'ENVIRONMENT RESEARCH INFRASTRUCTURES INNOVATION ROADMAP'

ENVRINNOV

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D1.1 ENVRI catalogue of services construction & ongoing update

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D1.1	ENVRI catalogue of services construction & ongoing update	CEA	Report	PU	M17

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V0	04/2025	First draft	NA	CEA
V1	25/05/2025	First full draft	Update services and catalogue interface	CEA
V2	03/06/2025	several	Update of services and review comments	CEA, JULICH

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Introduction

The report Milestone 1.1 of ENVRINNOV[1] compiled ENVRI[2] services with an emphasis on services beyond data services (these last ones being already well described in the ENVRI catalogue of services). The compiled services (beyond data) could be regrouped under the following high-level typology of services:

Innovation Services
- Technological
- Expertise

Research services

Training service
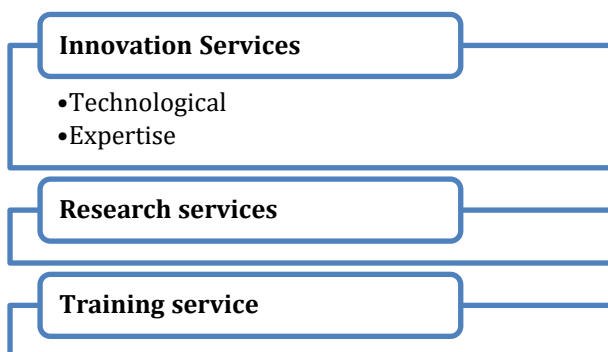
Innovation services

Technological

1. Access to highly specialized environmental (physical, biological, chemical) analyses utilizing unique RI's scientific instrumentation either in the field or in the lab (eg instrumented platforms, simulation chambers, …)
2. Test/validation/calibration/internal certification of technologies against RIs' reference instruments or standards; joint instrument testing
3. Mobile lab quality control platforms
4. Instrument loan service
5. Tool development support: Computation /Visualisation

Expertise

6. Development of new methodologies/protocols for specialized environmental applications.
7. Development of new observation techniques
8. Co design of cutting-edge instrumentation or new innovative research capabilities
9. Expert Consulting
10. Industry interfacing, collaborative research opportunities

Research services

11. Scientific exploitation (e.g. publication) to promote the use of new technologies by RIs and the Scientific community

Training services

12. Training services on demand and specific

In this deliverable 1.1 of ENVRINNOV, we describe the first version of the ENVRINNOV catalogue for **Innovation Services** together with a methodology for a regular monitoring and expanding of the catalogue.

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[1] https://envri.eu/wp-content/uploads/2025/02/MS1.1.-Compilation-of-ENVRI-services.pdf

[2] The current ENVRI Community brings together 26 European Research Infrastructures that are studying different aspects of the Earth system. https://envri.eu/about/

Structure and construction of the catalogue of Innovation Services

The catalogue of ENVRINNOV innovation services can be found under the ENVRI innovation HUB: https://innovation.staging.envri.eu/ at the same level as the Innovation Resources Toolbox and the Innovation Training Programmes (cf Figure 1).

The interface for the Innovation services follows a dash-board style architecture (Figure 2), emphasizing direct access to key information with minimal hierarchical depth. Content is structured across one or two levels only, enabling intuitive exploration without overwhelming the user. This design is based on simplified ergonomics, with few or no dropdown menus, allowing users to quickly reach key resources without navigating through complex structures. Such an approach enhances readability, reduces search time, and improves the overall user experience. To qualify as a service the description contains a service request form or a contact for further information.

The ENVRINNOV catalogue is already part of the ENVRI HUB NEXT Staging environment hosted on a Kubernetes Cluster provided by EGI/LIP.The graphical chart is compatible with the ENVRI-Hub federated, open-access platform. Link towards the ENVRI-Hub is provided on the same menu as the Innovation services. The ENVRI-Hub architecture is modular, scalable, and open-source, enabling seamless integration of domain-specific systems while preserving their unique structures. The Hub employs semantic web technologies, ontologies, and linked open data to facilitate interoperability. This design supports the development of higher-level services and ensures compatibility with the European Open Science Cloud (EOSC) by incorporating components like Authentication and Authorization Infrastructure (AAI), data storage solutions, and other service catalogues.

Figure 1: Screen shot ENVI Innovation HUB, https://innovation.staging.envri.eu/
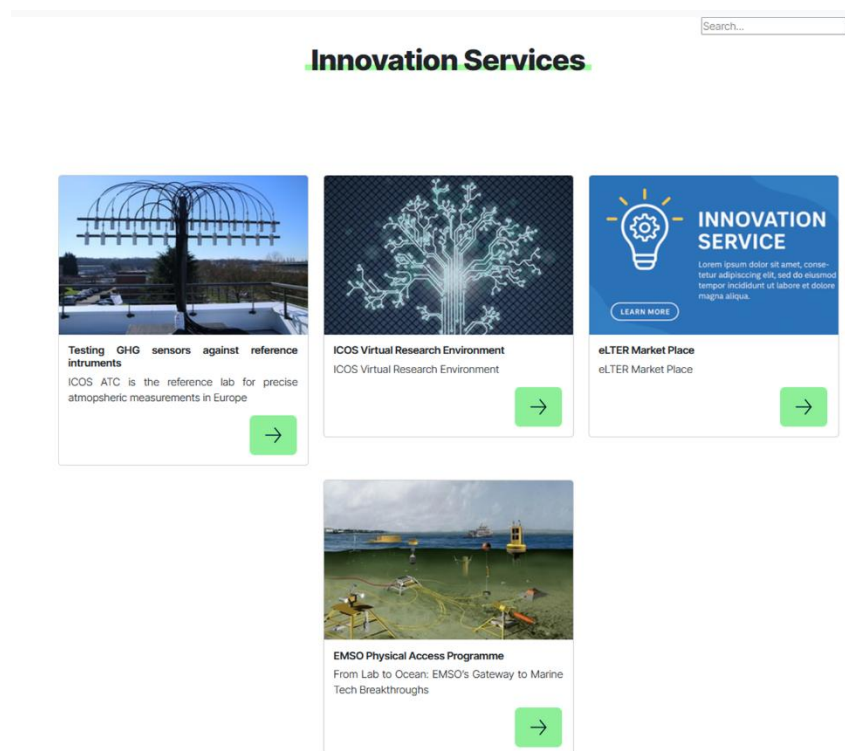
Figure 2: screenshot Innovation Services page v0

The innovation services are presented in the catalogue under a common template with the following items:

1. Service title
2. Description of the service
3. Description of the infrastructure/lab providing the service + a link to the infrastructure/lab's website
4. Link to the service request form
5. Past feedback: a "user success story" related to the service

The figure below is, as an example, a screen shot of the page for the "Testing GHG sensors against reference instruments" service; further described below.
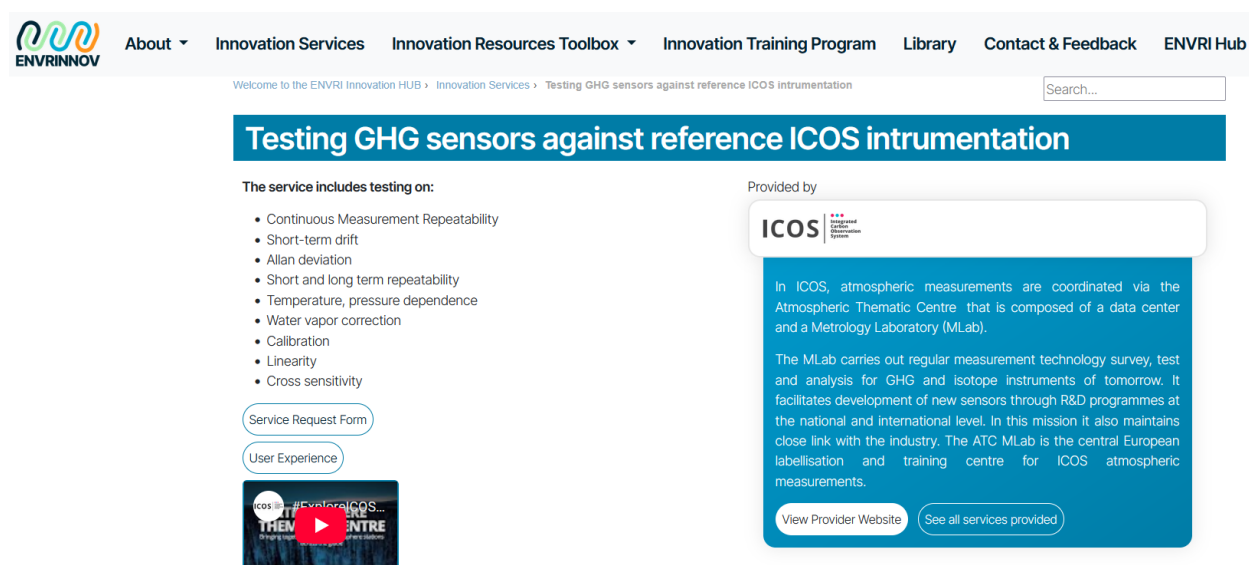
Description of the Innovation services of the first version of the ENVRINNOV catalogue

A first list of innovation services from the ENVRI Research Infrastructure (RI) was obtained by soliciting innovation contact points in the RIs. The services had to be in operation with already some positive user feedback.

The innovation service list is given below and the services are further described after that.

1. Testing GHG sensors against reference instruments
2. From Lab to Ocean: EMSO's Gateway to Marine Tech Breakthroughs
3. eLTER Market Place
4. ICOS Virtual research Environment
5. Evaluating mobile photometers an aerosol lidars
6. Virtual Access to visualization & analysis tools

Testing GHG sensors against reference instruments

- **Description of the service**

The service includes testing on:

- Continuous Measurement Repeatability
- Short-term drift
- Allan deviation
- Short and long term repeatability
- Temperature, pressure dependence
- Water vapor correction
- Calibration
- Linearity
- Cross sensitivity

- **Description of the infrastructure/lab providing the service + a link to the infrastructure/lab's website**

Service provided by ICOS ATC

In ICOS, atmospheric measurements are coordinated via the Atmospheric Thematic Centre (ATC) that is composed of a data center and a Metrology Laboratory (MLab).

The MLab carries out regular measurement technology survey, test and analysis for GHG and isotope instruments of tomorrow. It facilitates development of new sensors through R&D programmes at the national and international level. In this mission it also maintains close link with the industry. The ATC MLab is the central European labellisation and training centre for ICOS atmospheric measurements.

https://icos-atc.lsce.ipsl.fr/

- **link to the service request form**

https://forms.lsce.ipsl.fr/index.php/893423?lang=en

- **Past feedback: a "user success story" related to the service**

https://forms.lsce.ipsl.fr/index.php/893423?lang=en

From Lab to Ocean: EMSO's Gateway to Marine Tech Breakthroughs

- **Description of the service**

    EMSO Physical Access - Service Overview (https://emso.eu/physical-access/)

Purpose: Provides researchers and engineers with access to EMSO's Regional Facilities to deploy and test marine equipment, sensors, and technologies in real-world ocean conditions.
Facilities: In 2025, six Regional Facilities are available - four in the Mediterranean Sea and two in the Atlantic Ocean.
Support: Offers technical assistance, training, and co-development opportunities with experienced facility staff.
Funding: Each project can receive up to €15,000, covering operations, travel, shipping, and consumables, with a total of €90,000 allocated for 2025.
Application Process: Proposals are evaluated bi-monthly, with six cut-off dates throughout the year.

- **Description of the infrastructure**

Infrastructure Highlight - SmartBay Test Site

Location: Galway Bay, Ireland (53°14' N, 9°16' W), at a depth of 25 meters.
Description: SmartBay is Ireland's national marine test site and observatory, offering continuous oceanographic and environmental data in near-real time.
Capabilities: Supports remote sensor hosting and provides real-time data access for various marine research and technology development projects.
Website: www.smartbay.ie

- **Accessing the service**

- **Step 1**: Submit a Letter of Intent outlining your project idea.
- **Step 2**: Collaborate with the chosen Facility manager to prepare a detailed Project Proposal.
- **Step 3**: Send the finalized proposal in PDF format to: physical-access@emso-eu.org
- **Evaluation**: Proposals are reviewed every two months, with decisions communicated accordingly.
- **More Information**: Detailed application steps and rules are available on the EMSO Physical Access page.

- **Past feedback: a "user success story" related to the service**

User Success Story – Seagrass Blue Project

A groundbreaking project, **Seagrass Blue**, granted by **EMSO ERIC** within the **Physical Access Program**, aims to revolutionise seagrass restoration efforts for carbon removal and biodiversity enhancement to better face the ocean global challenges.

"This innovative approach holds great promise for the scientific community. Its applications span a wide range of restoration and aquaculture research initiatives, aimed at overcoming the limitations and costs of current restoration techniques. The integration of autonomous underwater robots for thorough monitoring introduces a trailblazing method of environmental stewardship", explained Chris Lewis, Chief Operating Officer of Seagrass Blue. (Link to the full news [here](#))

eLTER Market Place

- **Service title**

eLTER Market Place

Link: https://elter-ri.eu/elter-market-place

- **Description of the service**

The eLTER Market Place connects researchers looking for data with eLTER Site and Platform Coordinators who can offer a wealth of long-term observation data from their Sites and Platforms.
It enables and promotes pan-European and/or habitat-specific research, new research collaborations, and contributions to national and European research projects.
The eLTER Market Place enables researcher looking for long-term observational data from all over Europe, to reach hundreds of eLTER Sites and Platforms at once.
The eLTER Market Place lists data and project calls as well as other opportunities for project contributions that may be of interest to eLTER Site and Platform Coordinators

- **Description of the infrastructure/lab providing the service + a link to the infrastructure/lab's website**

eLTER provides researchers with access to approximately 250 research Sites and socio-ecological Platforms across Europe and biogeographical regions, establishing and offering harmonised and standardised data, services and training useful to citizens and experts in their joint efforts to find sustainable solutions to the Grand Societal Challenges.

Link: https://elter-ri.eu/

- **link to the service request form**

    https://elter-ri.eu/storage/app/media/media-center/eLTER%20Market%20Place_Template%20for%20providing%20data%20requests.docx

ICOS Virtual research Environment

- **Service title**

ICOS Virtual research Environment

- **Description of the service**

Collection of tools for interactive computing and sharing of computational ideas. In ICOS, Jupyter is utilised in multiple ways. It serves as a collaboration platform between researchers and scientists working with ICOS data sets and as information platform for policy makers and the public. Finally, Jupyter functions as an educational platform for explaining complex climate-related environmental processes based on ICOS data sets.

- **Description of the infrastructure/lab providing the service + a link to the infrastructure/lab's website**

The ICOS Carbon Portal is the centralized data hub of the Integrated Carbon Observation System (ICOS), providing free access to standardized, high-quality greenhouse gas data across Europe. It serves as a comprehensive platform for researchers, policymakers, and the public to explore data on atmospheric composition, carbon fluxes, and ecosystem interactions. The portal ensures data security, enforces ICOS data policies, and offers user-friendly interfaces for data discovery and access. It also supports long-term data archiving to guarantee future access and easy re-use. The portal is co-hosted by Lund University in Sweden and Wageningen University in the Netherland

https://www.icos-cp.eu/observations/carbon-portal

- **link to the service request form**

https://www.icos-cp.eu/data-services/tools/jupyter-notebook/exploredata-password

- **Past feedback: a "user success story" related to the service**
A key to open science: How Jupyter Notebooks bring ICOS data closer to scientists, students and the general public

https://www.icos-cp.eu/science-and-impact/science-contribution/success-stories/jupyter-notebooks

Evaluating mobile photometers and aerosol lidars

- **Service title**

Evaluating mobile photometers and aerosol lidars

- **Description of the service**

Develop and validate algorithms for innovative mobile photometers and aerosol lidars. Obtain R&D funding for innovative instrumentation and validation campaigns and ensure scientific valorisation of innovations in instruments and data processing.

- **Description of the infrastructure/lab providing the service + a link to the infrastructure/lab's website**

The ATOLL platform has advanced technologies enabling the monitoring of aerosol-cloud-gas composition and atmospheric variability from the ground to the stratosphere. Managed by the LOA, the platform operates two National Observation Services (PHOTONS-AERONET/EARLINET for aerosols

and NDACC-UV for UV radiation) as part of ACTRIS-France. It collaborates with institutions like IMT Nord Europe for in situ aerosol/gas measurements. The platform's photometry and Lidar activities are integrated into ACTRIS-EU's Central Facility CARS and labeled by the University of Lille, with ATOLL officially connected to ACTRIS-EU as a French National Facility for aerosol observations.

http://www-loa.univ-lille.fr/observations/plateformes.html?p=lille

- **link to the service request form**

Contact : Philippe Goloub

- **Past feedback: a "user success story" related to the service**

CIMEL and LOA collaborated within the AGORA-Lab Common Laboratory, using the ATOLL platform to develop and evaluate a new High Power Lidar (CIMEL CE710).

Virtual Access to visualization & analysis tools

- **Description of the service**

1- Footprint analysis tool for Carbon Monoxide anomalies: This model tool allows interpretation of all the CO measurement data recorded from equipped aircraft. The IAGOS products are already produced. You can select a date and visualize the footprint and source contributions (either anthropogenic or biomass burning from 14 defined regions over the world) throughout the vertical profile in the troposphere.

2- Time series analysis: This tool is meant to identify, select and combine data more effectively from ACTRIS, ICOS and IAGOS, including data coverage, colocation of data and visualisation of data along with basic statistics such as linear trends.

3- Climatologies and Anomalies of reactive gases: This tool allows the visualization of IAGOS data in terms of long-term average and monthly or seasonal anomalies over the visited airports.

4- Visualization tool for all (vertical profiles and cruise altitude) IAGOS data compared to the different versions of CAMS regional and global models.

- **Description of the infrastructure/lab providing the service + a link to the infrastructure/lab's website**

The IAGOS data center is the central data portal providing free and open access to standardized high quality IAGOS data (reactive and greenhouse gases, clouds and particles recorded by equipped aircraft between 0 and 12 km altitude) and elaborated products. The portal is hosted by CNRS in the frame of the Data Terra (AERIS component), French research infrastructure for an integrated observation of the Earth System and the environment. The portal ensures data security, enforces IAGOS data policies, and offers user-friendly interfaces for data discovery and access. It also supports long-term data archiving to guarantee future access and easy re-use. Data products are co-developed by the Laboratoire d'Aérologie in Toulouse.

1&2 are accessible via https://www.atmo-access.eu/virtual-access/#/
3 is accessible via https://services.iagos-data.fr/iriscc/anomalies
4 is accessible via https://www.iagos.org/products/

- **link to the service request form**

Services are free and open, no forms to fill. Access only requires a registration with valid email address. Users can address further requests to the following email address: info@iagos.org

- **Past feedback: a "user success story" related to the service**

Carlos Ordonnez, Professor at University of Madrid uses the different applications for elaborating classes and tutorial projects for undergraduate students. In particular, the timeseries analysis allows a wide range of investigations for Air quality examples.

The most recently available "anomalies service" provides diagnostics and statistics for a better understanding of the long time series, offering the possibility of the creation of a "tailored data set for ESM evaluation/improvement", and giving the broader context of dedicated campaigns or experiments. The service contributes to the characterization of the slow on-set processes over several decades, globally. Users can easily identify anomalies for all IAGOS measured species.

A Methodology for the continuous analysis and on-going updating of the catalogue of innovation services

To ensure the innovation service catalogue remains up-to-date and aligned with user needs, we propose a structured methodology comprising five key phases:

1. Stakeholder Engagement and Needs Assessment

Objective: Continuously gather input from users and stakeholders to identify gaps, refine offerings, and ensure relevance.

Steps:

1. **Identify Stakeholders**: Include researchers, industry users, research infrastructure managers, and policy-makers.
2. **User Feedback Mechanisms**:
   - Implement a feedback form on the e-catalogue interface for real-time suggestions.
   - Conduct regular surveys and interviews with users.
3. **Focus Groups**: Organize periodic workshops with representatives from key user groups to validate updates and identify emerging needs.
4. **Advisory Board**: Establish a multidisciplinary advisory board to guide updates based on sector trends and technological advancements.

2. Service Collection and Integration

Objective: Maintain a comprehensive and accurate inventory of services.

Steps:

1. **Service Provider Updates**:

- o Develop a standardized template for service providers to submit new offerings or updates to existing ones.
  - o Require periodic reporting (e.g., biannual) from service providers.
2. **Integration with Existing Databases**: Sync with databases maintained by related projects and European networks.
3. **Automated Data Validation**: Use automated tools to identify outdated information (e.g., broken links, inactive services).

3. Technical Infrastructure for Updates

Objective: Streamline the update process using technology.

Steps:

1. **Content Management System (CMS)**: Implement a robust CMS to enable real-time updates by authorized personnel.
2. **API Integration**: Facilitate data exchange with other relevant platforms to pull and push updates dynamically.
3. **User Authentication for Providers**: Allow service providers to log in, update their information, and track service metrics through a dashboard.

4. Communication and Promotion

Objective: Ensure stakeholders are aware of updates and can benefit from new services.

Steps:

1. **Update Notifications**: Notify registered users of significant updates via email or platform notifications.
2. **Training and Webinars**: Host sessions to educate users on newly added services or features.
3. **Social Media and Newsletters**: Promote new services via ENVRI's communication channels.

5. Monitoring, Evaluation, and Continuous Improvement

Objective: Evaluate the effectiveness of updates and refine the process based on findings.

Steps:

1. **Effectiveness Metrics**:
   - o **Relevance**: Percentage of users reporting satisfaction with available services.
   - o **Usage**: Number of services offered across key innovation domains.
   - o **Timeliness**: Average time taken to incorporate new services or update existing ones.
2. **User Analytics**: Use analytics tools to track user behavior and identify high-demand services.
3. **Annual Review**: Conduct an annual review of services, user feedback, and metrics to identify areas for improvement.
4. **Benchmarking**: Compare the catalogue against similar international initiatives to ensure competitiveness.

To effectively monitor the quantity and quality of services delivered through the ENVRI-Hub, we here propose four metrics to be evaluated on a yearly basis.

1. Service Availability
Measure the uptime of each service. Ensures reliability for users accessing services.

2. Response Time
Evaluate the average response time for accessing the service

3. User Engagement

Track the number of users accessing services.

4. Feedback and Satisfaction

Collect user feedback on service quality. Implement feedback mechanisms and address concerns; Ensure continuous improvement of services; Conduct surveys bi-annually.

Linking to the ENVRI catalogue of services

The information in the innovation catalogue will be integrated to the ENVRI HUB Next Catalogue of Services (COS). The integration will be achieved through the adoption of the DCAT-EPOS metadata profile used in COS (cf table below). This ensures semantic interoperability, discoverability, and alignment with FAIR principles across research infrastructures.

Label	DCAT Field	Description
Title	dct:title	The name or title of the dataset or service.
Text	dct:description	A textual description of the dataset or service.
Picture	foaf:depiction / foaf:logo	An image or logo representing the dataset, service, or provider.
Location	dct:spatial	The geographic area covered by the dataset or service.
Website	foaf:homepage / dcat:landingPage	The official website or landing page for the dataset or service.
Example of use (video)	dcat:distribution + dcat:accessURL + dcat:mediaType	A video or other media showing an example of how the service is used.
Application of service	dct:description / dcat:theme / dcat:keyword	Explanation of how the service is applied or used.
Logo	foaf:logo	A logo image representing the service or provider.
Expertise	dcat:theme / dcat:keyword / dct:subject	The domain expertise or subject area of the service.
Domain	dcat:theme	The thematic domain or category of the dataset or service.
Technology	dct:conformsTo / dcat:mediaType / dct:format	Technologies or standards used by the service.
Service description	dct:description	Detailed description of the service.
Service documentation	dct:references / dcat:documentation	Links to technical or user documentation.
Service provider	dct:publisher / foaf:Agent	The organization or person providing the service.
Data provider	dct:creator / dct:source	The source or creator of the data.
Temporal coverage	dct:temporal	The time period covered by the dataset or service.
Resource type	dct:type	The type of resource (e.g., Dataset, DataService).
Endpoint	dcat:endpointURL / dcat:endpointDescription	The technical access point (e.g., API endpoint).
Frequency update	dct:accrualPeriodicity	How often the dataset or service is updated.
License	dct:license	The license under which the data or service is provided.
Service parameters	dcat:servesDataset / dct:description	Parameters or inputs required by the service.
Service type	dct:type / dcat:DataService	The kind of service (e.g., WMS, REST API).
Service domain	dcat:theme / dct:subject	The scientific or thematic domain of the service.

Each service innovation entry will be described using these DCAT-EPOS fields.

The integration of the ENVRINNOV Innovation Catalog into the ENVRI-Hub NEXT Catalogue of Services (CoS) represents a strategic step toward enhancing service discoverability and reuse. This integration is guided by the DCAT-EPOS metadata profile, which ensures semantic alignment and compliance with FAIR data principles.

The integration process begins with ENVRINNOV conducting a comprehensive audit of its existing metadata. This involves reviewing all catalogued fields and aligning them with the DCAT-EPOS standard. Where necessary, metadata is enriched to include missing elements such as licensing information, temporal coverage, and access endpoints. Visual and multimedia components, including logos and example videos, are also incorporated to enhance the user experience.

Once the metadata is complete, it is converted into DCAT-compliant formats such as RDF/XML or JSON-LD. These records are then validated using established DCAT-AP/EPOS tools to ensure quality and interoperability. ENVRINNOV also develops an export interface or API to provide machine-readable access to the catalog. Accompanying this technical infrastructure is a set of documentation that describes the service parameters and provides guidance for integration.

On the ENVRI-Hub NEXT side, the CoS must be equipped to ingest external metadata that conforms to the DCAT-EPOS profile. This includes registering ENVRINNOV's metadata endpoint or importing static metadata files. To ensure semantic consistency, ENVRI-Hub NEXT aligns ENVRINNOV's themes, keywords, and domains with its own controlled vocabularies. Automated quality assurance checks are performed to verify the completeness and consistency of the metadata.

The integrated services are then incorporated into the ENVRI-Hub NEXT user interface, where they are presented with appropriate visual and descriptive elements. A feedback mechanism is established to facilitate communication between the two infrastructures, allowing for the resolution of metadata issues and the continuous improvement of the integration.

In addition to these individual responsibilities, both ENVRINNOV and ENVRI-Hub NEXT engage in joint actions to ensure the sustainability and effectiveness of the integration. A metadata governance agreement is established to define roles, responsibilities, and update cycles. Versioning and synchronization protocols are agreed upon to manage metadata updates. Finally, interoperability testing is conducted collaboratively to validate the integration and ensure that services are seamlessly discoverable and usable across the ENVRI-Hub ecosystem.

Example test ttl file for the ICOS service of Virtual Research Environment

```
@prefix dct: <http://purl.org/dc/terms/> .
@prefix dcat: <http://www.w3.org/ns/dcat#> .
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
@prefix ex: <http://example.org/> .

ex:ICOSVirtualResearchEnvironment a dcat:DataService ;
    dct:title "ICOS Virtual Research Environment"@en ;
```

```
    dct:description "Collection of tools for interactive computing and
sharing of computational ideas. In ICOS, Jupyter is utilised in
multiple ways. It serves as a collaboration platform between
researchers and scientists working with ICOS data sets and as
information platform for policy makers and the public. Finally,
Jupyter functions as an educational platform for explaining complex
climate-related environmental processes based on ICOS data sets."@en ;
    foaf:depiction <http://example.org/images/service.png> ;
    dct:spatial <http://sws.geonames.org/6255148/> ;  # Europe in
GeoNames
    foaf:homepage <https://www.icos-cp.eu/observations/carbon-portal>
;
    dcat:landingPage <https://www.icos-cp.eu/data-
services/tools/jupyter-notebook/exploredata-password> ;
    dcat:distribution <https://www.icos-cp.eu/science-and-
impact/science-contribution/success-stories/jupyter-notebooks> ;
    dcat:mediaType "video/mp4" ;
    dct:conformsTo <http://example.org/standards/OGC-WMS> ;
    dct:references <http://example.org/docs/service-doc.pdf> ;
    dct:publisher [ a foaf:Agent ; foaf:name "ICOS Carbon Portal" ;
foaf:homepage <https://www.icos-cp.eu/> ] ;
    dct:creator [ a foaf:Agent ; foaf:name "Lund University" ;
foaf:homepage <https://www.lu.se/> ] ;
    dct:creator [ a foaf:Agent ; foaf:name "Wageningen University" ;
foaf:homepage <https://www.wur.nl/> ] ;
    dct:temporal "2023-01-01/2023-12-31" ;
    dct:type <http://purl.org/dc/dcmitype/Dataset> ;
    dcat:endpointURL <http://example.org/api/endpoint> ;
    dct:accrualPeriodicity <http://purl.org/dc/terms/monthly> ;
    dct:license <https://creativecommons.org/licenses/by/4.0/> ;
    dcat:servesDataset <http://example.org/datasets/parameters> ;
    dcat:theme <http://eurovoc.europa.eu/100277> ;  # Climate change
    dct:subject "Climate Services" ;
    dcat:keyword "innovation", "climate", "data service" .
```