figure III.3.



Strategy	Value chain emissions abatement	Measures to balance unabated value chain emissions	Principe 1: Consistent with no net accumulation of GHGs in the atmosphere?	Principe 2: Consistent with the attainment of the Paris Agreement and SDGs?	Principe 3: Business model resilient in a net zero economy?
Strategy 1 Replacing abatement with carbon credits representing emission reductions	Value chain emissions are abated by an arbitrary amount	Unabated emissions are balanced by carbon credits representing emission reductions	No	No. The Paris Agreement cannot be attained without halting accumulating of GHGs in the atmosphere	No. Retaining a relatively high-emissions business model is unlikely to meet stakeholder expectations
Strategy 2 Replacing abatement with avoided emissions		Unabated emissions are balanced by avoided emissions due to sold products or services			
Strategy 3 Replacing abatement with negative emissions		Unabated emissions are balanced by an appropriate amount of CO_2 removal	Yes, if CO_2 sequestration is permanent	No. Overreliance on CO_2 removal generates trade-offs with other social and environmental goals	Uncertain. Overreliance on negative emissions may not address stakeholder expectations
Strategy 4 Abatement of emissions in line with science	Value chain emissions are abated at a rate consistent with Paris-aligned climate change mitigation scenarios	Unabated emissions are balanced by an appropriate amount of CO_2 removal	Yes, if CO_2 sequestration is permanent	Yes	Yes
Strategy 5 Climate positive approach		During the transition to net zero, unabated emissions are compensated When net zero is achieved, emissions are balanced with an appropriate amount of CO_2 removal			

L.1471(21)

Figure III.3 – Summary of decarbonization strategies and terminology
source: [b-SBTi Net Zero]

Strategies 4 and 5 give priority to GHG emissions reductions respecting a 1.5°C trajectory. According to strategies 4 and 5, scope 1, 2 and 3 emissions (Note: SBTi uses the term "value chain emissions") are to be reduced (Note: SBTi uses the term "abated") at a rate consistent with emission pathways that meet the ambition of the Paris Agreement, limiting warming to 1.5°C in 2100 compared to pre-industrial levels.

Appendix IV

UNFCCC Climate Neutral Now initiative

(This appendix does not form an integral part of this Recommendation.)

The Climate Neutral Now initiative is one of several initiatives launched by the UNFCCC secretariat to increase climate action by engaging non-party stakeholders (sub-national governments, organizations, organizations, individuals). It was launched in 2015 based on a mandate to promote the voluntary use of carbon market mechanisms recognized under the UNFCCC Convention.

It has evolved to become a much wider tool for awareness-raising, capacity building, partnership development, promoting and facilitating the estimation of carbon footprints, the reduction of those footprints, and voluntary compensation.

The Climate Neutral Now Initiative encourages and supports organizations and other interested stakeholders to act now in order to achieve a climate neutral world by 2050 as enshrined in the Paris Agreement. It is a tool to promote additional voluntary action on climate, and to provide recognition for it.

Claims of carbon neutrality, Net Zero or similar aims are out of the scope of the Climate Neutral Now initiative. Instead, UNFCCC addresses Net Zero as part of the Race to Zero initiative (see clause 7.1).

Participants follow the three steps (measure, reduce, contribute) and report on their actions and achievements annually. This approach is illustrated in Figure IV.1.

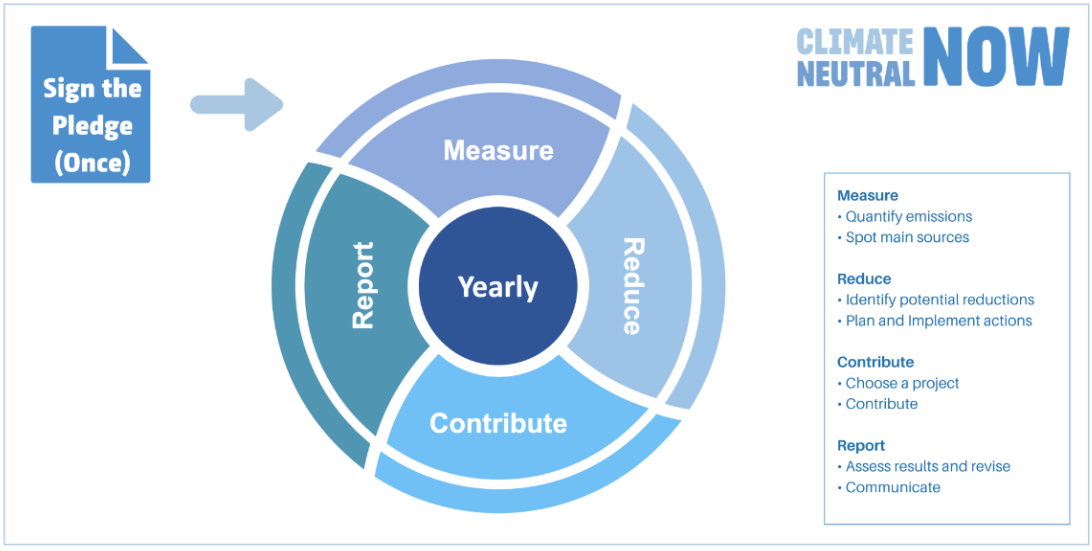


Figure IV.1 – Climate Neutral Now approach
source: UNFCCC website April 2021

Appendix V

Net Zero initiative

(This appendix does not form an integral part of this Recommendation.)

The Net Zero initiative is a private initiative by a French consulting organization, developed in cooperation with organizations and supported by a scientific council. This initiative defines how organizations can contribute to Net Zero at global level and released a publication on the topic in April 2020.

The Net Zero initiative recommends that organizations contribute to Net Zero at global level across three pillars as described in Figure V.1.

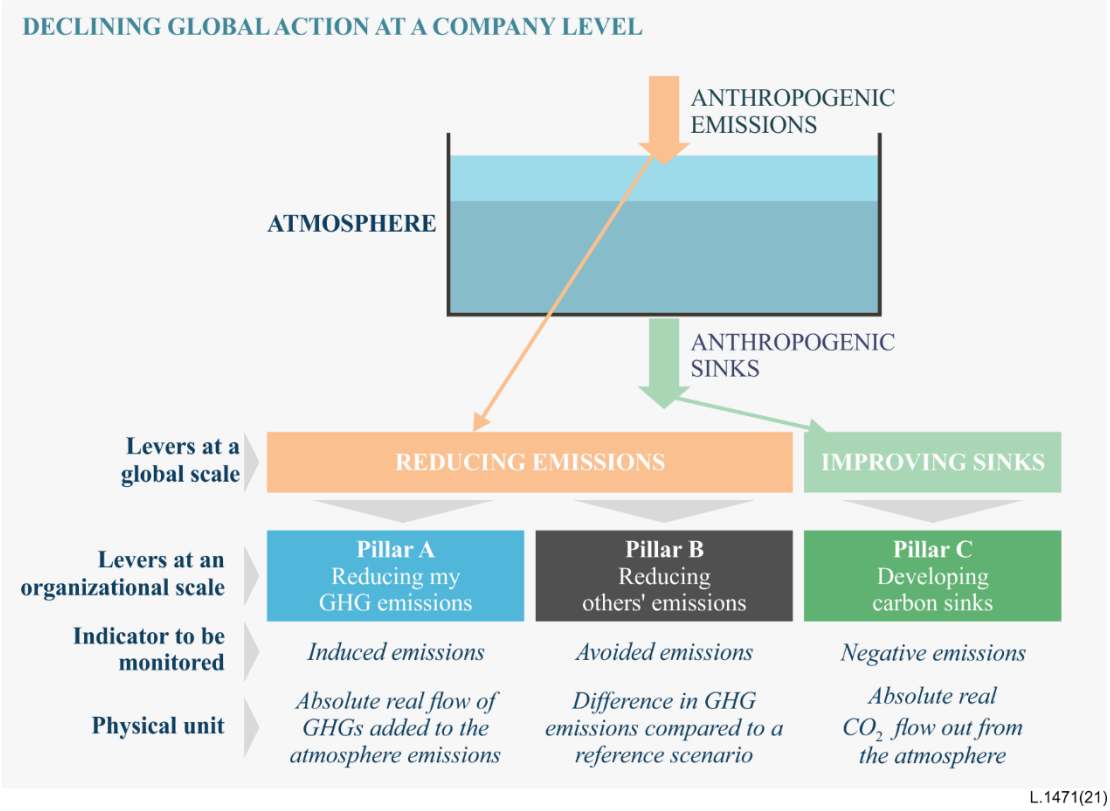


Figure V.1 – Declining Net Zero global action to organization level
source: [b-NZI initiative]

The framework is based on several key principles:

- Net Zero is only used to refer to the global goal of balancing the emissions and removals.
- Organizations can contribute to the trajectory towards global Net Zero.
- The three pillars shown in the Figure V.2 shall be rigorously distinguished and counted separately.

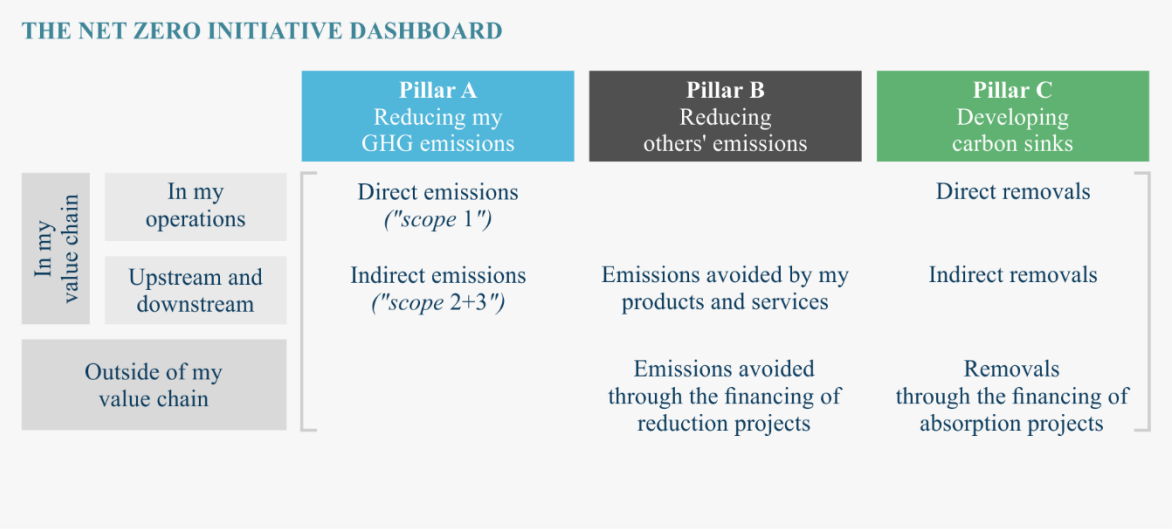


Figure V.2 – Net Zero initiative dashboard at organization level
source: [b-NZI initiative]

Each organization is then encouraged to:

- Measure its performance on these three pillars;
- Set ambitious objectives for each of them;
- Manage them dynamically over time.

Bibliography

[b-ITU-T L-Sup.37] ITU-T L-series Recommendations – Supplement 37 (2020), *Guidance to operators of mobile networks, fixed networks and datacentres on setting 1.5°C aligned targets compliant with Recommendation ITU-T L.1470*.

[b-ITU-T L-Sup.38] ITU-T L-series Recommendations – Supplement 38 (2020), *Guidance for information and communication technology manufacturers on setting 1.5°C aligned targets compliant with Recommendation ITU-T L.1470*.

[b-Exp Roadmap] J. Falk, O. Gaffney, A. K. Bhowmik, P. Bergmark, V. Galaz, N. Gaskell, S. Henningsson, M. Höjer, L. Jacobson, K. Jónás, T. Kåberger, D. Klingenfeld, J. Lenhart, B. Loken, D. Lundén, J. Malmodin, T. Malmqvist, V. Olausson, I. Otto, A. Pearce, E. Pihl, T. Shalit, *Exponential Roadmap* 1.5.1. Future Earth. Sweden. (January 2020)

[b-GHGP] Greenhouse gas Protocol. The Greenhouse Gas Protocol. 2004. Available [viewed 2021-08-25] at: https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf

[b-IPCC 1.5] Intergovernmental Panel on Climate Change (2018). Special report: Global warming of 1.5°C. Available [viewed 2020-03-25] at: https://www.ipcc.ch/sr15/

[b-IPCC Glossary] IPCC, 2018: Annex I: Glossary [Matthews, J.B.R. (ed.)]. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)].

[b-NZI Framework] Net Zero Initiative and Carbone 4. *Net Zero initiative, a framework for collective carbon neutrality*, *Net Zero initiative*, April 2020.

[b-RtZ Criteria] UNFCCC Race to Zero, *Starting Line and Leadership Practices 2.0* – In force from 1 June 2021. 2021. Accessed 2021-04-27. https://racetozero.unfccc.int/wp-content/uploads/2021/04/Race-to-Zero-Criteria-2.0.pdf

[b-RtZ info] UNFCCC Race to Zero, *Race to Zero campaign*, 2021. Accessed 2021-04-27. https://unfccc.int/climate-action/race-to-zero-campaign

[b-RtZ Lexicon] UNFCCC Race to Zero, *Race to Zero Lexicon*, 2021. Accessed 2021-04-27. https://racetozero.unfccc.int/wp-content/uploads/2021/04/Race-to-Zero-Lexicon.pdf

[b-RtZ Mobile operators] UNFCCC Race to Zero, *Mobile sector declares climate action breakthrough*. 2021. Accessed 2021-04-27. https://racetozero.unfccc.int/mobile-sector-breakthrough/

[b-SBTi Net Zero] Science-based targets initiative, *Foundations for science-based net-zero target setting in the corporate sector*, Version 1.0, 2020. https://sciencebasedtargets.org/resources/legacy/2020/09/foundations-for-net-zero-full-paper.pdf

[b-SBTi ICT] SBTi, *Guidance for ICT organizations setting science based targets – mobile networks operators, fixed networks operators and data centres operators*. 2020. https://sciencebasedtargets.org/resources/legacy/2020/04/GSMA_IP_SBT-report_WEB-SINGLE.pdf

[b-SCA] Swedish Consumer Agency, Tematisk PM Miljöpåståenden om klimatkompenserade produkter i marknadsföring, 2021. https://www.konsumentverket.se/contentassets/6059fffaa60b41daa76cf3dfe0849867/pm_miljopastaenden_klimatkompenserade_produkter_kov_2021_tillganglig.pdf

[b-UNFCCC Industry] Industry – Climate Action Pathway. Visited 2021-04-28. https://unfccc.int/climate-action/marrakech-partnership/reporting-tracking/pathways/industry-climate-action-pathway#eq-1

[b-UNFCCC Marrakech] *Marrakech Partnership for Climate Action*. Visited 2021-04-28. https://unfccc.int/climate-action/marrakech-partnership-for-global-climate-action

[b-UNFCCC Pathways] *Climate Action Pathways*. 2020. Visited 2021-04-28. https://unfccc.int/climate-action/marrakech-partnership/reporting-and-tracking/climate_action_pathways

[b-UNFCCC PA] United Nations Framework Convention on Climate Change (2015). *Paris agreement.* New York, NY: United Nations. 27 pp. Available [viewed 2018-11-16] at: https://unfccc.int/sites/default/files/english_paris_agreement.pdf

SERIES OF ITU-T RECOMMENDATIONS

Series A	Organization of the work of ITU-T
Series D	Tariff and accounting principles and international telecommunication/ICT economic and policy issues
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	Transmission systems and media, digital systems and networks
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	Cable networks and transmission of television, sound programme and other multimedia signals
Series K	Protection against interference
Series L	**Environment and ICTs, climate change, e-waste, energy efficiency; construction, installation and protection of cables and other elements of outside plant**
Series M	Telecommunication management, including TMN and network maintenance
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Telephone transmission quality, telephone installations, local line networks
Series Q	Switching and signalling, and associated measurements and tests
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks, open system communications and security
Series Y	Global information infrastructure, Internet protocol aspects, next-generation networks, Internet of Things and smart cities
Series Z	Languages and general software aspects for telecommunication systems

Printed in Switzerland
Geneva, 2021