



D17.5 SUSTAINABILITY PLAN

WORK PACKAGE 17 – COORDINATION OF RI COMMUNICATION, DEVELOPMENT AND IMPLEMENTATION OF THE ENVRI STRATEGY

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ABSTRACT

The cooperating research infrastructures in the ENVRIplus project worked from 2014 to beginning 2019 on the design, development, deployment, operation and use of common facilities. These efforts resulted in quite some services for all individual research infrastructures, as well as for their cooperative initiatives. From the very beginning of the project was attention for sustaining all the achievements after the end of the project. Considering that each individual research infrastructure has its own legal entity with dedicated governance and management, the challenge is to agree on modes of cooperation to keep tools and services of common interest up to date and operational. This deliverable 17.5 reports about the concluded Sustainability Plan. The plan is framed by the views of stakeholders, more specifically the views of the involved research infrastructures, and also of relevant scientific bodies, policy bodies. The methodology applied to craft the Sustainability Plan followed two approaches. First, a 'bottom-up' approach to identify and analyse each developed result in the ENVRIplus project in the perspective of relevance for all cooperating research infrastructures. The list of these research infrastructures is in Appendix A. Second, a 'top-down' approach to consider the future ENVRI structure, regardless of any funded collaborative project. Considerations in this respect depart from a common strategic view on the purpose and benefits of continued cooperation. The result of these approaches and multiple discussions in the BEERi resulted in a common view to position ENVRI strongly for the next decade. Agreements on a sequence of decisive steps to establish a sustained ENVRI will also support the collaborative infrastructure contributions to advanced research across traditional scientific borders, and to provide scientific support for a holistic understanding of our planet and its behaviour, processes, feedbacks, and fluxes. This also clarifies remaining challenges, as will partly will be tackled by the new ENVRI-FAIR project.

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DOCUMENT AMENDMENT PROCEDURE

Amendments, comments and suggestions should be sent to Wouter Los <w.los@uva.nl>

TERMINOLOGY

A complete project terminology is included in Appendix B.

PROJECT SUMMARY

ENVRIplus is a Horizon 2020 project bringing together Environmental and Earth System Research Infrastructures, projects and networks together with technical specialist partners to create a more coherent, interdisciplinary and interoperable cluster of Environmental Research Infrastructures across Europe. It is driven by three overarching goals: 1) promoting cross-fertilization between infrastructures, 2) implementing innovative concepts and devices across RIs, and 3) facilitating research and innovation in the field of environment for an increasing number of users outside the RIs.

ENVRIplus aligns its activities to a core strategic plan where sharing multi-disciplinary expertise will be most effective. The project aims to improve Earth observation monitoring systems and strategies, including actions to improve harmonization and innovation, and generate common solutions to many shared information technology and data related challenges. It also seeks to harmonize policies for access and provide strategies for knowledge transfer amongst RIs. ENVRIplus develops guidelines to enhance transdisciplinary use of data and data-products supported by applied use-cases involving RIs from different domains. The project coordinates 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.

ENVRIplus is expected to facilitate structuration and improve quality of services offered both within single RIs and at the pan-RI level. It promotes efficient and multi-disciplinary research offering new opportunities to users, new tools to RI managers and new communication strategies for environmental RI communities. The resulting solutions, services and other project outcomes are made available to all environmental RI initiatives, thus contributing to the development of a coherent European RI ecosystem.

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SUSTAINABILITY PLAN

1. INTRODUCTION

The development of the ENVRIplus Sustainability Plan is established as Task 17.5 in the WP17 (Coordination of RI communication, development and implementation of the ENVRI strategy). The task entailed the analysis of the most suitable, long-term operational and utilizable model for maintaining the cluster level common operations, services and collaborative bodies, boards and community platform beyond the ENVRIPLUS project life-time. The ENVRIPLUS sustainability plan would include means how to maintain the common operations and services provided during the projects. The plan is also meant to address the future development needs and actions for pilot and test cases and how to sustain the technological, data, management related project outcomes in a feasible organizational framework. The organizational framework should also ensure the continuation of the dissemination, training and communication actions of the cluster.

Many experts of research infrastructures worked together to develop novel tools supporting users of environmental research infrastructures in data production, or to access, retrieve, and analyse existing data. All these data represent the dynamics of our environment with respect to the planetary crust, the marine and fresh water bodies, the atmosphere, the impact of solar fluctuations, and the buffering role of the living environment. Apart from enhancing the services of individual research infrastructures on these environmental components, it is increasingly important to benefit from the combined services of these infrastructures. The ambition of the cooperating research infrastructures is to provide scientists the tools to work across conventional disciplinary boundaries, and to discover, extract and analyse/model selected data as dispersed across many different sources and in many different formats. The cooperating research infrastructures tackled these ambitions by developing operational tools and services. Moreover, this provided the basis for bringing together the facilities, resources and services in support of the scientific community for innovative research and improved informed environmental policies. As such, the task to develop the Sustainability Plan focused on ENVRIplus results to be sustained at the cluster level, thus relevant for all cooperating research infrastructures.

Environmental research infrastructures in Europe experienced in the last decade the benefits of working together in order to benefit from cooperative efforts. A key principle was to foster engagement of all European-level research infrastructures, independent of any European or other funding. The management of such infrastructures engaged in regular meetings of a common advisory panel, the Board of Environmental Research Infrastructures (BEERI) [9]. This Board entered a process to agree on sustaining the results of the ENVRIplus project after the end of this project. The ENVRIplus cooperation did not evolve in isolation. External stakeholders and their policies had impact on the individual research infrastructures and their ENVRI collaboration. These stakeholders are the respective national funding bodies of the research infrastructures, and also a variety of European and international policy bodies. Developing the new services was strongly promoted by European funding under contracts for two successive projects ENVRI (2011-2014) and ENVRIplus (2015-2019), and was leveraged by national and other domestic funding. Such catalyzing incentives proved to be crucial to foster cooperation between previously separated research infrastructure communities. Paragraph 3 reports about the stakeholder dynamics.

The original partnership in Task 17.5 included (between brackets the assigned person-months): Task leader: UvA[LIFEWATCH] (2), UHEL[ICOS] (3), participants: IFREMER[EURO-ARGO] (0.5), FZJ[IAGOS] (1), INRA[ANAE] (1), NERC[EPOS] (0.5).

2. METHODS

Sustaining the results of a collaborative project implies that all actors have to be aware of the implications of their joint responsibility in this respect. Responsibility refers to ownership of jointly developed project results, and to the future structure to maintain and update these results as common services. To this end, one approach was to identify crucial common services, products and other results to be sustained after the end of the project, and by which organisations. This “bottom-up process” focused on the results relevant for all research infrastructures. A number of ENVRIPLUS partners is prepared to sustain these results with continued service provision. However, not all required tasks could be taken up by individual organisations. Covering these tasks brings into consideration a kind of collaborative utilizable structure. This is a “top-down” process, focusing on the future ENVRI: what is the perspective for the infrastructures at the level of joint cooperation after the end of the funded ENVRIplus project.

The bottom-up process required intensive interactions with the WPs of ENVRIplus in order to identify their developed project results as relevant at the cluster level for in principle all involved research infrastructures. In addition, the relevant WP partners had to consider their responsibilities to sustain their developed services, how to advertise these, and to estimate associated efforts and annual costs. The top-down process asked primarily attention of the management of the research infrastructures. While being concerned with the construction and operation of their facilities, it proved to be a challenge to elaborate on common ENVRI challenges. Importantly, discussions in the BEERi assisted to appreciate each one’s positions and the expectations of collaborative efforts. In order to guide the discussions, two successive on-line surveys were run to receive input about the opinions. In addition, a dedicated workshop of the leadership of the research infrastructures promoted a common understanding on the process toward a sustained ENVRI. This workshop in November 2018 was moderated by the company Deloitte, and was very much appreciated by the infrastructure’s leadership. The resulting common views and planned actions are reported in the next paragraphs of this report.

3. ENVRI IN THE LANDSCAPE OF DEVELOPING POLICIES

3.1. CHALLENGES FOR ENVIRONMENTAL RESEARCH INFRASTRUCTURES

The ESFRI process to establish research infrastructures implies that individual initiatives must deal with their scientific communities, with presenting convincing plans, with a variety of funding bodies, with local site interests, and with a changing political landscape. It is in this context that sustaining the growing cooperation and interoperability of research infrastructures in ENVRI is not an easy dedication for the management of collaborating individual infrastructures. The emphasis in the last decade was on establishing new research infrastructures in Europe, and the understandable implication is that the infrastructure’s management is primarily concerned with its own internal business. The EC financial support for fostering cooperation in between environmental research infrastructures was attractive to explore and develop common practices, tools, and services. But sometimes this was considered as a distraction from the internal infrastructure’s challenges. It takes time to appreciate efficiency benefits of cooperation or joint external marketing, as well to manage expectations in regard to keeping control of internal power versus advantages of delegating tasks to cooperative efforts. Currently, the infrastructure’s view on utilizing data is changing. From putting data processing within a ‘walled garden’ (where many tools are brought together within a single curated platform), the new approach is a data

‘marketplace’ approach, where many tools are made available as micro-services within a wider market allowing users to find, compare, learn from others, and negotiate their preferred solutions or service level agreements. Apart from dealing with user demands, the management also has to deal with diverging interests of its national funders. Some of these funding bodies prefer to focus their policies on one or a few research infrastructures, while others don’t want to bother with individual initiatives and are encouraging merging efforts to avoid fragmentation.

3.2. THE ESFRI PROCESS

Developing the new services was strongly promoted by European funding under contracts for two successive projects ENVRI (2011-2014) and ENVRIplus (2015-2019), and was leveraged by national and other domestic funding. Such catalyzing incentives proved to be crucial to foster cooperation between previously separated research infrastructure communities. Since the beginning of this 21st century, the European Strategy Forum on Research Infrastructures (ESFRI) brought together national policy and scientific stakeholders to consider and to promote the establishment of new research infrastructures in scientific areas requiring innovations for breakthroughs [1]. ESFRI showed to be very effective in promoting intergovernmental agreements for supporting the construction and operation of new research infrastructures at European and sometimes at the global scale in all scientific disciplines. Despite the challenging process to come to agreements within the scientific community and between supporting governments, a growing number of European research infrastructures managed to reach agreement with and amongst funding countries, and started construction and successively entered their operational phase.

The European Commission published in 2018 a “Call for Action Report” asking attention for critical issues to ensure the sustainability of research infrastructures [7]. The report, drafted as a Staff Working Document of the European Commission, recognises that sufficient funding is crucial for sustaining research infrastructures and their cooperation, but concludes that sustainability of RI goes well beyond funding only, touching upon several dimensions such as scientific excellence, socio-economic impact or innovation. This is quite true for the environmental domain since societal and scientific challenges require full attention by the cooperating research infrastructures for tackling environmental complexity and its socio-economic impact of global change. Regrettably, the EC Staff Working Document is only addressing the sustainability of individual research infrastructures, and not their cooperative efforts while these are beneficial from the viewpoints of interoperability, user’s support, and efficiency. Clearly, ENVRI enters unknown territory in the process to sustain its cooperative efforts, tools and services. ENVRI does not enter this unknown territory alone, since cluster-projects in other scientific domains meet similar challenges. For example the CORBEL cooperative project of research infrastructures in the life sciences, offering more integrated access to data resources required for bio-medical research [8].

3.3. EXTERNAL STAKEHOLDERS VIEWS

The ENVRI and ENVRIplus projects were conditional for sharing experiences, for sorting out solutions for common technical problems, and for providing guidance to support users requesting data and services from more than a single data source. In addition, the cooperation in these ENVRI projects tackled common issues with respect to for example access services to multiple research infrastructures, ethical issues, training and exchange of staff, and common strategy development at the management level. These could not be developed in isolation, because also attention had to be paid to the relationship with parallel developments in *GEOSS* [2] and *COPERNICUS* [3], the European Union’s Environmental observation programme offering information services based on satellite observation and in situ data. Joint workshops assisted in defining each one’s work area with at one side the research infrastructures as

data generators, and at other sides GEOSS and COPERNICUS as portals for access to the data as relevant for their successive missions. Still, a seamless connection in between them is not obvious as the requirements by the scientific users of research infrastructures, and the policy oriented requirements of GEOSS and COPERNICUS users are not similar.

The *League of European Research Infrastructures* (LERU) published in 2017 a report on four golden principles for enhancing the quality, access and impact of research infrastructures [4]. First, a smart funding strategy is needed for research infrastructures to remain competitive, and to be leading and agile regarding further technological developments. Second, mechanisms should be developed to encourage cooperation, especially cross-border, thereby helping to avoid unnecessary duplication. Third, create a more robust and better connected European network of research infrastructures. Fourth, the academic community should play the leading role in planning and operating the research infrastructures. Indeed, these four principles touch on important and also sensitive issues. Scientists expect that the research infrastructures are leading in new technical developments and related user services. However, such a risk-bearing approach is very different from the more conservative risk-avoiding attitude of funding bodies (often ministries). This intrinsic tension complicates the sustainability of novel tools and services as described in this book, especially when this would require funding from different resources (individual infrastructures). Most environmental research infrastructures are inherently distributed, dictated by the need to collect data and observations locally from around the planet. This may be an advantage for financing research infrastructures as it allows for domestic funding solutions rather than (only) funding a not-national European or international organisation. The disadvantage is however that it often prohibits the second principle above on avoiding unnecessary duplication through cross-border cooperation.

Other policy bodies also addressed the challenges of sustaining research infrastructures and of international cooperation. A strong example is the *OECD Global Science Forum* (GSF) with its mandate to address scientific issues that require global solutions [5]. Much attention has been and still is on research infrastructures, especially internationally funded infrastructures, and the international access to their facilities. The GSF promotes the principle that the world's best researchers want to have access to the best infrastructure facilities, and that these facilities benefit from their innovative engagement. A continuous activity of the GSF is to identify policies and procedures that can strengthen the sustainability and the effectiveness of the functioning of research infrastructures during their entire life cycle (including their dismantling or potential reuse). Priority targets are to lower initial investment and operating costs by improved standard planning and business models; to accelerate construction and implementation phases by better adapted planning procedures; and to realize effective planning, budgeting and implementation of human-resources and controlled optimization of the running costs for Ris, considering that operational performance will lead to sustainable, attractive and productive research environments at both single-site and distributed Ris. However, this ongoing activity did not give attention to the implications of cooperation to promote the interoperability of research infrastructures.

3.4. THE LANDSCAPE OF ENVIRONMENTAL RESEARCH INFRASTRUCTURES

The ENVRI cooperation was and is still crucial for its joint ambition to contribute to advanced research and to addressing the grand challenges with respect to global change. Considering the complex interactions in the environment that cannot be studied from only a single perspective and supported by a single research infrastructure, interoperable infrastructure services enabling free access to and analysis of the gathered data are requiring novel ways to work together. In this respect, ENVRIplus invested much attention to elaborating its landscape of focal interest areas, both at the European and the international scale. As for the European scale, the deliverables D17.1 and D17.3 of the ENVRIplus project are reporting about the infrastructure landscape. D17.1 presents the progress made by the (atmospheric, marine,

biodiversity/-ecosystem, and solid earth) domains in the collaboration. D17.3 reports about the landscape analysis of the whole environmental infrastructure community in Europe. In addition, the ENVRIplus partnership is contributing to the project RI-scape, mapping the full European landscape of research infrastructures in all disciplines [14]. All these efforts proved to be crucial for sustaining the ENVRI community, since it fostered the internal cooperation, as well as the outreach to external communities benefitting from improved ENVRI services.

4. A NEW STRATEGY FOR ENVRI

4.1. STRATEGIES OF THE ENVRI AND ENVRIPLUS PROJECTS

ENVRI, as a cooperation of European environmental research infrastructures, started in the first half of the 2010 decade with a common strategic view serving as guidance for 10utilizing10 joint project activities. The strategy was based on the vision to provide scientific support for a holistic understanding of our planet and its behaviour, processes, feedbacks, and fluxes. The challenge is than to contribute to developing an environmental system model, a framework of all interactions within the Earth System, from solid earth to near space. Many of the urgent challenges we are facing (such as climate change, energy use, water availability, food security, land degradation, hazards and risks, life in mega cities, and human health) are closely related to complex interactions in the environment. Whilst each individual research infrastructure is concerned with its own domain of interest, it was thought imperative to find robust yet lightweight means to integrate various operations across research infrastructures to serve an increasingly multidisciplinary scientific community and to help addressing the urgent societal challenges. To this end, three resource ‘capitals’ were identified as strategic targets within a conceptual model.

- Technological Capital: Capacity to measure, observe, compute, and store data, with technologies, software, and analytical and utilization capabilities.
- Cultural Capital: Open access to data, services in between Ris, requiring rules, licenses, citation agreements, IPR agreements, machine-machine interactions, workflows, metadata, data annotations, etc.
- Human Capital: The specialists to make it all work, with also generalists overseeing more than only their own discipline.

The ENVRIplus project focused on implementing these ‘capitals’, and the next step is to benefit from the developed ‘capitals’ to address the above grand challenges.

4.2. CONSIDERATIONS FOR A NEW ENVRI STRATEGY: VISION AND PURPOSE

Two on-line surveys assembled the opinions of the RI leadership about a new ENVRI strategy, more specifically on a potential agreed vision and purpose of the ENVRI cooperation. In November 2018, in between the two surveys, a dedicated BEERi workshop discussed details of the further ENVRI strategy. This workshop was very well moderated by professionals of the Deloitte company. The following topics were discussed, resulting in preliminary conclusions.

4.2.1 A common understanding

In the main discussion participants looked at different perspectives to ENVRI community. In general, there was quite a high consensus among the participants on the need for and usefulness of ENVRI community and on its position in the society. The line between external and internal stakeholders was seen as unclear, as many of the RI members and scientists benefit both from the internal efficiencies within the ENVRI community as well as the impact ENVRI has on the society. In the discussion on the societal value creation by the ENVRI community, it was raised that ENVRI is perhaps not so strong in creating value for private industry but can instead be seen as more useful for preserving and conserving value. The participant’s opinions about the main external stakeholders for the ENVRI community focused on the societal impact of ENVRI services, and on internal efficiencies arising from their cooperation.

- Most important stakeholders:
 - Policymakers & lobbies; policymakers (high and low level); policy (through science); decision makers;
 - Scientific communities; researchers (multidisciplinary); working scientists and students; science and educators;
 - Private sector / industry; business: test beds, product/service development; insurance companies;
 - General public; citizens;
 - Funding agencies, national and international;
 - IPCC, UNFCCC, UNEP.
- Most important benefits from cooperation:
 - Common voice & legitimacy; Common contact point; Visibility;
 - Multidisciplinary approach to grand challenges; Cross domain knowledge, cross boundaries Understanding complexity of Earth systems,
 - Common access (data interoperability); improved efficiency for data users and providers
 - Sharing of experience, effective management, methods, harmonization, cost effective
 - Lobbying
 - Common strategy
- Most important impacts on society:
 - Breakthroughs in science; New solutions increasing our knowledge; Near real time information on environmental process
 - Educated public; Provide efficient answer to grand challenges; Improved awareness & decision-making;
 - Sustainability; Targeted solutions, eg. Mitigation and adaptation
 - Common authority of voice
 - Research & Innovation, PPP

4.2.2. Purpose and Vision

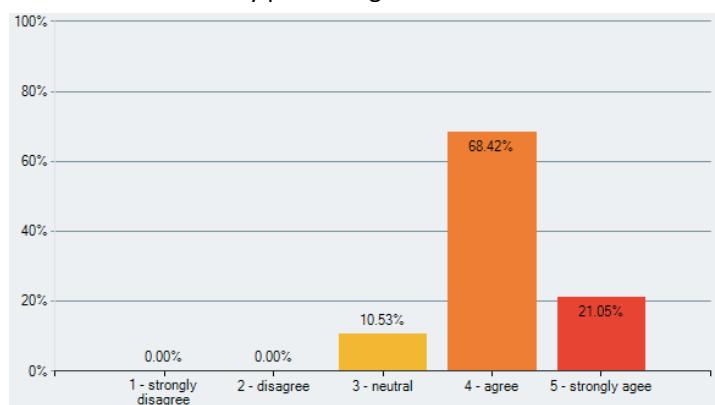
The workshop discussed a future-oriented vision (5-15 years). The development of a comprehensive Earth-systems model as a key part of the vision was reconfirmed. However, the complexities in ENVRI community were considered as a challenge to bring this part of the vision into reality. Nevertheless, the leadership present in the workshop believed in this perspective and voted for a few specific additional visionary statements (presented below in order of support).

- Provide multidisciplinary fair data and data-related services enabling societies to respond to grand challenges in an informed way and mitigate risks.
- Contribute by 2030 in making Europe the most attractive place to perform environmental research by providing a unique multidisciplinary network & cooperation of RI and related expertise.
- Establish a one-stop shop for information & data – access to strengthen the role and visibility of environmental RI delivering services for science and society.
- Deliver FAIR data and coordinated services for users to consume in support of environmental sciences by 2030.
- Provide qualified interoperable data for a good system approach that allows the modeling of dynamics of life on Earth.

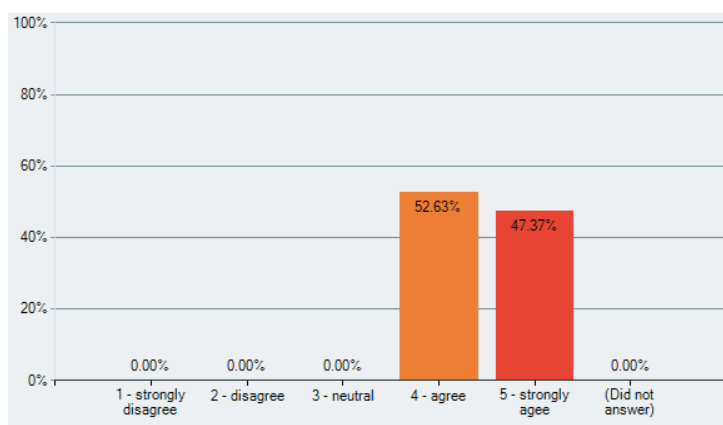
These outcomes of the discussion were used to open a survey to collect in a more systematic way the opinions of the research infrastructures engaged in ENVRIplus. This resulted in the following picture (with indicated preferences for the years from 2025 on). The response on the survey was 85%.

A. Purpose of the ENVRI cooperation (where can ENVRI create best value for society?)

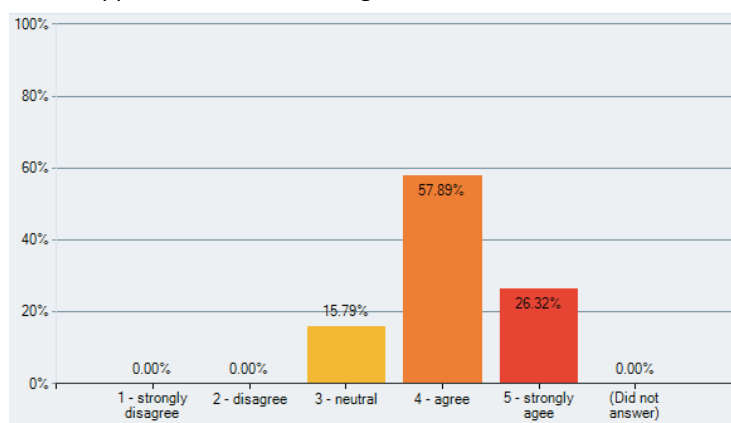
Advertise the significance of Earth sciences by promoting an informed and educated civilian and policy interest.



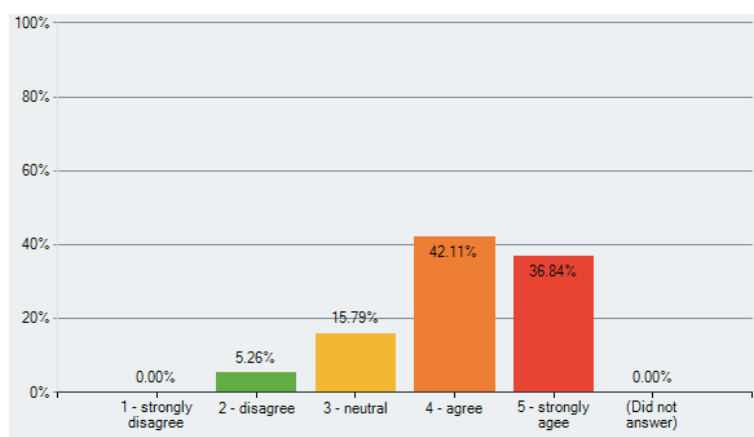
Present a common ENVRI voice and legitimacy by increasing the visibility of the cooperating RIs with advocacy, and provide a platform for discussion.



Provide combined infrastructure services from different RIs to address pressing and complex environmental issues (grand challenges), to support breakthroughs, or to offer near real-time information about environmental processes in support of decision-making.



Work together to make Europe the most attractive place to engage in environmental research.

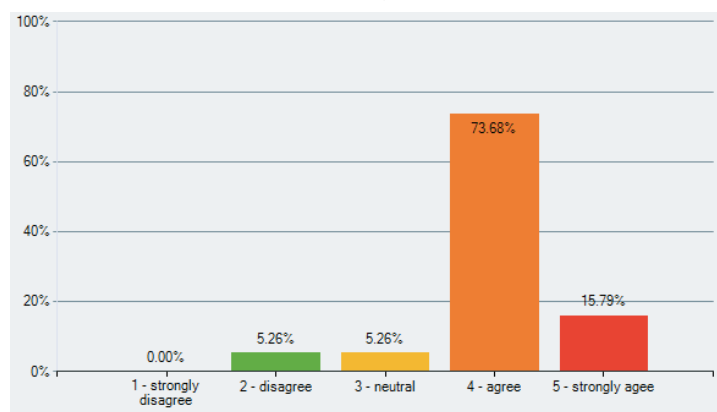


Comments

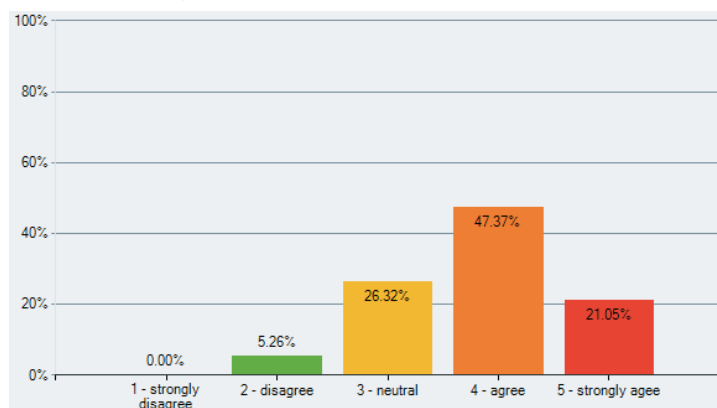
The strongest support is for advertising Earth sciences and promoting the visibility of the cooperating research infrastructures. The BEERi concluded in addition that ENVRI should not function as an exclusive monopoly by excluding new members and keeping the old ones. ENVRI can only keep legitimacy if it is based on scientific merits, not on science political power.

B. Operational efficiency (how can the ENVRI cooperation benefit the RIs?)

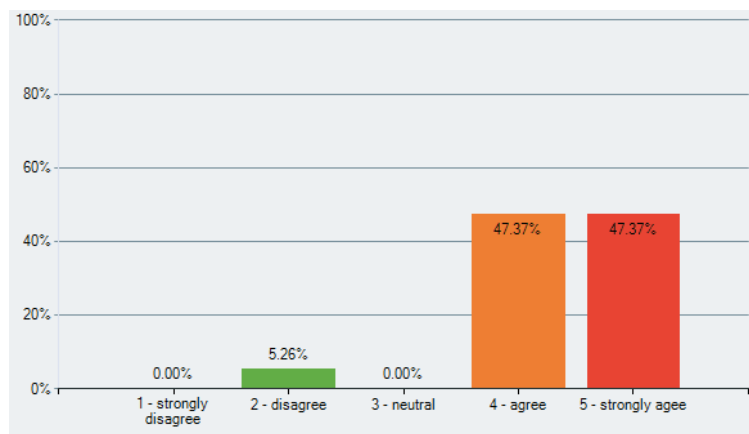
Establish a more recognizable ENVRI brand and credible reputation.



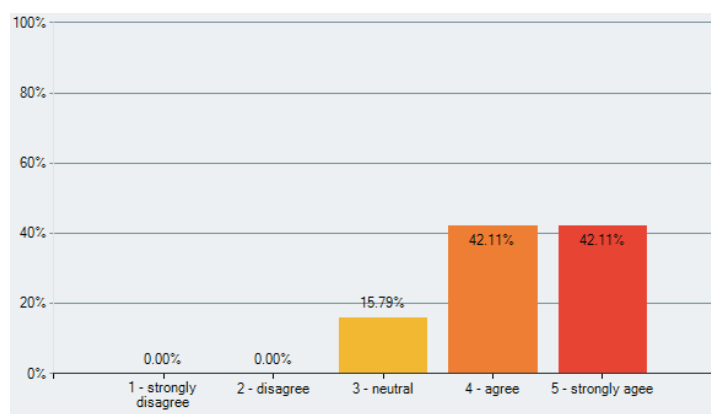
Overcome fragmentation from RI heterogeneity, competition, and cultural differences.



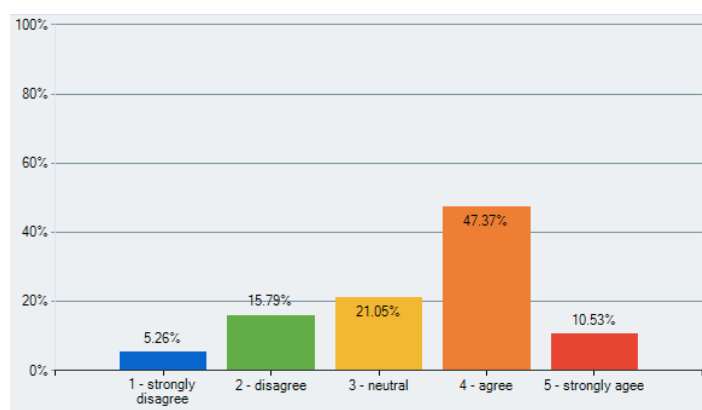
Share expertise on construction and operational approaches (including effective management, architecture, Reference Model, data processing capabilities and other methods, harmonization, ethical guidelines, cost effectiveness).



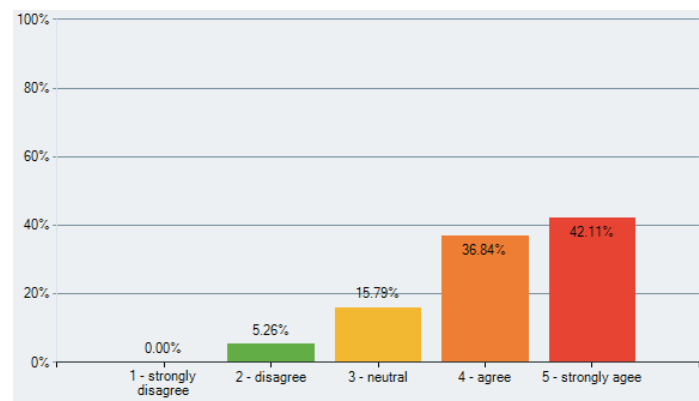
Provide multidisciplinary and fair data with data-related services, to support for example the modeling of Earth dynamics.



Offer integrated ENVRI user's access (*one-stop shop*) for interdisciplinary researchers, in addition to the existing access services of individual RIs.



Joint efforts for human capacity building (training, staff exchange, career planning, etc.).



Comments

- All questions about the benefits of internal efficiency in ENVRI cooperation receive strong support.
- Although multidisciplinary and fair data with data-related services receive sufficient support, the suggested action of offering integrated ENVRI user's access (one-stop shop) for interdisciplinary researchers (in addition to the existing access services of individual RIs) received slightly less support.
- Access for interdisciplinary projects is a process still to be validated at the level of individual RIs.
- The survey answers are indicating that all actions should be taken up by ENVRI with due attention on what are required practical operational approaches for individual RIs.

4.3. OBSTACLES AND SOLUTIONS

The BEERi workshop also addressed the most possible obstacles that could complicate reaching the future vision for ENVRI. The next top three considered obstacles are partly relevant for internal ENVRI policies, but partly also depending on external (funding) policies.

- Lack of visibility and communication.
This asks for more engagement of individual RIs with the overall ENVRI communication strategy, and RI leaders concluded on an action to instruct their communication officers in this respect. Demonstrating the added value of ENVRI requires a single ENVRI message. This partly requires communicating the ENVRI landscape with the complementary services of the involved research infrastructures.
- Reluctance in giving away autonomy and control.
This clearly a cultural obstacle, and understandable considering the fact that most RIs are in their initial construction phase. It implies that – while recognizing the common future vision of ENVRI – development steps must be taken with care.
- Complex, slow, and fragmented (inefficient) funding structures promoting competition within ENVRI, and thus reducing cooperation.
The rigidity of funding structures and the competition between RIs that it causes has to be tackled by presenting this problem to the actors involved, the national funding bodies and the European Commission. The ESFRI could have a key role in organizing a targeted discussion. This includes timely and efficient funding by setting up European coordination mechanism for public RI funding (JPI, EIB, ERDF, national sources). Action on this item is reported in paragraph 10.2 below.

4.4. AGREED NEW ENVRI STRATEGY AND ITS IMPLICATIONS

Paragraph 4.1 reminds that the ENVRIplus project focused on implementing the three technological, cultural, and human capitals, and that the next step would be to benefit from the developed 'capitals'. The BEERi workshop of November 2018 addressed this by discussing the future purpose and vision of ENVRI. In a following meeting early 2019, further discussions by the infrastructure leadership in BEERi revealed two main messages for an updated strategy. First, reconfirmation that ENVRI – as a large-scale cluster of European environmental research infrastructures – contributes to the societal challenges by providing high-quality multidisciplinary research data, services and expertise in a systemic way to mitigate societal risks. Second, that ENVRI aims to become a globally recognized cluster with strong international links and an attractive service portfolio for researchers, private sector and policy-makers.

The BEERi, in its meeting of 29 March 2019, adopted the following new ENVRI vision.

ENVRI – the large-scale cluster of collaborating European environmental research infrastructures – contributes to the grand societal challenges by providing in a systemic way high-quality multidisciplinary research data, services and expertise for scientific breakthroughs supporting the mitigation of societal risks. With these resources, it is the ambition that by 2030 ENVRI is internationally strongly positioned with its attractive service portfolio and access opportunities for researchers, private sector and policy-makers.

This vision has its implications for sustaining the common tools, services and other ENVRI products, in relation to any future ENVRI organization. These implications are highlighted in the following paragraphs.

5. THE FUTURE STRUCTURE OF ENVRI

5.1. CONSIDERATIONS FOR THE ENVRI COOPERATION

Different from the bottom-up analysis of the ENVRIPLUS results to be sustained (see par. 8), a top-down view considers how the research infrastructures want to proceed as a cooperative community. As for the question on the purpose and structure of a sustained ENVRI, the Implementation Roadmap for the European Open Science Cloud (EOSC) is offering interesting considerations for establishing a strong ENVRI community [10]. This Roadmap identifies six main action lines to ensure the successful implementation of the EOSC:

- Architecture: create a pan-European federation of existing and future data infrastructures and resources. Bringing European research data infrastructures together will be a great improvement on their current state of fragmentation;
- Data: foster the development of professional practices in research data management based on Findable, Accessible, Interoperable, and Re-usable (FAIR) principles;
- Services: make EOSC services available through a single access channel to all European researches regardless of their discipline or location;
- Access and Interfaces: simplify the use of data across different disciplines;
- Rules of participation: set out the rights, obligations and accountability of EOSC stakeholders;
- Governance: ensure EU leadership in data-driven science and adapt to new governance challenges.

The 2017 ESFRI report on the long-term sustainability of research infrastructures also presents arguments to foster a continued ENVRI community. Three recommendations are specifically relevant for the ENVRI cluster cooperation.

- Harmonise and integrate the operation of research infrastructures and e-infrastructures.
- Demonstrate the economic and wider benefit to society of research infrastructures.
- Coordinate at National and European levels.

A top-down view may focus on promoting the impact of the ENVRI cooperation for multidisciplinary research, on addressing global change challenges, and on influencing policy and political decisions. It implies that prior to investigating any preferred organizational ENVRI structure, a common view should exist on the future purpose of the ENVRI community. Agreed priorities based on shared visions, values, goals and roles, are assisting in sorting out preferred options for the future structure of ENVRI. Another top-down view is related to the efficiency benefits that the cooperating research infrastructures are expecting from a continued ENVRI cooperation. Which operational activities could be better utilizing within a common ENVRI community, rather than being addressed in each infrastructure separately? In paragraph 4 above is the report of the common views of the involved research infrastructures, ending up in a common updated strategy,

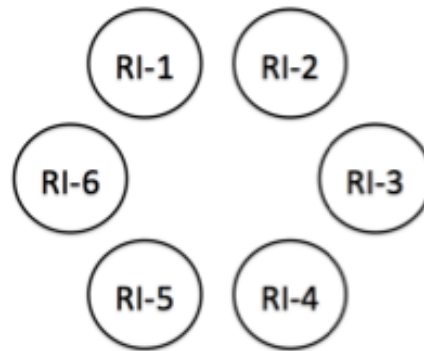
Two consecutive anonymous surveys collected the preferences and opinions of each research infrastructure, and a BEERi workshop discussed the pros and cons of alternative options to organise the future ENVRI, while taking into account the consensus of a common ENVRI strategy.

5.2. ORGANISATIONAL OPTIONS

There are different options to consider for a future ENVRI structure: finishing the ENVRI cooperation, proceeding with a network, or a federated cooperation, a modest or more extensive common legal entity, or even merging to a joint ENVRI research infrastructure.

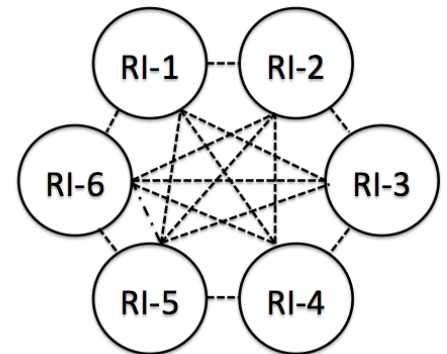
a. *Finishing the ENVRI cooperation*

This option would imply that each research infrastructure goes separately. Or, that some may conclude to proceed in a cooperative way, while others are leaving the ENVRI community. Of course, there may be irregular joint meetings, but bringing an end to the ENVRI cooperation will most likely reduce the voice and impact of the environmental cluster.



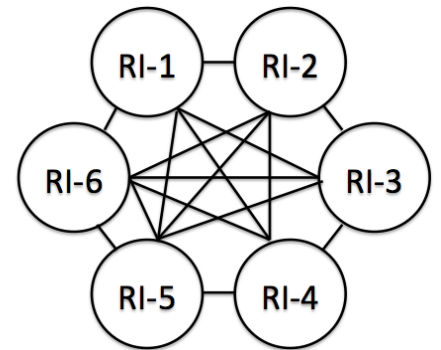
b. ENVRI network, without required commitments

An ENVRI network could be considered when enough research infrastructures prefer to meet regularly and consider joint activities, either at management level or at operational levels. A simple network can be organized on the basis of a Memorandum of Understanding (MoU) with some agreements on how to run the network. The MoU may have provisions on for example a rotating chair and secretariat, on the subjects to be discussed or initiated, and on how each infrastructure offers in-kind contributions for the benefit for all. The latter may include the preparation of joint project proposals.



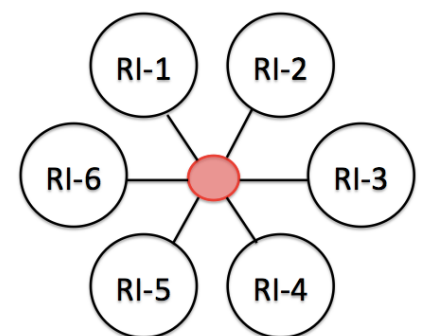
c. Federated structure with a joint consortium agreement

Similar to collaborative projects, the research infrastructures agree to work together within a Consortium Agreement on specific topics. It will state in which areas will be cooperated, how this will be governed and managed, and how any financial contributions from partners for joint activities will be arranged. Depending on the agreement, one or more individual infrastructures may be assigned with the task of chair, secretary and treasurer.



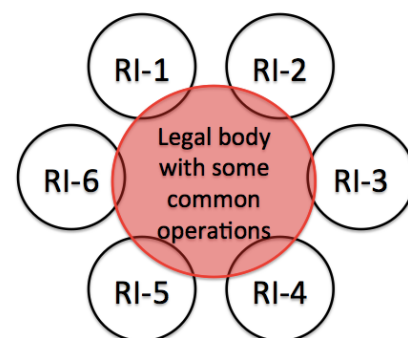
d. Establish an ENVRI legal body with limited roles

This would be a legal body with limited tasks and powers, mainly for organizing meetings and for organizing publicity. It is a cheap option, and has the advantage of a united “place”, both physically and on the Internet with a clear signal of the presence of ENVRI. Such a ‘small’ legal body should at least facilitate a secretariat and repository of joint undertakings. It may be considered to have in the legal body an independent director in charge, overseen by a board drawn from the cooperating research infrastructures.



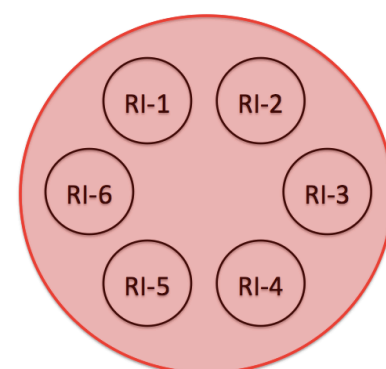
e. An ENVRI legal body taking up common tasks for the research infrastructures

The common tasks are the ones that can more efficiently and/or less costly be operated from the legal entity. As a consequence, the legal body will employ its own staff, and costs are to be covered by fees of the involved Ris. The Board of the legal entity (with representatives of the cooperating Ris) decides on the tasks that can better be operated by the legal entity.



f. Merge the individual infrastructures in a joint research infrastructure

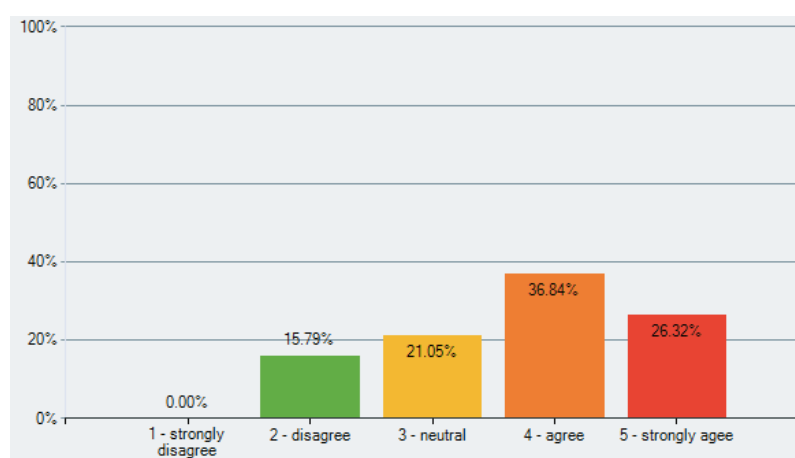
This would be a united legal ENVRI acting as an umbrella organization of federated research infrastructures as working units. Each individual infrastructure will continue its normal operations, while an overarching board takes care of the common interests. This board may appoint supervisory committees from the relevant communities for each RI. This is a similar set-up as for CERN and EMBL where different research facilities are operated within a common legal body.



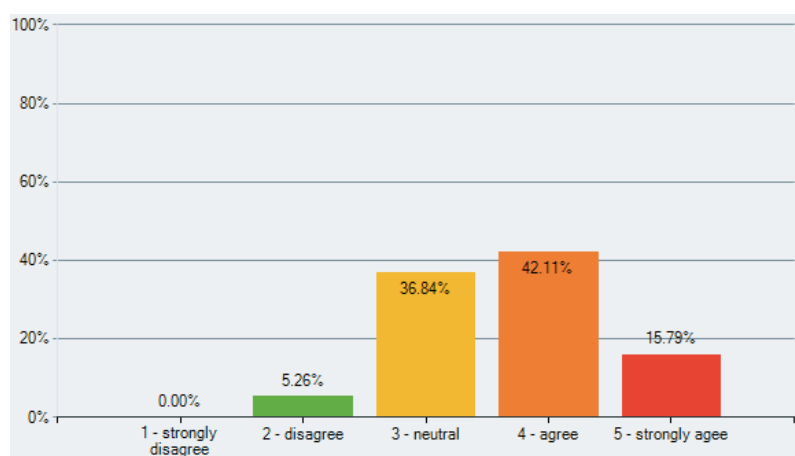
5.3 OPINIONS EMERGING FROM A SURVEY

After discussions in the BEERi workshop of November 2018, a survey collected the opinions of the research infrastructures about the organizational options in the previous paragraph. The respondents were asked to consider their opinions for a future situation from 2025 onwards. The survey only focused on the options c-f since in earlier discussions revealed that all research infrastructures prefer to agree on a formalized cooperative model.

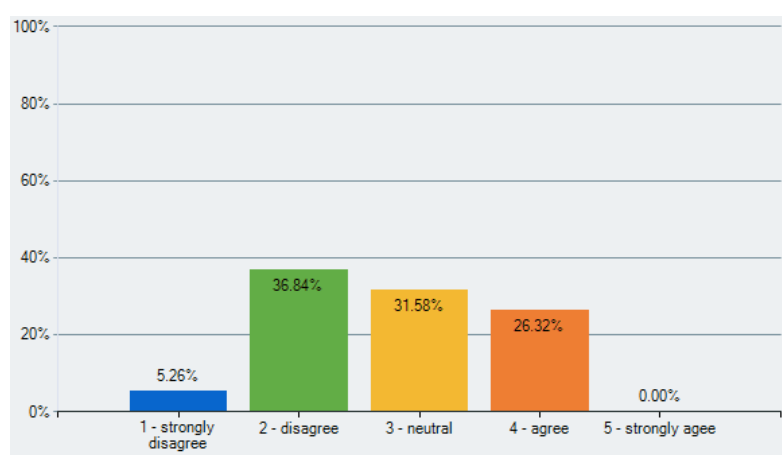
Option c: Federated structure with a consortium agreement



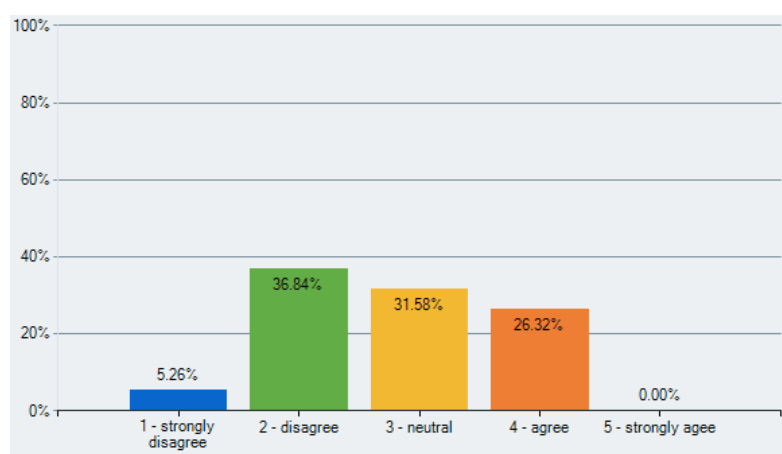
Option d: An ENVRI legal body with limited roles



Option e: An ENVRI legal body with agreed common tasks for the RI



Option f: Merge RIs in a joint RI



Comments

- The survey answers reconfirmed earlier discussions and conclusions.
- The agreed perspective is to aim at a common legal body, but to start by organizing the community of environmental research infrastructures in the framework of a Consortium Agreement.
- This allows for joint commitment to study and prepare a possible legal body with roles and tasks yet to be defined in more detail.

5.4 A STEPWISE APPROACH TOWARDS CONSOLIDATION OF THE ENVRI COOPERATION

The surveys and discussions about collaboration in a cluster of environmental research infrastructures revealed that nobody is in favour of finishing the ENVRI cooperation. At the long term, this would imply an agreement to establish an ENVRI cooperative body. The far-reaching option of merging all infrastructures within a single overarching research infrastructure was rejected. As for the intermediate considered options, the perspective is to plan for a legal body taking up a few common tasks, but to proceed through a step-by-step process. First, to collect signed Letters of Intent by each infrastructure, confirming the willingness to continue cooperation and the agreement to draft a Consortium Agreement (CA) matching with the above option c. Next to agree on entering a joint consortium based on the CA, and to experience how this would evolve. This has to underpin a future commitment to study and prepare a possible legal body with allocated tasks to be defined in detail.



The Letter of Intent below is in the process of signature by the research infrastructures.

LETTER OF INTENT to create more sustainable collaboration forms for the Community of European Environmental Research Infrastructures (ENVRI)

[Name of organisation] [, representing research infrastructure [Research infrastructure]]:

1. Recognises the work carried out so far within the ENVRI community in the context of FP7 ENVRI project, H2020 ENVRI PLUS project and within the Board of European Research Infrastructure Directors (BEERi) towards creating interoperable environmental research infrastructure landscape in Europe.
 2. Declares its willingness to collaborate together with the other European Environmental Research infrastructures in order to create more sustainable forms of collaboration for the ENVRI community, including preparation of Consortium Agreement for the research infrastructures (or their representing legal entities) and investigation of potential for creation of a new legal entity to facilitate coordination between the environmental research infrastructures, its role, business plan and mission.
 3. For the proper implementation of this collaboration declares its willingness to cooperate with the ENVRI working group dedicated to this work, by
 - a. giving timely responses and feedback to draft documents and questions to the ENVRI working group;
 - b. communicating the developments and plans to the internal and external stakeholders of the [Research infrastructure]; and
 - c. informing the appropriate decision making bodies of the [Research Infrastructure](including funding authorities) of these developments and plans.
 4. The duration of this letter of intent shall be for 3 years, or until the Consortium Agreement for the ENVRI cooperation is signed.
 5. This Letter of Intent does not create any legally binding obligations to the signatories.
-



In parallel, a working group, drawn from the research infrastructures, is preparing a draft Consortium Agreement outlining the priorities for common tasks and the related governance of the formalized cooperation. The BEERi workshop in November 2018 also concluded that legal work on a Consortium Agreement and for any future steps to an ENVRI legal body should be accompanied by formulating the ENVRI landscape and business plan. This is relevant to better define the future role and tasks of ENVRI as a cooperation of all European environmental research infrastructures, and the implications for structuring these tasks. This includes attention for the envisaged ENVRI roles and tasks apart from the ones of its constituent RI members. Already quite some preparatory efforts contributed to formulating the ENVRI landscape and business plan. As for the landscape analysis, it became clear that the European ENVRI cooperation is internationally unique and successful with its attractiveness for researchers around the world. The COOP+ project contributed to a better understanding of the international position of ENVRI, and the ENVRIplus deliverable 17.6 is focusing in a white paper on the European and ENVRI internal landscapes and cooperation. Preparations for the ENVRI business plan are building upon the views as emerging from the BEERi workshop in Riga (November 2018).

As with respect to ENVRIplus results to be sustained at the cluster level, this deliverable 17.5 contributes to drafting the business plan. At the short term the focus is on sorting out the common ENVRI priorities to be highlighted in the Consortium Agreement. These priorities will shape the activities to be governed by the Consortium Agreement, and will help individual Ris and the RI-domains to decide about their position in this regard. Part of the Consortium Agreement will be the intention to further explore the position and role of any future legal entity to support the ENVRI cooperation. This process will be agreed at a later stage by the membership of the ENVRI Consortium Agreement.

As for the ENVRI business plan, the focus is on the topics that individual Ris will not tackle, and on the topics that they prefer to do collectively for reasons of efficiency or costs. With this approach, the business plan also serves as a feasibility study. Following the outcomes of various discussions, the business plan will address:

1. What is the focus of ENVRI? (Purpose and Vision; unique offering, ENVRI brand)
 - This will be the revised ENVRI vision (new strategy statement) to be endorsed in the BEERi meeting.
 - The agreed vision can be detailed with the unique offerings, the roles and priorities of ENVRI.
 - Sustaining common services that cannot be secured by individual research infrastructures (see paragraph 6).
 - ENVRI brand; how should ENVRI be seen.
2. Who can you benefit? (Key stakeholders in which 'markets', which relations, benefits of cooperation, impact)
 - This paragraph can be elaborated within a view of the landscape within and outside ENVRI. Following the ENVRI focus and unique offering as described under 1, the interaction with and services for different 'market' stakeholders can be clarified. How do these stakeholder groups view the role of ENVRI?
 - Stakeholders are the individual cooperating Ris and their collaborative domains; the scientific users as organized in different ways; through science also the policy domain; the RI funding bodies.
 - To describe for each group of stakeholders: relations, benefits of cooperation, and impact.

3. How to reach stakeholders? (Solutions, obstacles, required resources)
 - This may end up in a list of ENVRI tasks, to be described with SMART goals (Specific, Measurable, Achievable, Relevant, Time-bound).
 - As said above, the tasks will deal with topics that individual RIs will not tackle, and on the topics that they prefer to do collectively for reasons of efficiency or costs. As such it may be considered to mention what ENVRI is explicitly not doing and belongs to the operational domain of individual RIs.
4. Commitments and constraints
 - What are requirements and costs when taking up the selected ENVRI tasks: technological, human, cultural, and any others.
 - What is expected from individual RIs when cooperating in a legal ENVRI structure (initially the Consortium Agreement).
 - Secure equity and trust amongst the cooperating RIs in ENVRI.
 - SWOT analysis (Strengths, Weaknesses, Opportunities, Threats).
5. How to structure it?
 - The focus for the short-term is a Consortium Agreement to structure to ENVRI cooperation with the above approach.
 - What are the implications when executing the selected ENVRI tasks?
 - The CA has also to address aspects of governance and management.



6. SECURING THE UPTAKE AND MAINTENANCE OF ENVRIPLUS RESULTS

6.1.1. FOCUS ON SUSTAINABILITY AT THE ENVRI CLUSTER LEVEL

The Task 17.5 on the Sustainability Plan is focused on ENVRIplus project results relevant at the cluster level. Results that are only relevant to one or a few research infrastructures should be secured by these facilities themselves. Sustaining results at the cluster level has its complications since it must become clear who are responsible for these. The identification of ownership of project results is important, since the owners are expected to take up the responsibility to sustain these results after the end of the project. Sustaining implies not only the maintenance and updates of services and products, but also their accessibility and user's support including training. It is also said in the Grant Agreement that (joint) owners may grant non-exclusive licenses to third parties to exploit jointly owned results. However, each one has to consider seriously what would be the wisest and most attractive way to proceed. In the annex C is the list of project results to be sustained, with indication of which organisations will secure maintenance and updates, and for which (few) ones an ENVRI body should take up solutions to secure sustainability. The process to sort out this classification is described in the next paragraph 6.2.

6.2 THE CATEGORIES OF ENVRIPLUS RESULTS

For the compilation of this report all WP leaders were invited to provide more details about the projects results deserving sustainability after the end of the project.

A. *Who are the owners of products/services to sustain?*

The ENVRIplus Grant Agreement (art. 26) states that project results are owned by the beneficiary/ies that generated them. As such the involved beneficiaries (or third parties licensed by them) have the responsibility to solve the sustainability of their results.

QUESTIONS

8. Who are the owners (organisations) for each identified product or service (see annex)?
8. Are these owners ready to take organizational responsibility for sustaining the products or services?
8. If not, do you agree to transfer ownership (or license it) to a different organization?

B. *Value proposition*

The cooperating research infrastructures have to understand why each product or service is relevant for them, and especially at the cluster level.

QUESTIONS

8. Why is your product or service important/valuable for the Research Infrastructures?
8. Which are the key user groups (which ENV RIs and in which domain); other ones? Did they already provide feedback?
8. How to advertise and provide support for deploying your product or service?



C. Required maintenance and other activities + annual costs

QUESTIONS

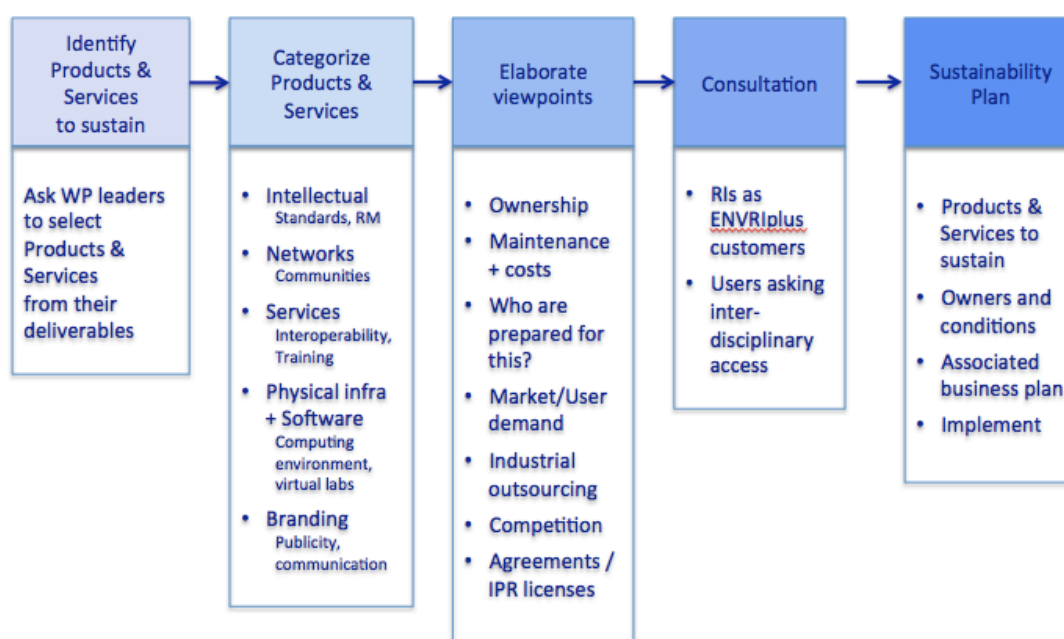
8. Which kinds of activities would be required to maintain, update, advertise, provide user's support and train for your product or service?
8. What would approximately be total annual costs for the previous activities (and if possible for each separate activity)?

The results of this inventory were categorized as follows.

- A. Intellectual
e.g. standards, concepts, reference docs
- B. Networks
e.g. active communities, expert groups, BEERI, peer review mechanisms
- C. (On-line) Services / Distribution channels
e.g. interoperable data, web services, training, helpdesks
- D. Physical infrastructure and software
e.g. computing environments, e-infrastructure, common virtual labs
- E. Branding
Selected products/services requiring ENVRI branding
Joint publicity and communication

As a next step, the WP leaders were asked to further clarify the ownership of results, applicable licenses, value propositions, required maintenance costs, and related annual costs. The identification of ownership of project results is important, since the owners are in principle expected to take up the responsibility to sustain these results after the end of the project. Sustaining results does not only imply the maintenance and updates of services and products, but also their accessibility and user's support including training. The project's Grant Agreement states that (joint) owners may grant non-exclusive licenses to third parties to exploit jointly owned results. Each project partner had to consider seriously what would the wisest and most attractive way to proceed.

The process to collect the required information followed a number of steps as visualized below.



This process was important to get all involved partners thinking about the future of their developed products. It was necessary to create awareness on any required agreements with the concerned partners to sustain their results for future use in the ENVRI community. But also on the question if such agreements should with each separate research infrastructure, or with a joint ENVRI structure acting on behalf of the research infrastructures. The latter simplifies the picture and would allow for a common license model for ENVRIplus results. With this perspective, a joint indexed catalogue of all services and tools may become reality. The catalogue should also provide contact details for getting specific information and on associated training. The work packages contributed to the process steps 1-3, while some BEERi members provided input for the step 4 on consultation. This allowed for concluding to step 5 as presented in Appendix C.

6.3 NEXT STEPS FOR SUSTAINING RESULTS

Quite some ENVRI partners committed to secure the sustainability of produced project results, and sometimes also by covering the involved costs. However, others indicated that sustaining their project results should be in the framework of an ENVRI organisation of any type. This would imply that the cooperating research infrastructures should agree on the establishment of a kind of common ENVRI body with a budget in order to avoid that ENVRI results will be lost in due time. This perspective has been discussed and conclusions are reported in paragraph 5 of this report.

Another concern is that sustaining ENVRIplus results also implies that the involved infrastructure communities have be informed in the upcoming years about this resource. After all, employees will be replaced and new ones will come in, and it is not likely that these persons are aware of the documents in their interest. This is also relevant for the interest in ENVRI services from outside the ENVRI community, within Europe and beyond. To this en an indexed catalogue of the relevant documents should provide for categories of interest summaries of each service, together with a contact person to provide explanations, and with information about any associated training. In addition, the ENVRI newsletters should appear – in regular intervals – short information items about a specific document and about updates of relevance. In this way the contents of the documents will continue to support the community. Advertising ENVRI internationally by providing information about ENVRI services and documentation in conferences and other events, and by articles in different media will assist how international users may benefit from these.

The ENVRI-FAIR project (paragraph 7) takes up parts these tasks and will secure their initial sustainability. This includes agreeing on Service-Level-Agreements with the organisations that offered to maintain different services.



7. ROLE OF THE ENVRI-FAIR PROJECT

The focus of the developing ENVRI business plan is primarily on securing the sustainability of jointly developed tools and services, through securing service-level-agreements with the infrastructures or other organisations maintaining these tools and services, and by taking up some common tasks in the envisaged common ENVRI utilization. As for the tools and services mentioned in this book, the cooperating infrastructures are in a good position with the project ENVRI-FAIR, running for four years from the beginning of 2019 [12]. This project is working on the uptake of the developed tools and services by individual research infrastructures, and will facilitate the planned process towards a legal ENVRI entity. The business of the ENVRI-FAIR project is very much concerned with the parallel European developments for establishing a European Open Science Cloud (EOSC) [6]. The overarching goal of ENVRI-FAIR is to establish sustainable, transparent and auditable data services, for each step of the data life cycle, compliant to the FAIR principles in the ENVRI community and connect it to the EOSC. Common policies, open standards, interoperability solutions, operational services, and stewardship of data on the basis of FAIR (Findable, Accessible, Interoperable, Re-usable) principles require a common approach. The final goal is to prepare the open access platform for interdisciplinary environmental research data in the European Research Area establishing the EOSC. More specifically, the high-impact ambition of ENVRI-FAIR is to establish the technical preconditions for the successful implementation of a virtual, federated machine-to-machine interface to access environmental data and services provided by the contributing research infrastructures. This ENVRI-hub is planned as a federated system of data policies and management, access platforms and virtual research environments. The system will be completely open source, modular and scalable and build on the experience available in the consortium and already operational systems.



8. CONCLUSIONS

8.1 IMPACT ON THE PROJECT

The agreed process with a perspective on a joint ENVRI consortium and leading to a common legal body is important to promote togetherness within the ENVRI community, and to demonstrate the joint ENVRI dedication to external stakeholders. To this end an ENVRI business plan is in preparation, highlighting its focus, the benefits for collaborating in between research infrastructures and with external stakeholders, the commitments to agree upon, and the process towards further consolidation.

The following list of actions has already partly implemented, while some other actions are waiting for the signature of a Letter of Intent by all interested research infrastructures.

November 2018:

- Distribute memo to BEERi members. Timing: November 26.
- Reformulate and redistribute the sustainability survey.
- Request a letter of Intent from all Ris. Timing: December.
- Presentation to DG research & commissioners.

December 2018:

- Comments from each RI to the vision before its finalization.
- Draft an updated and concise vision for further comments.
- Second round of comments from Each RI.
- Establishing of working group(s) for business plan and consortium agreement.

January 2019:

- Finalise and present the finalized vision.
- Agenda point for January BEERi meeting: reluctance to give up autonomy.
- Related to the above, drafting of a common statement on FP9 infrastructure program for discussion purposes.
- Agenda point for January BEERi meeting: “widen the funding structure” plan.
- Conduct initial legal consultation on Consortium agreement and draft the first discussion version of consortium agreement.
- Draft a process for formulating ENVRI landscape analysis and business plan.

February 2019:

- Draft a plan for European coordination mechanism.
- Draft document on coordinated funding presentation map.

March 2019:

- Commenting on the first discussion version of the consortium agreement by each RI.
- An ENVRI representative will coordinate communication with each RI about future cooperation in external visibility and communication and related internal efforts, taking into account national restrictions that the Ris may have.

Later in 2019:

The business plan will be developed later towards the summer. Responsible: Working group(s) (see above).



8.2 INITIAL VIEWS ON THE ENVRI CONSORTIUM AGREEMENT

The BEERi in its meeting on 29 March 2019 reflected on the outline of the ENVRI Consortium Agreement. The following principles were supported as a basis for drafting the Consortium Agreement.

Roles of the ENVRI Consortium Agreement

The overarching principle for the role of ENVRI is that the consortium will only take up tasks that can better be handled at the ENVRI cluster level. Following this, the ENVRI consortium has to take up at least the following roles.

- Secure the ownership, maintenance and support for ENVRI projects results that cannot be sustained by volunteering individual organisations.
- Develop and specify common interests, and represent (common / scientific / political / strategic) interests at the European level. (Not national !).
- Organise and implement ENVRI strategies, joint activities, advocacy, lobbying, communication, dissemination internally and externally.
- Maintain and support BEERi activities
- Support common project development and implementation.

Membership

- Open for all European level research infrastructures, and not restricted to ERICs. Requires specified definition & criteria.
- Research infrastructures to be represented by a legal entity (e.g. ERIC, AIBSL, or coordinating entity).
- Research infrastructures sign the Consortium Agreement.
- Current BEERi member RIs are automatic eligible, and invited to sign the ENVRI consortium, if they wish so.
- Applications subject to expression of “no objection” by the ENVRI members (in order to maintain consensus).
- An exit procedure required, for example when a research infrastructure is finished or its project status ended, or when an infrastructure itself does not consider value to be involved in ENVRI.

Governance and management

- The infrastructure members of ENVRI are represented in a General Assembly (= BEERi) with one vote for each RI. Its terms of reference may be similar to the current one for BEERi.
- The General Assembly is supported by an Executive Committee with a chair, secretary, and treasurer, and optionally a few additional persons. Members of General Assembly may nominate candidates for the Executive Committee.
- Members of the Executive Committee are elected by the General Assembly for 2 years, and individuals may be re-elected for two additional years.
- Volunteering research infrastructures may act as service organisations for financial administration (bank account), secretarial services, and others. When in-kind contributions



cannot cover all agreed costs, these should be (partly) financially covered by an agreed fee system.

8.3 IMPACT ON STAKEHOLDERS

In parallel with the above actions, it was considered how to communicate with the political level about adapted and appropriate funding arrangements for the infrastructures in the ENVRI community. Considering the steps taken by the ENVRI community to reduce fragmentation in its infrastructure landscape, it makes sense to address the current fragmented arrangements for funding the European-scale research infrastructures. These are mainly funded through financial support by different combinations of individual countries, and from a variety of other sources such as from JPIs, INTERREG, H2020, and individual DGs. This picture is the result of elaborate negotiations with potentially interested countries, but with the complication that not any country will financially contribute to all environmental research infrastructures. This implies that huge transaction costs result from all these negotiations, and to be repeated every five years for another cycle of financial security. Another implication is that this fragmented funding structure makes it for the ENVRI community difficult to pursue a joint scientific and technical policy to address the grand societal and scientific questions.

8.4. FUTURE CHALLENGES

The ENVRIplus project focused on bringing into place the capacities required for assisting researchers and other stakeholders in dealing with environmental challenges and providing key products for societal needs. Much progress has been made to improve cooperation in technology, and in a joint culture and in human capital. The next question is how to best benefit from the achievements as presented in this book. Clearly, the focus is than on supporting users in addressing the grand environmental challenges from solid earth to near space. Many of the present urgent challenges are closely related to complex interactions in the environment. Whilst each research infrastructure is primarily concerned with its own domain of interest, another challenge is to integrate various operations across infrastructures, supporting the growing multidisciplinary scientific community. Indeed, the Earth system and problems related to the grand challenges are far too complex and interdependent to be studied from only a single perspective and supported by a single research infrastructure. New scientific developments require measurements covering the entire interlinked Earth system, and more integrated and interoperable instrumentation and infrastructure services enabling free access to and analysis of the gathered information. The latter is what ENVRIPLUS put in place, and was recognized by the ESFRI in its 2018 Roadmap [13], stated as follows (p. 14).

“The concept of *multi-messenger* research relies on exploiting diverse sources of information from different research methodologies to yield an integrated complementary ensemble of data that becomes the true insight on the phenomenon studied. Generalizing to all fields of research, we can recognize that a *multi-messenger* approach is already at work in domains like environmental sciences and life sciences, and that there is a high potential to address complex phenomena like grand societal and scientific challenges – e.g. climate change, population increase and differential ageing, food and energy sustainability – by using synergistically research infrastructures from all fields”.

Possible approaches in this regard, and partly tackled by the new ENVRI-FAIR project [12], are the following.



- Challenge the scientific community to address the grand societal challenges with support by research infrastructures. An independent ENVRI scientific advisory body might be considered to define interdisciplinary research challenges, and to open up calls for inviting innovative researchers requiring advanced integrated services from the research infrastructures.
- Showcase the strengths and significance of ENVRI through user options to benefit from multiple sites and laboratory facilities, and of cross-use of experimental research platforms and vessels. An interesting consideration is to optimize the collaboration between industry, policy-makers and research infrastructures to promote a stronger impact of the research and innovation system, as also suggested in the ESFRI 2018 Roadmap [14].
- Be prepared to support interdisciplinary research, for example by providing data for a common minimal set of measurements/observations relevant for environmental variables regarding the Earth system, and a joint strategy to fill geographical gaps. An additional service could be to provide capacity for guiding and supporting interdisciplinary researchers requiring support from more than a single RI.

The benefit for the cooperating ENVRI research infrastructures is that they also will be challenged to provide joint services at the forefront of scientific discovery and societal impact.



REFERENCES

1. European Strategy Forum on Research Infrastructures (ESFRI), <https://www.esfri.eu>
2. GEOSS data portal, <http://www.geoportal.org>
3. COPERNICUS, <https://www.copernicus.eu/en>
4. LERU report on sustaining research infrastructures (2017), <https://www.leru.org/publications/four-golden-principles-for-enhancing-the-quality-access-and-impact-of-research-infrastructures>
5. OECD Global Science Forum (GSF), <http://www.oecd.org/sti/inno/global-science-forum.htm>
6. European Open Science Cloud, <https://www.eosc-portal.eu>
7. Towards establishing a European Action Plan for ensuring the sustainability of research infrastructures: Call for Action Report, https://ec.europa.eu/research/infrastructures/pdf/ri_policy_swd-infrastructures_2017.pdf
8. CORBEL, shared services for life-science, <https://www.corbel-project.eu/home.html>
9. Board of Environmental Research Infrastructures (BEERi) <https://www.envriplus.eu/beeri/>
10. Implementation roadmap for the European Open Science Cloud (EOSC), http://ec.europa.eu/research/openscience/pdf/swd_2018_83_f1_staff_working_paper_en.pdf
11. 2017 ESFRI report on the long-term sustainability of research infrastructures, https://ec.europa.eu/research/infrastructures/pdf/esfri/publications/esfri_scripta_vol2.pdf
12. ENVRI-FAIR project, <http://envri.eu/envri-fair/>
13. ESFRI 2018 Roadmap, <http://roadmap2018.esfri.eu>
14. RI-Scape – European research infrastructures in the international landscape, <https://riscape.eu>
15. COOP+, Cooperation of Research Infrastructures to address global challenges in the environmental field, <http://www.coop-plus.eu>



APPENDIX A

Research Infrastructures as involved in the Sustainability Plan

ACTRIS: Aerosols, Clouds, and Trace gases Research InfraStructure network

AQUACOSM : EU network of mesocosms facilities for research on marine and freshwater ecosystems open for global collaboration

DANUBIUS: The international center for Advanced studies on river-sea systems

DASSH: Data archive for seabed species (a UK marine biology resource centre)

DiSSCo: Distributed Systems of Scientific Collections

EGI : European Grid Infrastructure

EISCAT: EISCAT Scientific Association

ELIXIR: Distributed infrastructure for life-science information

EMBRC: European Marine Biological Resource Centre a consortium of research organisations interested in marine biology

EMODNET: The European Marine Observation and Data Network

EMSC: Euro-Mediterranean Seismological Centre

EMSO: European Multidisciplinary Seafloor and Water Column Observatory

EPOS: The European Plate Observing System

EUDAT : H2020 project on Research Data Services, Expertise & Technology Solutions (previously funded by FP7)

EUFAR : European Facility for Airborne Research

EUROCHAMP2020 : European atmospheric simulation chambers

EURO-ARGO: European ARGO programme (ARGO are a type of marine survey device)

EUROFLEETS: New operational steps towards an alliance of European research fleets

EUROGOOS: European Global Ocean Survey System

EuroSITES: European Ocean Observatory Network

ESONET Vi: European Seafloor Observatory NETwork

FixO3: Fix point open ocean observatories (survey programme)

GBIF: Global Biodiversity Information Facility

GROOM: Gliders for research ocean observation and management

IAGOS - In-service Aircraft for a Global Observing System

ICOS : Integrated Carbon Observation System

IS-ENES: RI for the European Network for Earth System Modelling

INTERACT: International Network for Terrestrial Research and Monitoring in the Arctic

JERICO: Towards a joint European research infrastructure network for coastal observatories

LifeWatch: European e-Science infrastructure for biodiversity and ecosystem research

LTER-EUROPE : European Long-term Ecosystem Research network of 21 national LTER networks

PANGAEA: Data Publisher for Earth & Environmental Science (Open Access library aimed at archiving, publishing and distributing georeferenced data from earth system research)

SeaDataNet: Pan-European infrastructure for ocean & marine data management

SIOS: Svalbard Integrated Arctic Earth Observing System



APPENDIX B

Acronyms

BEERi: Board of European Environmental Research Infrastructures - is an internal advisory board representing the needs of environmental Research Infrastructures

CA: Consortium Agreement - Legal contract between the ENVRIplus beneficiaries

CERN: European Organisation for Nuclear Research

COPERNICUS: previously known as GMES (Global Monitoring for Environment and Security), is the European Programme for the establishment of a European capacity for Earth Observation

COOP+: Cooperation of Research Infrastructures to address global challenges in the environmental field

CORBEL: Coordinated Life Science RIs

DL: Deliverable / Deadline

DoW: Description of Work

DoA: Description of Action

EMBL: European Molecular Biology Laboratory

GA: Grant Agreement - Contract between Coordinator and Commission

EC: European Commission

ENVRI : FP7 project on Implementation of common solutions for a cluster of ESFRI infrastructures in the field of environmental Sciences

ESFRI: the European Strategy Forum on Research Infrastructures

LERU: League of European Research Infrastructures

OECD: Organisation for Economic Cooperation and Development

EOSC: European Open Science Cloud

RI: Research Infrastructure

SLA: Service Level Agreement

WP: Work Package



APPENDIX C

Bottom up list of project results to be sustained

INTRODUCTION

Task 17.5 (Sustainability Plan) includes the following activities:

- Analyse the most suitable, long-term operational and organisational model for sustaining the *cluster level common operations*, services and collaborative bodies, boards and community platform after ENVRIplus.
- Include means how to maintain the common operations and services provided during the project.
- Also address the future development needs and actions for pilot and test cases, and how to sustain the technological, data, management related outcomes in a feasible organisational framework.
- The organisational framework should also ensure the continuation of the dissemination, training, and communication actions of the cluster.

This report provides an overview of the ENVRIplus products and services to be sustained as relevant for the cluster-level. (Results that are only relevant for one or a few Research Infrastructures are not listed, and will have to be dealt with by these infrastructures themselves).

The following information is provided for each relevant result of the WPs and Tasks.

Ownership

Owners are expected to take up the responsibility to sustain these results after the end of the project. According to the ENVRIplus Grant Agreement, owners may grant non-exclusive licenses to third parties to exploit jointly owned results.

8. Owners of each identified product or service.
8. Owner agrees to take organizational responsibility for sustaining the products or services.
8. Alternatively, transferred ownership to another organization (or licensed).

Value proposition

Explanation why the results to be sustained are relevant for the ENVRIplus research infrastructures, and/or other communities.

8. The importance/value of the product or service for Research Infrastructures.
8. The key user groups in ENVRIplus and elsewhere.
8. Advertisement and support provision for deploying the product or service.

Required maintenance activities and related costs

Sustaining implies not only the maintenance and updates of services and products, but also their accessibility and user's support including training.

8. The required activities to maintain, update, advertise, provide user's support and train for the product or service.
8. The approximately total annual costs for the previous activities



Theme 1

Theme 1 includes the work packages 1-4. Its approach to sustainability builds upon the progress as made during the project (where RIs initiated collaboration across domains for the first time in a coordinated manner) and to its objectives. The approach aimed at stimulating R&D for RIs procurement, developing a common metrological language adapted to the observation of our environment. This was done by building a network of key technologists of the RIs for a greater mutual benefit with a space for exchange on the “hardware” issues of our networks of observatories, a forum that allows fast transmission across RIs of best practices and state of the art technology, and a platform for joint research and co-development, demonstration of added value in the combination of RIs. Its sustainability pathway addresses both the need for further maturation of products and service to and for RIs, and its specialized networks of experts.

Beyond the end of the ENVRIplus project, appropriate steps shall be taken by the partner CEA:

- Seeking recognition by BEERi for this two prong approach: maturation of products and services through targeted continuation of developments, and networks of experts.
- Sustainability of expert networks.
- Sustainability of joint developments
 - Need ‘agile’ funding for developing specific products, services, exploratory ideas
 - across RIs (& industry, & public regulators, ...)

1) Listing of services and products with high potential

- Sensor Intercomparison guidelines cross-RI.
- Measurement/sensor Innovation strategy report.
- Prototype and testing standards for pCO₂ (cross-RIs).
- Drone marine/airborne services/access(cross-RIs).
- Recommendations for dense networks and sensor web enablement.
- Common Metrology reference for RIs (cross-RIs).
- Tool for harmonization of time series (prototype) (cross-RIs).
- Catalogue of RIs services for satellite/assimilation product validation.
- Catalogue and guidelines on energy solutions for remote operating sites.
- Set of standards for extreme environments.
- Temperature and humidity control firmware blueprint.
- Open source package for near real time data transmission and quality control.
- Fit-for-purpose deployment of RI services toward science users.
- Forum for collaboration across RIs on interdisciplinary challenges.
- Harmonization for methane monitoring (cross-RIs).
- Joint development, Metadata scheme --appropriate for infra of opportunity (subsea cable repeaters) to interact with RIs.

2) Expert networks

The requirement is to maintain engagement of the expert networks and keep RIs staff involvement at a level that benefits the RIs. The partner CEA takes the necessary steps to organize follow up meetings with groups by field of expertise, in which dynamic working groups can be set up to work on more specific topics of particular, timely interest to RIs.

3) Maturation of products and services

WP1, New sensor technologies, innovation and services

1. Owner



- a) Service: strategic foresight of the new technologies for environmental measurements/ consulting.
 - b) Service: integration of new sensors on autonomous/mobile platforms and harmonized testing in real conditions.
 - c) Service: establishment of technological choices/ technological requirements for dense networks of small sensors (regulatory affairs).
2. *Owner takes responsibility for sustainability?*
All ownership will remain attributed to the participating institutions.
3. *If no responsibility, is it agreed to transfer this?*
Not applicable.
4. *Why is it important for RIs?*
- a) Technologies with the high potential of becoming both relevant to Env RIs and commercially successful products shall be overseen (tech watch) and pointed out to attract the funding and procurement opportunities, necessary to bring them from the stages of early laboratory development (with mid-level TRL) to the stages of industrial production (high TRL).
 - b) RIs will have an opportunity to test their newly-developed sensors in real conditions.
 - c) Sensors, available on the market come with various specifications which makes difficult to assemble them in the dense networks. Development of common technological requirements is needed to overcome this obstacle and unify sensor specifications. Moreover, if a developed sensor can address multiple domains, the market will be much larger and then companies will be more confident for collaborative development.
5. *Which domains and which other user groups?*
- a) All domains: Atmosphere/ Marine/ Biosphere/ Solid earth. Scientists, who are interested in the further development and commercialization of technologies invented in the laboratory. Large industrial companies, interested in getting new ideas of technologies from the scientists (first hands) and creating the products answering to the requirements of final users. (Non) governmental organizations interested in estimation of environmental impacts/ climate change.
 - b) All domains: Companies and scientists producing novel marine sensors and doing measurements of environmental parameters in the seas (aqueous, biosphere, atmosphere and solid earth measurements).
 - c) All domains: Atmosphere/ Marine/ Biosphere/ Solid earth. Commercial companies, interested in development of sensors with compatible technological specifications.
6. *Continued advertisement and support?*
Communication, advertising and marketing services are needed.
7. *Which sustainability activities?*
- a) Highly qualified in their field scientists are needed, who will search and define the technologies in the early stage of development, based on the current requests of scientific community and possibilities of industrial providers.
 - b) Technical personnel running the ARGO-float is needed.
 - c) Technically qualified personnel working at the interface of science and policy is needed.

8. *Approximate annual sustainability costs?*
 - a) Specialized manpower (2 FTE), plus communication, advertising and marketing services.
 - b) Specialized manpower (2 FTE), plus Costs related to the support and maintenance of the fleet in a functioning state
 - c) Specialized manpower (1.5 FTE), plus Costs related to the development of regulatory routines, documents and recommendations.

WP 2, Metrology, quality and satellite validation

1. *Service:* Creation and maintaining of metrology database, containing contacts of metrology institutes, explanation and inter-relation of units in use and developing metrology-related tools, such as tool for harmonization of time series.
2. *Owner takes responsibility for sustainability?*
All ownership will remain attributed to the participating institutions.
3. *If no responsibility, is it agreed to transfer this?*
Not applicable.
4. *Why is it important for RIs?*
At the current stage of their development RIs carry out environmental measurements by means of various techniques, approaches and instruments. This large variety makes it difficult to compare, combine and analyse the results obtained from different sources and for different purposes. Common metrology approach is required in order to facilitate the information exchange between metrology experts of different RIs and to make the experimental results of different RIs mutually comparable; to allow smooth information exchange between RIs.
5. *Which domains and which other user groups?*
All domains: *Atmosphere/ Marine/ Biosphere/ Solid earth*. Communities of scientists, working in-between domains/ RIs.
6. *Continued advertisement and support?*
Some communication activities might be needed in order to advertise the existence of common metrology database/ service.
7. *Which sustainability activities?*
Qualified personnel needed to gather, summarize and update metrology database and to serve as a contact point for the metrology experts of numerous RIs
8. *Approximate annual sustainability costs?*
Some costs in relation to the maintenance of network service might be needed.

WP3, Improving measurement networks: common technological solutions

1. *Service:* facilities to test on field technical solutions for extreme conditions.
2. *Owner:* The national centre for scientific research (CNRS) and Grenoble Alpes University (UGA).
3. *Owner takes responsibility for sustainability?*
Yes. As a service unit, UMS SAJF 3370 is devoted to research support.
4. *If no responsibility, is it agreed to transfer this?*
Not applicable.
5. *Why is it important for RIs?*
Deliverables are reports and useful over some years. The set of standards does not describe a new standard, but rather the specific issues on standards that need to be taken into account in environmental RIs.

As an additional benefit, the test site at the Col du Lautaret can be sustained in the future for transnational access from all environmental domains. SAJF, located at 2 100 meters above the sea-level at the Lautaret pass, consists of the centennial Lautaret botanical garden and infrastructures devoted for research, sharing knowledge and outreach (socio-ecological dynamics of landscapes, global change and ecosystems functioning, evolutionary ecology of alpine organisms). SAJF is part of ANAEE and ILTER programs. SAJF hosts a connected technological platform dedicated to sensors tests and experimental new technologies who has been implemented for the ENVRIplus program.

6. *Which domains and which other user groups?*
For all academics, researchers or companies interested in investigating a typical mountain natural environment by monitoring environmental parameters, testing innovative systems for power supply, data transmission, aging tests of experimental devices, especially in winter time.
7. *Continued advertisement and support?*
Need ENVRI support for communication, advertising, WEB site, marketing.
8. *Which sustainability activities?*
Need permanent manpower for running the platform, and some technical updates
9. *Approximate annual sustainability costs?*
15 000 €/year.

WP4, Joint operations across the RI domains

1. *Service: Creation and maintaining of database for instrumentation deployment, methodologies and protocols, including field testing.*
2. *Owner takes responsibility for sustainability?*
All ownership will remain attributed to the participating institutions.
3. *If no responsibility, is it agreed to transfer this?*
Not applicable.
4. *Why is it important for RIs?*
Instrumentation used by various RIs normally requires very different approaches in handling/ installation and deployment, what creates additional difficulties, when different RIs perform joint environmental measurements by various instruments. Thus, description of methodologies and protocols is needed to facilitate and ease the joint deployment of instrumentation coming from different RIs and harmonization of measurements.
5. *Which domains and which other user groups?*
All domains, and for the communities of scientists, working in-between domains/ RIs, companies interested in the inter-domain measurements.
6. *Continued advertisement and support?*
Support is needed for communication / gathering and storing the data.
7. *Which sustainability activities?*
Qualified personal is needed to keep in contact with scientists willing to provide the methodologies and storing the information. Network resources are needed to store the information.
8. *Approximate annual sustainability costs?*
Resources needed to maintain network services and to support the personnel.

Theme 2

WP5 – Reference model guided RI design

Service: Reusable technical solutions for a set of prioritized common problems using an Reference Model guided approach, with a knowledge base for ENVRI RIs structured using an ontological representation of the ENVRI Reference Model (OIL-E), with links to other required ontologies.

1. *Owner*
University of Amsterdam (UvA).
2. *Owner takes responsibility for sustainability?*
UvA is able to take responsibility for OIL-E and the ENVRI Knowledge Base as part of its internal research agenda.
3. *If no responsibility, is it agreed to transfer this?*
Not applicable.
4. *Why is it important for RIs?*
OIL-E captures ENVRI RM as an ontology, and can be used as a basis for semantic linking, particularly classification of entities described in metadata. More and more metadata is needed to describe RI research assets (not only data, but tools, services, people, facilities, etc.), and OIL-E provides a proposed framework in conjunction with scientific vocabularies for data (e.g. EnvThes, Agrovoc, etc.). The Knowledge Base provides the basis for a knowledge graph of environmental science RIs, capturing architecture, the current semantic and technical landscape and other aspects not covered by traditional data product catalogues. The Knowledge Base can serve to systematically compare and analyse RI design and identify gaps, and can also serve as an incubator for different models for publishing RI meta-information on the Semantic Web as Linked Open Data, which can be used to determine how RIs can exploit the Semantic Web and the benefits of doing so.
5. *Which domains and which other user groups?*
WP5 services and data artefacts are primarily focused on RI architects and developers, though Semantic Web artefacts such as OIL-E and the Knowledge Base may be used by other services (e.g. catalogue services or recommender systems) that may be themselves used by other user groups.
6. *Continued advertisement and support?*
OIL-E and the Knowledge Base should be used to achieve practical ends (e.g. demonstrating the capabilities gained by modeling certain aspects of RIs, or semantic linking with other data sources such as provenance stores) within the confines of RI projects in order to encourage adoption by RIs as standards (OIL-E) or prototypes for future developments (replicating the knowledge base for specific cases and exposing the knowledge graph online for querying).
7. *Which sustainability activities?*
Training and promotion with examples of past applications of the model for specific RIs, to ensure that there are experts who understand and are able to apply the model to new cases. Uploading of OIL-E ontologies to common repositories with clear descriptions of purpose and use will increase exposure, though additional promotion will likely be needed to ensure continuing use. The Knowledge Base requires technical maintenance (currently provided by UvA), and should eventually be migrated to a community platform. Continuing development in the context of successor projects is needed at this stage to bring to the status of a mature product.
8. *Approximate annual sustainability costs?*

Major costs are associated with personnel costs to develop the services further in the context of future projects. Costs of support resources (e.g. server for the Knowledge Base) are relatively minor. If the Knowledge Base is adopted as a community resource of the environmental science RI cluster, then funds must be apportioned for maintenance and update, commensurate with the portion of an engineer's time per year diverted specifically to Knowledge Base management (depending on whether this includes development. This is expected to be from 5% salary [basic admin] upwards.

Service: ENVRI Reference Model

1. *Owner*
Cardiff University, University of Amsterdam, Environmental Agency Austria
2. *Owner takes responsibility for sustainability?*
The ENVRI RM is (in principle) open to the environmental science community, but will likely need some sort of 'lead architect' to ensure further sustainability. *Remark:* the question is not answered. Will Cardiff University, University of Amsterdam, and the Environmental Agency Austria take responsibility to sustain the ENVRI-RM in the future?
3. *If no responsibility, is it agreed to transfer this?*
ENVRI RM (or adaptations thereof for specific domains) is offered freely to anybody who wants to develop it further.
4. *Why is it important for RIs?*
The ENVRI RM provides a common set of stereotypes for environmental science RI architecture, systems, data and processes that can be used to compare different RIs and evaluate commonalities and gaps. A 'living' RM freely modified by the community can provide a basis for improving conceptual interoperability between RIs in that community.
5. *Which domains and which other user groups?*
WP5 services and data artefacts are primarily focused on RI architects and developers
6. *Continued advertisement and support?*
ENVRI RM should be promoted internally within the environmental science RI cluster by demonstrating the conclusions that can be drawn from modelling.
7. *Which sustainability activities?*
The use of the ENVRI RM is predicated on training and promotion of the reference model, with examples of past applications of the model for specific RIs, to ensure that there are experts who understand and are able to apply the model to new cases. If the video and training material are made available online; the actual cost for promotion can be done jointly with the other activities. This part can be relatively small. Updating and RI support for the ENVRI RM requires a lead architect for 5% of an engineer's time, depending on the complexity of the engineering tasks, and how RM is used in the engineering.
8. *Approximate annual sustainability costs?*
Major costs are associated with personnel costs to develop the services further in the context of future projects. Annual costs of support resources (e.g. hosting for ENVRI RM online) are relatively minor.

WP6 – Inter RI data identification and citation services

Reports: Data citation & identification will be basic services for many data infrastructures, and are required by many RIs. The WP6-related services are listed in the ENVRIplus Service Portfolio.

1. *Owner*
ICOS ERIC via the ICOS Carbon Portal (hosted by Lund University, the official ENVRIplus beneficiary).
2. *Owner takes responsibility for sustainability?*
Yes - they are integral parts of the operational data management activities of the ENVRIplus partners developing them - for example ICOS - and as such will by necessity be supported during a foreseeable future.
3. *If no responsibility, is it agreed to transfer this?*
Not necessary, all related software developed by ICOS is already now available at GitHub (<https://github.com/ICOS-Carbon-Portal>) under a GPL 3 license. It is therefore possible for any organization that wishes to implement its own instance to do so.
4. *Why is it important for RIs?*
The data ingestion service, coupled with the related ontology-based metadata catalogue and PID mining component, offers a comprehensive and FAIR method for any RI to ingest, archive and disseminate their digital objects. (Not only data.)
5. *Which domain and which other user groups?*
Atmosphere, Ecosystem/biosphere and Marine domains. Primary users are researchers with some connection to ICOS or similar observation networks, and modelers of atmospheric greenhouse gases & terrestrial ecosystems. (Some marine GHG modelers as well.) The modelers are mainly non-ENVRI.
6. *Continued advertisement and support?*
Via the ENVRI service portfolio, EOSC service catalog and scientific publications & conference contributions. Word of mouth will also be important.
7. *Which sustainability activities?*
The maintenance and further development will come from the core funding of ICOS. Advocacy and advertisement should come from users that tell the world how great this system is. Many external users will connect to the system and experience its strengths and signal eventual weaknesses. Training for users should not be needed as the front-end is self-explanatory and was developed based on user feedback. People that want to deploy the system can receive dedicated training on demand.
8. *Approximate annual sustainability costs?*
Approximately, for maintenance and further development and extensions, a part of the 1.24 M€ per year budgeted for the core activities. For giving training for deploying the system, about 1 man-week per year will be required.

Service: Data analytics facilities (D7.2)

1. *Owner*
The Data Analytics facilities resulting from T7.1 are part of a larger Open Source software system called gCube (www.gcube-system.org). The owners of this technology are mainly the developers that are, for Data Analytics, members of CNR ISTI. The facilities are offered with the “as-a-Service” delivery model. The owner of the Data Analytics aaS is CNR that operates and provides the facility by the D4Science Infrastructure (www.d4science.org). The e-infrastructure optimization platform DRIP (Dynamic Real-time Infrastructure Planner) resulting from T7.2 is open source software currently maintained by partner UvA.
2. *Owner takes responsibility for sustainability?*
CNR is already offering the Data Analytics facilities to a number of communities and initiatives. CNR is prepared for the product sustainability. UvA provides DRIP as part of its service offering in a number of projects and continues to offer it in new project proposals; UvA continues to take responsibility for sustaining DRIP.
3. *If no responsibility, is it agreed to transfer this?*
The software is made available to everyone willing to use it. The license is the EUPL (data analytics facilities) and Apache (DRIP) licenses.
4. *Why is it important for RIs?*
The facility supports a key phase of any scientific lifecycle (i.e. the processing / analysis). The facility is making distributed computing easy for scientists and is promoting open access practices. The platform enacts the “transformation” of existing algorithms and methods into processes made available by the WPS protocol, the OGC standard for processes. This largely facilitates the sharing and re-use of existing algorithms and processes. Moreover, the service offers the computing capacity needed to execute the algorithms by relying on a distributed computing infrastructure that can be configured to rely on computing capacity made available by EGI (and in future by other providers contributing to EOSC). DRIP supports the planning and provisioning of customized virtual infrastructures on Cloud and Cloud-like environments (including across multiple sites), as well as the fast deployment of application components, specializing in time-critical (e.g. deadline constrained) applications. This is of particular value to RIs that need to make targeted use of e-infrastructure (such as provided by EGI) to handle specific workflows (e.g. running a data subscription pipeline) outside of a curated virtual research environment such as provided by the Data Analytics facility described immediately above. Altogether, the contributions described provide a number of options for data processing to RIs based on their different needs.
5. *Which domains and which other user groups?*
The service has been successfully used by a large array of communities and cases in domains ranging from Cultural Heritage to Biodiversity, Fisheries, Agriculture, Social Sciences, and Environmental Sciences. DRIP’s functionalities are of interest to RI application developers and e-infrastructure providers who want to provide easier to customize IaaS (Infrastructure as a Service) facilities to RIs and researchers. DRIP’s functionalities are not limited to the scientific domain, but have been applied to commercial/industrial use-cases as well.
6. *Continued advertisement and support?*
The service is operated by D4Science and made available by several Virtual Research Environments. Some of these VREs are openly available, e.g. they can be used for

dissemination and showcase purposes. Several videos and scientific papers exists including ones where the service has been used to produce scientific results, e.g. G. Coro et al. (2018) Forecasting the ongoing invasion of *Lagocephalus sceleratus* in the Mediterranean Sea, *Ecological Modelling*, Volume 371, 2018, Pages 37-49, <https://doi.org/10.1016/j.ecolmodel.2018.01.007>

Requests for use can be sent to info@d4science.org . DRIP is provided online as open source (<https://github.com/QCAPI-DRIP>) and is being promoted in new projects and project proposals. As the software matures, it is intended to host DRIP on different marketplaces for e-infrastructure services (e.g. EGI marketplace) where appropriate.

7. *Which sustainability activities?*

The software is routinely maintained by D4Science that is operating it to serve existing communities and cases. Updates, support and training activities are provided in a best-effort in absence of a SLA. Once a new community is willing to use the service in a systematic and regular base a proper SLA is expected to be signed by the “consumer” and the provider.

[DRIP] The software is maintained by UvA and provided as an open source project with online documentation. The software does not require special expertise to use, but demonstration of the software in project events is a useful way to promote awareness of the software.

8. *Approximate annual sustainability costs?*

This largely depends on the number of users to be served, the computing capacity to be guaranteed, and the level of support to be offered, the set of services and facilities to be provided by one or more VREs.

[DRIP] Costs for promotion are typically dependent on the cost of providing a technical expert to demonstrate the software at workshops and other events. Cost of development is typically subsumed by project activities in the cost of personnel. Cost of operation is primarily the cost of operating virtual machines to host applications deployed by DRIP, something that DRIP itself is designed to minimize where possible.

WP8 – Data curation and cataloguing

Reports: Recommendations for curation, for cataloguing, and for provenance.

These recommendations need to be understood in a wide sense, including new methods and approaches, even concepts and ideas, which may be published in literature. ENVRIplus partners develop and test these usually through at least one use case involving at least one RI.

1. *Owners*
 - D8.1 Curation Report NERC
 - D8.2 Curation Demonstrator NERC
 - D8.3 Catalog Report IFREMER
 - D8.4 Catalog Demonstrator IFREMER
 - D8.5 Provenance Report EAA
 - D8.6 Provenance Demonstrator EAA
2. *Owner takes responsibility for sustainability?*

Not without a sustainability model covering ENVRIplus as a whole, probably linked with the European Open Science Cloud
3. *If no responsibility, is it agreed to transfer this?*

Yes, subject to suitable agreements concerning Intellectual Property
4. *Why is it important for RIs?*

Curation: essential for long-term availability of publicly-funded research assets
Catalog: essential for discovery, contextualization and re-use (FAIR) of publicly-funded research assets
Provenance: essential for assessing quality and relevance of publicly-funded research assets
5. *Which domains and which other user groups?*

All ENVRI RIs
All ESFRI (and other) RIs
6. *Continued advertisement and support?*

Via de European Open Science Cloud
7. *Which sustainability activities?*
 - 1 Maintain/update: staff effort 0.1 pms/m
 - 2 Advertise: staff effort 0.05 pms/m plus cost of materials
 - 3 User support/training: 0.1 pms/m plus cost of materials
8. *Approximate annual sustainability costs?*
 - 1: 12k€
 - 2: 6k€
 - 3: 12k€



WP9 – Service validation and deployment

Service: Service portfolio of theme 2, the full “data for science” package supporting RIs.

1. *Owner*
An agreement amongst the owners is in preparation to be finalized by the end of the extended project.
2. *Owner takes responsibility for sustainability?*
Most partners are capable to sustain the project results.
3. *If no responsibility, is it agreed to transfer this?*
It is considered to eventually transfer or share the operation efforts with a third-party.
4. *Why is it important for RIs?*
WP9 provides service portfolio containing a list of validated Theme2 service productions.
5. *Which domains and which other user groups?*
European environmental research community.
6. *Continued advertisement and support?*
ENVRIplus Service Portfolio provides a one-stop shop for ENVRIplus services, where users can find the latest information, development status, and evaluation of those services.
7. *Which sustainability activities?*
The ENVRIplus Service Portfolio will be provided by D4Science platform. Each service entry (description, status, updates) has to be maintained to be up-to-date.
8. *Approximate annual sustainability costs?*
~0.5FTE (including Service Portfolio and evaluation platform).



Theme 3

WP10 – Governance for sustainable and adjustable access to RIs

1. Reports, as a set of documents containing recommendations, guidelines and similar.
2. The Theme 3 and Work Package 10 final owners will be concluded by the end of the extended project
3. Currently not applicable.
4. It is clear that the success of a research infrastructure is measured by the research performed based on its data, software services, ICT and technical resources, and user expertise. Good environmental research is based on access to data and facilities. It is thus important to make sure that there exists a general framework of governance tools to ensure this access and that these tools are both flexible and sustainable.
5. The key user groups will be the RIs themselves, in particular on the management levels. These RIs do not necessarily need to be part of the ENVRI consortium.
6. The availability of the final documents is announced through the ENVRIplus channels.
7. Maintenance is required for the long term and would require to store and provide access to the documents.
8. The small annual costs are covered as part of the general IT costs of the owner.



WP11 - New Concepts and Tools for Physical Access

Service: Opportunities for combining advanced access tools at the interface of atmospheric and bio-ecological domains.

1. *Owner*
The access services offered is under the authority of the French research council "INRA".
2. *Owner takes responsibility for sustainability?*
Currently the AnaEE research infrastructure.
3. *If no responsibility, is it agreed to transfer this?*
See answer under 2.
4. *Why is it important for RIs?*
The service offers unique opportunities for combining advanced instrumentation at the interface of atmospheric and bio-ecological domains. Although multi-disciplinarity is a strong prerequisite here, the service aim here to promote inter-disciplinary research projects that not only draw on the knowledge from disciplines but to pool the resources and expertise from the two domains in order to improve or understanding of the related scientific questions that are being investigated during hands-on field experiments.
5. *Which domains and which other user groups?*
Most of the user applications came outside RIs in ENVRIplus indicating that the advertisement procedure alongside with its implementation is robust (see question 6). However regardless the service /RIs type the evaluation process of the proposals reveals that the projects leaders still need to contribute to effective multidisciplinary-/cross domain-access to fulfill the ENVRI goals and overcome standard transnational approach. To that end, proposal writing should be emphasized, so as to comply with call requirements, notably in terms demonstrating value added, access to new users and innovation potential. As such, communication between the applicant and the site PI-managers in advance should be more formalized to increase the quality of the proposals and their expected results.
6. *Continued advertisement and support?*
A successful advertising procedure plays an important role to attract potential users. For this reason a dedicated website was implemented with a description of the multi-disciplinary services alongside the instrumentation, the experimental design and the available technical logistics of the services to implement and support potential applicants. In addition to the website, the call services was widely advertised via the ENVRIplus newsletters, mailing lists and social networks (e.g., Twitter) of all ENVRIplus RIs, the websites or the ENVRIplus RIs and access providing platforms. Beyond ENVRIplus and its participating product/services, the sites for hosting interdisciplinary field studies have also been presented and marketed in other international research and development events. The call for application was sufficiently open (at least two months). Funding was offered to support user groups with up to 10 000 EUR for supporting travel and subsistence costs.
7. *Which sustainability activities?*
A well-designed advertisement tool alongside a dedicated qualify people are critical to satisfy the needs of individual users or organizations, attracting new users and building lasting relationships. When done effectively, the advertisement investments strengthen the RI services and help establishing trust, economic value and return of investments (e.g. through SMEs).

In this regard the services may require developing and implementing:



- Media strategies focus on circulating for example messages through media channels to manage how the media portrays the services of a given RI. The media tools might include releasing media statements and fact sheets, offering on-site media tours to encourage journalists to report positive messages about the services.
- Social media such as Facebook and Twitter which allows to follow and be followed by potential users, drive web traffic, manage issues by responding quickly to criticisms or negative perceptions, and increase exposure for the services brand
- Business events, which are great opportunities to gain exposure of the services and make sure accurate information reaches, targeted users.
- Speaking engagements, in other words speaking at events where potential users are likely to attend builds the reputation of the services - and draws new users.

In addition to the advertisement tools, updating the access procedure and managing it (e.g. define the modalities, conditions, and criteria of access) need to be sustained. As such qualify advertising professionals are may be needed to implement and sustain the access procedure and the advertisement strategy tools.

8. *Approximate annual sustainability costs?*

The approximately annual costs for the access tools would be € 40 000 to 55 000. This estimate does not include the access cost for users to the services.

Theme 4

WP12 – A Framework for Environmental Literacy

Service: Reports + module for the ENVRI Reference Model.

1. *Owner*
Main owners below (deliverables were developed jointly by all task participant institutions)
ICOS for Deliverable 12.3 (report)
ETH for Deliverable 12.2 (report)
EAA for Deliverable 12.1 (Reference Model module and appropriate documentation)
2. *Owner takes responsibility for sustainability?*
Reports: While the authors (organisations) of the reports are in principle willing and capable of sustaining the product (in my view this means putting a DOI on them and make them accessible in an appropriate long term archive, e.g. at the institution), ENVRI should eventually identify a joint long-term archive of these kinds of project results. RM module: See WP 5
3. *If no responsibility, is it agreed to transfer this?*
Reports: not necessary - the repository doesn't need to own it - and the license on the report (currently none) should allow 'anybody' to archive and redistribute
4. *Why is it important for RIs?*
D12.2 and D12.3 are summary papers that provide valuable information for RIs, in particular contexts. They serve mainly as reference / background material for future work.
D12.1 - the RM module - is of strategic importance for RIs as it provides a comprehensive and harmonized way for the 'societal impact' assessment of RIs (either as self-assessment or even externally).
5. *Which domains and which other user groups?*
D12.1 - the RM module - is domain independent, relevant for all within ENVRI (and likely any ENV related RI).
D12.2 is relevant for any RI / domain that deals with crisis relevant information, but it has its main focus in (solid) earth sciences.
D12.3 has its main interest group in the 'terrestrial ecosystem / biodiversity' domain. (Comment: this cannot be part of the cluster-level Sustainability Plan).
6. *Continued advertisement and support?*
D12.2 and D12.3 are already being advertised / published through domain specific channels (and may result in peer-reviewed publications at some stage). In principle the services should be valid / valuable for the longer term, but in reality things may change so fast that at least after 3-5 years these products should either be reviewed / updated.
D12.1 - the RM module - should be integrated in the 'publication and dissemination' mechanism of the ENVRI RM.
7. *Which sustainability activities?*
For the reports (D12.2 and D12.3) there are no such costs / activities.
For the RM module, similar support will be required as for any other component of the ENVRI RM.
8. *Approximate annual sustainability costs?*
The only cost would be associated to the D12.1 - RM module, and the assumption is only a few hours/month.



WP13 – Developing an Ethical Framework for RIs

Service: Report on questionnaire answers with respect to ethical and social issues; Ethical Label Template; Ethical Guidelines for RIs; Publicity contents.

1. *Owner*
INGV and ETHZ are the owners of all the products of the WP13.
2. *Owner takes responsibility for sustainability?*
Yes, but it depends on the development of future projects.
3. The practical application of the products developed in the WP13 has to be secured, although they are self-consistent. For the continuity of the work done, some key topics have been identified. The ENVRI community is advised to continue the exploration and understanding of specific ethical and societal issues of interest for research and technological activities. One of these issues is data management from the perspective of its social impact and the repercussions of the diffusion and use of data by different stakeholders. Another important issue is the analysis of the RIs-society-policy interface and the contribution of RIs in decision-making processes. Moreover, some activities have been already outlined: among them, seminars and training course on ethical and social aspects in research activities, targeted to RIs. Finally, the promoting activity of what already developed in the WP13 should be implemented, to be more effective and widespread.
4. *If no responsibility, is it agreed to transfer this?*
N/A
5. *Why is it important for RIs?*
D 13.1 Questionnaire

This product is important for RIs because it gave an idea of the awareness of participants in the ENVRIplus Project about ethical and social implications of their activities. Moreover it highlighted the necessity to develop an ethical framework that supports scientists in their work and can make the science-society interface more effective, in order to translate results of scientific activity into tangible benefits. Finally, the obtained results have been important for the further steps of the WP13, in particular to carry out the Ethical Label Template and the definition of Ethical Guidelines for RIs.

D13.2 Ethical Label Template

This product is important because it allows to characterize each product of the ENVRIplus project in an ethical and social perspective, with essential information about the ethical, social, environmental implications and impact of each product.

D13.3 Ethical Guidelines for RIs

The Ethical Guidelines are an important product because they have an orienting function for RIs. They include principles and recommendations for the RI Governing Bodies, to be used by partners for building their policies and their own codes of conduct.

D13.4 Contents for Websites, social media appearance, printed matter on ethical & societal issues for general public.

This product allows the dissemination of all the results of the WP13. Its goal is the translation of results obtained on ethical & societal issues into material suitable for the scientific community and the general public (publication on websites, social media, etc). In particular for the D13.3, this goal has been achieved through the

creation of Twitter templates for the ENVIRplus account and a handy leaflet. *Which domains and which other user groups?*

The key user groups are in all the domains, because the aspects treated by the WP13, and consequently the related products, are not strictly connected to a specific field but in several cases are related to cross-cutting themes.

6. *Continued advertisement and support?*

Through the ENVRI community portal and the individual RI portals.

7. *Which sustainability activities?*

Seminars and training courses on ethical and social aspects in research activities, targeted to RIs, would be useful to this aim. These activities would need of materials and tools *ad hoc* to be developed.

8. *Approximate annual sustainability costs?*

Total annual costs are about 25.000 euros.

WP14 – Citizen Observatories and Participative Science

Service: Reports + Applications + Templates

A necessary component of environmental Research Infrastructures is and will increasingly become participative or “citizen” science. This is for two key reasons: 1) it raises societal awareness and engagement about environmental change and 2) provides data that is otherwise logistically inaccessible for monitoring change on our planet. This work package developed and summarized resources for environmental Research Infrastructures to engage with the public in citizen science, an area providing innovative solutions for data or sample collection, management, processing, curation, annotation, and deposition.

1. Owners

Task 14.1. Imagery Annotation: Taking complex scientific images and turning them into data. Laboratoire Environnement Profond, Ifremer, Brest, France. D14.1

Prototype of a web-based annotation tool for user testing and D14.2 Report describing image annotation results

Task 14.2. Citizen virtual seismological observatory. EMSC owns its citizen seismology services and activities. D14.3 Report on development and implementation of a citizen seismology sensor observatory and education platform. D14.5 Test version of a EMBRC citizen observatory system.

Task 14.3. Marine biodiversity citizen participative science programme. The Marine Biological Association, Lifewatch Sweden and University of Gothenburg (UGOT).

D14.4 Guidelines for developing citizen sensor observatories and education platforms. Training scientists on concept; value and scope of citizens science. Development of recording app (crab app) for the training. App will continue to be provided by MBA and training materials maintained. Further development is dependent on further funding availability.

Task 14.4. RI Citizen Science Toolkit – Best Practices augmented by Leading Area test cases. ENVRIplus. D14.6 Review of existing Citizen Science tools and D14.9 . See summary report of WP14.

2. Owner takes responsibility for sustainability?

Reports: While the authors (organisations) of the reports are in principle willing and capable of sustaining the products (at the very least assigning a DOI and making them accessible in an appropriate long term archive), The ENVRI business plan should identify a joint long-term archive of these project results.

Applications/Databases: there is a separate issue in terms of maintaining developed applications and databases – in some cases there may be the institutional capacity to do so, but it should not be assumed. Embedding in various international citizen science data systems is being explored and implemented.

Task 14.3 - Training scientists on concept; value and scope for citizens science. Development of recording app (crab app) for the training. App will continue to be provided by MBA and training materials maintained. Further development is dependent on further funding availability. UGOT and Swedish LifeWatch will take responsibility for the developed products as a part of the Nordic e-Infrastructure Collaboration (<https://neic.no>), including training, maintenance and further development (if there are sufficient request from the users).

3. If no responsibility, is it agreed to transfer this?

Reports: not necessary - the repository doesn't need to own it - and the license on the report (currently none) should allow 'anybody' to archive and redistribute. Furthermore, these reports will benefit broader communities as windows into key case studies of marginal communities.

4. *Why is it important?*

Task 14.1: The online application Deep Sea Spy supports the annotation of thousands of images acquired by the EMSO RI using a citizen science approach. It not only facilitates the processing of the huge imagery archive, but also promotes research by raising awareness among the general public.

Task 14.2: Citizen seismology is an evolving field. It improves interaction and dialogue with society. In the longer run, it may create some professional vocations.

Task 14.3: UGOT Scope for research infrastructures to engage further than narrow science lines. Public engagement and actions. Different way of data collection grow the use of research infrastructures. The product allows individual researchers to build, maintain, and control their own citizen collection system, which is especially useful when building up citizen networks in other parts of the world. The system is also linked to a virtual research environment that allows for repeated and reproducible analysis of the collected data. The use case is published here: <https://www.frontiersin.org/articles/10.3389/fmars.2018.00164/full>

5. *Which domains and which other user groups?*

Task 14.1: Any RI acquiring imagery data can adapt the application to their own images. Another key user group is the public who benefits from the app to learn about the deep sea and research infrastructures.

Task 14.2: Society

Task 14.3: Marine; biodiversity

6. *Continued advertisement and support?*

Task 14.1: The advertisement requires huge media coverage. Working with educational stakeholders has proved efficient to spread the information and increase ocean literacy within the younger generation. A dedicated person to manage the project, write articles and update the project website would be ideal.

Task 14.2: Citizen seismology is not yet a mature field and has been constantly evolving and will keep evolving in the future. It makes extensive use of social media ensuring a significant public visibility.

Task 14.3: Through existing networks and organizations, as well as biodiversity e-infrastructures (e.g. <https://neic.no/deepdive/>, <http://www.swedishlifewatch.se/>)

7. *Which sustainability activities?*

Task 14.1: Scientific mediation, writing of articles, website updates, conferences, ideally these tasks would be undertaken by a project manager.

Task 14.2: EMSC has initiated citizen seismology back in 2004. We develop it through different funding opportunities. The maintenance in its current form probably cost about 1fte, but not evolving would kill the initiative in a few years time.

Task 14.3: Maintenance and training - Actual training events and development of further specific materials. We would like to continue to develop the dialogue of what can be offered to scientists within the research infrastructures

8. *Approximate annual sustainability costs?*

Task 14.1: Printing fees (educational booklets, stickers, flyers, posters): 5000 €, Event organization (rental, coffee, refreshments): 5000 €, Project manager contract (12 months): 58 000 €

Task 14.2: 70k€/yr for maintenance (manpower) ESMC

Task 14.3: 50 to 80k per year to keep the basic programme. To create hub and information resources 100K per annum.

Theme 5

WP15 – Training, e-Learning and courses

Service: Platform and contents for a variety of training opportunities.

1. *Owner*
For the e-learning and the serious game: University of Salento.
For content on the platform: University of Salento, INGV (teacher material platform, University of Cardiff (RM training courses), and EGI (e-infra training).
2. *Owner takes responsibility for sustainability?*
UniSalento indicated to service the platform beyond the project period for the ENVRI community. The position of the content experts is pending.
3. *If no responsibility, is it agreed to transfer this?*
Training platforms are now part of the ENVRI-FAIR project. It will be renovated by LifeWatch. A full new software package is foreseen, funded by ENVRI-FAIR with at least 4 more years of service availability. LifeWatch will sustain this after the end of the ENVRI-FAIR project. Developing new content is part of individual RI's responsibility and willingness.
4. *Why is it important for RIs?*
The e-learning platform is generic, can act as placeholder for all kinds of material from, by and for all RI's in ENVRI.
5. *Which domains and which other user groups?*
The e-learning platform is developed for ENVRI and designed that way, but could easily be extended outside ENVRI community.
6. *Continued advertisement and support?*
The training platform is a real community products and results, and should be taken up by the ENVRI community organisation (as a follow up project or a separate organization).
7. *Which sustainability activities?*
The content of the e-learning platform needs continued updating. The developing partners are not involved in new future projects or other activities. This requires attention, to find new owners or contract the current ones in a different way. The platform itself will require updates, and will be sustained LifeWatch.
8. *Approximate annual sustainability costs?*
Provisional estimate: a few person months/year.

WP16 – Staff Exchange

Service: Procedures for staff exchange

1. *Owner*
University of Bremen
2. *Owner takes responsibility for sustainability?*
No
3. *If no responsibility, is it agreed to transfer this?*
The owners agree to transfer this, while assuming responsibility for sustainability in the sense and to the extent that they describe what their thinkings and findings are for a continuation of RIs' staff exchange beyond the ENVRIplus project lifetime: as laid out below in point 7, this can basically occur in a **virtual mode**, in an **institutionalised mode**, or - minimalistically - on the basis of mutual agreements.



4. *Why is it important for RIs?*

The staff exchange program is an example on how to organize this in an ENVRI community situation. The material, forms, rules and funding mechanism are available and sustained. In general, the staff exchange programme is highly beneficial for involved RIs: mutual visits promote interdisciplinary thinking, work motivation, employee satisfaction and the exchange of opinions and solutions, and eventually contribute to solving repetitive problems. The wheel does not have to be reinvented every day by every person and networking is an intelligent add-on to science & research. This is the core essence of the exchange programme, making it valuable and worth preserving. The staff exchange programme was successfully launched and could motivate a large number of RI staff to engage, travel and share their knowledge within the ENVRI community. This knowledge transfer contributed to some highly useful products and ENVRI services which now are promoted as the ENVRIplus Science Demonstrators (see D9.2) such as the Sensor Registry (Use Case TC_4), the Support EISCAT_3D Users to Reprocess Data Using User's Algorithms (Use Case IC_3) and the New particle formation event analysis on interoperable infrastructure (Use Case TC_17). The impact of the staff exchange on the overall project was significant

5. *Which domains and which other user groups*

The necessity to ensure the sustainability of the Exchange programme results from the obvious benefit of intra-European research networking which essentially is based on the direct interaction between individuals who would not have met and interacted in other circumstances. Further, new drivers such as the EOSC, but also internationally accepted standards in the areas of good governance, compliance and ethical management are accelerating the development towards increasingly standardized processes in an increasingly globalized and virtualized (research) world. It starts with recognizing that things run better, smoother and more efficiently in a heterogeneous international community that is oriented towards the same goals and interests. The staff exchange programme was developed for ENVRI RIs and designed that way, but could easily be extended to any other research community or user group beyond ENVRI, at least to those adhering to the same working principles. Eventually, it all gets down to intelligently organizing the division of labour, creating added value and enhancing prosperity for all, be it through targeted cost savings, better economies of scale, or through better results and advances in knowledge overall. This applies to cross-border scientific research but not exclusively.

6. *Continued advertisement and support?*

Continued advertisement has to be taken up by the ENVRI community (as the follow up project ENVRIFAIR or a separate organization) after the transfer of the service. It appears reasonably fair to foresee a certain budgetary amount for public relations & advertising, both of which would most certainly focus on the Internet such as the ENVRI community platform, supported by ENVRIFAIR dissemination activities

7. *Which sustainability activities?*

Several options are targeted to support the sustainable continuation of the Exchange Programme beyond the project's lifetime with respect to organisational form and the necessary funding of the whole scheme:

- With regard to the organisational form, a **virtual mode**, web-based and unstaffed 'portal solution' rivals with an **institutionalised mode** relying on dedicated staff with a fixed office and clearly defined tasks and responsibilities.
- With regard to financing, a solution derived from an overarching EU budget, a solution based on the regular budget of a specially nominated institution or a solution based on membership fees/donations/endowment income can be considered.

In principle, it is of course also conceivable that the respective RIs bear exchange costs and organise staff exchanges on the basis of mutual agreements. All mentioned sustainability models do have their pros and cons, and are part of the ENVRI business plan.

In the **virtual mode**, the focus is on procedural streamlining, cost savings and speed. The downside is anonymity and a possibly higher inhibition threshold for first-time exchange users. In spite of the more cost-efficient organizational structure, at least basic financial resources are required here as well, of course. This mode would benefit from the fact that the *ENVRI community* is to some extent already accustomed to virtualized functional mechanisms. In this mode it would perhaps be worthwhile to check to what extent the recently started EOSC can be integrated in a supportive way.

In the **institutionalised mode**, the aspects of personal responsiveness, reliability and accountability would be more prominent. Here, a viable organizational or legal form would also have to be chosen, which would not only meet the effective operational requirements but also allow a maximum of controlling interventions while at the same time comply with local law. However, this is a political issue that needs to be agreed on by the ENVRI community.

In summary and in the light of the reasons given, it is highly desirable that the staff exchange programme, which has been so successful to date, continues in the future. The most feasible way to sustain an ENVRI staff exchange programme beyond ENVRIplus will most likely start in '**virtual mode**' under the umbrella of the ENVRI community, which would be a good organisational background and already provides the necessary RI network. For sustained funding, a mixed-model seems to be most appropriate which would include EU funds such as e.g. ENVRI-FAIR travel funds and moderate financial travel support from the involved RIs.

8. Approximate annual sustainability costs?

Annual monetary requirement: It can be assumed that the staff exchange costs below represent a good basis for future planning. In addition to the sum of the costs for the individual exchanges, an overhead for a (possibly proportionate) programme manager or coordinators/evaluators/budget controllers will be included. These roles do not necessarily require dedicated staff but associated work requires some funding. Additionally fixed annual budget is required for public relations/advertising as well as for maintaining an adequate IT infrastructure that relies on tested software resources. Based on the experiences we made during the ENVRIplus project, about 15.000 - 20.000€ would provide the necessary funding for about 5-8 exchange activities including bilateral RI visits and on-site RI meetings or workshops for smaller groups.

Budget items to be considered:

The following table gives an overview of the anticipated costs associated with a continued, managed EoP.

Item/Role	Estimated annual budget (€)	Comment
Administration	4.000	0.5-1 PM admin staff costs
Overheads	1.000	Office space, IT etc.
EoP Budget	20.000	Money to be distributed
Total	25.000	

The above numbers are based on the assumption that about 5-8 annual exchange activities will be funded and some funding to compensate administrative costs are available. The assumption is that the ratio between the actual staff exchange budget and administrative costs improves with a higher exchange budget to distribute.

Theme 6

RI communication and cooperation framework to coordinate activities of the environmental RIs towards common strategic development, improved user interaction, and interdisciplinary cross-RI products and services.

Network: Board of European Environmental Research infrastructures (BEERi).

1. *Owner*
All RIs as represented in the Board of European Environmental Research Infrastructures (BEERi)/RIs. Facilitation of the BEERi activity has been provided by FMI.
2. *Owner takes responsibility for sustainability?*
BEERi members agreed that BEERi will be kept alive and resources for it are seen obligatory. The top-down part of the sustainability plan is addressing the sustainability of the BEERi.
3. *If no responsibility, is it agreed to transfer this?*
Facilitation of the BEERi work (that has been done by FMI in ENVRIplus) can be discussed and agreed differently if needed. In ENVRI-FAIR, FMI leads together with CNRS/UHEL the Task related to BEERi activity.
4. *Why is it important for RIs?*
BEERi is the core of the ENVRI cluster as it is the decision body and takes care of the strategy development of ENVRI. BEERi follows the developments in RIs/domains, joins forces on achieving common opinion and understanding on proposals/initiatives as a cluster, tackles and gives updates on topics that are relevant for the ENVRI (e.g. EOSC, ongoing projects, industry collaboration, ESFRI activity, socio-economic impact etc.) and keeps discussion and collaboration alive between all env RIs and also initiatives outside the ENVRI community.
5. *Which domains and which other user groups?*
All domains.
6. *Continued advertisement and support?*
Via ENVRI community platform, ENVRIplus/ENVRIFAIR dissemination activities and common outreach activity (that is not connected to any specific projects).
7. *Which sustainability activities?*
BEERi meetings, ENVRI strategy and ENVRI sustainability plan.
8. *Approximate annual sustainability costs?*

Meeting organizations	5000-10000 €
Travels	50000-100000 €
Facilitation of BEERi work	3-6 PM

Service: ENVRI Community Platform

1. *Owner*
UHEL / EGI
2. *Owner takes responsibility for sustainability?*
It is not be a problem to license it from UHEL to ICOS.
3. *If no responsibility, is it agreed to transfer this?*
See under 2
4. *Why is it important for RIs?*



The platform serves as one collaboration and documentation space for the entire community. The entire idea behind the development of the platform was that it will be sustained after the project and all the documentation, guidelines, best practices etc. developed within different supporting projects will be available here. It also gives RIs possibility to advertise their news, events, products, developments to the entire community going beyond a specific domain. They can therefore reach much broader audience through the platform. It links and provide access to ENVRI community training platform. The platform can host websites of any future cluster projects or initiatives (sustained by the community or facilitated through EC funding) and it that sense it integrates past as well as future work done within the community.

5. *Which domains and which other user groups?*
All domains.
6. *Continued advertisement and support?*
The work has been initiated during the ENVRIplus, but its further development and advertising the platform requires additional resources.
7. *Which sustainability activities?*
Regular maintenance of the website. Resources for the further development (not so much needs to be done in terms of the functionality, but rather content of the platform. Resources for advertising the platform among the RIs would be needed. A person responsible for administrating the platform would be needed (at least 4PMs/year).
8. *Approximate annual sustainability costs?*
Covered in the ENVRI-FAIR project.

