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# D3.2 Orientation paper

## Procurement strategy to implement Pre-Commercial Procurement and Public Procurement of Innovative solutions

**Lead beneficiary: CPS**

Dissemination level: Public

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**Project abstract**

**PROTECT aims at levering innovation procurement to unlock the climate service (CS) market's potential to support urgent climate adaptation and mitigation. The project will allow public and private organisations to build up and integrate their knowledge and skills about climate change, environmental observation (EO) and innovation procurement, notably enabling public authorities to shift to a proactive governance model, using innovative public procurement approaches to increase value and climate impact for money. It shall increase access of CS SME providers across Europe to public procurement markets and shape solutions that best address public demand, both specific and systemic. The initial focus will be on five encompassing application domains (Utilities, Green cities, Health, Land use & Marine environment, Security) and their contributions to the areas of sustainability in Horizon Europe's Cluster 6. The project will source and assess existing and high-potential CS solutions and technologies that use EO data. It will engage with an extensive and varied community of procurers, inform the definition and aggregation of their needs and functional requirements for CS, explaining, fostering and supporting a 'buying with impact' approach. Clearer, less fragmented demand shall guide and support R&D for future CS. PROTECT will prepare the operational ground for one or more joint, cross-border or coordinated pre-commercial procurement (PCP) processes and identify short-term actions so that Public Procurement of Innovative Solutions (PPI) can be activated towards or right after the project's end. At policy level, it will provide decision-makers for procurement, climate and policy, at EU, national, regional and local levels, with practical recommendations and guidelines to boost the use of innovation procurement for climate action.**

**Keywords**

**State-of-the-art (SOTA) analysis, Technology Readiness Levels (TRL), procurement strategy**



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# Abbreviations and Acronyms

| | |
|---|---|
| AI | Artificial Intelligence |
| AKIS | Agricultural Knowledge and Innovation Systems |
| API | Application Programming Interface |
| CAN | Contract Award Notice |
| CN | Contract Notice |
| COTS | Commercial Off-The-Shelf |
| CS | Climate Services |
| EAFIP | European Assistance For Innovation Procurement |
| EO | Earth Observation |
| EU | European Union |
| FAIR | Findable, Accessible, Interoperable and Reusable |
| FRAND | Fair, Reasonable and Non-Discriminatory |
| GEOSS | Global Earth Observation System of Systems |
| GDPR | General Data Protection Regulation |
| GHG | Greenhouse Gas |
| GPA | Agreement on Government Procurement |
| GUI | Graphical User Interface |
| HAA | City of Haarlem |
| HE | Horizon Europe |
| IPRs | Intellectual Property Rights |
| IWRM | Integrated water resource management |
| NBS | Nature Based Solutions |
| NDA | Non-Disclosure Agreement |
| OMC | Open Market Consultation |
| PBG | Public Buyers Group |
| PC | Project Coordinator |

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| | |
|---|---|
| PCP | Pre-Commercial Procurement |
| PIN | Prior Information Notice |
| R&D | Research and Development |
| SMEs | Small and Medium Enterprises |
| SOTA | State Of The Art |
| TCO | Total Cost of Ownership |
| TED | Tenders Electronic Daily |
| TRL | Technology Readiness Level |
| SWVA | Soil Water Vegetation Atmosphere System |
| WTO | World Trade Organization |


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# Executive Summary

This orientation paper recommends the implementation of Pre-Commercial Procurement (PCP) and Public Procurement of Innovative Solutions (PPI) regarding four identified challenges with a higher climate and procurement impact selected in the framework of the PROTECT project. The PCP and/or PPI approach is justified in each case based on the information obtained as a result of the activities carried out during the preparatory phase of innovation procurement projects following the European Assistance For Innovation Procurement initiative's methodology.[1]

The identification and selection of procurement challenges and the definition of the procurement approach relates to the outcome of the five main steps in the preparatory phase described in this orientation paper: (1) needs identification and assessment; (2) state-of-the-art (SOTA) analysis; (3) open market consultation (OMC); (4) business case development; and (5) procurement strategy design.

The first orientation paper recommended PCP as the main procurement instrument to tackle the following four procurement challenges, as the functional requirements cannot be achieved by one existing solution and thus R&D is required:

- **FLOODS CHALLENGE:** Rapid-mapping, predicting, preventing different types of floods and improving coordination efforts, relevant to marine and coastal environments, sustainable cities and civil protection and security agencies
- **FIRES CHALLENGE:** Predicting, preventing fires, tracking and tracing causality (causers) in different scenarios (waste, forest/nature, other), relevant to environmental agencies, sustainable cities, agriculture, forestry and land use, as well as for civil protection and security agencies.
- **WATER CHALLENGE:** Climate resilient solutions for predicting, connecting data, planning, supply-demand, relevant to the application domains marine and coastal environments, energy and utilities, sustainable cities, agriculture, forestry and land use, as well as for civil protection and security agencies.
- **INFRASTRUCTURE CHALLENGE:** Sustainable & resilient re-development, buildings restoring & adaptation), relevant to sustainable cities, energy and utilities and civil protection and security agencies.

The scope of the abovementioned four (4) challenges and use cases was reassessed based on the OMCs' results and the discussions held with public buyers committed to implement a PCP. The result was the selection of **one overarching Water (management) challenge clustering different use cases. The aim is an integral assessment of day-to-day Soil Water Vegetation Atmosphere System (SWVA) conditions with space-based value chains based on local/central knowledge (Artificial Intelligence, Earth Observation-Inversion/hydrological modelling, etc.)** to provide a first basis of local water intelligence for the use case stakeholders. Driven by the functions required by the organisations the data on SWVA conditions can support regular or crisis management processes (e.g. risk indicators) in different application domains. As such, the testing and validation strategy requires the support of technical organisations that will support the PCP implementation. Since the work of these organisations falls outside the scope of PROTECT CSA, the methodology, technical criteria and test planning will be part of the follow up PCP.

Based on the developments mentioned above, this paper details the procurement strategy for a PCP considering the requirements of the relevant Horizon Europe on PCP action.[2] The strategy includes an

[1] See the European Assistance for Innovation Procurement (EAFIP www.eafip.eu).
[2] "Customisation/pre-operationalisation of prototypes end-user services in the area Climate Change Adaptation and Mitigation" call is for a consortium of public procurers (the "buyers group") to prepare, launch and implement a pre-commercial procurement procedure that responds to a commonly identified challenge in the area of climate adaptation and mitigation. https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/wp-call/2023-2024/wp-9-food-bioeconomy-natural-resources-agriculture-and-environment_horizon-2023-2024_en.pdf#page=555

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**updated setup** for the PCP phased approach, the number of suppliers per phase, the budget allocated by supplier per phase, and the duration of each phase.

# 1. Introduction

The orientation paper prioritises recommendations for the procurement challenges with a higher climate and procurement impact and indicates whether a PCP or a PPI is the best procurement approach to address the four identified procurement challenges based on the TRLs assessed in Task 1.3 - Sourcing CS technologies and providers, and finetuned in Task 3.2 -.SOTA analysis. PROTECT aims to prepare a PCP, but the possibility of a PPI approach has also been considered.

In this orientation paper, the possible use of PCP and/or PPI approaches are justified based on the information obtained as a result of the activities carried out during the preparatory phase of an innovation procurement project following the EAFIP methodology.[3] There are five main steps in the preparatory phase, namely: (1) needs identification and assessment; (2) state-of-the-art (SOTA) analysis; (3) open market consultation; (4) business case development; (5) procurement strategy design.

For this purpose, the orientation paper presents in section 2 the methodology applied for the identification and selection of four procurement challenges and the outcomes of the abovementioned preparatory steps.

Section 3 provides a description of use cases in each of the four challenges, stating the current situation and the desired future functionalities, as well as the general findings of a preliminary patents and standards search.

Section 4 describes the Water (management) challenge as result of further scoping the needs with public buyers. The scope and methodology to select use cases is explained.

Section 5 provides the main considerations for the selection of a PCP and/or PPI approach.

Section 6 focuses on the requirements of the PCP approach and updated procurement strategy of a future PCP of Water management innovations considering the specific requirements of the HE PCP call on the “Customisation/pre-operationalisation of prototypes end-user services in the area Climate Change Adaptation and Mitigation”.[4]

Finally, section 7 provides main conclusions and recommendations.

Additionally, the annexes include a diagram of the Water (management) challenge, previous information on the four challenges related to Floods, Fires, Water and Sustainable and resilient infrastructure, the summary of the results of the e-pitching sessions, the summary of the Commercial Off The Shelf (COTS) search, and an overview of the procedures that could be used under the PPI approach.

This orientation paper has been updated with information obtained at the completion of the tasks related to the SOTA analysis, the Business case development and the fine-tuning of the procurement strategy based on the work performed with the commitment public buyers in preparation of the PCP-WISE proposal based on the outcomes of the PROTECT project.

[3] See the European Assistance for Innovation Procurement (EAFIP www.eafip.eu).
[4] The €19 million pre-commercial procurement call is fully funded by the EU. The goal of the “Customisation/pre-operationalisation of prototypes end-user services in the area Climate Change Adaptation and Mitigation” call is for a consortium of public procurers (the “buyers group”) to prepare, launch and implement a pre-commercial procurement procedure that responds to a commonly identified challenge in the area of climate adaptation and mitigation. https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/wp-call/2023-2024/wp-9-food-bioeconomy-natural-resources-agriculture-and-environment_horizon-2023-2024_en.pdf#page=555

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# 2. Methodology

One of the objectives of the PROTECT project is to identify public buyers' common pressing challenges and unmet needs, and to define if the functional requirements can be tackled by existing solutions, by innovative solutions closer to the market, or whether R&D is needed to develop and test prototypes.

If the solutions are available in the market, a traditional procurement procedure may be conducted. In case the challenge requires a solution which is near to the market or already on the market in small quantity but does not meet public sector requirements for large scale deployment yet, the PPI approach may be applied by using one of the procurement procedures established in the EU public procurement directives.[5] When there are no solutions in the market to satisfy the unmet need and there is a significant gap which requires that the public buyer steers the development of solutions to satisfy its needs and gathers knowledge about pros/cons of alternative solutions from different providers, the PCP approach can be applied to create a competitive supply base.

To identify the common pressing challenges and unmet needs, the methodology applied in the context of the PROTECT project consisted of a value engineering approach, consultations and workshops with public buyers, and the selection of 4 procurement challenges based on six criteria (Table 1). To recommend the most suitable procurement strategy (traditional procurement, PCP or PPI) based on the technology readiness of potential solutions to address each challenge, the preparatory steps of the EAFIP methodology have been followed, as explained in the following sections.

The value engineering approach consists of 3 stages: (i) Pre-study (including surveys and desk research); (ii) Workshops (pain point workshops and consultations); and (iii) Post-study (analysis and recommendations for the implementation of innovation procurement approaches). Value techniques[6] where used to describe the scope of problems, use cases, functional requirements, the present state and the desired (wished) future situation during the first five pain point workshops, one per application domain: (1) Marine and Coastal environment, (2) Sustainable Urban Communities, (3) Civil Security and Protection, (4) Energy and Utilities, and (5) Agriculture, Forestry and other Land Use.

Further analysis was conducted to select those challenges with high impact in more than one application domain and with cross-border relevance, which revealed after the preliminary analysis on the patents and standards that there is room for innovation beyond the state state-of-the- art given the specific functional requirements. The analysis led to the selection of 4 procurement challenges across application domains and relevant to different public buyers from different EU Member States, which were communicated through the Open Market Consultation (OMC) to receive feedback from the market. The results of the OMC and the following steps are also described in the sections below.

After the submission of D3.1 Orientation Paper, the work with public buyers was resumed with the purpose to scoping the R&D needs and use cases based on the insights obtained from the previous steps and the commitment to prepare a proposal for the HE PCP call. Based on the work of public buyers, it was deemed necessary to define one overarching challenge that could cluster several use cases relevant to crises management. In this sense, the Water (management) challenge was selected based on the rationale that water intelligent solutions and related EO data are crucial to provide climate services linked to the challenges of floods, fires and sustainable and resilient infrastructure as explained in section 4.

[5] Directive 2014/24/EU of the European Parliament and of the Council of 26 February 2014 on public procurement and repealing Directive 2004/18/EC and Directive 2014/25/EU of the European Parliament and of the Council of 26 February 2014 on procurement by entities operating in the water, energy, transport and postal services sectors and repealing Directive 2004/17/EC.

[6] See report ANNEX VIII Common needs in five domains using value methodologies (T1.5) in D2.1 Cross-cutting analysis of drivers of the demand for climate services and barriers.

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## 2.1. Needs assessment and prioritisation

With the purpose of identifying, assessing, and prioritising needs in the context of the PROTECT project, two sets of pain point workshops were carried out in March and September 2023. First, five workshops (one per application domain) took place on 28th and 29th of March of 2023. The second set of four workshops took place on 18th and 19th of September and focused on four challenges selected out of the seven challenges initially identified (five from the workshops, one per each application domain, and two additional proposed from consultations with public buyers). During the more in-depth workshops tackling each of the four challenges, relevant information was provided regarding the SOTA analysis and the OMC.

As a result of the first five workshops, five challenges and related keywords for the IPR search were identified. The outcome consisted of a description of the problem and functional requirements, a use case stating the ‘as is’ present situation and the ‘wish’ optimal future situation that could be achieved with innovative solutions. In addition, a value pilot and keywords were preliminarily defined. The identified challenges in the five application domains expressed as functional requirements were:

- **Marine and Coastal environment**: Rapid and reliable mapping of flooded areas for planning, preventing, predicting and post-event intervention and cooperation.
- **Sustainable Urban Communities:** Thermal monitoring and predicting waste fire to avoid spontaneous ignition in waste storages and air pollution, using automated notification of risk of fire based on the modelling of certain conditions (like the level of humidity, air temperature, height of the pile of waste, etc.).
- **Civil Security and Protection:** Identifying illegal dumping of waste in water and sending automated alerts to law enforcement agencies to prevent the flow of waste causing cross-border damages, and producing standardised reports that can serve as proof of responsibility in (criminal) judicial proceedings.
- **Energy and Utilities:** Predicting the demand for sweet water from different users aimed at connecting the supply and demand of water for diverse uses (such as farming) in the water value chain to tackle periods of drought.
- **Agriculture, Forestry and other Land Use:** Detecting climate vulnerability in the face of challenges like salinity affecting reproductivity of vegetation, through automated analysis that supports the decision of experts in preparing resilience plans.

Following the first set of pain point workshops, a series of consultations with public buyers took place, identifying two additional challenges: (1) Building and restoring resilient cities infrastructure, and (2) Predicting peak traffic times & CO2 emissions by types of transportation. These two challenges and the five challenges identified in the pain point workshops were defined as seven challenges with potential impact across application domains.

From the seven challenges, four were selected for the in-depth second set of pain point workshops. The methodology to determine the four challenges was based on 6 criteria: (1) commitment to lead a buyers group; (2) interest of public buyers; (3) genuine need to solve a problem as part of the strategic plan of an organisation; (4) expected impact of EO and CS on several sectors; (5) technology readiness level (TRL) (if COTS are available or there is enough room for innovation to conduct a PCP); and (6) EU wide network, interregional cooperation and cross-border interest.

The assessment of criteria (1), (2), (3) and (6) was based on the feedback from interested public buyers (through EU Survey questionnaires and consultations). For the assessment of the impact criterion (4), several elements were taken into account, such as the European level impact, expected replicability of the solution for other public buyers/regions, impact on sustainability and climate linked to primary needs (air, water, food, shelter), safety and security, the prevention of risks, and the impact on several users and sectors. The TRL of potential solutions criterion (5) was based on the preliminary results of the

SOTA analysis consisting of the patents and standards search using keywords on the intelligent IPlytics platform[7], the e-pitching results and the assessment of COTS.[8]

The four selected challenges and the related functional requirements were analysed more in depth during the second set of four pain point workshops, one per challenge:

- **FLOODS CHALLENGE:** Rapid-mapping, predicting, preventing different types of floods and improving coordination efforts, relevant to marine and coastal environments, sustainable cities and civil protection and security agencies
- **FIRES CHALLENGE:** Predicting, preventing fires, tracking and tracing causality (causers) in different scenarios (waste, forest/nature, other), relevant to environmental agencies, sustainable cities, agriculture, forestry and land use, as well as for civil protection and security agencies.
- **WATER CHALLENGE:** Climate resilient solutions for predicting, connecting data, planning, supply-demand, relevant to the application domains marine and coastal environments, energy and utilities, sustainable cities, agriculture, forestry and land use, as well as for civil protection and security agencies.
- **INFRASTRUCTURE CHALLENGE:** Sustainable & resilient re-development, restoring & adaptation of existing neighbourhood's, including buildings, bridges, roads etc, relevant to sustainable cities, energy and utilities and civil protection and security agencies.

These challenges were reassessed by public buyers and user stakeholders to define the concrete R&D scope of a future PCP. The Water challenge was selected and further scoped as the need of water intelligence for the **integral assessment of day-to-day SWVA conditions with space-based value chains based on local/central knowledge (AI, EO-Inversion/hydrological modelling, etc.)**. The data on SWVA conditions can support regular or crisis management processes (e.g. risk indicators) related to floods, fires and resilient infrastructure in different application domains

The definition of the challenges was the first step of the preparatory phase in the application of the EAFIP methodology (Figure 1), followed by the SOTA analysis, the OMC, the business case development and the design of the procurement strategy choosing for a PCP or PPI approach based on the TRL of the potential solutions.

[7] https://platform.iplytics.com
[8] See the OMC Report. http://www.protect-pcp.eu/wp-content/uploads/2023/11/PROTECT-OMC_Report_2023_FINAL2_27-11-2023.pdf

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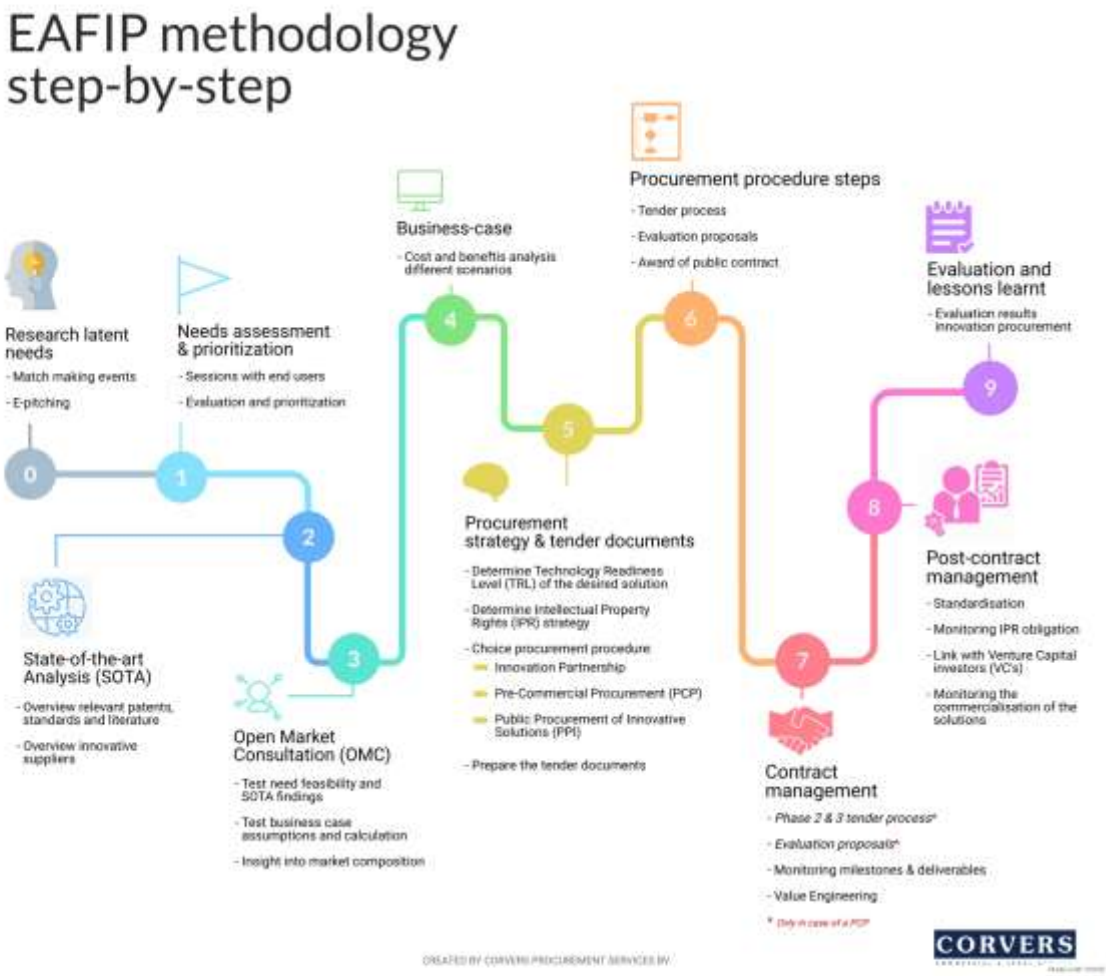


*Figure 1: The steps of an Innovation Procurement project based on the EAFIP methodology*

For the actual implementation of the PCP based on the concrete R&D scope of water intelligence, additional preparatory work will be required in cooperation with the committed public buyers, users stakeholder group and supporting technical organisations. Together, they will select the final use cases and design the testing and validation plan as explained in section 6.

## 2.2. SOTA analysis

The main goal of the SOTA analysis is to identify if there is enough room for innovation to set the grounds for a future PCP. The SOTA analysis consists of three activities:

(i) Analysing the Intellectual Property Rights (IPR), listing the existing patents and standards;

(ii) Mapping of the Commercial-Off-The-Shelf (COTS) products; and

(iii) Assessing the material collected, translating this into a list of technologies and assessing the TRL level of these technologies.

The preliminary results of the SOTA analysis are based on the IPR and standards search using selected keywords on the IPlytics intelligent platform (https://www.iplytics.com/), the e-Pitching sessions conducted on 18th and 19th September (see Annex 2) and the COTS mapping (see Annex 3).

During the mapping of the EO-based climate services at EU level performed in the frame of PROTECT, suppliers were able to provide more details regarding the technology used to provide their services. This

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information, combined with a desk research, concluded that the providers' most used COTS products are open data platforms such as Copernicus.

In addition, the initial results showed that there is research going on in fields related to the 4 challenges and solutions tackling some but not all of the functionalities defined under each of the challenges.

The analysis of the standards and COTS has not revealed any relevant standards for the four challenges. Regarding the COTS, the initial search indicated that a number of products are available in the market but they can only partially address the gaps and needs of the procurers. Therefore, the preliminary conclusion is that there are grounds for a PCP in any of the 4 challenges (Floods, Fire, Water and Infrastructure).

In the context of PROTECT, an analysis of mapped climate services used the following TRLs.

| TRL | Definition |
|---|---|
| 1 | Preliminary algorithmic stage. Publication of research results. |
| 2 | Individual algorithms or functions are prototyped. |
| 3 | Prototype of the main functionalities of the integrated system. |
| 4 | Alpha version. Preliminary release of non-mature software version; distributed to a community at an early stage of the software development life-cycle; that implements the main functionality of the software and by which preliminary verification and validation activities are archived. |
| 5 | Beta version. Preliminary release of non-mature software version; distributed to a community at an early stage of the software life-cycle, that implements the complete functionality of the software and by which preliminary verification and validation activities are archived. |
| 6 | Ready for use in an operational or production context, including user support, as a building block or a tool. |
| 7 | Demonstrator. Building block and tailored generic software product qualified for a particular purpose. |
| 8 | System qualified and ready to be applied in an operational environment. |
| 9 | Has been applied in the execution of an operational environment |

*Table 1: Technology readiness levels (TRLs) applied to the assessment of mapped Climate Services*

## 2.3. Open Market Consultation results

A Prior Information Notice (PIN)[9] published in Tenders Electronic Daily (TED) announced the OMC on potential future procurement activity. The rules and objectives of the PROTECT OMC, as well as the challenges, the potential public buyers and the PCP approach, were described in the OMC Document and its annexes. The OMC was performed under the law of one of the potential lead procurers, City of Haarlem, which is Dutch law.

Through the OMC, the Public Buyers Group (PBG) organized under the PROTECT project communicated the needs related to the four challenges and informed market operators about the

[9] https://ted.europa.eu/udl?uri=TED:NOTICE:574857-2023:TEXT:EN:HTML&src=0

upcoming PCP of R&D services for the "Customisation/pre-operationalisation of prototypes end-user services in the area Climate Change Adaptation and Mitigation".[10] During the OMC, it was explained that the preparation of a PCP proposal would respond to commonly identified challenges (by a group of 20 potential public buyers) in the area of climate adaptation and mitigation that can be better addressed jointly.

The OMC also aimed to understand the market operators' capabilities to satisfy the PBG's needs and to obtain their input on the viability of the procurement plans and conditions described in OMC document and annexes.

In sum, the objectives of the OMC were to:

1. Validate the findings of the SOTA analysis and the viability of the set of technical and financial provisions.
2. Raise awareness of the industry and relevant stakeholders (including other users) regarding the upcoming PCP.
3. Collect insights from the industry and relevant stakeholders (including users) to finetune the tender specifications.

The target groups of the OMC were users (including other public buyers with similar unmet needs) and technology vendors. All interested parties were invited to take part in the OMC. However, it was clarified that the participation in the future PCP may be restricted to companies from EU and Associated Countries and that the 100% of R&D services would be required to be performed in the EU or Associated Countries.

The participation in the OMC was voluntary and non-binding and was at the own expense and risk of market operators. A market operator could not charge the PBG any costs for participation in the OMC or for (re) use of its information in the context of a future procurement procedure. It was also clarified that the participation in the OMC is not a condition for submitting a tender in the subsequent procurement, does not lead to any rights or privileges for the participants, and is not part of any pre-qualification or selection process. Neither the provided input in the OMC could be used to evaluate future proposals.

The OMC activities consisted of:

- **Four webinars** that took place on 15th and 16th November 2023. The webinars were carried out in English and broadcasted online. The recordings of the webinars are published on the PROTECT website, with the aim to enlarge the audience.
- **A request for information** in the form of an EU Survey questionnaire which was filled out by 18 respondents.
- **Other activities and questionnaires** as deemed necessary within the scope of the project, including a publication of a **Q&A document**.

Based on the feedback provided in the EU Survey questionnaire, the majority of respondents belonged to start-ups and SMEs, as indicated in the figure below.

[10] "Customisation/pre-operationalisation of prototypes end-user services in the area Climate Change Adaptation and Mitigation".https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/wp-call/2023-2024/wp-9-food-bioeconomy-natural-resources-agriculture-and-environment_horizon-2023-2024_en.pdf#page=555

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**Type of organization:**

| | | Answers | Ratio |
|---|---|---|---|
| Startup | | 8 | 44.44 % |
| SME | | 7 | 38.89 % |
| Public organization | | 1 | 5.56 % |
| Private organization | | 1 | 5.56 % |
| Other | | 2 | 11.11 % |
| No Answer | | 0 | 0.00 % |

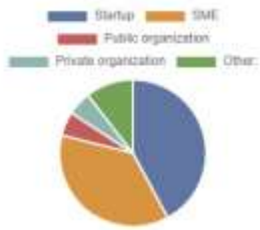


*Figure 2: Type of organisations who replied to the Request for Information using the EU Survey tool*

The participants who replied to the EU Survey questionnaire were from organisations in France, Germany, Greece, Luxembourg, Italy, Spain, the Netherlands and United Kingdom.

**According to the respondents of the Request for Information, the four challenges can be tackled including:**

- Irrigation control and weather forecast services.
- A methodology to assess flood risk based on past events, satellite radar data and digital elevation models (DEMs).
- A range of services for water management in a platform combining 3 services: (1) monitoring irrigated and non-irrigated plots and characterizing irrigation practices; (2) mapping water bodies and monitoring water availability, and (3) monitoring water quality (turbidity, chlorophyll-a concentration, etc.).
- Measuring atmosphere gases (GHG), both measure the carbon release in case of fire, and provide inputs during the fire about the atmosphere and, thus evolution of the fire (providing data and analysis about atmosphere gases during and after the fire).
- Cybernetic data collecting devices are in the state of levitation for hours.
- Measures to fight against environmental and public health damages and climate change using remote sensing span from visible to microwave electromagnetic spectrum.
- For the **FIRE challenge,** specific expertise can be useful to detect littering and illegal dumping and to assess the environmental risk and the climatic conditions that increase the likelihood of fire outbreaks.
- For the **Water resilience challenge,** the combination of different observations will be key to developing advanced KPIs that attempt to correlate information on drought, weather, water consumption, water pollution, crop type and cycles etc.
- Services for resilient cities (wildfire, extreme heat, flooding, droughts) and Blue-Green Infrastructure (location, health, risk) and overlay these to help mitigate risks (especially related to climate risks).
- Use of hyperspectral data with high spectral resolution allowing to locate water sources (classification) and study the water composition. This type of data is openly or privately accessible via several providers.
- Because climate change will pose a challenge for the water supply and management, there are currently different initiatives, methods and approaches used to plan and manage the activities in this area, but there is a lack of connection between them. The tools, methods, norms, etc. of application in areas such as basin management, distribution networks, water infrastructure (dams, reservoirs, etc.), agriculture, etc. are completely different and it is not possible to

implement an overarching management system. Despite the fact that nexus between water, agriculture and other sectors are of high relevance in the scientific literature, it is proposed to develop: (1) Methods for identifying the probability of occurrence (both in the current and future climate) of drought, episodes of high water flow and other situations that may pose a risk for water management; (2) Systems and methods for processing observation data from local stations, gauges, earth observation, etc.; (3) Methods for identifying risk level considering climate trends and projections in conjunction with socioeconomic trends (land use changes, demands, etc.); (4) Early warning- detection and prediction systems; (5) Basin and water management systems (considering status, monitoring & forecast –estimated progression) allowing to manage water resources in the face of droughts, high river flow events, scarcity, etc.; (6) Maps & graphical representation of water information derived from observational data and integrated digital twins (simulating hydro-climatology, basin, network, infrastructure and all components of the water cycle).

- Meso modelling of Urban Heat Island and Micro Modelling of Thermal Comfort. For policy makers and urban designer to make decision for more adapted cities and public places and to assess the effectiveness of climate adaptation measures and applied adaptations.
- Micro modelling of flooding to assess effectiveness of climate adaptation measures and applied adaptations. Combination of both variables to facilitate decision making process mainstreaming.
- There are solutions developed to track coastline resilience, and other blue-economy related challenges.
- Use of satellite imagery, raster maps, and servers to facilitate structured management and analysis of Big Geo Data. Tapping into existing data services on public data, without compromising data.
- Monitoring GHG emissions from energy infrastructure (power plants, gas pipelines).,
- Customisation/development of existing platforms for Flood Mapping at high resolution and mitigation measures assessment.

**Providers indicated as possible contribution to EO outcomes the following:**

- Irrigation control and weather forecast.
- Services based on satellite imagery and Earth observation technologies.
- Earth observation capabilities and AI to solve environmental problems. Earth Observation, and in particular satellite imagery, is the only means to regularly classify events of interest at scale, with high accuracy and cost-effectively. AI is key to automating classification at scale in very large volumes of data acquired during observation. Over the past decade, both fields have benefited from synergetic effects and their combined use is triggering the environment moment, a moment when we have the necessary tools to measure anthropogenic environmental impacts and inform decision making and policy. Our expertise is threefold: Remote sensing processing, advanced AI technologies and environment.
- Deploying a solution for water resilience (water pollution and water management) which are applications related to EO.
- A predictable demand for fresh water. This will be allowed through tools and systems that will take in consideration the regulatory landscape and policies (flood, biodiversity, water quality, etc.) providing a cohesive framework for water management. The system will be capable of effectively handling stress situations (both in the long-term/planning and in the short-term/operational timescales) through data-driven decision-making and interventions, allowing simulation of activities such as changes in the reservoir management policies, new infrastructure for water storage, supply and consumption, water saving measures, etc. connecting the supply and demand sides for sweet water.

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- Water quality requirements for different purposes (industrial, biodiversity, bath, etc.). A comprehensive understanding of the consequences and a combined approach to relevant data within the entire water cycle chain will be achieved and facilitated by policy guidance, user engagement, surveys, etc.
- Assessment of the evolution of the LST (in cities) using images to evaluate the effectiveness of climate adaptation measures.
- Access and analytics in space and time, through a huge spectrum of 3rd party clients, without programming.
- Focus on mitigation of GHG emissions using EO data.
- Platform aligned with the expected outcomes of the call by leveraging Earth Observation data (including Copernicus program), to enhance flood preparedness and response. With a worldwide the service, at high-resolution, exploiting satellite and geospatial data with AI, to provide accurate flood risk intelligence and scenario analysis, fostering mitigation and climate adaptation strategies adoption. This can contribute to reducing demand fragmentation as it addresses common needs across regions. Furthermore, the platform has scalability, capability to ingest local user data when available, and a flexible business model (Software As a Service or Data As a Service) to foster market uptake of climate solutions, encouraging investments in mitigation/adaptation measures, economic growth and climate resilience.

**Providers pointed out the room for innovation in the following specific areas:**

- Exploring the relationship between floods and ecosystems.
- The state-of-the-art algorithms. Earth observation algorithms are not yet able to distinguish between different types of waste. And to the best of our knowledge there is no model that combines external data and satellite imagery to detect anomalies in waste facilities that could trigger fire.
- The combination of all the data that is currently available and developing solutions in this way so that the information is made accessible.
- Despite the availability of various software and infrastructure tools to study drought probability, risk level, water management, etc., no application is proposed to study the level of water pollution and the impact of human activities (industry, agriculture, etc.) near water sources.
- Some topics for development beyond state of the art are (1) Common methodologies, terminologies, metadata, etc. for all the agents and activities involved in water cycle; (2) Overarching systems that integrate the monitoring and modelling of all the subsystems of the water cycle (climatology, hydrology, water storage and distribution, water consumption, sanitation, etc.); (3) Inclusion of different timescales: most of the tools already existing operate in the short-term scale, but the inclusion of forecast and projections in the seasonal, annual, decadal and multidecadal scales can bring benefits for planning and managing; and (4) Consideration of the water-soil-other activities nexus.
- The potential inferences of LST to Air Temperature. Developing monitoring and effectiveness assessment model though the analysis of evolution of the LST (in cities) using the Landsat 8 and 9 images.
- Safe AI integration, location-transparent federation, automatic data fusion across data archives, and more are needed to maximise EO exploitation.
- It was emphasised that while the current market offers a mix of commercial and free solutions for medium-resolution flood mapping and weather forecasting, a specific solution sets itself apart by delivering a unified global coverage and cloud-based platform that not only meets already part of the FLOODS CHALLENGE needs but goes above and beyond. It provides high-detail flood maps, interoperable with every GIS software, leverages on fast flood algorithms, enable interaction for mitigation measures effects testing (“”what if””) and does not require highly

skilled professionals to be run. Acknowledging the gaps, the solution can undergo further development to fulfil all the requested innovation needs.

**Providers proposed the following developments:**

- Prescription maps.
- Merging flood analysis with agricultural and forestry monitoring applications.
- Other tools to complete a range of long-term water management solutions.
- Models of gas dispersion, inverse modelling to define the original source LTA UAVs.
- A model that integrates multiple observations from multiple instruments. One of the difficulties is the spatial and temporal registration. The others concern the constitution of dataset sufficient to make the model learn. Self-supervised learning and semi-supervised learning methods will be leveraged to reduce the need of label.
- Combining different data sources together, looking further into the use of AI.
- Tools for analysing the composition of water sources & rivers and studying areas of activity near water sources (agricultural zones using chemicals (pesticides, herbicides, etc.); industries, air pollution (impacting rainfall) will add value for the water resilience plan.
- Some actions including: (1) The analysis of the legal framework, responsible public authorities and other relevant agents, tools, methodologies, etc. in each of the subcomponents of the water cycle; (2) The development of new observational methods for water cycle management; (3) The generation of overarching digital twins, simulating weather/climate, hydrology, water infrastructure, distribution and sanitation networks, demand (e.g. agriculture, tourism, etc.); (4) The development of simulation framework (including both physical and data-driven methodologies such as artificial intelligence) for evaluating the effectiveness of actions and measures to optimize the water cycle components, allowing to make actionable decisions in the short, medium and long term; (5) Guidance, training and visualization tools, including tailored dashboards for different decision-makers.
- Potential inferences of LST to Air Temperature. Developing monitoring and effectiveness assessment model though the analysis of evolution of the LST (in cities) using the Landsat 8 and 9 images.
- Meso modelling of Urban Heat Island and Micro Modelling of Thermal Comfort. For policy makers and urban designer to make decision for more adapted cities and public places and to assess the effectiveness of climate adaptation measures and applied adaptations.
- Micro modelling of flooding to assess effectiveness of climate adaptation measures and applied adaptations.
- Combination of both variables to facilitate decision making process mainstreaming NBS.
- The modelling of thermal comfort and the impact of the climate change on it, and the modelling of the impact of the new urban planning project on the thermal comfort.
- Multi-stakeholder participations to benefit from mutual collaboration for win-wins.
- Focus on the creation of scalable products that can be quickly accessed and used by any organisation, not creating boundaries.
- Allow anybody to have access to information, so anybody (not just specialised technical departments) can benefit from it, accessing the webpages/information at will.
- Enhance datacubes, European-based rasdaman, enhance and integrate further sources and developments.
- Operational and daily monitoring of GHG emissions from infrastructure and facilities worldwide.

- API for access to flood risk intelligence, Climate scenarios for all types of FLOODS, 3D Digital Twin, link to ground stations for AI -based flood river stage forecasting

It has been emphasised during the OMC that developments could be achieved by bringing together advances in imaging systems such as hyperspectral imaging, which provides information on water and soil composition based on spectral reflectance at several wavelengths, and the Copernicus Sentinel-5P to study air quality and pollution in regions where water sources & rivers are located, as well as advances in AI and computer vision methods, and big data analysis.

**Among the certifications and standards indicated as relevant to the PCP project are:**

- EASA Rules.
- ISO14064 related to GHG procedures, quantification, measurement etc.
- A very diverse set of certifications applicable to the different components of the water cycle. The harmonization of data for the whole water cycle is planned to be done under the STAC Specification.
- ESA BIC incubation, FrenchTech labelling.
- INSPIRE, ISO, OGC coverage standards for spatio-temporal data & services: Coverage Implementation Schema, WCS, WCPS.

Some participants pointed out that there are a lot of certifications and standards. However, certification and standard procedures are intensive processes. This should be investigated during the solution design phase.

In conclusion, the OMC confirmed the initial assumptions that the functional requirements of the four challenges cannot be tackled by one solution and that R&D efforts are required to address existing technology gaps.

## 2.4. Business case development

With the information gathered in the previous steps, the preliminary business case was based on the public buyers' prioritised unmet needs (and specific technology gaps) to organise the pre-commercial procurement and achieve the underlying objectives while keeping the costs and risks to an acceptable level. The baseline has been drawn on a layered approach and common taxonomy to collect water related data, develop comparative alternatives based on desired functionalities and outcomes and Total Cost of Ownership (TCO) calculations. Section 6 provides the updated foreseen procurement strategy, including the PCP budget.


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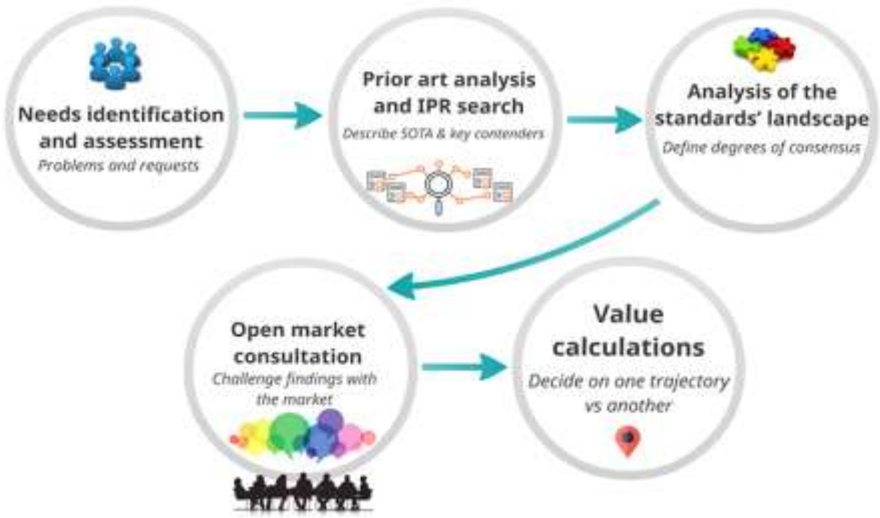


*Figure 3: The five steps summarising the Business Case – EAFIP methodology*

## 2.5. Procurement strategy

The PCP or PPI approach depends on the maturity of potential solutions corresponding to the TRL framework (Figure 4). The selected challenges for a PCP approach are those where potential solutions are between TRL 3-5. Those challenges for which solutions available are at higher TRL 7-9 may be addressed by a PPI approach. The following figure illustrates the relationship between the TRL (or maturity of the solutions) and the procurement approach/strategy.

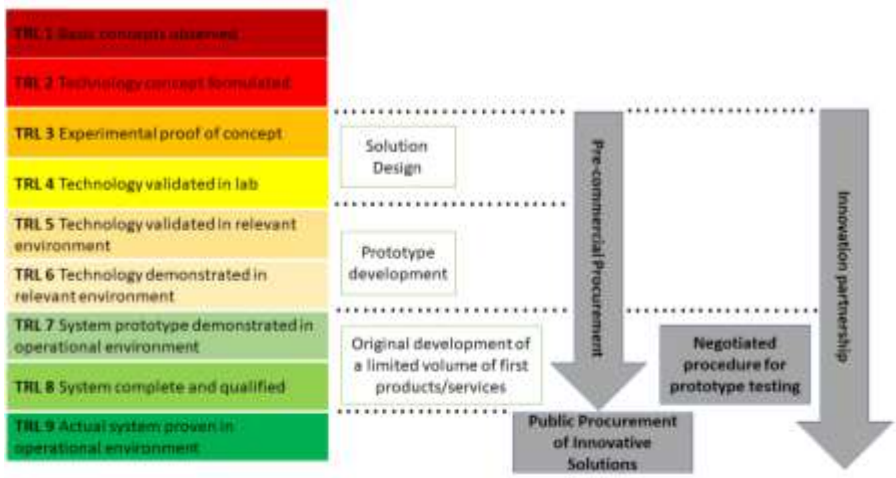


*Figure 4: Relationship between the technology readiness levels (TRLs) and the procurement approaches*

In addition, from the mapping of legal frameworks regarding the regulation of PCP, subcontracting, market consultations and joint cross-border procurement, the legislation in the Netherlands, Finland and Greece has shown to be more innovation friendly than other countries.

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# 3. Procurement Challenges

In the following sections, the four selected challenges are described based on use cases that present the current situation and the desired outcome from potential innovative solutions. A reference to the type of contracting authorities/entities for each challenge has been made. The preliminary findings of the patent and standards search and related technologies are outlined for each challenge.

## 3.1. Flood challenge

**Use case**: Rapid mapping of floods

Currently, the mapping of flooded areas (marine, coastal areas and rivers) during severe events can take weeks, resulting in delays in response and prevention. Public organisations lack reliable tools for predicting, preventing and responding to such events in a timely manner.

The desired outcome is to establish a system for rapid mapping that enables predictions and projections to identify risks and define benchmarks. This will involve the development and utilization of software capable of higher resolution and timely acquisition of satellite information.

**Contracting authorities/entities**: Cities.

The preliminary patent and standards analysis revealed research on the following aspects:

- Methods for identifying the probability of occurrence of a flood event (risk indicators).
- Flood measuring and trigger system (usually by making grids of the regions).
- After event evaluation of the affected area.
- Flood map production.
- Systems and methods are provided for processing observation data.

It also revealed several technologies & tools: satellite imagery, computer vision, artificial intelligence, multi sensor input (drones etc), image analysis, statistical analysis, and mathematical analysis, kernel algorithm, visible-infrared band images of a region, water based network devices.

## 3.2. Fires challenge

**Use case 1: Fire in storage waste facilities**

This use case relates to facilities where waste is stored and prone to spontaneous fires, occurring three or more times a year (in one city). These incidents are particularly prevalent during the summer months when temperatures are higher. While data on previous fire events exist (temperature conditions, height of piles, heat waves, composition of garbage, location of storages or disposals) there is no automated solution available to predict fires and make informed decisions for prevention. As a result, environmental agency inspectors bear the responsibility of monitoring these facilities, placing a significant burden on staff resources.

The desired outcome is an automated notification system that promptly identifies the risk of fire in waste storage facilities. This allows public bodies to take swift and appropriate measures, such as engaging qualified companies or industries with expertise in waste management. By preventing fires, this solution aims to mitigate air pollution and reduce potential damage associated with such incidents. It is expected to obtain an automated notification system based on the processing data including COPERNICUS data.

**Contracting authorities/entities**: Environmental agencies.

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**Use case 2: Wildfire**

This use case relates to wildfires starting in forests/fields with crops or grasslands with low vegetation which could start due to a combination of lack of water/drought and certain conditions which create a first spark.

Intelligence can be developed to understand the patterns and develop risk maps. Focus on high-risk areas, measure these areas. Provide water information to provide risk maps. Develop local databases (local datahubs) with the same standards. A local system should provide more frequent information than what is available on larger scale. Rebuild water intelligence to understand water levels and when the thresholds are approached in terms of risk mapping.

The desired outcome is an automated notification system that promptly identifies the risk of fire. This allows public bodies to take swift and appropriate measures. By preventing fires, this solution aims to mitigate air pollution and reduce potential damage associated with such incidents. An automated notification system is expected to be obtained based on the processing data, including COPERNICUS data.

**Contracting authorities/entities**: Environmental agencies, LEA's, fire brigades

**Use case 3: Fire cause tracing/tacking**

This use case relates to identifying, tracing, and tracking the cause (and the culprit) of the fire. It is challenging for law enforcement agencies to trace the individuals responsible for criminal behavior (e.g., setting fire or dumping substances that cause fire to official waste dumping sites/facilities). In the event that a fire consumes part of a waste dumping site, it is vital to be able to compare the site's condition before and after the fire. This comparison would enable us to determine the amount of waste that was burnt and, consequently, evaluate the environmental damage caused. Additionally, the same technology could be used to establish whether the amount of waste entities dumped into the site matches the amount they report officially. Furthermore, there is a lack of effective measures to inform and prevent the cross-border effects. Additionally, the absence of usable data hinders the ability to gather evidence for criminal proceedings.

The desired outcome is the implementation of an alert system that sends notifications to competent authorities, aiming to prevent the illegal dumping of waste/ illegal activities that could lead to fires in dumping sites and mitigate the risks of cross-border damage. The system would enable us to compare the state of the waste dumping site before and after the fire, determine the amount of burnt waste, and define the extent of environmental damage. Additionally, the system would be able to verify if the amount of waste entities dumped into the dumping site is consistent with their official reports. Furthermore, standardized reports and information should be readily available and admissible in civil and criminal proceedings. This will facilitate the establishment of responsibilities in accordance with the applicable laws and regulations within the specific judiciary system.

**Contracting authorities/entities: LEA's, fire brigades.**

The preliminary patent and standards analysis revealed research on the following aspects:

- Methods for identifying fire risk level.
- Early warning- prediction.
- Fire management system (status, monitoring & forecast –estimated progression).
- Maps & graphical representation of fire information.

➔ None of the results was related to waste fire specifically but the inventions identified can provide a technological basis for the challenge.

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It also revealed several technologies & tools: satellite imagery, multi sensor input (drones etc), vegetation information, and weather data, statistical analysis, and mathematical analysis, cloud-to-ground lightning distribution characteristics, water based network devices.

## 3.3. Water challenge

**Use case: Demand for fresh water**

Currently, there is unpredictability in the demand for fresh water, and there is a lack of connection between the supply and demand of fresh water. Regulations exist in each EU Member State that determine the use of water from various sources, such as channels, treated sewage water, and drinking water, and different purposes such as for agriculture. However, there is a lack of a common language among different stakeholders (users involved such water companies, industry, farmers, etc.) involved in the water cycle chain. Additionally, while data is available in certain regions, there is a lack of connectivity between data hubs and repositories.

The desired outcome Is a predictable demand for fresh water. The regulatory landscape and policies should be clearly defined, providing a cohesive framework for water management. The system should be capable of effectively handling stressful situations through data-driven decision making and interventions. The supply and demand for sweet water should be interconnected based on diverse needs of users such as farmers, companies, and industries, while also considering the specific conditions and water quality requirements for different purposes. A comprehensive understanding of the consequences and a combined approach to relevant data within the entire water cycle chain should be achieved and facilitated by effective policy guidance.

**Contracting authorities/entities: Water authorities/companies, water sanitation authorities**

The preliminary patent and standards analysis revealed research on the following aspects:

- Methods for identifying the probability of occurrence of a drought.
- Systems and methods are provided for processing observation data.
- Methods for identifying risk level.
- Early warning- prediction.
- Water and drought management system (status, monitoring & forecast –estimated progression).
- Maps & graphical representation of water information.

It also revealed several technologies & tools:: satellite imagery, multi sensor input (drones etc), computer vision, vegetation information, and weather data, statistical analysis and mathematical analysis, water based network devices, ground measuring data, GUI, use of database management systems in handling future data.

## 3.4. Sustainable and resilient infrastructures challenge

**Use case: Integrated sustainable climate adaptation of existing neighbourhood's**

Currently, there is a need for integrated sustainable re-development, restoring & climate adaptation of existing neighbourhoods both in urban and rural areas.


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The desired outcome is to find a solution to climate adaptation for this complex situation (vulnerable urban &/ rural areas with a combination of heat, flooding, water scarcity, storms and droughts) using integrated climate services.

**Contracting authorities/entities:** Cities.

The preliminary patent and standards analysis revealed research on the following aspects:

- After event evaluation of the affected area.
- Calculation of different scenarios using combination of possible climate effects (e.g. temperature, flooding, storm, drought).
- Creation of a thermal map of a region.
- Urban heat island detection method.
- Systems and methods are provided for processing observation data.
- Analysis of urban morphology.
- Methods for monitoring and managing urban water resources and hydrology through a network of stations.
- Early warning-prediction.
- Methods for identifying risk level .

It also revealed several technologies & tools: digital aerial and satellite imagery, photography, computer vision, artificial intelligence, multi sensor input (drones etc), image analysis, statistical analysis and mathematical analysis, airborne and spaceborne sensors, deep learning, ground-based data gathering, remote sensing data, data modelling, open source geographical data, image processing, remote sensing image and high-resolution remote sensing image with possibility to combine this data with other important data layers, for example demographical map in order to see if some vulnerable groups (old/dement/less valid people/young children) live in potential risk area, where evacuation or transportation could provide additional difficulties compared to other, not vulnerable groups

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# 4. Further scoping needs and use cases

Further discussions followed the analysis of the market consultation results in the process of obtaining the commitment of public buyers around the 4 identified challenges described in section 3. Since the challenges covered broadly the desired end-to-end climate change solutions, where several technologies would need developments to tackle all the functional requirements, it was deemed necessary to work on defining the scope of the R&D based on the technical analysis of the needs and use cases by the end-users of the potential solutions in specific operational environments.

In this context, the public buyers committed to lead and procure jointly a PCP of research and development services, agreed on selecting one overarching Water (management) challenge covering different use cases in connection with floods, fires and resilient infrastructure (because of too little or too much water). The Water (management) challenge requires Earth Observation (regional) data in a layered approach that identifies which data is available and what data needs to be obtained to understand the climate patterns. EO-data will be crucial for the provision of climate services that help improve operations in different application domains.

## 4.1. The overarching Water challenge

Based on the prior art analysis and preliminary patent search, which showed that no solution was already available on the market or close to the market to fully tackle the desired outcome and functionalities of the four challenges, the public buyers decided to focus on one challenge that could be further scoped to integrate use cases relevant to the other challenges and several end-users in different application domains. In this process, an overarching Water challenge was selected given that water management has an impact in crises related scenarios concerning floods, fires and resilient infrastructure. The Water (management) challenge aims to solve the problem of water intelligence needs and data requiring the development of original solutions, which will ideally reach TRL 8 through the PCP approach.

In particular, the analysis conducted on the SOTA concerning the Water challenge reveals a complex landscape ripe for innovation. Specifically, the analysis of patent applications and industry trends highlights the absence of a dominant technological leader in the water resilience domain, signalling an environment favourable to innovation.

The convergence of advanced technologies such as Artificial Intelligence (AI) and remote sensing, with a focus on addressing drought prediction and water management, highlights a promising trajectory toward enhancing water resilience. Furthermore, an examination of patents submitted for the Water challenge indicates intermediate TRLs averaging between 5 (minimum) and 7 (maximum), suggesting readiness for practical application and a commitment to addressing water-related concerns offering a solid foundation for further development and adaptation to specific needs within the PCP framework.

Leveraging COTS products like Sentinel-1 and ESA-Copernicus EO datasets presents additional opportunities to enhance the capabilities of patented technologies, facilitating continuous access to high-quality data for improved water resource management. These innovative solutions have the potential to significantly mitigate challenges related to water distribution and decision-making processes, which will advance water resilience both locally and globally. These technologies have the potential to significantly contribute to the ensuring a resilient and sustainable water future through continued development and strategic integration.

The PCP would focus on using satellite data for smart management of freshwater distribution across various sectors like urban, rural (agriculture/nature), drinking water (industries, food/cooling), and recreation. Ensuring a balanced supply and demand of freshwater is crucial for both city and rural areas, especially as extreme climate conditions like droughts and floods become more common. In this sense,

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the PCP project would emphasise on leveraging Earth observation data to monitor water quantity and quality, starting with a focus on quantity.

To mitigate extreme climate/water situations, water managers need to anticipate with day-to-day operational information in their management area (dashboards) and build up their local intelligence as a prerequisite to anticipate on related crises (caused by too little or too much water). Additional layers to the system such as wind, sun, heat, drought, subsidence, greening would be considered in relation to climate change consequences affecting water adding value. An additional benefit of adding the extra layers to the system is that this system could be used for multiple approaches by European public authorities.

In this context, through the PCP, public buyers aim to steer the European market to make synergies for the development of solutions based on the functional needs identified from the demand side. Through the PCP, several contractors will be able to compete in the creation of innovative solutions, opening the possibility for researchers and companies to work on future technologies and services that will contribute to more sustainable processes, while fostering new business opportunities to the commercialisation of products and services.

The functional specifications and technical requirements should be aligned with the destination topics on innovative governance, environmental observations and digital solutions in support of the Green Deal, and deploying and adding value to environmental observations, as well as contributing to the Agricultural Knowledge and Innovation Systems (AKIS) by having relevant use cases.

In sum, the Water (management) challenge aims to develop and test water intelligence innovative solutions beyond the state-of-the-art for climate adaptation using space and EO-based information to prevent and mitigate 3 water related crisis challenges (floods, fires and infrastructure impact). The general objective is to be more climate resilient through a better EO-based information position and alignment between regional water management, cities, communities and crisis organisations across EU Member States borders and in common river basin systems.

For this purpose, twenty one (21) use cases have been identified (see Annex 2) and it is deemed necessary to apply a methodology to select a smaller number of representative use cases (e.g. five (5) use cases) to be tackled in the PCP. The solutions developed should be tested and validated against the criteria, functional and performance requirements defined in the use cases.

## 4.2. Methodology and selection of use cases

The customisation/pre-operationalisation of Water (management) innovations through PCP aims to obtain R&D services up to TRL (Technology Readiness Level) 8, where phase 1 will produce solution designs, phase 2 will test prototypes/technologies in a lab environment, and phase 3 will perform field validation by end-users testing services (based on specific use cases) in different operational environments.

The methodology proposed to select use cases for the implementation of the PCP project includes a layers approach, a common water taxonomy and the overview of the EO-based value chain for water intelligence to understand the requirements of the identified use cases. In this sense, the identified use cases should be further analysed, scoped and clustered (in comparable problems) in order to select five representative use cases within the activities conducted in the framework of the envisaged PCP.

**LAYERS APPROACH**

This approach consists of 4 layers of information: (1) Base layer 1: For users; (2) Base layer 2: Water (Taxonomy); (3) Layer 3: Water Dynamics (Thresholds/scenarios); and (4) Layer 4: (Water related) risks.

**Base layer 1 For the user:** A standard description of our (static) world provides us with base information (information carrier layer for harmonization of information and exchange) such as location, elevation, weather, land use maps, soil maps, administrative boundaries, infrastructure. Many existing European data sets and standards (Copernicus, INSPIRE, High Value Datasets, etc.) are already available and will be evaluated and considered in the context of this project. These common information carriers (The Copernicus Land Service, High-Res Layer Imperviousness) provide a basis for our dynamic changing world.

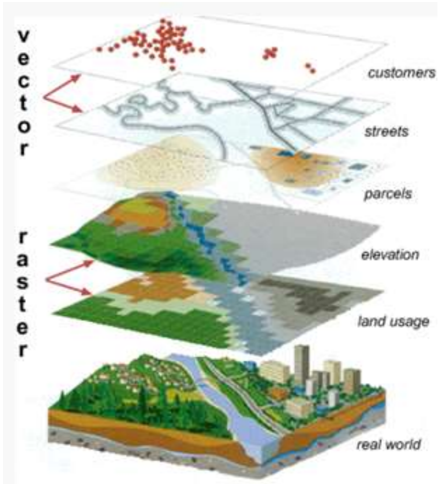
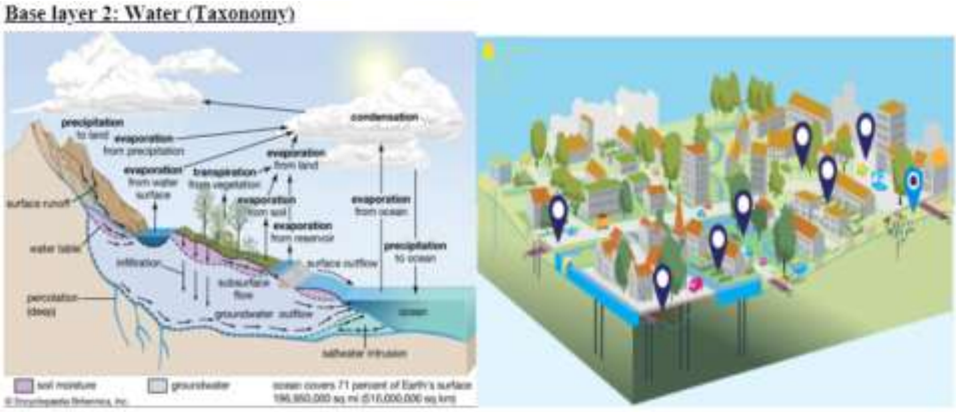



*Figure 5. Base layer 1*

**Base layer 2 Water (Taxonomy):** The regular water cycle processes can be described/modelled with key variables which can be partly measured/observation by EO and partly modelled and mostly in combination with each other. Local knowledge and ground measurements are essential to understand the quality of these exercises. Harmonizing the monitoring of the local SWVA (Soil Water Vegetation Atmosphere System)-system conditions, provide a common understanding in order to support and solve water distribution issues within common river basin areas (cross border and between management areas) Observed by EO: evapotranspiration, soil moisture, temperature, rain, etc. Modelled: see hydrological cycle on the left, either common applied centralised standard model instrumentarium or local modelling/knowledge/tailored instrumentarium, resulting notably into the amount of water in the soil profile and indicator for groundwater levels.

Base layer 2: Water (Taxonomy)



**The regular water cycle processes** can be described/modeled with key variables which can be partly measured/observation by EO and partly modeled and mostly in combination with each other. Local knowledge and ground measurements are essential to understand the quality of these exercises in rural and urban areas.
Observed by EO: evapotranspiration, soil moisture, temperature, rain, etc.

*Figure 6. Base layer 2 Water Taxonomy*

**Layer 3 Water dynamics:** Due to extreme climate events amplified by longer-term, often nonlinear evolutions of the climate, the regular water cycle transforms into different categories of crises/hazards:

- Extreme changes to the water cycle cause drought, flooding and with consequences on the short and long term for our soil-water-atmosphere system of our living world (water dynamics layer).
- Critical (sector specific) thresholds are passed, e.g., saturation of topsoil causing runoff, critical combustion factor of biomass/nature vegetation or critical groundwater level for irreversible subsidence of infrastructure.
- Impact on sectors: agriculture, nature, city infrastructure, economy, living conditions.
- Using climate scenarios, one can simulate and improve these threshold criteria in cases of too much or too little water in the soil-water-vegetation system.

**Layer 4: (Water related) risks.**

The risk of too dry or too wet conditions is partly determined by the potential impact (physical damage) to various sectors combined with equally important, if not more, alpha factors such as increased pressure on key resources from economic development, communities' strategies to build resilience while protecting all sectors of society, ideological fault lines around conflicting uses and priorities, and more.

Risk can be seen as the product of chance by impact, the result of the vulnerability of a sector or a human community to a certain degree of exposure to the occurring hazard category. EO can play a role for both factors in the product. It also powerfully contributes to creating data for learning processes (AI e.g. for vulnerability assessment) and developing a better, more uniform Risk Language.

## USER DRIVEN EO-BASED VALUE CHAIN FOR WATER INTELLIGENCE

In the implementation process the (selected) use cases in Europe will provide a representative spectrum of requirements for the procurement process. The basis is the integral assessment of day-to-day SWVA conditions with space-based value chains based on local/central knowledge (AI, EO-Inversion/hydrological modelling, etc.). This will provide a first basis of local water intelligence for the use case stakeholders. Driven by their required functions in their organisations, translation from the SWVA conditions towards regular or crisis management processes (e.g. risk indicators) can be achieved.

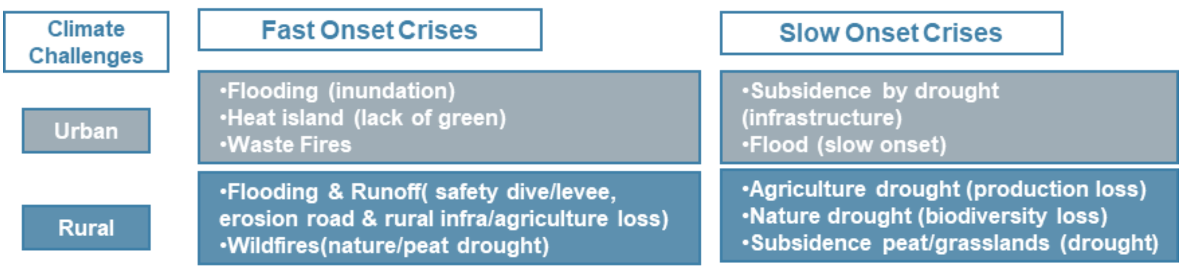



*Figure 7: Use case categories driving the value chain*

## COMMON TAXONOMY MATRIXES

Based on the four information layers, the common taxonomy matrixes can be used to identify available and missing elements to understand the conditions of water and soil in regular conditions and in extreme conditions, also in urban areas.

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### Service Matrix Regular Conditions (Soil-Water-Vegetation-Atmosphere system)

| Service Layer in EU Usecase | A1. Information carrier & standard raster X,Y,Z, & vector actualisation/mutation of (admin) borders | A2. DTM (detailed) | A3. Rainfall ao weather parameters | B1. Evapotranspiration (soil-veg-atm system) | B2. Soil Moisture Top & soil profile | B3. Groundwater level |
|---|---|---|---|---|---|---|
| 1. Base (start of EO valuechain) | Lufo, High Res Satellite (yearly update), mutations AI based | LIDAR, LuFo | International Radar Composite Ground Radar, Sat based, weathermodels (ECWMF) | | | |
| 2. Water Regular | Update (EO/AI based) changes in water management infrastr. channels,areas, dikes,etc | Improve 3D (hydro)logical spatial (sub) river basin model (EO/AI) | Input to EO-based waterbalance modeling/AI based | > Innov. fieldobservation<br>> (MW,Opt) Sat soil-veg evapotransipration &<br>> A3/B1 Input to EO-based waterbalance model/AI based | > Innov. fieldobservation<br>> MW Sat TopSoil system<br>> A3/B1 input to EO-based soil;-water-atm modeling (wateravailability) | > Innov. fieldobservation<br>> Groundwater level (A3/B1 input toEO/AI based modeling |
| 3. Water(+ or -) Dynamics conditions/limits (Sector inputs) | Update/actualise/map per sector management admin/area/delineation (AI-based) | Update DTM/basin model due to (erosion or subsidence) | Weather / climate scenarios (short and long term) | Per sector Threshold determination of soil-water system (scenario modeling) | Per sector Threshold determination of soil-water system (scenario modeling) | Per sector Threshold determination of soil-water system (scenario modeling) |
| 4. Risk see crises matrix D1 to D5 | | | | | | |

### Service Matrix Regular Conditions in Urban Areas (Soil-Water-ATM system)

| Service Layer in EU Usecase | A1. Information carrier & standard raster X,Y,Z, & vector actualisation/mutation of (admin) borders | A2. height model (detailed) | A3. Rainfall ao weather parameters | B1. Evapotranspiration (soil-veg-atm system) | B2. Soil Moisture Top & soil profile | B3. Groundwater level |
|---|---|---|---|---|---|---|
| 1. Base (start of EO valuechain) | Lufo, High Res Satellite (yearly update), mutations AI based | 3D-city modeling (height streetlevel/building (LIDAR, cm-dm in Z) | city temperature, sunshine, wind,rain weathermodels (ECWMF) | | Maps of Stoniness of city (street) for infiltration | |
| 2. Water Regular | Update (EO/AI based) changes in water management infrastr. channels,areas, dikes,etc | Improve 3D (hydro)logical spatial (sub) surfacewater model (EO/AI) | Input to EO-based waterbalance modeling/AI based | > Innov. fieldobservation<br>> (MW,Opt) Sat soil-veg evapotransipration &<br>> A3/B1 Input to EO-based waterbalance model/AI based | > Innov. fieldobservation<br>> MW Sat TopSoil system<br>> A3/B1 input to EO-based soil;-water-atm modeling (wateravaibility) | > Innov. fieldobservation<br>> Groundwater level (A3/B1 input toEO/AI based modeling |
| 3. Water(+ or -) Dynamics conditions/limits (Sector inputs) | Update/actualise/map per sector management admin/area/delineation (AI-based) | Subsidence (mm/yr) by satelite INSAR | Weather / climate scenarios (short and long term) | Per sector Threshold determination of soil-water system (scenario modeling) | Per sector Threshold determination of soil-water system (scenario modeling) | Per sector Threshold determination of soil-water system (scenario modeling) |
| 4. Risk see crises matrix D1 to D5 | | Risk subsidence street, building, sewerage | | | | |

### Service Matrix Extreme Conditions (too dry, too wet)

| Service Layer in EU Usecase | C1. Drought | C2 Wild Fires | C3. Water Quality | C4. Subsidence (urban/rural) | C5. Water excess |
|---|---|---|---|---|---|
| 1. Base | Input from A services | Input from A services | Input from A services | Input from A services | Input from A services |
| 2. Water Regular | Input from A/B services | Input from A/B services | Input from A/B services | Input from A/B services | Input from A/B services |
| 3. Water crises (+ or -) Dynamics process modeling (Sector inputs) | > Input to improving/cal/val drought model (agro, city, ecosystem dependent)<br>> Realtime & scenario modeling | > Input to improving/cal/val fire distribution & fire figting process model (ecosystem dependent)<br>> Realtime & scenario modeling | > Input to improving/cal/val ground/surface water quality model (agro, city, ecosystem dependent)<br>> hind-, now, & forecast & climate scenario modeling (decadal trends-analysis) | > Input to improving/cal/val subsidence process model (agro, city, ecosystem dependent)<br>> hind-, now, & forecast & climate scenario modeling (decadal trends-analysis) | > EO-Saturation Top soil<br>> EO-surface/flood extent<br>>Input to waterbalance & Runoff model (agro-, city-, ecosystem dependent)<br>>Input to waterbalance & Inundation model (agro-, city-, ecosystem dependent |
| 4. Impact/Risk Indicator (Sector inputs) | D1. Sector dependent **Impact/Risk drought** indicator modeling (evolution) | D2. Sector dependent **Impact/Risk wild fire** indicator modeling (evolution) | D3. Sector (agro, city, ecosystem, drinking water) dependent **Impact/Risk water quality** indicator modeling (evolution) | D4. Sector dependent **Impact/Risk subsidence** indicator modeling (evolution) | D5. Sector dependent **Impact/Risk waterexcess** indicator modeling (evolution) |


This project has received funding from the Horizon Europe Framework Programme (HORIZON) under grant agreement No 101060592

### Service Matrix Extreme Conditions in Urban Areas

| Service Layer in EU Usecase | C1. Energy transition (wind, sun) | C2 Quality of living (Heat Island, greening) | C3. Water scarcity (green, gr water) | C4. Subsidence grey infra (urban) | C5. Water excess in the city (floods, inundation) | C6 Maintenance & climate adaptation of city infra |
|---|---|---|---|---|---|---|
| 1. Base | Input from A services | Input from A services | Input from A services | Input from A1,2 services | Input from A services | Input from A services |
| 2. City management Regular | Input from A/B services | Input from A/B services | Input from A/B services | Input from A/B services | Input from A/B services | Input from A/B/C services |
| 3. City crises (+ or -) Dynamics process modeling (Sector inputs) | > Input to improving/cal/val wind and sun models (city, ecosystem dependent)<br>> Realtime & scenario modeling | > Input to improving/cal/val heat island and greening models (ecosystem dependent)<br>> Realtime & scenario modeling | > Input to improving/cal/val ground/surface water quality model (city, ecosystem dependent)<br>> hind-, now, & forecast & climate scenario modeling (decadal trends-analysis) | > Input to improving/cal/val subsidence process model (city, ecosystem)<br>> hind-, now, & forecast & climate scenario modeling (decadal trends-analysis) | > EO-Saturation Top soil<br>> EO-surface/flood extent<br>>Input to waterbalance & Runoff model (city-, ecosystem dependent)<br>>Input to waterbalance & Inundation model (city-, ecosystem dependent | Thresholding critical maintenance levels wrt lifecycle of infra), climate adaptation of excisting infrastructure, city process models |
| 4. Impact/Risk Indicator (Sector inputs) | D1. Sector dependent **Impact/Risk wind(storm)** indicator modeling (evolution) | D2. Sector dependent **Impact/Risk heat island and greening** indicator modeling (evolution) | D3. Sector (city, ecosystem, drinking water) dependent **Impact/Risk water quality and scarcity** indicator modeling (evolution) | D4. Sector dependent **Impact/Risk subsidence** indicator modeling (evolution), grey infra, ecosystem biodiversity, foundation (assets) risk map | D5. Sector dependent **Impact/Risk waterexcess** indicator modeling in urban areas (evolution) | Risk Critical infrastructure (energy, water, etc.)<br>Impact on regular infrastucture, modeling (evolution) |

*Figure 8: Service matrixes*

### USE CASES

Climate change of the past decades has already had a major impact on our SWVA. This impact is expected to increase further in the future, in accelerating and highly nonlinear ways resulting from physical climate processes combined with consequences of increasing anthropic pressure, including the effects of maladaptation. As this system forms the basis for many functions of our society, the need to integrate and monitor the anticipated and potential impacts of climate change in a structural and consequent manner seems imperative, as has been done in meteorology with weather parameters for more than a century. Of course, the disbalance in our SWVA-system results in serious impacts for each sector in the short and the long term.

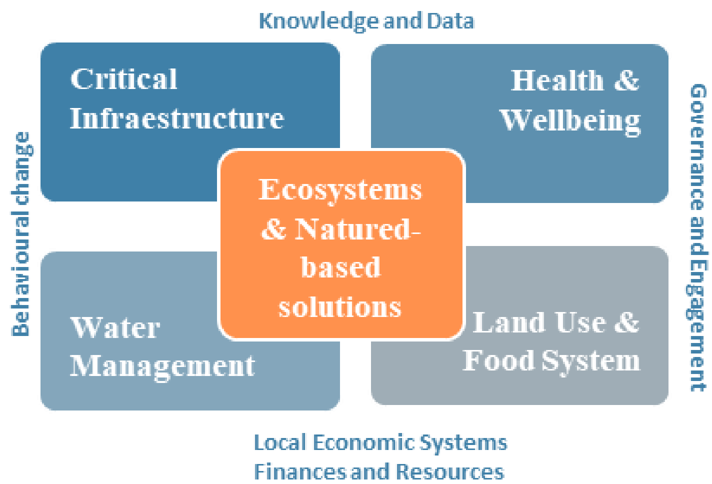


*Figure 9: Key community systems and enabling conditions*

In this context, demonstrations of potential solutions would take place across important sectors such as agriculture, nature, urban livelihoods, (drinking, surface, ground) water and safety in general, with information from integrated EO-based service development in space and time.

In the preparation of the PCP, the selected use cases should represent a range of European regions with a serious climate-induced disbalance in the SWVA-system. While those use cases generally start from short term issues encountered by the concerned stakeholders, climate change tends to increase their frequency, intensity and coupling with other issues it aggravates, resulting in long-term systemic crises.

Examples of chain effects due to serious shortage on water availability in the SWVA-system are:

1) Agriculture: drought, suboptimal production and harvest losses, deterioration of soils.
2) Urban: heat island effects, stress on green areas and livelihoods, waste dump fires, subsidence and damage to infrastructure.
3) Nature: groundwater/wildfires, subsidence peat lands.

The long-term effects of disbalance in the SWVA-system are degraded conditions induced or aggravated by climate change. Persistent drought in certain regions poses significant risks such as infrastructure subsidence, agricultural challenges, biodiversity degradation, and increased wildfires. These issues align with the Key Community Systems outlined in the Horizon Europe Mission Adaptation. Through the related use cases, the intention is to tackle these challenges beyond water management, contributing to broader community resilience. The efforts aim to enhance enabling conditions, going beyond mere knowledge and data, to foster sustainable solutions for communities facing climate-related threats.

The aforementioned process will ensure that the selected challenge is shared among the end users at EU level.

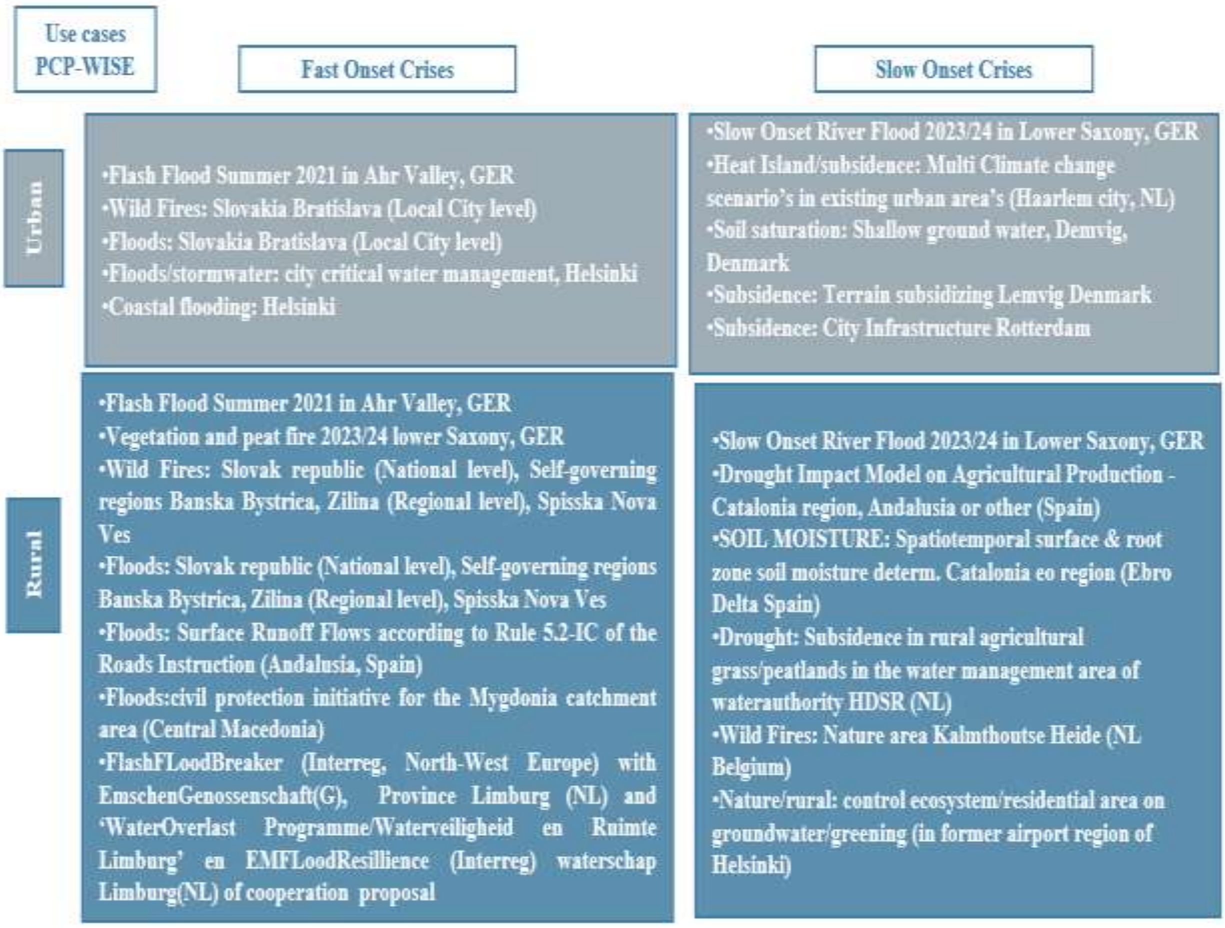


*Figure 10: Initial identified use cases*

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# 5. Considerations to select a PCP or PPI

The procurement strategy aims to provide guidance on how public organisations across Europe can make strategic use of public procurement instruments to obtain innovative and sustainable goals for the green and digital transformation considering the selected procurement challenges. As indicated above, there are two main modalities or trajectories that an innovation procurement project could follow: the PCP and the PPI. The type of procurement and related IPR conditions will depend on the maturity of the solutions which could potentially tackle the functional requirements.

The main differences between PCP ”and P'I are described in Table 2:[11]

| | PCP | PPI |
|---|---|---|
| When? | The identified challenge requires R&D to get new solutions developed and tested. No commitment to deploy (PPI) yet. | Challenge requires a solution which is near to the market or already on the market in small quantity but does not meet public sector requirements for large scale deployment yet. No R&D involved (R&D already done, or no R&D needed to solve challenge). |
| What? | Public procurer buys R&D to steer development of solutions to its needs, gather knowledge about pros/cons of alternative solutions, avoid supplier lock-in later (create competitive supply base). | Public procurer acts as launching customer/early adopter/first buyer for innovative products and services that are newly arriving on the market (not widely commercially available yet). |
| How? | Public procurer buys R&D from several suppliers in parallel (comparing alternative solution approaches), in form of competition evaluating progress after critical milestones (design, prototyping, testing). IPR related risks and benefits of R&D are shared between procurer and suppliers to maximize incentives for wide commercialization. | Public procurer announces the intention to buy a critical mass of innovative solutions to trigger industry to bring products on the market with desired quality / price ratio within a specific time. After verification if the market was able to deliver the desired quality/price – e.g. via a test and/or certification – the public procurer buys a significant volume of innovative solutions. |

*Table 2: Main differences of the PCP and PPI approaches (EAFIP Toolkit)*

In principle, the four challenges identified in the context of the PROTECT project are suitable for a PCP approach followed by a PPI for the deployment of the solutions developed in the PCP. However, it is important to: (i) obtain a more detailed assessment of the specific technology gaps to be addressed by

[11] EAFIP Toolkit www.eafip.eu/toolkit

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the R&D efforts, which will be provided by the final results of the SOTA analysis, and (ii) to have a clear cost/benefit analysis of addressing those gaps regarding the value that the functionalities would provide to the public buyers in terms of the impact of the (to be developed) climate services and EO applications, which will be based on the business case.

Additionally, it could be the case that some public buyers are interested in available prototypes and solutions (e.g. those presented in the e-pitching) which are at higher TRL and respond to a specific functionality, which could be tested (under the PPI approach) following the negotiated procedure without prior publication purely for the purpose of research, experimentation, without the possibility of purchasing the solution as such.

In the following sections, the specific characteristics of the PCP and PPI approach are explained.

## 5.1. Pre-Commercial Procurement (PCP)

PCP is an approach to procure R&D services that involves competitive development in phases, risk-benefit sharing under market conditions and that aims to create growth and jobs in Europe. It challenges innovative players on the market, via an open, transparent and competitive process, to develop new solutions for a technologically demanding mid- to long-term challenge that is in the public interest and requires new research and development. In this context, PCP enables the co-creation of innovative solutions by R&D suppliers (e.g. technology providers, research institutes) and public buyers.

This instrument is explained in the Communication from the EC "Pre-commercial Procurement: driving innovation to ensure sustainable high quality public services in Europe". [12]

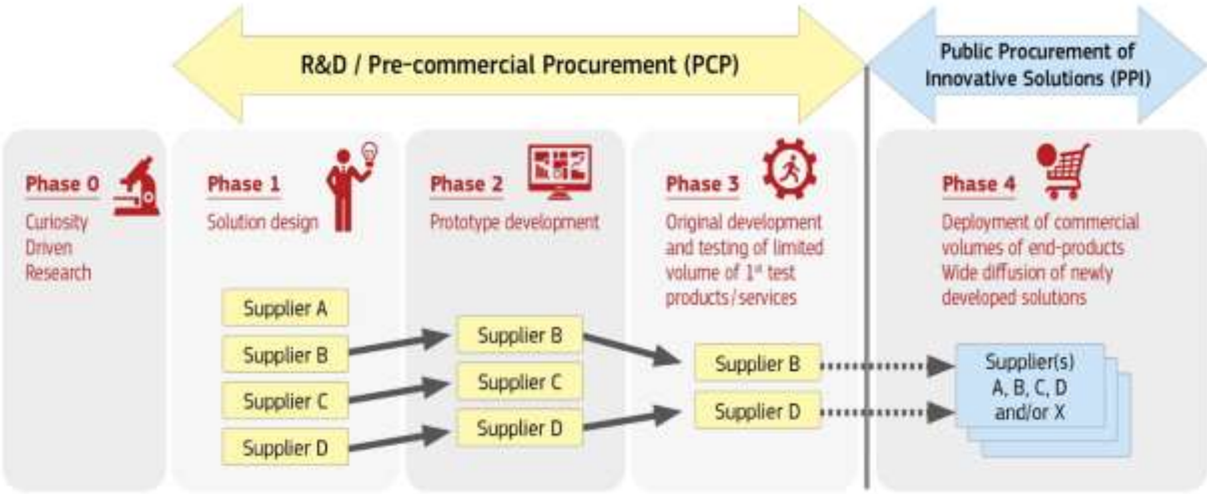


*Figure 11: PCP/PPI scheme, European Commission COM(2007)799 final Based on "Pre-commercial procurement: driving innovation to ensure sustainable high quality public services in Europe", COM(2007) 799 final*

PCP identifies the best possible solutions the market can develop, by comparing alternative solution approaches from different technology vendors in parallel. By steering the development of innovative solutions towards concrete public sector needs, PCP may trigger industry to initiate R&D that was previously unthought-of. In PCP, procurers are thus demanding customers, who are articulating advanced solution requirements as potential future early adopters of the developed solutions (which will be selected in a separate PPI procurement that follows the completion of the PCP).

Procurers also share the IPR related risks and benefits of undertaking new developments with the R&D providers participating in PCP. IPR ownership rights remain vested in the participating R&D providers, while the public procurers keep license free rights to use the developed solutions, the possibility to

[12] "Pre-commercial procurement: driving innovation to ensure sustainable high quality public services in Europe", COM(2007) 799 final, 14.12.2007 (PCP Communication). See also the Commission Staff Working Document SEC(2007) 1668.

require participating R&D providers to license IPRs to third party providers at reasonable market conditions, and an option that enables procurers to call back the IPR ownership rights in case the participating R&D providers fail to commercialise solutions within a specific timeline after the PCP. This approach maximises the incentives to commercialise the developed solutions to other markets.

PCP was defined in 2007 in the PCP Communication in full compliance with the legal framework.[13] The 2014 public procurement directives clarify that PCP is exempted from its remit and the 2014 and 2022 State aid framework for Research and Development and Innovation[14] clarifies the conditions under which PCP is done according to market conditions and therefore does not constitute State aid.

Due to its characteristics, PCP is exempted from the GPA of the WTO and consequently of the EU Public Procurement Directives. This is of particular interest to foster European strategic autonomy and resilience, since contracting authorities may require the performance of the R&D services to take place in Europe, which in turn strengthens Europe's technological potential and increases the resilience of Members States to potential supply chain disruption in emerging technologies. It also supports the goal of having an autonomous Europe when it comes to key enabling technologies.

The use of multiple sourcing in PCP also strengthens EU strategic autonomy and resilience. By triggering in a forward-looking way a range of suppliers to develop new innovative solutions that can address upcoming mid-to-long term procurement needs, public procurers can bring in competition from new innovative companies into a supply chain that was previously plagued by supplier lock-in, or build up a totally competitive pool of European suppliers that can address its strategic needs in the future with solutions that are 'made in Europe'.

The IPR and commercialisation conditions that can be used in PCP also contribute to fostering EU strategic autonomy. It is a key characteristic of PCP to leave the IPR ownership rights with the participating contractors so that they can commercialise their solutions more widely, which increase the range of European suppliers able to deliver solutions to the public sector, thus enhancing resilience and strategic autonomy. This comes with a condition to commercialise the solutions within a specified time. This condition can be extended with the requirement to perform the majority of the commercialisation activities in Europe (e.g. production, marketing, service delivery facilities) also after the PCP contracts ends. In addition, the procurer can restrict exclusive transfer and licensing of the results/IPR from the PCP to non-EU suppliers. An IPR call back clause ensures that the public procurer can require IPR ownership rights to be transferred back to the procurer in case a supplier does not respect the PCP's place performance conditions, establishment and control from Europe obligations, IPR obligations or commercialisation obligations or in case other EU strategic autonomy or essential security interests are compromised (e.g. in case of a merger or acquisition of a PCP supplier by a non-EU entity).

In conclusion, PCP is justified on the grounds that R&D is needed (between TRL 3-8) to achieve the functional requirements. This is the case of the four challenges where potential solutions still need substantial R&D. Thus, an active demand side is needed to steer the developments to ensure that solutions will meet all the functional and technical requirements (e.g. regarding cross-border interoperability and standardisation) where suppliers are not likely to invest in developing in such solutions on their own.

# 5.2. Public Procurement of Innovative solutions (PPI)

PPI approach refers to the procurement where contracting authorities act as a launch customer of innovative goods or services which are not yet available on a large-scale commercial basis and may include conformance testing. Market readiness prior to deployment can be verified through e.g.

[13] PCP is exempted from the application of the European public procurement directives, but remains subject to the applicable provisions of the Treaty on the Functioning of the European Union and the EU competition rules.
[14] "Framework for state aid for R&D&I", COM(2014) 3282 (2014 EU State Aid Framework) and "Framework for State aid for research and development and innovation. C(2022) 7388 final of 19.10.2022.

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conformance testing, certification or quality labelling of solutions. In PPI, procurers act as launch customers, also called early adopters or first buyers of the innovative solutions.

PPI focuses on innovative solutions which are not yet available on a large-scale commercial basis. This also includes solutions based on existing technologies that are used in a new, innovative way. The solutions may have been (partially) demonstrated with success on a small scale (e.g. field testing of a first batch of products) and may be nearly or already available in small quantities on the market. However, due to residual risk or market uncertainty, the innovations are not being produced at large scale yet and do not meet market price/quality requirements of procurers for wide deployment yet.

While PCP focuses on the R&D phase prior to commercialization, PPI concentrates on the commercialization/diffusion of solutions. In other words, PCP only covers the procurement of R&D services, in a way that is clearly separated from any potential subsequent purchase of commercial volumes of end-products.

A PPI approach targeting solutions at higher TRL (7-8) can be applied using any of the different types of contracting procedures as established in the EU Public Procurement directives based upon a procurement strategy designed on a business case. PPI may include compliance testing, certification and labelling, but it can also refer to the testing of prototypes in a lab or an operational environment. PPI can also entail the combination of the R&D and deployment of commercial solutions through an Innovation Partnership procedure.

The PPI can establish IPR conditions to stimulate, for example an open source and open hardware approach. The PPI can implement criteria and contract performance clauses to foster innovative solutions, interoperable standards, as well as social and environment considerations such as those established in the soft law of the International Labour Organisation (ILO). The PPI can also implement value engineering clauses in framework agreements to stimulate the possibility to add value along the contract term through the systematic analysis of the functions and the possibility of reducing costs while enhancing the efficiency of solutions. A PPI can take place as a joint cross-border procurement bringing together several public organisations across Europe. For this purpose, they may use of the funding schemes of the Horizon Europe Programme.

For a PPI approach, depending on the scope and the object of the procurement, open, restricted, and negotiated procedures are available under Directive 2014/24/EU (Annex 4).

Among these procedures, the negotiated procedure without prior publication may be used for public supply contracts: (a) where the products involved are manufactured purely for the purpose of research, experimentation, study or development; however, contracts awarded pursuant to this point shall not include quantity production to establish commercial viability or to recover research and development costs. This procedure, which can be used for prototype testing, is regulated in the Public Procurement Directives. [15]

[15] See Recital 50 Directive 2014/24/EU, Art. 32(3)(a) Directive 2014/24/EU, and art. 50(b) Directive 2014/25/EU.

# 6. The PROTECT follow up PCP's procurement strategy

PROTECT supports urgent action for climate adaptation, mitigation and resilience and brings together public buyers to use the PCP approach in order to foster and speed up the development of innovative solutions for Climate Services based on Earth Observation that best fit the specific and systemic needs of the public demand. In this context, PROTECT is preparing the operational ground for a PCP proposal in response to the Horizon Europe pre-commercial procurement call "Customisation/pre-operationalisation of prototypes end-user services in the area Climate Change Adaptation and Mitigation" fully funded by the EU with to €19 million.[16]

The initial focus for the follow up PCP is on the four common challenges identified across five application domains (Energy & Utilities, Sustainable Urban Communities, Agriculture, Forestry and other Land use, Marine and Coastal Environments and Civil Security and Protection) which fit into the mid-to-long-term innovation plans of the public buyers. The findings of the analysis conducted, as explained in the sections above, show that there is room for innovation in all the four challenges, with some more specific solutions addressing the floods challenge which may require less R&D efforts. However, the analysis (including the completion of the SOTA analysis and business case) and discussions with public buyers may lead to the choice of one overarching challenge (which could be the water challenge as deemed essential to other challenges to anticipate on climate risks of floods, fires and subsidence).

The envisaged future PCP will be a joint procurement of research and development services launched to reinforce public demand driven innovation in end-user services in the area of climate adaptation and mitigation. Public buyers from different EU Member States and different types of users (e.g. water agencies, environmental agencies, first responders, firefighters, LEAs and cities) aim to use the PCP approach as an effective demand-side innovation action and a useful tool to close the gap between supply and demand for innovative solutions. In principle, the solutions developed and tested in the future PCP are expected to achieve TRL 7-8 to deliver successful innovative and fully tested product(s) and/or service(s) that meet the common needs of the public buyers speeding up the time-to-market and providing best value for money.

The future PCP on the customization/pre-operationalisation of prototypes of end-user services in the area of Climate Change Adaptation and Mitigation will contribute to the European Green Deal related domains benefiting from further deployment, uptake and exploitation of Environmental Observation data and products. Furthermore, it will contribute to fit-for-purpose Environmental Observation Systems and a strengthened Global Earth Observation System of Systems (GEOSS).[17]

The PCP proposal will take into consideration the following topics:

- **Innovative governance, environmental observations and digital solutions in support of the Green Deal (2023/24):** To take advantage of the use, uptake, and deployment of environmental observations as well as digital and data-based green solutions, assessed through the European Green Deal's 'do no harm' principle, is key for innovative governance models and for designing, implementing and monitoring science-based policy. To maximise impacts of R&I on the ground and spark behavioural and socio-economic change, the knowledge and innovation produced throughout the whole cluster should be widely disseminated to and exchanged between the key stakeholders and end users. In particular, the

[16] HORIZON-CL6-2024-GOVERNANCE-01-5: Customisation/pre-operationalisation of prototypes end-user services in the area Climate Change Adaptation and Mitigation.

[17] The mission of the Group on Earth Observations is to build the Global Earth Observation System of Systems (GEOSS) GEOSS (earthobservations.org) https://www.earthobservations.org/geoss.php. If projects use satellite-based earth observation, positioning, navigation and/or related timing data and services, they must make use of Copernicus and/or Galileo/EGNOS (other data and services may additionally be used).

Agricultural Knowledge and Innovation Systems (AKIS) need to be strengthened in line with the 2023-2027 CAP to accelerate the required transformative changes.

- **Innovating with governance models and supporting policies:** Considering that transformative changes such as those required within the European Green Deal are dynamic processes and require appropriate governance. To ensure coordination and collaborative and informed decision-making, governance of multiple channels and networks that provide readily available and robust data and information from different sources is required. The activities will consider new ways to govern the transition process and strengthen the governance, in particular by ensuring i) appropriate and inclusive engagement with stakeholders, e.g. civil society and regional and local actors, ii) environmental observations coverage, and iii) that information and knowledge is made available and accessible. R&I for governance to support the European Green Deal should provide insights into the opportunities to overcome potential institutional barriers such as lock-ins, path dependency, political and cultural inertia, power imbalances and the ways to strengthen the effectiveness and efficiency of regulatory pathways. It should also help create synergies and linkages between different policy instruments and funding opportunities. Innovative governance supporting the European Green Deal objectives needs to recognise, cope with and promote resilience and inclusiveness in the face of on-going shocks and disruptions across Europe and the world, whether these be climatic, ecological, economic, social, geopolitical or related to agricultural inputs and resources, food, health, bio-based sectors or the wider bioeconomy. The creation of networks with the public (citizen engagement) and researchers, including also through digital technologies, can step up transformation and enhance resilience in different areas, such as food. Critical risk assessment and reduction strategies need to be incorporated, including the diversification of infrastructures, resources and knowledge through more self-sufficiency and autonomy. Innovative governance will: i) support social innovation in the bioeconomy and bio-based systems (e.g. revitalisation of local communities with innovative bio-based business models and social innovation, or with co-creation and trust-building measures for biotechnology and bio-based innovation systems); ii) assess existing and emerging trade-offs of land and biomass; and iii) strengthen the national bioeconomy networks in countries taking part in the Central-Eastern European Initiative for Knowledge-Based Agriculture, Aquaculture and Forestry in the Bioeconomy (BIOEAST Initiative).[18]
- **Deploying and adding value to environmental observations**: Data and information obtained through environmental observation is of great value when assessing the state of the planet and is crucial to supporting the European Green Deal and the climate and ecological transitions. Integrating this information from different sources (space-based, airborne including drones, in-situ and citizens observations) with other relevant data and knowledge while ensuring (better) accessible, interoperable or deployable information, provides the information necessary for shaping the direction of policy development in the broad context of Cluster 6A strong link to Copernicus, the European Earth observation and monitoring part of the EU Space programme (in Cluster 4 - Digital, Industry and Space) and the European Space Agency's (ESA) Earth observation programme, as well as support to the Group on Earth Observation (GEO), its European regional initiative (EuroGEO), the Global Earth Observation System of Systems (GEOSS) and the European Commission initiative *DestinationEarth*[19] is foreseen for topics on environmental observations. R&I activities relevant to the ocean, seas and coastal waters will complement and support the UN Decade of Ocean Science for Sustainable Development and

[18] https://bioeast.eu/. The new partnership 'Agriculture of Data' will help improve the sustainability performance of agricultural production and strengthen policy monitoring and evaluation capacities through using the full potential of Earth and environmental observation and data technologies. It will address public and private sector interests in a synergetic way. This will be done through responsible R&I delivering data-based green solutions and through establishing governance structures which allow for systemic approaches to capitalising and using data. The partnership for a 'Climate-neutral, sustainable and productive Blue Economy' will enable a just and inclusive transition to a climate-neutral, sustainable and productive blue economy providing for a healthy ocean, people's wellbeing, and a blue economy that is in harmony with nature and whose benefits are distributed fairly.

[19] https://digital-strategy.ec.europa.eu/en/policies/destination-earth.

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the UN Decade on Ecosystem Restoration, the G7 Future of the Seas and Oceans Initiative, the European Global Ocean Observing System (EOOS) and the GOOS 2030 strategy.

- **Digital and data technologies as key enablers:** Digital and data-based innovation, in complementarity with activities supported by Cluster 4 and the Digital Europe Programme, should bring benefits for citizens, businesses, researchers, the environment, society at large and policymakers. The potential of the ongoing digital transformation, and its wider impacts – both positive and negative – need to be better understood and monitored in view of future policy design and implementation, governance, and solution development. The potential for digital and data technologies, including AI-, IoT-, and augmented reality-based solutions, to increase the sustainability and resilience of production and consumption systems, as well as industry and services, in sectors covered by this Cluster will be exploited. This destination will contribute to the development, support and take up of innovative digital and data-based solutions to support communities, economic sectors relevant for this cluster and society at large to achieve sustainability objectives. The focus is on overall sustainable solutions tailored to the needs of end-users and/or the systems. More specifically, R&I activities will contribute to economic circularity by promoting reuse of materials and waste reduction, adding value to existing knowledge and increasing cost-effectiveness, safety and trustworthiness of innovative environmentally friendly technologies in and across primary production sectors, food systems, bio-based sectors, bioeconomy, and sectors related to the oceans and biodiversity. It will also increase attention given to precision and collaborative technologies and contribute to the human-centric twin green and digital transitions. This is a key policy objective that is also supported by the cross-cutting objective pursued by the CAP, the EU digital strategy, the European industrial strategy, the circular economy action plan, the SME strategy and the European data strategy.
- **Strengthening agricultural knowledge and innovation systems (AKIS):** It refers to the organisation and knowledge flows between persons, organisations and institutions who use and produce knowledge for agriculture and interrelated fields. Knowledge and advice to all actors relevant are key to improving sustainability.
- **Social innovation**: It has the potential to strengthen the resilience of communities, increases the relevance, acceptance and uptake of innovation, and helps bring about lasting changes in social practices, therefore acting as a system changer. Social innovation is recommended when the solution is at the socio-technical interface and requires social change, new social practices, social ownership or market uptake. If required, the topics will be coordinated with European Space Agency (ESA) actions so that ESA space data and science can be proactively integrated into the relevant research actions.

In this context, the PCP proposal should set out a credible pathway contributing to innovative governance and sound decision-making on policies for the green transition and more specifically to one or more of the following impacts:

- Innovative governance models enabling sustainability and resilience notably to achieve better informed decision-making processes, societal engagement and innovation.
- Areas related to the European Green Deal benefit from further deployment and exploitation of environmental observation data, products and “green” solutions.
- A strengthened Global Earth Observation System of Systems (GEOSS).[20]
- Sustainability performance and competitiveness in the areas covered by Cluster 6 are improved through further deployment of digital and data technologies as key enablers.

[20] The European Commission is a member and co-chair of the Group on Earth Observations (GEO), as such the European Commission adopted the GEO Canberra Declaration and Commission Decision C(2019)7337/F1, and committed to contribute to the GEO objectives, including to the Global Earth Observation System of Systems (GEOSS). Where appropriate, proposals are encouraged to cooperate with the European Commission Knowledge Centre on Earth Observation (KCEO) https://knowledge4policy.ec.europa.eu/earthobservation_en, in order to e.g. disseminate and exploit results.

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- Stakeholders and end users including primary producers and consumers are better informed and engaged thanks to effective platforms such as AKIS.
- Strengthened EU and international science-policy interfaces to achieve the Sustainable Development Goals.

The PCP proposal will also assess the compliance with the "Do No Significant Harm" principle according to which the project's activities should not support or carry out activities that cause a significant harm to any of the six environmental objectives of the EU Taxonomy Regulation.[21]

## 6.1. The Public Buyers

Twelve (12) public buyers have committed to participate in the PCP as part of the PBG in the context of the proposal submitted to the HE PCP call. Several technical organisations are also committed to support the development of the testing and validation plans. Other seventeen (17) organisations are interested in joining as supporting organisation and/or the Stakeholders Group (SG). In addition, eleven (11) organisations provided letters of intent as part of Task 3.6. to participate in the further development of use cases and benefit from the activities and lessons learned from the project.

| Role | Organisation | Country |
|---|---|---|
| Lead Procurer | STICHTING TOEGEPAST ONDERZOEK WATERBEHEER | THE NETHERLANDS |
| Public Buyer | HET WATERSCHAPSHUIS (hWh) | THE NETHERLANDS |
| Public Buyer | FORUM VIRIUM HELSINKI OY (FVH) | FINLAND |
| Public Buyer | MINISTERSTVO VNUTRA SLOVENSKEJ REPUBLIKY (MINISTRY OF INTERIOR SLOVAKIA) (MoI) | SLOVAKIA |
| Public Buyer | GEMEENTE HAARLEM (CITY OF HAARLEM) | THE NETHERLANDS |
| Public Buyer | BUNDESANSTALT TECHNISCHES HILFSWERK (THW) | GERMANY |
| Public Buyer | REGION OF CENTRAL MACEDONIA (RCM) | GREECE |
| Public Buyer | FORENINGEN KLIMATORIUM (KLIMATORIUM) | DENMARK |
| Public Buyer | BENEGO – GRENSPARK KALMTHOUTSE HEIDE | BELGIUM |
| Public Buyer | INSTITUT CARTOGRAFIC I GEOLOGIC DE CATALUNYA (ICGC) | SPAIN |
| Public Buyer | CITY OF ROTTERDAM | THE NETHERLANDS |
| Public Buyer | SLOVENSKA AGENTURA ZIVOTNEHO PROSTREDIA (SLOVAK ENVIRONMENTAL AGENCY) (SEA) | SLOVAKIA |

[21] As per Article 17 of Regulation (EU) No 2020/852 on the establishment of a framework to facilitate sustainable investment (EU Taxonomy Regulation).

PROTECT

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| | | |
|---|---|---|
| First Responders | BAYERISCHES ROTES KREUZ (BRK) | GERMANY |
| First Responders | ISEM-INSTITUT PRE MEDZINARODNU BEZPECNOST A KRIZOVE RIADENIE, NO (ISEMI) | SLOVAKIA |
| Technical Institution | INSTITUT D'ESTUDIS ESPACIALS DE CATALUNYA FUNDACION (IEEC) | SPAIN |
| Technical Institution | CLIMATE-KIC HOLDING BV (CLIMATE KIC) | THE NETHERLANDS |
| Technical Institution | AEROSPACE VALLEY (AV) | FRANCE |
| Technical Institution | FRAUNHOFER GESELLSCHAFT ZUR FORDERUNG DER ANGEWANDTEN FORSCHUNG EV (FRAUNHOFER) | GERMANY |
| Technical Institution | UNIVERSITEIT TWENTE (UT-ITC) | THE NETHERLANDS |
| Technical Institution | FUNDACIO PRIVADA I2CAT, INTERNET I INNOVACIO DIGITAL A CATALUNYA (I2CAT) | SPAIN |

*Table 3: Organisations committed to participate in the Water challenge PCP*

A brief description of the public buyers is provided below:

1. STOWA works collaboratively with universities, knowledge institutions, and the business community, and supports water boards in meeting short and long-term water management challenges.
2. HET WATERSCHAPSHUIS (HWH) facilitates knowledge sharing and resource optimisation, strengthens the Netherlands' resilience against water-related challenges. Together, these organisations play a vital role in ensuring effective water management practices nationwide, contributing to the country's sustainability and resilience against water-related risks.
3. FORUM VIRIUM HELSINKI (FVH) is dedicated to advancing Helsinki's smart city initiatives through technology and innovative solutions by engaging diverse stakeholder to contribute to Helsinki's climate goals.
4. THE MINISTRY OF INTERIOR OF THE SLOVAK REPUBLIC (MOI) ensures efficient procurement of goods and services. Through initiatives like the iProcureNet project, MOI promotes innovation in public procurement, addressing security sector needs and fostering cross-border collaboration.
5. THE CITY OF HAARLEM is a recipient of the 2022 Innovation iCapital Award, is a leader in innovation within the Netherlands. With a focus on climate adaptation, sustainability, and fostering innovative SMEs and startups, Haarlem aims to procure 100% circular by 2030, addressing challenges such as urban heat island effects and local flooding.
6. BUNDESANSTALT TECHNISCHES HILFSWERK (THW) is a civil protection agency in Germany, providing technical relief nationally and internationally, and civil protection.
7. THE REGION OF CENTRAL MACEDONIA (RCM) is known for its extensive track record in initiatives such as participation in the INCAREHEART PCP procurement process and its unique mechanism supporting the regional ecosystem's capacity, extroversion, startup support, and project scaling within the framework of RIS3.

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8. KLIMATORIUM – INTERNATIONAL CLIMATE CENTER IN DENMARK spearheads collaborative efforts to address climate challenges at local and global levels. Through a living lab approach and circular thinking, Klimatorium develops sustainable solutions and fosters knowledge dissemination to build climate resilience.
9. BENEGO - GRENSPARK KALMTHOUTSE HEIDE (GKH) fosters cooperation in the Dutch and Belgian border in topics including climate change, water management and innovation.
10. THE CARTOGRAPHIC AND GEOLOGICAL INSTITUTE OF CATALONIA (ICGC) provides expertise in geo-information science, security strategies, and spatial data infrastructure.
11. THE CITY OF ROTTERDAM is one of the main cities in the Netherlands characterised for being one step ahead in innovations.
12. SLOVAK ENVIRONMENTAL AGENCY (SEA) specialises in environmental protection and climate change adaptation. Engaged in environmental monitoring and informatics, SEA actively contributes to designing, developing, and implementing environmental information systems, particularly in geoinformatics and remote sensing.

Other organisations are committed to join to provide their expertise :

1. BAYERISCHES ROTES KREUZ (BRK), the Bavarian Red Cross is committed to a more social, better and stronger Bavaria, ready to crises and disasters.
2. ISEMI, a non-profit organization supporting the implementation of security strategies for various international organizations, specializing in areas such as police cooperation, counter-terrorism, and emergency management.
3. THE INSTITUTE OF SPACE STUDIES OF CATALONIA (IEEC) is a distinguished space research and innovation hub with 25 years of expertise, spearheading Catalonia's New Space Strategy for global prominence in space endeavours and the Bavarian Red Cross (BRK) play pivotal roles in environmental stewardship, urban infrastructure development, and disaster relief.
4. CLIMATE-KIC is Europe's premier climate innovation agency, catalysing collective action to bridge the gap between climate commitments and reality.
5. AEROSPACE VALLEY is France's top innovation cluster in aeronautics, space, and unmanned systems, fuels regional growth and job creation through research and development, fostering collaboration between industry and academia to advance aerospace technologies.
6. FRAUNHOFER AVIATION & SPACE, comprising over 30 institutes, conducts and fosters innovation in climate resilience, aerospace technology, and research advancement.
7. UNIVERSITY OF TWENTE, FACULTY ITC (UT-ITC), ITC collaborates with international organizations to address global challenges through spatial data analysis and research.
8. THE I2CAT FOUNDATION drive transformative solutions using advanced technologies. Together, these diverse partners form a robust consortium committed to addressing complex societal challenges through innovation, collaboration, and knowledge exchange.

In addition, the following entities have expressed their support to the PCP proposal and willingness to be part of a Stakeholder Group.

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| No. | Organisation | Supporting | Stakeholder Group (SG) |
|---|---|---|---|
| 1 | ARPA Lombardia | | X |
| 2 | European Association for Remote Sensing Companies (EARSC) | | X |
| 3 | French National Fire Officers Academy (ENSOSP) | | X |
| 4 | Hoogheemraadschap De Stichtse Rijnlanden (Regional Water Authority | | X |
| 5 | Irrigation Community Segarra-Garrides in Catalonia | X | X |
| 6 | Ministry of Climate Action, Food and Rural Agenda. Government of Catalonia | | X |
| 7 | Ministry of Interior of France | | X |
| 8 | Netherlands Space Office | | X |
| 9 | Provincie of Limburg | | X |
| 10 | Région Provence Alpes Côte D'azur (PACA) | | X |
| 11 | Technology Centre of Catalonia (EURECAT) | | X |
| 12 | Toulouse Métropole | X | X |
| 13 | Waterschap Limburg | X | |
| 14 | Zilina Self-Governing Region | | X |
| 15 | Municipality of Fundão | | X |
| 16 | Emschergenossenschaft/Lippeverband | | X |
| 17 | Regional Council of Nouvelle-Aquitaine | X | |

*Table 4: Supporting organisations and members of the Stakeholder Group*

This preliminary overview of the committed parties shows a diverse array of institutions including research institutions, public agencies, innovation clusters, technical and supporting organisations, that bring a wealth of expertise and resources to implement a PCP for the Customisation/pre-operationalisation of prototypes end-user services in the area Climate Change Adaptation and Mitigation, to address the Water management challenge.

## 6.2. The PCP setup and planning

As discussed above, PCP is an approach that allows public procurers to buy R&D from several competing suppliers in parallel, to compare alternative solution approaches, and to identify the best value-for-money solutions that the market can deliver to address their needs. In PCP, there is a risk-


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benefit sharing under market conditions between the public procurer and the suppliers, and a clear separation between the PCP and the deployment of commercial volumes of end-products. The value of the total amount of products covered by the contract must be **less than 50 % of the total value of the PCP contract.**

The PCP tender will start with the publication of the contract notice along with the request for tenders, the framework agreement, and the phase contracts. After evaluating the offers submitted by the market operators according to the rules established in the tender documents, the contracts will be awarded and a contract award notice will be published. The process will be monitored to ensure sound deployment, integration, and validation of the PCP.

The PCP procedure will comprise three phases of solution design, prototype implementation, and validation and demonstration of the solutions:

- **PCP Phase 1 – Solution design [4 months**]: During this phase, the contractors will be asked to describe the solution providing the complete architecture and design thereof and verifying the technical, economic and organisational feasibility of their solution to address the PCP challenge.
- **PCP Phase 2 – Prototype development (and testing of technologies) [9 months]:** This phase concerns the development of the first prototypes of the solutions, which will be tested. Contractors will develop a first prototype based on the design documents delivered in the previous phase and test their solutions in lab conditions. Prototypes will be tested and verified to provide a measure of the technical performance of each solution in a controlled environment. During and at the end of phase 2, the Public Buyers (PB) will request from the contractors a series of deliverables in order to evaluate their progress and the performed activities and obtained results.
- **PCP Phase 3 – Validation and demonstration of the solutions (end-users piloting services in operational environment) [6 months]:** This phase will validate the final solutions in diverse conditions, using the detailed scenarios and processes developed in the verification and validation strategy. During phase 3, a feedback mechanism will be established between the PB Group and the selected contractors in order for the latter to receive requests for improvements directly from the end users. The PBG will request from the contractors an Integration Report. Finally, a Field Acceptance Report related to the accomplishment that the two final solutions which have been deployed and that the validation tests have been successfully performed in a real operational environment will be requested.

Evaluations after each phase will progressively identify the solutions that offer the best value for money and meet the customers' needs. This phased approach allows successful contractors to improve their offers for the next phase, based on lessons learnt and feedback from procurers in the previous phase. Using the phased approach with gradually growing contract sizes per phase will also make it easier for smaller companies to participate in the PCP and enable SMEs to grow their business step-by-step with each phase. The initial estimation of the PCP budget is shown in Section 6.3. Table 7. The reasoning for the PCP budget allocation with emphasis in Phase 2 is based on the complexity of the technology and the development required given the multiple layers and use cases that will be clustered and tackled in Phase 2.

After each phase, intermediate evaluations will be carried out to progressively select the best solutions. Contractors that are evaluated as successful after phase 1 will be invited to bid for phase 2 contracts. Likewise, contractors that are evaluated positively after phase 2 will be invited to bid for phase 3 contracts. During phases 2 and 3, contractors will be invited to communicate with the PCP Consortium about any specific requirements to ensure the developments made within the project.

In principle, one overarching challenge (with several selected use cases) will be tackled possibly in one PCP without lots. In phase 3, up to two selected solutions may be validated.

The law applicable to the potential future PCP will be the law of the lead procurer, which may be Dutch law.

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## 6.3. Budget per phase

The initial description of the PCP budget per phase presented in the OMC document was based on the HE PCP 19M grant and the options of having a PCP comprising two challenges and possible sub-challenges, to allow a larger number of providers to participate, in particular in the phase 1 and phase 2 of the PCP. This approach, however, needs to be further analysed and defined in consideration of the results of the business case.

In this regard, the tables below should be taken as mere examples including the expected number of suppliers, the budget per supplier and the duration of each phase. In case of less suppliers admitted to each phase based on the evaluation (award) criteria, the remaining budget may be shifted to increase the budget for the successful suppliers in the next phase.

In D3.1 Orientation Paper (first version), four (4) options were presented which included two challenges and a higher number of suppliers per phase. However, based on the discussions held with the public buyers who expressed their commitment to be involved in the PCP, a new budget allocation for the overarching Water challenge is justified by the strategy to incentivise the market cooperation and synergies of consortia built up on specific complementarities of technology providers, as explained below.

### Budget and contractors per PCP phase

The following table summarizes the selected procurement approach for the overarching Water challenge on the number of contractors, budget per contractor, total budget per phase, duration per phase and total PCP budget.

| PCP Phase | No. Contractors | Budget per contractor | Total budget | Phase duration |
|---|---|---|---|---|
| Phase 1 solution design | 5 | 300000 | 1500000 | 4 months |
| Phase 2 prototype development | 3 | 2400000 | 7200000 | 8 months |
| Phase 3 testing and validation | 2 | 1554544 | 3109088 | 6 months |
| | | **TOTAL** | **11809088** | **18 months** |

*Table 5: PCP phases, number of suppliers, budget and phase duration*

### The overarching Water challenge and the market rationale

Given the complexity of the overarching Water challenge that aims to comprise several use cases in different domains, the procurement strategy seeks to encourage the technology providers to make synergies and combine their skills, work field and technologies to tackle all the use cases. As such, the PCP strategy, specifically the number of contractors per phase and the budget allocated per phase will steer the market to build up consortia to submit a bid.

In the context of PCP, a contractor would represent a consortium/group of large and small companies expected to consist of:

1. At least 1 big (mostly civil) engineering company with a capable hydrological/hydraulic division (they mostly work on road-/channel construction/tunnels/groundwater management in cities and rural areas. They deliver professional services for clients, based on sound contracts with deliverables mostly with government or industries (capable liabilities/financial, legal, contractual division needed). Besides their operational experience they also have a professional workaround dealing with projects, subcontractors, and milestones/deliverables and capable of TRL8 (even to TRL9/10 when having good client divisions), They provide/host also mostly the IT facilities in combination with below subcontractors.
2. A group of small specialised companies:

a) hydrological modelling/service companies (in subcontract of the above large company) with a track record of hydrological (pre-commercial not scientific) projects executed for operational request of water management authorities (regional, national). They have to focus on the mandatory SWVA system development towards TRL8. The space component can be input to this from the category 2b and 2c

b) satellite value-added companies who deliver specific operational spatial/temporal information products related to the specific requirements for the use cases selected (proven portfolio to clients, not research projects only) as input to the hydrological value chain, they have their internal IT-data chain facilities for processing, but need to link up with the hydrological modelling chain. Mostly 1 or 2 specialistic satellite value chains are in 1 company. So, it is expected to have more SMEs in this category in the consortium

c) Sometimes a and b are combined in 1 specialised company but requires critical mass and capacity to have a TRL8 operational (processing/data/information/delivery) environment.

3. Knowledge partner (institute or applied R&D organization or applied research company) who can address specific research issues and have enough networks to find the best solution direction.
4. Solution architect (IT) company who can combine/integrate all the various aspects of the total solution and also facilitate the links between all IT aspects in the consortium and client environment, but also is aware of the AI, OGC, INSPIRE, privacy directives and EC regulations.
5. A specific professional communication/organisational/sector company: The functional translation to link up with client environment is often a separate company who can speak the right (water/functional/management) language (and have the trust) of the client.
6. (Optional) A legal and IPR specialised company could help the consortium in developing patents (and mutual internal partner/owner rights of the) long-term services for TRL8 services.

In addition to the contractor strategy, the PCP setup should guarantee some crucial aspects (procurement essentials):

- Avoid creating preferred selling (locked in) mechanisms in the European market. Thus, it is necessary to develop a competitive strategy during the project and for the project afterlife. In this manner, it would be possible for other new consortia to still have a chance to provide services in the future. As developments are fast in this specialised field, it is important to ensure flexibility to improve/update the service portfolio. Therefore, this requirement needs to be communicated in the outreach to the market.
- Doing a 3 years project, the organisations can learn on procurement (in this specific sector), learn on gaps/missing components for further future development, so during and after the project it is important to build up an awareness for a future R&D programme with priorities (recommendation for other programmes in EU for applied research in water/climate domain).
- It is important to be adaptive to ongoing (national/EU climate policy and water management) developments during the project and with that a fit future vision and strategy building as a team.
- Define other topics that need to be discussed with the public buyers, support organisations and stakeholders.

Phase 2 is the most challenging phase as all of the above aspects need to be addressed in the prototyping and professionally further to be elaborated in the phase 3.

The strategy will evolve during the project in discussion with the installed governance/advisory teams in place.

## 6.4. Evaluation of bids in the PCP

The tender documents will include specific provisions and related evaluation criteria. An initial indication on the evaluation committees involved and the steps to be followed are provided in this section. These aspects will be further defined and modified if needed at a later stage during the preparation of the actual PCP process.

In the PCP tender, after receiving the bids from interested technology providers, these will be evaluated according to the rules established in the tender documents, and the contracts will be awarded. The award of the contracts will be published in TED via a Contract Award Notice (CAN).

For the purpose of the evaluation of the bids, the following different bodies can be appointed:

- **The Administrative Procurement Committee (APC)** will be composed by at least three members of the Lead Procurer and will have a dedicated role with the view to support and spend up the tender procedures during the procurement execution. In this regard, the APC members will support the Lead Procurer on the tender's evaluation (evaluating the tenders against the exclusion and selection criteria, contact excluded bidders).
- **The Financial Evaluation Committee (FEC)** will be constituted by a group of experts, representatives from the Buyers Group, specialising in economic and business aspects of the procurement process. Chaired by the Lead Procurer's representative, the FEC receives supplementary assistance from economic advisors as necessary. The FEC conducts comprehensive reviews to assess the project's financial and business viability. Throughout all phases of the PCP process, the FEC supports the evaluation of the end-of-phase reports submitted by contractors. Its primary objective is to ensure alignment with economic and business-related requirements as drafted in the tender as well as to provide feedback on their commercialisation plans. Decisions within the FEC are reached through consensus and are then presented to the Procurement Evaluation Board (PEB) for final decision-making. This collaborative approach ensures that financial considerations are carefully integrated into the broader project framework, ultimately enhancing the project's overall success.
- **The Technical Evaluation Committee (TEC)** will be comprised of technical and domain-specific experts, a representative from the Buyers Group, and chaired by the Lead Procurer's representative. It will receive support (without voting rights) from expert advisors as needed. The primary responsibility of the TEC is to ensure the project progresses in a timely manner and the delivery of high-quality results. Throughout all phases of the PCP process, the TEC will review the end of phase reports and the proposals submitted by contractors, ensuring compliance with technical requirements. The committee proposes acceptance or rejection of deliverables and the proposals to the PEB. The TEC addresses complaints submitted by economic operators during the tendering process, providing recommendations to the PEB for final decision. Decisions within the TEC are reached through consensus, reflecting a collaborative approach to project oversight and decision-making.
- **The Procurement Evaluation Board (PEB),** chaired by the Lead Procurer representative and integrated of at least one representative from each end user, will serve as the decision-making body overseeing the tendering process and subsequent contract execution**.**

Bids will be evaluated in a non-discriminatory and transparent manner.

At the end of the evaluation procedure, a ranking will be drawn up, in which the technology providers will be inserted based on the overall score achieved, in descending order.

In case the bids of two or more technology providers obtain the same overall score, but with different partial scores for the price and for all the other different evaluation elements, the technology provider who obtained the best score on the technical offer will be placed first in the ranking.

The evaluation process and initial contract award will follow steps:

- Step 1: Checking the exclusion criteria per technology provider. Performed by the APC.


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- Step 2: For technology providers passing step 1, checking the selection criteria per technology provider. Performed by the APC.
- Step 3: For technology providers passing step 2, checking the pass/fail award criteria per technology provider. Performed by the APC.

Formal Approval by PEB of the outcome of the three prior steps.

- Step 4: For technology providers passing step 3, evaluating the Bids based on the weighted award criteria. Performed by TEC.
- Step 5: Opening of the financial offers. Performed by APC.
- Step 6: Evaluation of the financial offers. Performed by FEC.

Formal Approval by PEB of the outcome of the two prior steps.

- Step 7: Final ranking by PEB.
- Step 8: Provisional award decision by PEB & communication thereof.
- Step 9: Final award decision after the standstill period (ten days) & signing of framework agreement and phase 1 contract.

This approach should be further fine-tuned based on the detailed design of the procurement strategy and the evaluation scheme**.**

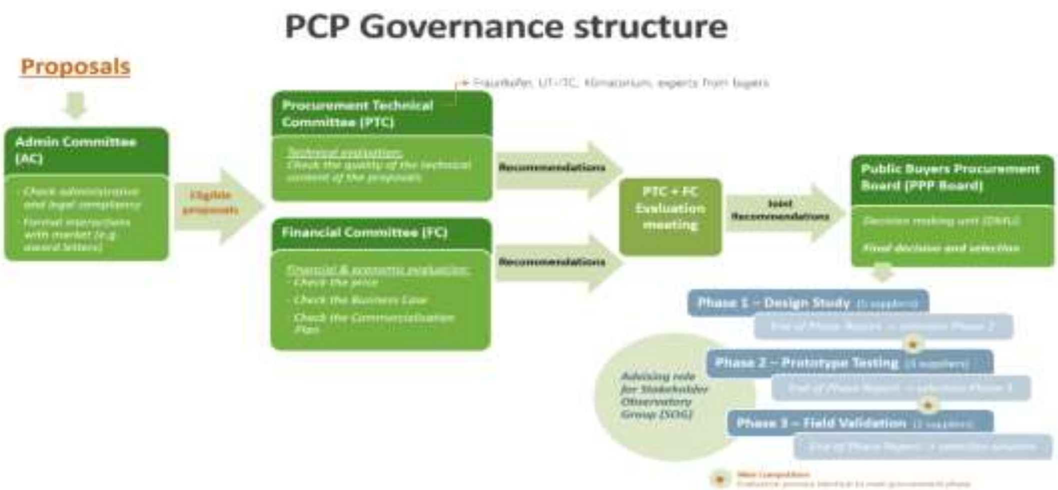


*Figure 12: Possible PCP Governance structure*

## 6.5. Contract's implementation

During the implementation of the potential future PCP, it is recommended to have effective tools to monitor performance of the R&D suppliers and provide regular feedback during each phase. For example, each contractor could be assigned a main contact person (their supervisor) appointed by the procurers as the main point of contact.

Other relevant activities to be considered are :

**Pre-monitoring:** A kick-off meeting per contractor can be scheduled at the beginning of each PCP Phase and the selected contractors will be requested to present their implementation schedule for the PCP Phase that they are entering. During the same meeting, the supervisor will present the framework for the review. The objective is to establish a close and fruitful communication channel with the contractors, in order to ensure from the early beginning of the action that the project is implemented according to the needs of the buyers.

**Monitoring:** Contract implementation can be monitored and reviewed against the expected outcomes for each phase. The intensity of monitoring and communication between the Public Buyers Group and the contractors will increase from Phase 1 to Phase 3. For instance, regular meetings with the contractors by videocall or face-to-face, on-site visits to the contractors' locations to check and discuss the status of the work and progress, or any other suitable way. Ad-hoc meetings and on-site inspections are also possible in the event that the R&D development has halted or slowed down.

**Post-monitoring:** At the conclusion of the monitoring activities, the supervisor will provide written feedback for each contractor at each PCP Phase. This feedback will generally consist of overall comments and remarks about the contractor's outcomes under review. Monitoring activities will be continued after the PCP is completed. Specifically, it will be checked whether the contractors are successfully commercializing the R&D results within the call-back period defined in the PCP framework agreement. If that is not the case, the PCP Consortium will ask the R&D suppliers to give licenses under Fair, Reasonable And Non-Discriminatory (FRAND) terms to other third parties, or will ask to transfer back the ownership of results to the Public Buyers Group. Other contractual obligations of the contractors that go beyond the end of the PCP are, for instance, providing information or support to the Public Buyers' Group in connection with the PCP solution, contributing to standardization, obligations regarding publication of information about the contract, auditing/keeping data obligations, etc.

The intensity of monitoring and communication will increase from Phase 1 to Phase 3 through regular contacts with each R&D provider by teleconference means, face-to-face meetings or any other way that is suitable.

**Data management:** The data collected and generated during PCP-WISE will be managed in line with the FAIR principles (Findable, Accessible, Interoperable, Reusable) according to the needs of the project. Types of data/research outputs (e.g. experimental, observational, images, text, numerical) and their estimated size; if applicable, combination with, and provenance of, existing data: (1) Persistent identifiers like digital object identifiers (DOIs) and trusted repositories ensure data findability. (2) Open access timelines and provisions for restricted data access are outlined, considering intellectual property rights (IPR) and verification needs. (3) Interoperability standards, formats, and vocabularies for data and metadata enhance data exchange. (4) Data reusability is facilitated through licensing agreements (e.g., Creative Commons), and tools/models for data generation and interpretation are provided. (5) Curation, storage, and preservation costs are managed by dedicated teams responsible for data management and quality assurance. These practices not only enhance open science rigor, but also contribute to addressing gender disparities by promoting transparency and inclusivity in research processes. This effort will also tie into the Data Management Plan (DMP) for the project, which stipulates the data management principles that the consortium partners will adhere to in their work.

## 6.6. Testing strategy

The testing strategy will consider the challenge requirements, outcomes and impact of the PCP. The testing strategy will be developed by defining the selection, compliance and award criteria, performance conditions and IPR strategy. A verification and validation strategy will be in place in order to summarise the technical verification and operational validation processes that will be followed for evaluating the companies. This takes into account external systems, applications, protocols and data formats for the development of the interoperability and integration strategy of the PCP solutions, as well as IPR clauses attached to the proposed solutions.

Verification and validation activities should be planned, notably at the end of each PCP phase. While verification is often understood as a technical evaluation or testing targeting compliance with requirements or non-functional conditions, validation is a broader concept and also covers assurance that nontechnical phase outcomes (as interoperability, replaceability, re-usability, (cost) efficiency,

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timeliness, etc) are in line with PCP Buyers group needs and expectations, and fully integrate climate change implications as well as short term requirements.

Further work is required in PCP Phase 0, including the definition of the verification and validation strategy targeting comprehensive and systematic approach to the activities from curiosity driven research concept to the actual acceptance testing. In this sense, the verification and validation strategy will not only deal with specific procedures for the evaluation of the performance, or assurance parameters, but also the link between various levels of abstractions, from scenarios, requirements, specifications and others to the final technical solution or cost assumption validations. It includes the following steps:

- Step 1: definition of the overall verification and validation strategy that describes the approach including procedures and processes regarding the verification and the validation activities after each phase.
- Step 2: definition of the technical verification strategy that analyses how the PCP Consortium will verify that the prototypes being built at PCP Phase 2 meet system requirements. Evaluation or testing activities related to this step should be performed with the support of the technical advisors.
- Step 3: definition of the operational validation strategy that describes the methods, measures and procedures needed to assure that PCP users are satisfied with outcomes of each phase, and that these outcomes are in line with their needs and expectations, including requirements, specifications, planning, cost assumptions, internal feasibility and other issues. For the validation in each phase, KPAs (Key Performance Areas), KPIs (Key Performance Indicators) and (Project Management Owners) MOEs should be defined. The core of the operational validation strategy should be the definition of a benchmark methodology for the developed solution. In order to compare the final solutions validated in Operational environment in PCP Phase 3, the results generated by the PCP prototypes should be assessed using the use cases developed.

## 6.7. Intellectual Property Rights

Intellectual Property Rights (IPRs) are the rights that adhere to creations and grant the holder(s) thereof a monopoly on the use of that creation for a specified period and subject to certain exceptions. The underlying aim of granting such (temporary) monopoly is to incentivise creators to share their creation with the public, and to achieve the social benefits of increased creative activity.

Traditional IPRs – such as patent, copyright and trademark – are generally fully disclosed to the public domain, meaning that the essential qualities of the protected subject matter are made available for public inspection. Public and third party use of IPRs is however curtailed by the requirement of needing a ‘license’ to use the IPR productively.

In the context of the PCP, the IPR will be distinguish between “background IPR”, “sideground IPR” and “foreground IPR” depending on when they are generated.

**“Background IPR”** refers to the pre-existing intellectual property and trade secrets produced before the project and which the parties (public buyers and contractors) bring to the PCP, and which may be built-upon, modified or improved during the procurement. As a general rule, the background IPR remains the property of the party who generated it. Given this, access rights may need to be granted to the public buyers to ensure that they are able to conduct the activities they are involved in during the PCP (e.g., analysing and testing of solutions) and to use the PCP results that incorporate background IPR.

**“Sideground IPR”** refers to intellectual property produced during the period of the PCP but not in the activities covered by the PCP contract itself. In the vast majority of cases, the sideground IPR remains the property of the party who generated it. Given this, access rights may need to be granted to public procurers to ensure they are able to conduct the activities they are involved in during the PCP project

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(e.g., analysing and testing of solutions) and to use the PCP results, which incorporate the sideground IPR.

**"Foreground IPR"** refers to the intellectual property and trade secrets produced in and during the PCP.

In the potential future PCP, the contractors will retain ownership of the IPRs that they will generate during the PCP and will be able to use them to exploit the full market potential of the developed solutions. Contractors will be in a position to commercialise the innovations derived from a public procurement, to secure the appropriate protection of the intellectual property and to defend – if necessary – the intellectual property rights in court. In exchange, the public buyers will receive an irrevocable, indefinite, worldwide, royalty-free, non-exclusive license to use all project's results at no additional cost. Moreover, it might have the right to require the companies that participate in the PCP to license the results to other third parties, under FRAND conditions.

In case of non-exploitation of the results or abuse of the results against public interests or failure to commercialize the results, the Public Buyers Group will have the right to require the transfer of the IPRs generated by the company during the PCP (call back clause).

The results will be disseminated according to open access rules and obligations, whilst safeguarding at the same time the IPRs of the members of the PROTECT and the contractors (both background and foregrounds rights).

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# 7. Conclusions and recommendations

As a result of the activities conducted in the framework of the PROTECT project**, four procurement challenges have been identified and selected with the purpose of exploring the feasibility and grounds to implement a PCP**. The common challenges and functional requirements are considered to have a high climate and procurement impact with cross-border relevance for multiple public buyers and users across Europe.

Based on the preliminary results of the preparatory steps (following the EAFIP methodology), in particular the SOTA analysis and the results of the Open Market Consultation, it is possible to reach the conclusion that **the four challenges require R&D efforts in order to tackle the functional requirements identified in the different use cases**. Therefore, the recommended approach for the four challenges is the possible implementation of a PCP.

Nevertheless, it has been noted that **some existing solutions could tackle some functionalities of the floods challenge**. In this case, it could be possible to apply the PPI approach, in particular one of the procedures established in the Public Procurement Directives for the only purpose of testing solutions without the possibility of actually purchasing the solution as such. This approach could be also applied by public buyers interested in any of the solutions presented during the e-pitching sessions.

Further analysis of the OMC results and discussions with the public buyers led to **scoping one challenge that could cluster different use cases** relevant to the other 3 challenges. As a result of the agreement of committed public buyers, the Water (management) challenge was selected given the importance and impact of water intelligence solutions on use cases related to floods, fires and sustainable and resilient infrastructure across domains, to be validated by end users from cities, agricultural agencies, first responders and water management agencies.

The justification of the selected use cases is the integral assessment of day-to-day SWVA conditions with space-based value chains based on local/central knowledge (AI, EO-Inversion/hydrological modelling, etc.). This will provide a first basis of local water intelligence for the use case stakeholders. Driven by the required functions in their organisations, the translation from the SWVA conditions towards regular or crisis management processes (e.g. risk indicators) can be achieved.

For the preparation of the PCP proposal to respond to the HE PCP call, **this orientation paper has set some considerations for the selection of the PCP and/or PPI approach**, and possible provisions to strengthen the EU strategic autonomy and resilience, such as the 100% of R&D performance in EU Member States or Associated countries. It may also be **important to consider allowing a good number of suppliers to participate in phase 1 and phase 2 of the PCP** increasing the chances of alternative solutions and incentivising more startups and SMEs to present (joint) bids in the PCP tender.

The paper has also outlined the relevant topics and guidelines to set up the procurement strategy based on the selection of **the Water (management) challenge linked to EO data relevant for crises** prediction, prevention and mitigation, including updated allocation of the PCP budget, the evaluation of bids, the contract implementation, the testing strategy and the intellectual property rights regime.

In this context, this **Orientation Paper was updated to reflect the developments in the assessment of needs and the procurement strategy** linked to the outcomes of the work performed in cooperation with the committed public buyers who submitted the proposal to the HE PCP call. In the implementation process the (selected) use cases in Europe will provide a representative spectrum of requirements for the procurement process.

Finally, it is recommended to consider additional preparatory activities and the final selection of use cases once/if the PCP HE grant is awarded to finetune and tailor the PCP tender documents accordingly.

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# ANNEXES

# ANNEX 1 – CHALLENGES & USE CASES

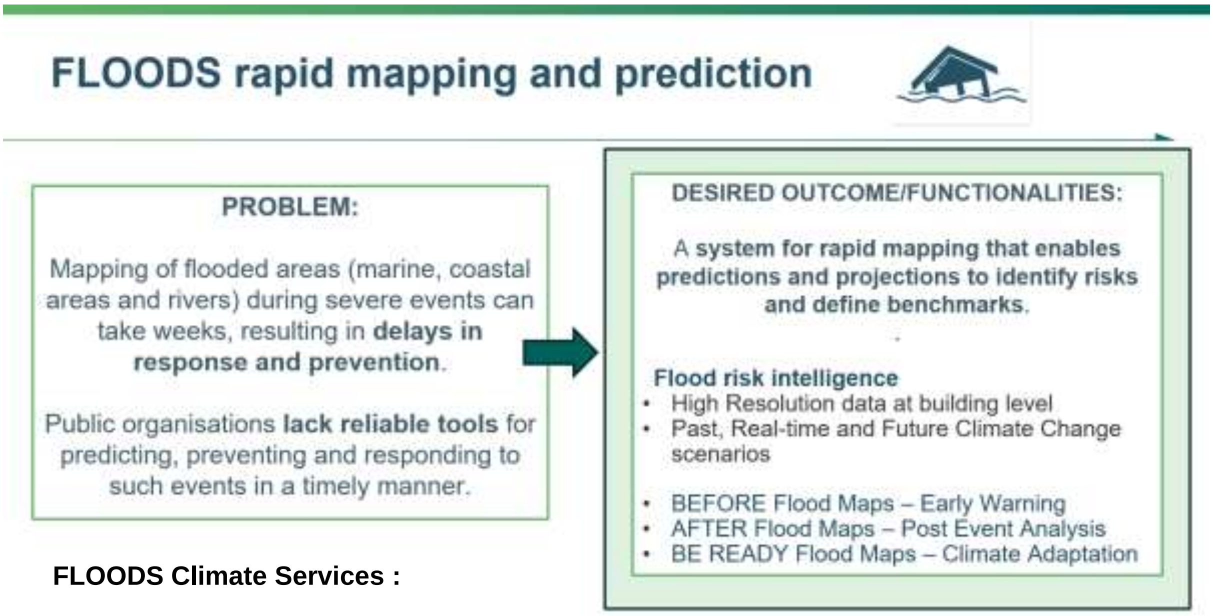
## 1. Floods challenge

Currently, the mapping of flooded areas (marine, coastal areas and rivers) during severe events can take weeks, resulting in delays in response and prevention. Public organisations lack reliable tools for predicting, preventing and responding to such events in a timely manner.

Some foreseen steps are:

1. Implementing a unified repository for historical data along with a single Application Programming Interface (API)
2. Connecting rapid mapping and climate services to the repository
3. Transforming mapping processes into algorithms for more efficient and automated analysis.
4. Utilising efficient tools and systems to support the mapping and analysis tasks.
5. Ensuring proper utilisation of the tools by a skilled team with the necessary expertise.

The desired outcome is to establish a system for rapid mapping that enables predictions and projections to identify risks and define benchmarks. This will involve the development and utilisation of software capable of higher resolution and timely acquisition of satellite information.




**FLOODS Climate Services :**

- Digital Twin and EO, climate and geospatial data integration
- Cloud and API based solution
- Fast algorithms for real time mapping
- Specific routine for what if scenarios
- Changing Climate
- Resilient Cities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- User friendly and tailored for non-expert in hydrodynamic model

**BEFORE Flood Maps – Early Warning**

- Support Emergency Operations
- Support Early Warning
- Displacement of people at high risk
- Put in place rapid mitigation measures for reducing the damages
- Rapid Mapping tools
- What if scenarios
- River Breaching or overtopping
- Extreme Sea Level
- High Resolution Data
- LIDAR Data'

**AFTER Flood Maps – Post Event Analysis**

- Flood Mapping from Satellite images
- Copernicus Sentinel
- Cosmo Sky Med
- From Flood Mask to Flood Depth
- Damage Assessment building by building

**BE READY Flood Maps – Climate Adaptation**

- Support Land Use Planning and Adaptation Strategies in Cities
- Identification of hot spot Risk
- Support in localizing and designing mitigation measures
- Physical Barriers
- Nature based Solution

**Currents Gaps and Innovation Needs**

**High resolution data gaps**
- Lack of flood data and risk maps
- Uneven coverage at global level
- Parametric Insurance Not Possible

**Complex tools for selected experts**
- Cost, Time and CPU-intensive Solutions
- Targeted highly skilled professionals

**Static View of Flood Risk**
- Not Possible to simulate a changing Resilient City with Adaptation and Mitigation infrastructures
- Multiple hazards/damages and climate scenarios


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## Floods in regional adaptation

- **Flood risks figure prominently in major risk assessments and adaptation strategies in regions across Europe:**
  a) Marine & coastal: Flooding risks in almost all coastal regions: sea level rise [Med FR,ES,northern IT,northern DE,PL], marine submersion [North and Baltic seas,ES-n,IT-n,FR-se], extreme rainfall, thunderstorms and gales [PL,ES-n], combinations of those factors [DE-n,ES-n,NL,LT,FR-w]
  b) Sustainable urban communities: Risk of flooding in urban areas (heavy rainfall, river overflow, marine submersion, sea level rise), aggravated by soil degradation, itself amplified by droughts [BE,NL, IT,PL,FR]
  c) Energy & utilities: multiplication of flooding (extreme rainfall, sea level rise) to disrupt energy production [DE,LT,PL]; risk of landfill flooding [LT]
  d) Agriculture, forestry and other land use: Negative impact on land use from floodings combined with droughts, heavy rains, storms [IT-n,ES-n,LT,PL]; increasing flooding risk in agricultural areas [FI,DE-e,IT-w/n,FR]

## Legal texts relevant to the Floods challenge (EU level)

**The EU Floods Directive**

- Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks (publ. 6 November, 2007)
- Each EU country is required to assess all areas under risk of significant floods, to create Flood Hazard Maps and Flood Risk Maps for such areas in terms of possible flood extent and assets & humans at risk, and to take adequate and coordinated measures to reduce flood risk
- The general public must have access to this information and a say in the planning process
- The Floods Directive is closely coordinated with the Water Framework Directive

## Legal texts relevant to the Floods challenge (nat'l level)

**Transposing the EU Floods Directive**

- The Directive was transposed into national laws mostly between 2008 and 2010
- In most cases, this appeared either within new Water Laws, Water Acts, or updates / amendments of the current ones
- In complement: national flood risk management plans; plans at the level of regions / river basins / sub-regions
- Working Group set up within CIRCABC to support implementation of both the Floods Directive and the Water Framework Directive
- 6-year cycles to reduce the risk of flood damage: 1st cycle 2010-2015, 2nd cycle 2016-2021, 3rd cycle 2022-2027; results from 2nd cycle reported for 19 countries, public consultation concluded in 5 more, 3 ongoing or delayed

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## 2. Fire challenge

Currently, there are several scenarios of fires initiated by different causes and having a harmful effect on the environment.

One scenario or use case relates to facilities where waste is stored and prone to spontaneous fires, occurring three or more times a year (in one city). These incidents are particularly prevalent during the summer months when temperatures are higher. While data on previous fire events exist (temperature conditions, height of piles, heat waves, composition of garbage, location of storages or disposals) there is no automated solution available to predict fires and make informed decisions for prevention. As a result, environmental agency inspectors bear the responsibility of monitoring these facilities, placing a significant burden on staff resources.

In this waste fire use case, the foreseen steps are:

1. Exploring the technical boundaries to understand the possibilities of providing frequent data updates and establishing the required preparedness frequency.
2. Developing a comprehensive model using both existing and new data to predict waste fires.
3. Aggregating all data from past waste fire incidents can be instrumental in this process.
4. Training the model based on defined conditions and relevant factors, such as the evolving composition of waste over time and temperature variations.
5. Utilizing the gathered data to anticipate fire occurrences, enabling timely preventive actions.
6. Implementing automated notifications to alert environmental; agencies about the risk of fire, empowering them to take necessary measures such as engaging contracted companies or industries experienced in managing waste storage facilities. This proactive approach aims to prevent air pollution and minimize potential damage.

The desired outcome is an automated notification system that promptly identifies the risk of fire in waste storage facilities. This allows environmental agencies to take swift and appropriate measures, such as engaging qualified companies or industries with expertise in waste management. By preventing fires, this solution aims to mitigate air pollution and reduce potential damage associated with such incidents. It is expected to obtain an automated notification system based on the processing data including COPERNICUS data.

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**WASTE FIRES**

**Definition:**
**An uncontrolled fire in a waste storage site**

+/- 77 waste fires/year in the Netherlands

+/- 60 waste fires/year in Sweden

+/- 25 waste fires/year in Austria

**CONTRIBUTING FACTORS**

Type of waste / contamination

Amount of waste

Ambient temperature (variation and level)

Ambient moisture content / rainfall

Wind

On-site remediating factors

**USE CASE**

Prediction of waste fires with AI by combining remote sensing, historical and weather data.

**FORESEEN STEPS**

EXPLORING BOUNDARIES

AGGREGATING DATA

MODEL DEVELOPMENT

TRAINING THE MODEL / ON-SITE VALIDATION

UTILISATION OF PREDICTIONS

IMPLEMENTING NOTIFICATIONS

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Another use case or fire scenario (also for wild/forest fire) relates to identifying, tracing, and tracking the cause (and the culprit) of the fire. It is challenging for law enforcement agencies to trace the individuals responsible for criminal behaviour (e.g., setting fire or dumping substances that cause fire to official waste dumping sites/facilities). In the event that a fire consumes part of a waste dumping site, it is vital to be able to compare the site's condition before and after the fire. This comparison would enable us to determine the amount of waste that was burnt and, consequently, evaluate the environmental damage caused. Additionally, the same technology could be used to establish whether the amount of waste entities dump into the site matches the amount they report officially. Furthermore, there is a lack of effective measures to inform and prevent the cross-border effects. Additionally, the absence of usable data hinders the ability to gather evidence for criminal proceedings.

In this identification, trace and track use case, some foreseen steps are:

1. Conducting a comprehensive assessment of existing monitoring capabilities to identify gaps and potential improvements.
2. Defining the types of substances that are commonly illegally dumped, drawing from previous experiences and specific case studies.
3. Develop a model that uses both existing and new data to compare the amount of waste before and after an incident occurs.
4. Aggregate all data from past waste fire incidents or incidents involving the dumping of more waste than officially reported.
5. Developing appropriate measures to address these incidents.
6. Establishing timely communication channels between environmental agencies, firefighters, and other relevant law enforcement entities to promptly notify them of potential risks and share investigation outcomes.
7. Defining and implementing possible interventions to tackle wild fires and/or at dumping sites to prevent further illegal activities and mitigate damage.
8. Standardizing the reporting and data collection processes, ensuring the admissibility of the gathered information in both civil and criminal courts. This will enable the establishment of responsibilities in accordance with the applicable laws within specific judiciary systems.

The desired outcome is the implementation of an alert system that sends notifications to competent authorities, aiming to prevent the illegal dumping of waste/ illegal activities that could lead to fires in dumping sites and mitigate the risks of cross-border damage. The system would enable us to compare the state of the waste dumping site before and after the fire, determine the amount of burnt waste, and define the extent of environmental damage. Additionally, the system would be able to verify if the amount of waste entities dump into the dumping site is consistent with their official reports. Furthermore, standardized reports and information should be readily available and admissible in civil and criminal proceedings. This will facilitate the establishment of responsibilities in accordance with the applicable laws and regulations within the specific judiciary system.

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## Fires in regional adaptation

- **Fire risks figure prominently in major risk assessments and adaptation strategies in regions across Europe:**
  a) Sustainable urban communities: sharply increasing fire and wildfire risks in virtually every country, strongly amplified by heatwaves and urban heat islands
  b) Energy & utilities: increased risk of landfill fires [e.g. LT]
  c) Agriculture, forestry and other land use: fast-increasing risk of fires [BE,FI-s,IT-n/c,FR,DE,ES,,,]

## Legal texts relevant to the Fire challenge (EU level)

**The EU Waste Framework Directive**

- Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste
- Basic principles include waste management to avoid endangering human health, harming the environment, creating risks for water, air, soil, plants, animals, causing a nuisance through noise or odours
- It is built on a 5-step waste hierarchy: prevention > preparing for re-use > recycling > recovery > disposal
- It sets targets to every EU country
- There is a strong emphasis on circular economy objectives, which is prominently reflected in several national laws
- However, very limited reference is made to fire risks and illegal dumping, and generally to climate dimensions

## Legal texts relevant to the Fire challenge (nat'l level)

**Waste related texts**

- Almost all EU countries have a Law on Waste or on Waste Management
- In a few cases, waste regulations are part of a broader environmental conservation law (France, Greece, the Netherlands)
- In Belgium and in Italy for instance, the waste sector is regulated by a set of more specific texts; in some cases, most of the regulations are at regional level (e.g. Austria)
- General waste regulations tend to be explicit on the categories of waste, specific risks, technical requirements, prevention of pollution; in contrast, they say little or nothing explicit about fire risks, only a few mention illegal dumping, and the link with climate change issues is not mentioned

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# 3. Water resilience challenge

Currently, there is unpredictability in the demand for fresh water, and there is a lack of connection between the supply and demand of fresh water. Regulations exist in each EU Member State that determine the use of water from various sources, such as channels, treated sewage water, and drinking water, and different purposes such as for agriculture. However, there is a lack of a common language among different stakeholders (users involved such water companies, industry, farmers, etc.) involved in the water cycle chain. Additionally, while data is available in certain regions, there is a lack of connectivity between data hubs and repositories.

In this use case, some foreseen steps are:

1. Gaining a comprehensive understanding of the current situation, including existing mechanisms and policies in place.
2. Exploring how drought-related issues regarding water supply and demand are addressed and determining the type of new services needed to support coping with stress situations based on common language.
3. Identifying the relevant responsible public authorities and their intended uses, while also identifying any existing data gaps.
4. Identifying the different users and purposes for the supply of water like in agriculture.
5. Developing a system that combines EO data and utilizes Artificial Intelligence (AI) for modelling purposes. This system should effectively integrate and analyze relevant data to provide actionable insights.
6. Utilizing database-driven solutions to enhance the distribution of water. This involves identifying factors such as saline concentration, pollution levels, substances, algae presence etc., using EO data, to ensure efficient and informed water distribution.
7. Providing accurate information to water authorities regarding who needs to collect water, when and how to distribute it in a treated manner, to meet specific demands and avoid unnecessary discharge of sweet water.
8. Establishing a resilient system where different stakeholders, including water companies, farmers, and industries, collaborate during drought periods. This collaboration should be based on a comprehensive understanding of the water conditions and quality requirements for different purposes. Guidance and decisions from a policy perspective should be achieved to comprehend the consequences and combine relevant data throughout the entire water cycle chain under a unified taxonomy.

The desired outcome is a predictable demand for fresh water. The regulatory landscape and policies should be clearly defined, providing a cohesive framework for water management. The system should be capable of effectively handling stress situations through data-driven decision making and interventions. The supply and demand for sweet water should be interconnected based on diverse needs of users such as farmers, companies, and industries, while also considering the specific

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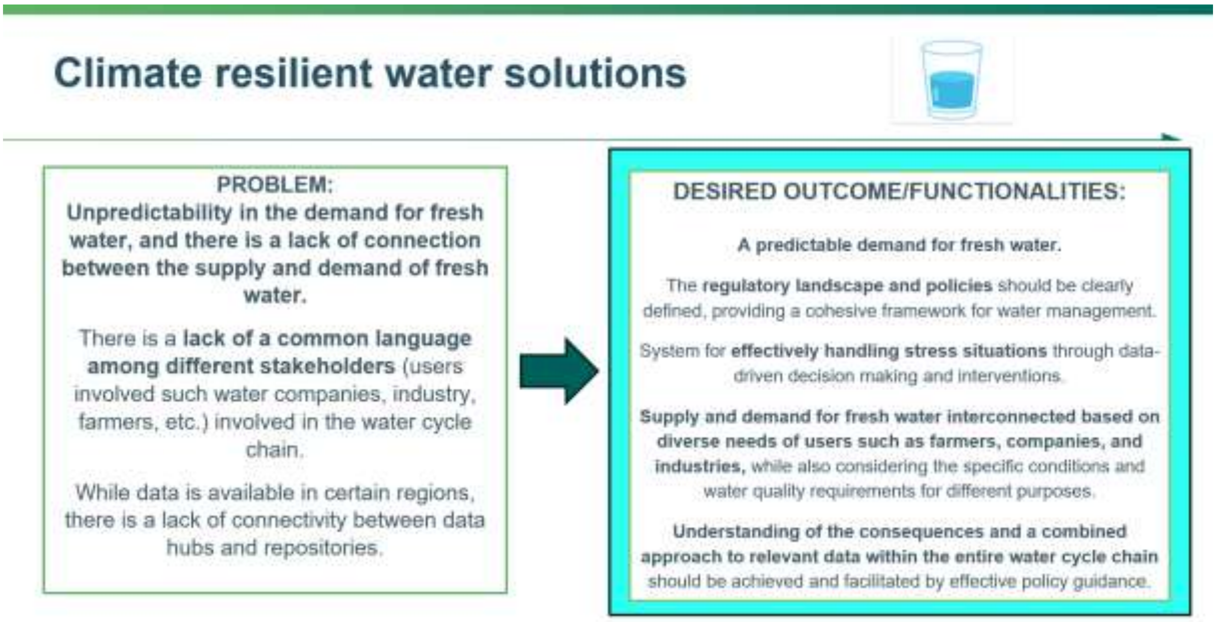
conditions and water quality requirements for different purposes. A comprehensive understanding of the consequences and a combined approach to relevant data within the entire water cycle chain should be achieved and facilitated by effective policy guidance.




**Examples of use for Climate Adaptation**

- Greenhouse gas emission indicators (water management):
- In case of droughts: $CO_2$ emission by peat oxidation (subsidence)
- In case of water excess: $CH_4$ en $N_2O$ emission in anaerobic soil conditions
- Salinization risks (due to increase of drought and seepage pressure by sea level rise)
- Insight in the available sweet water storage in large Lakes like Ijsselmeer (relevant for the Dutch National LCW commission decision support)
- Insight in the amount of local water storage (saturation level) in soils in times extreme climate conditions in management areas (to anticipate timely for local flooding (e.g. Limburg 2021)
- Insight in drought conditions (agriculture & nature), irrigation limitations/ban, etc
- Transition/monitoring of the rural area functions in future (distribution of blue, green grey infrastructure).

The Dutch Waterschapshuis and STOWA national water management information production hub (through its SAT-WATER programme)

**European/national water monitoring resources**

- Monitoring Water Quantity and Quality (regular): https://www.rijkswaterstaat.nl/en/water/water-management
- Monitoring extreme high water & Early warning (crisis): https://www.rijkswaterstaat.nl/en/water/water-management/monitoring/efas
- Main waterway network & maintenance, construction & traffic management (European level): for economic drivers like Transport, Storage, recreation cooperation Netherlands, Germany (Rhine), Belgium (Scheldt): https://www.eurisportal.eu/

**European/national/regional watermanagement resources (https://www.efas.eu/en/monitoring )**

- EFAS collects near real-time water level and river discharge observations to display national/regional threshold exceedances
- European wide, observation-based flood monitoring:
- EU-EO & insitu/model based instrument https://emergency.copernicus.eu/mapping/ems/rapid-mapping-portfolio
- National data on hydrology & meteo & satellite based information: https://www.efas.eu/en/share-your-data-efas
- Dutch examples on national operational EO based information products: e.g. OWASIS (hydrology), WIWB (meteo)
- Gridded meteorological maps (CEMS
- National data on hydrology & meteo & satellite based information: https://www.efas.eu/en/share-your-data-efas
- Dutch examples on national operational information products: e.g. KNMI, WIWB (meteo)
- EFAS provides a number of hydrological monitoring products based on LISFLOOD simulations driven by observed meteorological input
- Soil moisture and snow water equivalent (mostly model based, maps on national initial conditions),
- Dutch examples on national operational EO based information products: e.g. LIBV, soil moisture & OWASIS)

The water challenge needs to be tackle from a regional, national and European perspective, due to the cross-border impact on climate and socio-economics.

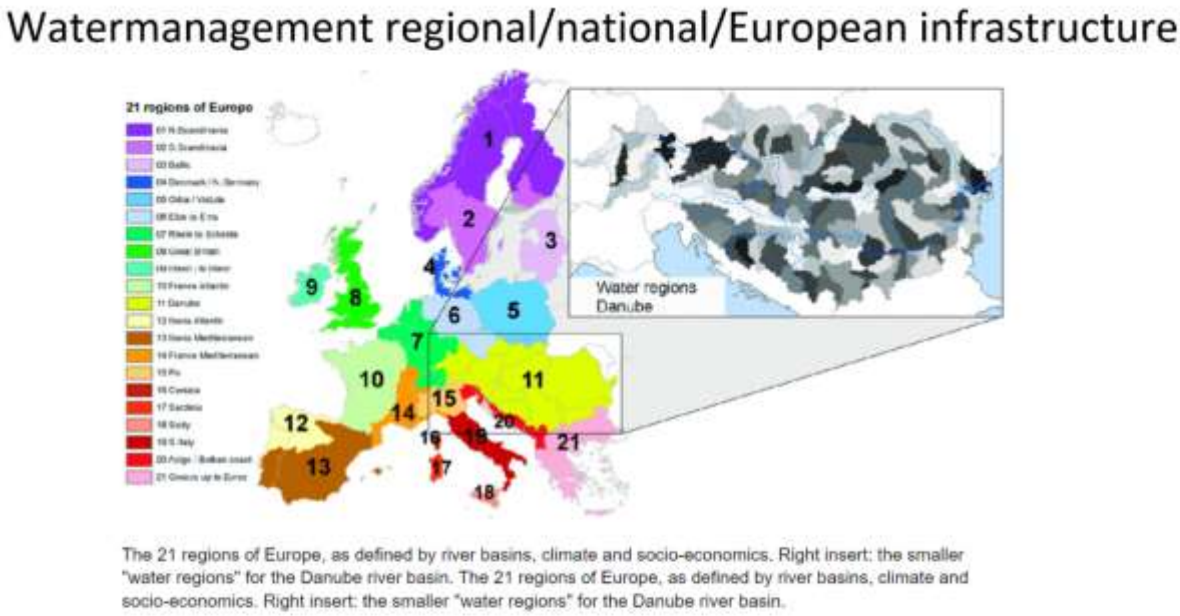



*Figure credit: Hans van Leeuwen, Het Waterschapshuis/Stowa, presentation on 13th September 2023*

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## Water issues in regional adaptation

- **Water quality and availability risks figure prominently in major risk assessments and adaptation strategies in regions across Europe:**
  a) Marine & coastal: Quality degradation of coastal waters [FR], increased saltwater intrusions, salinization, freshwater shortages [FR-w,IT-c,ES,NL], decreased water quality [LT,IT-c], eutrophication of water bodies, damaged ecosystem services (ES-n,IT-c,DE-n]
  b) Sustainable urban communities: Water quality and quantity affecting a.o. energy and utilities [southern Europe, now also concerning BE,NL,DE-s]
  c) Energy & utilities: Increased frequency of droughts and of heatwaves [LT,PL,BE,DE,ES,FR,IT] with consequences on water quality and quantity;
  d) Agriculture, forestry and other land use: More frequent and longer droughts [DE,IT-n,NL,ES], often coupled with water quality and quantity concerns [BE,IT,ES-n,FR,LT], competition for water between urban and agricultural use; threats of lower water recharge and decrease in aquifer levels [FR-se,IT-s,ES,NL], risks on pastures and fodder [PL]; reduced river flows, higher transpiration and water stress [ES,FR]; impacts aggravated as more frequent or abundant irrigation required in agriculture [DE-w,IT-n,ES]

## Legal texts relevant to the Water challenge (EU level)

**The EU Water Framework Directive**

- Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy
- Latest version published in 2014; adaptation to climate change not included in the Directive itself but agreement from Member States in 2009 to integrate it in the 6-year River Basin Management Plans (RBMPs) elaborated under the WFD – *cf.* "River basin management in a changing climate - a Guidance document"
- Each EU Member State is required to use their RBMPs and Programmes of Measures to protect and, where necessary, restore water bodies in order to reach good status (chemical and ecological), and to prevent deterioration
- The Floods Directive is closely coordinated with the Water Framework Directive
- Forging a climate-resilient Europe - the new EU Strategy on Adaptation to Climate Change refers to water (and particularly freshwater) availability and sustainability notably in its section 2.3.4

## Legal texts relevant to the Water challenge (nat'l level)

**Transposing the EU Water Framework Directive**

- The Directive is implemented primarily through the RBMPs
- Some of the RBMPs are transnational (e.g. Danube, Elbe, Oder, Rhine, Sava) and are closely articulated with water policies in the different countries involved
- Each EU Member State is covered by between 1 and 14 RBMPs, managed at national or regional levels; some of the RBMPs ae not literally centred on one river and cover a hydrographic unit or region
- RBMP process includes identification of "significant water management issues" and broad public consultations
- Working Group set up within CIRCABC to support implementation of both the Floods Directive and the Water Framework Directive
- 6-year cycles: 1st cycle 2010-2015, 2nd cycle 2016-2021, 3rd cycle 2021/22-2027

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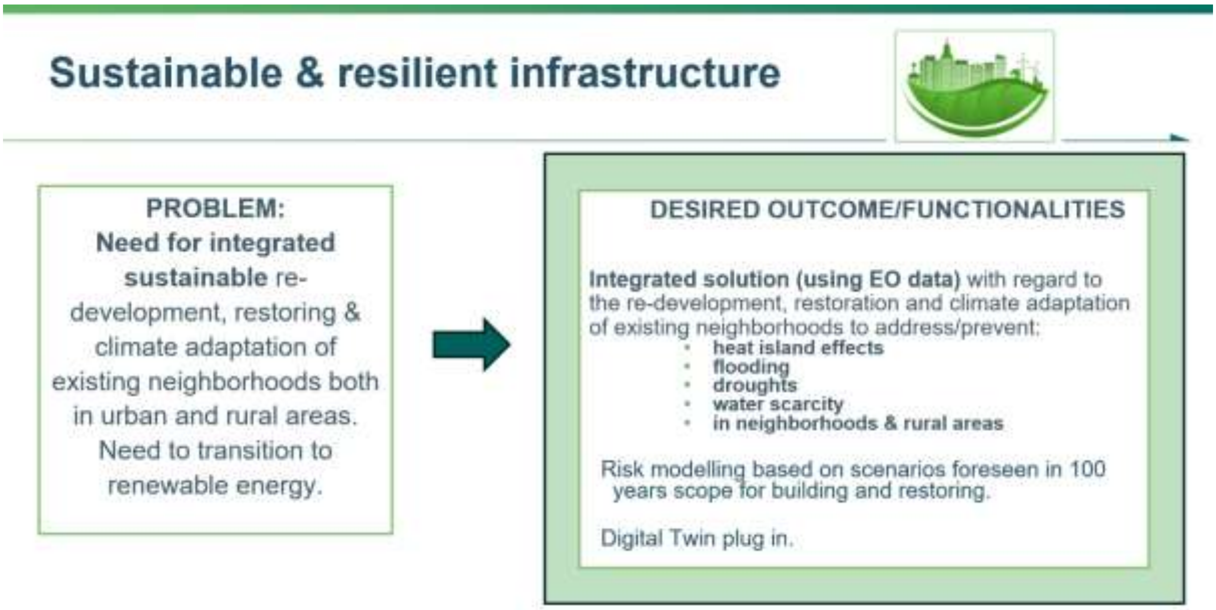
# 4. Sustainable Infrastructure challenge

Currently, there is a need for integrated sustainable re-development, restoring & climate adaptation of existing neighbourhoods both in urban and rural areas.

In this use case, some foreseen actions are:
- Developing an integrated solution (using EO data) with regard to the re-development, restoration and climate adaptation of existing neighbourhoods (including buildings, bridges, roads, etc) to address/prevent/monitor:
  - heat island effects
  - flooding
  - droughts
  - water scarcity
  - Heavy wind/ storm
  - in neighbourhoods & rural areas

- Measuring the effectiveness of climate adaptation measures and applied adaptations and monitoring.
- Calculation of scenarios and risks using different climate effects (such as heat, flooding, drought, storm etc).
- Prediction of risks.
- Developing an integrated climate service that combines possible adaptation measures such as heat island and water scarcity prevention, measures that address flooding and droughts in neighbourhoods & rural areas for modelling purposes and possible scenarios with existing limitations (e.g., narrow streets, protected historical monumental buildings, bridges, water scarcity faced by farmers, etc.) and given other priorities such as green, energy transition, parking.
- Exploring most common limitations, barriers and impossibilities that stand in the way of implementing climate adaptation of the existing infrastructure. Using the outcomes to find an innovative solution given these limitations.

The challenge is to find a solution to climate adaptation for this complex situation (vulnerable urban &/ rural areas with a combination of heat, flooding, water scarcity and droughts) using integrated climate services.




Some use cases are:

- Nature-based solutions (NBS) to tackle flood risks in case of heavy rains, especially surrounding critical infrastructure (e.g. railways, hospitals, energy network etc.).
- Specifically: Finnish buildings largely wooden, massive insulation etc. cannot survive flooding.
- Snow (amount, moisture level) growing challenge
- Heat mitigation with NBS
- Local energy production/energy renovations
- EO for identifying the most critical sites (e.g. urban heat island, areas losing greenery/impervious surfaces) and potential sites for solar etc.
- Urban hydrology after storms/heavy rain
- Early warning/alert systems for authorities/public
- Existing NBS and implementation strategies
- Tools for evaluating impact of NBS/climate change/future urban development/construction to urban heat (effectiveness of adaptation measures)
- Impact/cost evaluation tools for energy renovations (https://helsinginilmastoteot.fi/en/energy/energy-renovation-what-why-and-how/)z
- Advise on how to do a climate adaptation of existing neighborhoods to address water scarcity, heat islands, floods as an integral solution.
- Monitoring of water scarcity, heat islands, floods for existing neighbourhoods.
- Information on renovations to different building stocks (e.g. heritage buildings, old industrial sites etc.).
- How can heat, heavy rainfall and other extreme weather expressions could be used to produce energy.
- Cities need solutions for climate adaptation of existing neighbourhoods and energy transition to renewable sources at the same time.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## Sustainable infrastructure in regional adaptation

- **Risks to sustainable infrastructure figure prominently in major risk assessments and adaptation strategies in regions across Europe:**
  a) Marine & coastal: Flooding risks in almost all coastal regions: sea level rise [Med FR,ES,northern IT,northern DE,PL], marine submersion [North and Baltic seas,ES-n,IT-n,FR-se], extreme rainfall, thunderstorms and gales [PL,ES-n], combinations of those factors [DE-n,ES-n,NL,LT,FR-w]
  b) Sustainable urban communities: Swelling and shrinking soils resulting from hydrogeological instability [IT,FR-s], creating vulnerability for building foundations in urban areas, landslide risks
  c) Energy & utilities: Increased frequency of droughts and of heatwaves [LT,PL,BE,DE,ES,FR,IT] with indirect impacts of water scarcity or hotter waters on e.g. energy production; consequences of ocean acidification on infrastructures [FR-w]; extreme events and longer term processes threatening railways and roads [FR]; coupled issues on water availability / quality and energy production [large cities]

## Elements from EU's Climate Adaptation Strategy relevant to the Sustainable Infrastructure challenge

- Forging a climate-resilient Europe - the new EU Strategy on Adaptation to Climate Change (publ. 24 February, 2021)
- Systemic approach to support the further development and implementation of adaptation strategies and plans at all levels of governance; cross-cutting priorities: integrating adaptation into macro-fiscal policy, nature-based solutions for adaptation, and local adaptation action
- Support implementing nature-based solutions (NBS) on a larger scale, notably blue-green infrastructures, and the development of financial approaches and products that also cover nature-based adaptation
- Support the development of rapid response decision support tools to enrich the toolbox for adaptation practitioners
- Support the integration of climate resilience considerations into the criteria applicable to construction and renovation of buildings and critical infrastructure

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## Sustainable infrastructure – a space for multiple systemic interactions


Credits: Blue Green Solutions / Imperial College London, EIT Climate-KIC

## Legal texts of reference at EU and national levels

- **EU foundational documents:**
  a) EU Floods directive (2007)
  b) EU Waste Framework Directive (2008)
  c) EU Water Framework Directive (2000)
  d) EU Strategy on Adaptation to Climate Change (2021)
- **At national levels:**
  a) Water laws/acts or amendments thereof; flood risk management plans
  b) Laws/acts on waste, waste management
  c) River basin management plans (RBMPs)
  d) National and regional climate adaptation strategies and action plans

**This is also a dynamic process with cycles and multiple iterations**

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# ANNEX 2 – SELECTED WATER CHALLENGE

The Water (management) challenge is underpinned by the fact that climate change has more and more consequences on our water availability and distribution and with that an increasing impact to our daily European life. The European River basins are a result of melting snowpacks of the European mountainous areas (upstream) and local rainwater (along the river basin). Both sources of water are under constant change due to dynamics in (extreme) weather patterns and regressing/decreasing snow areas and glaciers in the mountains. As the main European rivers are sharing their basins/tributaries amongst the various European country borders (Rhine, Danube, Meuse, etc.), it is important to cooperate with each other in terms of managing the sparse fresh water along the whole extent of the basin. A joint European water intelligence is required within the basin area, between the countries (cross border) and between the water management areas/administrations.

The distribution of water along the river basin and the dynamic weather patterns (rain/temperatures/wind) requires a joint water management strategy based on an overall local monitoring of the soil-water-vegetation-atmosphere system. The core is the water balance of this system, which can be actualised locally and spatially by using a day-to-day regular frequent EO-based hydrological modelling validated by local inspections and knowledge of water management authorities. The Copernicus River Basin monitoring system (EFAS) on (supra) national level is a first good guess for the primary river systems in Europe and can provide the boundary conditions and prior general indication for the local situation in local river systems.

For the envisaged development of an integral Water intelligence system (using EO data) as a prerequisite to anticipating extreme climate conditions and their potential impacts on society, the organisation and governance of the future climate change PCP project foresees different groups of users, notably: (a) water management agencies; (b) environmental agencies; (c) first responders; (d) sustainable and resilient cities; (e) agricultural agencies.

In the abovementioned context, the intention is that the PCP project focuses especially on the local regions and their soil-water-vegetation conditions and their local dynamics in water availability for the aforementioned sectors. When local weather conditions lead to extreme (long) drought spells (lack of rain) or high temperature the pressure on the soil-water system will increase with all kinds of consequences and ultimately crises situations. And when weather conditions lead to extreme local (high intensity and/or long lasting) rains the soil-water system cannot cope with and store the abundance of water with impacts to rural and urban infrastructure from runoff, erosion, and inundation. Factors with no physical origin also apply - due to land use, urban sprawling, territorial development patterns, but also usage and behaviors, all factors that do not originate directly in climate change but have a much more critical impact due to climate change and to the partial or downright insufficient awareness of the consequences of such choices in a context of climate change with accelerating consequences.

Across Europe, recent water system imbalances have led to extreme events and localised crises, underscoring the need for proactive crisis anticipation. Water managers in both rural and urban areas must employ common water intelligence garnered from regular monitoring across various scales. By being the first responders equipped with water intelligence, they can develop current spatial risk maps, aiding in crisis prioritization and refining risk reduction strategies.

A unified water taxonomy is essential for monitoring local water balance, crucial in anticipating climate change-induced crises. Leveraging Earth observation-based water balance modelling holds significant potential for managing and mitigating water dynamics' societal impacts. Integration of knowledge and capacity into matured operations, reaching Technology Readiness Level (TRL) 8, stands to benefit water, nature, agriculture, and urban managers alike. Therefore, the PCP procurement strategy mandates comprehensive research and development of solutions, ranging from TRL5 to TRL8, necessitating collaboration among larger and smaller SME consortia. Furthermore, the selection of

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representative use cases and stakeholders across Europe should guide the procurement process, ensuring harmonization in water intelligence standards

The Water (management) challenge wil be addressed on the basis of three main pillars:

- Production/organisation of common operational information products on the local/regional water/soil/climate systems and new needs (R&D developments).
- Interoperability mechanisms between Member State organisations through common procurement mechanisms.
- An active user network for exchange, validation, improvement, update, experience (guided by established European technical partners).

# 1. Impact of the Water challenge

The expected impact of the Water intelligence PCP is linked to the importance of water which is essential for life on Earth. Water is the critical natural resource which underpins all social and economic activity. In the last century, water use grew twice as fast as the world's population, and today water scarcity affects more than 40 percent of the global population (ESA). The dedicated goal on water in UN's 2030 Agenda for Sustainable Development has put the spotlight on water policy at global level and in national planning to avoid an accelerating 'water crisis' towards 2030. A 'water crisis' is ultimately a management crisis that can be solved through the application of sound water management policies and integrated water resource management (IWRM) initiatives. The successful implementation of water polices and IWRM requires access to reliable data and information on key water related challenges. EO data can powerfully contribute to addressing these data needs. This is especially relevant where policies and management decisions should be based on reliable information.

Furthermore, the Taxonomy Regulation, a classification system established by the EU to identify whether or not a given economic activity should be considered "environmentally sustainable", identifies six environmental objectives: (1) climate change mitigation, (2) climate change adaptation, (3) sustainable use and protection of water and marine resources, (4) transition to a circular economy, (5) pollution prevention and control, and (6) protection and restoration of biodiversity and ecosystems. The PCP on Water intelligence has the potential to contribute to the majority of these objectives particularly to climate adaptation and sustainable use and protection of water resources. Climate information can help end-users make climate smart decisions. The climate information can range from seasonal forecasts to long-term projections. It can be combined with other sectoral information (e.g., population distribution, crop distribution, coastal protection) that is relevant for assessing exposure and vulnerability to climate hazard, and may include weather services, which focus on short-term forecasts (e.g., hazardous weather conditions).

According to the Taxonomy Regulation, an economic activity that pursues the environmental objective of climate change adaptation should contribute substantially to reducing or preventing the adverse impact of the current or expected future climate, or the risks of such adverse impact, whether on that activity itself or on people, nature or assets. This environmental objective should be interpreted in accordance with relevant Union law and the Sendai Framework for Disaster Risk Reduction 2015–2030. In this context, the PCP on Water intelligence should include use cases related to risk prevention and management related to floods, fires and impact on infrastructure, taking into account the relevant legal framework..

Moreover, the environmental objective of the sustainable use and protection of water and marine resources, according to the Taxonomy Regulation, should be interpreted in accordance with relevant Union law, including Regulation (EU) No 1380/2013 of the European Parliament and of the Council and Directives 2000/60/EC, 2006/7/EC, 2006/118/EC, 2008/56/EC and 2008/105/EC of the European Parliament and of the Council, Council Directives 91/271/EEC , 91/676/EEC and 98/83/EC and Commission Decision (EU) 2017/848, and with the communications of the Commission of 18 July 2007 on 'Addressing the challenge of water scarcity and droughts in the European Union', of 14 November 2012 on 'A Blueprint to Safeguard Europe's Water Resources' and of 11 March 2019 on 'European

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Union Strategic Approach to Pharmaceuticals in the Environment’. In addition, the Water Framework Directive and the Proposal for a Directive on Soil Monitoring and Resilience (Soil Monitoring Law) will be considered. In this sense, PCP-WISE will consider EU policy and regulations where relevant.

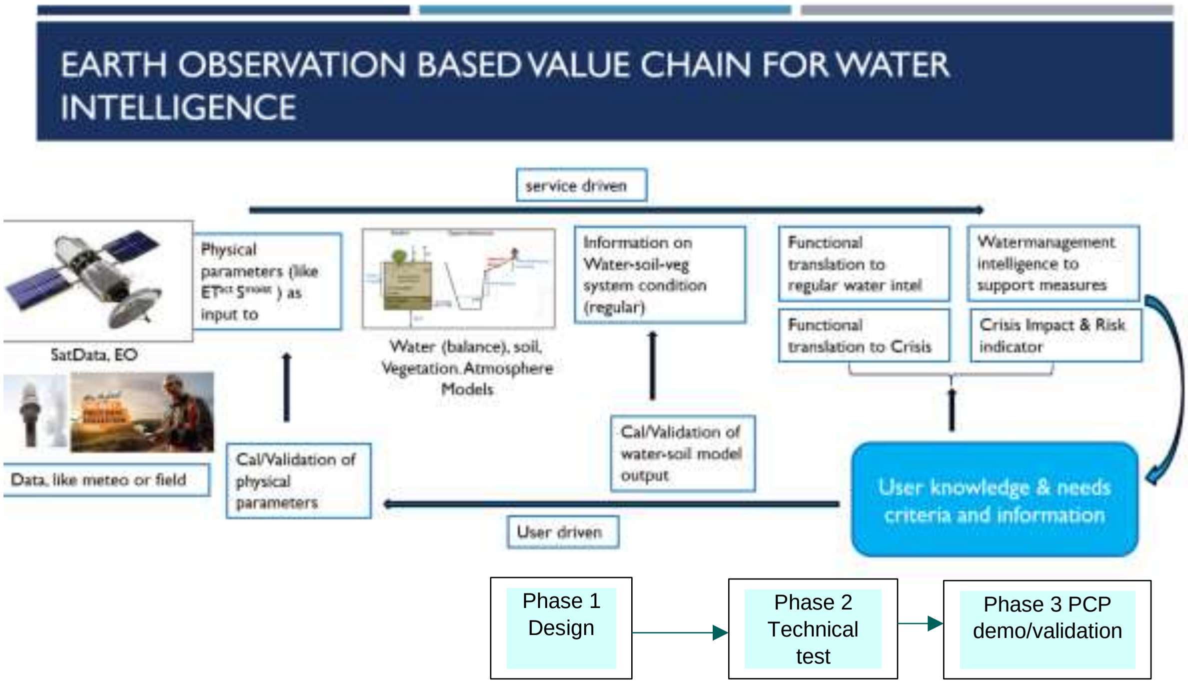


*Figure 13: Value chain for water intelligence and PCP phases*

# 2. Identified use cases

| | Fast Onset Crises | Slow Onset Crises |
|---|---|---|
| **Urban** | Flash Flood Summer 2021 in Ahr Valley, GER | Slow Onset River Flood 2023/24 in Lower Saxony, GER |
| | Wild Fires: Slovakia Bratislava (Local city level | Heat Island/subsidence: Multi Climate change scenarios in existing urban areas (Haarlem city, NL) |
| | Floods: Slovakia Bratislava (Local city level) | Soil saturation: Shallow ground water, Demvig, Denmark |
| | Floods/stormwater: city critical water management, Helsinki | Subsidence: Terrain subsidizing Lemvig Denmark |
| | Coastal flooding: Helsinki | Subsidence: City Infrastructure Rotterdam |
| **Rural** | Flash Flood Summer 2021 in Ahr Valley, GER | Slow Onset River Flood 2023/24 in Lower Saxony, GER |
| | Vegetation and peat fire 2023/24 lower Saxony, GER | Drought Impact Model on Agricultural Production – Catalonia region, Andalusia or other (Spain) |
| | Wild Fires: Slovak Republic (National level), Self-governing regions Banska Bystrica, Zilina (Regional level), Spisska Nova Ves | Drought: Subsidence in rural agricultural grass/peatlands in the water management area of waterauthority HDSR (NL) |
| | Floods: Surface Runoff Flows according to Rule 5.2-IC of the Roads Instruction (Andalusia, Spain) | Wild Fires: Nature area Kalmthoutse Heide (N, Belgium) |
| | FloodsL civil protection initiative for the Mygdonia catchment area (Central Macedonia) | Nature/rural: control ecosystem/residential area on groundwater/greening (in former airport region of Helsinki) |
| | FlashFloodBreaker (Interreg, North-West Europe) with EmschenGenossenschaft(G), Province Limburg (NL) and 'WaterOverlast Programme/Waterveiligheid en Ruimte Limburg' and EMFLoofResilience (Interreg) waterschap Limburg (NL) of cooperation proposal. | |

*Table 6: Identified use cases*

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# ANNEX 3 – SUMMARY OF E-PITCHING

As part of the market analysis, PROTECT carried out e-Pitching sessions on 18 and 19 September 2023. Participants (26 in total) from 8 different countries (France, Lithuania, Germany, Italy, Luxembourg, Finland, Morocco, The Netherlands) presented their solutions and R&D roadmaps. While some of the presented solutions (at TRL 7-9) tackle aspects related to the PROTECT challenges, none of them seem to cover all the functionalities related to a specific challenge. However, the potential of further developments and combination of technologies seem promising for the future PCP challenge, considering the maturity of solutions (at TRL 4-6) and the expected R&D plans.

A summary of the Climate Services presented are as follows:

**Climate Services based on Earth Observation:**

- Measure the environmental benefits provided by nature-based projects
- Added-value products based on Sentinel-1 SAR data
- IoT systems in the state of suspension for sustainable near real-time EO
- Autonomous flying UAV solution for flood prevention
- Measurement of emissions
- Satellite measurement of greenhouse gases
- Urban Data Analytics for urban climate risk and mitigation action - simulation of impact
- Cloud-based precision solar radiation service for clean energy in European cities
- Wild Fire Risk Monitor
- Satellite and Drone Technology for Rapid Observation and Notification of Environmental Threats
- Thermal comfort modelling for more liveable and sustainable cities of tomorrow
- Making Agritech sustainable
- Local early warning system for flooding
- Urban Resiliency Monitor
- Geo Big Data Technology For Diverse Climate Service Product Development
- Safer Places: Global Platform
  AI-based Digital Twin Solution for Flood Risk Intelligence
- Assuring food security by mitigating risk for aquaculture farms using Earth Observation technologies
- Democratisation of Local Climate Awareness
- Measuring temperature to manage water, ecosphere and climate resilience
- Air Pollution & Urban Heat Island mitigation by Urban vegetation
- High-resolution weather data operator and certifier
- Services for flood and coastal risk management
- Ensuring food production through irrigation monitoring

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- Soil Organic Carbon Monitor

**Type of entity (multiple answers are possible)**

| | | Answers | Ratio |
|---|---|---|---|
| Natural person, individual expert, professional | | 0 | 0 % |
| Micro/SME, startup enterprise | | 26 | 100 % |
| R&D institution (public or private) | | 3 | 11.54 % |
| Technology transfer centre (public or private) | | 0 | 0 % |
| Government body or agency | | 0 | 0 % |
| Civil society organisation | | 0 | 0 % |
| University or training centre | | 0 | 0 % |
| Large enterprise | | 0 | 0 % |
| Standardisation body | | 0 | 0 % |
| Other (please specify) | | 0 | 0 % |
| No Answer | | 0 | 0 % |

**Current status of solutions proposed**

| | | Answers | Ratio |
|---|---|---|---|
| Idea (TRL 1-3) | | 2 | 7.69 % |
| Prototype (TRL 4-6) | | 11 | 42.31 % |
| Tested product/service (TRL 7-9) | | 14 | 53.85 % |
| No Answer | | 0 | 0 % |

**Ownership**

| | | Answers | Ratio |
|---|---|---|---|
| 100% of the proposer/presenter | | 21 | 80.77 % |
| Shared with third parties | | 3 | 11.54 % |
| IPR held by third parties | | 2 | 7.69 % |
| No Answer | | 0 | 0 % |

*Table 7: Summary of e-Pitching results*

# ANNEX 3 – SUMMARY OF COTS

| Product Name | Company | Description | Relevance with the use case | TRL (estimated) |
| --- | --- | --- | --- | --- |
| Copernicus Data | Copernicus | At the core of our service is providing access to data and tools related to atmospheric monitoring. We also support our users by providing quality assurance information, and advice on how to use and interpret data. | Is being used by many companies to provide services | 9 |
| SENTINEL-1 Data | CREODIAS | Sentinel-1 is a key component of the European Space Agency's (ESA) Copernicus programme, designed to provide valuable and reliable radar imagery for Earth observation. This radar satellite constellation consists of two identical satellites, Sentinel-1A and Sentinel-1B, working together to enable continuous and all-weather imaging of the Earth's surface.<br><br>Sentinel-1's primary mission is to acquire synthetic aperture radar (SAR) data, offering a unique perspective for monitoring various aspects of the Earth. SAR technology enables imaging of the Earth's surface regardless of weather conditions, daylight, or cloud cover, ensuring the acquisition of critical data under any circumstances. | Is being used by many companies to provide services | 9 |

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| | | | | |
|---|---|---|---|---|
| **Pleiades-1A Satellite Sensor (0.5m)** | Pleiades-1A | AIRBUS Defence & Space Pleiades-1A satellite sensor was successfully launched on December 16, 2011, and provides 0.5m high resolution satellite image data. Watch video of Pleiades-1A satellite launch.<br><br>The Pleiades-1A satellite is capable of providing orthorectified color data at 0.5-meter resolution (roughly comparable to GeoEye-1) and revisiting any point on Earth as it covers a total of 1 million square kilometers (approximately 386,102 square miles) daily. Perhaps most importantly, Pleiades-1A is capable of acquiring high-resolution stereo imagery in just one pass and can accommodate large areas (up to 1,000 km x 1,000 km). | Is being used by many companies to provide services | 9 |
| **Sentinel Hub** | Sentinel Hub | We make satellite data (Sentinels, Landsat and other providers) easily accessible for you to be browsed or analyzed, within our cloud GIS or within your own environment.<br><br>Get satellite imagery on your table without worrying about synchronization issues, storage, processing, de-compression algorithms, meta-data or sensor bands.<br><br>Take a look at our Sentinel Hub brochure for more information. | Is being used by many companies to provide services | 9 |
| **OpenEO Platform** | European Space Agency | openEO platform provides intuitive programming libraries to process a wide variety of earth observation datasets. This large-scale data access and processing is performed on multiple infrastructures, which all support the openEO API. This allows use cases from explorative research to large-scale production of EO-derived maps and information. | Is being used by many companies to provide services | 9 |

*Table 8: Commercial Off-The-Shelf Products*

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# ANNEX 4 – OVERVIEW OF PPI PROCEDURES

The table below shows an overview of the main characteristics of each procedure in the PPI approach.

| Directive 2014/24/EU<br>General overview of the procedures<br>Article 26 | | |
|---|---|---|
| **Preferred procedures** | **Open procedure - Article 27** | Any interested economic operator may submit a tender in response to a call for competition (no “preselection” as in restricted procedure) |
| | **Restricted procedure - Article 28** | **Two staged procedure:**<br>1. Any economic operator may submit a request to participate in response to a call for competition.<br>2. Only those economic operators invited to do so by the Contracting Authority following its assessment of the information provided may submit a tender. |
| **"Exceptional" procedures** | **Competitive procedure with negotiation (negotiated procedure)**<br>**Article 29** | **Two staged procedure:**<br>1. Any economic operator may submit a request to participate in response to a call for competition.<br>2. Only those economic operators invited to do so by the Contracting Authority following its assessment of the information provided may submit a tender.<br><br>The Contracting Authority will identify the subject-matter of the procurement by providing a description of the needs and the characteristics required and indicate which elements are the minimum requirements.<br><br>Unless indicated in tendering document, the Contracting Authority will **negotiate** the initial and all subsequent tenders.<br>• The minimum requirements and award criteria are not subject to negotiations.<br><br>In the negotiations, equal treatment of all tenderers has to be guaranteed.<br><br>Negotiations can take place in successive stages in order to reduce the number of tenders. |
| | **Competitive dialogue - Article 30** | **Two staged procedure:**<br>1. Any economic operator may submit a request to participate in response to a call for competition.<br>2. Only those economic operators invited to do so by the Contracting Authority following its assessment of the information provided may participate in the dialogue. |

| | | |
|---|---|---|
| | | **Best price-quality ratio as only award criteria.**<br><br>The Contracting Authority will define its needs and requirements, as well as the award criteria and an indicative timeframe.<br><br>The Contracting Authority will open a dialogue to identify and define the means to satisfy the defined needs.<br>• **It is possible to discuss all aspects of the procurement with the chosen participants.**<br><br>During the dialogue, equal treatment of all tenderers has to be guaranteed.<br><br>The dialogue can take place in successive stages in order to reduce the number of tenders. |
| | Innovation Partnerships Article 31 | Two staged procedure:<br>1. Any economic operator may submit a request to participate in response to a call for competition.<br>2. Only those economic operators invited by the Contracting Authority following its assessment of the requested information may submit research and innovation projects aimed at meeting the needs identified by the contracting authority that cannot be met by existing solutions.<br><br>The goal is to develop an innovative product, service or works and purchase the results.<br><br>The Contracting Authority will identify the need for an innovative product, service or works **that cannot be met by purchasing products, services or works already available on the market**.<br>• Indicate which elements are minimum requirements.<br>• Include Intellectual Property Rights provisions.<br><br>Innovation partnership can be with one or with several partners and be structured in successive phases following the sequence of steps in the research and innovation process.<br><br>The Contracting Authority will **negotiate** the initial and all subsequent tenders.<br>• The minimum requirements and award criteria are not subject to negotiations. |

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| | | |
|---|---|---|
| | | In the negotiations, equal treatment of all tenderers has to be guaranteed.<br><br>Negotiations can take place in successive stages in order to reduce the number of tenders. |
| | **Negotiated procedure without prior publication**<br><br>**Article 32** | There is an exhaustive list of cases that must be duly justified by the Contracting Authority which wants to follow the procedure. |

*Table 9: Procurement Procedures for Public Procurement of Innovative solutions*

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