D3.1
A strategic action plan for enhancing uptake of ENVRI data by the private sector

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Deliverable abstract

The action plan is developed to address private sector clients/users of ENVRI services by defining and implementing strategies for strengthening RI innovation-cooperation awareness and preparedness and promoting industry uptake of ENVRI services in compliance with FAIR standards.

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DELIVERY SLIP

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DOCUMENT AMENDMENT PROCEDURE

Amendments, comments and suggestions should be sent to the Project Manager at manager@envri-fair.eu.

GLOSSARY

A relevant project glossary is included in Appendix A. The latest version of the master list of the glossary is available at http://doi.org/10.5281/zenodo.4471374.

PROJECT SUMMARY

ENVRI-FAIR is the connection of the ESFRI Cluster of Environmental Research Infrastructures (ENVRI) to the European Open Science Cloud (EOSC). Participating research infrastructures (RI) of the environmental domain cover the subdomains Atmosphere, Marine, Solid Earth and Biodiversity / Ecosystems and thus the Earth system in its full complexity.

The overarching goal is that at the end of the proposed project, all participating RIs have built a set of FAIR data services which enhances the efficiency and productivity of researchers, supports innovation, enables data- and knowledge-based decisions and connects the ENVRI Cluster to the EOSC.

This goal is reached by: (1) well defined community policies and standards on all steps of the data life cycle, aligned with the wider European policies, as well as with international developments; (2) each participating RI will have sustainable, transparent and auditable data services, for each step of data life cycle, compliant to the FAIR principles. (3) the focus of the proposed work is put on the implementation of prototypes for testing pre-production services at each RI; the catalogue of prepared services is defined for each RI independently, depending on the maturity of the involved RIs; (4) the complete set of thematic data services and tools provided by the ENVRI cluster is exposed under the EOSC catalogue of services.

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1 Introduction

Research Infrastructures (RIs) of the Environment Domain, as defined by ESFRI, cover the main four subdomains of the complex Earth system (Atmosphere, Marine, Solid Earth, and Biodiversity/Terrestrial Ecosystems), and form the Science Cluster of European Environmental and Earth System Research Infrastructures (ENVRIs). ENVRIs are key providers of high-quality environmental research data and services in Europe, collected from distributed in-situ observing systems.

Thirteen ENVRIs[1] are involved in the ENVRI-FAIR (ENVironmental Research Infrastructures building FAIR services Accessible for Society, Innovation and Research) project promoting the development of a set of FAIR data services for each of the RI participating in the project, which enhances the efficiency and productivity of researchers, supports innovation, enables data- and knowledge-based decisions and connects the ENVRI Cluster to the European Open Science Cloud (EOSC). The data services and products developed by ENVRIs are targeting mainly the scientific communities and stakeholders at regional, national and international scales. However, the project is considered as strategic to engage specific collaborative actions with the private sector to enhance the uptake of ENVRI data services. Ensuring that the products and services have the collaborative potential for policies and effective innovation actions is the goal of ENVRI-FAIR Task 3.4.

During the course of the project, two main initiatives were pushed forward and served as the basis for this report. The first one was the organisation of a workshop in November 2021 bringing together research infrastructures and private sector representatives to discuss how to better exploit the innovation potential of ENVRIs (ENVRI-FAIR MS8). The second initiative was the creation of a dedicated catalogue of services developed in the frame of ENVRI-FAIR to address the needs of the ENVRI private sector clients/users. This will be achieved by developing and implementing strategies to strengthen the RI innovation-cooperation awareness and preparedness and by promoting industry uptake of ENVRI services in compliance with FAIR standards (ENVRI-FAIR D3.5).

The work related to this specific catalogue and its integration in the ENVRI-Hub will be detailed in section 2.1 of this report. The most relevant initiatives and projects which could foster private sector engagement with ENVRIs are exposed in section 2.2. This leads to the development of the Strategic action plan for enhancing the uptake of ENVRI data section 3.

2 State of the art

2.1 Previous ENVRI projects outcomes

a. The ENVRIplus deliverable D1.1

The ENVRIplus project was funded under H2020 and lasted over 51 months with a very large number of activities, workshops, internal and external consultations, and the creation of new tools and services mainly for the benefit of the participating Research Infrastructures.

[1] Research Infrastructures – ENVRI-FAIR – ENVRI Community

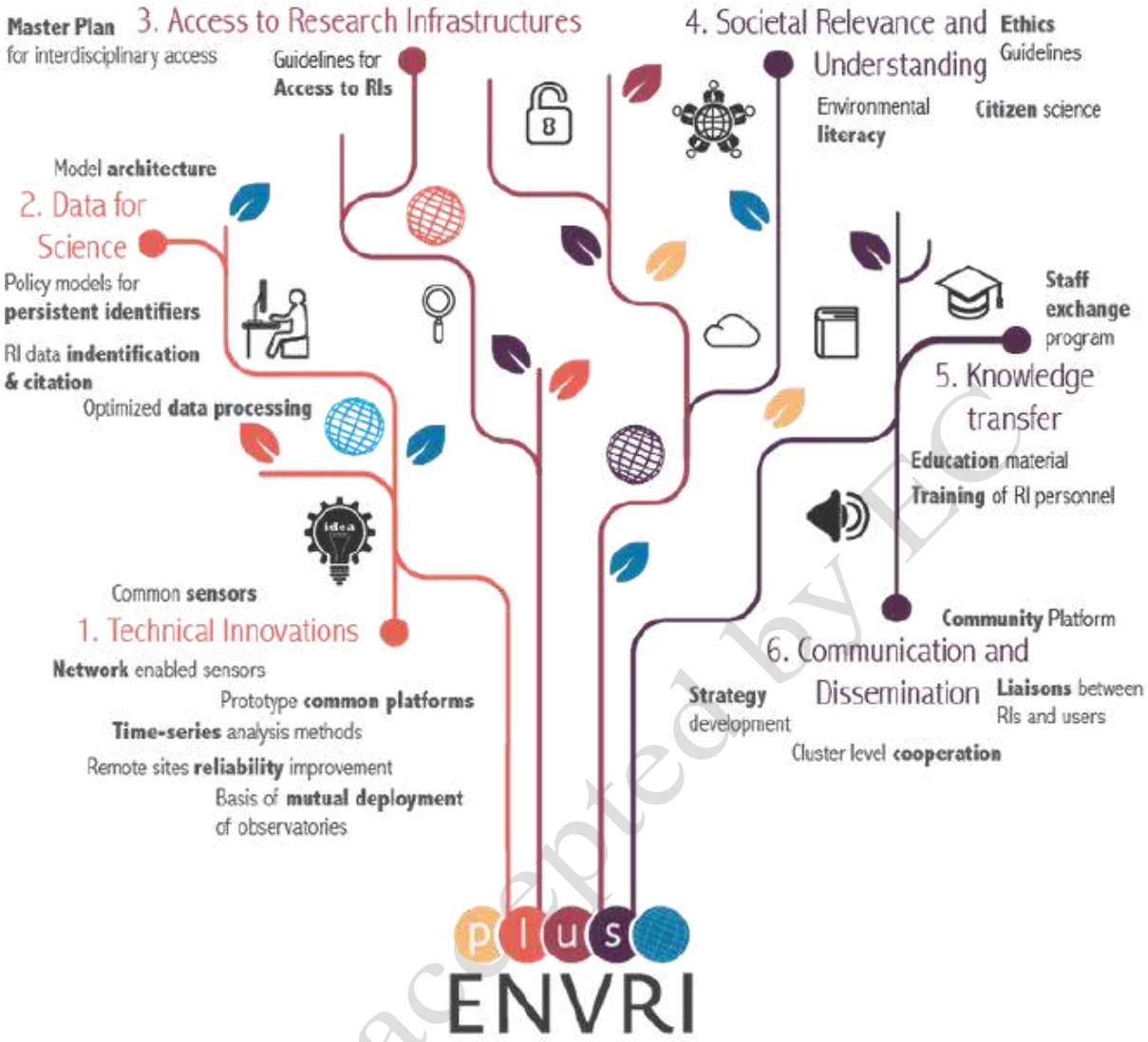

Figure 1: ENVRIplus project scheme

The project had 3 overarching goals:

1. favouring cross-fertilisation between infrastructures,
2. implementing innovative concepts and devices across RIs, and
3. facilitating research and innovation in the field of environment to an increasing number of users outside the RIs.

Specifically, it aimed to improve Earth observation monitoring systems and strategies, including actions towards harmonisation and innovation, to generate common solutions for the information technology and data-related challenges shared, and to harmonise policies for accessing and provide strategies for knowledge transferring amongst RIs.

In addition, very useful guidelines have been developed to enhance trans-disciplinary use of data and data products supported by applied use cases involving RIs from different domains as well as coordinated actions to improve communication and cooperation, addressing Environmental RIs at all levels, from management to end-users, implementing RI-staff exchange programs, generating material for RI personnel, and proposing common strategic developments and actions for enhancing services to users and evaluating the socio-economic impacts.

Of particular interest for this report is the deliverable 18.5 of ENVRIplus, entitled: “RI INNOVATION AND INDUSTRY LIAISON PREPAREDNESS ROADMAP”, where the “Research Infrastructures Innovation-Preparedness Roadmap” was firstly introduced.

The roadmap is a powerful tool, firstly to help RIs to achieve better structure internally and to develop fruitful and long-standing relationships with the industry and secondly, it to spur RIs to better communicate and package success stories of existing ties with the industry to clearly demonstrate the significant economic benefits from public investments in the RIs.
In particular, the roadmap suggests a set of basic measures and actions that RIs can adopt and undertake to organise and position themselves more effectively in identifying and dialoguing with prospective private sector partners.
Going deeper, the roadmap has two overarching objectives:

1. develop a common methodology and set of action items to help the RIs “walk the talk” vis-à-vis strengthening innovation-partnering with industry;
2. work towards being able to offer ESFRI a regular source of RI innovation success stories to complement those of the RI scientific achievements, and thus help better showcasing the Return on Investment (ROI) of the large public investments in the 50+ RIs on the ESFRI Roadmap, each costing an average of €1.5 billion to construct and between €2 and €120 million annually to operate (source ESFRI).

Table 1 ENVRIplus RI "Innovation-Readiness" action-plan Recommendations

13 RI "Innovation-Readiness" action-plan Recommendations
1. Introduce "Innovation Cooperation with Industry" as a priority in every ENVRI's Annual Strategic Plan
2. Ensure that its website homepage has a high-level "Industry" or "Innovation" menu tab and section
3. Prepare an annual Innovation and Industry-Liaison Strategy as an annex to the RI Business Plan
4. Hire a full-time Innovation/Industry Liaison officer(s)
5. Hire a Communications Officer(s) with commercial experience
6. Set a target for how much cooperation with Industry should ideally contribute to RI annual revenues (%)
7. Establish a multi-disciplinary, gender-balanced, Industry Advisory Committee
8. Highlight four Industry-cooperation Success Stories on its website and in annual reports to the EC and ESFRI
9. Make sure its Data Portal offers users open, user-friendly access to RI data and services
10. Publish an online RI Services Catalogue, inclusive of specific services/opportunities for/with industry
11. On its website, make readily available a standard Service-level Agreement and IP Policy Guideline for SMEs interested in licensing RI data to (co-)develop value-added products and applications
12. Establish an annual Training Action Plan and Program as annexes to the Business Plan in consultation with industry to bring together RI researchers and company engineers and managers
13. Develop an RI Talent-Attraction Exchange Program with industry to train the next generation of young scientists and engineers

In the next chapter, we will present an improved version of this Roadmap, developed in the context of the H2020 project ENRIITC and presented in its deliverable 3.1. This new version of the enhanced roadmap is composed of five main initiatives, including suggestions for effective Industry Contact Officer recruitment, and a list of 17 key areas.
Another interesting aspect of the ENVRIplus project's outcomes is the analysis of the potential, and partially actual, interactions between RIs and other societal partners, as traced by its deliverable 1.1 "Emerging technologies, emerging markets: fostering the innovation potential of Research

Infrastructures", and how it is influenced by EU funds. The results presented in the final report referred to the RIs within the environment ESFRI cluster. A number of conclusions are presented below.
Figure 2 summarises the ways by which RIs and the industry could collaborate and some characteristics, peculiarities, and potentialities of each of them, which have been highlighted.

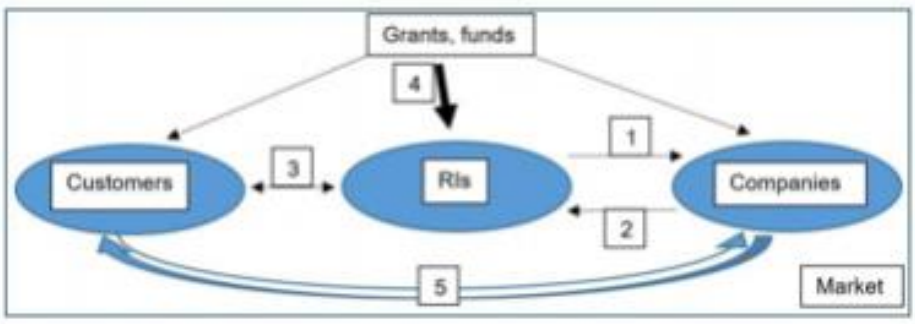

Figure 2 - Interactions of RIs with other participants in the market.

The arrows between the RI body, the customers and the companies in Fig. 1 represent:

1. **Services that RIs can provide to companies**:
   - Representing large groups of end-users, RIs are capable of purchasing products of high cost, which can be shared among multiple end-users, like companies, in the framework of the Trans National Access activity.
   - As large entities, connecting numerous research institutes and governmental structures, RIs can collect the demands for standardisation and metrology and pass them to the companies for future implementation.
   - RIs can predict natural disasters affecting business and human well-being. This is a valuable capability for business management and crisis prevention.
   - Co-designing innovation. RIs can promote the development of new products and services as well as adapt them to market needs and rules.
   - RIs can provide the facilities necessary for the testing of new technologies.
   - RIs can perform data collection and management, to support companies and generate income.
2. **Services that companies can provide to RIs**:
   - Companies can sell their innovative devices to RIs. In case the devices are of high cost, RIs will be able to purchase them in contrast with the single users/scientists.
   - Companies can provide new services to the RI, to a larger extent than to single users.
   - Data collection and transmission. While using the facilities of RIs, companies can collect data at a low cost. This data can be shared with the members of RIs to make their work more efficient.
3. **Services that RIs can provide to customers (end-users) and vice versa:**
   - Is can assure that all the customers (end users) have equal possibilities to access the facilities for environmental measurements and climate change investigations, as well as to the data provided by each and every RI.
   - RIs provide transferable and reusable data and knowledge.
4. **RIs become an attractive receiver of grants and funding:**
   - Given the same amount of financial support, RIs can provide access to research facilities to a larger number of scientists or other interested communities.
5. **Direct interactions between the end users and producing companies:**
   - Direct interactions are possible but are never as beneficial as interactions through the RIs due to the reasons mentioned in points 1-4.

b. The ENVRI-FAIR deliverable D3.5

In the frame of ENVRI-FAIR project, a catalogue of services for the private sector was drafted and published in April 2022 in order to analyse the innovative products and services developed by ENVRIs, and to spur them to better communicate those services towards industrial partners.
The main content of the catalogue was focused on the collection of the existing services targeted to the industry sector, as well as on the main recommendations enabling better industrial use of the existing services of the RIs. Listing existing ENVRIs services in a way users could discover, recognise, understand and access them to achieve their research goals would help users to better understand what RIs can provide to them.
The main target group of the report were industrial partners, as well as non-traditional end users (public sector bodies interested in ENVRI services, non-governmental associations etc.).
The methodology applied in order to build the report was composed of two different steps:

- As a first step, ENVRI-FAIR WP3 team organised the first ENVRI-FAIR Innovation workshop on November 9th, 2021. This virtual workshop aimed at discussing how to better unlock and exploit the innovation potential of Research infrastructures and how to boost ENVRIs cooperation with industry as providers of advanced services, procurers of leading-edge technologies and partners in the development of new data driven products and applications.
- As a second step, Task 3.4 partners designed a survey targeting ENVRI managers to share the status of their RI collaboration with the industry. The survey questions were designed based on the workshop outcomes and previous surveys on innovation in RIs. Such an example is the EMSO Innovations and Industry Service Group Survey on RI's Facilities Current Relations with Industry. The table to collect descriptions of RI services was based on the methodology developed by the project CATRIS - the Catalogue of Research Infrastructure services - to make sure that detailed descriptions of services will be available and interoperable with the catalogue developed by CATRIS.

Subsequently, the report provided an accurate analysis of the current situation in terms of available services and practises targeted to the private sector inside the ENVRIs, members of the Board of ENVironmental Research Infrastructures (BEERI). From these results, the status of the relationship with industry appeared to be still in development. Depending on the maturity of the RIs the service provision was not yet fully centralised and the resources to promote and liaise with industry were scarce.
The detailed results of the analysis could be synthesised as follows:

- *Landscape:*
  Most ENVRIs are organised as distributed research Infrastructures (12 out of 13 respondents). Distributed RIs enable the research community to use specific facilities, resources and services that are associated with different geographical locations. It is worth noting the diversity of structures: the number of nodes differ from one to another as well as the maturity of RIs. Some RIs are already established European Research Infrastructure Consortia (ERICs) while others are in a project or preparatory phase. This structure impacts the way ENVRIs operate and provide services as some are not at a stage where they can offer centralised, aggregated services to users.

- *ENVRI Services:*
  - The results show that data services, analysis and other types of web services as applications are the most frequently demanded by the industry. Remote or physical access to facilities is also requested, albeit less often.
  - ENVRI services are mostly used by users affiliated to academic or research organisations. The private sector is only mentioned by 2 RIs. In general RI data services are open to any interested users, typically under a CC-BY licence. There is often no direct means for the RI to know who the users are, except if specific user feedback processes have been established by the RI or if specific curation services have been requested.

- *Industry profile:*
  The results highlighted that the main industrial users of the RIs offering service for the private sector are Small and Medium Enterprises (67%), while the big companies represented the 22% and the start-up companies only the 11%.

- *RI collaboration and measures targeting the private sector*
  The report depicted the specific measures undertaken by ENVRI respondents to promote collaborations and invest resources in strengthening this relationship. Most RIs consider collaboration with industry to be important for their organisation with an overall score of 4.1 out of 5. While the existence of data and access policies are rather developed in ENVRIs, specific measures targeting industry are still under development or non-existent for most RIs. They are willing to engage more (via the organisation of specific events or via sharing success stories about their industrial relations).
  Regarding Intellectual Property Rights (IPR) and data ownership, for some RIs industrial users are treated the same way as other users, some don't have the case as they don't have industrial users yet, others have a specific clause for private sector notably with regards to the submission of data to the RI data centre (the submission is not mandatory when it could jeopardise a potential commercial use).
  Regarding the development of an RI Catalogue of services, more than 75 % of the RIs recognise the importance of having a catalogue of services to help users obtain a clear understanding of the services offered.
  Regarding the actual means of collaboration and the future actions to strengthen collaboration between industry and RIs, the importance of EU funded projects came out as a driver of collaboration as well as industry training programmes by RIs' central laboratories. On the contrary, the awareness raising was considered as the main barrier preventing the RIs collaborating with industry, followed by the need for dedicated funded projects enabling co-designed pilots with industrial partners.
  Starting from the recommendations provided in the frame of ENVRI PLUS project, D18.5 "ENVRI PLUS RI-Innovation-Roadmap", further updated recommendations to help RIs develop collaborations with the private sector were identified:

  FRAMEWORK:
  The need of having an Innovation or Industry Liaison officer inside each Research Infrastructure was already identified in the frame of ENVRIplus project. It's well recognised that specialised RI staff could act as facilitators to bridge the gaps between RI and industry. RI industry-liaison staff need to be highly competent, experienced individuals with specific knowledge of technology transfer and commercialisation strategies, including patenting processes, along with excellent market insight, extensive professional networks and a clear view and understanding of key science themes and drivers.
  Unfortunately, depending on their structure and main objectives, some RIs may not have the capacity to hire one person dedicated to innovation. The collaboration with regard to innovation **between several RIs of the same ENVRI domain could be envisaged.**
  In the framework of the ENRIITC project (detailed in Section 2.2.a of this deliverable), such idea has been further analysed and developed, leading up to propose the creation of an **Industrial Liaison and Contact Officers (ILOs/ICOs) Hub (IISCSH).**
  The core activity of the hub would be to provide advice and support to all manner of RIs in their engagement with industry, drawing upon existing experience and good practice and building its body of knowledge as the hub matures. The hub will get a head start by building on the ENRIITC actions and network.
  Supporting the IISCSH for the part related to ENVRIs would be a first step for ENVRIs to jointly make progress towards their innovation preparedness.

  ACTIVITIES:
  Regarding the type of activities most needed to promote an efficient collaboration between Industry sector and Research Infrastructures, increasing the **awareness** is the most critical one. The ability of the RIs to attract users from the private sector could be linked to the attention put to the dissemination and promotion of the services offered by the RIs. Making information and services offered by RIs

understandable to non-traditional end users – not only industry – is crucial. There is a need for better awareness of the other sector from both sides. Specific actions could be undertaken to increase ENVRI visibility, such as maintaining a dedicated section of the RIs' respective main websites and carrying out targeted dissemination campaigns, events and/or specific actions in social media are means to promote ENVRIs and their services.

Moreover, it was suggested performing a **market analysis:** this will allow the RIs to better target the industrial segment which are the most relevant for their activities.

Another crucial activity that will enable the strengths of the cooperation between RIs and industry was highlighted, such as the **joint development and implementation of project opportunities.**

A practical list of actions needed to further promote ENVRIs' services was elaborated and embedded.

2.2 Relevant initiatives/projects on the engagement of the private sector

a. ENRIITC, The European Network of Research Infrastructures and Industry for Collaboration

ENRIITC was an H2020 project funded by the European Commission, with a consortium composed of 11 Partners and 60+ Associated Partners working together to establish a pan-European network of Industrial Liaison and Contact Officers (ILOs/ICOs) to improve the RI-industry cooperation and boost the innovation ecosystem in Europe. The project ended in December 2022.

The ENRIITC network is meant to enable Industry Liaison Officers (ILOs) and Industry Contact Officers (ICOs) mutual learning, facilitate collaboration between RIs and industry, develop and refine strategies and best practices to foster these collaborations, raise awareness among the industry for collaboration opportunities with research infrastructures, and demonstrate the impact. Through these initiatives, the network is helping unlock the under-exploited innovation potential of the European Research Infrastructures and maximise their societal and economic benefits across the whole innovation value chain. It is worth noting that ENRIITC scope is larger than just ENVRIs and encompasses RIs from all ESFRI domains.
The main outcomes of the H2020 project ENRIITC are:

1. The creation of a sustainable and integrated European network of ILOs and ICOs, which includes almost 500 network partners and 60+ associated partners.
2. The development of a new framework for providing services to research infrastructures and industries, including the development of best practices and guidelines.
3. The development of strategies for exploiting the innovation potential of the European Research infrastructures, for innovation and industry-RI collaboration, for training and outreach towards the industry and a practical guide for the organisation of brokerage events.
4. The development of a sustainable business model for the network, including the development of a governance structure and the identification of funding opportunities for future sustainability.

The roadmap is still composed of five main actions, which are listed below, that are particularly targeted to help nurture RIs wishing to better engage with the industry via a core support environment:

1. Establish a pan-European ICO/ILO network
2. Adopt a set of core competencies for ICOs and ILOs.
3. Specific key actions for review and implementation for each RI
4. Building strategic alliance relationships
5. Develop a European Research and Knowledge Exchange Strategy tailored for RIs

The most relevant novelty of the ENRIITC version of the roadmap is related to point 1 and entails the introduction of a pan-European hub-and-spoke network managed by an "Innovation and Industry Services Central Support Hub".
The network should contain the following components:

- An “Innovation and Industry Services Central Support Hub” joined by ILOs from all countries and ICOs from all interested RIs.
- A sub-organisation at the ESFRI domain cluster level composed of Industry Contact and Innovation specialists working in close collaboration with the central hub.
- Two steering boards taking decisions on the hub priorities representing the ILO side (e.g. PERIIA[2] board) and the ICO side (the ICO network mentioned above).

The core activity of the hub is to provide advice and support to all manner of RIs in their engagement with industry, drawing upon existing experience and good practice and building its body of knowledge as the hub matures.
This model perfectly encompasses the model the ENVRI Community is developing for the ENVRI Community Innovation Hub and should be further exploited by the other ESFRI clusters created for the development of the EOSC Marketplace.

b. EOSC Digital Innovation Hub

The European Open Science Cloud (EOSC) is a framework project that aims to create a virtual environment to store, share, and analyse research data, enabling collaboration across borders and disciplines. EOSC provides a common platform accessible to all researchers for data sharing, collaboration, and support services, addressing challenges in data management through the development of common standards and protocols. The project brings together stakeholders from across Europe and intends to create a harmonised research area promoting open science and innovation to accelerate scientific progress and drive economic growth.
EOSC is part of the European Commission's vision of a "European Data Space," which seeks to maximise the value of data as a driver of innovation and growth. It enables researchers to easily discover, access, and use data, tools, and services that are relevant to their research needs, offering a range of support services, such as training and guidance on data management.
In this sense, EOSC is committed to promoting collaboration between researchers and industry partners. Working with industry is crucial for driving innovation and developing solutions that have a real impact on society. Thus, it has several initiatives in place to boost engagement with industry, which are briefly described below.

Digital Innovation Hubs (DIHs)
The DIHs are a vital component of the EOSC project, providing researchers and industry partners with access to cutting-edge technologies, tools, and services. By providing access to these resources, the DIHs enable researchers and industry partners to work together on innovative projects, bringing new products and services to market more quickly.

Marketplace
The EOSC Marketplace connects users with a broad range of services, such as data storage and processing, reproducible analytics software, and applications. The Marketplace is designed to be user-friendly and accessible to researchers at all levels of expertise, enabling industry partners to easily find the resources they need to conduct their research.

Industry Engagement Strategy
The EOSC project has a dedicated Industry Engagement Strategy that is designed to identify and engage with key industry stakeholders. The strategy aims to build strong relationships with industry partners and promote collaboration between industry and research organisations.

Open Innovation
The EOSC initiative promotes open innovation, encouraging industry partners to collaborate with researchers and share their expertise. By working together, industry partners and researchers can leverage each other's strengths, leading to the development of innovative solutions that have a real impact on society.
Overall, the EOSC project recognises the vital role that industry plays in promoting innovation and economic growth. By providing industry partners with access to cutting-edge technologies, tools, and services, and fostering collaboration between researchers and industry partners, the EOSC project is helping to accelerate research and innovation in Europe.

[2] Pan-European Research Infrastructure ILO Association: https://www.periia.eu/

c. ENVR'INNOV, the ENVironment Research infrastructures INNOVation Roadmap

ENVRINNOV, which stands for ENVironment Research infrastructures INNOVation Roadmap, is a proposal submitted under the topic HORIZON-INFRA-2023-DEV-01-05, that aims at co-designing, testing and validating a common Innovation Roadmap for the European Environmental and Earth System Research Infrastructures community. This Roadmap will, on one hand, aim at paving the way for the ENVRI community to establish and operate an ENVRI Innovation Hub (EIH), for the future development of new state-of-the-art technologies and services and, on the other hand, will take care of developing policies, tools and gather the community that would ensure the successful implementation of such roadmap.
Amongst the different goals that characterise this proposal, it emerges the objective to closely cooperate with industry and with the private sector to define, digitalise, and promote the uptake of common ENVRI innovation strategies for new technologies and services development.
Within the main approach of the proposal there is also the willingness to establish common frameworks for actors in the wider EU environmental scientific domain and actively encourage a structured collaboration for the identification of emerging needs/gaps to be filled through innovation, and to enable co-creation of new technologies and services to meet them, a big effort will be dedicated to the engagement of EU industry, the largest force for innovation in the EU ecosystem.
In particular, an entire work package – WP6, will be devoted to draft the ENVRI Innovation Roadmap while developing the ENVRI Innovation Hub governance, structure and business model to ensure its long-term operation and sustainability.
Therefore, within work package 6, the work will progress in parallel on two different tracks:

- Consolidate a first version of the roadmap keeping into due consideration, e.g., the common ENVRI innovation policies, a capacity building strategy, a strategy to involve key stakeholders with emphasis on industry, a business model and an implementation plan for the ENVRI Innovation Hub;
- Identify the proper structure and governance for the long-term operation and sustainability.

d. ERIC FORUM 2, The European Research Infrastructure Forum second edition

In the frame of the just-ended ERIC Forum project, a set of activities dedicated to Innovation (WP6) was implemented and in particular, three deliverables were published related to:

- The synergies between ERICs and the (Regional) Research and Innovation Strategies for Smart Specialisation -RIS3.
- the integration of ERIC development into pan-European infrastructures, particularly in the new EOSC.
- Some suggestions on how ERIC Forum Members can foster internationalisation.

At the end of January 2023, a proposal was submitted as the follow-up of the above-mentioned activities and, in the case of funding, the intention is to continue and focus more and more on the work already done to strengthen a strong commitment to the innovation and in particular to the relationships with Industry sector.
Building upon the outcomes of the work done by several ERICs in past H2020 projects, a dedicated task has been foreseen which aims at assessing and tuning of strategies and best practices, already drafted, for engaging the industry as a partner of the ERICs. The main outcome of this task will be to improve coordination among the ERICs and their capacity in collaborating with the private sector by having a common approach that will reinforce their sustainability and their socio-economic impact. Synergies with the ENRIITC network will be strongly considered when possible.

e. ECCSELERATE, an ECCSEL ERIC project

ECCSEL ERIC
is a distributed, integrated research infrastructure encompassing interlinked transnational scientific facilities and national nodes for CO2 Capture, Utilisation, Transport and Storage (CCUS). It is a collaborative effort between several European countries to advance research and development in the field of carbon capture, utilisation, and storage (CCUS) technologies.

In the framework of the ECCSELERATE H2020 project (https://cordis.europa.eu/project/id/871143), the project team developed the deliverable D1.2 titled "Industrial Services model" to develop a tailor-made portfolio of research and technology development services for CCS (Carbon Capture and Storage) to actively engage industry (including SMEs) that could be of interest for this report.

The overall idea presented in ECCSELERATE is firstly the organisation of a workshop with industry representatives coming from the industrial sectors of interest to have feedbacks on their priorities and the most valuable data services and products the RI could provide.

Industry representatives could be categorised into groups depending on the sector, size, and products and have been asked about their needs expressing interest in specific services taken from a provisional list developed internally. Table 3 in D1.2[3] presents the list of potential ECCSEL services to the industry and an overview of perceived interest.
Another relevant point that comes from D1.2 is the recognition of the importance of outreach, capacity building, and training activities.
Those activities have been recognised as useful from one side to showcase the success stories and explain the added value of services and on the other side to provide training on practical examples about how to improve their business using the RI's services.
In addition, in D1.2 it has been recognised as relevant the launch of Joint Research Activities to complement the training activities and develop use cases for collaborating with the industry in a cross-sectoral way to develop technologies that can reach higher TRLs.

From the workshops, the following aspects of joint research projects were highlighted:

- Cross-sectoral collaboration with other end-users
- Cross-sectoral collaboration on utilisation
- Look for pre-competitive projects
- Incorporate less active companies in joint research projects

Finally, in D1.2 it has been found as appreciated by the industry the development of a cross-sectoral high-quality knowledge sharing service if it does not consist of sales pitches and that can consist of:

- Sessions that enable open innovation and cross fertilisation involving the industry, technology providers and technology institutes as part of the transnational access call;
- Develop a knowledge sharing format with industry, based on the current academic knowledge sharing within the RIs.

f. Other relevant projects

Co-design projects or pilots with specific end-users is a way for ENVRIs to engage further and build trust and relationships with industry and private sector in general. Several ongoing initiatives involving ENVRIs and industry are detailed below:
The e-shape (EUROGEOSS Showcases: applications Powered by Europe) project is a unique initiative that brings together decades of public investment in Earth Observation and in cloud capabilities into services for the decision-makers, the citizens, the industry and the researchers. Ultimately, e-shape funds EuroGEO, as Europe's contribution to the Global Earth Observation System of Systems, aiming at bringing together Earth Observation resources in Europe. 36 pilots are co-designed either - with public authorities or companies - within this project in 7 areas - climate, water, disasters, renewable energy, agriculture, health and ecosystem – where ENVRIs could play a substantial role. The goal is to reach more end users. For instance, the Climate pilot on Global Carbon and Greenhouse Gas Emissions involved directly ICOS. Some pilots (in the forestry field notably) co-design with industrial partners and help having developed tailored service.
The ATMO-ACCESS project is the organised response of distributed atmospheric research facilities for developing a pilot for a new model of Integrating Activities. The project involves IAGOS, ICOS and ACTRIS. In this project, the entire scientific community as well as private sector actors have the opportunity to access the main European atmospheric research platforms, to participate in scientific experiments, to train new measurement techniques, to test new sensors or to develop new applications based on data from research infrastructures. One task of the project is to engage further with stakeholders from the private sector and innovators in technology. This will be done by establishing working groups

[3] https://www.eccsel.org/media/112705/eccselerate-d12-industrial-services-model-final-v2b1.pdf

to co-design the pilots. The services offered could comprise data but are also for testing prototypes or comparing instruments.

3 Strategic Action Plan

In ENVRI-FAIR task 3.4, an analysis has been performed based on the results gathered by a survey submitted to the ENVRI's managers to assess the current situation in terms of relations with the industry, and available services and practices targeted to the private sector.

In order to develop the Strategic Action Plan, we are going to perform a SWOT analysis using the results of the survey presented in D3.5 as well as the evidence that emerged in the other deliverables of the ENVRI-FAIR project and in the conferences and workshops realised so far. The SWOT analysis will work as a situational analysis to have insights into the external and internal barriers and drivers that affect ENVRI's ability to achieve its goals in terms of the usage of the data produced by the private sector.

The results of the SWOT analysis are the following:

STRENGTHS

- The majority of the respondents to the survey have an Access Policy to their research products, as well as a policy / guideline for industry engagement.
- Actual collaborations with the private sector are well balanced among national, local, and international levels.

WEAKNESSES

- Regarding Intellectual Property Rights (IPR) and data ownership, some RIs treat industrial users the same way as other users. But some others have specific clauses for the private sector.
- Only a small number (2 out of 13 respondents) of the ENVRIs have a dedicated section of the website dedicated to industry or innovation.
- Only one RI has a Strategy and/or Action Plan for collaboration with companies/industry. The same pattern occurs for tailored services offered to the private sector.
- Only 2 out of 13 RIs have hired an innovation officer.
- Only 33% of the RIs that responded have already developed a Catalogue of Services.
- In the case of data services, they are usually open to anyone under a CC-BY license, and the RIs do not know who the users are most of the time also because Google Analytics has been declared against privacy laws in some countries like Italy, France, Norway, naming few.

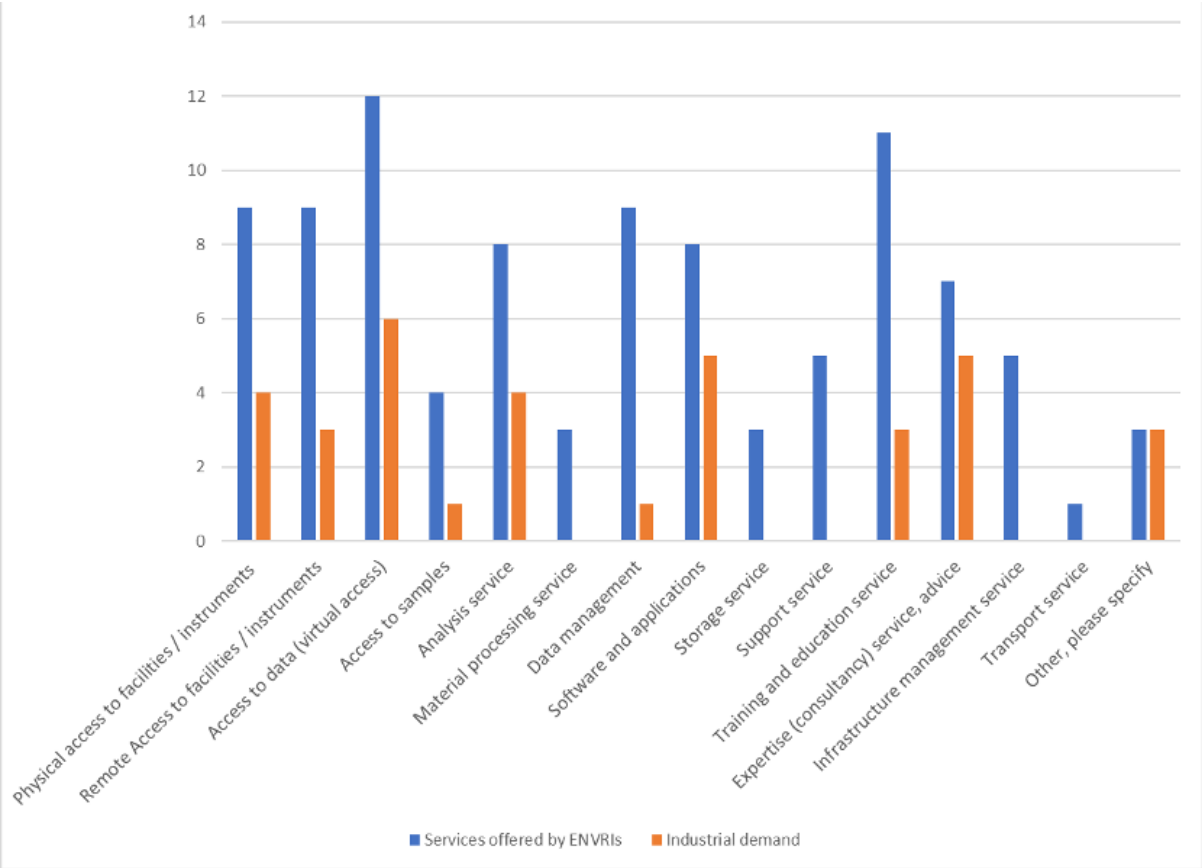

Figure 3: Services offered by ENVRIs and demand from industrial clients

OPPORTUNITIES

- ENVRI services are mostly used by users affiliated with academic or research organisations The private sector is only mentioned by 2 RIs.
- Figure 4 in particular illustrates the services offered by responding ENVRIs in blue and the most requested services by industrial clients in orange. The results show that data services, analysis and applications are most frequently demanded by the industry.

THREATS

- Data quality management and the lack of CoreTrustSeal (or similar FAIR repository certifications) certifications, as well as a clear statement on the provenance of data (e.g. use of shared identification for the data sources (e.g. Persistent Identifier (PID)), could prevent the private sector to use the ENVRIs' data.
- The lack of Access Policies and/or Data Management Plans could be a barrier in the process of uptaking ENVRI's data by the private sector.
- Lack of funds for supporting the development of projects for collaborating with the industry in co-designing products.
- Lack of plans for the development of better awareness of the other sector from both sides, RIs and private sector.

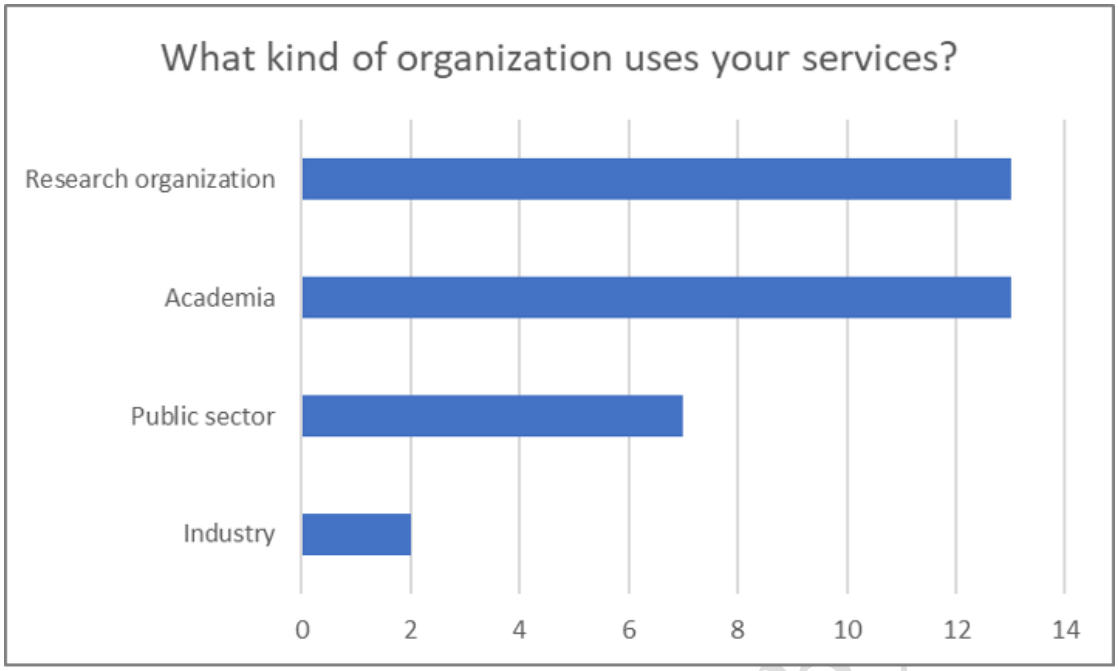

Figure 4: ENVRI services users' organisation type

Starting from the outcomes of the SWOT analysis, the Strategic Action Plan presented in this chapter is meant to define a path to nurture the uptake of ENVRI's data by the industry.

Because the landscape of the private sector in Europe is quite complex and diverse, as well as the data and services offered by the ENVRIs, the Strategic Action Plan requires a systematic approach to involve the key stakeholders, develop clear goals, and monitor the results.

Specifically, the main components of the Strategic Action Plan are summarised by the following steps:

- Step 1: Identify and engage key stakeholders
- Step 2: Set specific goals
- Step 3: Develop and adopt a roadmap
- Step 4: Monitor and evaluate progress

Starting from the beginning, the first step is to identify the key stakeholders in the private sector who are likely to benefit from the current environmental data produced by ENVRI, including industries, SMEs, non-governmental organisations (NGOs), and industry associations.

The second step is to set specific goals such as increasing the number of private sector companies using environmental data to a specific target or developing new partnerships between the ENVRIs and private sector companies making sure that the goals and their tangible products are Specific, Measurable, Achievable, Relevant, and Time-bound (SMART).

The third step is the uptake of the "RI Innovation and Industry-Liaison Preparedness Roadmap" developed in ENVRIplus with the appropriate advancements developed in the ENRIITC updated and fine-tuned for the purposes of ENVRI-FAIR, and adequately prepare the ENVRIs to be ready to build fruitful interactions with the private sector in exchanging research data.

The final step is to monitor and evaluate progress made by reaching the goals set in the previous steps to ensure that the goals have been achieved and to identify areas for improvement.

Each step is developed in the following sections.

3.1 Step 1 - Identify and engage key stakeholders

Identifying key stakeholders likely to benefit from environmental research data involves understanding the different entities who's the operation could be potentially impacted by environmental issues and could benefit from the uptaking of ENVRIs's data.
But in order to try to match the ENVRI's offer in terms of data with the private sector needs, a Data Catalogue and a clear value proposition should be developed with explicit guarantees on the quality and the FAIRness of the data. Quality management protocols, Data Management Plans, and trusted and certified data repositories (e.g. CoreTrustSeal) are deemed as critical in this sense.
In particular, the value proposition should explain the benefits that ENVRI's data could provide to private companies. It should outline the primary reason why a customer should use ENVRI's data, highlighting their quality and reliability. A strong value proposition is essential for attracting and retaining customers, and it should be clear, concise, and focused on addressing the customer's needs or pain points. A well-crafted value proposition should communicate the value of the data product or stream in a way that resonates with the target audience and helps to build a strong brand identity.

The following actions could be considered to identify key stakeholders:

1. **Define a clear portfolio of data**: start by defining the purpose and scope of the research performed by the ENVRIs and develop the Data Catalogue produced out of it, with a clear reference to data quality, data stewardship and data management actions and procedures that have been adopted to guarantee the reliability and high quality of data. This will help identify the stakeholders who may be interested and attract them with a unique and high-quality product. The work done in developing the test platform for the ENVRI-Hub[4] goes in this direction.
2. **Identify relevant industries**: identify the industries that are likely to be interested in environmental research data. For instance, data that could be related to climate change's effects on agricultural productivity could be interesting for farmers, agricultural businesses, and food processors just to name a few. Also, relations with partnerships developed at the European level should be explored.
3. **Research government agencies**: Identify government agencies that regulate or oversee the production and dissemination of environmental data. These agencies may be stakeholders in the uptake process, as they may push for adopting specific standards or vocabulary and set up specific frameworks for Intellectual Property Rights (IPR) and data ownership as mentioned in the ENVRI-FAIR D3.5.
4. **Identify advocacy groups**: identify advocacy groups or non-governmental organisations (NGOs) that focus on environmental issues and climate change. These groups may be interested in the data and may use them to advocate for change. Of particular interest are also the projects related to the involvement of citizens in science activities. The platform EU-Citizen.Science[5] could be of reference on this topic.
5. **Engage with stakeholders**: once the potential stakeholders are identified, the next step is to organise bilateral contacts to better understand their perspectives and needs. This can be done by conducting interviews, surveys, or focus groups to gather feedback on the ENVRIs value proposition. In addition, outreach, training, and capacity-building activities are very well recognised as key in strengthening the links and transferring the added value of the offered products.

By following the above steps, the ENVRIs can identify and engage key stakeholders who are likely to benefit from research environmental data and ensure that the data produced are relevant and impactful for them. On the other hand, the outcomes could also suggest starting to collect data on new variables to respond to the private sector's needs in an ongoing dialogue with it.

A detailed look into each of the previously mentioned items.

Define a clear portfolio of data
The scope of research performed by the ENVRIs is broad as it encompasses a wide range of topics related to the environment, contributing to the achievement of the 4 key strategic orientations of the Horizon

[4] https://hubtest.envri-fair.eu/about
[5] https://eu-citizen.science/

Europe strategic plan[6]. Indeed, the ENVRI Community brings together 26 European Research Infrastructures that are studying different aspects of the Earth system in order to understand the complex interactions between its components and to identify and address environmental challenges such as climate change, biodiversity loss, pollution, and resource depletion.
The starting point for defining an ENVRI Data Catalogue or Portfolio is the ENVRI Hub which hosts the ENVRI Catalogue of Services that contains descriptions of the RI services that provide data, metadata, semantic assets, taxonomic information, and more. The main focus of the ENVRI Catalogue of Services is on services that provide machine-accessible endpoints. An ENVRI Catalogue of Services tailored to the industry is already under development (ENVRI-FAIR D3.5) and will be hosted in the near future by the ENVRI Innovation Hub which is planned to be part of the ENVRI Hub itself.

Identify relevant industries
Environmental research can affect a wide range of industrial sectors, as environmental issues can have significant impacts on business operations and supply chains. According to the most recent EUSPA - European Union Agency for the Space Programme- EO and GNSS Market Report"[7] about the Earth Observation (EO) Market, 16 market segments may either strongly interested in or impacted by EO data. From the report emerged also that the total revenues for EO data in 2021 accumulate to **€536m** across all segments, and that for the same year, the global turnover across EO data and value-added services amounts to **€2.8 bn**. Again, that means the financial and business opportunities for the provision of data and services by the ENVRIs are huge.

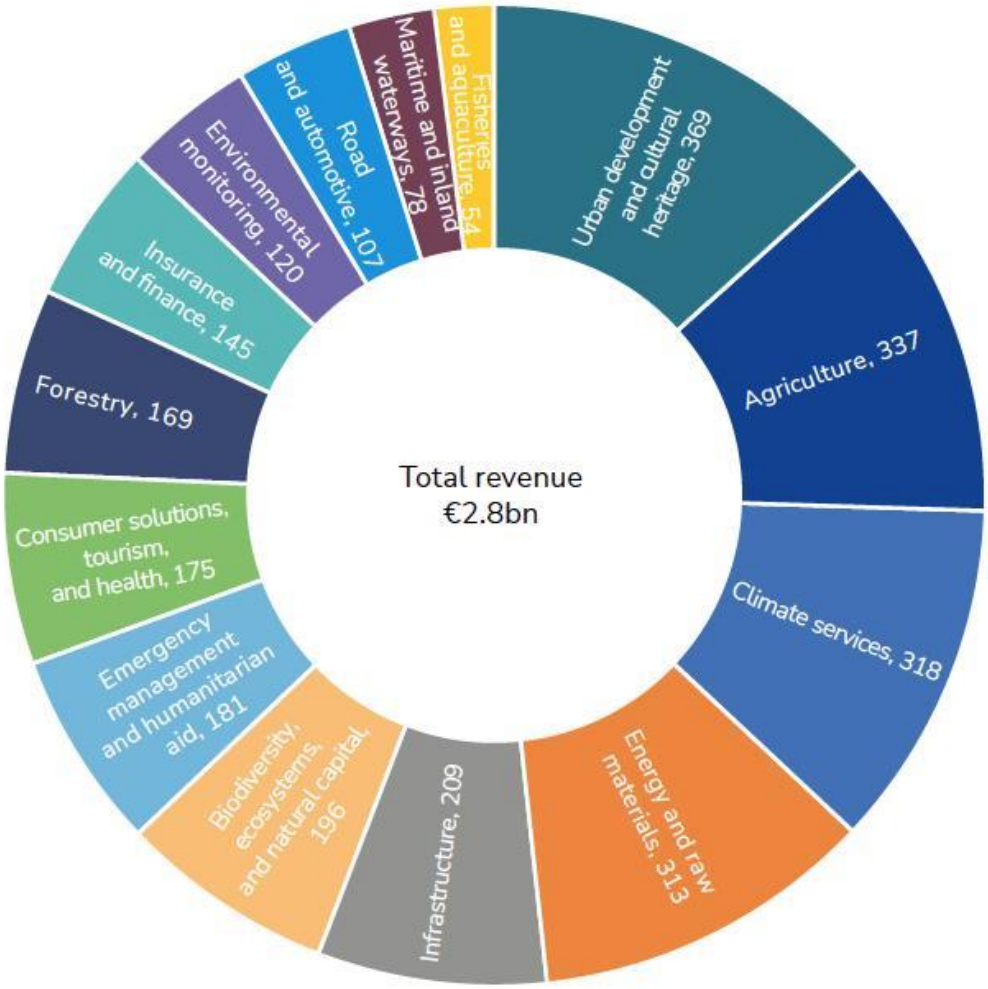

Figure 5: Proportional distribution of revenue by segments (based on values of €m, 2021), credits EUSPA.

[6] https://op.europa.eu/en/web/eu-law-and-publications/publication-detail/-/publication/3c6ffd74-8ac3-11eb-b85c-01aa75ed71a1
[7] https://www.euspa.europa.eu/european-space/euspace-market/earth-observation-market

Here below are listed the market segments that are likely to be affected by environmental research and could potentially benefit from taking up ENVRIs data:

1. **Climate services:** the climate crisis is already impacting almost all industrial sectors severely and environmental data are becoming more and more necessary for taking informed decisions and for developing adapting strategies and policies to the new conditions. The main users of climate services are international, national and local public bodies, policymakers and environmental agencies.
2. **Energy**: the energy sector, including fossil fuel extraction, power generation, and renewable energy plants (e.g. wind, hydropower, solar, geothermal and bioenergy), is likely to be significantly affected by the outcomes of environmental research. Data on climate change, air pollution, and the environmental impacts of energy production can influence energy policy and investment decisions.
3. **Agriculture, food production, and fishery**: data on soil health, and the impacts of climate change on crops can influence farming practices and food production systems. In a similar way, data about the health of the fresh waters (lakes, reservoirs, ponds, rivers, streams, wetlands and even groundwater) and oceans, on water quality and the study of aquatic mesocosms, could positively affect the fishery.
4. **Transportation**: this sector, including the automobile and aviation industries, is also likely to be affected by environmental research. Data on air pollution, climate change, temperature humidity and energy use in transportation systems can influence transportation policy and investment decisions.
5. **Manufacturing**: data on CO2, waste reduction, and resource efficiency can influence manufacturing practices and product design.
6. **Construction**: research into sustainable building materials, energy-efficient building design, and the impacts of construction on ecosystems can influence building codes and regulations as well as manufacturing processes and supply chains.
7. **Mining and extractive industries**: research into the environmental impacts of extraction activities can influence mining practices and regulations.
8. **Consumer Solutions, Tourism and Health**: health apps interested in monitoring air quality and UV are already using environmental data. Tourism sector could be interested in, for instance, having insights about wave conditions and water quality. Data about the quality of air and soil components could be as well interesting for the endpoints of the food chain or other value chains in the provision of consumer solutions.
9. **Insurance and Finance**: earth observation data are already used to compute parametric products for finance and insurance stakeholders. Raw data and specific data products could help insurance companies in the process of assessing the risk and consequently in setting the products' prices.
10. **Urban Development and Cultural Heritage**: environmental data can be key enablers for urban planning and the development of more sustainable and smarter urban environments. ENVRI's data could also be relevant to cultural heritage preservation and restoration.

Concerning the partnerships[8], on 14 June 2021, the Commission adopted Decision C(2021)4113 on the approval and signature of the memoranda of understanding for 11 Co-Programmed Partnerships. The goal is to boost investments in R&I and to address the major climate and sustainability challenges, towards making Europe the first climate-neutral economy. To support those partnerships the EC put over 8B€ for the partnerships to run from 2021 to 2030.

The areas identified by the EC for grouping the partnerships are the following five:

- Health
- Digital, industry, and space
- Climate, energy, and mobility
- Food, bioeconomy, natural resources, agriculture, and environment
- Partnerships across themes

[8] https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/european-partnerships-horizon-europe_en

Research government agencies
There are several European government agencies that regulate, oversee or disseminate environmental research activities and outcomes. Here are a few examples:

Table 2: European government agencies regulating/overseeing/disseminating environmental research activities and outcomes.

European Environment Agency (EEA)[9]	EEA is an agency of the European Union that delivers knowledge and data to support Europe's environment and climate goals. EEA core tasks are defined in the founding EU regulation[10] and include supporting policy development and key global processes; offering analytical expertise; providing and maintaining an efficient reporting infrastructure for national and international data flows. In collaboration with Eionet, EEA informs decision-makers and the public about the state of Europe's environment, climate change and wider sustainability issues. A complete list of Data providers and partners can be found on the EEA website[11].
European Commission Directorate-General for Environment[12]	The Directorate-General for Environment is the part of the European Commission that develops and implements policies related to the environment. It is responsible for EU policy on the environment and proposes and implements policies that ensure a high level of environmental protection and preserve the quality of life of EU citizens.
European Topic Centre on Air Pollution and Climate Change Mitigation (ETC CM)[13]	It is a consortium of 15 European organisations working in partnership with the European Environment Agency under a framework partnership agreement for the period 2022-2026. The ETC CM informs decision-makers and the public by presenting reliable and comparable data and information on climate change mitigation, energy, and transport in Europe.
Eurostat[14]	Eurostat is the statistical office of the European Union, and it collects and provides high-quality statistics and data on Europe, including environmental statistics and data. It delivers data across nine Statistical themes[15] among which are "Environment and energy" and "Agriculture and fisheries".
European Space Agency (ESA)[16]	ESA is an intergovernmental organisation dedicated to space exploration and research. It operates various Earth observation satellites that collect valuable environmental data. These satellite missions provide information on climate change, land use, deforestation, oceanography, and other environmental parameters. Its mission is to shape the development of Europe's space capability and ensure that investment in space continues to deliver benefits to the citizens of Europe and the world.
European Food Safety	EFSA is an agency of the European Union that provides scientific

[9] https://www.eea.europa.eu/en
[10] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32009R0401
[11] https://www.eea.europa.eu/data-and-maps/data-providers-and-partners#c0=5&c5=all&b_start=0
[12] https://commission.europa.eu/about-european-commission/departments-and-executive-agencies/environment_en
[13] https://www.eionet.europa.eu/etcs/etc-cm#:~:text=The%20European%20Topic%20Centre%20on,for%20the%20period%202022%2D2026.
[14] https://ec.europa.eu/eurostat
[15] https://ec.europa.eu/eurostat/web/main/data/statistical-themes
[16] https://www.esa.int/

Authority (EFSA)[17]	advice and risk assessments on food safety. It conducts research and provides guidance on a range of environmental issues related to food safety, including pesticides, contaminants, and genetically modified organisms. Its mission is to deliver independent and transparent scientific advice to policymakers, through cooperation with its partners in an open dialogue with society.
Joint Research Centre (JRC)[18]	JRC is the Commission's science and knowledge service. The JRC employs scientists to carry out research in order to provide independent scientific advice and support to EU policy.
Network of the Heads of Environment Protection Agencies (EPA Network)[19]	EPA Network is a collaboration of environmental protection agencies from European countries. They exchange information and best practices in environmental management and monitoring. The network facilitates the sharing of environmental data and promotes cooperation among member agencies.
The European Environment and Sustainable Development Advisory Councils Network (EEAC Network)[20]	EEAC Network brings together advisory bodies established by national or regional governments or parliaments. EEAC members offer independent advice to their respective national or regional governments and parliaments related to climate change, the environment, and sustainable development.
European Centre for Medium-Range Weather Forecasts (ECMWF)[21]	ECMWF is an intergovernmental organisation that provides weather forecasting and climate research services. It produces and distributes weather and climate data, including atmospheric conditions, temperature, precipitation, and climate projections. These data are crucial for understanding and predicting environmental changes.
Copernicus Programme[22]	the Copernicus Programme is an initiative of the European Union in partnership with the European Space Agency (ESA). It aims to provide accurate and up-to-date environmental information using a constellation of Earth observation satellites. Copernicus offers a wide range of data products on land, ocean, atmosphere, climate, and emergency management.

The above organisations / initiatives play a crucial role in collecting, analysing, and disseminating environmental data across Europe, facilitating evidence-based decision-making, and fostering sustainable development.
Other agencies and organisations at the national and regional levels may also have a role in regulating and overseeing environmental research.
Finally, it is useful to remind that the access and use of RIs data, tools and services by the industry is firstly regulated by the "European Charter for Access to Research Infrastructures - Principles and Guidelines for Access and Related Services"[23].

[17] https://www.efsa.europa.eu/en
[18] https://commission.europa.eu/about-european-commission/departments-and-executive-agencies/joint-research-centre_en
[19] https://epanet.eea.europa.eu/
[20] https://eeac.eu/
[21] https://www.ecmwf.int/
[22] https://www.copernicus.eu/en
[23] https://ec.europa.eu/info/sites/default/files/research_and_innovation/2016_charterforaccessto-ris.pdf

Identify advocacy groups

About the Advocacy groups in Europe, Table 3 lists the main advocacy groups in Europe that focus on environmental issues.

The groups listed have an important role in raising awareness, promoting policy change, and mobilising public support for environmental issues across Europe. They work towards a more sustainable and environmentally conscious future and can potentially be interested in taking up ENVRI's data in order to support the decision-making process.

Table 3: Main advocacy groups in Europe focusing on environmental issues

Greenpeace[24]	Greenpeace is an international environmental organisation known for its direct actions and campaigns on various environmental issues, including climate change, deforestation, overfishing, and pollution. It operates in many European countries and has a significant presence across the continent.
Friends of the Earth Europe[25]	Friends of the Earth Europe is a network of environmental organisations that work together to promote sustainable development, biodiversity conservation, and climate justice. They advocate for policies that prioritise environmental protection and engage in grassroots campaigns across Europe.
WWF Europe[26]	WWF (World Wide Fund for Nature) is a global conservation organisation with a presence in Europe. WWF Europe focuses on protecting endangered species, conserving habitats, promoting sustainable development, and addressing climate change through advocacy, research, and conservation projects.
European Environmental Bureau (EEB)[27]	The EEB is a network of environmental NGOs across Europe. It acts as a platform for cooperation and collaboration among environmental organisations and advocates for strong environmental policies at the European Union level. The EEB covers a wide range of issues, including biodiversity, pollution, climate change, and resource management
BirdLife Europe and Central Asia[28]	BirdLife Europe and Central Asia is a partnership of national bird conservation organisations across Europe. They work to protect bird species and their habitats, advocate for nature conservation, and promote sustainable land and water management practices.
Climate Action Network (CAN) Europe[29]	CAN Europe is a coalition of NGOs working on climate change issues. They advocate for ambitious climate policies and measures to address the climate crisis. CAN Europe engages in policy analysis, lobbying, and public awareness campaigns to push for a sustainable and low-carbon future.
Environmental Coalition on Standards (ECOS)[30]	ECOS is an international NGO with a network of members and experts advocating for environmentally friendly technical standards, policies and laws. ECOS is an organisation that focuses on promoting environmental sustainability in European standardisation processes. They work to ensure that standards developed at the European and international levels consider environmental factors, contribute to circular economy practices, and support sustainable development.
Transport & Environment	T&E is the European Federation for Transport and Environment AISBL, a

[24] https://www.greenpeace.org/eu-unit/
[25] https://friendsoftheearth.eu/
[26] https://www.wwf.eu/
[27] https://eeb.org/
[28] https://www.birdlife.org/europe-and-central-asia/
[29] https://caneurope.org/
[30] https://ecostandard.org/

(T&E)[31]	European NGO that advocates for sustainable and clean transport solutions. They work to reduce the environmental and health impacts of transportation, promote electric mobility, and push for more sustainable transport policies and regulations.
Health and Environment Alliance (HEAL)[32]	HEAL is a network of environmental and health NGOs in Europe. They advocate for policies that protect human health from environmental degradation, including issues such as air pollution, chemical exposure, climate change, and the health impacts of unsustainable practices.

Engage with stakeholders

A relevant topic mentioned in point 5 that comes from ECCSELERATE D1.2 is the recognition of the importance of outreach, capacity building, and training activities.

Those activities have been recognised during ECCSELERATE as useful by the industry representatives to kick off knowledge exchange activities and present in a deeper way what ENVRIs have to offer.

In addition, the organisation of brokerage events in particular dedicated to Industry Contact Officers working in the RIs and Industry Liaison Officers, appointed by the European governments to scout for opportunities for the National industries, could be quite impactful in creating a first layer of relationships with the National and European Industries and Industry Associations. A very useful guide in this sense could be found in the ENRIITC D3.4 titled "A practical step-by-step guide for ILOs/ICOs to organise brokerage events"[33]. Another valuable deliverable from the same project to enhance the cooperation between the RIs and the industry is D3.2 titled "Strategy for innovation and industry-RI cooperation"[34]. In this deliverable 17 recommendations are presented, organised under four themes which cover both the internal organisation and priorities within the RI, and strategies and tools for engaging with companies and ecosystems surrounding the RI.

The process suggested for identifying the key stakeholders, as well as the other ones proposed in this document, should be planned by using the Rolling Wave approach or the Progressive Elaboration[35] approach, typical of the Agile methodology in order to guarantee efficient use of the resources and maximise the quality in the process management. In addition, it is not meant to be a one-time process but an iterative one. Indeed, the landscape of stakeholders is continuously changing as well as the ENVRI offer in terms of data and service. The suggestion is to update the Data Portfolio on a regular basis and review the list of key stakeholders every six months.

3.2 Step 2 - Set specific goals

In the process of fostering the uptake of ENVRI's data by the private sector, it is important to identify a set of goals and targets so as to have clear and measurable objectives.

Here below are described some specific goals that can support the value proposition definition and strengthen the relationships with the private sector:

GOAL 1: Increase awareness

The first goal should be to increase the private sector's awareness of the importance of environmental data and its potential value to their business. This can be achieved through targeted communication strategies such as workshops, conferences, or webinars that showcase the potential benefits of environmental data uptake by private sector businesses in particular for the development of new products, reducing the time-to-market and supporting the decision-making process. The building brick could be to develop a factsheet to showcase the impact ENVRI data could have in each of the private sectors identified above and organise tailored workshops as also suggested by the successful experience of ECCSELERATE.

GOAL 2: Develop tailored environmental data products

Another goal can be to (co-)develop tailored environmental data products that are relevant to the private sector to enrich the ENVRI portfolio of data using as input the outcomes of Step 1. This can involve

[31] https://www.transportenvironment.org/
[32] https://www.env-health.org/
[33] https://enriitc.eu/project/deliverables/
[34] https://enriitc.eu/project/deliverables/
[35] https://en.wikipedia.org/wiki/Progressive_elaboration

collaboration with private companies to identify their specific needs and co-designing data products that meet those needs. The work done in ECCSELERATE could suggest a path for gathering data about industries' needs and developing an ongoing knowledge exchange mechanism to proactively identify new opportunities for collaboration.

GOAL 3: Improve data quality, harmonisation and accessibility
Private sector businesses need accurate and reliable data to make informed decisions and develop new value chains to reduce the time-to-market. A goal can be to explicitly clarify the level of quality, harmonisation and interoperability of ENVRI's data in a continuing effort of improving them by a clear work plan, spanning all over the data production cycle, for the definition and adoption of better data collection methods, FAIR certifications for the data repositories and improving data management procedures and standards together with the accessibility. The plan developed in ENVRI-FAIR to introduce SPARQL endpoints to enable semantic search in the ENVRIs and the stimulation for the more pervasive use of digital Persistent IDentifiers (PIDs)[36] and FAIR Digital Objects[37] (FDOs) is for sure a significant step forward to increase the added value of ENVRI's data.

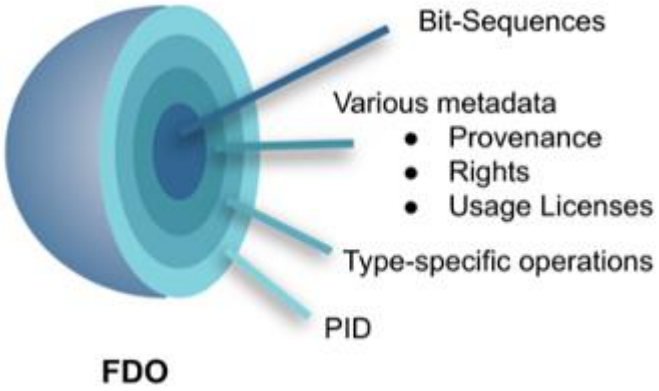

Figure 6: Visualisation of the definition of Fair Digital Object as defined in the GO-FAIR project. Credits: GO-FAIR.

GOAL 4: Foster partnerships
The fourth goal should be to foster partnerships between the private sector and research institutions to facilitate the co-creation of environmental data products. This can help to build trust between the private sector and research institutions and ensure that the data products meet the private sector's needs. The expected impact is to have not only the private sector as a supplier of the ENVRIs but also a user and a full partner to actively participate in the European Innovation Ecosystem facilitating the exploitation of disruptive discoveries and the opening of new markets.

GOAL 5: Develop case studies
Developing case studies that demonstrate the value of environmental data to the private sector should be the last goal which can help Step 1 of the Strategic Action Plan. These case studies can showcase the potential financial and reputational benefits of using high-quality environmental data produced by ENVRIs and can serve as examples for other businesses to follow. The "ENVRI user story video competition"[38] developed in 2021 is a very good example of what can be done in this sense. Indeed, it is not only a matter of the intrinsic value of ENVRIs data but also to showcase the broader values coming from accessing remote places, as in the case of SIOS the won the competition, getting unique data directly from the local environment and getting to know the context in order to interpret annotations, procedures and peculiarities of the specific locations.

In order to facilitate the carrying out of the monitoring activities foreseen in Step 4, it is strongly recommended to define for each of the above-mentioned goals quantitative and qualitative metrics and specific targets. Some of them could be extracted from the KPIs defined by ESFRI in the document titled "Monitoring of Research Infrastructures Performance, Working group report, 2019"[39].

[36] https://en.wikipedia.org/wiki/Persistent_identifier
[37] https://www.go-fair.org/
[38] https://envri.eu/envri-user-story-video-competition-knows-its-winner/
[39] https://www.esfri.eu/latest-esfri-news/report-esfri-working-group-monitoring-ris-performance

3.3 Step 3 - Develop and adopt a roadmap

Taking advantage of the work done in the H2020 projects ENVRIplus and ENRIITC, previously mentioned, and looking ahead towards the ENVRI Innovation Hub and a similar office in the ERIC Forum Secretariat, currently being defined, the roadmap we are defining in this chapter will perfectly fit the puzzle concerning the ENVRI's part of it.

RIs are at the centre of the knowledge triangle and, as such, they are key for European competitiveness. In order to continue to play a key role in the European Innovation Ecosystem, RIs should overcome fragmentation by strengthening the collaboration level among them and improving the efficiency and the value propositions of services offered to the stakeholders.

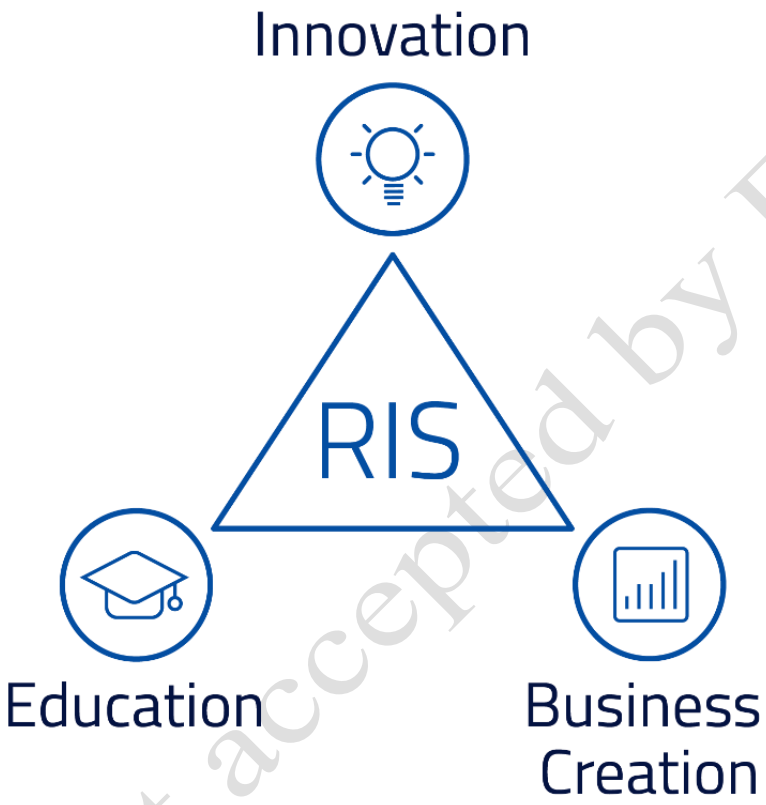

Figure 7: The concept of Knowledge triangle developed in the EU Lisbon Strategy and at the basis of the creation of the European Institute of Innovation and Technology (EIT)

Accordingly, the "Research Infrastructures Innovation-Preparedness Roadmap" proposal developed in ENVRIplus D18.5, and fine-tuned by ENRIITC, offers a modern and up-to-date set of guidelines that define a path the ENVRIs are invited to follow to develop permanent and fruitful relationships with the private sector, including industry, and boost the European innovation chain. The adoption of the roadmap will facilitate the uptake of the ENVRIs data by the private factor having it as a full partner.

As said in the previous chapters, the roadmap has two overarching objectives:

- develop a common methodology that could be useful for all the ENVRIs regardless of the RI being single-sited or distributed, or if it is an e-infrastructure or not;
- work towards being able to offer ESFRI not only a regular source of RI innovation success stories but also provide to the RIs of other ESFRI domains, best practices and lessons learnt that could be used to successfully implement the roadmap in other domains.

Indeed, the evidence came out from the recently implemented surveys provides a clearer view of the way in which the ENVRIs and the EU RIs at large are collaborating with the private sector and the range of collaborations in place suggests that there is a strong need for preparing the EU RIs to level up the effort and the results in this subject matter.

Looking at the roadmap in more detail, it is composed of five main parts, listed below:

1. Establish an ENVRI Innovation network
2. Adopt a set of core competencies for ICOs
3. Implement specific key actions
4. Building strategic alliance relationships
5. Develop an ENVRI Research and Knowledge Exchange Strategy focused on innovation practices

Regarding the first point, the ENVRI Community Innovation Network is meant to be a hub-and-spoke network with a central ENVRI Innovation Hub that is in constant contact with the Industry Contact Officers located in each RIs. The ENVRI Innovation Hub will be part of the ENVRI Hub and will be developed if the Horizon Europe proposal ENVRINNOV is successful starting early 2024.
Aligned with the ESFRI White Paper's[40] strategic objective to "accelerate the exploitation of EU RIs as knowledge and innovation hubs", the ENVRINNOV project aims at coordinating the co-design, test, and validation of a common ENVRI Innovation Roadmap to set a credible long-term pathway for the ENVRI community to:

- spearhead the evolution and coordination of an ENVRI Community Innovation Network, and
- establish an ENVRI Innovation Hub (EIH), positioned at the core of the Network, responsible for its orchestration and management.

Individual ENVRIs will act as nodes in the Network, enriching it with their innovation capacity. The added value of the EIH will be in providing the necessary environment (including the digital platform, assets, trends' intelligence, people and resources), to create links between the ENVRI community and wider ecosystem actors and enable co-creation for the development of new technologies and services. During the project, the EIH will be digitalised and possibly embedded into the ENVRI-Hub portal, establishing synergies, and inter-linkages with pertinent ecosystem players, including the European Open Science Cloud (EOSC) and its Digital Innovation Hub (EOSC-DIH).

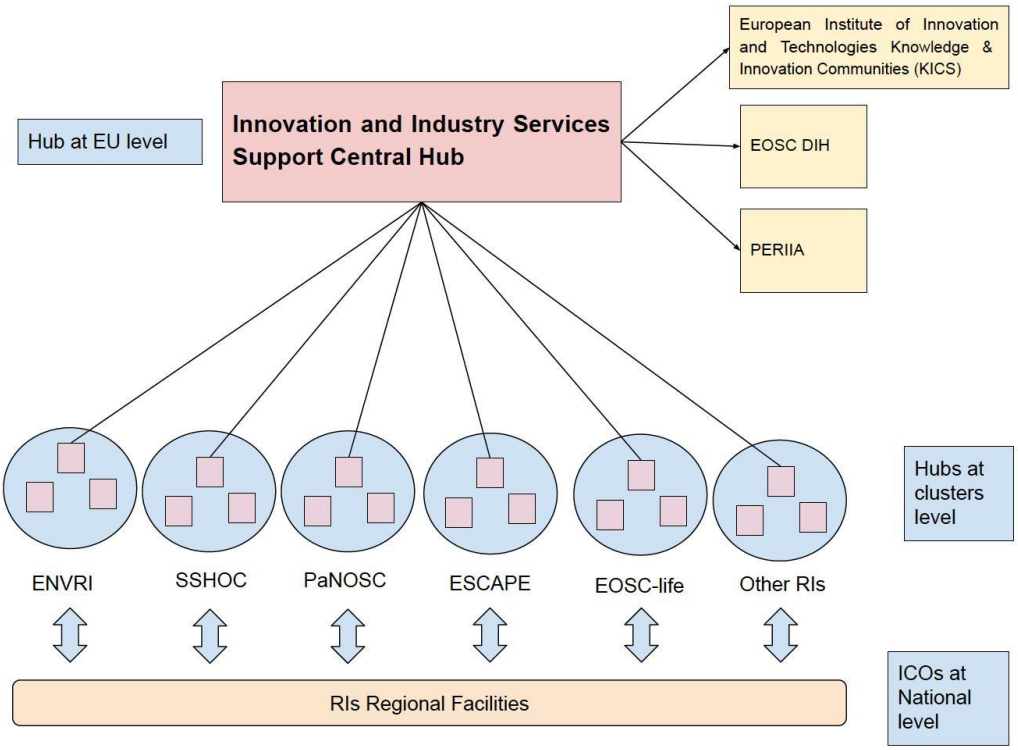

Figure 8 - ENRIITC Hub-and-spoke pan-European network for supporting RIs in building fruitful relationships with industry

[40] https://www.esfri.eu/esfri-white-paper

As foreseen in the cross-domain pan-European Innovation Network model developed during the ENRIITC project (D3.1) (fig.7), the ENVRI Innovation Hub should be part of a broader network involving all the other ESFRI clusters and non-ESFRI RIs. In this sense, the roadmap presented here paves the way for the ENVRINNOV Roadmap, which is focused on a series of practical developments to support the technology transfer, data uptake and outreach activities.

Regarding point 2, the recommended starting point is for each RI to appoint an Industry Contact Officer (ICO) with a set of core competencies as outlined in the ENRIITC project (D3.1). Indeed, due to the complexity of the role, the ICO needs to have a wide range of competencies, from technology transfer and commercialisation strategies, including patenting processes, to excellent market insight, extensive professional networks and a clear view and understanding of key science themes and drivers.
It is also desirable that the ICOs have adequate legal and economic competence to make an initial assessment of whether an invention or process is patentable or not, and with sufficient marketing and business skills in order to identify commercial partners.
A specific proposal for the list of competencies (hard skills) and soft skills has been developed within the ENRIITC D3.3 entitled "Strategy for the training of ILOs/ICOs and outreach towards industry".
Regarding the implementation of specific key actions, a detailed list of 17 key areas with recommended actions has been presented in the ENRIITC D3.2 "Strategy for innovation and industry-RI cooperation" to help the RI improve their collaboration with industry and to establish a common baseline for RIs for developing systematic innovation-partnering industry-liaison programs.

The 17 recommendations listed in Table 4 have been grouped under four themes, listed above, which cover both the RI's internal priorities, and strategies and tools for engaging with companies and ecosystems surrounding the RI:

1. **Organisational support for innovation:** measures concerning the RI internal structure and prioritisation of resources setting specific goals and targets (partially covered by Step 2).
2. **Engaging the innovation ecosystem:** important points regarding the interaction with stakeholders in the innovation ecosystem surrounding the RI.
3. **Industry collaboration models:** options and perspectives on how to set up collaborations.
4. **Funding structures for increased industry collaboration:** strategies for pursuing supplementary funding for innovation activities in collaboration with companies (Regional or National initiatives, European initiatives, international initiatives).

The discussions in the different fora clearly demonstrate that no "one-size fits all" strategy for industry engagement can be envisioned, and that each of the RIs should adapt those general recommendations to its own characteristics. But overall, it is important to have common guidelines that are applicable regardless of the domain and the structure of the RI as a baseline for further developments.

Table 4: The 17 recommendations categorised into four groups: Updated version of ENVRIplus RI "Innovation-Readiness" action-plan Recommendations

17 RI "Innovation-Readiness" action-plan Recommendations	
Organisational support for innovation	1.1 Develop a strategy for innovation with industry
	1.2 Organisation of the RI
	1.3 Industry advisory board
	1.4 Other processes to support an innovation culture
Engaging the innovation ecosystem	2.1 Industry clusters and associations
	2.2 RTOs and Technological infrastructures
	2.3 Universities
	2.4 ICOs and local nodes of distributed RIs
	2.5 ILOs as national nodes/multiplier
Industry collaboration models	3.1 Confidentiality
	3.2 Liabilities
	3.3 Collaboration and co-development
	3.4 Innovation procurement
	3.5 Service models
Funding structures for increased industry collaboration	4.1 National initiatives
	4.2 EU level initiatives
	4.3 National ministries and agencies

Moving to point 4, in addition to what it has been said in the Step 1, each individual RI should pursue collaboration with relevant local/national/European stakeholders to be an active member of the European Innovation Ecosystem. In parallel, the ENVRI Community Innovation Hub will ensure that the RI operational and sustainability model is understood and recognised at a European level. Indeed it is key that innovation policies and strategies recognise the role of RIs in the broader innovation ecosystem and lower the barriers for them and the potential individual collaboration partners (see key area 2) to put in place concrete collaborations.
In this perspective the following European organisations are key in the innovation ecosystem and should be involved in strategical partnerships building activities:

Table 5: Key European organisations in the innovation ecosystem

EARTO[41]	EARTO promotes Research and Technology Organisations (RTOs) and represents their interest in Europe. RTOs are non-profit organisations whose core mission is to produce, combine and bridge various types of knowledge, skills and infrastructures to deliver a range of research and development activities in collaboration with public and industrial partners of all sizes. EARTO network counts over 350 RTOs in more than 32 countries.
The European Institute of Innovation and Technologies[42] **(EIT) Knowledge & Innovation Communities (KICS)**	EIT is key for cooperation on joint Entrepreneurship Training programmes and Industry-partnering event organisation.
The PERIIA Network[43]	PERIIA has the aim of paving the way and preparing for the initiation of the Pan-European Research Infrastructure ILO Association as a formal European association. In fact, the ENVRI Community Innovation Hub should try to develop joint activities with PERIIA.
EIROFORUM[44]	It is the forum for policy coordinating and lobbying between 8 Big Science organisations.
The EOSC Digital Innovation Hub (DIH)[45]	It is an international and multi-partner cooperation that supports companies in easily accessing the digital technologies and services offered by EOSC.
The League of European Research Universities (LERU)[46]	LERU is a prominent advocate for the promotion of basic research at European research universities. LERU with its 23 members aims at furthering politicians', policy makers' and opinion leaders' understanding of the important role and activities of research-intensive universities.

Supplementary to these high-level interactions, the ENVRI Innovation Hub and each RIs should ensure strong links with the industry via the four different categories listed below. Representatives from these groups should be involved on a regular basis in the ENVRI's innovation fora or projects:

1. **Industry Association and Interest Group Aggregators**: Pan-EU and national industry federations and associations, as well as industry lobbies and interest groups that actively follow

[41] https://www.earto.eu/
[42] https://eit.europa.eu
[43] https://periia.squarespace.com/
[44] https://www.eiroforum.org/
[45] https://eosc-dih.eu/
[46] https://www.leru.org/

and advise on socio-economic issues and technology developments, on behalf of private sector members and stakeholders.

2. **Industrial suppliers**: Most often, these are found in networks or clusters operated by national ILOs that include companies operating as providers of both off-the-shelf components and state-of-the-art technologies.
3. **Industrial collaborators**: Potential RI industry partners who are engaged in technologies of interest for RIs, for example, superconductivity, cryogenics, big data processes and AI.
4. **Industrial users**: Industry in this group mainly acts as a user of the RI facilities, services and data, for early stage applied industrial research and for testing innovative developments and products. Additionally, the industry uses RIs for training within the framework of exchange programmes. In this respect, the access to RIs by industry is regulated by the "European Charter for Access to Research Infrastructures - Principles and Guidelines for Access and Related Services" as mentioned above.

In the past, it has been noted that relationships between RIs and local stakeholders are of greatest benefit when starting collaborations with the private sector. For distributed RIs that means a lot of opportunities in the locations where the regional facilities are located. Geographically restricted collaborations have been identified as fundamental drivers for the eventual enlargement of the collaboration to other entities that could be distributed or linked with the local business community at the international level.

Finally, regarding point 5 on the development of an ENVRI Research and Knowledge Exchange Strategy focused on innovation practices, that will be mainly done within the development of the ENVRI Innovation Roadmap in the ENVRINNOV project. The overall idea is to develop an innovation strategy similar to the ones developed in the UK by the University of Salford[47] or University of Oxford[48] that are functional to the objective.

[47] https://www.salford.ac.uk/sites/default/files/2020-06/Research-and-Knowledge-Exchange-Strategy-Web.pdf
[48] https://researchsupport.admin.ox.ac.uk/files/knowledgeexchangestrategypdf

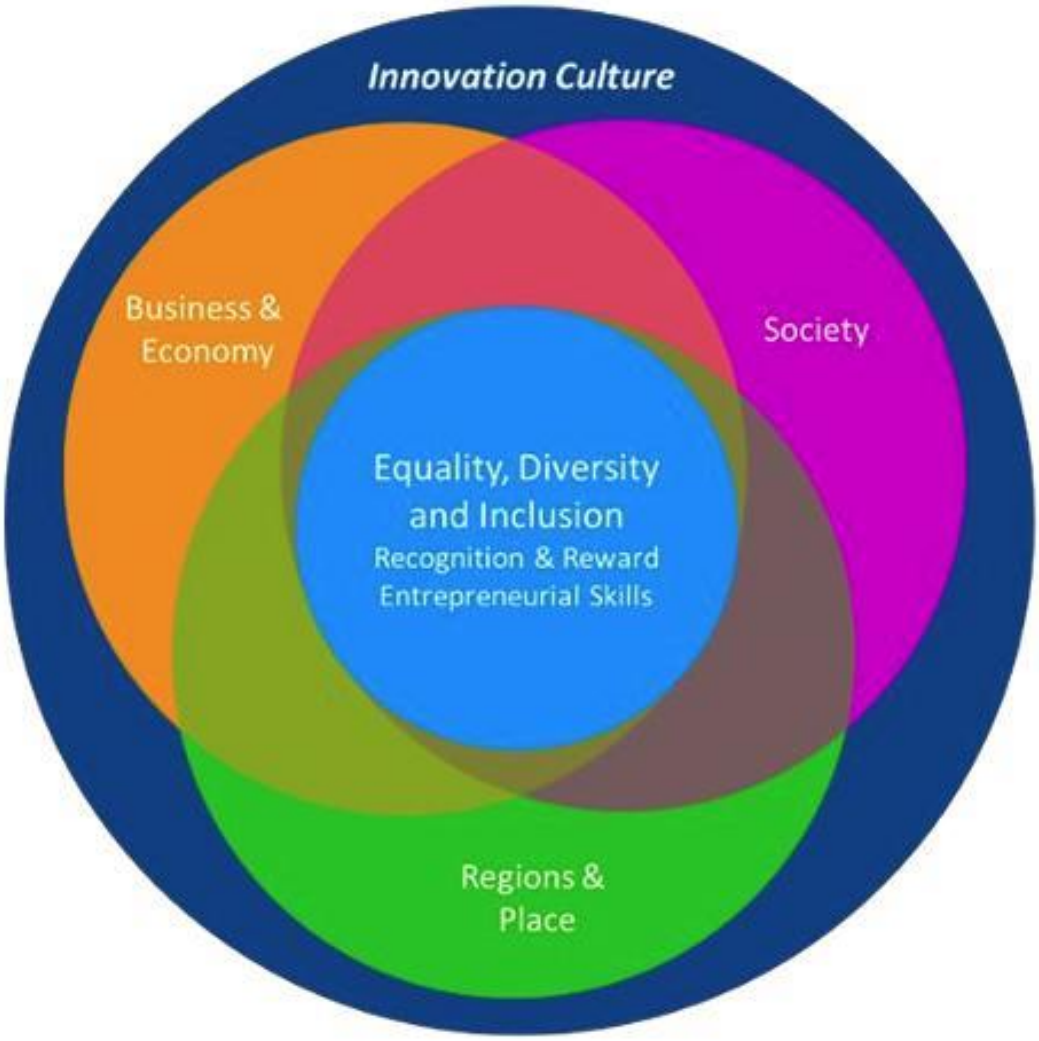

Figure 9: Knowledge Exchange Priority Areas 2021-2025. Credits, University of Oxford.

The key objectives of an ENVRI and at large European RI Innovation Strategy could be:

- Enable RIs to be the core engine of the innovation supply chain facilitating the development of spin-offs, start-ups, and partnerships with private entities in close cooperation with the universities.
- Have systematic knowledge exchanges with industries all over Europe to activate a virtuous cycle to add value to the research outcomes and products and create new markets.
- To produce internationally excellent research together with the industry to foster European excellence in science and innovation companies.
- To exploit the potential of RIs as excellent workplaces for researchers' training and career development for functioning as a high-quality pipeline of future research and industry leaders starting from graduates and postgraduates, or industry employees to become conversant with the latest scientific discoveries, technologies, and scientific methodologies.

3.4 Step 4 - Monitor and evaluate progress

Monitoring and evaluating progress at the end of the implementation of the presented action plan is essential for ensuring accountability, assessing effectiveness, facilitating learning and improvement, supporting decision-making, engaging stakeholders, and optimising resource allocation. It enables the ENVRIs to make evidence-based decisions on future actions, learn from the first iteration activity, and start the process of continuously improving the strategic planning and implementation processes.

Looking in detail at the motivations to perform this last Step, here are the most relevant:

- **Effectiveness assessment**: it allows for an assessment of the effectiveness of the actions taken. It helps answer questions such as: Did the implemented actions achieve their intended outcomes and objectives? Did they produce the desired impact? By evaluating progress, it becomes possible to gauge whether the strategic plan successfully addressed the identified goals and achieved the desired results.
- **Learning and improvement**: it provides opportunities for learning and improvement. The ENVRIs can identify what worked well and what didn't, enabling them to learn from both successes and failures. This knowledge can then be used to improve future iterations of this strategic action plan. Finally, it allows for the identification of best practices, lessons learned, and areas for improvement.
- **Decision-making**: it provides important information for decision-making processes. By assessing progress, decision-makers can make informed choices about the future direction. They can identify areas where adjustments or corrective measures are needed and allocate resources more effectively based on the results and findings of the evaluation.
- **Stakeholder engagement**: it helps engage stakeholders throughout the implementation process by sharing progress updates and evaluation results. The ENVRIs can involve the stakeholders from the very beginning in decision-making to fine-tune the plan and increase transparency and trust. Finally, it allows stakeholders to provide feedback, share their perspectives, and contribute to the ongoing improvement of the strategic action plan kicking off the collaboration before the real collaboration on data uptake starts in a co-design environment.
- **Resource optimisation**: it enables organisations to optimise resource allocation. Indeed, assessing progress, the ENVRIs can identify areas where resources were underutilised or misallocated. This information helps reallocate resources to activities or strategies that have proven more effective and efficient, thereby maximising the impact of available resources.

In order to assess the outcomes of the steps presented in the plan, we suggest the following methodology to monitor and evaluate progress.

Figure 10: The Monitoring process life cycle

1. **Collect and analyse data:** collecting and analysing data on the use of environmental data by the private sector before and after putting into action the plan, can provide insights into the level of uptake and areas where more support is needed to kick off the collaboration. This can involve tracking website analytics (where possible in compliant with the GDPR and local privacy laws),

surveying users, or monitoring the use of data products through AAI mechanisms like the EGI Check-in service[49] that operates as a central hub to connect federated Identity Providers (IdPs) with EGI service providers.

2. **Conduct impact assessments:** impact assessments can help understanding the broader impacts of ENVRI data uptake by the private sector. This can involve assessing changes in production chains, cost savings, and other economic and environmental outcomes.
3. **Use feedback mechanisms**: establishing feedback mechanisms can provide insights into the private sector's experience of using ENVRI data products. This can involve collecting feedback through surveys or establishing user groups where private sector representatives can provide feedback and suggestions for improvement.
4. **Monitor partnerships**: monitoring partnerships between research institutions and the private sector can help to understand the level of engagement and the success of collaborative efforts. This can involve monitoring the number and nature of partnerships formed and tracking the level of involvement of private sector partners in research projects.
5. **Evaluate progress against goals:** regularly evaluating progress against the set of goals identified in Step 2, can help to determine whether the initiatives are on track or if adjustments are needed. This can involve conducting regular progress reviews, comparing progress against benchmarks, and adjusting goals as necessary.

[49] https://www.egi.eu/service/check-in/

4 Conclusions

This deliverable reports the strategic plan for strengthening RI innovation-cooperation awareness and preparedness and promoting industry uptake of ENVRI data services in compliance with FAIR principles.

The strategic plan is based on the data collected through the activities performed in the frame of T3.4, such as the survey, the workshop, the previous deliverable D3.5 as well as the analysis of some deliverables edited by other European projects dealing with the relation between Research infrastructures and industry.

The document acknowledges the need for a systematic approach to enhancing the uptake of ENVRI data by the private sector, which is based on four specific steps:

- Step 1: Identify and engage key stakeholders
- Step 2: Set specific goals
- Step 3: Develop and adopt a roadmap
- Step 4: Monitor and evaluate progress

The above-mentioned steps could be implemented individually by each ENVRI R as well as jointly, such as a collaborative activity to be included in future projects.

A collaborative activity to **Define, test, validate, digitalise, and promote the uptake of common strategies to enhance innovation across the ENVRI community network** has been already planned by some Research Infrastructures which submitted a project proposal named ENVRINNOV, in the Horizon Europe call HORIZON-INFRA-2023-DEV-01-05, in March 2023. Other Research Infrastructures involved in ENVRI-FAIR submitted different proposals in the same call and could promote the same systematic approach to the uptake of ENVRI data by the private sector.