Current landscape of initiatives and standardisation norms and approaches

Deliverable 1.1

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Climateurope2

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About Climateurope2

Timely delivery and effective use of climate information is fundamental for a green recovery and a resilient, climate neutral Europe, in response to climate change and variability. Climate services address this through the provision of climate information for use in decision-making to manage risks and realize opportunities.

The market and needs for climate information has seen impressive progress in recent years and is expected to grow in the foreseeable future. However, the communities involved in the development and provision of climate services are often unaware of each other and lack interdisciplinary and transdisciplinary knowledge. In addition, quality assurance, relevant standards, and other forms of assurance (such as guidelines, and good practices) for climate services are lagging behind. These are needed to ensure the saliency, credibility, legitimacy, and authoritativeness of climate services, and build two-way trust between supply and demand.

Climateurope2 aims to develop future equitable and quality-assured climate services to all sectors of society by:

- Developing standardisation procedures for climate services
- Supporting an equitable European climate services community
- Enhancing the uptake of quality-assured climate services to support adaptation and mitigation to climate change and variability

The project will identify the support and standardisation needs of climate services, including criteria for certification and labelling, as well as the user-driven criteria needed to support climate action. This information will be used to propose a taxonomy of climate services, suggest community-based good practices and guidelines, and propose standards where possible. A large variety of activities to support the communities involved in European climate services will also be organized.

Executive Summary

Climate services provide climate information for use in decision-making to manage risks and improve preparedness for climate change. Climateurope2 aims to develop future equitable and quality-assured climate services to all sectors of society by developing standardisation procedures for climate services and supporting an equitable European climate services community. The project will identify the support and standardisation needs of climate services, including the existing landscape of standards and standardisation activities dedicated to increase climate resilience of cities, infrastructure and sectors as well as standards relevant for the components and processes to provide quality climate services.

The work described in this deliverable aims at describing the standardisation importance and context as well as it gathers the outputs of standard and guidelines search and describes the most relevant standardisation initiatives to Climateurope2 project.

There are different standardisation activities at international, European and national level dealing with climate change, community resilience and risk that provide an umbrella for data and user engagement etc. in relation to climate change. It should be highlighted that the landscape of initiatives is expected to grow due to different drivers. The London declaration approved in September 2021 by which ISO committed to combat climate change through standards and achieve climate agenda by 2050. This has translated into a commitment to review current and developing standards with a climate change perspective. To achieve this goal, new working groups/subcommittees (e.g. ISO/TC 224) and guidelines (ISO Guide 84) have been created.

Regarding the screening search of the existing standards, this has focused on four pillars targeting to describe the context and needs in relation to:

- Climate change, security, risk and resilience of cities
- Quality Management
- Adaptation solutions
- Sectoral standards requiring environmental parameters

In order to identify those standards relevant to Climateurope2 a two-step screening methodology was followed:

1. Title and descriptors relevancy: from more than 6000 entries 193 standards passed the first screening criteria
2. Abstract and index relevancy: 91 standards passed the second screening criteria

These 91 identified standards were complemented with another 29 standards that resulted from an occasional search to the ISO website and TECNALIA's own knowledge on 'climate change' and 'sustainable cities and communities' set of standards, giving a total of 120 potential standards of interests in various fields: from nature-based solutions and water management standards which

performance and maintenance may depend on climate data to energy, building and transport sectoral standards requiring environmental data.

Furthermore, this standard search was complemented with a revision of the guidelines, requirements and good practices, mainly from the World Meteorological Organisation (WMO). It has to be highlighted that these documents often refer to quality management standards as reference documents for their development.

The performed analysis described in this deliverable will be revised and complemented as the project's activities advance and will incorporate WP 2 to 5 requirements, needs and vision in accordance with Task 1.3 *Synthesis and guidance information*.

Keywords

Standards, standardisation, climate services, gap analysis, climate adaptation

1 Introduction

Climateurope2 aims to develop future equitable and quality-assured climate services to all sectors of society by developing standardisation procedures for climate services, supporting an equitable European climate services community and enhancing the uptake of quality-assured climate services to support adaptation and mitigation to climate change and variability. In order to address these objectives, the evaluation of the current landscape of standards and standardisation initiatives is evaluated in this document. This analysis will be reviewed as the project evolves.

1.1 Objectives of the work

Task 1.1 of the Climateurope2 project aims at clarifying the existing landscape of technical, procedural and performance norms and standards and identifying initiatives supporting standardisation of climate services. This allows to understand areas of standardisation which are more mature than others, identify gaps and opportunities to support standardisation through Task 1.4 *setting the ground for standardising climate services* or other relevant activities within Climateurope2.

1.2 Structure of this report

The report is divided into 3 sections. Following this introduction, Section 2 describes the used methodology for the data gathering of the standardisation initiatives, published or under development standards as well as relevant guidelines, requirements and good practices. Section 3 focuses on a summary of the results and conclusions of the standard search. Finally, Section 4 establishes the next steps that will be carried out (under task T1.3 *Synthesis and guidance information*) to continue feeding and updating the landscape of standards as the Climateurope2 project evolves and generates new knowledge such as frameworks, methodologies and guidance.

1.3 Equitable statement

This deliverable and the work to develop its content has been produced considering three criteria: Equity, Diversity and Inclusion.

- **Equity** is understood as all individuals to have equal opportunity to contribute and access the information derived from this work. This will help to remove barriers and avoid systemic biases while having equal opportunity to benefit from the knowledge resulting from this Landscape. To achieve this, TECNALIA and BSC have led various meetings aimed at awareness raising among the different WPs regarding activities developed within WP 1 and thus breaking silos of knowledge among WPs. The outputs of this work will be accessible to all members of the consortium via this deliverable and follow up meeting (Task 1.3) to periodically retrieve inputs, requirements and needs around standardisation as the Climateurope2 project evolves.
- **Diversity** is understood as differences in race, gender, age, background and perspectives etc., as well as different degrees of experience in climate services, research expertise and roles in Climateurope2. A diversity of perspectives (*e.g.* working team, consortium composition etc.) has been accommodated within the work to achieving research excellence and promote equitable outputs from Climateurope2.

- **Inclusion** is understood as the practice of ensuring that all individuals and their perspectives and contributions are valued and respected. To achieve this, an effort to hear and integrate the views from different WPs and individuals has been made and was a guiding principle in all the meetings held.

2 Methodology

2.1 Standardisation initiatives involvement

The Climateurope2 project team has been participating in different standardisation initiatives related to climate change adaptation and standards in sectors with climate data needs. These activities have allowed to identify and map the existing landscape of standards related to climate services. In particular, the team has been participating in:

- *ISO/TC 207/SC 7/TG 2 "Adaptation"*
- *CEN/TC 467 "Climate Change"*
- *CEN/TC 465 "Sustainable Cities and Communities"*
- *UNE CTN 216/GT 02 "Cambio climático"*: This is the national "mirror" group of CEN/TC 467
- *UNE CTN 178 "Ciudades inteligentes"*. national mirror group of:
    - *ISO/TC 268 Sustainable cities and communities*
    - *IEC/SyC Smart Cities SyC Electrotechnical aspects of Smart Cities*
    - *CEN-CLC-ETSI/SF on Smart and Sustainable Cities and Communities*
    - *CEN/TC 465 "Sustainable Cities and Communities"*
    - *CEN/WS SCS - Description and Assessment of Good Practices for Smart City Solutions*
- Other sectoral Technical Committees.

The terminology and abbreviations used in this list is explained in section 3.1, that also synthetises the most relevant information collected.

2.2 Standards search

Additionally, to the involvement in standardisation initiatives and forums related to climate services, a search of standards that could be relevant to climate services has been performed using a standard database accessible by DIN. The search has been focused on four pillars as seen in Figure 1. Two of the pillars have the objective of mapping the current standardisation framework which can be relevant to consider when developing climate services while the other two pillars (adaptation measures and sectoral standards) aim at identifying standards that require or could require essential climate variables (ECV) and/or climate data in the planning, design and operation phases.

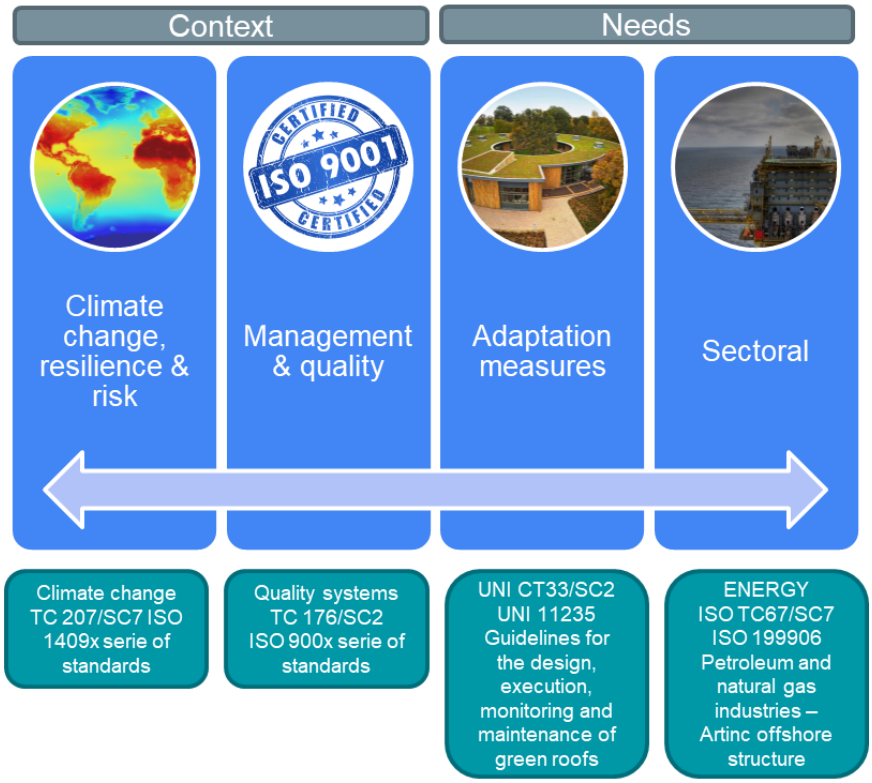

Figure 1. The four pillars of standard search and an example of the type of standard that lies under each category

2.2.1 Step1: Methodology for standard search

The standards research was carried out using the SNIF (Semantisches Normen-Informations-Framework, engl.= Semantic Standards Information Framework) reference database. SNIF is a software solution for standard research developed by DIN Software GmbH. SNIF has access to about 80,000 documents, of which about 4000 are standards from official standards organisations such as ISO, CEN, or DIN. The software has access ***only*** to DIN adoptions of CEN and ISO documents.
The search is carried out in German, but the results are shown in English as well. The software allows i.a. the following research options:

1. different search fields (document number, date of issue, classification, etc.),
2. variable search settings,
3. filters to refine search results,
4. extensive linking options,
5. search in the index and by subject groups,
6. automatic updating of identified standards,
7. full text research,
8. status of the document (active/ withdrawn)

First, the relevant themes and keywords were defined. These keywords were the inputs for the search using the SNIF database. An overview of the search terms used is shown in Table 1. In order to achieve

the best possible result various search strategies were combined. This search was occasionally complemented by direct search into the ISO websites.

Table 1. Overview of relevant keywords for standard search

No. of search	Keyword	Number of hits (SNIF)
1	Amphibic houses & floating houses	168
2	Back-up power generator	181
3	Bioclimatic house/architecture	0
4	Cool pavement or roof	0
5	Water storage	2494
6	Dike	8
7	District energy/heating	4
8	Exterior shading device	18
9	Flood gates	61
10	Green roof	119
11	Trees	656
12	Park	29
13	Green façade	35
14	Infiltration basin	19
15	Passive cooling	288
16	Permeable pavement	7
17	Rainwater harvesting system	15
18	Retention pond	23
19	SUDs (sustainable drainage system)	61
20	Storm-surge barrier	0
21	Swales	1
22	Transport	3297
23	Drainage	522
24	Energy	3056

25	Agriculture	253
26	Building	482
27	Forestry	158
28	Fishery	13
29	Climate change	751
30	Risk	3016
31	Resilient cities	65

2.2.2 Step2: Screening assessment of relevancy

The SNIF search resulted in a high number of hits (see Figure 1). Thus, in order to identify those standards relevant to Climateurope2 a two-step screening methodology was followed. Title, descriptors, abstract and index were reviewed to evaluate if each standard is relevant for climate service standardisation and/or promotion with the next results:

1. Title and descriptors relevancy: 193 standards passed the first screening criteria

2. Abstract and index relevancy: 91 standards passed the second screening criteria

These 91 identified standards were complemented with another 29 standards that resulted from an occasional search to the ISO website and TECNALIA's own knowledge on 'climate change' and 'sustainable cities and communities' set of standards.

It has to be highlighted that the outputs of the screening assessment do not necessarily assure that the identified standards are relevant to Climateurope2 project as the consortium partners do not have access to the full standard documents. However, this analysis will identify standards for which it may be relevant to grant full access to.

2.3 Guidelines, recommendations and good practices search

Standards may come in different forms which represent the institutional setting, degree of participation and type of assurance among other factors. Furthermore, standards may progress from one to another and therefore the overview of the standards landscape cannot only be used in isolation to which standards exists but also how industries and climate service markets may develop and apply the standards.

Thus, despite the focus of the landscape is to analyse the standardisation initiatives and technical, procedural and performance norms related to climate services from 'formal' standardisation bodies, it was considered relevant to expand the scope to other relevant normative and descriptive documents

from reference organisations. Thus, a search using non nonspecific search engines as Google was carried out using the keywords shown in Table 2.

Table 2. Overview of the analysed themes and keywords for guidelines, recommendations and good practices

THEME	KEYWORDS
Quality	Quality management (system) AND meteorological service Quality management (system) AND Hydrological service Quality management (system) AND climate service Quality management AND climate monitoring Quality management AND (climate) prediction Quality assurance AND climate service Certification AND climate service Certification AND meteorological (service) Certification AND hydrological (service) Climate service AND best OR good practices Metrological traceability chain assurance
Climate Data	Climate data management AND best OR good practices Statistical analyses characterization datasets AND best OR good practices Climate products AND best OR good practices Climate variables AND measurement AND good practices OR Guidelines Meteorological data processing AND best OR good practices Climate data AND uniformity OR standardisation Representation AND meteorological data AND Good OR Best practices Representation AND forecast AND Good OR Best practices Representation AND climate data AND Good OR Best practices Climate data rescue AND best OR good practices Maintenance AND climate datasets Climate AND interpretation metadata Climate monitoring AND best OR good practices
Climate Observation	Global observing System OR Global observation AND best OR good practices Observational network AND best OR good practices Surface meteorological observing station AND best OR good practices Monitoring climate AND uniformity OR standardisation Climate observation dataset AND best OR good practices
Climate Prediction	Seasonal Climate Forecast AND Guideline OR good practices Climate Forecast AND Guideline OR good practices

3 Results and conclusions

3.1 Standardisation initiatives landscape

The importance of standardisation in general

3.1.1 The importance of standardisation in general

Standards are reference document that represents a consensus among players in a given industry and that define characteristics, rules and procedures in a specific industry or activity. [1] Most standards are voluntary but may be included in regulations to facilitate enforcement.

A customer can impose a standard to its providers to accept their services or products, but very frequently, the market systematizes the collective knowledge, that is "distillated" to define a set of written principles, rules, references, characteristics, protocols, etc that benefits all players. So, usually standards are based on consensus and reflect the commitment of players in a given field to achieve a level of quality, safety, that is recognized and approved.

Table 3. Benefits for different individual participating in standardisation (source: DKE[2])

Companies	Supervisors	Standards experts	Entry-level staff
- Fulfilment of market requirements - Competitiveness due to a time and knowledge advantage - Productivity and efficiency due to early insights into market developments and regulatory processes - Stronger market position due to prompt implementation of new regulations - Cost reduction	- Suitable development of the company - Broad, well-founded access to the topic - Detecting developments and trends early on and having your say - Influence on the results of standards by incorporating own interests	- Broad, interdisciplinary network - Promotion and career opportunities - Constant information about trends and developments in technology and regulations - Representation of your company´s interests	- Deep, founded insights into the respective industry early on - Exclusive knowledge of trends and development in technology and regulations - Clear orientation on the future and networking - Rapid promotion and career

[1] BNQ. *The importance of standardization*. https://www.bnq.qc.ca/en/the-importance-of-standardization.html. Consulted on 06/02/2023.
[2] DKE. *Standards & Specifications*. https://www.dke.de/en/standards-and-specifications/importance-of-standardization. Consulted on 06/02/2023.

Standards mean that consumers can have confidence that products are safe, reliable and of good quality[3]. In a more interconnected world, where the outcome of one organisation is used for other organisations for creating value and distribution chains, standards allow to optimize the development of complex services such as climate services. They can contribute to make them trustable for the final user, but also providing value for all the value chain, optimizing activities as data transfer, quality assurance and control, sustainability, communication, interoperability, etc.

Thus, standards and specifications represent knowledge in the form of regulations and guidelines that are documented in writing and can be easily distributed. They help organisations to understand each other better so they can react faster and act accordingly. In all aspects of life, there are standards that play an important role providing multiple benefits.

3.1.2 Overview of standardisation initiatives and organisations involved

In general terms, a standard is a technical document designed to be used as a rule, guideline or definition[4]. Usually, International, European and National Standardisation bodies create standards by bringing together all interested parties such as manufacturers, consumers and regulators of a particular material, product, process or service, aiming at benefiting all parties through increased product safety and quality as well as lower transaction costs and prices.

These bodies are referred to as standard-setting organisations (or SSO), entities whose primary activities are developing, coordinating, promulgating, revising, amending, reissuing, interpreting, or otherwise maintaining standards that address the interests of a wide base of users outside the standards development organisation. Other definitions of SSO are:

" an organisation accredited by the American National Standards Institute that develops and maintains standards for information transactions or data elements, or any other standard that is necessary for, or will facilitate the implementation of, this part"[5]

"any organisation, group, joint venture, or consortium that develops standards for the design, performance, or other characteristics of products or technologies"[6]

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[3] ISO. *Benefits of standards*. https://www.iso.org/benefits-of-standards.html. Consulted on 06/02/2023.

[4] CEN/CENELEC. 2023. *European Standards. What is a standard?* https://www.cencenelec.eu/european-standardisation/european-standards/. Consulted on 06/02/2023.

[5] U.S. Government Publishing Office. *Electronic Code of Federal Regulations (e-CFR). Title 45 - Public Welfare. Subtitle A - Department of Health and Human Services. Subchapter C - Administrative data standards and related requirements. Part 160 - General administrative requirements. Subpart A - General Provisions. § 160.103 Definitions.* https://www.govinfo.gov/content/pkg/CFR-2013-title45-vol1/pdf/CFR-2013-title45-vol1-sec160-103.pdf.

[6] Federal Trade Commission. 2016. *Patent Assertion Entity Activity: An FTC Study*. https://www.ftc.gov/reports/patent-assertion-entity-activity-ftc-study

SSOs are very diverse, and some examples of organisations promoting a wide range of standards are the International Organisation for Standardisation (ISO), the European Committee for Standardisation (CEN), the American National Standards Institute (ANSI), the European Telecommunications Standards Institute (ETSI), etc. Other SSOs have a clear focus on specific sectors and activities being clear leaders in a particular field, geography or domain, such as the European Computer Manufacturers Association (ECMA), the American Bankers Association (ABA), and the Institute of Electrical and Electronics Engineers (IEEE).

In some fields of technology one or few SSOs with a clear dominating position for standard development (e.g. the mobile telecommunication standards are mostly developed at 3GPP[7] and ETSI). However, sometimes several SSOs are active in a particular domain, as the case of the Internet Engineering Task Force and the Internet Architecture Board. In this case, that is maybe the current situation for most of the component of Climate Services, agents aiming to standardise their products have to choose the right one to optimize the effort of standardising a product, a process, practice, etc. These decisions are driven by contextual factors, such as the industry context and a decision-makers' firm characteristics, and especially SSOs' characteristics.[8]

Not all standards are developed by SSOs with a participative approach as those mentioned above (ISO defines its role as the conductor of an orchestra while the orchestra is made up of independent technical experts nominated by its members, the national standardisation bodies). When a published standard achieves widespread acceptance and dominance it can become a broader "de facto" standard for an industry. This happened several times in the IT industry where individual companies created standards that allowed to develop successful technologies (e.g. the modem protocol developed by Hayes[9]). On the other hand, the history of the proprietary bus and power connector standard "lightning"[10], imposed by Apple to the peripheral developers, is an example of a standard that hampered the market and finally was abandoned and banned[11].

This section maps the initiatives developed by SSOs with a clear link with climate services design, development and operation with the goal of optimizing the decisions that will be taken if future activities of the Climateurope2 project. Before moving on in that direction, it will present some of the most relevant SSOs related to climate services.

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[7] The 3rd Generation Partnership Project. *About us*. https://www.3gpp.org/about-us. Consulted on 06/02/2023.

[8] Wiegmann, P. M., et al. 2022. *Competing Standard-Setting Organizations: A Choice Experiment*. *Research Policy*. Volume 51, Issue 2, March 2022, 104427. https://doi.org/10.1016/j.respol.2021.104427.

[9] Wikipedia. *Hayes command set*. https://en.wikipedia.org/wiki/Hayes_command_set. Consulted on 06/02/2023.

[10] Apple Fandom. *Lightning (connector)*. https://apple.fandom.com/wiki/Lightning_(connector). Consulted on 06/02/2023.

[11] European Parliament. 2022. *News European Parliament. Deal on common charger: reducing hassle for consumers and curbing e-waste*. https://www.europarl.europa.eu/news/en/press-room/20220603IPR32196/deal-on-common-charger-reducing-hassle-for-consumers-and-curbing-e-waste.

3.1.3 The International Organisation for Standardisation (ISO) and the International Electrotechnical Commission (IEC)

ISO (International Organisation for Standardisation)[12] [13] is a global federation of national standard-setting organisations. ISO is a voluntary organisation made up of standard-setting bodies from over 160 nations, with one standard-setting body representing each member country. For example, DIN represents Germany, NEN, Netherlands, BSI, United Kingdom, etc. National standards organisations that are ISO members work together to establish and promote international standards for technology, scientific testing techniques, working conditions, social challenges, and more. ISO and its members then sell publications containing details about these standards.

Another worldwide standards organisation that creates standards for electronic technology is the International Electrotechnical Commission (IEC). The IEC collaborates with other standards organisations such as ISO, the International Telecommunication Union, and the IEEE.

International Standards are developed by ISO technical committees (TC) and subcommittees (SC) by a six-step process[14]: 1) Proposal stage, 2) Preparatory stage, 3) Committee stage, 4) Enquiry stage, 5) Approval stage, 6) Publication stage. There is also a Fast-track procedure if a document with a certain degree of maturity is available at the start of a standardisation project (e.g. a standard developed by another organisation).

As a result of this process ISO Committees develop various forms of publications:

- International Standards specify rules, standards, or characteristics for actions or their outcomes in order to achieve the greatest degree of order in a particular setting. It can take many different shapes. Other examples include test techniques, codes of practice, guideline standards, and management system standards, in addition to product standards.

- Technical Specifications cover work that is still under technical progress or where it is anticipated that an International Standard will be agreed upon in the future, but not immediately. A Technical Specification is published for immediate use, but it also allows for comments. The goal is for it to be modified and reprinted as an International Standard in the future.

- Technical Report provides material that is distinct from the preceding two publications. It may comprise data acquired from a poll, for example, or from an instructive report, or knowledge concerning the considered "state of the art".

- Publicly Available Specification is released in response to an urgent market need, and it represents either the agreement of experts within a working group or the consensus of an

[12] According to ISO, “ISO” is not an acronym, but a name is derived from the Greek word “isos” which means “equal”.
[13] ISO. https://www.iso.org/. Consulted on 06/02/2023.
[14] ISO/IEC. 2022. *ISO/IEC Directives, Part 1. Procedure for the Technical work*. https://www.iso.org/sites/directives/current/part1/index.xhtml. Consulted on 06/02/2023.

entity outside of ISO. Publicly Available Specifications, like Technical Specifications, are published for immediate use and also serve as a mechanism of collecting feedback for ultimate development into an International Standard. Publicly Available Specifications have a maximum life of six years before being turned into an International Standard or being removed.

- International Workshops Agreements (IWA) are documents produced through a workshop meeting rather than through the full ISO technical committee process. Market players and other stakeholders directly participate in developing an IWA and do not have to go through a national delegation.

ISO is the largest developer and publisher of International standards and some of its most popular standards are potentially of interest for climate services. Some examples of relevant ISO standards, some of them jointly developed with IEC are:

- ISO 9001 and related standards[15]: This set of standards specifies how organisations may create and maintain successful quality assurance systems in the manufacturing and service sectors. Their principles are recommended by the WMO as the basis for Guidelines on Quality Management in Climate Services[16].

- ISO/IEC 20000 certification[17]. This ISO standard develops a technical definition for IT service management and codifies best practices. It could support every step of climate service lifecycle, from ideation to planning, from delivery to improvement. ISO/IEC 20000-1:2018 ('part 1') specifies requirements for "establishing, implementing, maintaining and continually improving a service management system (SMS). An SMS supports the management of the service lifecycle, including the planning, design, transition, delivery and improvement of services, which meet agreed requirements and deliver value for customers, users and the organisation delivering the services.

- ISO/IEC 27001 and related standards[18]. This set of standards for information technology security approaches specifies a six-step procedure for developing and implementing information security policies and procedures that may be of relevance to any source of climate data. ISO/IEC 27001 is the most well recognized international standard for information security management systems (ISMS) and their requirements. More than a dozen ISO/IEC 27000 standards offer further best practices in data protection and cyber resilience.

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[15] ISO. *ISO 9001 and related standards.* https://www.iso.org/iso-9001-quality-management.html. Consulted on 05/02/2023

[16] WMO. *Guidelines on Quality Management in Climate Services.* WMO-No. 1221. https://library.wmo.int/index.php?lvl=notice_display&id=20652#.Y9hRv3bMKUk. Consulted on 05/02/2023

[17] BSI. *ISO/IEC 20000-1 Service Management. Delivering quality and value through services*. https://www.bsigroup.com/en-GB/iso-20000-service-management/.

[18] ISO. *ISO/IEC 27001 and related standards. Information security management*. https://www.iso.org/isoiec-27001-information-security.html. Consulted on 05/02/2023

- *ISO/IEC 17799:2005, Information technology — Security techniques — Code of practice for information security management*[19], establishes guidelines and general principles for initiating, implementing, maintaining, and improving information security management in an organisation. It contains best practices of control objectives and controls in the areas of information security management related to climate services provision as information systems acquisition, development and maintenance, business continuity management, etc.

- *ISO/IEC 12207, Systems and software engineering — Software life cycle processes*[20] establishes a standardised lifecycle management process for all software, an intrinsic element of most climate services.

- *ISO/IEC 31000, Risk management*[21], defines a risk management framework for standardising definitions of risk-associated terms and offers guidelines for any person, business or agency. This family of standards defines an approach to managing risks, including risk identification, risk analysis, risk evaluation and risk assessment. Climate change adaptation related climate services usually focus on the IPCC approach to risk[22], but ISO/IEC 31000 is a reference in industrial and business landscape.

ISO standards for adaptation

The ISO 1409x series are designed to help organisations develop measures and report on adaptation activity in a verifiable way[23]. Since a central goal of a substantial part of climate services is to support adaptation, it is of interest to consider how this set of norms take into account the uptake of climate information into the adaptation cycle.

The first International Standard on climate adaptation is *ISO 14090, Adaptation to Climate Change - Principles, Requirements, and Guidelines*. It focuses on integrating adaptation inside or across organisations by assisting in understanding the effects and uncertainties of climate change and how they may be utilized to influence decision-making. It applies to every organisation, no matter its size, kind, or character, including local, regional, and worldwide enterprises and governments. The standard, which provides a solid foundation for adaptation planning, is supplemented by new ISO 1409x series extensions that provide greater detail on specific issues:

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[19] ISO. *ISO/IEC 17799:2005. Information technology — Security techniques — Code of practice for information security management*. https://www.iso.org/standard/39612.html. Consulted on 03/02/2023.
[20] ISO. *ISO/IEC/IEEE 12207:2017. Systems and software engineering — Software life cycle processes*. https://www.iso.org/standard/63712.html. Consulted on 03/02/2023.
[21] ISO. *Popular standards. ISO 31000. Risk management*. https://www.iso.org/iso-31000-risk-management.html. Consulted on 22/02/2023.
[22] IPCC. The concept of risk in the IPCC Sixth Assessment Report: a summary of cross Working Group discussions. https://www.ipcc.ch/site/assets/uploads/2021/02/Risk-guidance-FINAL_15Feb2021.pdf
[23] ISO. 2022. *Environment. Climate change adaptation*. https://www.iso.org/publication/PUB100449.html

- *ISO 14091, Adaptation to climate change – Guidelines on vulnerability, impacts and risk assessment*, gives recommendations on assessing the risks associated with climate change impacts. Its application aims to reduce vulnerability by addressing medium- and long-term adaptation demands, and it will assist all businesses in improving their awareness of system vulnerabilities and the importance of these vulnerabilities to their operations.

- *ISO/TS 14092, Adaptation to climate change – Requirements and guidance on adaptation planning for local governments and communities*, provides particular guidance for local governments. This standard is identified as "TS" or Technical Specification because it is the most "procedural" of all the series. It lays out a systematic strategy that uses impact assessment (detailed in ISO 14091) to determine an organisation's local climate vulnerability and adaptable capability and to assist the necessary national adaptation plan. Monitoring and assessing plan execution, including stakeholders, documenting, and iteratively modifying current adaption plans and policies are all fundamentals.

- *ISO 14093, Mechanism for financing local adaptation to climate change – Performance-based climate resilience grants – Requirements and guidelines*, which defines a framework for a country-based system that assists in channelling climate money to subnational authorities. Its purpose is to aid in climate change adaption and promote local resilience.

Furthermore, *ISO 14080, Greenhouse gas management and associated activities - Framework and principles for climate action*, aids organisations in identifying, analysing, creating, and managing climate action methodologies. This encompasses adaptation to the effects of climate change as well as greenhouse gas reduction in support of long-term sustainability. Such acts may be taken by or on behalf of projects, organisations, jurisdictions, economic sectors, technology and goods, policies, programs, and non-governmental activities.

3.1.4 The European Standardisation Organisations

CEN, CENELEC, and ETSI are the officially recognised European Standardisation Organisations or European Standards Bodies. They define a Standard as a document, established by consensus and approved by a recognized body that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context. Standards should be based on consolidated results of science, technology and experience, and aimed at the promotion of optimum community benefits.

- The European Committee for Standardisation (CEN)[24] brings together the national standardisation bodies of 34 European countries (EU and EFTA countries). It provides a platform for the development of European standards and other technical documents on various types of products, materials, services, and processes. These include air and space, chemicals, construction and more.

[24] CEN. *European Committee for Standardisation*. http://www.cenelec.eu/. Consulted on 23/02/2023.

- The European Committee for Electrotechnical Standardisation (CENELEC)[25] is in charge of standardisation in the field of electrotechnical engineering. CENELEC's voluntary standards aid in the facilitation of commerce between nations, the access to new markets, the reduction of compliance costs, and the growth of the EU single market. CENELEC also facilitates worldwide market access through its strong relationship with the International Electrotechnical Commission (IEC).

- The European Telecommunications Standards Institute (ETSI)[26] develops standards for information and communications technologies (ICT) that are internationally relevant. Fixed, mobile, radio, convergent, broadcast, and internet technologies are also included in these standards. The mission of ETSI is to develop and maintain technical standards for its members.

In the case of ETSI, industry can participate directly in the standards development process. However, business can only have access to CEN and CENELEC via national standards agencies. While several ETSI standards are very useful for climate monitoring networks, CENELEC and, in particular, CEN, are of particular interest in terms of climate service development and provision, therefore their procedures and activities are examined more below.

The procedure for developing new European Standards (Denoted as EN) involves drafting, enquiry, formal vote, and finalization and implementation. [27] The actions required to prepare, approve, publish and update a Technical Specification (TS)[28] and a Technical Report (TR)[29] are slightly different, but all of them are developed by Technical Committees and Working groups. Technical Committees (TCs) establish standards with a certain scope, within which a work programme or business strategy designated standards is developed and executed. TCs operate on the basis of national involvement by CEN Members, with delegates representing their various national perspectives. This approach enables the TCs to make balanced judgments that reflect broad agreement. In the case of major projects of work, a Subcommittee might be formed inside a TC. Working Groups (WGs) are where specialists, chosen by CEN Members but speaking in their individual capacities, get together to generate a draft that will become the eventual standard. This represents an underlying notion of "direct participation" in standardisation processes.

As an alternative to this procedure for defining new standards, Workshops are particularly relevant in emerging or rapidly changing technologies that require quickly developed specifications or results of research projects. They produce CEN and/or CENELEC Workshop Agreements (CWAs). The standardisation of components of climate services of interest is planned in Climateurope2 task 1.4. CWA is the mechanism initially considered most interesting, but this decision will be reviewed during project implementation.

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[25] CENELEC. *European Committee for Electrotechnical Standardisation*. http://www.cenelec.eu/
[26] ETSI. *European Telecommunications Standards Institute*. http://www.etsi.org/
[27] CEN-CENELEC. *European Standard (EN)*. https://boss.cenelec.eu/homegrowndeliverables/en/pages/. Consulted on 06/02/2022
[28] CEN-CENELEC. *Technical Specifications*. https://boss.cenelec.eu/homegrowndeliverables/ts/pages/. Consulted on 06/02/2022
[29] CEN-CENELEC. *Technical Reports*. https://boss.cenelec.eu/homegrowndeliverables/tr/pages/. Consulted on 06/02/2022

The role of standards in support of Innovation and Technology Transfer according to CEN-CENELEC

CEN-CENELEC have published several guiding documents of high interest for the climate services sector. One of the most interesting ones is the CEN-CENELEC Guide 39: The role of standards in support of Technology Transfer[30]. One interesting outcome from this publication for the climate services sector, is the link between the technological development stages and types of standards. Usually, standards become more relevant where a technology matures (higher Technology Readiness Levels or TRLs). However, standards can support all stages of innovation, since the subjects that can be addressed by standards cover the full innovation cycle, as illustrated by the examples suggested in Figure 2. This is or particular interest for climate services, whose components, activities, individual services, etc. are in a wide range of TRLs.

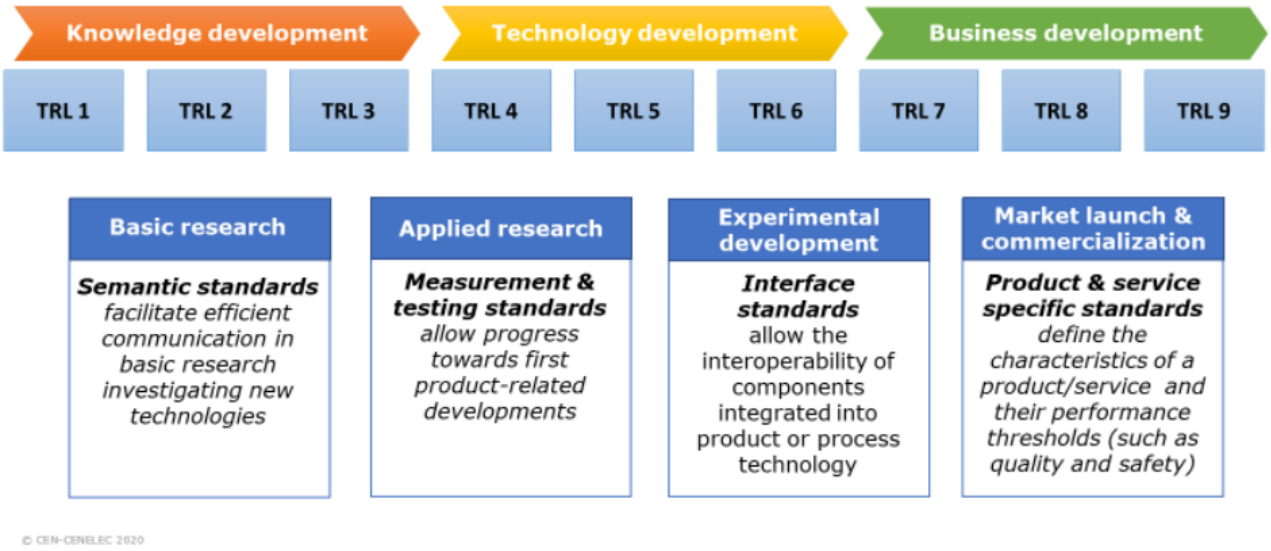

Figure 2. Types of standards and Technology Readiness Levels (TRLs)

Another document of interest is the CEN-CENELEC Position Paper "CEN and CENELEC input to Horizon Europe Strategic Plan 2025-27"[31] . This document is a reply to the European Commission's consultation on European R&I programmes 2014-2027 with the aim to provide input on pre-normative research needs which could contribute to shaping the strategic orientations for Horizon Europe's Strategic Plan 2025-2027[32]. The current draft of this document outlies different ways in which standardisation can be addressed in research projects, for instance:

[30] CEN-CENELEC. 2022. *CEN-CENELEC Guide 39:2022 (E). The role of standards in support of Technology Transfer*. https://www.cencenelec.eu/media/Guides/CEN-CLC/cenclcguide39.pdf
[31] CEN-CENELEC 2022. *CEN-CENELEC Position Paper "CEN and CENELEC input to Horizon Europe Strategic Plan 2025-27". DRAFT*. December 2022. Restricted access.
[32] CEN-CENELEC. 2022. CEN and CENELEC ready to contribute to the Horizon Europe Strategic Plan 2025-27. https://www.cencenelec.eu/news-and-events/news/2022/newsletter/issue-38-horizon-europe/. Consulted on 06/02/2023.

– Standardisation Roadmap: In this project deliverable, the current status of standardisation in a specific area is outlined following an extensive analysis of a topic regarding standardisation. It includes future fields of activities and concrete recommendations.

– Standardisation Strategy: In this project deliverable, standardisation proposals in a specific area – not necessarily limited to the scope of one single CEN/CENELEC Technical Body – are usually summarized focusing on innovative and upcoming topics.

– Contribution to existing and/or initiating new standards or other standardisation deliverables: A proposal for changes to existing standards and/or for creating new standards can be delivered following an in-depth gap analysis during the project.

Climateurope2 activities are contributing to these 3 points. In contrast, in the position paper, CEN and CENELEC also welcome two recent initiatives that the European Commission is undertaking to support the value of standardisation in valorising research results that haven´t been explored by Climateurope2 yet:

- Code of Practice for researchers on standardisation currently being developed to provide a set of recommendations on how beneficiaries of public R&I funds can best valorise projects results through standardisation.

- Standardisation Booster to support EU Research and Innovation projects to valorise results through standardisation and address urgencies identified in the EU Strategy on Standardisation.

The position paper also encourages research projects to liaise with Technical committees with relevant activity in the field of interest (

Table 4). This is also a way to be explored in Climateurope2.

Table 4 Concrete paths to take advantage of standardisation according to CEN-CENELEC Guide 39 and the approaches to address them in Climateurope2

Way of connecting with standardisation proposed by CEN-CENELEC	Approach in Climateurope2
By screening existing standards on national, European, and international level, you will be able to access leading knowledge, resources and industry and market practices on the topic you are working on, so that you can avoid reinventing the wheel and be aware of the standardisation existing context and ensure interoperability.	This document summarizes the first screening of standards and standardisation initiatives. These activities will continue during the whole project in the framework of Task 1.3.
By accessing the national mirror group of an existing Technical Committee at European or international level, you will be able to be updated on and contribute to standardisation work in progress. Where no suitable standard exists to support the market entrance of your technology you will, with the support of your national mirror group, be able to propose modifications to existing standards so that they meet your needs or to propose and even lead a new standard.	The leader of WP1 (TECNALIA) is part of two Spanish mirror groups related to climate change adaptation and Sustainable Cities and Communities'
By contributing to the development of a CEN and/or CENELEC Workshop Agreement (CWA); the CWA development happens through the direct participation of stakeholders without making use of national delegations.	The development of one or several CWAs for standardising the components and/or processes linked to climate services that are mature enough is planned in Task 1.4
By joining a Technical Committee if you are a European R&I project: the Projects financed by European Research and innovation initiatives (such as Horizon 2020, Horizon Europe, the Connecting Europe Facility (CEF), the Digital Europe Programme (DIGITAL), the European Cooperation in Science and Technology (COST), etc) can participate in relevant Technical Committees of CEN and CENELEC, through the project liaison concept.)	The leader of WP1 (TECNALIA) is participating in several Technical Committees and Working groups in the field of climate change, climate change adaptation and provision of climate information.

Standardisation landscape according to CEN-CENELEC

CEN-CENELEC Guide 39 summarizes the standards landscape (in its organized, pluralistic, transparent, and consensual form). The three European Standardisation Organisations that are officially recognized as competent in the area of voluntary standardisation for Europe Regulation (EU) No 1025/2012 are CEN, CENELEC, and ETSI (the European Telecommunication Standards Institute), and hold an intermediate position in this landscape, as shown in Figure 3.

The International Organisation for Standardisation (ISO) and the International Electrotechnical Commission (IEC) are the international counterparts of CEN and CENELEC. The Vienna (between CEN and ISO) and Frankfurt Agreements (between CENELEC and IEC) defines European and worldwide collaboration in standards definition. They allow for the concurrent creation of both European and

worldwide standards, with technical debates taking place just once, generally on an international scale. Cooperation agreements may then exist with ISO or IEC Technical Committees, enabling among others the publication of dual logo standards, facilitating de development of standards that are created both at the International and European level. Examples are IEC/IEEE 62704-2, ISO/ASTM 52915, IEEE/ISO/IEC 29148, etc. CEN policy is to use international standards whenever possible, and there are procedures for the transposition of ISO standards into European Standards either without change or with common modifications, quoting part of the ISO standard, and making normative or informative (dated or undated) reference to the ISO standard.[33]

Discussions in CEN, CENELEC, ISO, and IEC Technical Committees are based on input from national delegates who reflect the views stated by similar groups at the national level, known as "national mirror groups". These national mirror groups are made up of volunteer experts and stakeholders who contribute directly to the development of standards (see Figure 3).

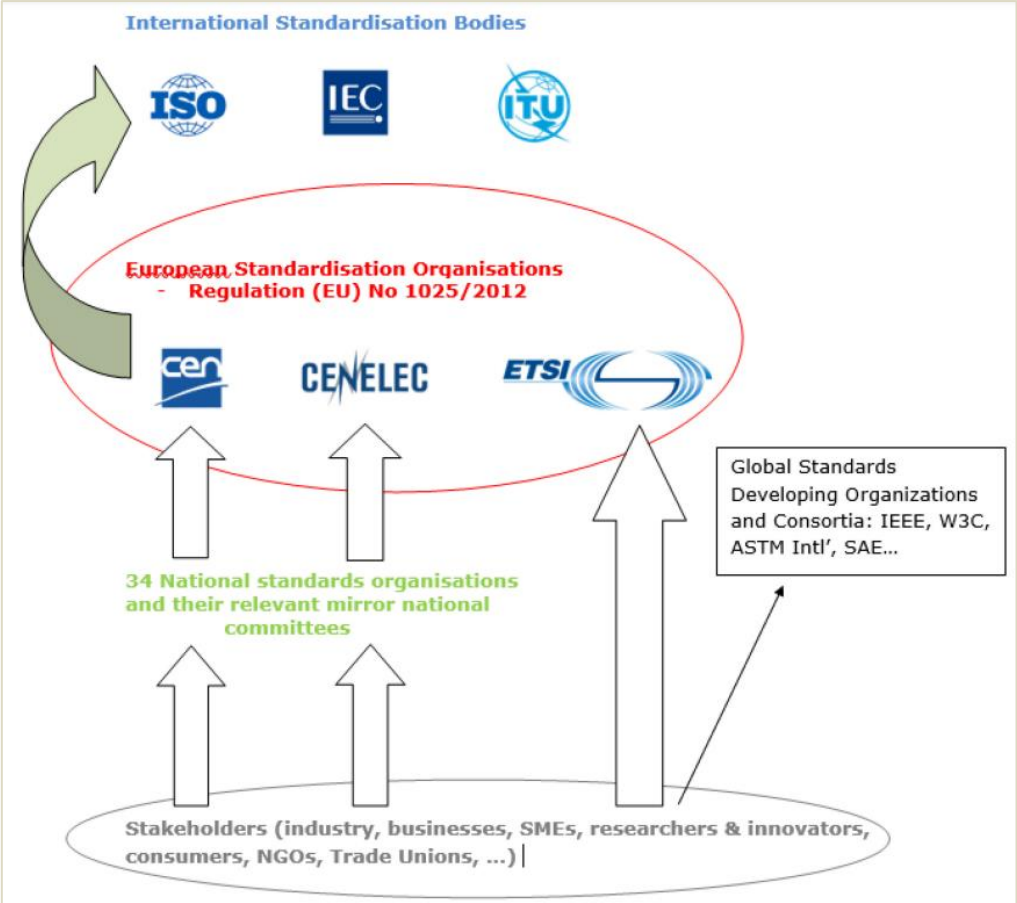

Figure 3. Standardisation landscape according to CEN-CENELEC Guide 39:2022 (E)

[33] CEN-CENELEC. *CEN policy for the transposition of International Standards into European Standards*. https://boss.cen.eu/reference-material/guidancedoc/pages/transpopolicy/. Consulted on 06/02/2023.

As indicated above, there are other Standards Developing Organisations additional to those referred to in Regulation (EU) No 1025/2012. Some of them have a global presence and are a reference in certain domains. CEN admits the role of organisations such as the IEEE, W3C, etc. that usually counts with their own procedures for creating and reviewing standards.

CEN-CENELEC Coordination Group "Adaptation to Climate Change" (ACC-CG)

The first version of the European Union Strategy on Adaptation to Climate Change [COM(2013) 216 final][34] identified standards as an effective instrument for improving the climate resilience of infrastructures across Europe. The sectors identified as priority sectors in the EU Strategy were:

- Transport infrastructure;
- Energy infrastructure;
- Buildings/construction;
- ICT infrastructures that are closely interconnected with and support the functioning of the sectors mentioned above

This resulted in the Standardisation Request (Mandate M/526) addressed to the European Standardisation Organisations (ESOs) in support of implementation of the *EU Strategy on Adaptation to Climate Change [COM (2014) 3451 final]* issued by the European Commission (EC). The *CEN-CENELEC Adaptation to Climate Change Coordination Group (ACC-CG)* was created for coordinating standardisation activities and guides the implementation of the standardisation request. Kick-off meeting was held in Brussels on 20 January 2015. It is not clear if the activities of this group have finalized, but the project team involved in it has not received communication from mid-2022 and the public information has not been updated recently, so it is possible to consider that this initiative finalized.

In parallel, guidance tools have been developed which support standard writers in including climate change adaptation (CCA) in standards in a systematic way. The ACC-CG focused on the following activities:

- Revision or development of infrastructure standards in susceptible areas. Ten CEN and CENELEC Technical Committees (TC) were recognized as working on the revision or development of chosen priority standards. The standards chosen are for construction, transportation, and energy infrastructures. The ACC-CG assisted TCs in rewriting these criteria by connecting them with climate and sectoral specialists. These new and amended standards are intended to serve as examples of best practices for addressing climate change adaptation in standards. The project team was a member of one of these TCs (ISOTC163/SC2/WG16, which was in responsibility of revising the ISO 15927-4 2020(E) standard). The conclusion is that integrating engineering practice with climate data provision is difficult, and taking climate change estimates into account in engineering practice is not straightforward.

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[34] European Commission, 2013. *COM(2013) 216 final. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: An EU Strategy on adaptation to climate change*. https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2013:0216:FIN:EN:PDF

- Connecting infrastructure norms to future climate circumstances. Information on future climate circumstances is crucial for addressing CCA in standards. Knowledge in this sector is rapidly expanding, yet it appears that it is frequently difficult to comprehend and use. The goal of this effort was to create a Technical Report (which might subsequently be transformed into a standard) that gives recommendations for the systematic use of climate-related data.

- Adaptation measures scaling up to the European level. Physical adaptation strategies, such as the consequences of extreme weather events, can be employed to minimize or alleviate some of the negative effects of climate change. This project focuses on finding areas where European standards can aid market adoption of adaption strategies. Permeable pavements, cool (reflective) materials, and nature-based solutions such as swales and green roofs are examples.

- Addressing climate change adaptation in other infrastructure standards. This project focuses on infrastructure standards in other sectors that are sensitive to climate change but are not yet included in the present set of standards for revision or development. The CEN-CENELEC guide *Tailored guidance for standardisation technical committees: How to include adaption to climate change (ACC) in European infrastructure standards*[35] was developed. This guide differs from previous guides on how to include ACC, as CEN-CENELEC Guide 32, Addressing climate change adaptation in standardisation[36] and ISO Guide 84, Guidelines for addressing climate change in standards[37], in its clear focus on infrastructure standards.

3.1.5 The National Standardisation Bodies

National standardisation organisations as BSI, DIN, UNE, AFNEF, have the role of producing standards at national level. They are also responsible for the publication of international and European standards in other languages. In some countries, a unique organisation acts as counterpart of the European and international standardisation organisation in the fields of Electrotechnical, Telecommunications and general standardisation. However, in other countries, this role is assumed by several national organisations as shown in Table 5.

Table 5. Examples of national standardisation bodies and its European and international counterparts

[35] CEN-CENELEC. 2022. *Tailored guidance for standardisation technical committees: How to include adaption to climate change (ACC) in European infrastructure standards*. https://boss.cen.eu/media/BOSS%20CEN/ref/climate_adpatation_in_standards_guidance.pdf

[36] CEN-CENELEC. 2016. *CEN-CENELEC Guide 32, Addressing climate change adaptation in standardisation. Edition 1, 2016-04*. https://www.cencenelec.eu/media/Guides/CEN-CLC/cenclcguide32.pdf

[37] ISO. 2020. *ISO Guide 84:2020. Guidelines for addressing climate change in standards*. https://www.iso.org/standard/72496.html

Level	General	Electrotechnical	Telecommunication
International	ISO	IEC	ITU
European	CEN	CENELEC	ETSI
National (German)	DIN	DKE	DKE
National (United Kingdom)	BSI	BSI	BSI

National standardisation bodies develop national standards following a procedure that is very similar to the CEN and ISO procedures, but sometimes the publication and dissemination of draft and final versions is communicated through legal binding procedures, making them mandatory.

Some national standardisation bodies are in charge of the official translation of the CEN standards to other languages. As an example, The UNE-EN standards are the official version in Spanish of the European standards. They are standards adopted and harmonized after the approval of the specific body within the national standardisation structure of UNE (the Spanish standardisation body).

It is interesting to note that some countries have developed initiatives aligned with the ACC-CG, identifying national standards that can contribute to climate resilience and adaptation. One example of this approach is the document *Adaptation Standard: Analyse bestehender Normen auf Anpassungsbedarfe bezüglich Folgen des Klimawandels*[38]. Developed by Adelphy, it identifies areas in which standardisation can concretely support adaptation to climate change and contribute to resilience to the consequences of climate change, including the protection of people and goods through climate-adapted construction, the reduction of the effects of heat waves through adapted building technology and improved flood prevention by taking into account the effects of climate change on heavy precipitation. The related standards are identified, and, in line with the conclusions of the participation of the project team in the ACC-CG initiative, the authors indicates that standardisation committees must become more familiar with the inclusion of climate data in their work and receive support for this. This documents also concludes that standard-setting organisations must give more strategic priority to the topic and modify procedural guidelines for the work of standardisation committees to encourage them to consider climate change. As explained in the next section, this is starting to be changed thanks to the London Declaration.

In other countries the inclusion of climate change perspectives in national standards is being implemented in specific sectors. This is the case of the OSKA declaration of intent 'Climate change and cooling of buildings', a widely supported agreement to adapt Dutch standards for new construction and renovation to the impacts of a changing climate. Partly with the help of NEN, the Dutch standardisation body, the OSKA platform (Consultation Standards Climate Adaptation) has made a national agreement signed by a broad coalition to adjust standards accordingly.

[38] Kind, C., Terenzi, A. and Hauer, M. 2021. *Climate Change 56/2021. Adaptation Standard: Analyse bestehender Normen auf Anpassungsbedarfe bezüglich Folgen des Klimawandels* https://inis.iaea.org/collection/NCLCollectionStore/_Public/53/029/53029771.pdf?r=1

3.1.6 The London declaration

In September 2021, ISO and IEC approved the London Declaration, a commitment to combat climate change through standards. [39] The Declaration reads: "ISO hereby commits to work with its members, stakeholders and partners to ensure that ISO International Standards and publications accelerate the successful achievement of the Paris Agreement, the United Nations Sustainable Development Goals and the United Nations Call for Action on Adaptation and Resilience." On January 2022, CEN and CENELEC also signed the declaration, joining forces with ISO, IEC, stakeholders and partners to ensure that International and European Standards accelerate achieving the goals of the Paris Agreement, the UN SDGs and the Green Deal.[40]

ISO and CEN have many International Standards that are essential in supporting the climate agenda, and an accrued consideration of climate science will be needed to ensure that climate-friendly standards become the norm across all industries.

To help deliver on ISO commitments, the Technical Management Board (TMB)[41] has developed an action plan that will support the ISO technical community. The action plan will focus on:

- Working with committees to prioritize the revision of selected, high impact standards.
- Identifying opportunities for the development of new standards and pathways as to how standardisation can contribute to climate action.
- Increasing the participation of underrepresented stakeholders in the development of standards.

Some of the specific activities that are being studied include the identification of standards likely to incorporate climate change perspective, to promote and disseminate the ISO Guide 84:2020 (*Guidelines for addressing climate change in standards*), to establish a group of climate change consultants to assist TC's, etc. ISO Central Secretariat is working with the TMB to implement this action plan, and progress will be reported to the ISO Council in the coming months.

In simple terms, the London Declaration is a commitment to actively factor climate science into the development of standards. So, from its conception, this is an opportunity for channelling the outcomes of climate science and services into more standardisation activities.

3.1.7 Standards within industry context

[39] ISO. *London Declaration: ISO commits to climate agenda*. https://www.iso.org/news/ref2726.html
[40] CEN-CENELEC. 2022. *Standards for the Climate: CEN and CENELEC signed the London Declaration*. https://www.cencenelec.eu/news-and-events/news/2022/press-release/2022-01-13-london-declaration/
[41] ISO. *ISO/TMB*. https://www.iso.org/committee/4882545.html

Standards come in different forms which represent the type of assurance that such standards can provide as well as within what type of assurance programme such standard operates. However, the same standard can also have different levels of demand towards the entity/product that is being assessed against a particular standard. For example, considering quality management systems around project implementation the use of climate service standards may change as such projects go through the different phases of project design, planning, financing, start-up, implementation, etc. Where at the early phases of project design the standard may allow default data and/or put generic requirements on the data accuracy, as the project moves through the different phases the standard may also require more detailed data with a higher level of accuracy. Even if the standards themselves do not require them, the consumers of the standards (i.e. entities that use that standard and the entities that require or demand the standard to be used) may expect that higher data quality is progressively applied as the projects move through the development stages.

Equally, standards may progress from one to another and therefore the overview of the standards landscape cannot only be used in isolation to which standards exist, but also how industries and climate service markets may apply the standards across the project cycle (planning, financing, implementation, operation, etc.)

In next versions of this document some initial examples of standards and standardisation initiatives that can improve climate services uptake and or help to define their characteristics and outcomes for specific sectors will be identified and analysed. In Task 1.3 of WP1 the consortium will explore in more detail the correlation between the standards and the context in which they are operated by examining a number of example industries/sectors. This will be done using a template designed in the framework of the project (See Figure 4), that will help both the mapping of the used standards and requirements as well as identifying potential gaps that currently exist within the standards and/or standardisation processes.

Figure 4. Template for the analysis of relevant sectors for climate services standardisation

3.1.8 Visual representation of the standardisation activities landscape related to climate services

This deliverable is focused on the standardisation activities related to climate change, resilience both from the framework perspective as well as from the sectoral and solutions perspective. It also considers other important frameworks that apply to climate services such as the quality management. Figure 5 summarizes the main standardisation activities and the interlinkages that may be relevant for Climateurope2.

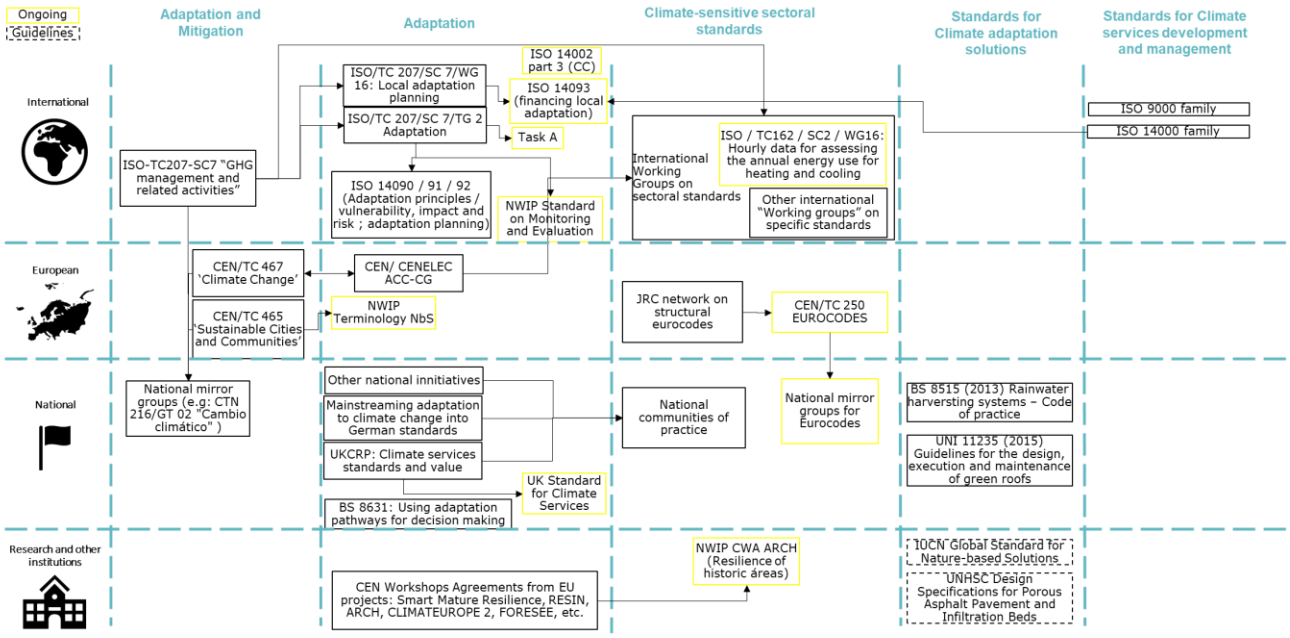

Figure 5. Examples of standardization initiatives related to climate services

On the left, the role of international and national standardisation organisations is represented. ISO and CEN have technical committees focusing on climate change. It should be noted that both cover mitigation and adaptation topics. Although it is possible to identify these committees as the main candidates to contribute to the standardisation and promotion of climate services, it should not be forgotten that many other committees work (or may work) on standards that require climate data, promote adaptation and can contribute to create good practices for the agents involved in the creation of climate services, etc. In Figure 5, it is highlighted CEN/TC465 as an example, but many others, as those cited in next section, are of interest.

The national "mirror" groups or committees link the activities of the ISO and CEN committees, technical groups, etc. with the communities of interest in each country. They are led by the national standardisation bodies, which can also greatly contribute to the objectives of Climateurope2. Some national standardisation bodies have developed standards which may be of interest to the climate services actors. For example, the British Standards Institution (BSI) has developed few relevant standards such as BS8631: *Adaptation to climate change - Using adaptation pathways for decision making* or the UK standard on Climate Services developed by BSI in the framework of the United Kingdom Climate Resilience Programme (UKCRP), etc.

The ACC-CG was the first initiative for mainstreaming climate change perspective in standards at European level. At national level this approach has been replicated at least in Germany. This initiative considered a wider scope, including formal standards, technical norms, regulations linked to climate resilience, etc. It has detected different potential actions for improving climate resilience in sectors as urban planning, water management, etc. The Declaration of London, signed by ISO and CEN, opens a new scenario in this topic, as it encourages to include climate change considerations (mitigation and adaptation) in each standard developed or reviewed. The implementation of this initiative is still under discussion but should be followed to evaluate the interest for the actors involved in climate services.

It should also be highlighted an increasing standards development channeled by research projects. It is common that European research projects exploit part of the knowledge generated by standards, being the procedure of CEN Workshop Agreement the most suitable, and thus, followed one. Some examples of projects developing CWAs relevant for climate services are ARCH; SMR, etc. CEN Workshop Agreement *CWA 17727:2022. City Resilience Development - Guide to combine disaster risk management and climate change adaptation – Historic areas* is one of the latest examples.

The third column of the diagram reflects sectoral standards (building, infrastructure, transport, etc.) that may need or are in process of their revision to incorporate climate change which could benefit of climate services. However, it has to be noted the complexity to map the entire list of climate-sensitive sectoral standards as this would require e.g. to participate in all standardisation activities. This report advances in this regard in next section by identifying standards that can contribute to promote climate services from the demand side. In the diagram, as a clear example, the activity of the ISO/TC 163/SC 2/WG 16 is highlighted. This Working Group is currently studying the approach for considering climate change projections in a method for developing a reference year of hourly values for assessing the average annual energy for heating and cooling. One of the activities in progress is the evaluation of the most pertinent meteorological data for the standard purpose (*ISO 15927-4:2005* , *Hygrothermal performance of buildings — Calculation and presentation of climatic data — Part 4: Hourly data for assessing the annual energy use for heating and cooling*). The other example included in the diagram is the Structural Eurocodes, that involve climate data for defining loads (thermal, snow, wind, etc.) for infrastructure design.

Within the standards that can promote climate services by requiring climate information, it is worth noting, due to their objectives, the standards that are related to activities and measures that can be classified as climate change adaptation measures. In the diagram this has been reflected as a fourth column. Some of the standards developed in this area have not been promoted by standardisation bodies but other organisations, research groups, etc. Two examples are included with dashed lines: *IUCN Global Standard for Nature-based Solutions*[42] and the *UNHSC Design Specifications for Porous Asphalt Pavement and Infiltration Beds*[43].

The right part of the figure seeks to highlight that a number of standards may be useful for the activities involved in the design and development of climate services. A clear example of this type of standards is the ISO 9000 family for quality systems management on which other standards are based to ensure the quality of their processes. Other standards, such as those mentioned in section 3.3, may be relevant to optimize climate services.

3.2 Standards landscape

The focus of this standards landscape is to provide information related to:

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[42] IUCN. 2020. *IUCN Global Standard for Nature-based Solutions.* https://portals.iucn.org/library/sites/library/files/documents/2020-020-En.pdf.

[43] UNHSC. 2009. *UNHSC Design Specifications for Porous Asphalt Pavement and Infiltration Beds*. https://www.unh.edu/unhsc/sites/unh.edu.unhsc/files/pubs_specs_info/unhsc_pa_spec_10_09.pdf

- standards requiring climate information which may be likely to incorporate the outcomes of climate service such as sectoral norms or standards related to adaptation measures
- standards that may support climate services & their value chain by providing general frameworks of quality management, climate change, sustainable cities and communities and risk

This will help to identify gaps and opportunities around standardisation which can support the uptake of climate services.

Figure 6 to Figure 9 present a summary of the identified standards, technical committees and standardisation bodies around the four pillars shown in Figure 1.

The outputs of the standards search on climate change, risk and resilience (Figure 6) showed that ISO has advanced on the definition of complementary frameworks on these topics, which has been addressed by four technical committees: *TC 207 Environmental management*, *TC 262 Risk management*, *TC 268 Sustainable cities and communities* and *TC 292 Security and resilience*. These technical committees provide 37 standards which are an umbrella to help on the definition of the framework in which the future Climateurope2 activities, including those supporting standardisation activities related to climate services, can be encompassed. It has to be highlighted that ISO/TMBG (Technical Management Board – groups) has published the ISO Guide 84:2020 which objective is to provide guidelines on how to consider climate change in the planning, drafting, revision and updating of ISO standards. It provides a framework and general principles for standard developers on how to include adaptation and mitigation to climate change within their standardisation activities. The desired outcome of the application of this guide is on one hand to increase preparedness and resilience while minimizing disaster risks related to climate change and on the other hand to reduce or limit the release of GHG (Green House Gasses) emissions.

At European level, the number of standards in these fields is lower probably to the newer foundation of technical committees such as CEN TC 465 (in 2020) and CEN TC 467 (in 2021). The search highlighted that at EU level standards are being developed as CEN Workshop Agreements (CWA) in the field of Sustainable cities and communities. Furthermore, at national level, DIN (the German normalization organisation) has been driving standardisation activities through its own activities or the German Engineering Association (VDI). While VDI has focused on environmental meteorology related to urban climate and planning, the standards published by DIN focused on stakeholder engagement related to climate change and smart cities.

Figure 7 presents the reference documents in relation to environmental and quality management which have been developed by *ISO TC 176 Quality management and quality assurance* and *ISO/TC 207 Environmental management*. Despite that TC 176/SC 2 Quality systems has published 6 documents based on the abstract, the most relevant standard and reference worldwide is the ISO 9001 Quality management systems – Requirements, which is intended to be applicable to any organisation, regardless of the products and services it provides. ISO 9002 provides guidance for the application of ISO 9001.

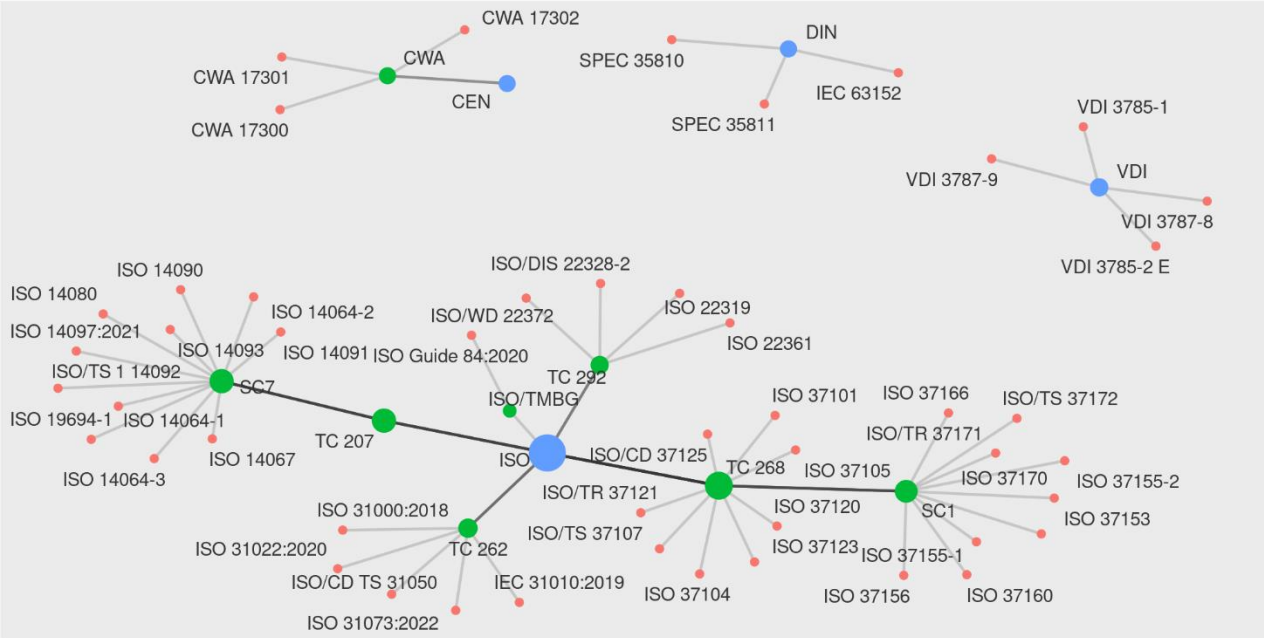

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Figure 6. Graph diagram representing the landscape of standards that may be relevant to Climateurope2 in the fields of climate change, risk and cities and communities' resilience

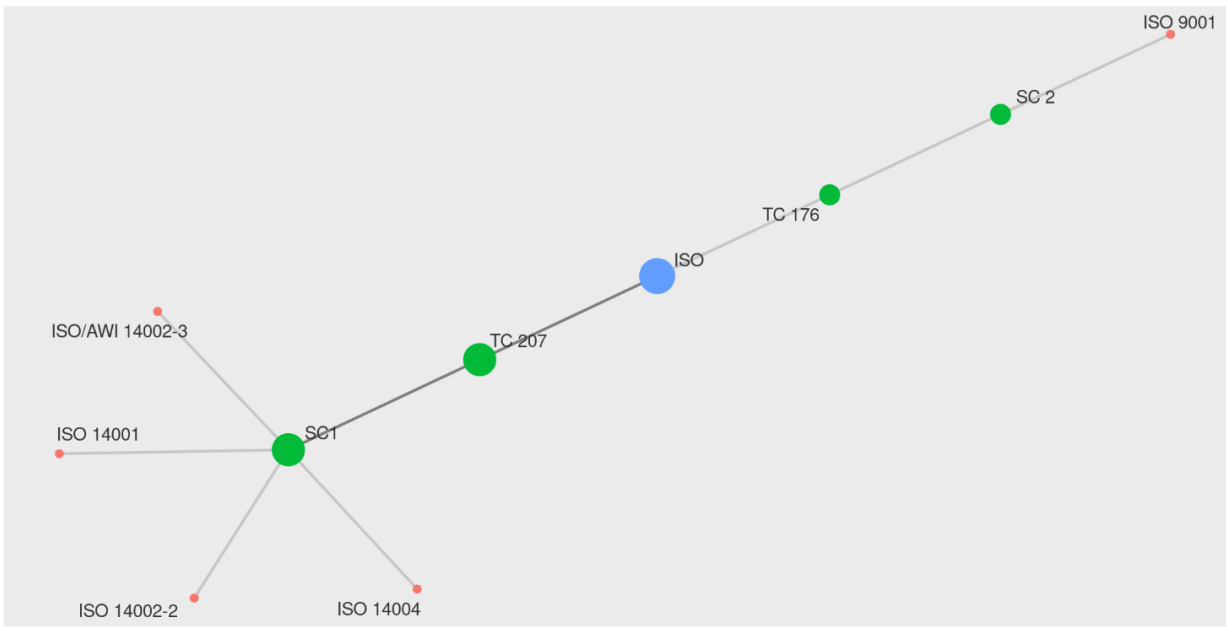

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Figure 7. Graph diagram representing the landscape of standards that may be relevant to Climateurope2 in the fields of quality management

At international level, the search outputs show that sectoral standards (Figure 8) that require or may be prone to consider climate change in their revision lie around four main topics: Energy (*ISO/TC 67, Oil and gas industries including lower carbon energy*), Building (*ISO/TC 59 Buildings and engineering works* and *TC 163 Thermal performance and energy use in the built environment*), Water (ISO/*TC 224 Drinking water*, wastewater and stormwater systems and services) and Agriculture and Forestry (*TC 23 Tractors and machinery for agriculture and forestry*).

At European level the standards produced by CEN/CENELEC which may be climate dependent are mainly associated to buildings and railways application which have been developed across different technical committees.

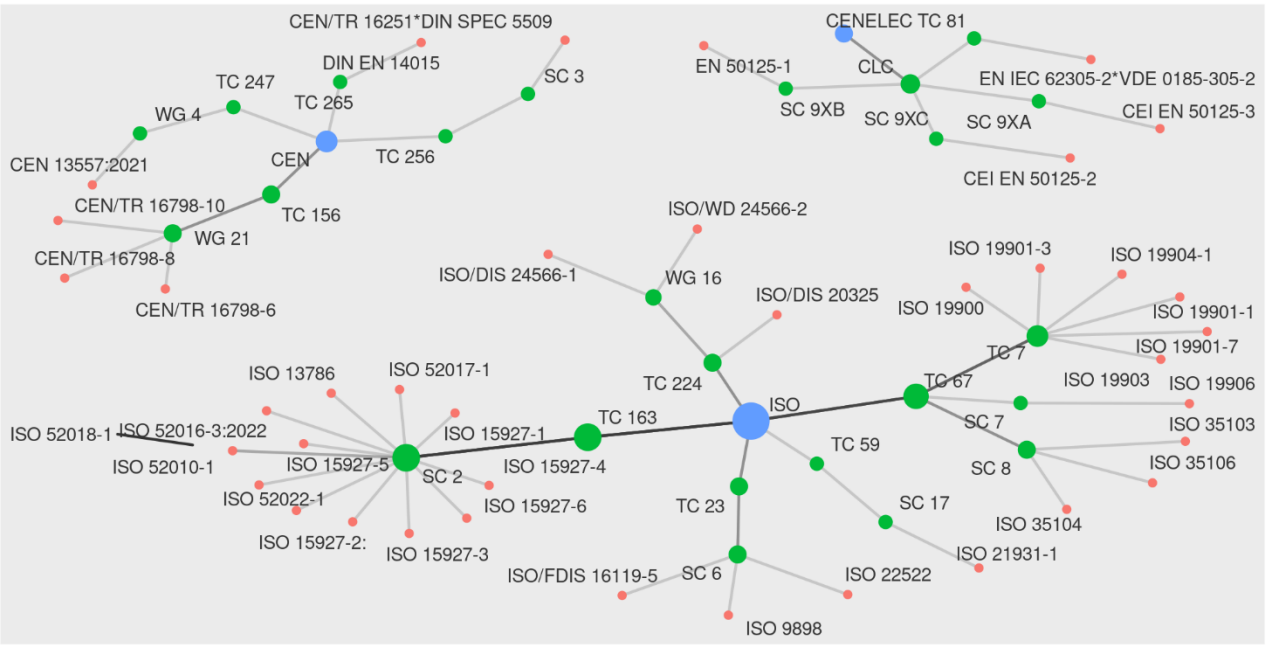

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Figure 8. Graph diagram representing the landscape of sectoral standards that may benefit from climate services

There are a variety of technical solutions to address adaptation to climate change. These solutions vary in terms of the hazard they address, the nature of the measure (e.g. grey vs. green) and the implementation location. Environmental parameters are relevant for all green solutions as their performance and design depend on the ECV such as rain intensity, temperature etc. Grey or service adaptation solutions need to consider climate in their design and/or planning to achieve the objectives they are designed for. Figure 9 presents the type of adaptation solutions that were analysed (searches 1 to 21). The output of the search highlights the scattered work in standardisation link to adaptation measures, probably as a consequence of the variety of solutions. In contrast to previous searches, where ISO leads the publication of standards, for adaptation solutions the British Standardisation Institution (BSI) is driving the development of standards which can be applied for adaptation to climate change. However, CEN, DIN, UNI, SIA, NEN and ÖNORM have also developed standards. Most standards are related to water management, nature-based solutions such as green roofs, landscapes or trees and SUDs (sustainable urban drainage systems).

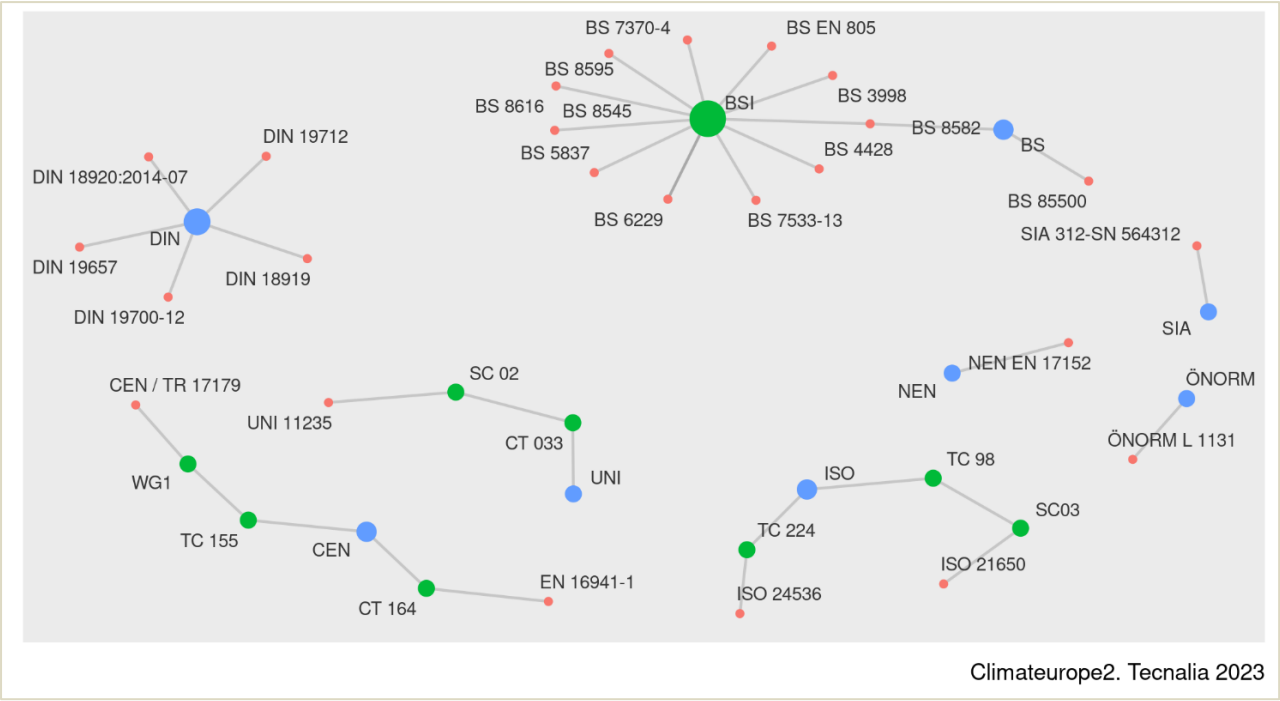

Figure 9. Graph diagram representing the landscape of standards related to adaptive technical solutions that may benefit from climate services

3.3 Guidelines, recommendations and good practices landscape

The analysis of guidelines, technical requirements, recommendations and good practices targeted documents preferably from reference institutions such as the World Meteorological Organisation (WMO), United Nations Development Program (UNDP) or the European Centre for Medium-Range Weather Forecasts (ECMWF). Reports from EU research projects related to climate services were also consulted, however scientific articles were excluded as the focus was on established protocols, guidelines and not the state of the art of scientific literature.

While 49 documents were analysed, only the 32 published from WMO were considered relevant and directly related to the purpose of Climateurope2 landscape. These publications are mainly addressing WP2 perspective which will be further explored as the project evolves. Figure 10 presents in a word cloud a summary of the most common terms/topics addressed in the WMO documents related to Management & quality, climate data, climate observation and forecasting.

From the analysed documents, the *WMO-1221 Guidelines on quality management in climate services* has to be highlighted. These guidelines and best practices for implementing a Quality Management System around climate services follows the ISO 9001 quality standard. The report is structured in steps to implement a process approach, namely data, climate monitoring, prediction, and services. The document also covers aspects to consider such as personnel training, user requirements and the importance of monitoring the process to improve it.

Several WMO documents refer to their accordance to ISO standards. WMO guidelines, requirements and good practices highlighting that they are in line with ISO standards are the following:

- *ISO 9000:2015 Quality management systems – Fundamentals and vocabulary*
- *ISO 9001:2015 Quality management systems – Requirements*
- *ISO 19011:2018: Guidelines for auditing management systems*
- *ISO 19115:2003 Geographic information - Metadata*
- *ISO 19139:2007 Geographic information - Metadata- XML schema implementation*
- *ISO/IEC 19757-3:2006 'Information technology – Document Schema Definition Language (DSDL)– Part 3: Rule-based validation – Schematron'*
- *ISO 5725-4:2020 Accuracy (trueness and precision) of measurement methods and results*
- *ISO 29990:2010 Learning services for non-formal education and training – Basic requirements for service providers*
- *ISO 639-2:1998 Code for the representation of names of languages – Part 2: Alpha-3 code*
- *ISO 3166: 2020 (all parts) Codes for the representation of names of countries and their subdivisions*
- *ISO 8601:2005 Data elements and interchange formats – Information interchange – Representation of dates and times*
- *ISO 23950:1998 Information search and retrieval protocol*
- *ISO 1100-1: 1996 Measurement of liquid flow in open channels-Part I: Establishment and operation of a gauging station.*
- *ISO 748:1997 Measurement of liquid flow in open channels-Velocity area methods.*

These references to various types of standards addressing very technical, international quality management systems as well as learning related standards highlight the importance of standards to provide replicable, transparent, trustful meteorological, hydrological and climate services.

Other WMO publications beyond global observing systems, seasonal forecasting, climatological practices *etc.* covering other topics necessary for climate services development are available such as user engagement and climate service communications. However, the latter have not been considered within this deliverable as it is expected to be incorporated once the standardisation framework is developed. This will facilitate WP 2 to 5 vision to be integrated within the landscape. But this search has already started to emerge standard needs in the context of climate data and processes (WP2).

Figure 10. Word cloud of the keyword related to all analysed WMO documents (n=32)

4 Future perspectives

Task 1.1 sets the ground for supporting and/or standardising climate services or its component within the context of Climateurope2. The work described in this deliverable aims at describing the standardisation importance, context and gathers the outputs of a screening search of the existing standards based on four pillars targeting to describe the context and needs:

- Climate change, risk and resilience communities
- Quality management
- Adaptation solutions
- Sectoral standards requiring or with potential requirements for climate data

This deliverable also describes the standardisation initiatives related to climate services detected through an active involvement in technical committees, working groups and other standardisation bodies at international, European and national level.

WP1 was conceptualized to be able to accommodate new insights from the outputs of the work from other tasks and work packages. Task 1.3 *Synthesis and guidance* will coordinate with WPs 2-5 to periodically retrieve and synthesise information related to good practices, requirements, level of maturity and include inputs from the work carried out in those WPs. This will allow to update the landscape deliverable as necessary.

The objective of next steps in relation to the landscape is to identify future input perspectives considering not only the advances and priorities of WP 2 to 5, but also extending the standard search to new topics aligned with the Task 1.2 *Framework*. This will allow to continue search for gaps and opportunities of the different climate service components while analysing the maturity of these components and processes.

Furthermore, future updates of this deliverable to identify relevant standards for Climateurope2 will be carried out by the use of i2i platform[44], which is advertised as a user-friendly Standards Management solution. The main advantage compared to this deliverable's search is that it contains a larger database of standards with over 1.6 million Standards from 360+ publishers including ISO, IEC, IEEE, ANSI, API.

[44] SAI Global. *SAI Global i2i – Information to Intelligence.* https://infostore.saiglobal.com/en-gb/standards_management/

Annex A

List of standards included in Figure 6 to Figure 9.

Sectoral norms

Organisation	Technical committee	Title
CEN	TC 256	*CEN/TR 16251*DIN SPEC 5509 Railway applications - Environmental conditions - Design guidance for rolling stock; English version CEN/TR 16251:2016*
CEN	TC 156	*Energy performance of buildings - Ventilation for buildings - Part 10: Interpretation of the requirements in EN 16798-9 - Calculation methods for energy requirements of cooling systems (Modules M4-1, M4-4, M4-9) - General; English version CEN/TR 16798-10:2017*
CEN	TC 156	*Energy performance of buildings - Ventilation for buildings - Part 6: Interpretation of the requirements in EN 16798-5-1 and EN 16798-5-2 - Calculation methods for energy requirements of ventilation and air conditioning systems (Modules M5-6, M5-8, M6-5, M6-8, M7-5, M7-8); English version CEN/TR 16798-6:2017*
CEN	TC 156	*Energy performance of buildings - Ventilation for buildings - Part 8: Interpretation of the requirements in EN 16798-7 - Calculation methods for the determination of air flow rates in buildings including infiltration (Module M5-5); English version CEN/TR 16798-8:2017*
CEN	TC 247	*Cranes - Controls and control stations; German and English version prEN 13557:2021*
CEN	TC 265	*DIN EN 14015 Specification for the design and manufacture of site built, vertical, cylindrical, flat-bottomed, above ground, welded, steel tanks for the storage of liquids at ambient temperature and above; German and English version prEN 14015:2017*
CENELEC	CLC	*EN 50125-1:2014 Railway applications - Environmental conditions for equipment - Part 1: Rolling stock and on-board equipment*
CENELEC	CLC	*CEI EN 50125-2 Railway applications — Environmental conditions for equipment — Part 2: Fixed electrical installations*
CENELEC	CLC	*CEI EN 50125-3 Railway applications — Environmental conditions for equipment — Part 3: Equipment for signalling and telecommunications*
CLC	TC 81	*EN IEC 62305-2*VDE 0185-305-2Protection against lightning - Part 2: Risk management (IEC 81/645/CD:2021*
ISO	TC 67	*ISO 19906:2019 Petroleum and natural gas industries — Arctic offshore structures*

Organisation	Technical committee	Title
ISO	TC 59	*ISO 21931-1:2022(en)* *Sustainability in buildings and civil engineering works — Framework for methods of assessment of the environmental, social and economic performance of construction works as a basis for sustainability assessment — Part 1: Buildings*
ISO	TC 224	*ISO/WD 24566-2* *Drinking water, wastewater and storm water systems and services — Adaptation of water services to climate change impacts — Part 2: Stormwater services*
ISO	TC 224	*ISO/DIS 24566-1* *Drinking water, wastewater and storm water systems and services — Adaptation of water services to climate change impacts — Part 1: Assessment principles*
ISO	TC 224	*ISO/DIS 20325(en)* *Service activities relating to drinking water supply and wastewater systems — Stormwater management — Guidelines for stormwater management in urban areas*
ISO	TC 163	*ISO 13786:2017* *Thermal performance of building components — Dynamic thermal characteristics — Calculation methods*
ISO	TC 163	*Energy performance of buildings - Energy needs for heating and cooling, internal temperatures and sensible and latent heat loads - Part 3: Calculation procedures regarding adaptive building envelope elements (ISO/DIS 52016-3:2022); German and English version prEN ISO 52016-3:2022*
ISO	TC 163	*Energy performance of buildings — Indicators for partial EPB requirements related to thermal energy balance and fabric features — Part 2: Explanation and justification of ISO 52018-1*
ISO	TC 163	*ISO 52018-1:2017* *Energy performance of buildings — Indicators for partial EPB requirements related to thermal energy balance and fabric features — Part 1: Overview of options*
ISO	TC 163	*ISO 52010-1:2017* *Energy performance of buildings — External climatic conditions — Part 1: Conversion of climatic data for energy calculations*
ISO	TC 163	*ISO 52022-1:2017* *Energy performance of buildings — Thermal, solar and daylight properties of building components and elements — Part 1: Simplified calculation method of the solar and daylight characteristics for solar protection devices combined with glazing*
ISO	TC 163	*ISO 52017-1:2017* *Energy performance of buildings — Sensible and latent heat loads and internal temperatures — Part 1: Generic calculation procedures*
ISO	TC 163	*ISO 15927-6:2007* *Hygrothermal performance of buildings — Calculation and presentation of climatic data — Part 6: Accumulated temperature differences (degree-days)*

Organisation	Technical committee	Title
ISO	*TC 163*	*ISO 15927-1:2003 Hygrothermal performance of buildings — Calculation and presentation of climatic data — Part 1: Monthly means of single meteorological elements*
ISO	*TC 163*	*ISO 15927-5:2004 Hygrothermal performance of buildings — Calculation and presentation of climatic data — Part 5: Data for design heat load for space heating*
ISO	*TC 163*	*ISO 15927-3:2009 Hygrothermal performance of buildings - Calculation and presentation of climatic data — Part 3: Calculation of a driving rain index for vertical surfaces from hourly wind and rain data*
ISO	*TC 163*	*ISO 15927-2:2009 Hygrothermal performance of buildings — Calculation and presentation of climatic data — Part 2: Hourly data for design cooling load*
ISO	*TC 163*	*ISO 15927-4:2005 Hygrothermal performance of buildings — Calculation and presentation of climatic data — Part 4: Hourly data for assessing the annual energy use for heating and cooling*
ISO	*TC 67*	*ISO 19900 Petroleum and natural gas industries - General requirements for offshore structures (ISO 19900:2019); English version EN ISO 19900:2019*
ISO	*TC 67*	*Petroleum and natural gas industries - Specific requirements for offshore structures - Part 1: Metocean design and operating considerations (ISO 19901-1:2015); English version EN ISO 19901-1:2015, only on CD-ROM*
ISO	*TC 67*	*Petroleum and natural gas industries - Specific requirements for offshore structures - Part 3: Topsides structure (ISO/DIS 19901-3:2022); English version prEN ISO 19901-3:2022*
ISO	*TC 67*	*Petroleum and natural gas industries - Specific requirements for offshore structures - Part 7: Stationkeeping systems for floating offshore structures and mobile offshore units (ISO 19901-7:2013); English version EN ISO 19901-7:2013, only on CD-ROM*
ISO	*TC 67*	*Petroleum and natural gas industries - Concrete offshore structures (ISO 19903:2019); English version EN ISO 19903:2019, only on CD-ROM*
ISO	*TC 67*	*Petroleum and natural gas industries - Floating offshore structures - Part 1: Ship-shaped, semi-submersible, spar and shallow-draught cylindrical structures (ISO 19904-1:2019); English version EN ISO 19904-1:2019, only on CD-ROM*
ISO	*TC23*	*ISO/FDIS 16119-5* *Agricultural and forestry machinery — Environmental requirements for sprayers — Part 5: Aerial spray systems*
ISO	*TC23*	*ISO 22522 Crop protection equipment — Field measurement of spray distribution in tree and bush crops*
ISO	*TC 23*	*ISO 9898:2000* *Equipment for crop protection — Test methods for air-assisted sprayers for bush and tree crops*
ISO	*TC 68*	*DIN EN ISO 35103 Petroleum and natural gas industries - Arctic operations - Environmental monitoring*

Organisation	Technical committee	Title
ISO	*TC 68*	*DIN EN ISO 35104 Petroleum and natural gas industries - Arctic operations - Ice management*
ISO	*TC 68*	*DIN EN ISO 35106 Petroleum and natural gas industries - Arctic operations - Metocean, ice, and seabed data*
VDI		*VDI 3957-20 Biological measuring techniques for the determination and evaluation of effects of air pollutants (biomonitoring) - Mapping of lichens to indicate local climate change*
VDI		*VDI 4656 Design and dimensioning of micro combined heat and power plants*
VDI		*VDI4710-1 Meteorological data for building-services purposes - Non-European climatic data*
VDI		*VDI4710-2 Meteorological data for technical building services purposes - Degree days*
VDI		*VDI 4710-3 Meteorological data for the building services - t,x correlations from 1991 to 2005 for 15 climatic zones in Germany*
VDI		*VDI 4710-4 Meteorological data for the building services - t,x correlations and wind statistics for 122 European cities*

Technical adaptation solutions

Organisation	Title
BSI	*BS 85500 (2015) Flood resistant and resilient construction - guide to improving the flood performance of buildings*
BSI	*BS 8582 (2013) Code of practice for surface water management for development sites*
BSI	*BS 3998:2010 Tree work. Recommendations*
BSI	*BS 4428:1989 Code of practice for general landscape operations (excluding hard surfaces)*
BSI	*BS 5837 (2012) Trees in relation to design, demolition and construction*
BSI	*BS 6229:2003 Flat roofs with continuously supported coverings. Code of practice*
BSI	*BS 6229:2018 Flat roofs with continuously supported flexible waterproof coverings. Code of practice*
BSI	*BS 7370-4:1993 Grounds maintenance Recommendations for maintenance of soft landscape (other than amenity turf)*

Organisation	Title
BSI	*BS 7533-13 Pavements constructed with clay, natural stone or concrete pavers. Part 13: Guide for the design of permeable pavements constructed with concrete paving blocks and flags, natural stone slabs and setts and clay pavers*
BSI	*BS 8545:2014 Trees: from nursery to independence in the landscape. Recommendations*
BSI	*BS 8595:2013 Code of practice for the selection of water reuse systems*
BSI	*BS 8582:2014 Code of practice for surface water management for development sites*
BSI	*BS 8616:2019Specification for performance parameters and test methods for green roof substrates*
BSI	*BS EN 805 Water supply. Requirements for systems and components outside buildings*
CEN	*DIN EN 16941-1 On-site non-potable water systems - Part 1: Systems for the use of rainwater;*
CEN	*CEN / TR 17179 Thermoplastics piping and ducting systems – Rainwater infiltration and storage attenuation systems*
DIN	*DIN 19712 (2013) Flood protection works on rivers*
DIN	*DIN 18919 (2016) Vegetation technology in landscaping - Care of vegetation during development and maintenance in green areas*
DIN	*DIN 18920:2014-07 DIN Vegetation technology in landscaping - Protection of trees, plantations and vegetation areas during construction work*
DIN	*DIN 19657:2022-06 Protection of watercourses, dikes and coastlines*
DIN	*DIN 19700-12:2004-07 Dam plants - Part 12: Flood retarding basins / Note: Applies in conjunction with DIN 19700-10 (2004-07), DIN 19700-11 (2004-07).*
ISO	*"ISO 21650:2007(en)*
ISO	*Actions from waves and currents on coastal structures"*

Organisation	Title
NEN	*BS ISO 24536:2019 Service activities relating to drinking water supply, wastewater and stormwater systems. Stormwater management. Guidelines for stormwater management in urban areas*
ÖNORM	*NEN EN 17152 Plastics piping systems for non-pressure underground conveyance and storage of non-potable water – boxes used for infiltration, attenuation and storage systems*
SIA	*ÖNORM L 1131 Horticulture and landscaping - Green area on roofs and ceilings of buildings - Directives for planning, building and maintenance (Austria)*
UNI	*SIA 312-SN 564312 Greening of roofs*

Quality management

Organisation	Technical committee	Title
ISO	TC 176	*ISO 9001:2015 Quality management systems — Requirements*
ISO	TC 207	*"ISO/AWI 14002-3 Environmental management systems — Guidelines for using ISO 14001 to address environmental aspects and conditions within an environmental topic area — Part 3: Climate*
ISO	TC 207	*ISO 14001 Environmental management systems - Requirements with guidance for use (ISO 14001:2015); German and English version EN ISO 14001:2015*
ISO	TC 207	*ISO 14002-2 Environmental management systems - Guidelines for using ISO 14001 to address environmental aspects and conditions within an environmental topic area - Part 2: Water (ISO/DIS 14002-2:2022); German and English version prEN ISO 14002-2:2022*
ISO	TC 207	*ISO 14004 Environmental management systems - General guidelines on implementation (ISO 14004:2016); German and English version EN ISO 14004:2016*

Climate change, risk and resilience

Organisation	Technical committee	Title
CEN	CWA	*CWA 17300 City Resilience Development - Operational Guidance*

Organisation	Technical committee	Title
CEN	CWA	*CWA 17301 City Resilience Development - Maturity Model;*
CEN	CWA	*CWA 17302 City Resilience Development - Information Portal;*
DIN		*IEC 63152 Smart Cities - City Service Continuity against disasters - the role of the electrical supply (IEC SyCSmartCities/55/CD:2018); Text in German and English*
DIN		*SPEC 35810 Stakeholder Engagement - Guidelines for decision making processes dealing with climate change; Text in German and English*
DIN		*SPEC 35811 Scenario Planning - Guidelines for decision making processes dealing with climate change; Text in German and English*
ISO	TC 207	*ISO 14090:2019 Adaptation to climate change — Principles, requirements and guidelines*
ISO	TC 207	*ISO 14091, Adaptation to climate change – Guidelines on vulnerability, impacts and risk assessment*
ISO	TC 207	*ISO/TS 1 14092, Adaptation to climate change – Requirements and guidance on adaptation planning for local governments and communities*
ISO	TC 207	*ISO 14093, Mechanism for financing local adaptation to climate change – Performance-based climate resilience grants – Requirements and guidelines*
ISO	ISO/TMBG	*ISO Guide 84:2020 Guidelines for addressing climate change in standards*
ISO	TC 207	*ISO 14080, Greenhouse gas management and related activities – Framework and principles for methodologies on climate actions*
ISO	TC 207	*ISO 14064-1 Greenhouse gases - Part 1: Specification with guidance at the organisation level for quantification and reporting of greenhouse gas emissions and removals (ISO 14064-1:2018); German and English version EN ISO 14064-1:2018*
ISO	TC 207	*ISO 14064-2 Greenhouse gases - Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements (ISO 14064-2:2019); German and English version EN ISO 14064-2:2019*
ISO	TC 207	*ISO 14064-3 Greenhouse gases - Part 3: Specification with guidance for the verification and validation of greenhouse gas statements (ISO 14064-3:2019); German and English version EN ISO 14064-3:2019*

Organisation	Technical committee	Title
ISO	TC 207	*ISO 14067 Greenhouse gases - Carbon footprint of products - Requirements and guidelines for quantification (ISO 14067:2018); German and English version EN ISO 14067:2018*
ISO	TC 207	*ISO 14097:2021 Greenhouse gas management and related activities — Framework including principles and requirements for assessing and reporting investments and financing activities related to climate change*
ISO	TC 207	*ISO 19694-1:2021 Stationary source emissions — Determination of greenhouse gas emissions in energy-intensive industries — Part 1: General aspects*
ISO	TC 268	*ISO 37153:2017 Smart community infrastructures — Maturity model for assessment and improvement*
ISO	TC 268	*ISO 37155-1:2020 Framework for integration and operation of smart community infrastructures — Part 1: Recommendations for considering opportunities and challenges from interactions in smart community infrastructures from relevant aspects through the life cycle*
ISO	TC 268	*ISO 37155-2:2021 Framework for integration and operation of smart community infrastructures — Part 2: Holistic approach and the strategy for development, operation and maintenance of smart community infrastructures*
ISO	TC 268	*ISO 37156:2020 Smart community infrastructures — Guidelines on data exchange and sharing for smart community infrastructures*
ISO	TC 268	*ISO 37160:2020 Smart community infrastructure — Electric power infrastructure — Measurement methods for the quality of thermal power infrastructure and requirements for plant operations and management*
ISO	TC 268	*ISO 37166:2022 Smart community infrastructures — Urban data integration framework for smart city planning (SCP)*
ISO	TC 268	*ISO 37170:2022 Smart community infrastructures — Data framework for infrastructure governance based on digital technology in smart cities*
ISO	TC 268	*ISO/TR 37171:2020 Report of pilot testing on the application of ISO smart community infrastructures standards*
ISO	TC 268	*ISO/TS 37172:2022 Smart community infrastructures — Data exchange and sharing for community infrastructures based on geographic information*
ISO	TC 268	*ISO 37101:2016 Sustainable development in communities — Management system for sustainable development — Requirements with guidance for use*

Organisation	Technical committee	Title
ISO	TC 268	*ISO 37104:2019 Sustainable cities and communities — Transforming our cities — Guidance for practical local implementation of ISO 37101*
ISO	TC 268	*ISO 37105:2019 Sustainable cities and communities — Descriptive framework for cities and communities*
ISO	TC 268	*ISO/TS 37107:2019 Sustainable cities and communities — Maturity model for smart sustainable communities*
ISO	TC 268	*ISO 37120:2018 Sustainable cities and communities — Indicators for city services and quality of life*
ISO	TC 268	*ISO/TR 37121:2017 Sustainable development in communities — Inventory of existing guidelines and approaches on sustainable development and resilience in cities*
ISO	TC 268	*ISO 37123:2019 Sustainable cities and communities — Indicators for resilient cities*
ISO	TC 268	*ISO/CD 37125 Environmental, Social and Governance (ESG) Indicators for Cities*
ISO	TC 292	*ISO/DIS 22328-2 Security and resilience — Emergency management — Part 2: Guidelines for the implementation of a community-based early warning system for landslides*
ISO	TC 292	*ISO/WD 22372 Security and resilience — Resilient Infrastructure — Guidelines*
ISO	TC 292	*ISO 22319 Security and resilience - Community resilience - Guidelines for planning the involvement of spontaneous volunteers (ISO 22319:2017); German and English version prEN ISO 22319:2021*
ISO	TC 292	*ISO 22361 Security and resilience - Crisis management - Guidelines for developing a strategic capability (ISO/DIS 22361:2021); German and English version prEN ISO 22361:2021*
ISO	TC 262	*ISO 31000:2018 Risk management — Guidelines*
ISO	TC 262	*IEC 31010:2019 Risk management — Risk assessment techniques*
ISO	TC 262	*ISO 31022:2020 Risk management — Guidelines for the management of legal risk*
ISO	TC 262	*ISO 31073:2022 Risk management — Vocabulary*
ISO	TC 262	*ISO/CD TS 31050 Guidance for managing emerging risks to enhance resilience*
VDI		*VDI 3785-2 Environmental meteorology - Methods of urban and site-related ground-based climate measurements with mobile measurement systems*
VDI		*VDI 3785-1 Environmental meteorology - Methods and presentation of investigations relevant for planning urban climate*

Organisation	Technical committee	Title
VDI		*VDI 3787-8 Environmental meteorology - Urban development in view of climate change*
VDI		*VDI 3787-9 Environmental meteorology - Provision for climate and air quality in regional planning*