Climateurope2

Climateurope2: Supporting and standardising climate services in Europe and beyond

29 November 2024

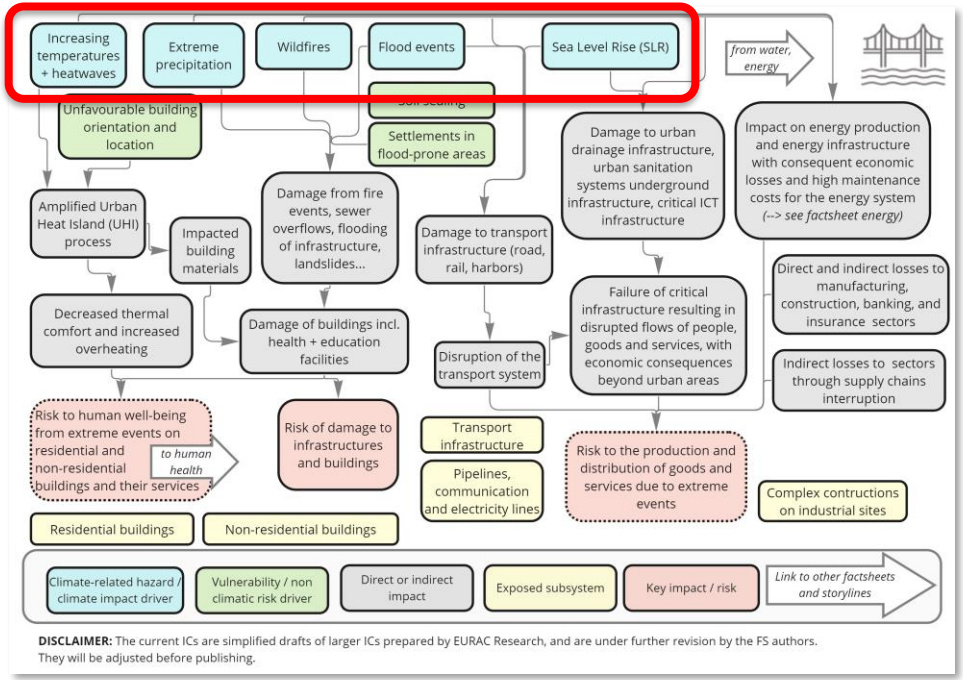
Francisco Doblas-Reyes (ICREA and Barcelona Supercomputing Center)
Asun Lera St Clair (DNV and Barcelona Supercomputing Center)

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101056933. The sole responsibility for the content of this document lies with the Climateurope2 project and does not necessarily reflect the opinion of the European Union.

Climate information and climate services

Climate risk assessment, climate adaptation and climate mitigation require access to reliable **climate information.**

Climate services are the **provision of climate information** so as to **assist decision-making** by individuals and organisations. The service involves **appropriate engagement**, an **access mechanism**, and **responsiveness to user needs**. It builds on that fact that climate is just one out many other drivers.



EUCRA (2024)

Quality assurance of climate services

Quality assurance assesses the fitness-for-purpose of climate services against **standards** from multiple angles: tools, workflows, data, applications, provenance, documentation, user engagement, etc.

For instance, software quality assessment should be based on the standard ISO/IEC 9126 and extensions (e.g., ISO/IEC 25010:2011).

What are standards?

Standards are specifications, measurable requirements, processes or performance conventions, aimed at achieving consistency in processes, products, and services.

They are developed through consensus by legitimate organisations* to ensure conformity and quality.

*ISO, CEN, ASTM etc.

Why are they needed?

Current challenges

- Lack of widely agreed, auditable criteria for climate services limits transparency, trust, and equitable market growth.
- Fragmented guidance and best practices lacking comprehensive coverage and consensus.

Benefits

- Establish shared terminology and methodologies for comparison and compatibility.
- Ensure product functionality, reduce risks, and uphold health, safety, and rights.
- Build credibility, relevance, and legitimacy in climate services.

Need for comprehensive guidance

- Define clear distinctions between components that can be standardised and those still evolving.
- Establish certification mechanisms and accredited actors for quality assurance.

Path forward

- Involvement of all relevant actors in creating comprehensive, consensus-based standards.
- Equitable participation to build two-way trust between providers and users.
- **Climateurope2**'s approach focuses on addressing these gaps by fostering robust standardisation frameworks.

Climateurope2 objectives

Standardising

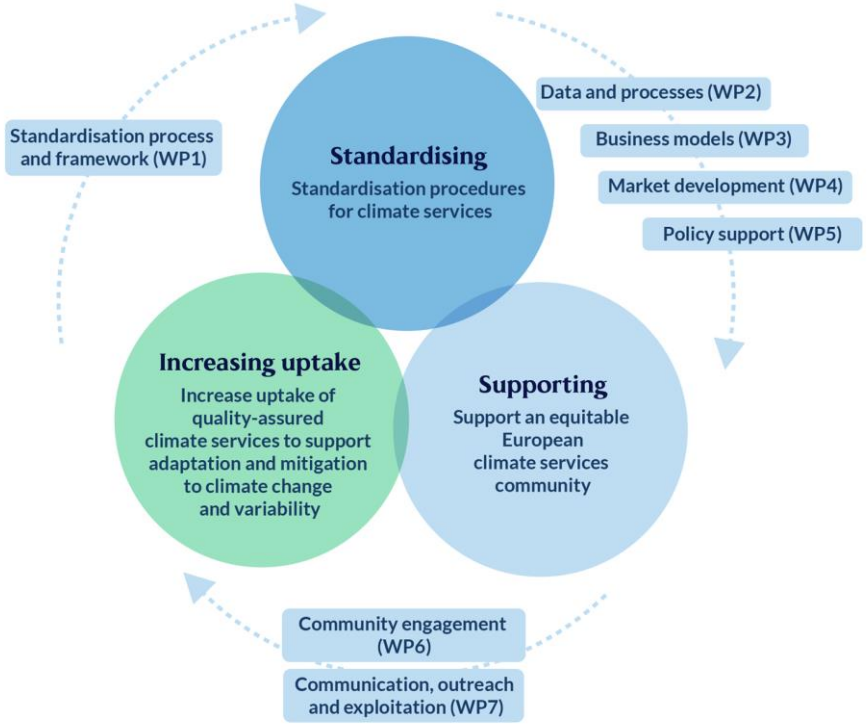
Development of standardisation procedures for climate services

Supporting

Support of an equitable European climate services community

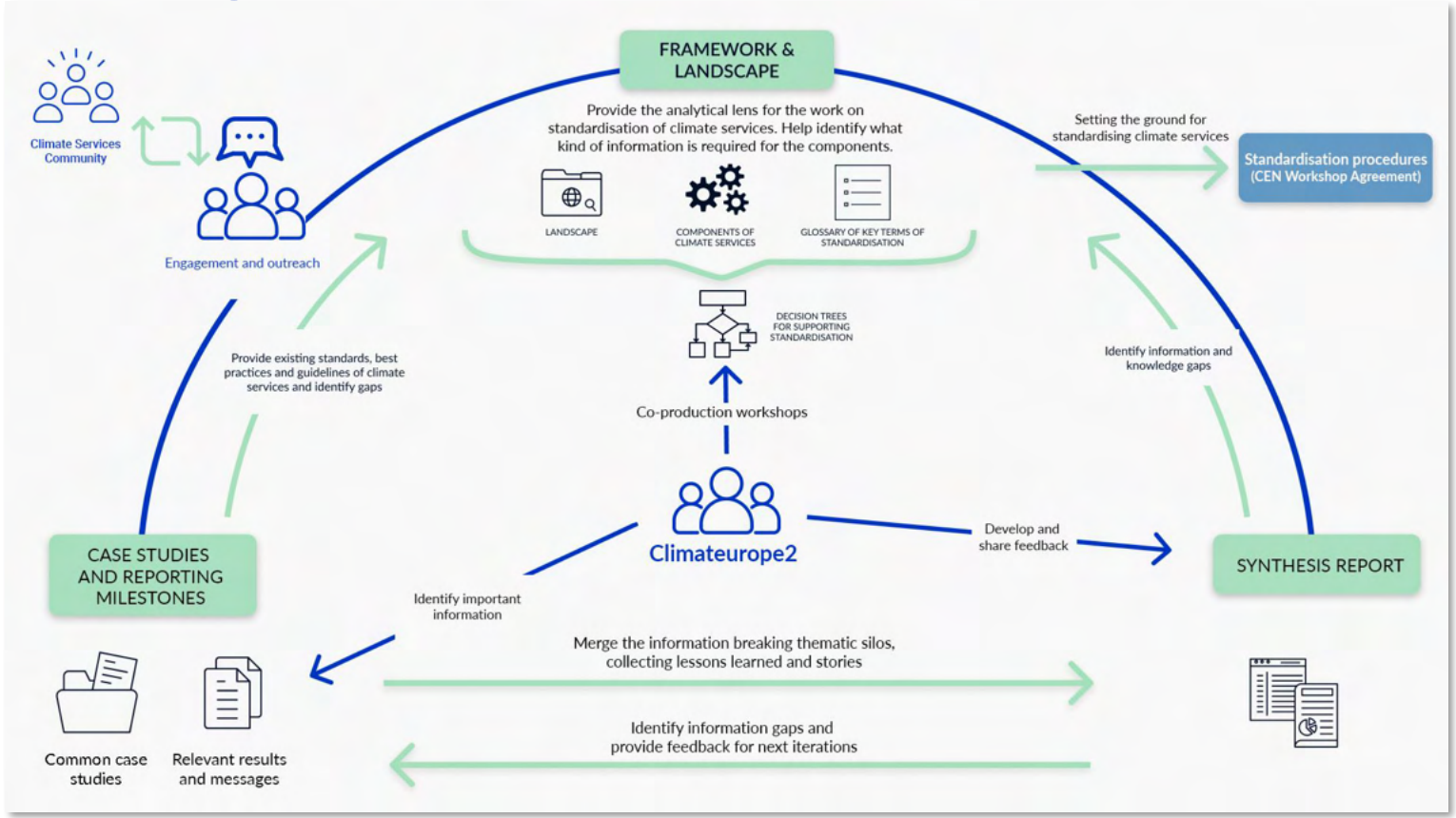
Increasing uptake

Enhancement of the uptake of quality-assured climate services to support climate adaptation and mitigation

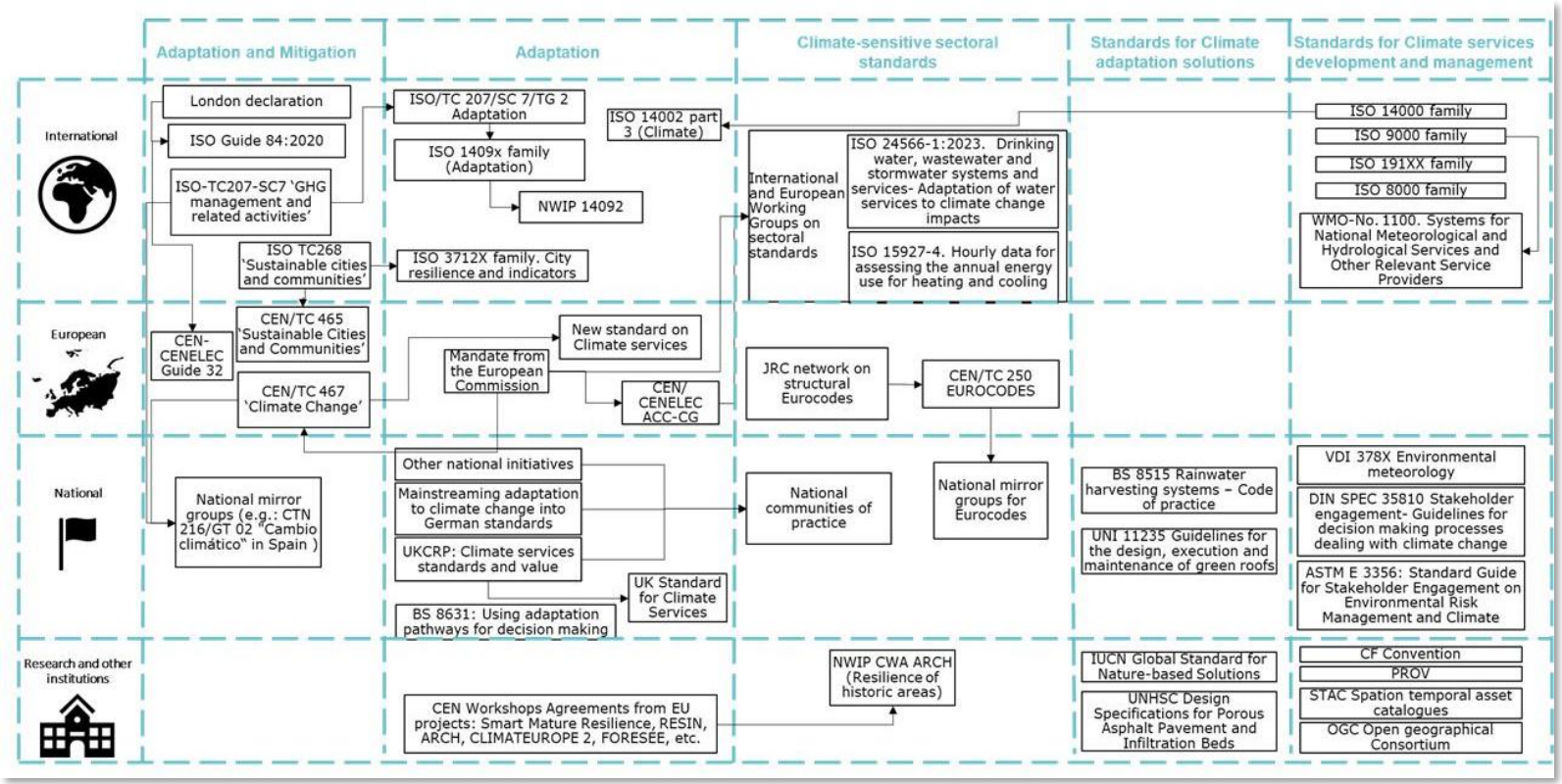


CSA Horizon Europe, Sep 2022-Feb 2027

Preparing recommendations for standards



Landscape


Adaptation and Mitigation
Adaptation
Climate-sensitive sectoral standards
Standards for Climate adaptation solutions
Standards for Climate services development and management
International
European
National
Research and other institutions
London declaration
ISO Guide 84:2020
ISO-TC207-SC7 'GHG management and related activities'
ISO TC268 'Sustainable cities and communities'
CEN-CENELEC Guide 32
CEN/TC 465 'Sustainable Cities and Communities'
CEN/TC 467 'Climate Change'
National mirror groups (e.g.: CTN 216/GT 02 "Cambio climático" in Spain)
ISO/TC 207/SC 7/TG 2 Adaptation
ISO 1409x family (Adaptation)
NWIP 14092
ISO 3712X family. City resilience and indicators
New standard on Climate services
Mandate from the European Commission
CEN/ CENELEC ACC-CG
Other national initiatives
Mainstreaming adaptation to climate change into German standards
UKCRP: Climate services standards and value
UK Standard for Climate Services
BS 8631: Using adaptation pathways for decision making
CEN Workshops Agreements from EU projects: Smart Mature Resilience, RESIN, ARCH, CLIMATEUROPE 2, FORESEE, etc.
ISO 14002 part 3 (Climate)
International and European Working Groups on sectoral standards
ISO 24566-1:2023. Drinking water, wastewater and stormwater systems and services- Adaptation of water services to climate change impacts
ISO 15927-4. Hourly data for assessing the annual energy use for heating and cooling
JRC network on structural Eurocodes
CEN/TC 250 EUROCODES
National communities of practice
National mirror groups for Eurocodes
NWIP CWA ARCH (Resilience of historic areas)
ISO 14000 family
ISO 9000 family
ISO 191XX family
ISO 8000 family
WMO-No. 1100. Systems for National Meteorological and Hydrological Services and Other Relevant Service Providers
BS 8515 Rainwater harvesting systems – Code of practice
UNI 11235 Guidelines for the design, execution and maintenance of green roofs
IUCN Global Standard for Nature-based Solutions
UNHSC Design Specifications for Porous Asphalt Pavement and Infiltration Beds
VDI 378X Environmental meteorology
DIN SPEC 35810 Stakeholder engagement- Guidelines for decision making processes dealing with climate change
ASTM E 3356: Standard Guide for Stakeholder Engagement on Environmental Risk Management and Climate
CF Convention
PROV
STAC Spation temporal asset catalogues
OGC Open geographical Consortium

Climate services components

Climate services components

Decision context

- Completeness of description of decision-making context
- Adaptability and flexibility to e.g., evolving regulatory regimes or transferability for different purposes
- Subsidiarity
- Salience of climate service/fitness for purpose
- Market creation and innovation friendliness qualities

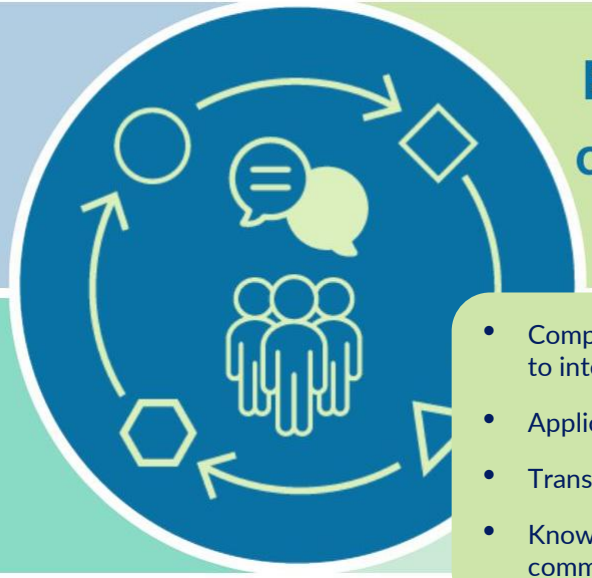
Ecosystem of actors and co-production processes

Knowledge systems

Climate services components

Decision context

Ecosystem of actors and co-production processes



Delivery mode and evaluation

- Completeness of stakeholder mapping and methodologies to integrate all voices
- Application of knowledge co-production methods
- Transparency on the scope of the service
- Knowledge brokerage, literacy, and diversity of communication channels to ensure awareness of services

Climate services components

Decision context

Delivery mode and evaluation

Knowledge systems

- FAIR principles (Findable, Accessible, Interoperable and Reusable) for any kind of digital data
- Storylines/narratives approach usage
- Provenance, traceability of climate and other data, information, and knowledge
- Accuracy specifications and uncertainties
- Degree of completeness/use/consideration of multiple types, sources, and systems of knowledge and their integration
- Data and processes quality control and assurance
- File and metadata formats
- Backwards compatibility

Climate services components

- Knowledge brokerage, literacy, and diversity of communication channels
- Accessibility of the climate service
- Visualisation
- Timeliness
- Accountability/feedback processes
- Reflexiveness
- Conducive to open science
- Auditability and certifiability

Ecosystem of actors and co-production processes

Delivery mode and evaluation

Knowledge systems

Process to identify guidelines

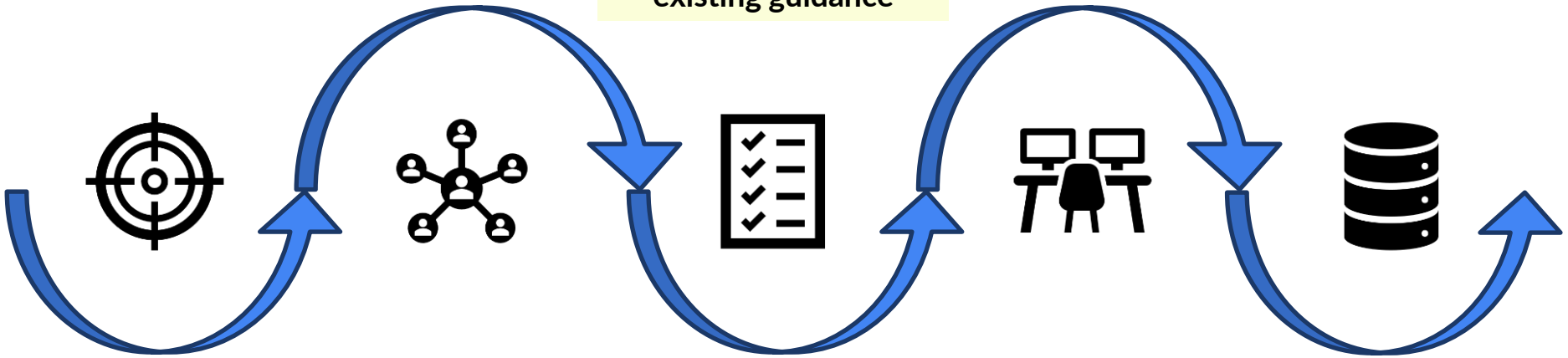
1. Agree on the scope of guidelines

2. Identify roles and responsibilities among Climateurope2's work packages

3. Agree on an analytical structure to assess and categorise existing guidance

4. Identify sources and conduct search and characterisation

5. Create a centralised database of reference documents

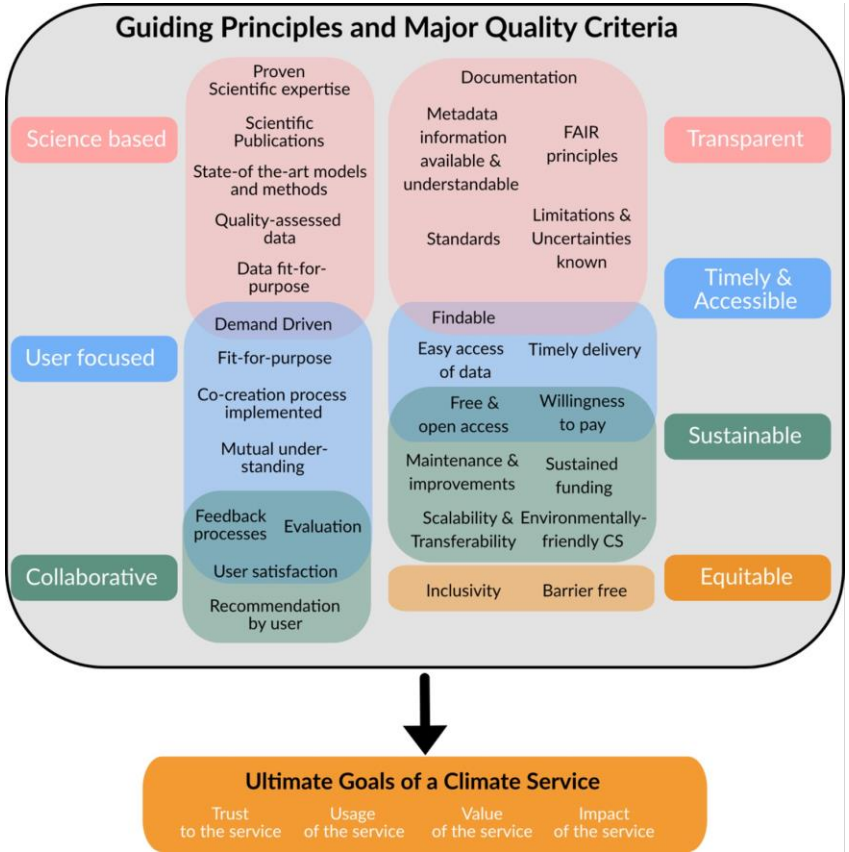


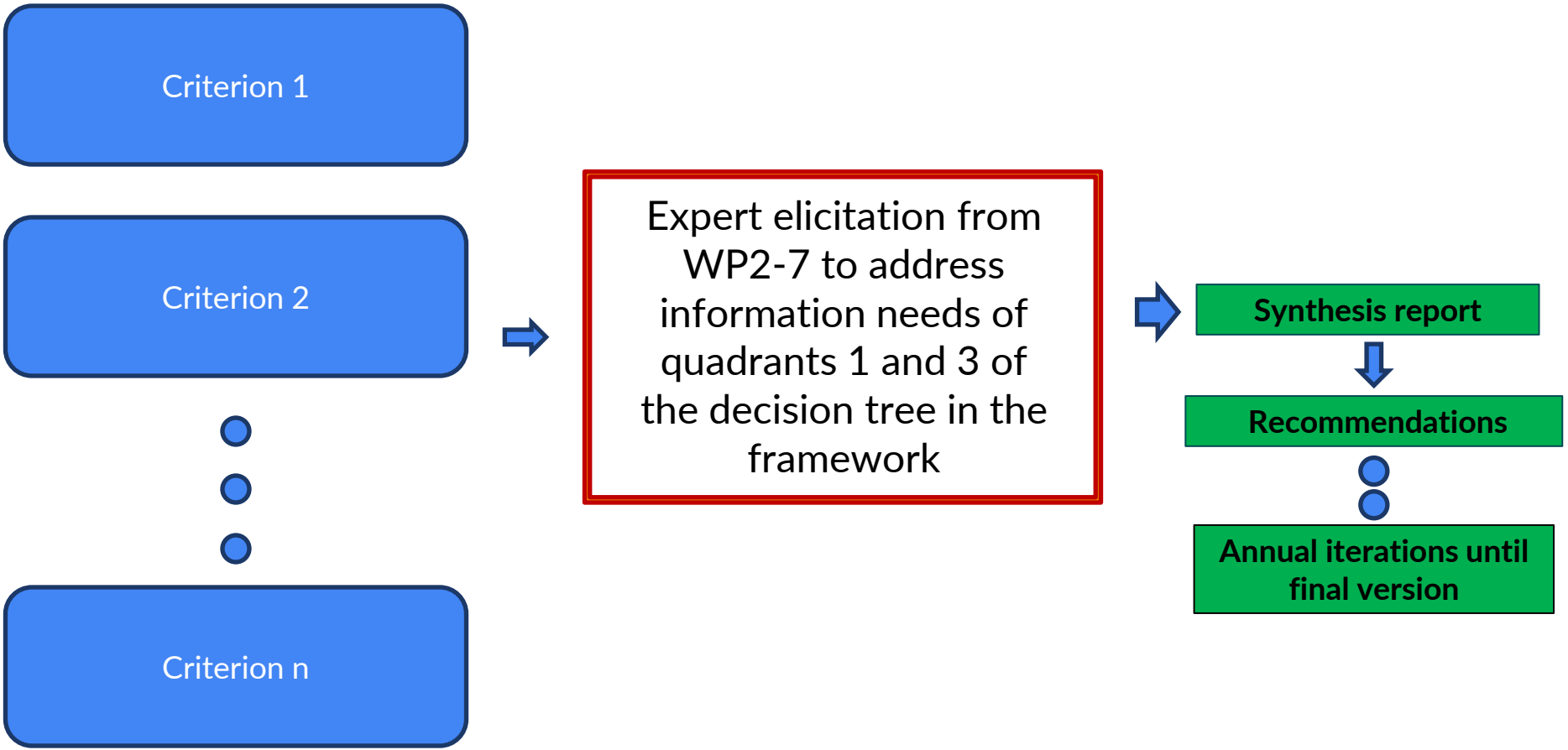
	Metadata, format and vocabulary	Provenance
Definition	Data about data, including descriptions, applicability, ownership, access paths, rights and volatility.	Allows to document and track the origins and history of data, information, and processes.
Key insights so far …	Key actors in climate services have identified metadata best practices in connection with data and software. Several communities have developed metadata, format and vocabulary conventions. Findable (F), Accessible (A), Interoperable (I) and Reusable (R) principles apply to both data and software and should apply to the whole life cycle. The evolution of formats, vocabularies and metadata is usually not backwards compatible. The link between data and metadata should be always preserved. Metadata readability must be ensured for both humans and machines.	Provenance provision is demanding, but is a key component in traceability, transparency and comparability. WMO is updating their Climate Data Management Specifications to include requirements for a provenance management system. Non-domain specific recommendations on how to represent provenance information are provided by the World Wide Web Consortium. A range of provenance schemes is used in the climate services community, but there is no unique globally adopted scheme. The use of Persistent Identifiers is widely recommended.
Working on …	How general data management practices differ across sectors.	Collecting evidence for a *must have* regarding Persistent Identifiers and provenance models.

	Quality verification	Uncertainty and risk assessment
Definition	The quality of a system is the degree to which the system satisfies the stated and implied needs of its various stakeholders and thus provides value.	The words “uncertainty” and “risk” means different things to different people, and in different contexts. The IPCC (2021) defines uncertainty as “a state of incomplete knowledge that can result from a lack of information or from disagreement about what is known or even knowable.” Risk is defined by the IPCC as “the potential for adverse consequences for human or ecological systems,” arising from the interaction between climate-related hazards with the exposure and vulnerability of the affected system.
Key insights so far …	Many standards and guidelines exist for quality management, cybersecurity, systems and software engineering, geographic information, etc. The existence of these standards doesn’t guarantee their compliance. Many actors don’t know they exist, or why they should invest time on them. Open-source and scientifically validated verification tools are being developed. FAIRness validation tools exist. Verification vocabulary is inconsistently used through the community. The scope and strategies in quality control and assessment are diverse and context dependent.	There has been a proliferation of regulations, standards and guidelines for risk assessment. Not all of them are specific to climate risk assessment, but many may nevertheless be very relevant if they deal with climate-related risks (e.g., recommendations for disaster risk management). Very few guidelines and standards include transition risks, and few address complex risk assessments for compound and cascading risks. Not all guidelines and standards strictly adopt the IPCC risk framework. Yet there are common elements, such as the importance of defining the scope of the analysis and the need to collect quality data on hazard, exposure and vulnerability. Different methods exist depending on the objective, scope and data availability of the analysis. Few guidelines however address uncertainties, and almost all lack specific guidance on how to communicate the results of a risk assessment. There are many tools and services (including data portals) to

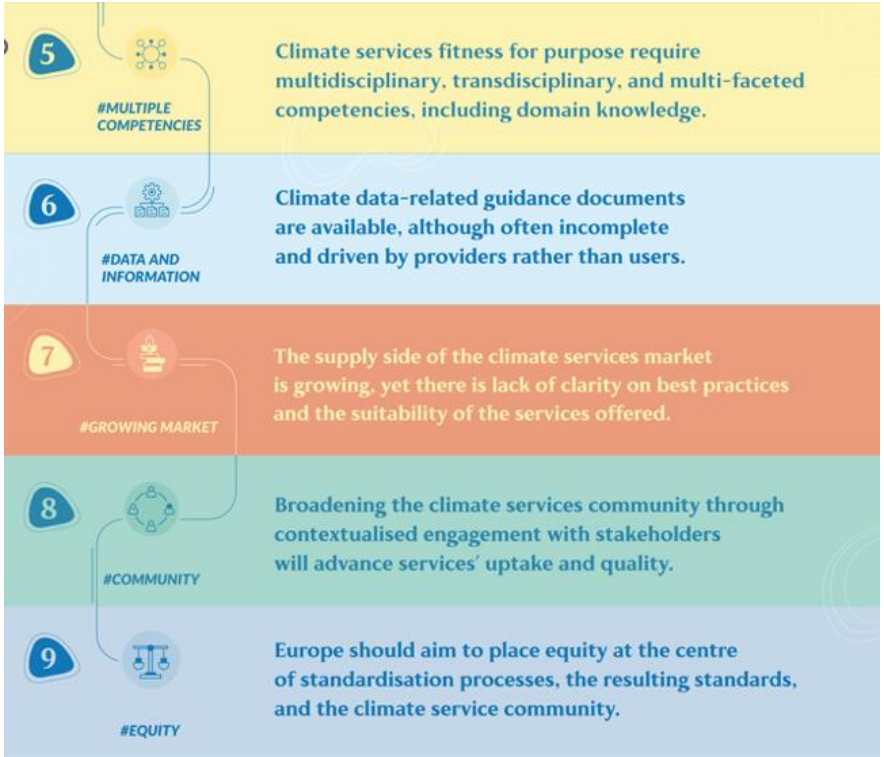
Quality aspects of climate services

Guiding principles for high-quality climate services and quality criteria suggested from literature and stakeholder engagement.




Criterion 1
Criterion 2
Criterion n
Expert elicitation from WP2-7 to address information needs of quadrants 1 and 3 of the decision tree in the framework
Synthesis report
Recommendations
Annual iterations until final version

Key messages (v1)



1

The standardisation of climate services supports evidence-based resilience to climate impacts, green investments, and transformations to a sustainable future.

Climate services are essential for addressing the risks associated with climate variability and change, inform mitigation and adaptation pathways, and ensure robust sustainability reporting and disclosure to unlock sustainable finance. Yet, criteria supporting the quality of these services or how they may be fit for purpose need more guidance, regulation and agreed-upon legitimate standards. Standards, quality assurance, and certification schemes have the potential to enhance the quality, salience, credibility, and legitimacy of climate services, and raise the bar in the climate services market. Lessons harvested from CE2 can catalyse the dialogue to formulate requirements to be considered in standardisation processes.

#SUSTAINABLE FUTURE

Climateurope2

Funded by the European Union

2

Breaking down climate services into interrelated components enables the assessment of their quality, efficiency, and effectiveness, and to distinguish what should not be standardised.

Climate services can be defined as the provision of climate information such that decision-making is facilitated. The service should include engagement between users and providers, be based on scientifically credible information and expertise, have an effective access mechanism, and respond to users' needs. Given the variety and complexity of climate services and their fluid boundaries, breaking down a climate service into a set of interrelated components is useful. The components identified by CE2 are 1) the decision context, 2) the ecosystem of actors and co-creation processes involved in co-producing, evaluating, and taking up climate services, 3) knowledge systems of different types, and related selection, evaluation, and translation processes, and 4) the delivery mode and its evaluation.

#CLIMATE SERVICES COMPONENTS

Climateurope2

Funded by the European Union

3

Climate services can be governed through both, formal standardisation processes and alternative institutional mechanisms.

There is no set of guidelines or standards regulating climate services, and the current landscape needs to be more diverse and cohesive. Climate services can benefit from a suite of design or technical standards that benchmark a minimum set of quality criteria for structural specifications (such as data provenance), performance standards setting outcome specifications (such as salience criteria), and procedural standards setting specifications for processes (such as co-production processes). Some components of climate services may not be fully suitable nor may require formal standardisation. In those cases, alternative forms of governance and institutional mechanisms can guide their suitability and quality.

#CLIMATE SERVICES GOVERNANCE

Climateurope2

Funded by the European Union

4

Climate services shall demonstrate to be user-focused, science-based, transparent, collaborative, timely, accessible, sustainable, and equitable.

Although there is no single set of quality, salience, and usability criteria for the totality of climate services, collecting existing scientific and technical knowledge and evidence from empirical studies for the different components enables identification of key requirements. Recognized factors are that deep understanding of decision contexts is key, as is learning from ongoing delivery of services (including stories of failures) and collecting empirical evidence as to what constitutes optimal co-design and co-production with users. Climate services fitness for purpose also depends on the interaction and interoperability across different types of knowledge and experiences.

A wide variety of stakeholder groups with different roles, interests and goals should be adequately involved in the climate services value chain in a balanced and democratic manner.

#BENCHMARKING

Climateurope2

Funded by the European Union

5

Climate services fitness for purpose require multidisciplinary, transdisciplinary, and multi-faceted competencies, including domain knowledge.

All decision contexts in the broad sense for which climate services are needed (including contexts in which the climate information is produced, the decision to which it applies, and its local, sectoral or regulatory context), are all important conditions for successful services. These conditions can influence the outcome and impact of a climate service and thus, also its quality, efficiency and salience for the decision at hand. Transdisciplinary approaches integrating scientific knowledge with sectoral and domain expertise are critical to take into account local specificities, cultural and
normative contexts.
Thus, the integration of a multiplicity of competences and experience is required for climate services fit for purpose.

#MULTIPLE COMPETENCIES

Climateurope2

Funded by the European Union

6

Climate data-related guidance documents are available, although often incomplete and driven by providers rather than users.

Meteorological, hydrological and climate data are the elements of a climate service that have a more organised community, available requirements, quality criteria and technical documentation. However, key aspects remain unresolved, such as data provenance, traceability of derived indicators, and data interoperability, curation, and exploitation scenarios. In addition, the diversity of standards combined with the importance of integrating climate data with other type of data relevant for different decision contexts, remains a challenge. The merging of multiple knowledge systems, and fostering appropriate understanding during engagement and co-production with users, indicates that this relative maturity of climate data quality criteria falls short, requiring interfaces with other equally important knowledge systems.

#DATA AND INFORMATION

Climateurope2

Funded by the European Union

7

The supply side of the climate services market is growing, yet there is lack of clarity on best practices and the suitability of the services offered.

To date, the climate services market has been dominated by public providers who have played a key role in giving access to public climate datasets. There is an increasing number of private climate service providers, who aim to translate climate data to satisfy both public and business needs.

Although the value of climate services (economic, social, cultural) is still poorly understood, it appears that market success is built on an understanding of decision-making contexts and on localising the service provision (e.g., in cities to assess health risks or for financial disclosures). Potential innovative climate service business models need further study, as not all (partly publicly funded) innovations have reached the market.

A taxonomy capturing success factors of climate services and their components will help identify standardisation opportunities.

#GROWING MARKET

Climateurope2

Funded by the European Union

8

Broadening the climate services community through contextualised engagement with stakeholders will advance services' uptake and quality.

The climate services community that has so far engaged with Climateurope2 consists primarily of research-focused participants. This may be limiting as there is the potential to miss out on insights from the private sector and other climate service professionals, as well as the wider climate service user community, whether in the public or private domains. Creating a tighter knit community will help advance knowledge sharing and open ways to benchmark climate services.

There will be no one size fits all: for example, engagement with the private sector will benefit from a sectoral approach. New creative engagement and communication strategies, including the use of art, need to be considered in reaching out to underrepresented stakeholders. Engagement needs to be respectful and mindful of inclusiveness and carbon emissions.

#COMMUNITY

Funded by the European Union

9

Europe should aim to place equity at the centre of standardisation processes, the resulting standards, and the climate service community.

Placing equity at the centre of climate services governance is a choice Europe can make to avoid economic interests to dominate climate services. It is an ethical choice to work towards ensuring power balance, and equal access to information, resources, and support to adapt and mitigate the impacts of climate change to vulnerable and marginalised communities. At the same time, equity also has an efficiency value. A climate service should provide relevant data to the community it serves. In turn, users tend to have more trust in a climate service that they have contributed to build and over which they feel ownership.

Standardisation processes need to enshrine all types of mechanisms that ensure equity, empowering stakeholders with different capabilities and accessibility constraints to engage with the process.

#EQUITY

Climateurope2

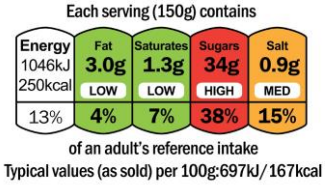
Funded by the European Union

Certification, labelling, etc.

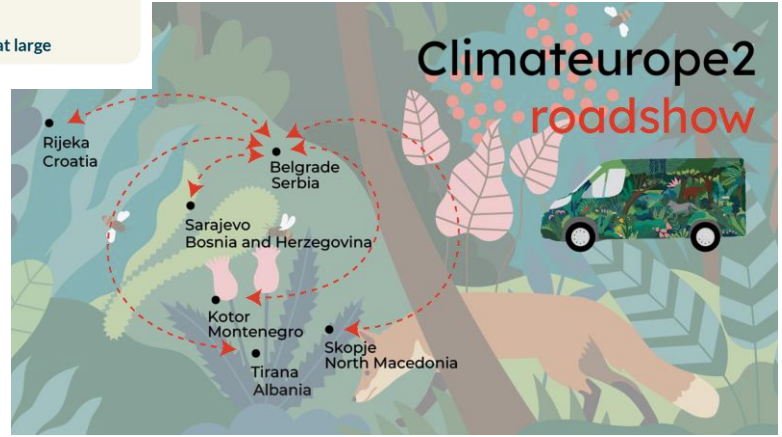
List of agreed terms

Term	Definition	Source
Certification	Third-party attestation related to an object of conformity assessment, except accreditation.	ISO 17000
Quality assurance	Part of quality management focused on providing confidence that quality requirements will be fulfilled.	ISO 9000
NB: **Accreditation**: The system of rules, procedures and management for carrying out certification, which must always be provided by an independent or third party provider.		
Verification	Confirmation, through the provision of objective evidence, that specified requirements have been fulfilled. The term "verified" is used to designate the corresponding status.	ISO 9000

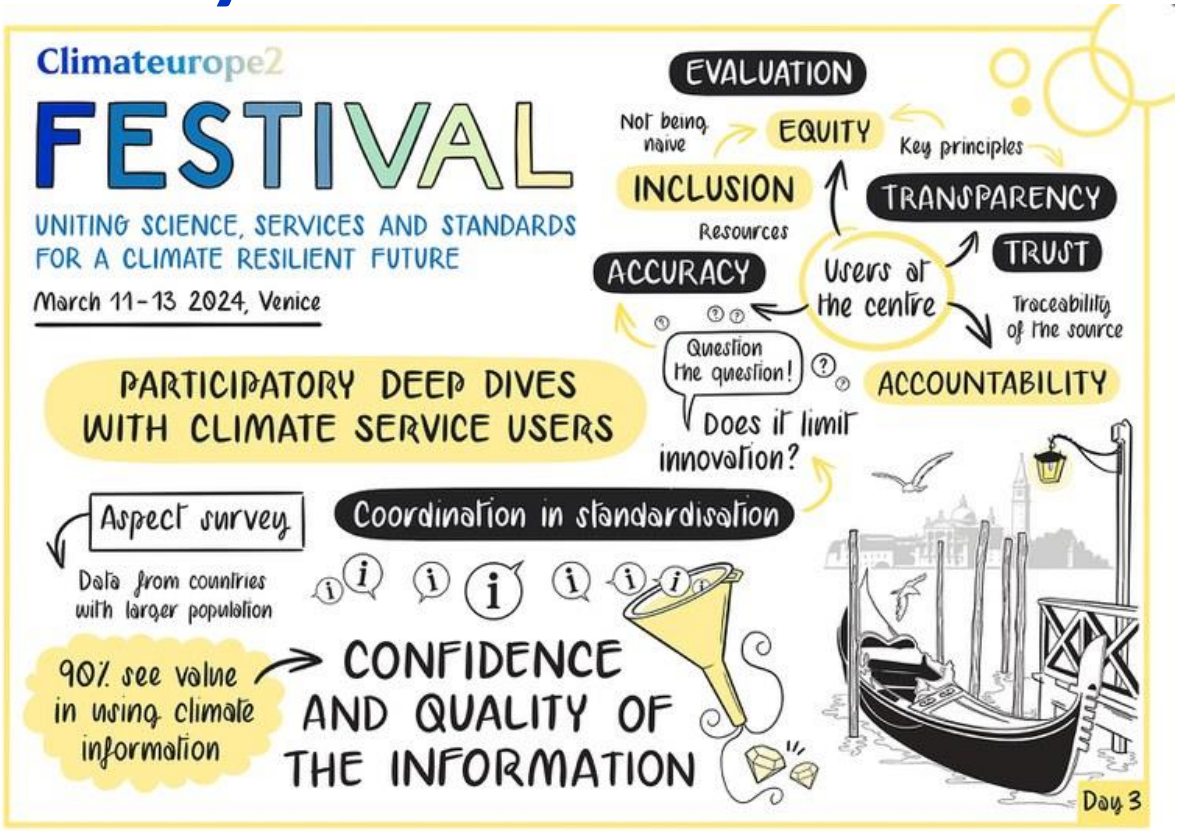
Labelling: Demonstration of compliance. A label or symbol that conveys a product or service has been verified by an independent party such that discloses information or meets requirements. e.g:, food safety labelling; DNV Seal; ecolabels; descriptions of use or side effects…etc



Community and audience



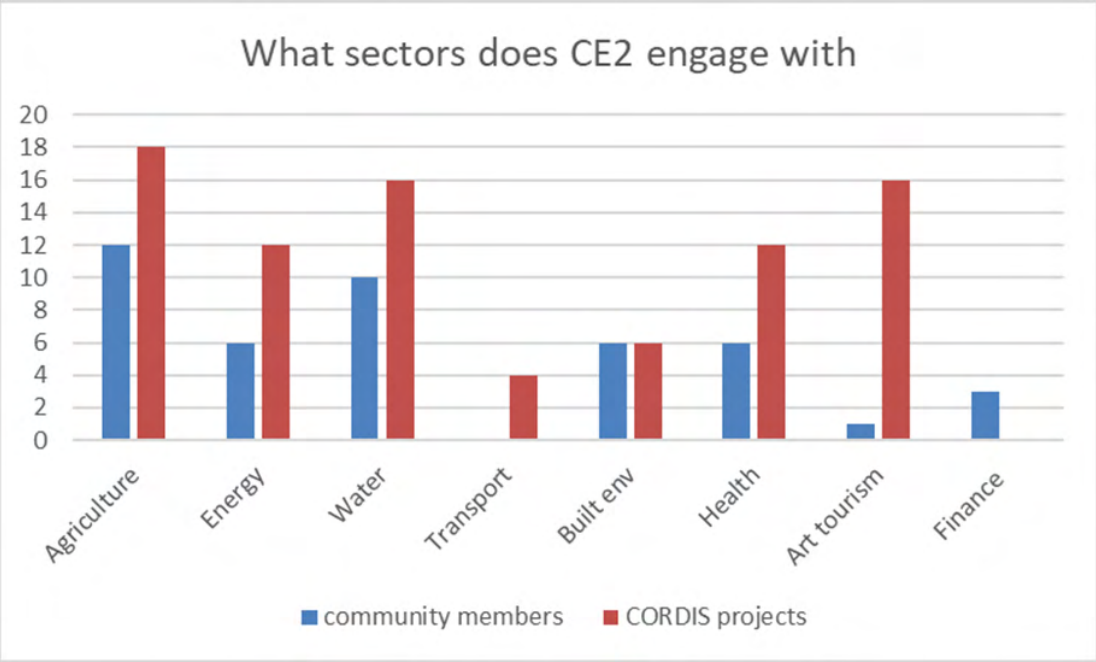
Community activities



Network and community

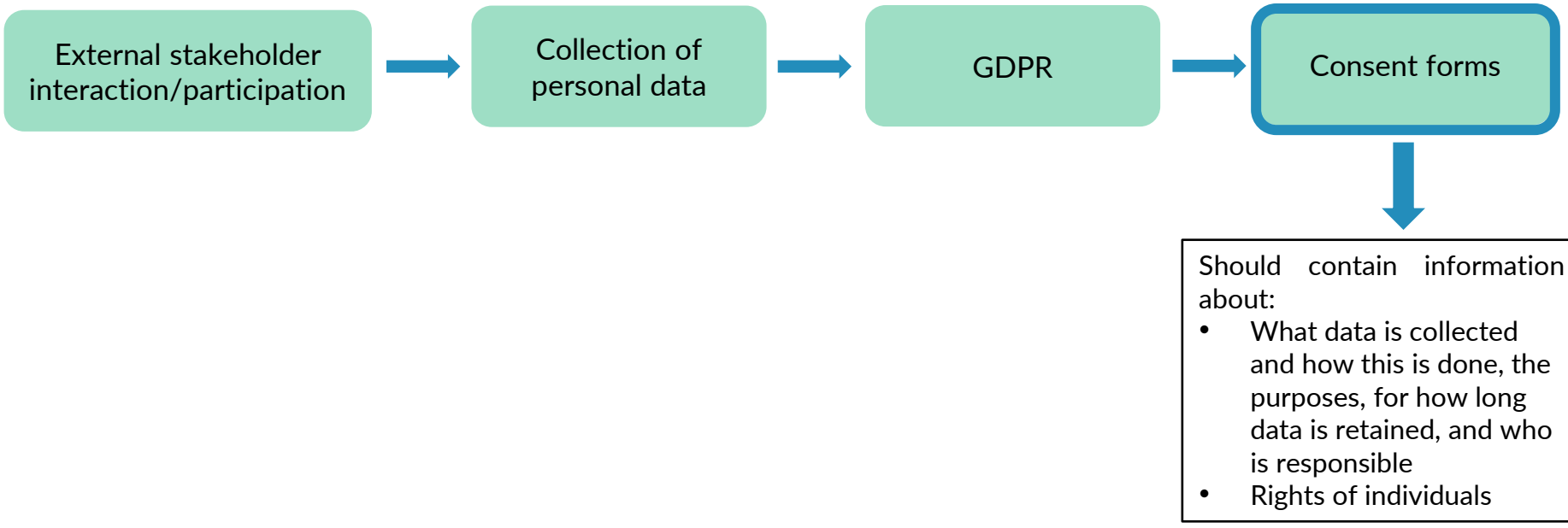
- Which sectors are active? Number of projects in CORDIS related to sectors
- Which sectors are in the community? Climateurope2 #members per sector (as of Oct 2024)

- Agriculture, forestry and fishing (18)
- Mining
- Manufacturing (1)
- Energy (Electricity, etc) (12)
- Water supply, sewerage, waste (16)
- Construction
- Wholesale and trade
- Transportation and storage (4)
- Accommodation and food services
- Information and communication
- Financial and insurance
- Real estate (6)
- Professional, scientific, technical (4)
- Human health (12)
- Art entertainment and recreation (16)
- Other services (88)



Engagement innovation

Personal data management



Link to CEN-CENELEC

TC 467 is tasked with implementing a standardisation request from DG CLIMA
The TC has created a new WG on adaptation

- Develops standards for integrating environmental conditions into existing standards
- It will be in charge of the standardisation of climate services
- It has adopted recommendations from the Adaptation to Climate Change Coordinating Group (ACC CG) for the technical report “Adaptation to climate change – Guidelines on using climate data in infrastructure standards”

Climateurope2 contributes via a CEN Workshop Agreement and has a liaison agreement with CEN-CENELEC

European Commission | Climateurope2

INFORMATION

https://climateurope2.eu/
https://earth.bsc.es/climateurope2

CONNECT

contact@climateurope2.com
climateurope2.eu

@climateurope2
climateurope2

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101056933. The sole responsibility for the content of this document lies with the Climateurope2 project and does not necessarily reflect the opinion of the European Union.