Technical and Scientific Description Appendix 1. Compliance with the Article 4 of the EC regulation 723/2009 on ERICs

Version 7.1
16/10/2020

Compliance with the Article 4 of the EC regulation 723/2009 on ERICs

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Necessity

The provisioning of services by continental ecosystems is central to a sustainable bio-economy, health, food security and human welfare. Anthropogenic activities are seriously threatening ecosystems, resulting in an unprecedented environmental crisis challenging the present and future of human societies. Multiple global change drivers influence continental ecosystems, including changes in land use and nutrient input, food, raw material and bio-energy production, climate change at global and local scales, loss of biodiversity, and pollution. Several of these global change drivers represent persistent threats for sustainable food production, water quality or the global equilibrium of element cycles on Earth. We need to determine the short- and long-term response of ecosystems, how these responses will feed back to global processes, and how human societies can adapt to and mitigate changes in ecosystem functioning.

AnaEE addresses how major biogeochemical cycles, biodiversity and the relationship between biodiversity and ecosystem functions, including agricultural ecosystem functions, will change under the various experimental drivers simulating future changes. This allows AnaEE to provide comprehensive assessment and solutions in terms of land-use change, climate change, mitigation, and adaptation to future conditions.

AnaEE will provide key services to develop long-term strategies and policies aimed at strengthening the management of all ecosystems towards reducing greenhouse gas emissions and enhancing carbon sequestration, but also for addressing current climate change challenges whether in terms of reducing food security or non-production ecosystem services. The infrastructure itself and the results provided by AnaEE, together with modelling platforms, will provide policy makers the mapping decision support tools for early detection of the most vulnerable areas and ecosystems, enabling them to take early action.

Added-value for the strengthening of the European Research Area (ERA) and improvement of the relevant research fields at the European level

The AnaEE RI strengthens the ERA as it provides a unique, integrated infrastructure of experimental platforms in all European climate zones (and some platforms overseas), with all types of applied pressures. AnaEE will interconnect the climate manipulation experiments with modelling and analytical platforms that help to understand the impacts of climate change on ecosystem processes and up-scale the results to a continent-wide scale or even larger territory. In addition to modelling platforms, remote sensing platforms or analytical laboratories within AnaEE are used to identify the acclimation and defence mechanisms or climate change impacts on ecosystem functions, from regional to molecular scales. AnaEE represents an integrated infrastructure that enables large scale gradient studies across geographic, climatic, elevation or soil gradients that are necessary for successful long-term predictions of climate change impacts for almost all combinations of ecosystem type and local soil and climatic conditions.

Moreover, as AnaEE experimentally manipulates the environmental drivers, it provides essential data on the future evolution of the release of atmospheric compounds, which can explain the observations of eLTER, ICOS or ACTRIS on the long term. These complementarities between the experimental approach (AnaEE) and the observational approach (all other infrastructures) are summarized in Figure 2 of the main document. Its capability to experimentally simulate a huge range of environmental pressures, whether as single factors or in interaction, is a strength that will guarantee the flexibility to be able to meet shifting as well as newly emerging societal and scientific priorities arising in 5 or 10 years from now.

One of the main added values provided by the integrated experimental infrastructure AnaEE is represented by services for climate change adaptation and mitigation. This is mainly because adaptation or mitigation measures can only be tested against the complex of climate factors expected in the future and also because the effectiveness of adaptation measures must be verified with the proper experimental design, i.e. compared to the no-action situation (control). This will gradually establish a strong link between ecosystem research and food security to ensure sustainable provision of production and non-production ecosystem functions. AnaEE as integrated infrastructure provides the most efficient way for the industry to find, develop and test adaptation measures applicable at continental level, or also to explore how to adjust them to specific climatic and soil conditions

AnaEE-ERIC will strengthen the position of Europe, as the integration level provided by its infrastructure will be unique in the world.

AnaEE will strive for the participation of new European countries, helping their scientific community to build experimental and modelling platforms at the best level, participating in the formation of new generations of scientists, thus increasing European collaboration.

Effective access

Access will be granted to the research community based on the sole merit of the proposal, evaluated by a proposal review committee (for full description see Appendix 5). To enhance the quality of the projected experiments, as well as to optimize the load on the infrastructure, we have implemented a procedure to optimize scientifically and technically the proposals, with the participation of the Independent Proposal Review Committee, the platform operators and representatives, and AnaEE-ERIC Service Centres.

The data products will be available following open access and FAIR policies. Models are freely available in an integrated way, thanks to the DMC, to evaluate and analyze, alone or together with the data from other RIs (e.g. ICOS, ACTRIS or eLTER), resulting in sound science and predictive results.

The effective access to the experimental facilities will be facilitated by alternative means such as remote access and serviced experiment (when the physical intervention is performed by a duty scientist or a skilled operator). This not only saves time and money for the user, but also provides access to a larger community on a cost-effective basis, while saving precious resources from our planet and limiting the emissions of greenhouse gas (GHG).

Syntheses and statistics will be performed on the results and data from AnaEE-ERIC, thanks to the ISC, will be made available to the research community, to the economic sector, as well as to policy makers, NGOs and the society at large.

Mobility of knowledge and/or researchers within the ERA, increase of the use of intellectual potential throughout Europe

AnaEE will contribute to the mobility of knowledge and/or research with the ERA. Together with the CIHEAM it has already contributed strongly to an INFRAIA proposal for starting communities, making available part of its research capacity for capacity building. AnaEE platforms are open to researchers from all over Europe. The associated status for platforms allows new communities to work and collaborate with AnaEE while they develop towards the quality level required to include them as full members of the RI.

AnaEE experimental platforms may be used to test new technologies and protocols, or management methods, either for scientific research or for the needs of applied research or for the industry. Training for PhD and master students will be made by providing tools for their research, and also with summer schools, workshops, and intensive field work campaigns. Platforms, and AnaEE services can

be accessed either physically or remotely by all users. The data, open access, will be FAIR, and tools, as well as training, will be provided to help users to use them, either alone or in combination with the data from other RIs. AnaEE will work with its stakeholder committee (SHC) to ensure that the knowledge is published in a form that is customized to the community targeted (e.g. a representative from an organization of farmers will be a member of the SHC).

Dissemination and optimisation of the results of activities in Community research, technological development and demonstration

The results of the AnaEE RI will be disseminated through internal communication, outreach, and distribution through scientific journals and the web.

The publication of research results in peer-reviewed journals will be the goal of projects that use the infrastructure, and they will be made available through the web portal of AnaEE-ERIC. Communication of results will be made also by organizing or participating in conferences and workshops. All the data acquired from the AnaEE RI will be made available to the largest community through its own data portal, as well as European wide access portals such as AnaEE. AnaEE-ERIC will actively ensure proper reference and availability thanks to the FAIR principle it implements.

AnaEE will have an active innovation policy, thanks to its Technology Centre. New products will be elaborated for the measurements of parameters with the industry, and the infrastructure will be used widely by the industry. AnaEE will also, together with specialists, develop new management methods and agricultural practices for sustainable agriculture.

The results of the research from AnaEE-ERIC will be also synthetized and made available to a wider audience thanks to the Interface and Synthesis Centre. Position papers, synthesis and statistics will help policy makers to base regulations aimed at the preservation of biodiversity and ecosystems on a rational basis

The communication plan develops the actions that are aimed at raising citizen awareness on the state of ecosystems in Europe, and the main actions that can be taken for the mitigation and adaptation in face of the global change impact. Independent testing of possible devices, methods, and regulations by AnaEE-ERIC will raise the confidence of the society towards political action in this domain.

Technical and Scientific Description Appendix 2. AnaEE's relevance for major types of European ecosystems

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AnaEE's relevance for major types of European ecosystems

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1. Agriculture

As mentioned, the AnaEE facilities can accommodate the major ecosystem types in Europe, which directly links the RI to major economic and societal value. Agricultural land covers 47% of the EU territory and over 95 % of the EU-28's 12.2 million farms (pre-Brexit) are categorized as family units that depend directly on agricultural land[1]. In 2013, over 22 million people were working directly in the agricultural sector, and the export of agricultural products generated a positive balance of over 21 billion euros. However, the current landscape of agro-climatic zones is likely to be severely disturbed by climate change (Figure 1). Unless a coordinated action plan is set up at national and European levels, many farmers will face income losses in a future climate with more extreme events (Figure 2); every 5% reduction in agricultural production would result in a €8 billion income loss for the EU as a whole[1]. Droughts, for instance, could lower crop yields by an average of 10 to 15 % in relatively moist climates. The 2018 drought in Central and NW Europe even led to production loss for main crops up to 50 %, and scientists have warned that similar droughts could become common occurrences even before 2050.

This calls for urgent adaptation strategies for European agriculture, which is where the experimental, forward-looking AnaEE network can provide major advantages in collaboration with the agro-industry (seed production, fertilizer, crop protection, etc.), for example, by:

- Development of innovative adaptation crop management technologies ensures increased water retention, nutrient use efficiency and carbon sequestration: no-till technologies, intercropping, cover crops, precision agriculture, robotics.
- Screening newly developed crop cultivars for climate robustness (resistance to drought, flooding, heatwaves) in enclosed and open-field facilities under different global change scenarios.
- Testing fertilizers that minimize nutrient losses through leaching under more variable rainfall
- Climate-proofing and optimizing crop irrigation under drought. Explore the inoculation of agricultural land with mycorrhizae to reduce nutrient inputs and losses.
- Assessing and reducing the environmental impact of crop protection products through open-field tests.
- Testing sustainable amendments on fields to sequester carbon (negative emission technology) on the long term.

[1] https://ec.europa.eu/info/horizon-europe-next-research-and-innovation-framework-programme_en

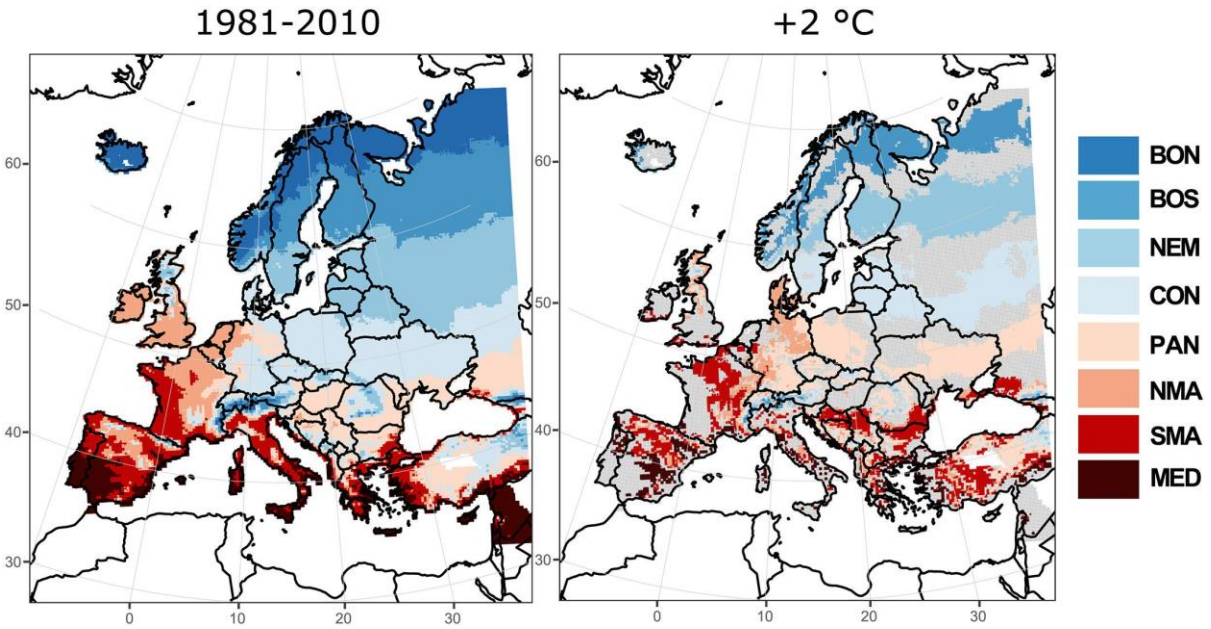

Figure 1: Agro-climate zonation of Europe based on growing season length (GSL) and active temperature sum (ATS) obtained as an ensemble median from five different CORDEX climate model simulations during the baseline period (1981–2010). (b) Ensemble median spatial patterns of agro-climate zones migration under 2 ° C global surface warming according to RCP8.5. Grey areas represent regions where no change with respect to the baseline period is simulated. The identified agro-climate zones are named as follows (going from north to south): boreal north (BON), boreal south (BOS), nemoral (NEM), continental (CON), Pannonian (PAN), northern maritime (NMA), southern maritime (SMA) and Mediterranean (MED)[2].

2. Forests and forestry

About 35% of the EU territory, totalling 215 million hectares (ha) is categorized as forest, representing 25% of the world forest resources[3]. The EU forest-based sector (woodworking and furniture industries, pulp, paper and converting industries, and forest owners) accounts for some 7% of the EU's manufacturing GDP and employed 3.4 million people across the EU-28 in 2012, whose livelihood is likely to be severely affected by climate change[4]. Around 90% of the raw wood material input if the sector comes from EU forest resources. Furthermore, forested land has major importance regarding carbon sequestration and biodiversity conservation. European forests currently constitute a sink for 450 million tons of CO2 per year; 5 million tons of carbon are furthermore stored in woody biomass and 30 million tons in forest soils[5]. Maintaining this storage capacity will be crucial in the mitigation of climate change globally. However, ongoing environmental change presents several threats. Forest resistance to perturbations decreases as mean annual precipitation decreases, making forests in dry areas very susceptible to droughts. Moreover, pest outbreaks can aggravate the direct climate change pressures on forests. For example, bark beetle outbreaks often coincide with drought as trees suffering from drought stress tend to have reduced defences against pathogens and herbivores, leading to improved feeding opportunities for these insects and their offspring[6,7], reduced incomes, offsetting production gains.

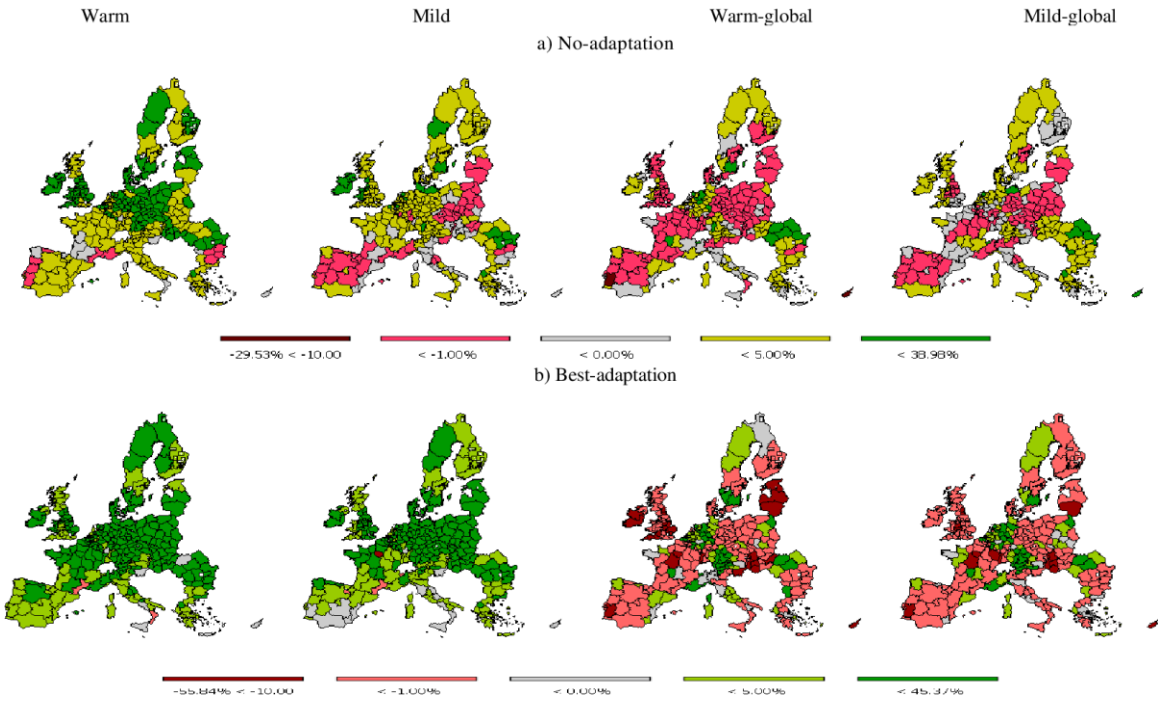

Figure 2: Income change in agriculture in the EU 27 with no adaptation or best adaptation according to the model developed in: https://ec.europa.eu/jrc/en/research-topic/forestry.

AnaEE has the capacity to experimentally study the responses to these and other pressures on forest functioning, and provide detailed information on the underlying mechanisms. This is especially relevant regarding adaptation, as such measures for forestry need to be planned well in advance, in order for the forests regenerated today to cope with future climate conditions over the course of several decades. Considering the current uncertainty as to the extent and speed of such changes, conclusive targeted research results on adaptation options will vary between regions, making the European-wide AnaEE platform combination uniquely positioned in testing different management options. Unique to AnaEE infrastructure is the capacity for targeted, manipulative long-term experiments at whole-plot levels with a high degree of mechanistic knowledge of ecosystem functioning in a variety of forest types across Europe.

3. Grasslands and shrublands

Grassland covers 21% of the European land surface, which corresponds to about a third of the agricultural area (Eurostat). It is one of the most versatile ecosystem types in Europe, ranging from monoculture production grassland under frequent harvesting/fertilizing, to diverse, extensively managed natural or semi-natural grassland. Grassland delivers a wide array of ecosystem services such as the provision of forage for livestock, the conservation and protection of soil and water resources against erosion, eutrophication and pesticides, the sequestration of carbon, acting as a biodiversity reservoir and habitat for wildlife, thus also supplying pollination services to agriculture, and contributing to the attractiveness of the landscape. Grassland delivers about 40% (in dry matter) of the 500 million tons of animal feed needed by the EU livestock sectors (Eurostat). These functions are mainly influenced by different components of global change: altering precipitation, climate-warming, and invasive species. Regions which become warmer and wetter (northern and north-western Europe) will likely see increased pasture yields, while regions which become warmer and drier (southern and south-eastern Europe) will likely suffer decreased pasture yields. Plant protein concentration in grasslands is also likely to decrease throughout Europe[8].

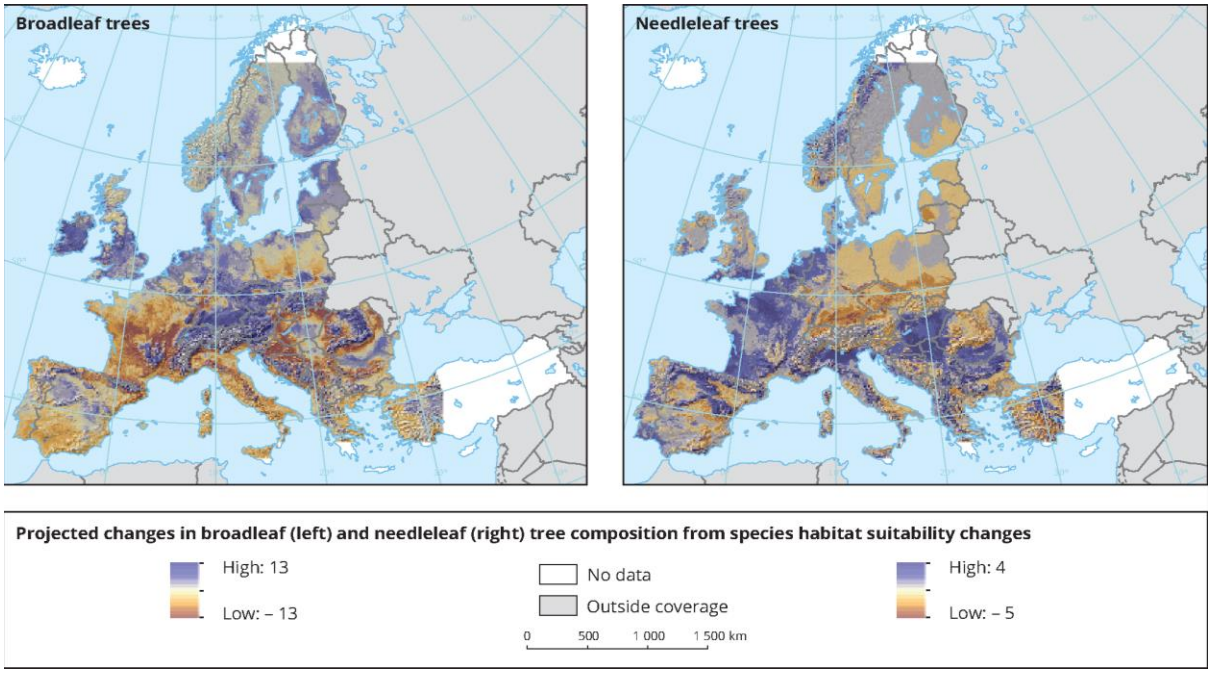

Figure 3: 1990-2090 changes in the tree species distribution from the climate projections using 6 regional climate models using the A1B scenario of future emissions. Left panel, broadleaf; right panel, needleleaf. Blue, increase; brown, decrease. From the MotiVE report, © European Environment Agency (EEA)

On the other hand, shrublands cover 7% of the European land surface and include natural, semi-natural and cultural landscapes spanning from wet moorlands in north-western Europe over *Calluna* heathlands along the Atlantic coastline from northern Norway to Portugal to the central European steppe shrublands and southern European Mediterranean maqui ecosystems. They provide multiple ecosystem services[9] (including human recreation, grazing and hunting, biodiversity, clean water and soil carbon storage with at least one example supporting a climate change mitigation potential through increased soil carbon storage at elevated CO2 concentrations[10]. Because they are low-statured ecosystems, that include many different functional types (e.g. annual herbs, perennial grasses and woody shrubs), they provide the opportunity to study potentially diverging effects of different functional types to changing pressures but still at plot scales that are much more experimentally manageable than in forest ecosystems.

The AnaEE facilities can test a wide range of possible adaptations for safeguarding grassland and shrubland ecosystem integrity and functioning, e.g.:

- Re-evaluating standard management practices (mowing, grazing, fertilizer inputs, irrigation) under climate change
- Evaluating the importance of species diversity and composition as stabilizing factors for e.g. ecosystem productivity and resilience
- Testing the potential for preventing nutrient losses from cropland into adjacent water bodies using grassland and shrubland margins
- Testing the potential of applying sustainable amendments to sequester carbon (negative emission technology)
- Searching for grass varieties resistant/resilient to rainfall deficits, rainfall excess and heat extremes under gradually rising atmospheric CO_2

Figure 4: Brandbjerg (Denmark) facility in winter (© University of Copenhagen).

4. Wetlands, rivers and lakes

There are several million kms of streams and rivers, 73,000 km^2 of wetlands and more than a million lakes across the European territory (Eurostat). 'Freshwater', including wetlands at the boundary of fresh and salt water, provides for a multitude of ecosystems and ecosystem services, which play a crucial role in European economy and culture. Besides recreation and tourism, services provided by wetlands, lakes and streams include climate change mitigation (e.g. through C sequestration) and adaptation (e.g. through flood buffering), sediment and nutrient retention and processing, hydrological regulation, energy supply, support of biodiversity through their nursery function and food production through fisheries. Ecosystem services provided by aquatic ecosystems are key to the European economy and food supply. For example, twenty-two of the European Union's Member States have commercial inland fisheries with an associated fleet of 14,000 boats and 17,000 fishermen (in addition to numerous recreational and subsistence fishermen) grossing a total annual catch of 35,000 tons. Conserving biodiversity in the aquatic continuum is key to these fisheries, since fish depend on a healthy food web, and multiple key species depend on multiple aquatic habitats for their life cycle (e.g. nursing in upstream rivers and wetlands).

The services provided by aquatic ecosystems are degraded by multiple man-made alterations, e.g. climate change, eutrophication (i.e. nutrient enrichment, often manifesting in harmful algal blooms) and emerging pollutants, hydrological modification and alteration (through channelling, damming, flood control regulations), urbanization and habitat fragmentation. Only a fraction can be regarded as pristine and while water bodies are much cleaner than in the 1980's, less than 50% are considered to be in a good or optimal ecological condition. The complex ecological interactions in the aquatic continuum of lakes, streams and wetlands imply that sound and detailed knowledge on the biogeochemistry, microbiology, ecology and hydrology of these systems is crucial to implement solid management decisions for their conservation and restoration. Ecosystem services should be taken into account in management decisions at both the catchment and local ecosystem level.

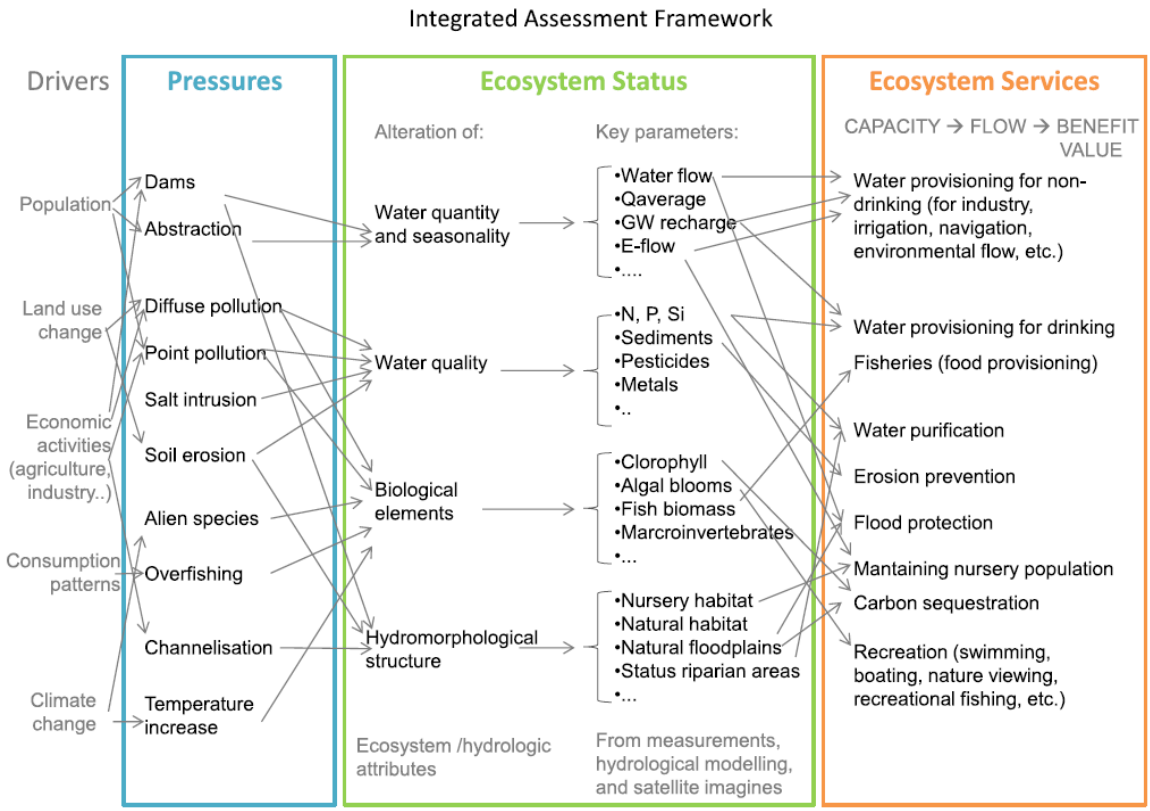

Figure 5: The integrated assessment framework in which the AnaEE experimental infrastructures will provide added value. Multiple pressures can be combined, and their effects on different system components assessed. This is essential information to manage the multitude of ecosystem services provided by aquatic ecosystems through habitat management, restoration and implementation of nature-based solutions[11].

AnaEE can stimulate an innovation-driven cooperation between key research players and policy and industry stakeholders, that fosters science-driven management of aquatic ecosystems, and maximizes both ecosystem services and biodiversity, e.g.:

- Facilitate research on the integrated impact of multiple global change drivers on aquatic ecosystem functioning, e.g. combined effect of pollution, climate-warming and alteration of hydrology.
- Test novel blue engineering solutions that protect aquatic ecosystem structure, e.g. river banks, wetland or vegetated river patches in the face of hydrological and other climate related changes, at the same time optimizing, restoring and safeguarding the ecosystem services and biodiversity.
- Test novel solutions for blue carbon sequestration under future climate conditions.
- Optimize the design of large-scale ecosystem-based adaptation restoration projects (e.g. wetlands for flood protection) through the assessment of vegetation-sediment-atmosphere interactions under different conditions.
- Development of indicators for ecosystem services, e.g. carbon sequestration, that can be used for efficient monitoring of functionality of aquatic nature-based solutions.

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Technical and Scientific Description Appendix 3 - Contribution of AnaEE to the Sustainable Development Goals

Version 7.1
16/10/2020

Cover page, from left to right, and top to bottom:
Enclosed growth facility at Højbakkegård, Denmark (© University of Copenhagen)
Inside the Gembloux Ecotron, Belgium (© University of Liège)
Preparing a macrocosm at the Montpellier Ecotron, France (© CNRS)
The Planaqua CEREEP aquacosm facility in Saint-Pierre-Lès-Nemours, France (© ENS - CNRS)
The O3HP open-air manipulation platform at the Observatoire de Haute-Provence, France (© CNRS)
The open-air FACE experiment from Risö fields, Denmark (© Technical University of Denmark)

Contribution of AnaEE to the Sustainable Development Goals

As the RI in experimental ecosystem ecology, AnaEE goals are in line with the sustainable development goals (SDG) from the 2030 agenda for sustainable development adopted by all the United Nations Member States in 2015. AnaEE research contributes to these goals, helping EU to achieve them through science-based policies, economic development, support to better management practices, and by raising citizen awareness. As a body and employer, AnaEE-ERIC will also contribute to these goals. Table 4 details the contribution of AnaEE RI and AnaEE-ERIC to each specific goal.

SUSTAINABLE DEVELOPMENT GOALS

1 NO POVERTY	Balanced ecosystems, new management practices for agro-ecosystems value local food production, adaptation to changing climate conditions, helping farmers to live from their work.
2 ZERO HUNGER	One of the main objectives of AnaEE is the development of adaptation and mitigation methods for agro-ecosystems, increasing their productivity in a sustainable way while keeping the quality of products.
3 GOOD HEALTH AND WELL-BEING	Biodiversity, ecosystem in good health, plant health, clean fresh waters are central for good health and well-being.
4 QUALITY EDUCATION	AnaEE will provide material to the teachers, and its scientific results will have an impact on curricula, contributing to quality education. It will also contribute to capacity building.
5 GENDER EQUALITY	AnaEE will have an equal opportunity policy for its staff. All staff members are treated in a fair manner and they have equal opportunity to achieve their goals in work.
6 CLEAN WATER AND SANITATION	Core to AnaEE research are wetlands, rivers, lakes and sustainable agriculture, which include minimization of nutrient runoff to water reservoirs. The balanced and sustainable functioning of these ecosystems is central for preserving the resource in clean water. AnaEE research will contribute to public policies for the preservation of clean water.
7 AFFORDABLE AND CLEAN ENERGY	Ecosystems provide raw materials for energy production. AnaEE results will ensure that the production of energy from wood and plants will be sustainable, and respectful.
8 DECENT WORK AND ECONOMIC GROWTH	Innovative management methods and technologies for the sustainability of ecosystems will result in new, often skilled, jobs in bio-economy. For agriculture, the solutions proposed by AnaEE will result in growth of farmers' income.

Innovative management methods and technologies for the sustainability of ecosystems will result in new, often skilled, jobs. This in turn will favorize the emergence of new business in the bio-economy.

AnaEE will treat all staff members in a fair manner and they have equal opportunity to achieve their goals in work. Work and life of each staff member should be in balance. Better functioning agro-ecosystems result in the growth of the income for the farmer, and reduced inequalities.

Sustainable agriculture leads to sustainable rural communities. In addition, ecosystems and the services they provide are central to the welfare of the citizens.

AnaEE ERIC provides data on ecosystems which relates to anthropic induced changes. Results from the research performed at AnaEE will support science-based policies. Resources and GHG emissions will be saved by remote access to our experimental facilities.

The research at AnaEE platforms is strongly focused on the impact of climate change on ecosystems as well as how we may benefit from ecosystems and intelligent management of them for climate mitigation purposes. AnaEE will propose adaptation and mitigation solutions to the society at large

Among AnaEE core objectives, is the sustainability of continental water ecosystems. AnaEE will propose solutions for the adaptation and mitigation of wetland, lake and river ecosystems.

As the experimental, pan-European research infrastructure for terrestrial ecosystems, AnaEE has a major role to play for the conservation and adaptation of life on land, including advising citizens and policy makers.

Ecosystems provide essential resources for humanity and life on Earth. It will advise also the policy makers (science-based policy).

AnaEE partners with scientists from all over the world, helping to build capacities in environmental research. It will also partner with NGOs and institutions for a better future. Finally, AnaEE partners already with RIs in the Food and Health, as well as in the environmental domains.

Technical and Scientific Description Appendix 4. Contribution of AnaEE to the objectives of the European Green Deal

Cover page, from left to right, and top to bottom:
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Contribution of AnaEE to the objectives of the European Green Deal

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Preserving and restoring ecosystems and biodiversity 5
A zero-pollution ambition for a toxic free environment 5
Mobilizing research and fostering innovation 5

As a pan-European RI in both the Food and Health, and Environment domain of the ESFRI, AnaEE has to support and contribute to European policies.

We examine here the compliance of AnaEE with the relevant objectives of the European Green Deal, as presented to the EU Parliament[1] and main bodies.

Figure 1. The European Green Deal.

Increasing the EU's climate ambition for 2030 and 2050

Under this objective, "the Commission will adopt a new, more ambitious EU strategy on adaptation to climate change". This is at the core of AnaEE's ambition. As mentioned in 3.4 of the present document, AnaEE will be in the position to develop and test mitigation and adaptation measures in response to global changes.

From 'Farm to Fork'; designing a fair, healthy and environmentally friendly food system

Thanks to its experimental facilities in agro-ecosystems and aquatic, continental ecosystems, AnaEE will develop and study management and agricultural techniques that comply to the objective of preserving balanced ecosystem functioning. This imply short supply chains for food production. Enclosed facilities, as well as open-air platforms will allow to study the adaptation of agro-ecosystems

[1] COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS The European Green Deal, COM/2019/640

to climate change. At least one representant of farmer's representative organization will be part of the Stakeholder Committee (SHC).

Preserving and restoring ecosystems and biodiversity

This is at the core of AnaEE's objective. AnaEE will be in position to test adaptation and mitigation measures for the preservation and restoration of ecosystems and biodiversity, supporting evidence-based regulations. Specialists in law, and policy makers will be members of the Stakeholder committee.

A zero-pollution ambition for a toxic free environment

In this domain AnaEE can support pollution measurements and their impact on terrestrial and aquatic ecosystems. Moreover, thanks to its experimental facilities, AnaEE will be able to forecast the impact of pollutants on ecosystems, taking into account their possible evolution in the future, and the effective impact of policies in the domain of the prevention of pollution.

Mobilizing research and fostering innovation

Innovation is at the heart of AnaEE. AnaEE will participate enthusiastically to the Horizon Europe program. Moreover, the integration of experimentation and modelling will help to test new regulations, participating to evidence-based regulations.

Technical and Scientific Description
Appendix 6. Data Management Plan

Version 7.1
16/10/2020

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Data Management Plan

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1. FRAMEWORK AND SCOPE

1.1. Reference documents

(a) Statutes of AnaEE-ERIC
(b) AnaEE Scientific and Technical Document
(c) User Access policy document

1.2. Administrative information

Initiative	**AnaEE-ERIC** Analysis and Experimentation on Ecosystems
Responsible	AnaEE
Contact details	
Reference number/ID	

1.3. Purpose of the Data Management Plan

In the current context of open science, and consequently the sharing of data from scientific research, the AnaEE infrastructure aims to offer all the tools and services enabling the scientific community, but also experts from the industry, NGOs, policy makers, or the general public, to access and reuse the data produced during the projects it hosts. The diversity of scientific themes addressed during research projects leads us to handle a wide variety of data related to the physical, chemical and biological aspects of an ecosystem. This is why it is essential to take data management into account throughout the data life cycle, from the design of experiments to the sharing of data in a sustainable manner. The different actors of the infrastructure as well as the project leaders will be involved in the data management process in order to provide quality data and metadata according to FAIR principles.
This Data Management Plan (DMP) is therefore intended to be the reference document specifying good practices to be implemented at each stage of the data life cycle. A data management plan is, of course, a living document that will have to adapt to changes in ecological research but also to technical developments relating to the data. This is why we will try to describe how it contributes to the continuous improvement of the production of FAIR datasets by implementing quality control throughout the process of producing and then sharing the data.

1.4. Research framework, activities and objectives of data collection

AnaEE is a distributed research infrastructure of experimental platforms all across Europe. (Figure 1) The platforms may either be open-air or enclosed; their specificities is that all platforms are designed to perform manipulation of the ecosystem in order to simulate the stresses applied to ecosystems by climate changes and anthropogenic activities, and test different evolution scenarios. In addition, AnaEE features analytical platforms that are able to perform deep analysis, and modelling platforms to allow the users to interpret the data within the framework of various theoretical models.

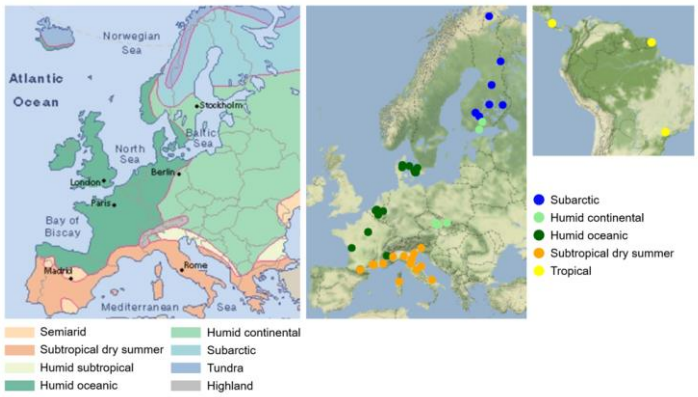

Figure 1: Climatic zones of Europe (left panel), and the geographic coverage of the AnaEE platforms in founding countries (middle and right panels). Note that AnaEE includes 3 tropical platforms in central and South America.

The ERIC will coordinate the activities of AnaEE (Figure 2). It will evaluate and optimize the proposals. A technology centre (TC) helps the platforms to maintain a high standard in quality, and foster new technological solutions. The Interface and Synthesis Centre (ISC) will make studies to integrate the results and exchange with the society. The Data and Modelling Center (DMC) will make the data available with the appropriate standards, and provide models for the interpretation. The Central Hub (CH) performs the central administrative tasks. It will also be the central portal for the access to all AnaEE services, and for the proposals from users.

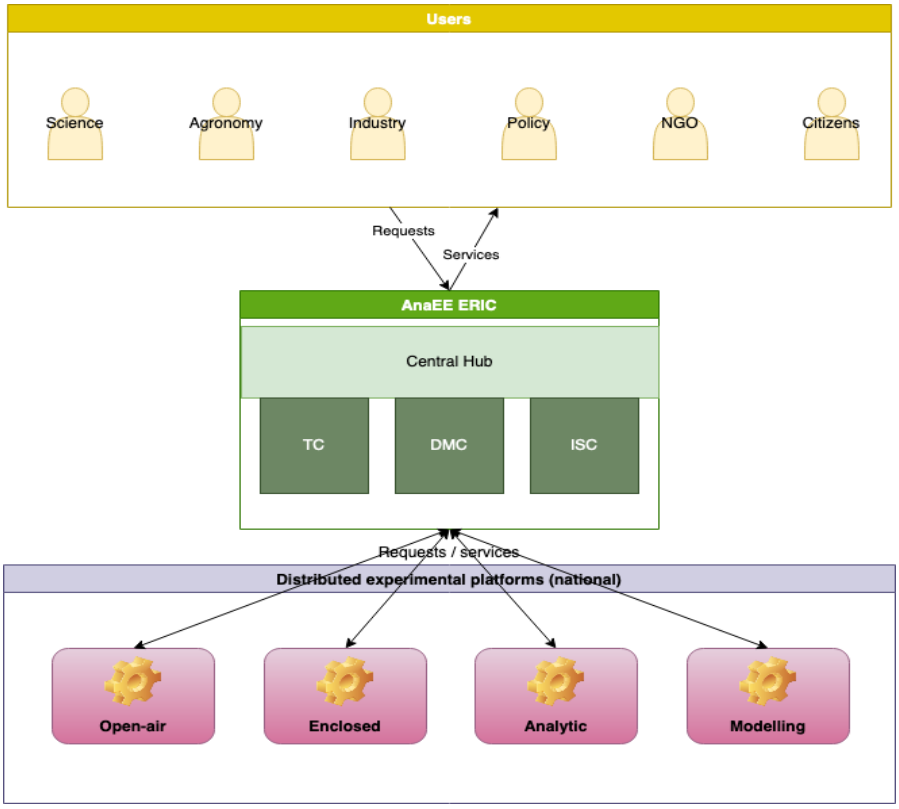

Figure 2: The organization of AnaEE. The ERIC will be the interface with the users, with an integrated offer of services, and receiving requests. Thanks to the Services Level Agreements, the requests will be analysed and sent to the appropriate distributed platforms, taking into account their offer of services.

The access to the services provided by AnaEE is documented in the appropriate document and in the user guide.

The review procedure and project life is a 2 step procedures that can be described as follows (Figure 3):

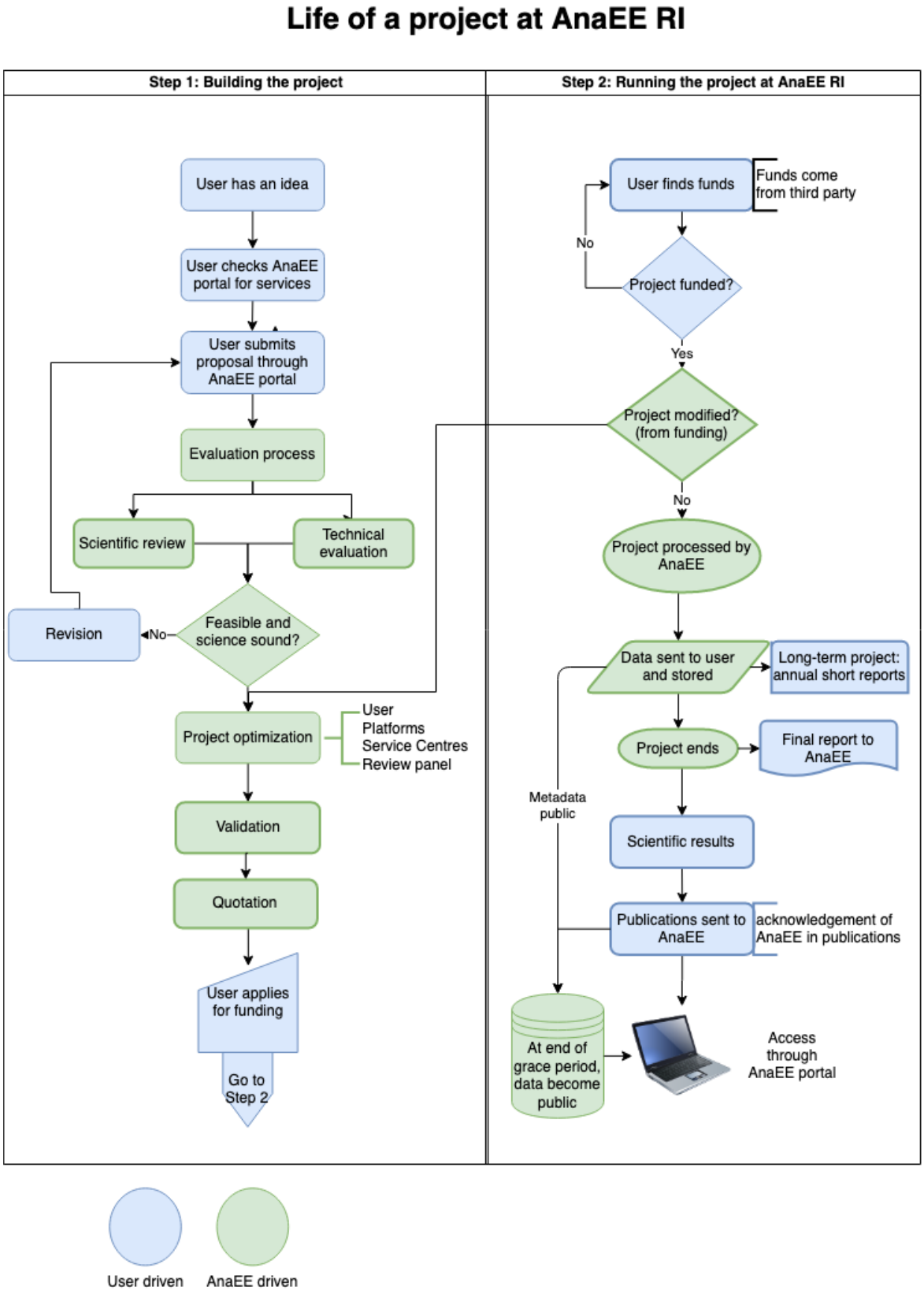

Figure 3: Description of the procedure for user project access to AnaEE platforms and services.

In Step 1, the user takes advantage of searching the web portal platforms and service catalogue for the most relevant platforms and services for the given project idea. He/she can also contact AnaEE directly

for advice. The user then submits a pre-proposal online through the web portal. The Central Hub facilitates that a scientific review is performed by the Project Review Committee. Upon a positive review, the Central Hub requests a technical feasibility check at the relevant platforms and Centres as well as their pricing for the suggested service taking into account the constraints related to data sharing. During this process, both the review panel and the platform(s) and Service Centre(s) representatives are urged to provide ideas for potential scientific and technical improvements (project optimization) of the project proposal. The Central Hub provides this feedback together with the review and the quotation for the suggested services to the user, who can now use this information and budget in the project proposal submitted to a funding body.

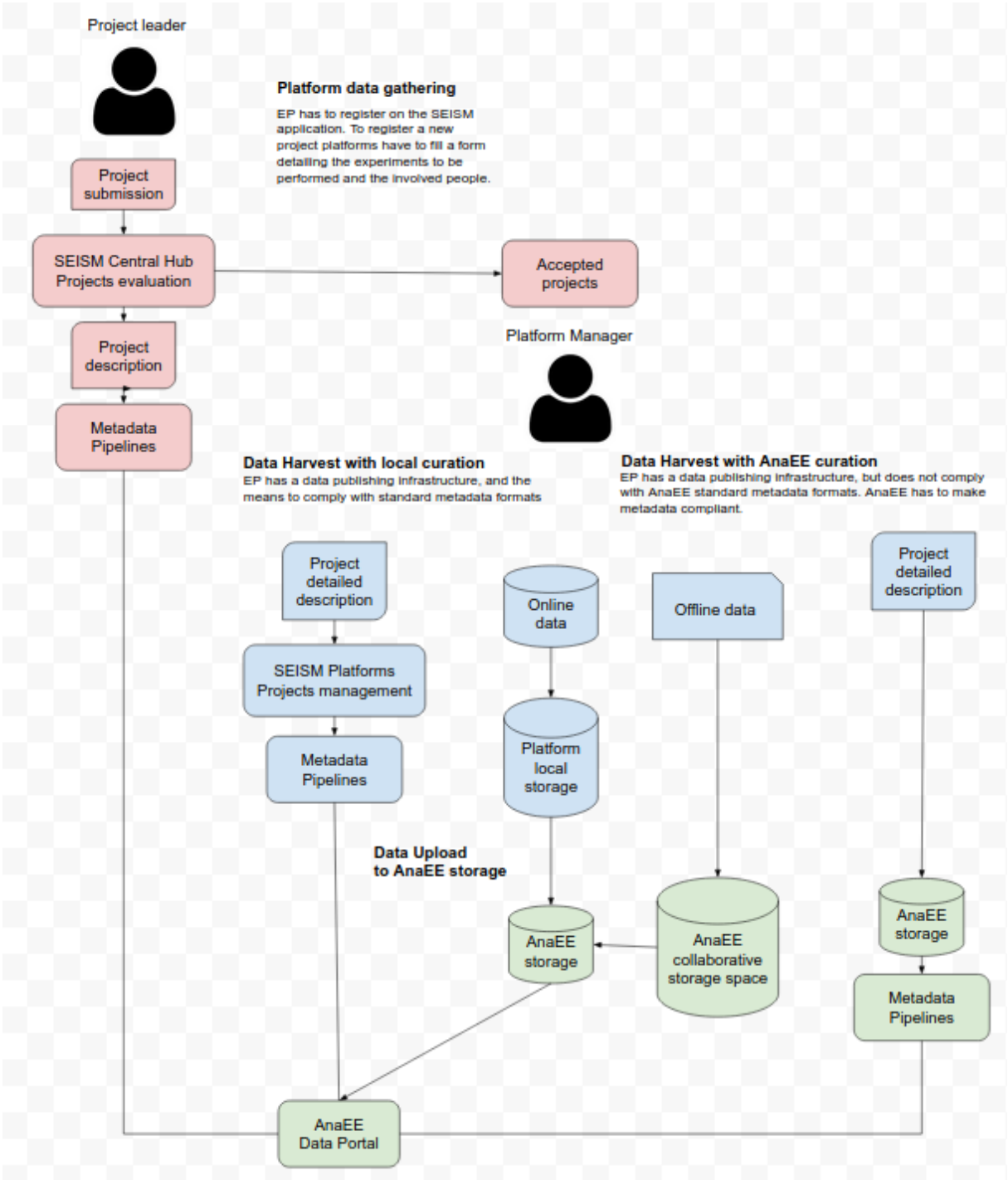

Figure 4: Description of the procedure for taking charge of the projects and the means implemented by the different actors in data management.

In Step 2, projects that succeed with obtaining funding can go into AnaEE processing and scheduling on the relevant platforms. If the project proposal was changed compared to the optimized and validated project proposal (in step 1) – this part of step 1 must be repeated. The final project proposal must include a Data Management Plan, dedicated to the project, compliant with general principles and best practices described in this document. Once the project has moved into AnaEE processing, the AnaEE DMC stores project metadata in a dedicated and restricted collaborative storage space, which will be accessible through its Web services by the research team and the platform team. The AnaEE processing consists in an iterative revision of the dataset that may follow the collection of the dataset; the goal of such revision is to ensure the meeting of a series of data quality criteria expressed in this document. Once a dataset is approved, it can be published and distributed on the AnaEE Web services. Optionally the owner of a dataset can ask for a so-called grace period, i.e. a delay between approval and publication during which the dataset will be available only to a restricted group of users. Access to publications is then facilitated through the web portal.
The Central Hub will collect annual reports of longer projects and final project reports when projects end, as well as the scientific results and papers resulting from the user projects.

1.5. Project Data Management Plan proposal

The diversity of data types produced within the AnaEE infrastructure requires to organize data management at each step of the data production process. The actors in this process are different at each step and the challenge is to clarify what responsibilities they have and what tools or services they will use to coordinate the management of AnaEE's data. While the bulk of the work is expected from research platforms and research teams involved in the project, AnaEE's centres will offer support on all data management tasks.
We will distinguish 2 types of Data Management Plans:
Background DMP: The "Background Data" includes all the data produced by the platform on a continuous basis and characterizes the environmental conditions of the ecosystem under study over the long term. The variables measured are the same for all projects hosted by the platform but these projects will be able to use these datasets over the project period or take into account longer periods if necessary (data prior to the project which constitutes a history of the life of the ecosystem under study).
Foreground DMP: The "Foreground Data" part corresponds to the variables measured over the period of a one-time project that is shorter in duration. They may correspond to measurements or sampling, analyses of these samples or observations of biodiversity.
The "Background Data" corresponds to the environmental conditions of the ecosystem and the "Foreground Data" to the effects of treatments applied to the ecosystem of our platforms during a time-limited project.
Two types of data management plan templates will be provided to platforms and project leaders. Platform managers will mainly contribute to the drafting of the "Background Data" and project leaders to that of the "Foreground Data".

Datasets are the central objects of AnaEE Data Management Policy: they are self-contained sets of information that include data and all the metadata required to re-use that data. Examples of dataset are: a database of historical and georeferenced observations, an archive of field observation, an archive of laboratory analysis results, a set of field or laboratory images, a set of system logs. A project dataset is composed by the "Foreground Data" and the "Background Data" over the project period.

The Data Management Plan of a candidate AnaEE project is a self-regulation document compiled by the project's regulating body describing:

- **Data collection workflow**: how data is acquired, processed, and packaged into a deliverable.
- **Data Conservation Plan**: how data is planned to be stored during the AnaEE evaluation and after its publication.

- **Data licensing policy**: how data should be accessed and used after publication, different dataset may have different licensing policies, although a coherent general project policy is expected.
- **Candidate datasets**: the data deliverables expected from the aforementioned data workflow.

1.6. Data Management Process implementation

Implementation of the DMP is necessary at both the central and local level. The final responsibility for implementing the DMP lies with AnaEE Central Hub. The Technological Centre and the Data and Modeling Centre will ensure the DMP is being implemented at the local level.
AnaEE Central Hub and Data Modeling Centre will support them by organizing the necessary training and the establishment of a data management working group. This working group of data managers and scientists will have a representative for each type of platform and take responsibility for the actualization of the DMP when needed.

With regard to data and metadata, the implementation process of AnaEE's scientific projects offers different tools and services to:

- Collect project description metadata at the project design and production stages
- Extract the "Background" and "Foreground" data
- Collect metadata of the project's completion
- Store the data produced
- Provide a portal for discovering and accessing datasets

This process must be flexible and compatible with the different practices of each platform. This is why we take into account the cases where the platforms will not use the metadata collection tool proposed by AnaEE or their current data sharing practices in thematic data warehouses.
Of course, the AnaEE infrastructure will invite, through training and support, the platforms to standardize their practices.

We identify the following main tasks in data management implementation:

- **Data description and collection**: the central task in data management, data collection includes also reuse of previously collected data. This first phase relies on research platforms and research teams involved in the project, and is supervised by the Central Hub and the Technology Centre.
- **Quality of the data management process**: the gathered data has to be curated with appropriate metadata, documentation, and other materials to improve its fruitability. The Central Hub and the Data Modeling Centre support research platforms in this task.
- **Storage and Backup Management**: storing data and assuring its availability over time is primarily a research platform responsibility to ensure backup. The AnaEE Technology Centre and Data and Modeling Centre support research platforms in arranging an adequate storage solution.
- **Meeting legal and ethical requirements**: the current legal frameworks around data management impose high standards that will be enforced by the Central Hub and implemented by research platforms
- **Data sharing management**: finally, the data needs to be findable and accessible both within AnaEE partners and among external organizations. The Data and Modeling Centre will offer services to store persistently, publish data and manage the access to said data. Research platforms are expected to use such services and to align their existing data sharing services with the AnaEE data catalog.

Activities may include, but are not limited to:

- Format conversion to comply with AnaEE format recommendations;
- metadata curation to comply with metadata standards supported by AnaEE;
- documentation curation for a better human understanding of the dataset;
- metadata curation to make it machine-readable;

- storage system revision to comply with AnaEE data management policies;
- API development or revision to comply with AnaEE guidelines.

1.7. Quality assurance process

We will distinguish 2 quality approaches concerning the management of AnaEE data. One of these approaches is a "product" quality approach concerning the quality of the datasets that are delivered to the research teams using our platforms. The 2nd approach is a "process" quality approach concerning the quality of the data management "process".
Indeed, the quality of the datasets is linked to the data management process but especially to the good experimentation practices applied on the platforms to observe, sample, correctly measure the ecosystem parameters and increase the reliability and robustness of the data sets. This role of training in good practices and their improvement is the responsibility of the Technology Centre.
As infrastructure data managers, we will focus on the quality of the process that enables the provision of datasets according to FAIR principles. It is therefore necessary to identify for each stage of the data life cycle, the human and material resources to be implemented, the criteria to be met to guarantee the FAIR principles and the indicators to verify that these criteria are met in order to improve them on a continuous basis.

Figure 5: Data life cycle.

In Table 2 are described the actions to be implemented by the different actors throughout the data life cycle to produce data sets compatible with the requirements of the FAIR principles:
To implement this quality approach, AnaEE has identified tools and services that enable the various actors in the data life cycle to meet the performance objectives of the criteria we have set. We will strive to set these improvement targets during periodic data management plan working groups involving representatives of the different types of platforms (Table 3).

Table 2: Actions to be implemented by the different actors throughout the data life cycle to produce data sets compatible with the requirements of the FAIR principles

		Data life cycle		**Planning research**	**Collecting data**	**Processing and analyzing data**	**Publishing and sharing data**	**Preserving data**	**Re-using data**
		Responsibility		CH, Platforms and Research team	TC, DMC, Platforms and Research team	DMC and Research Team	ISC, DMC, Research team	DMC and Research Team	DMC
Requirements to be FAIR		Resources or services							
Data description and collection or reuse of existing data		How?		SEISM, INRAE pipeline	SEISM, INRAE pipeline				
		Data types and formats		SEISM, INRAE pipeline	SEISM, INRAE pipeline				
Documentation and data quality		What metadata?		SEISM, INRAE pipeline	SEISM, INRAE pipeline				
		What are the measures to control data quality?		Objectives, criteria and indicators	Curation scripts production	Curation scripts catalog	Curation scripts catalog		Usage tracking

Storage and backup		How for data and metadata ?			Collaborative data storage space			DMC cloud infrastructure	
		Implementation of security and data protection?			DMC support to implement the adequate solution			CC IN2P3 mirroring	
Legal and ethical requirements, codes of conduct		RGPD?		CH, legal assistance			DMC Data Portal		Usage tracking
		Intellectual property?		CH legal assistance			DMC Data Portal		Usage tracking
		Ethics and codes of conduct?		CH legal assistance			DMC Data Portal		Usage tracking
Data sharing and long-term preservation		How and when do we share? Restrictions and embargoes?		CH legal assistance			DMC Data Portal; API portal	DMC cloud infrastructure and CC IN2P3 mirroring	DMC Data Portal; API portal
		How and where will the data to be retained over the long term					Data Portal	DMC cloud infrastructure	

		be selected?							
		Methods and software tools needed to access and use the data?				Data Portal; API portal	Data Portal; API portal	Data Portal; API portal	Data Portal; API portal
		How do you assign a PID?				Data Portal	Data Portal		

Table 3: Criteria, means and indicators of the AnaEE data

Data life cycle		Planning research	Collecting data	Processing and analysing data	Publishing and sharing data	Preserving data	Re-using data
Objectives		Increase the number of	Increase the reliability of	Increase datasets manipulatio	Increase number of datasets	Ensure 100% of data preserved	Provide reusable datasets across multiple scientific domains

		projects supported	data acquisition Increase a rich metadata collection	ns to process and analyse its	published and shared		
Criteria							Download rate over 5 years and 10 years. Claimant's scientific field.
Indicators							Number of downloads over 5 years/10 years. Percentage of origin of applicants.

1.8. Related documents, policies and procedures

Several documents contain statements that define the framework of this data management plan and therefore need to be referred to:

- AnaEE statutes
- AnaEE Technical and Scientific Description
- AnaEE Data Policy
- “Background” DMP template
- “Foreground” DMP template

2. DATA COLLECTION

In this section we present data collection guidelines and best practices adopted by AnaEE and its partners. This section is ever-evolving and research platforms should refer to the Technological Centre and the Data Modeling Centre for the latest updates and state of the art best practices.
AnaEE is running a survey over its research platforms to assess data collection de facto standards and best practices

2.1. Background data versus foreground data

According to the specificity of AnaEE's platforms, we can distinguish 3 types of data:

- observation data produced continuously on the platform over the long term,
- data produced during a project over the short to long term term,
- data from sample analysis.

As we described it earlier, long-term data can be considered as “background” data and are generated by the platform even if no particular project is in progress; data produced by observations or experimentation specifically installed for the needs of a project during the project and data from sample analysis are the “foreground” data that are the hosted project-specific data.
Since long-term data are data produced "continuously" over long periods of time, a data management plan dedicated to the measurement of these environmental variables is written and updated by the platforms that have this type of data.
When these platforms host short-term projects, they produce a dedicated data management plan for the project, referring to the long-term data management plan if it is part of the project deliverables.

2.2. Nature and types of data

The study of terrestrial and aquatic ecosystems requires the observation, instrumentation or sampling of the various compartments that make them up. In order to better understand the interactions between the different environments (atmosphere, soil, water, etc.) as well as the interactions between the different biodiversity compartments that occupy these environments, AnaEE's platforms use a wide variety of sensors, analytical instruments and sampling or biodiversity observation methodologies. For this reason, we will focus on accurately describing the types of long-term observational data from our platforms as well as the current analysis and measurement capabilities commonly used on our platforms (Background data, Table 2).
As "foreground" data is constantly evolving due to the diversity of the projects and the use of sometimes very innovative instrumentations and methodologies, these will be described in the data management plan dedicated to each project

Table 4: Table of Background Data Types for AnaEE Platforms

	Thematic data type category	Research domains	Data formats	Data files types
Physical data	Soil water content	Soil Science	CSV	
	Soil temperature	Soil Science	CSV	
	Water temperature			
	Meteorological data	Atmospheric Science	i.e. netCDF	
Chemical data				
Biological data				

2.3. Standards and methodologies in data collection

The perpetual evolution of instrumentation and the needs of ever more innovative research projects push to develop new experimental systems and new methodologies using the latest technologies. This is why we strive to standardize as much as possible the formats of our data and metadata by using the most widely used formats and best suited to the project and its research theme. In addition, recommended formats are compliant to the FAIR principles (see table 4).
These "foreground" data are described in the management plans dedicated to each project. The Technological Centre's mission is to ensure the standardization of the instrumentation and methodologies used to harmonize "upstream" the data formats and metadata produced. In addition, in relation to the Data and Modeling Centre, data and metadata formats will, if necessary, be harmonized "downstream" by providing a collaborative data curation catalog of conversion scripts to the most interoperable common formats.
Interoperability of formats remains the essential condition for any type of machine to be able to reuse them and the various AnaEE data management stakeholders will seek to work towards this goal in a continuous improvement process.

2.4. Metadata standards

Data and metadata standards and formats are a key aspect for technological and semantic data operability in order to make data discoverable for promoting international and interdisciplinary access and use of research data.
The standards and formats used during data collection by the platforms and research teams are very varied. This is why AnaEE proposes and develops software tools (SEISM application) to simplify data and metadata collection (TC), semantically annotate metadata and make them compatible with the semantic web (INRAE pipeline) deployed locally or by the DMC. These tools facilitate data sharing and long term access by structuring datasets and their metadata to make them fully discoverable, interoperable and machine-readable.
Thanks to the semantic annotation tools developed by AnaEE (INRAE pipeline), all metadata standards will be transformed into RDF graphs compatible with the semantic web and any type of machine (Table 2).
Metadata standards are integrated into the project tracking tool (SEISM). Project leaders and platform managers will select the most suitable standards available to describe all the elements of the project (Table 5) in a metadata standards catalog provided by AnaEE.
AnaEE expects the project DMP to identify the datasets produced by the project, herein candidate datasets, and to include the following basic information for each candidate dataset that will undergo AnaEE evaluation:

- Abstract: a short textual description of the candidate dataset.
- Owner: the person or organization who legally owns the data therein provided.
- Contact person: one or more individuals responsible for the communication with AnaEE for that candidate dataset.
- Means of accessing the data: if the dataset is served with an API, an endpoint will be needed, otherwise if the dataset consists of downloadable files, one or more download links, if the data is hosted on a cloud provider, adequate access keys should be provided; these links and credentials should remain active for the whole revision of the dataset.
- Format and structure: all the information required to open, navigate, and access the dataset’s structure.

These metadata are the minimum metadata to be associated with a dataset. It is therefore necessary to expand this base with much richer metadata to describe the full production context of a dataset.

2.5. Documentation and metadata collection

AnaEE acknowledges that for a dataset to be reusable by a large community of users, it is essential to describe all the conditions under which the data were generated. The user therefore needs to have a clear and as precise as possible description of the context of the measurement, described with controlled vocabularies and associated documentation. In this section we provide an outline of documentation and metadata curation best practices AnaEE expects from its research platform.

The AnaEE infrastructure develops tools (SEISM and INRAE pipeline) to structure the metadata collection from the conception of the scientific project and during the implementation of the experimental protocol (TC and Central Hub). The collection of a minimum set of core metadata is a mandatory requirement for all datasets, for their discovery, while rich metadata is also recommended to ensure a full interoperability and reusability of data, including most of the provenance elements. In any case, the metadata should explicitly include the persistent identifier of the data it describes.

A project monitoring and resource management tool (SEISM) facilitates project leaders and platform managers in collecting metadata by describing the experimental protocol, the equipment used and the associated documentation, the measurement chain and its lifecycle (maintenance, calibrations, ...) that allows to measure experiment variables, the human resources involved...

In a second step, this metadata is processed in a semantic annotation pipeline to provide metadata in the form of RDF graphs compatible with the semantic web, to ensure data findability and interoperability (INRAE pipeline).

The DMC will provide national platforms with guidelines and operational tools (thesaurus, ontologies, etc.) to implement metadata and data standardization.

These tools provide discovery metadata as well as technical metadata to the Data Portal managed by the DMC in the form of a catalogue. The semantic metadata is pushed to AnaEE data storage to benefit from the same persistent unique identifier as the dataset. Catalog provided by the DMC, through a search engine, allow data users to quickly find links to data from the discovery metadata.

In order to facilitate metadata structuration and improve interoperability, AnaEE recommend metadata standards

Table 5: Recommended metadata standards for data.

Metadata standard	Description
Darwin-Core Archive (DwC-A)	**Biodiversity informatics data standard (https://github.com/gbif/ipt/wiki/DwCAHowToGuide)**
NetCDF CF	**Climate and Forecast Metadata (http://cfconventions.org/)**
ISO 19115/19139	ISO/TS 19139:2007 defines Geographic MetaData XML (gmd) encoding, an XML Schema implementation derived from ISO 19115 (https://www.iso.org/standard/32557.html)
EML	Ecological Metadata Language (https://knb.ecoinformatics.org/tools/eml)
CSW	OGC Catalogue Services Specification - **2.0.2** OGC 07-006r1
DCAT	Data Catalog Vocabulary (https://www.w3.org/TR/vocab-dcat-2/)
SoilML	ISO 28258:2013(en) Soil quality — Digital exchange of soil-related data

2.6. Recommended persistent formats for sharing, reuse and preservation of data

Given the diversity of scientific themes related to ecosystem studies, AnaEE's platforms produce different types of data, including raw data, geospatial data, images, soundtracks, videos and documents.

It is therefore necessary to list the formats (Table 6) used to move towards standardization in common and standard formats that can be used by the greatest number of people. If these formats are different, it is strongly encouraged to provide software tools to convert these files.

While allowing for uploading and treatment of any form of raw data coming from publishers, DMC fosters and has preference for structured formats in implementing its internal storage mechanisms, as they allow for better automatic treatment regarding collection, update retrieval and data quality verification.

In particular, Relational Databases allow for extraction of a portion of the dataset, not forcing potential users to download the whole of it. Also Cloud storage(e.g. Azure Blob Storage or Amazon S3) or NoSQL databases.

Moreover, the adoption of APIs to publish data would allow Research Infrastructure to have a layer of abstraction on top, permitting internal refactoring or information reorganization (e.g. migration from a RDBMS to a NoSQL architecture), not impacting the publication on the DMC Data Portal as long as the APIs contract is respected.

Table of recommended and accepted formats by data type:

Table 6: Recommended and accepted data format per data type.

Type of data	Recommended format	Other acceptable formats for data preservation
Quantitative tabular data with extensive metadata	XML; JSON	
Quantitative tabular data with minimal metadata		
Geospatial data	GML; netCDF; GeoJSON; **KMZ; GPX;**	SHP; GeoTIFF; OWS; WFS;
Qualitative data	XML; **SQL;**	**CSV; XLS; TM8; m38; n38; DAT; LOG; MDB**
Digital image data		Jpeg; PNG; BMP; TIFF;
Digital audio data		mp3
Digital video data		mp4
Documentation and scripts		

2.7. Data quality assurance

AnaEE's platforms provide long-term data (background) and project data (foreground). The data acquisition processes are very clearly defined for background data but are very specific for foreground data. The data quality process is monitored by the DMC according to the criteria and indicators defined in section 1.7 to ensure that all means have been implemented to produce data according to FAIR principles.
We will focus here on the quality of the data produced in terms of continuity and reliability of the measurement chain used, taking into account sensor drifts and missing data.
For this reason, a data quality index can be provided by the platforms for both types of data, provided that the quality criteria are clearly defined and that the research and platform teams provide the raw data as well as the various scripts for processing the data and calculating the quality index. Users will be able to apply the processing scripts according to the criteria that meet their expectations or they will be able to propose other criteria and other scripts to evaluate the quality of the data.
In addition, the events in the laboratory notebook related to data acquisition will have to be specified so that users will be able to identify the data disturbed by particular events (machine breakdowns, human interventions ...).
The AnaEE evaluation of dataset quality will be performed by using the endpoints provided, that are expected to host up-to-date data.

3. STORAGE AND BACKUP

In this section we will describe currently adopted practices for data storage management and requirements that research platforms are expected to meet in their data management activities. As for the previous technical sections, also this section is in continuous evolution and may be revised to fit the de facto standards in storage and backup solutions.
AnaEE acknowledges that cloud storage services can nowadays be considered a commodity and believes that this trend is not going to change in the near future due to existing market trends and initiatives such as the EOSC.
AnaEE encourages research platforms in preferring such technologies over on-premise data centers for a number of reasons that include, but are not limited to: scalability, security, replicability, resilience, and operational cost. AnaEE's platforms are responsible for ensuring the secure long-term storage of the data they collect. They can liaise with the DMC to help them implement appropriate solutions.. This data is then pushed at an appropriate frequency to the AnaEE data storage.
For each project, the research team and the platform managers open a closed-access collaborative data storage dedicated to the project. This allows for versioning of the dataset, secure backup and easy open access as soon as the embargo period is over. This collaborative storage is provided by the DMC that will only have to open the access to datasets collected during the project.

3.1. Persistent solutions

AnaEE DMC provide a long-term storage to centralize all the data production from AnanEE Platforms. This storage is a cloud storage (e.g. Azure Blob Storage or Amazon S3). To secure this backup, a mirror backup will be deployed at CC IN2P3 which guarantees a long term perennial backup.AnaEE divides persistence solutions into three categories:

- **File storages:** unstructured storage solutions that are used to store serialized files and are typically accessed with protocols such as ftp, sftp, or smb. May or may not have files arranged in a directory hierarchy.
- **AnaEE Data storage :**

- **Document databases**: loosely structured databases that may host a large number of semi structured documents in formats like JSON, XML, or CSV and usually provide an API that allows querying with SQL-like languages, optionally they can be accessed with an ad-hoc developed API that provides a more user-friendly facade. This solution is fit for IoT and application data.

3.2. Assurance of adequate storage capacity

The capacity needed to store data and metadata is assessed at the project design stage, taking into account the data formats generated and the frequency of acquisition sufficient to demonstrate the effects predicted by the scientific hypotheses.
It is up to the research platforms to coordinate the deployment of adequate storage solutions and to maintain them over time, sustaining all the related costs.
The AnaEE DMC hosts datasets on its cloud storage to grant its availability and preservation over time. More specifically, the DMC will store data on a cloud solution that grants replication, high fault tolerance, scalability, and allows to periodically create snapshots to prevent data loss in the unlikely event of catastrophic system failures.

3.3. Responsibilities for back-up and recovery

AnaEE assumes that each adhering platform has storage space sized according to the specific nature of their activity. As such, platforms are responsible also for replication and backup of their datasets. Platforms are expected to either demand these responsibilities to a third-party provider or provide secure storage space locally or adequate disaster recovery procedures that will allow for the reconstruction of data sets and their metadata in the unlikely event that data storage fails.
AnaEE's DMC ensures that the latest data sets are backed up on its storage space but cannot guarantee the recovery of data that has not been transferred to the storage space if the frequency of data transfers is not regular.

3.4. Risks and mitigations regarding data security, assurance to secured access

Access and security of the data sets produced by the AnaEE platforms is guaranteed by the DMC data storage. Of course, the security of these accesses is a strong criterion and is provided by a cloud storage (e.g. Azure Blob Storage or Amazon S3).
Data stored locally at the platform level must be secured without direct access to the external network.
It remains for the moment difficult to control and monitor the use of data sets that are shared freely. However, some projects for the development of tools to monitor the use of datasets initiated within the ENVRI-FAIR project, whom AnaEE is participating to, could be launched in the near future in order to monitor compliance with citation conditions or to evaluate the impact of a dataset on the scientific community by quantifying its reuse.

4. SELECTION AND PRESERVATION

4.1. Data to be retained or destroyed for contractual, legal, or regulatory purposes

The datasets generated by the AnaEE infrastructure will initially be provided in their entirety, i.e. the raw data, associated metadata, and the scripts for processing the raw data. As long as it is possible to maintain this permanent storage, it will be maintained for as long as possible. However, if this storage reaches a high cost for a low rate of reuse, an evaluation of the minimum dataset required for its exploitation will be set up in order to define the most optimal compromise between storage cost and interest of the dataset. The AnaEE Interface and Synthesis Centre may undertake

actions to valorize these datasets in order to verify that this dataset can be reused by other research fields or other public and private actors.
Some clashing needs could arise from a legal standpoint: for example, complying to GDPR may force DMC to grant to publishers the "right of oblivion", but deleting published data could compromise the persistence implied by the use of DOIs. These conflicts must be regulated by the legal part of the Consortium.

4.2. Foreseeable research uses for the data

It is difficult to assess the potential of a dataset at the time of publication. The AnaEE infrastructure will conduct campaigns to assess the impact of the datasets it produces on the scientific community. Indicators on the diversity of users within the scientific community, but also towards the public decision making spheres and private companies will allow to improve this impact and to carry out dissemination actions by the ISC to the actors who would not have understood the interest of the data produced by the AnaEE RI.

4.3. Long-term preservation plan

Preservation of the AnaEE infrastructure datasets is ensured by the DMC data storage and it mirror storage in the CC IN2P3.

5. DATA ACCESS AND SHARING

In this section we describe the AnaEE policy on accessing and sharing approved datasets and resources in general. The content of this section applies to datasets and resources that have been approved for publication by AnaEE.

5.1. Data publication workflow and policies

Once a dataset has met its quality requirements and has been approved for publication, AnaEE will assign it systematically a Persistent Identifier in the form of a Digital Object Identifier (DOI) as stated in the AnaEE Scientifical Technical Document. The proposing project will also be asked to provide a bibliographic reference to a companion paper or a technical report to perfect the publication information.
When both the DOI and the reference will be ready, the dataset will be published.
The dataset's owner may optionally negotiate with AnaEE a so-called grace period, i.e. a delay between approval and actual publication during which only the dataset's metadata will be visible to the community. The grace period request must be presented before publication to the revisers and the AnaEE central Hub and motivated. Acceptable motivations may include, but are not limited to:

- delays in the publication process of a companion paper or other dataset-related material;
- external organizational constraints imposed by third parties;
- pre-existing non-disclosure agreements with third parties.

Grace periods are meant to be exceptions and can last up to a year. After the end of the grace period the dataset will be published automatically in its integrity.
Datasets are published with the license specified in their corresponding project DMP, hence the responsibility for choosing an appropriate license relies on the proposing party described in the next 5.3 section.

Then, in order to allow findability and accessibility of the data production of the AnaEE infrastructure, the DMC provides a Data Portal to access the datasets produced during research projects.

This portal allows the scientific community and the general public (see Figure 2) to easily retrieve the datasets and associated publications thanks to discovery metadata. In addition, the data users will be able to find the associated cleaning, processing and analysis scripts as well as the models developed by the community. These scripts and models will be published in the AnaEE Developer Portal, which is also managed by the DMC.

5.2. Data publication tools

AnaEE encourages its research platforms to get their own data publication systems where possible. Recommended systems are CKAN, GeoNode, GeoNetwork, and in general all OSGEO supported products. Resources to be published on AnaEE services will then be linked and accessed through the original publisher's platform, preventing duplication issues and simplifying the enforcement of licenses and user access policies. Research platforms that don't have their own data publication system may upload their datasets into the services provided by the AnaEE DMC.
AnaEE will provide primarily two online data publication tools: the Data Portal and the API portal. Both systems are Web based, have federated user access with the AnaEE Identity Provider, and are maintained by the AnaEE DMC on its cloud space.
The data portal provides a Catalog of all datasets published by the RI, in the form of a Web Application. Such an application will allow the user to browse the catalog, search the catalog leveraging its metadata, access data and metadata, and preview the data. The same tool will also allow AnaEE platforms to manage dataset revisions and to keep track of the AnaEE evaluation process.
The Data Portal is built on top of the CKAN data management system and serializes its data in a data warehouse and a file storage hosted in the DMC cloud space. Various formats can be foreseen for uploading data (refer to relevant section in this document), and the underlying tools can provide some degree of automatic discovery of structure in said data to allow for map plots, chart plots, tabular views and querying. Metadata curation and upload is however the responsibility of the publishing platforms.
The API portal is built on top of MIcrosoft's API Management technology and provides a catalog of available Restful APIs developed by AnaEE and its partners, examples of such APIs may include, but are not limited to programmatic access to data warehouses, simulation models, and Artificial Intelligence models. The API portal allows its user to register to APIs and to request authorization keys to query the said APIs. Publishing a new API on the API portal requires a research platform to host all its components and to provide the DMC with an OpenApi 3.0 specification along with adequate credentials to access the API.
THe API portal is online at the following address: https://anaee-api-portal.developer.azure-api.net
Both the Data Portal and the API portal allow for advanced user authorization management: users can be organized in groups and have different individual or group privileges on the resources therein hosted. Resource access and visibility on these portals can be granted or restricted, depending on the use case, either by the resource owner or by the system administrator.

5.3. Data Licensing Policies

AnaEE encourages the adoption of liberal licenses that allow users to access the data and use it to develop new data products and hopefully contribute to the advancement of human knowledge. AnaEE encourages also third parties who may build new products on top of the published resources to share their results like AnaEE did with its data, hence the preferred license for AnaEE datasets is Creative Commons Attribution-Share Alike (CC BY-SA 3.0). AnaEE may reject dataset proposals that have license clauses that may hinder their fruition in the research community.
The AnaEE recognizes that for some third party stakeholders, the preferred license, as well as other liberal licenses, may be incompatible with their organizational and commercial constraints. In order not to impede this type of partnership, AnaEE therefore encourages its research platforms to also

adopt dual licensing or open licensing delay policies to meet the needs of the open science community and other organizations involved.

The project DMP must specify a publishing license for each candidate dataset. AnaEE expects the project AnaEE acknowledges four types of projects with different data policy requirements:

- **Academic observation**: initiatives mostly funded by AnaEE partners themselves that aim at creating long lasting resources whose main aim is expanding academic knowledge in general and that can serve multiple other research projects.
- **Academic projects**: deliverable-oriented projects supported by European, national, regional or local funds, these projects have a discrete lifespan and the deliverable licensing must meet the funding body's requirements.
- **Academic/Private consortium cooperation**: projects wherein private sector actors are involved either as work package units or funders and may impose some constraint on data publishing.
- **Private sector**: projects entirely funded by a private sector operator that may involve non disclosure agreements, hence limiting the possibility of publishing project data.

These four project stereotypes do not differ from each other in terms of AnaEE governance or general framework, but may produce artifacts with different licensing policies to meet their funder's requirements. The adoption of a non-liberal license, i.e. all rights reserved, for the produced datasets should therefore be supported by a brief report indicating the reasons why a liberal license is not viable.

AnaEE strongly supports Open Access publication in all of its forms, however AnaEE acknowledges that there exists a wide array of Open Data licenses, some of which are incompatible with each other.

AnaEE deems acceptable all the major open data licenses, namely: CC-0, CC-PDM, CC-BY-ND, CC-BY-NC-ND, CC-BY, CC-BY-SA, CC-BY-NC, CC-BY-NC-SA, OCD-PDDL, ODC-BY, ODC-ODbL, OGL 2.0, and OS OpenData.

It is important however to stress that these licenses are not equivalent, and picking an appropriate one is far from a trivial decision. These licenses have different features that are summarized in the following table:

	Permissions			**Requirements**					**Prohibitions**
License	Reproduction	Distribution	Derivative Works	Notice	Attribution	Share Alike	Copyleft	Lesser Copyleft	Non-Commercial
CC0	X	X	X						
CC-PDM	X	X	X						
CC-BY-ND	X	X		X	X				
CC-BY-NC-ND	X	X		X	X				X
CC-BY	X	X	X	X	X				
CC-BY-SA	X	X	X	X	X	X			
CC-BY-NC	X	X	X	X	X				X

CC-BY-NC-SA	X	X	X	X	X	X			X
ODC-PDDL	X	X	X						
ODC-BY	X	X	X	X	X				
ODC-ODbL	X	X	X	X	X	X			
OGL 2.0	X	X	X	X	X				
OS OpenData	X	X	X	X	X	?			

In general, AnaEE encourages the usage of the most liberal licenses, which are CC-0, CC-PDM, and ODC-PDDL. Adopting these liberal licenses allows AnaEE's end users to build and publish derivative products for research and business purposes as well, while less liberal licenses may prevent derivative products from being published with Open Data licenses or from being developed at all, hence making them not reusable. The following table shows the compatibility matrix between source data licenses and derivative product licenses.

	Permissible License for derivative												
Original License	CC0	CC-PDM	CC-BY-ND	CC-BY-NC-ND	CC-BY	CC-BY-SA	CC-BY-NC	CC-BY-NC-SA	ODC-PDDL	ODC-BY	ODC-ODbL	OGL 2.0	OS OpenData
CC0	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
CC-PDM	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
CC-BY-ND	-	-	-	-	-	-	-	-	-	-	-	-	-
CC-BY-NC-ND	-	-	-	-	-	-	-	-	-	-	-	-	-
CC-BY	N	N	Y	Y	Y	Y	Y	Y	N	Y?	Y	Y	Y
CC-BY-SA	N	N	N	N	N	Y	N	N	N	N	N	N	N
CC-BY-NC	N	N	N	Y	N	N	Y	Y	N	N	N	N	N
CC-BY-NC-SA	N	N	N	N	N	N	N	Y	N	N	N	N	N
ODC-PDDL	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
ODC-BY	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y
ODC-ODbL	N	N	N	N	N	N	N	N	N	N	Y	N	N
OGL 2.0	N	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y
OS OpenData	N	N	N?	N?	N?	Y	Y?	Y	N	Y?	Y	N	Y

In addition to these limitations, some licenses are not compatible between them, preventing the merging of data published under different licenses. For instance a data set published with CC-0 License cannot be integrated with data taken from a CC-BY-ND one, despite both of them being considered open data licenses. In other cases the merging of two data sets is not forbidden, but its reuse is limited by the less liberal license, forcing the author of the merged data to publish it under the less liberal of the two licenses. For the sake of clarity, we present in the following table the acceptable publishing licence for an hypothetical data product obtained by merging, with no further processing, two data sets.

	Second License												
First License	CC0	CC-PDM	CC-BY-ND	CC-BY-NC-ND	CC-BY	CC-BY-SA	CC-BY-NC	CC-BY-NC-SA	ODC-PDDL	ODC-BY	ODC-ODbL	OGL 2.0	OS OpenData
CC0	No restrictions	No restrictions	-	-	CC-BY	CC-BY-SA	CC-BY-NC	CC-BY-NC-SA	No restrictions	ODC-BY	ODC-ODbL	OGL 2.0	OS OpenData
CC-PDM	No restrictions	No restrictions	-	-	CC-BY	CC-BY-SA	CC-BY-NC	CC-BY-NC-SA	No restrictions	ODC-BY	ODC-ODbL	OGL 2.0	OS OpenData
CC-BY-ND	-	-	-	-	-	-	-	-	-	-	-	-	-
CC-BY-NC-ND	-	-	-	-	-	-	-	-	-	-	-	-	-
CC-BY	CC-BY	CC-BY	-	-	CC-BY	CC-BY-SA	CC-BY-NC	CC-BY-NC-SA	CC-BY	CC-BY	ODC-ODbL	CC-BY	OS OpenData
CC-BY-SA	CC-BY-SA	CC-BY-SA	-	-	CC-BY-SA	CC-BY-SA	-	-	CC-BY-SA	CC-BY-SA	ODC-ODbL	CC-BY-SA	OS OpenData
CC-BY-NC	CC-BY-NC	CC-BY-NC	-	-	CC-BY-NC	-	CC-BY-NC	CC-BY-NC-SA	CC-BY-NC	CC-BY-NC	-	CC-BY-NC	OS OpenData
CC-BY-NC-SA	CC-BY-NC-SA	CC-BY-NC-SA	-	-	CC-BY-NC-SA	-	CC-BY-NC-SA	CC-BY-NC-SA	CC-BY-NC-SA	CC-BY-NC-SA	-	CC-BY-NC-SA	OS OpenData
ODC-PDDL	No restrictions	No restrictions	-	-	CC-BY	CC-BY-SA	CC-BY-NC	CC-BY-NC-SA	No restrictions	ODC-BY	ODC-ODbL	OGL 2.0	OS OpenData
ODC-BY	ODC-BY	ODC-BY	-	-	ODC-BY	CC-BY-SA	CC-BY-NC	CC-BY-NC-SA	ODC-BY	ODC-BY	ODC-ODbL	ODC-ODbL	OS OpenData
ODC-ODbL	ODC-ODbL	ODC-ODbL	-	-	ODC-ODbL	ODC-ODbL	-	ODC-ODbL	ODC-ODbL	ODC-ODbL	ODC-ODbL	ODC-ODbL	OS OpenData
OGL 2.0	OGL 2.0	OGL 2.0	-	-	CC-BY	CC-BY-SA	CC-BY-NC	CC-BY-NC-SA	OGL 2.0	ODC-BY	ODC-ODbL	ODC-ODbL	OS OpenData
OS OpenData	OS Open Data	OS Open Data	-	-	OS OpenData	OS OpenData	?	?	OS OpenData	OS OpenData	?	OS OpenData	OS OpenData

The adoption of less liberal licenses such as CC-BY-ND, CC-BY-NC-ND, CC-BY-SA, CC-BY-NC, CC-BY-NC-SA, and ODC-ODbL limits the reusability of data and therefore prevents it to be considered truly FAIR. While AnaEE will accept these licenses, it will require proposing platforms to justify them with clear and well documented constraints. A third party can negotiate an embargo to keep a competitive and commercial advantage over products from the AnaEE Infrastructure but they will have to commit to making the data that generated these products public at the end of the negotiated embargo period. Different or bespoke licenses can be accepted if adequately supported by concrete motivations. Dual Licensing is acceptable and encouraged to maximize the impact of the published data.

5.4. User Access and authorization policies

AnaEE expects from adhering research platforms to be open towards user access federation and committed towards improving accessibility to its scientific data. Research platforms are also expected to manage their user accounts within an identity provider compliant with OpenID and LDAP standards.

AnaEE has its own Identity Provider compliant with LDAP and OpenID protocols. Such a system is used to manage user access to all services maintained by AnaEE at DMC level. Research platforms may request to federate their own Identity Providers with the AnaEE one to allow their users to authenticate on all AnaEE services with no need of registering additional accounts.

Research platforms can also use, under request to the DMC, to use the AnaEE Identity Provider as a login method for their services.

On top of user identification, AnaEE can also provide User Authorization to systems supporting the OAuth 2.0 protocol and accept authorization federation with OpenAuth 2.0 compliant authorities. This is meant to allow a finer and more robust control over user access to critical resources.

Technical and Scientific Description Appendix 8. Work Program 2020-2021

Version 7.1
16/10/2020

Cover page, from left to right, and top to bottom:
Enclosed growth facility at Højbakkegård, Denmark (© University of Copenhagen)
Inside the Gembloux Ecotron, Belgium (© University of Liège)
Preparing a macrocosm at the Montpellier Ecotron, France (© CNRS)
The Planaqua CEREEP aquacosm facility in Saint-Pierre-Lès-Nemours, France (© ENS - CNRS)
The O3HP open-air manipulation platform at the Observatoire de Haute-Provence, France (© CNRS)
The open-air FACE experiment from Risö fields, Denmark (© Technical University of Denmark)

Work program 2020 - 2021

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I. Context

AnaEE (Analysis and Experimentation on Ecosystems) is a Research Infrastructure that brings together a series of state-of-the-art experimental and analytical platforms throughout Europe. By linking these platforms to modelling approaches, AnaEE advances our understanding of the environmental impacts of ongoing global change, and fosters adaptation and mitigation strategies for safeguarding ecosystem services and their economic and societal benefits. It forges evidence-based adaptation and mitigation strategies that assure plant, soil, water, biodiversity and ecosystem health today and in the future. Those strategies are needed to maintain essential services to society, including carbon sequestration, food security, clean water, biodiversity.

Characteristic to AnaEE, its versatile facilities can simulate environmental drivers from land-use change, pollution, biological invasions, rising atmospheric greenhouse gases concentrations, and to increasing extreme events such as droughts and heatwaves. AnaEE has the potential to look into the future, thanks to the integrative and coordinated usage of its experimental, analytical and modelling facilities. It provides open and easy access to resources and services to a broad user community world-wide to conduct excellent experimental research, foster innovation and provide high-quality information.

AnaEE is a key structure to obtain the knowledge necessary to tackle the complex global environmental challenges facing human societies.
As we are getting closer to becoming an operational research infrastructure, we feel that it is of the utmost importance to further bring the AnaEE community together: the platform operators, the scientific users, and more generally those interested in our activities.
This work program is designed for the late implementation — start-up of the operational phase of the ERIC and Research Infrastructure, i.e. end of 2020 until 2022.
It has been divided into 4 “construction” areas, that represent the key priorities for a starting RI. Thirteen work packages have been identified as priorities for the coming year. Several of these tasks are related to the starting phase of the ERIC, while some others are likely to continue in the following years. A fifth “construction area” (WA0), visible on the Gantt chart, represent the actions made for the ESFRI evaluation and the ERIC application.
In addition, WA0 represents the actions taken for the evaluation by ESFRI, and the step 2 application of the ERIC.

II. Work Program Structure

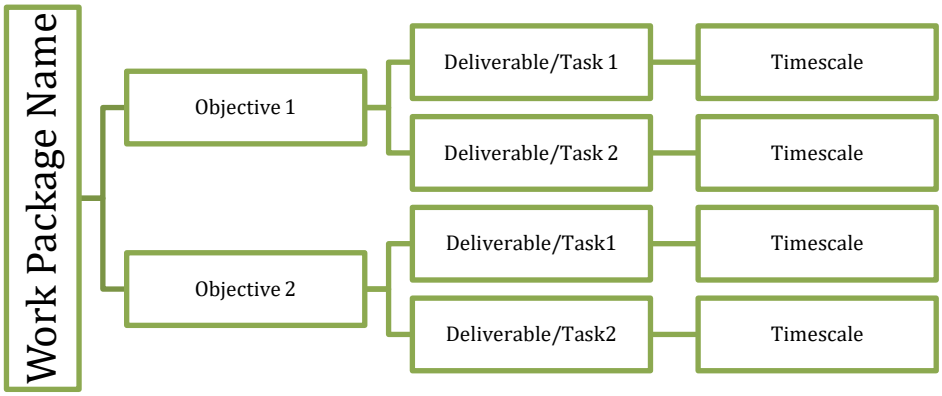
This work program aims to define a common framework for the next months before the ERIC startup phase, until the kickoff phase of the ERIC (taken as from 1/06/2020 until end 2022). **14 Work Packages** are distributed into 4 main areas of work, which are the following:

- **Area 1:** Building a sustainable ERIC
- **Area 2:** Towards an operational ERIC
- **Area 3**: Consolidate the AnaEE community
- **Area 4:** AnaEE in the international research ecosystem

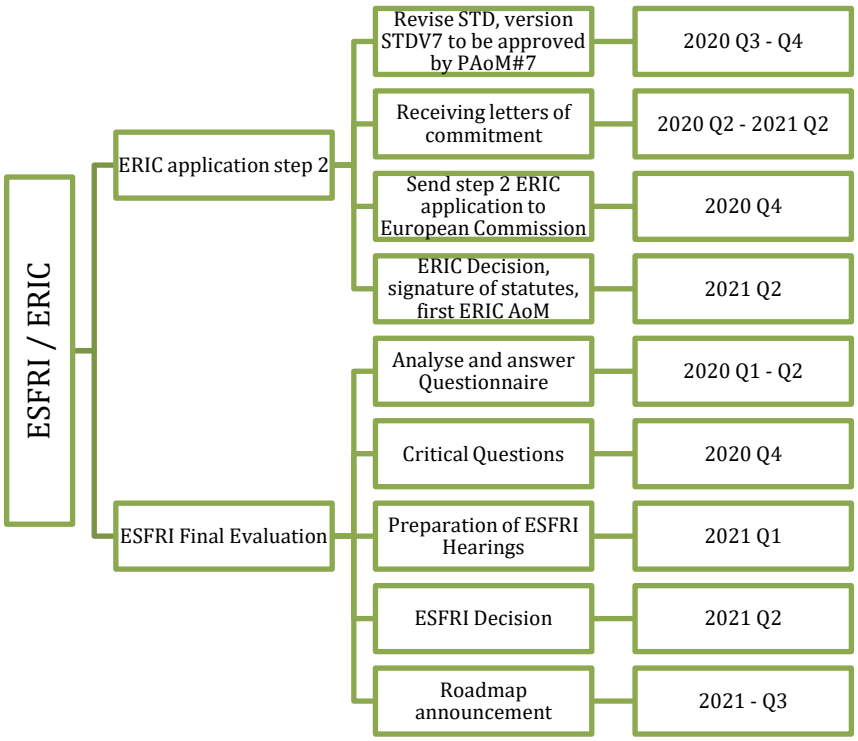
The indicated timescales and the smart charts have to be interpreted as followed:

- **Pre-ERIC Phase**: 2020 Q4; 2021 Q1 & 2, where QN (N = 1 .. 4) denotes the quarter of the year
- **ERIC:** 2021 Q3 & 4
- **QN++** denotes a task that starts at quarter QN, and is likely to extend beyond 2021.

- **Our hypothesis is an official launch of the ERIC in June 2021 (when the first Assembly of Members takes place).**



0 - Work Area 0: ESFRI and ERIC



ERIC application step 2

France, as the leading country, has started, through the French Ministry for Higher Education, Research and Education (MESRI), to request the letters of commitment (LoC) from the members and observers (Belgium, Czech Republic, Denmark, Finland, Italy, and CIHEAM-IAMB). As soon as enough members have signed, France will send the formal request to establish the ERIC to the European Commission. This request will include the LoCs, the statutes of the ERIC, and the Scientific and Technical Document (STD). This last document, which will be approved by the final pre-ERIC Assembly of Members in October 2020, describe the vision of AnaEE, its scientific relevance and added value, organization, services provided to the community, training and outreach, etc.

ESFRI Final Evaluation

Last June, AnaEE replied to the ESFRI questionnaire. We expect to receive the "critical questions" from the ESFRI evaluation committees by the end of the year, followed by hearings, which will take place in February or March 2021. The formal decision for the "Landmark" status will be announced by mid-2021. We will prepare carefully our reply to the critical questions and the hearings. This will be also the opportunity to present the last developments of the RI, as we will continue the implementation to be in position to start being operational as soon as the ERIC has been established.

1 - Work Area 1: Building a sustainable ERIC

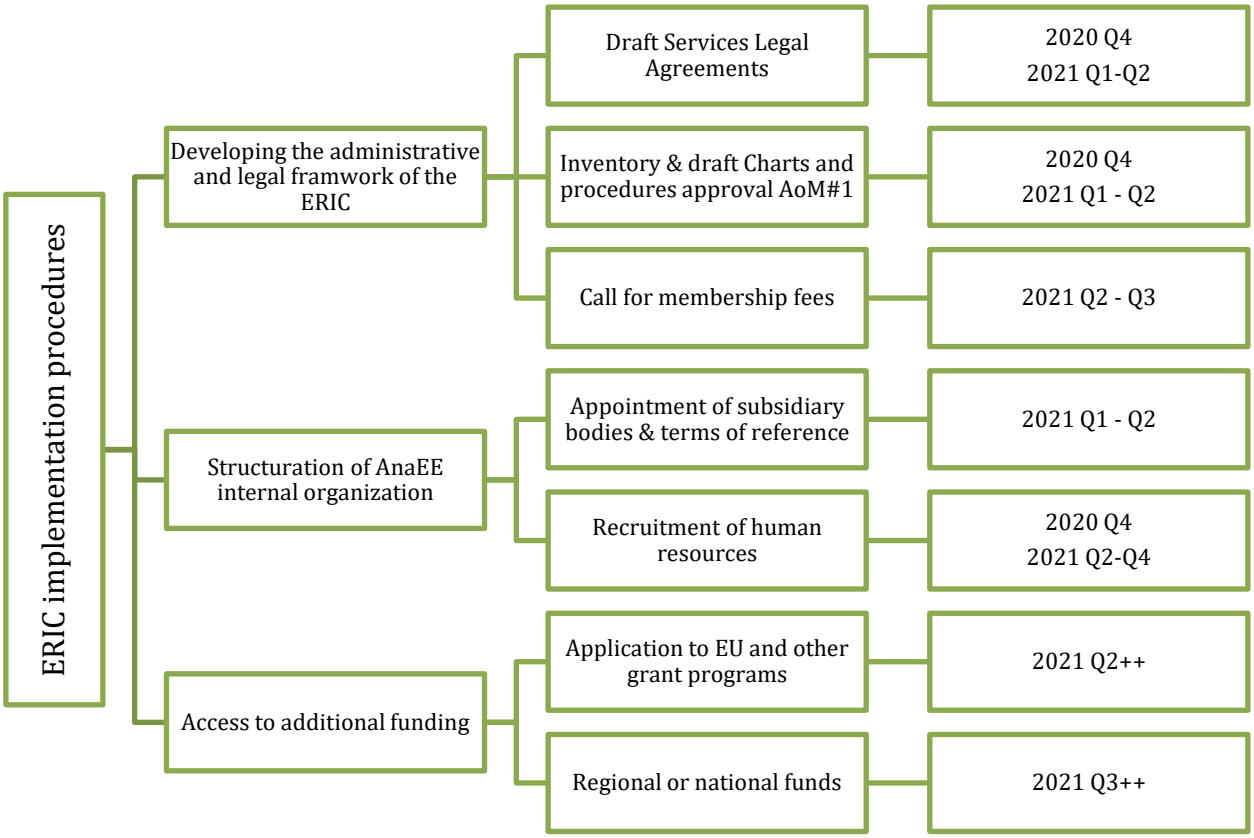
This Work Area refers to the overall management of AnaEE ERIC and contains the following 5 main Work Packages:

- WP11 Implementation procedures
- WP12 Strategy
- WP13 Building a profitable relationship between the ERIC and the Platforms
- WP14 Quality
- WP15 Core IT

1. 1. WP11 ERIC implementation procedures

WP Leader: CH
Participants: TC, DMC, ISC, Platforms, National Nodes

The AnaEE ERIC will coordinate the access to the experimental, analytical and modelling National Platforms (NP) and organize the collaboration with the European user community and stakeholders. The Central Hub (CH) is in charge of the overall coordination, together with the three Service Centres (SC): The Technology Centre (TC), the Data and Modelling Centre (DMC), and the Interface and Synthesis Centre (ISC).



Developing the administrative and legal framework for the ERIC
Service Level Agreements (SLA), will describe the services given by the ERIC to the platforms, and from the platform to the ERIC. This coming year will be dedicated to set out the principles in the service agreements (share of the platform devoted to AnaEE, access procedure, amount of resources available at the platform etc…). The SLAs will be discussed with each platform manager, and signed with the host institution. The SLAs will be drafted during the pre-ERIC phase and officially approved during the first ERIC AoM.

As AnaEE-ERIC will be a European Research Infrastructure Consortium (ERIC), we will prepare the rules of procedures that conform to the European and national (host country) rules (including finance, HR, procurement rules). Drafting these rules during the pre-ERIC phase, which will be approved during

the first AoM, will speed-up the process of recruitment, early administrative tasks, and first procurements of the ERIC.

AnaEE will call for membership fees that will be needed for the operationalization of AnaEE.

Structuration of the AnaEE internal organization

Several bodies will be appointed to support AoM's and DG's work. The statutes provide for the Independent Scientific Advisory Committee (ISAC), the Independent Ethical Advisory Committee (IEAC), the Stakeholder Committee (SHC), the Management Board (MB). Duties have to be clearly defined for each subsidiary body in its terms of reference. Other subsidiary bodies can be established by the AoM as needed. The DG can appoint working groups. This is already foreseen for the independent Program Review Committee, in charge of the evaluation of the proposal submitted to AnaEE, as well as other technical committees.

The ISAC provides advice on the criteria for the acceptation of platforms, on the strategy, on the collaboration with other infrastructures and bodies, it analyses the activity reports and provides recommendations on the work program and long-term strategy, and gives foresight on ecosystem sciences and the links with food security and the bio-economy. An interim ISAC has been appointed by the interim AoM before the establishment of the ERIC. The ToRs will be written and approved by the first ERIC AoM, together with the final composition of the ISAC.

The IEAC advises the AoM and the DG on ethical issues to be considered by the ERIC or the national platforms in their activities, or issues arising from specific programs proposed for consideration by AnaEE. The ToR of the IEAC will be discussed and drafted during the pre-ERIC phase, for approval and appointment of the IEAC at the first ERIC AoM.

The SHC is composed of representatives of the bodies and institutions that have an interest in the services and results delivered by AnaEE. It advises AnaEE on the work program and strategy, user accommodation, collaboration with other structures, and the communication plan.

The Management Board is a committee composed of the DG and the heads of the service centres. It advises the DG on all matters related to the day to day life of the ERIC, as well as in the preparation of the budget, the work program and all matters of consideration for the DG.

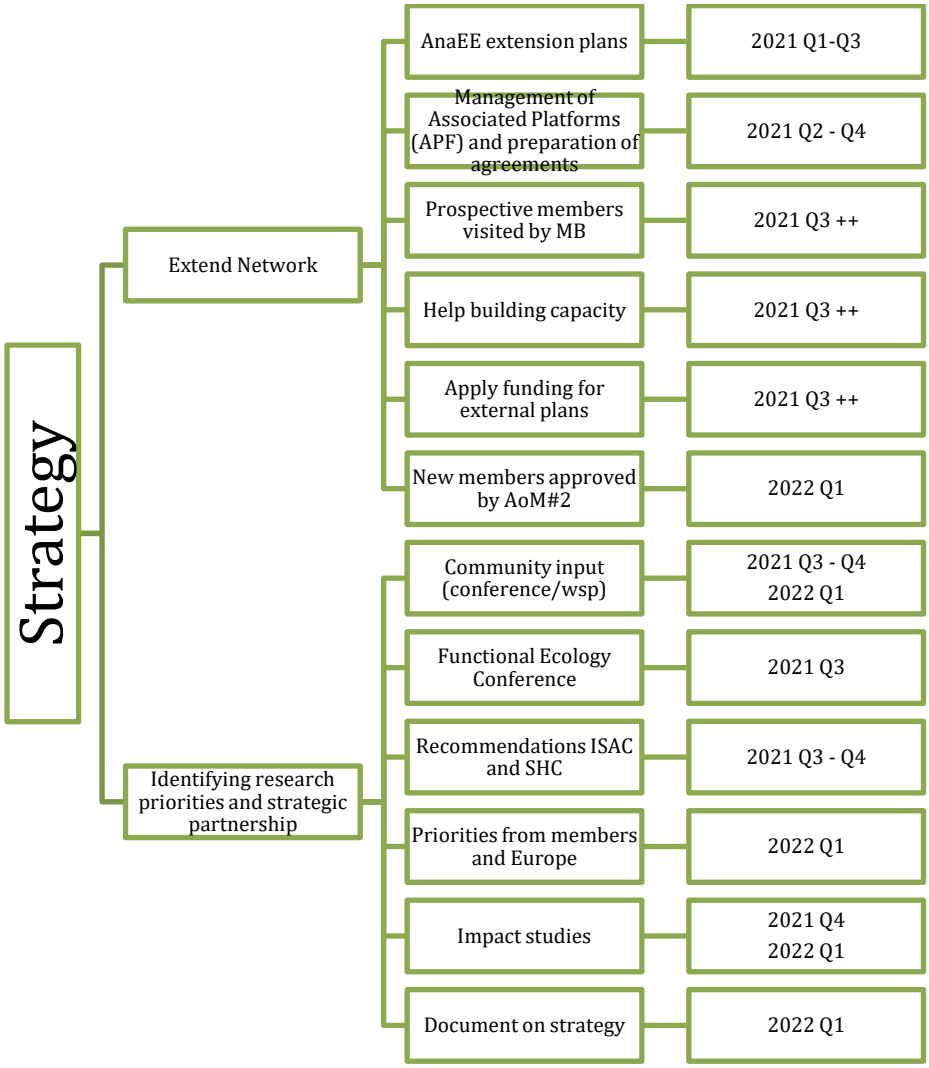
A Finance Committee will be proposed to the AoM, with representatives of the AoM, in order to make a link with the DG and Central Hub services, and to promote the discussion for the financial report and preparation of the next budget (either annual, and update of the pluri-annual projections).

Access to additional funding

AnaEE will develop a systematic and ambitious plan of grants application to European and national/regional funds, and will develop links with the industry. Our objective, after the ramp-up period, is that 30% of the revenues of AnaEE will come from grants, partnership, and service provision. In particular, the Horizon Europe program will feature opportunities that AnaEE should not miss.

1.2. WP12 Strategy

WP Leader: CH
Participants: TC, DMC, ISC, National Nodes, Platform types representatives



Extend AnaEE network

One of the main tasks of AnaEE, already during the early life of the ERIC, will be the extension of the service offer, and the increase of the number of members. The later results in a better service offer, and enhanced sustainability. The sustainability of AnaEE-ERIC will be achieved by increasing the number of members (countries), therefore reducing the impact of a possible withdrawal from one member, and reinforcing the interest for non-member and member countries of AnaEE.

The extension of the platform numbers (which can be either in countries already member of the ERIC, or from newcomers) will result in:

- Better geographical/climate/environment coverage,
- Larger variety of experimental drivers that can be applied to the ecosystems, or, for analytical platforms, more large and specific instrumentation available, or, for modelling platforms, a larger palette of models,
- Increase of the number of user-days, resulting in larger numbers of user proposals being accommodated,

- Increased resilience and flexibility, e.g. in case a technical problem or adverse conditions prevent the accommodation of an experiment on a given platform.

AnaEE-ERIC will discuss with each national node of their extension plans. The discussion with prospective countries will offer the opportunity to discuss their platform network, and the possibilities for evolution, including digging for funds.

As part of our efforts to give the best services to our users, to increase the network of countries involved, and to help new platforms to reach the quality level requested by AnaEE we have established a status of Associated Platforms (APF). This status will result from an agreement between AnaEE and the owner of the data (research institute typically). This status will be granted for 1 year, with possible renewal. The Central Hub will coordinate the preparation of the draft agreements.

Sanitary situation permitting, we will resume the visits to European countries to promote AnaEE services and explore cooperation. For example, we propose a visit of the Management Board for a one- to two-day scientific workshop, and, whenever needed, a contact with the appropriate administrative authorities.

Identifying research priorities and establish strategic partnership

During the first year of its life, AnaEE-ERIC and AnaEE-RI will have to build a 10-year strategic plan, which will guide its action for its first term. This strategic plan will be probably revised after 4 years, in line with the first evaluation of the RI and the end of the first 5-year term of the ERIC. Albeit the strategy of the early AnaEE-RI has been defined in its Scientific and Technical Document, we feel that several circumstances call for a revision of the strategy: the ERIC will be in its first 1-2 years, and some experience will be gained; the horizon Europe will start at the same time of the ERIC, together with the Green Deal strategy of the European Community, which lead to changes in the overall framework of research and innovation in Europe; new members may come, and their priorities should be also taken into account in the future strategy of AnaEE; The ERIC will be in position to sign MoUs and agreement with other recognized bodies, mostly other RIs, to build a better collaborative framework; the scientific community will build-up around the RI. The tools are the different AnaEE bodies, AoM, management board, user committee, the ISAC and the stakeholder committees, the conferences, and among them the AnaEE Functional Ecology Conferencec(the first is planned for fall 2021), and the various contextual materials, EU policy and strategy, members strategies, IPBES, etc. A social impact study will also provide guidance on the priorities, as well as the initiatives AnaEE can have towards its stakeholders.

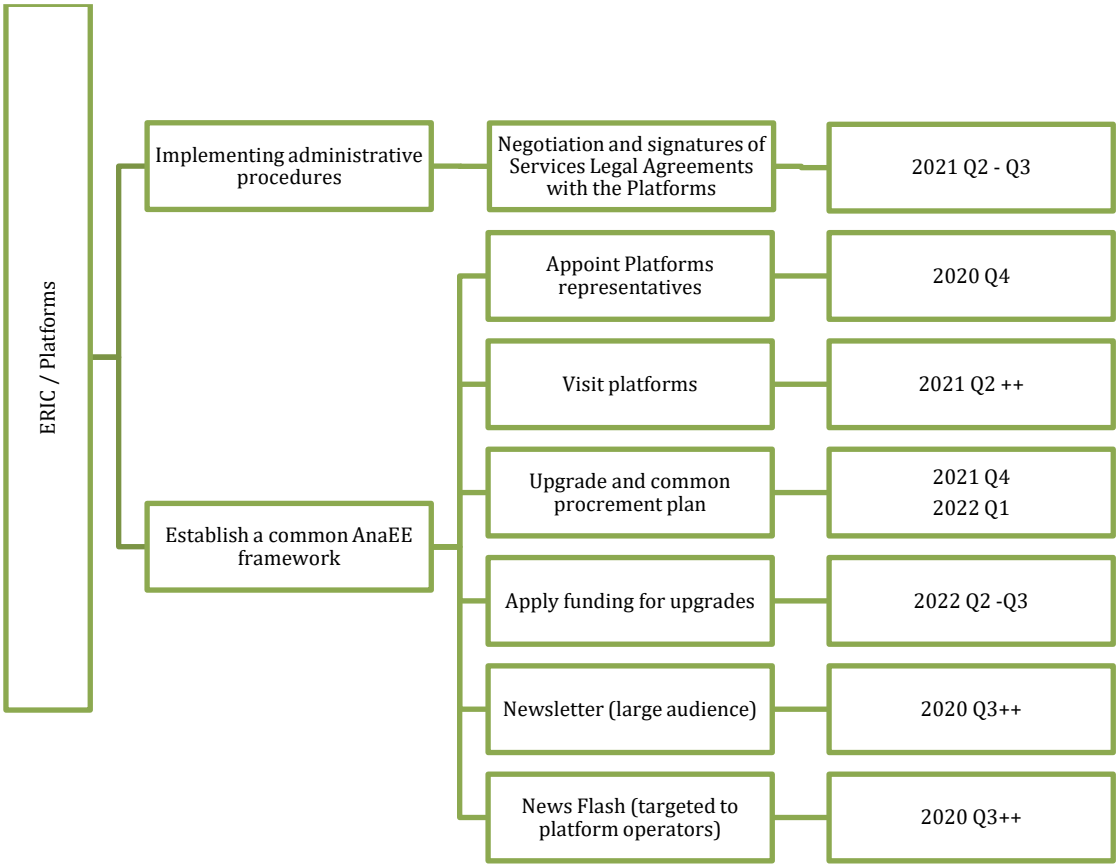
A general Functional Ecology Conference (FEC) will be planned in 2021 and meetings with users and members will be set up to determine research priorities.

During the implementation phase, AnaEE, has already identified three priority domains that lead to case studies, and will be further elaborated to lead to specific calls for proposals.

- Soil and plant health and their relation with ecosystem functioning,
- Greenhouse gas emissions in ecosystems and their reeducation, especially in agriculture
- Carbon Storage in terrestrial ecosystems.

1.3. WP13 Building sustainable relationship between the ERIC and the Platform network

WP Leader: CH, TC
Participants: Platforms, TC, DMC



Implementing Administrative procedures

Once the ERIC will be established, Service Level Agreements (SLA) will be negotiated and signed with each platform participating to AnaEE. Principles in the service agreement will be defined like the share of the platform devoted to AnaEE, access procedure, amount of resources available at the platform etc. They will also describe the services given from the ERIC to the platforms, and from the platform to the ERIC. A draft SLA is already circulating, with the principles defined in the STD.

Develop an AnaEE common framework

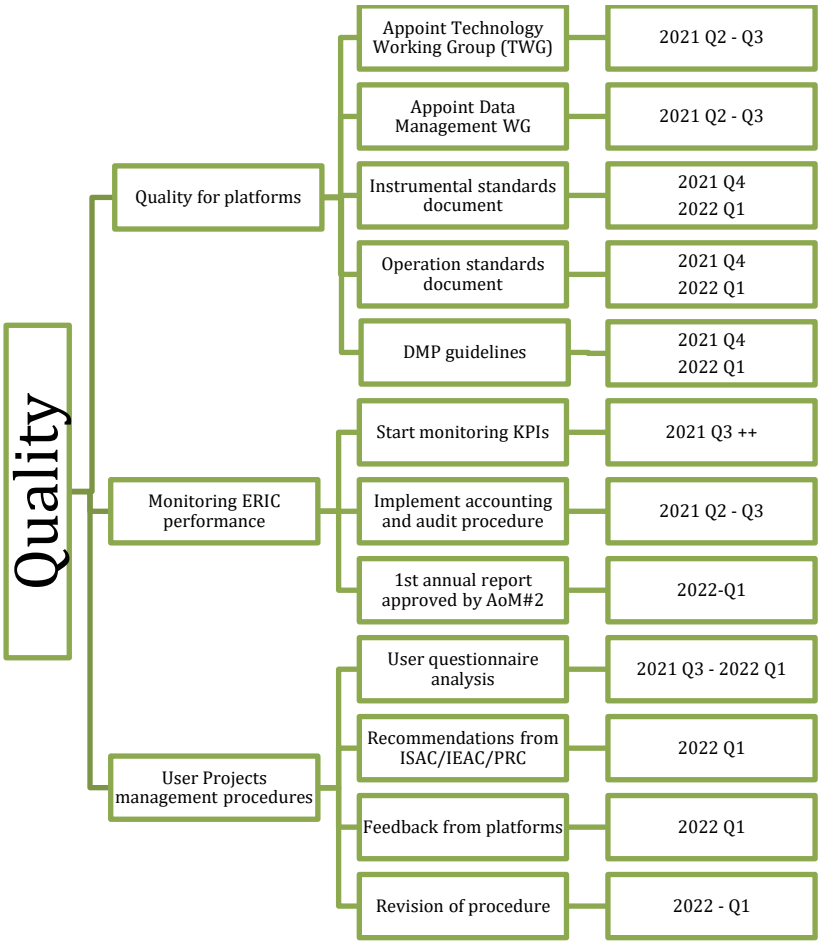
AnaEE will appoint platform representatives for collocated platforms, enclosed platforms, open-air platforms, aquatic platforms, modelling platforms and analytical platforms.

Depending on the evolution of Covid-19 crisis, visits from the Management Board to the platforms will be planned starting 2021 Q2.

AnaEE will aim to strengthen the network of national nodes and platforms members by developing a common culture around AnaEE. The aim is to create bonds and bridging gaps in cultures, languages and approaches. Firstly, we did create a bimonthly newsletter that features information about AnaEE implementation, projects, available call. It provides also a channel for the platforms to share the news about their projects. Secondly, we will create a News Flash communication in order to share specific information related to contacts with stakeholders, specific calls etc…

1.4. WP14 Quality & Monitoring

WP Leader: CH,
Participants: TC, ISC, DMC, platforms



Quality for platforms

To ensure the possibility to launch quickly multiplatform experiments studying climate change impacts across geographical, climatic and soil gradients, it is crucial to ensure a fast process of standardization, the implementation of new technologies for the measurement of ecosystem processes and also the extension of the use of new experimental designs based on gradient (regression) type of experiments. To this end, technical workshops, demonstrations and practical training events will be organized for small groups of platform managers, technicians, users and early stage researchers. Experimental design, measurements of ecosystem processes and technological equipment will be harmonized. To support this training process, technical notes, manuals and methodological papers will be published to provide users and platform managers with step-by-step support to install and operate the most recent technical equipment.

A Technology Working Group (TWG) and Data Working Group (DWG) will be set up. The TWG will develop experimental procedures and measurements, in order to standardize acquisition methods and data across National Platforms as well as push for and adopt new developments. This will include experimental designs, instrumentation, sampling, measurement procedures and calibrations The TC will provide references for cross comparison calibrations and will ensure that AnaEE procedures are aligned, and even lead, other international infrastructure standards.

AnaEE will appoint TWG and DWG. Instrumental standards document and operation standards document will be developed once AnaEE is set as an ERIC.

Monitoring ERIC performance

The KPIs will be collected and maintained by the Central Hub, and reported both to the executive management and to the AoM on a regular basis. We consider that the global and reasoned use of the set of qualitative as well quantitative indicators proposed here can help to monitor the achievements of AnaEE over the 5-year evaluation periods and be a useful guide for the overall strategic management of the infrastructure.

The set of KPIs described in the STD will be progressively implemented starting with the short term KPIs.

The accounting procedure will be implemented at the start of the ERIC, in compliance with the best European and national (host country) practices. Accounting will be performed by a specialized subsider. Audit will be performed by an independent, authorized, provider.

AnaEE Central hub will submit an annual report to the AoM (Financial Report, Achievements etc…)

User projects management procedures

AnaEE will have to manage complex proposal over a relatively long life time. It is important to monitor the efficiency of AnaEE both at proposal time, and along the life of scheduled project. This can be done via user questionnaires that provide a feedback on the quality of the process.

The proposal review committee and ISAC will be asked also to provide their recommendation, and feedbacks from the platform operators and managers will be of importance.

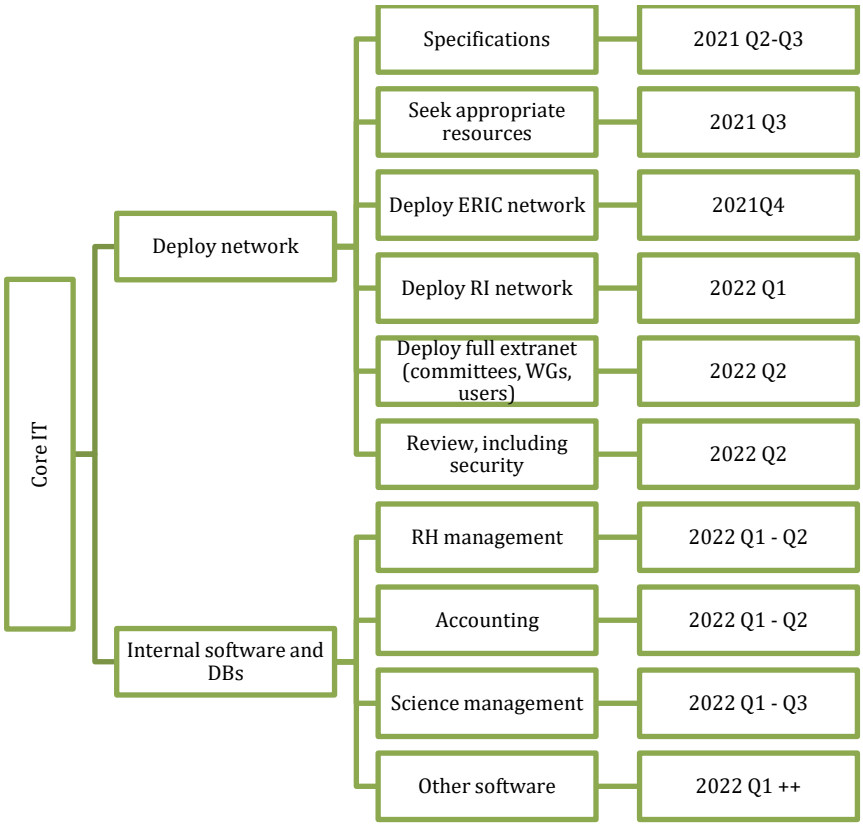
Platforms will be closely associated in this process, as they will be the first users of new technologies. Therefore, they will be associated along the whole process from identifying promising developments to evaluating their relevance for AnaEE, their readiness level, to the implementation on-site and training of operators/users, to the identification of problems.

AnaEE-ERIC, together with national nodes and platform owners will find the way to fund new developments, and new instrumentation to deploy on site. This WP will start this virtuous path of having mutual and rich thinking in new technological developments.

After 2 years of operations, from the survey of the users, PRC, platforms, we will revise the access procedures, especially the software that manages the user proposals and projects.

1.5. WP15 Core IT

WP Leader: CH
Participants: TC, DMC, ISC



Core IT for the ERIC has to be developed in order to:

- Provide a network with appropriate security rules that links the CH and SCs of the ERIC
- Provide a network with appropriate security rules that links the ERIC with the NNs and PFs (RI network)
- Provide a network with appropriate security rules that links AnaEE-RI with the users and stakeholders
- Provision to implement tools and associate space for the everyday tasks of the ERIC and RI, including administrative, RH, finances, user management, RI management, etc.
- Provide and maintain tools for the communication and outreach of the ERIC

The main task for this WP will be the specifications, followed by design and implementation. Internal, in-kind, and external advice/outsourcing will be sought.

2 - Work Area 2 Towards an operational RI

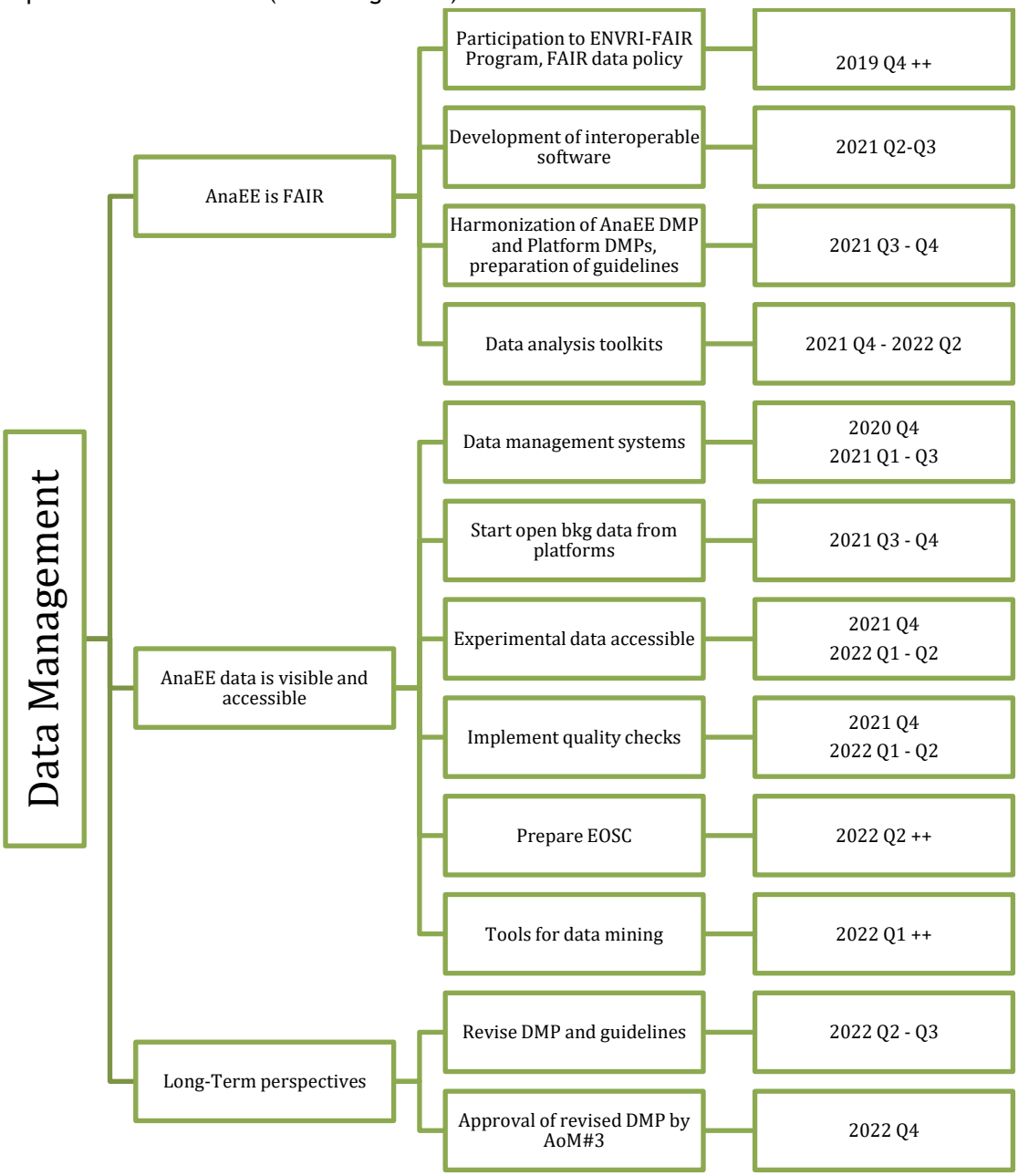
This Work Area refers to the operationalization of AnaEE and contains 5 main Work Packages:

- WP21 Data Management
- WP22 Modelling
- WP23 Platform Access and TNA
- WP24 Training
- WP25 Capacity Building & Training

2.1. WP21 Data Management & Access

WP Leader: DMC
Participants: Platforms, TC

The **Data and Modelling Centre** (DMC) will be responsible for the processing of the data and metadata, the provision of data to the users (either the direct users or the community), the access to the models and model factory. The overarching common objective of the Data Modelling Centre (DMC) is to create and enable a suitable environment for scientific data to be Findable, Accessible, Interoperable and Reusable (i.e. being 'FAIR').



AnaEE is FAIR

AnaEE is a member of the ENVRI community and actively participates in the ENVRI-FAIR program. Thanks to the common expertise shared in ENVRI-FAIR, we develop interoperable software and data management systems that can be accessed by other communities. These developments make it

possible to provide datasets enriched with metadata compatible with the semantic web and readable by machines. AnaEE's open and FAIR data policy aims at fostering Data Science in general and the exploitation of research data on ecosystems by Artificial Intelligence methods, therein including Deep Learning, in particular.
Part of the task is the development, in relation with the platform, of software to ensure the quality of data as it is acquired.
Data quality will be improved by analyses over larger datasets through National Platforms synergies or by comparing model predictions with new data. The DMC will develop visualization, statistical and data analysis tools and act as a resource center for data analysis toolkits. DMC will develop guidelines and operational tools (thesaurus, ontologies, etc.) to implement metadata and data standardization (data tool kits, software products).
DMPs will be proposed by the platforms, and included in the SLAs after evaluation and compliance check by AnaEE-ERIC and approval by the AoM.

AnaEE data is visible and accessible
DMC will be responsible of linking remotely sensed data to model resources.
A key objective is the full interoperability of experimental datasets collected on AnaEE platforms. Access to data will consequently be centralized and benefit from a user-friendly, single querying tool in the data portal hosted on the master AnaEE portal. Workflows for data publication and mining of DOIs will be created. The model for data will be open access, with a policy approved by the AoM to determine the period and conditions for private use of the data by the users at the origin of the proposed experiment.
Software products developed by the DMC will be made freely accessible. Code will be available in open repositories (e.g. Github) and technical documents will be made freely available.

It is of paramount importance that in the context of open science, the data from research and experiments performed at AnaEE RI are shared with the scientific community and also with the experts, the industry, and more generally with the society at large. This of course includes not only the data, but the tools used to work with and to interpret them. AnaEE will contribute to the EOSC (European Open Science Cloud).

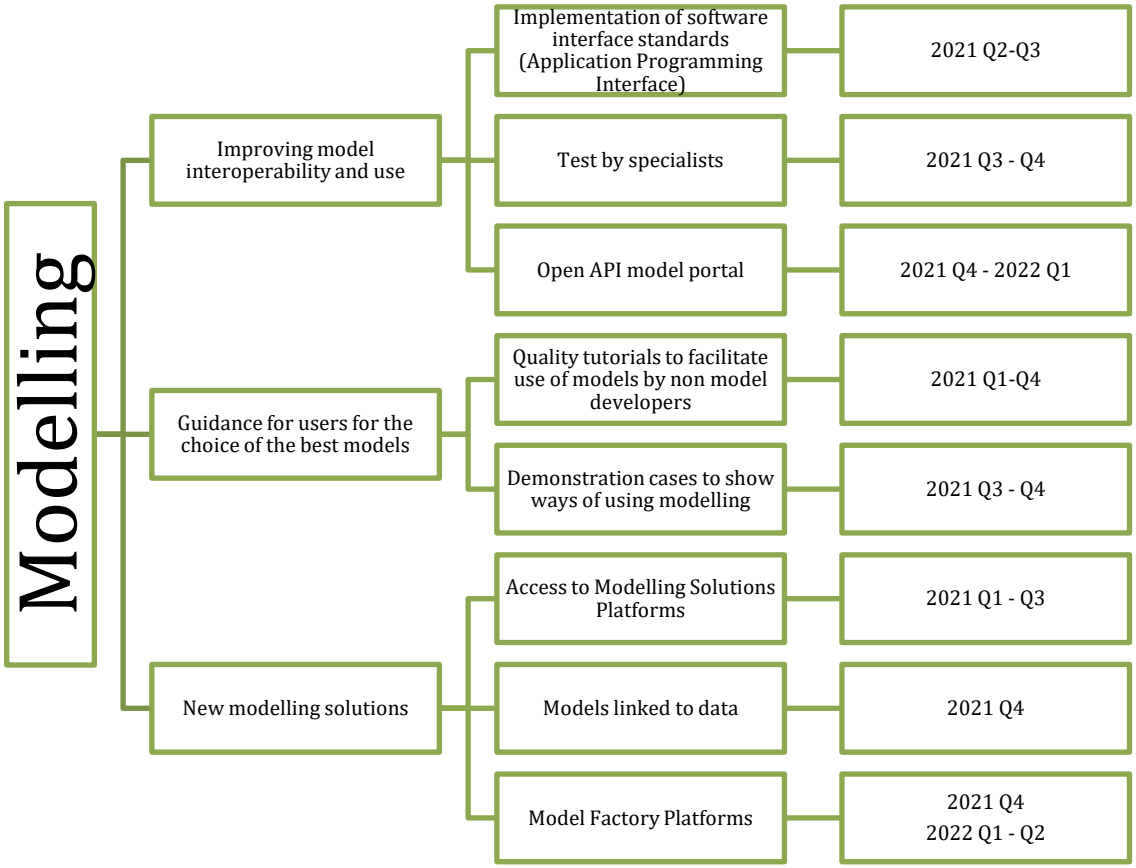
Long-term perspectives

The DMP will be revised and updated guidelines will be provided. The revised DMP will be approved by the AoM in 2023 Q1.

2.2 WP22 Modelling

WP Leader: DMC
Participants: Platforms

Mathematical models allow us to develop and test our understanding of the complex quantitative relationships between processes within ecosystems, the interactions with their environments, their functioning and behaviour under various pressures.



Improving model interoperability and use

The DMC will define and implement a range of software interface standards (Application Programming Interfaces) to facilitate the interoperation of individual models and across components within modelling factories.

The integration of data and modelling services adds value to AnaEE users. Integrated models can be applied to planning experiments in open-air or enclosed platform sites. Conversely, the statistical uncertainties highlighted in modelling exercises may guide experimental schemes. Data inferred from experiments and assimilated into process models will provide a more reliable basis for policy decisions. AnaEE will present users – whether they are experts in modelling or not – with a one-stop shop for information on and access to a wide range of ecosystems models (through AnaEE modelling platforms) as well as tools to develop new ones (through AnaEE model factory platforms).

Guidance for users

AnaEE will also provide users with guidance as the choice of the best models to interpret their results within the more general context of their research project. Models delivered by the AnaEE Data and Modelling Centre will be in form of components, accessible through a well-defined interface to enable the sharing of capabilities between project and codes. The DMC will facilitate the use of models by non-model developers by ensuring that quality tutorials are available for running the available models, and organizing training workshops on resorting to models to conceive an experiment or interpret experimental datasets.

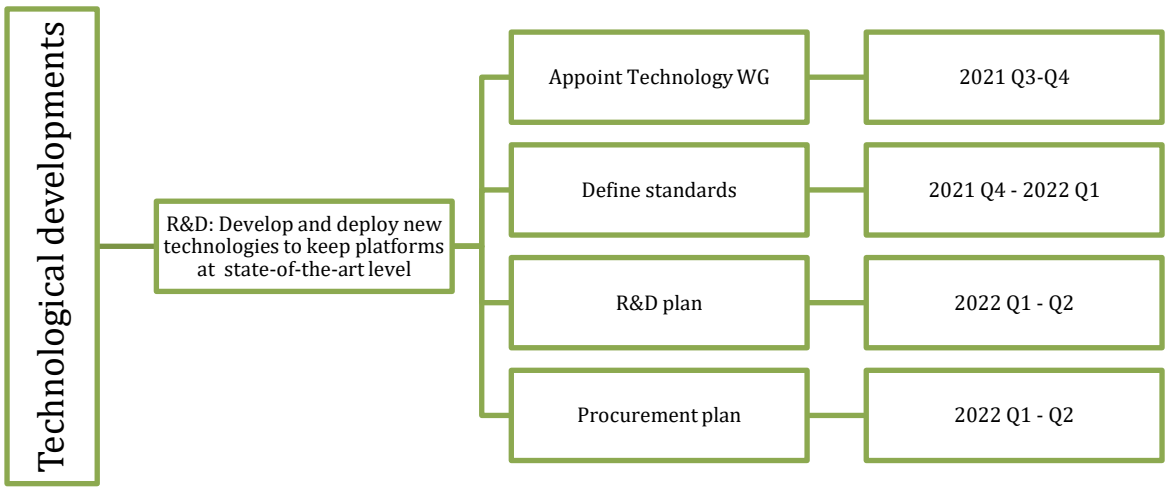
The DMC will particularly address the issue of linking data with modelling solutions using different modelling platforms. Platforms have different architectures and will require specific realizations to access data and to keep the information provided *via* metadata to properly structure output data

persistence. The DMC will thus set up demonstration cases to show ways of using modelling to enhance interpretation, upscaling, design of experimental treatments and measurements, etc., as well as the use of measurements and findings to improve models. Cases will be developed in consultation with national nodes and AnaEE advisory bodies, with the aim to encompass a range of systems, questions and challenges suitable for approaching through the integration of modelling with experimental activities.

Ensuring access to modelling solutions and develop new models

The DMC will facilitate access to two types of national AnaEE Modelling Platforms including Modelling Solution Platforms (around a well-established and supported model), and Model Factory Platforms (an advanced facility offering access to models, model development tools and integrated simulation facilities to its users). The DMC will grant access to recognized process-oriented and other models corresponding to key aspects of ecosystems complexities. Model factories will provide tools to enable the composition of new models through user-friendly linking model components.

2.3 WP23 Technological developments



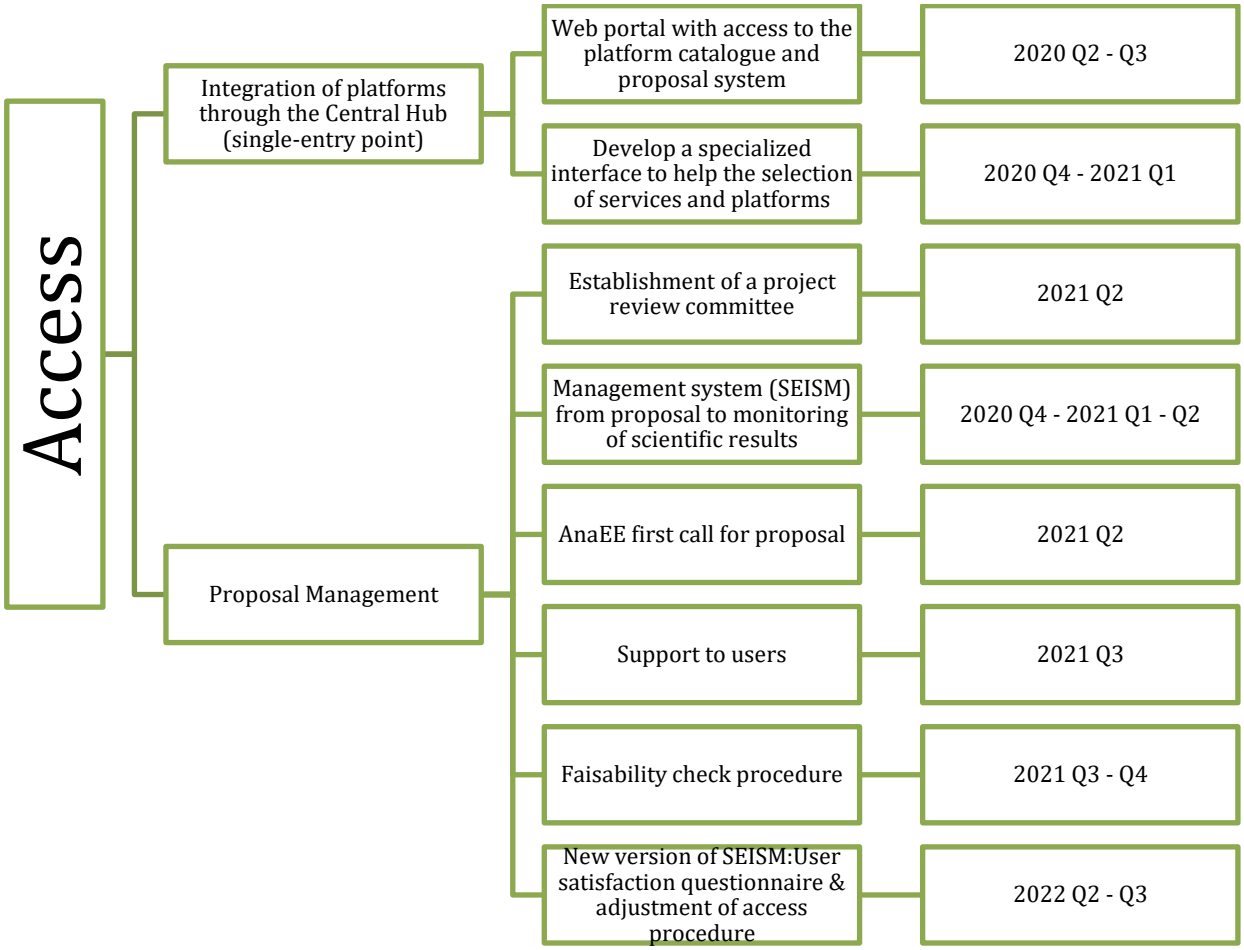
R&D: Develop and deploy new technologies to keep the platforms at the state-of-the-art

It is of paramount importance to keep platforms at the best state of the art level. R&D actions should be performed by TC to identify new instrumental avenues, and new needs. DMC can help in this process by implementing signal analysis treatment to identify biases and spurious data. This can be done, e.g. thanks to the use of AI, or other promising methods.

Technology foresight workshops will bring together TWGs, relevant industries and specialists upstream of the instrumentation used in AnaEE platforms (physics, chemistry, ITC) or other disciplines where such instrumentation is further developed (medicine, high energy physics, space science). Together, they will determine which new technology to develop or adapt to the needs of ecosystems science.

2.4 WP24 Platform Access & TNA

WP Leader: CH (Single-entry point)
Participants: TC (technical access) DMC (Data access), Platforms (technical quality of measurements during the execution of user projects)



Integration of platforms through the central hub

The Central Hub will be the unique point of entry to the AnaEE Research Infrastructure (RI). The hub features a web portal with access to the platform catalogue, the service catalogue, and a specialized interface to help the selection of services and platforms; users will also enter their proposal through the portal, which will be also the single-entry point to get the data from the platforms.

The AnaEE web portal provides a single-entry point to all platforms as well as administrative support to ease the access. The web portal contains a service catalogue including the main features of each platform and information about on-going research activities as well as the primary results that have been generated. It also contains a search algorithm allowing identifying the relevant platforms for specific research topics according to metadata collected by the AnaEE Technology Centre. Central Hub is in charge of the web portal management.

Proposal management

The AnaEE user project procedure follows user projects from the time of the first submission of a pre-proposal via the web portal until final project termination. The procedure is designed to ensure maximum scientific and technical quality of user projects, as well as project reporting to AnaEE and facilitation of open access to project data after potential grace period following project termination.

All proposals related to trans-national access (TNA), will be managed by AnaEE; for AnaEE, TNA is understood as the access by a user team that is not a national user from the country of the platform, or, projects that involve platforms located in different countries members of AnaEE.

Central Hub will set up a project review committee that will provide expert feedback and review for potential improvements of the project proposal to maximize novelty and efficient overall usage of platform services and expertise.
After 2 years of operations, from the survey of the users, PRC, platforms (see WP #4), we will revise the access procedures, especially the software that manages the user proposals and projects.

The compliance checks and evaluation of proposals is at the heart of the AnaEE-ERIC added-value. AnaEE-ERIC has to design and implement efficient procedures to be in position to evaluate new proposals and ensure that their scheduling is made without delay. This need a close collaboration between the ERIC, the Proposal Review Committee, and the platform managers.
The procedures to be implemented are:

- The eligibility check, which should be done without delays. The eligibility includes that the investigator team have provided a compliant DMP, have agreed with the access rules including OA and FAIRness, including also the timely delivery of a short report on results and papers from their research, not forgetting to mention AnaEE as well as the platform they used.
- The feasibility assessment is performed mostly at platform level, and ensure that there is no obstacle to the implementation of the proposal as it is. Problems will be reported to the investigators which will have the opportunity to provide answers, and possibly to adapt their implementation plans. Part of this procedure can be performed during the optimization procedure (see below), under the monitoring of AnaEE and the PRC.
- The independent Proposal Review Committee will be in charge of the scientific and technical evaluation of the proposals. Usual conflict of interest rules will be enforced. AnaEE-ERIC will implement a fast and speedy system to provide the proposal materials to the PRC, and to ensure rapid feedback to the investigators. An appeal procedure will be implemented, in case the review has not followed the standard rules of evaluation.
- Given the potential complexity of proposals, involving platforms in several geographical locations, as well as of different types, the Access Document has made provision for an optimization step in the proposal. This step should be a dialog between AnaEE, the platforms, and the investigators, under the supervision of the PRC (and following its advice), that is intended to enhance the quality of the proposal, the scientific output, and to ease the technical feasibility and implementation. Precise rules should be implemented in order to ensure that the process will be limited in time and results in effective measures.

AnaEE-RI access rules are clear. Access now has to become effective. AnaEE has to present its offer of services to the scientific user community, and beyond that the possible other users, such as the private research groups, and other stakeholder users, as mentioned in the STD. The first step will be to advertise the offer, and provide training, during events that can be organized or not by AnaEE. As an exemple, the AgroECO 2020 conference will feature an AnaEE day (3/12/2020) for that purpose.

AnaEE has also to support users through the proposal evaluation procedure, and more generally, along the project life. This will be the role of dedicated personnel in AnaEE ERIC, and of the platform operators. Effective procedures have to be discussed and written in the SLAs and other documents.

AnaEE will provide support and guidance to scientists upstream of project proposal submissions, particularly young scientists; and acts as a facilitator in the incubation of projects and further features a scientific officer to advise scientists in the preparation of multi-platform projects.

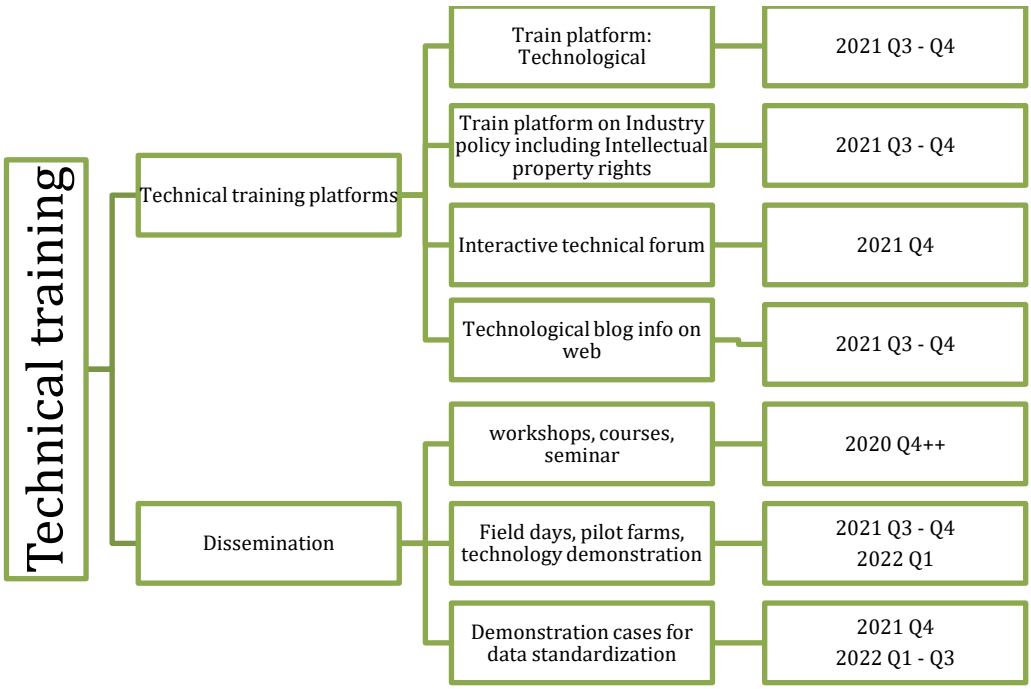
The AnaEE Central Hub will coordinate specific calls in collaboration with the other service centres, platform administrators, the research community and other AnaEE stakeholders, and will assist the application process; and manage and report TNA/VA activities.
AnaEE will follow and communicate on the future EU calls opening (Horizon Europe, Innovation Funds, EGD calls) and all relevant call within the AnaEE network. Depending on the type of call, AnaEE will support consortia either through a direct participation, or by providing advice, quotations, etc.
We will release the first AnaEE call for trans-national proposals in 2021.

3. Work Area 3: Building the user and stakeholder communities

3.1 WP31 Technical Training

WP Leader: TC
Participants: DMC, ISC, Platforms
This WP on Technical Training organizes the training of the platform operators the responsible of platforms, users and possibly staff of the ERIC.

The TC is responsible for coordinating the training of users and platform operators. The TC will help AnaEE platforms to master new techniques and to stay up-to-date with cutting-edge technologies leading to new understanding of processes.



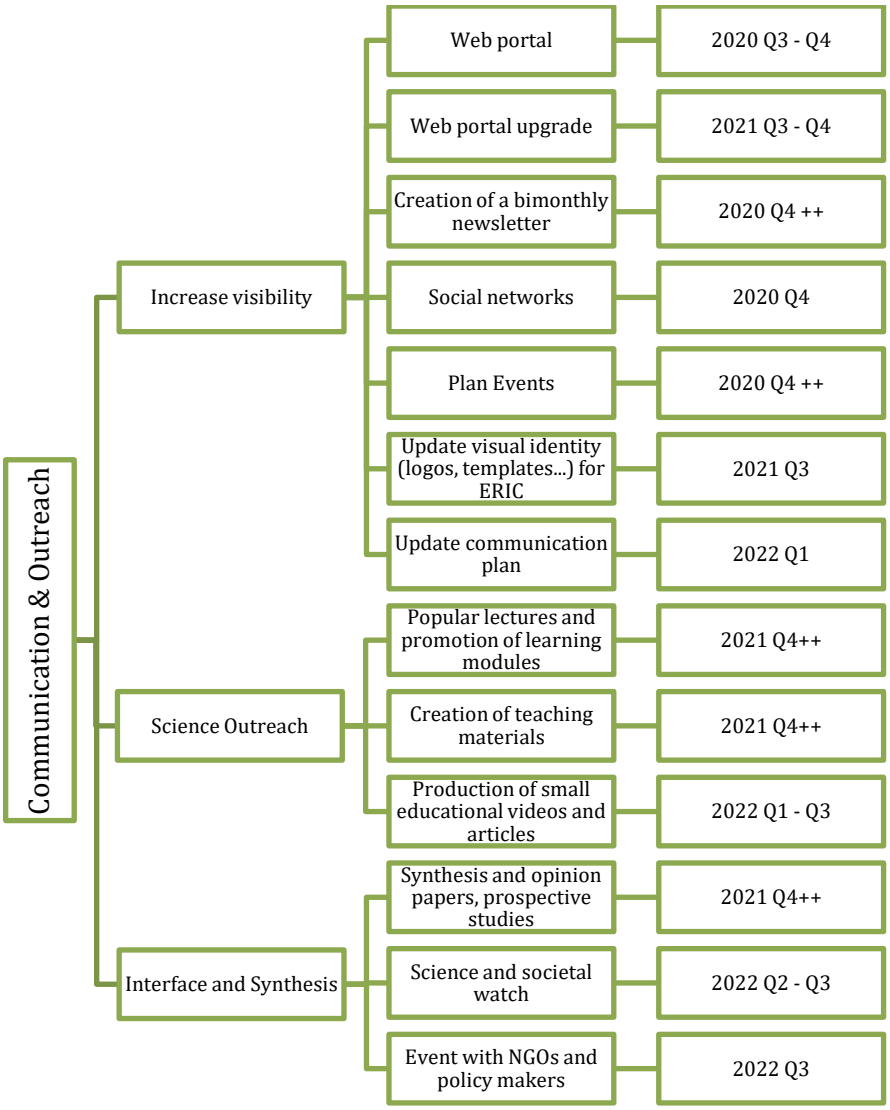
Help AnaEE platforms to master new techniques and stay up-to-date
The TC will organize training sessions for the users, either scientific or industrial. Training sessions will include theoretical and practical workshops, seminars, or intensive courses. Training activities will primarily target AnaEE platform personnel. Platform managers will be trained in industry policy, with particular emphasis on Intellectual Property Rights policy.
The TC will continuously feed the Technology section of the AnaEE portal. The portal will feature the list of the TWG, their respective activities, and reports (for the public part). It will make widely available AnaEE standards and recommended protocols, calibration procedures, cross-calibrations

and reference sensors information. The interactive technical forum will facilitate exchanges between platform personnel so that partner companies and scientists may compare demand and the availability of technical solutions.
Specific attention will be paid to the training of users on combining the models and experiments, as well as on the use of new multifactorial statistical tools that will provide a significant shift in the interpretation of large datasets obtained from join multiplatform experiments. The target audience for such training will be platform managers, PhD students and early-career researchers.
Finally, training will also be conducted on the use of the latest analytical approaches in the field of remote sensing, mobile laboratories for the analysis of biogenic volatile compounds, metabolomic, transcriptomic and genomic analyses. The main goal is to present users with the opportunities provided by these analytical approaches for understanding the ecosystem processes or for upscaling of data obtained in experiments. The targeted audience will be similar as in the case of modelling and data processing training.

Dissemination
To this end, technical workshops, demonstrations and practical training events will be organized for small groups of platform managers, technicians, users and early stage researchers. Experimental design, measurements of ecosystem processes and technological equipment will be harmonized. To support this training process, technical notes, manuals and methodological papers will be published to provide users and platform managers with step-by-step support to install and operate the most recent technical equipment. Field days, pilot farms, technology demonstrations, technical workshops will also be organized.
Demonstration cases will be prepared to show ways of using modelling to enhance interpretation, upscaling, design of experimental treatments and measurements. Cases will be developed in consultation with national nodes and AnaEE advisory bodies, with the aim to encompass a range of systems, questions and challenges suitable for approaching through the integration of modelling with experimental activities.

3.2 WP32 Communication & Outreach

WP leaders: ISC & CH
Participants: Platforms, DMC, TC



Increase AnaEE visibility

An attractive and coherent visual identity has been designed for AnaEE, including a logo, templates and all recognizable visual elements associated with AnaEE output, notably products and services devised at platform-level (reports, data, papers, in-house generated technology, etc.). This visual identity, embodied by the AnaEE logo, will be integrated to all presentations, particularly during international conferences and events – or as new developments come to be promoted through the AnaEE website. The visual identity will be updated to reflect the institutional evolution of AnaEE (i.e. ERIC). The leaflet, designed in 2016, will be updated as well.

AnaEE's website showcases the advancement of key projects, provides contact details to all relevant parties, regular news postings and events updates. It is articulated to dedicated social media platforms, which include a Twitter account, a LinkedIn, and a Facebook page, as well as other media in this rapidly evolving sector. An email newsletter in HTML format, is being prepared on a bimonthly basis, to present all project advancements and relevant news to external audiences.

Participation in international conferences plays a key role in disseminating AnaEE planning efforts to all stakeholders, actively promoting the potential of the infrastructure and its services and products portfolio. The tools for conferences and events include:

- A concise A4 brochure, outlining key points of AnaEE.
- A kakemono has been made which is displayed at all major events
- Presentations of AnaEE are requested, e.g. at the EGU assembly.
- Case studies
- A standard PowerPoint presentation (and style) as a base for AnaEE speakers in conferences
- A 4-minute video

Communication with the community will go through the creation of a bimonthly newsletter including case studies, updates on AnaEE projects, EU calls, events calendar, the training of the operators and scientists of the platforms, capacity building and networking, workshops. Discussions will also occur on the occasion of the signature of Service level agreement which will legally bound the platforms and AnaEE.

This external outreach policy will derive further strength from a targeted press relations effort, especially through special reports on key AnaEE publications. Requests from the media will be met with case studies and any appropriate materials, as well as referrals to the relevant AnaEE spokesperson.

AnaEE will strive to enable its funders as well as key external stakeholders to meet with the European Commission and other policy-makers, funding agencies as well as business and civil society funders.

An annual Stakeholder Outreach Day will be organized in conjunction with the Assembly of members. AnaEE will provide key input regarding the development of long-term strategies and policies.

Science Outreach

AnaEE will ensure that students at different levels of education are aware of the production and non-production functions and services provided by ecosystems, with particular respect to their roles in global carbon cycle, climate mitigation and adaptation. To do so, in cooperation with experts in didactics, AnaEE will be involved in creating and publishing motivational teaching materials for elementary and secondary school students.

In order to deliver those messages, AnaEE will produce educational short videos and popularization articles, and will organize workshops and conferences. A web-based educational platform will be developed to demonstrate in a user-friendly way the role of ecosystems in the carbon cycle, nutrient cycling and the importance of individual ecosystem services such as biodiversity, provision of drinking water and others. Field days, pilot farms, technology demonstrations, technical workshops will also be organized.

Interface and Synthesis

Synthesis and opinion papers will be made by ISC as well as expert reports, maps and graphical portals that could be used for example by members in the formation of National climate adaptation plans, and in the development of basic principles, specific measures, support mechanisms and control tools in the implementation of Common agricultural policy on national level.

ISC will organize scientific prospective studies and lobbying for research programs

Major gaps in ecosystem sciences and mobilization of AnaEE platforms will be identified by leading scientists and representatives of international expert panels, such as the IPCC and IPBES. This information will be transferred to research funding agencies by the AnaEE DG together with the head of the Interface and Synthesis Centre, with the assistance of leading scientists.

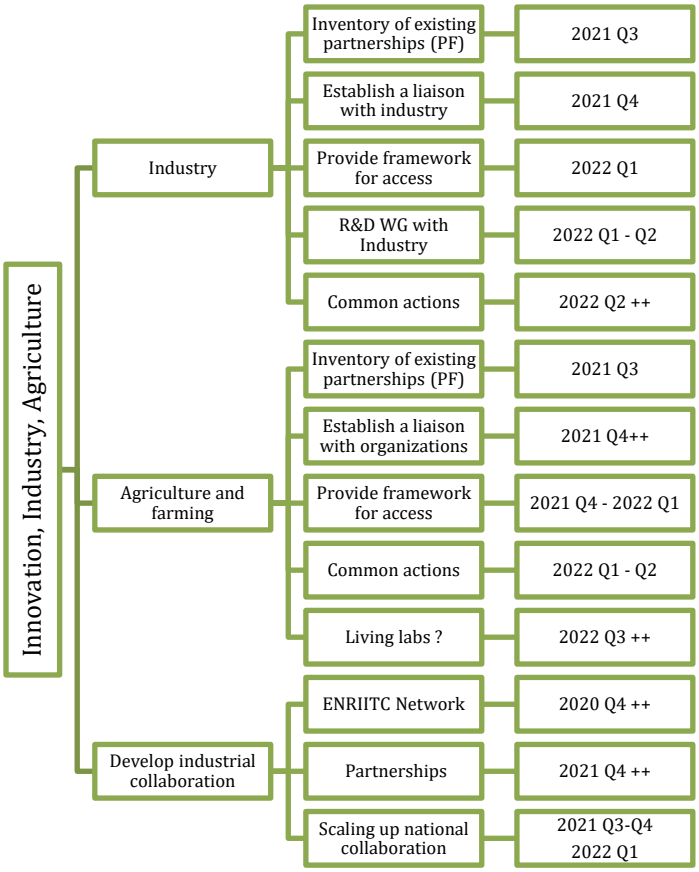
ISC will organize data/knowledge syntheses on specific ecosystem science aspects incorporating AnaEE generated and worldwide published data. One of the first topics to be considered will involve the combined impacts of heat and drought on terrestrial ecosystems.

ISC will be elaborating societal scenarios and innovation needs beyond AnaEE results.

Scenario building requires workshops to be organized with policy-makers, relevant professionals and industries. Opinion/recommendation papers could be outputs of these meetings. Emerging innovative ideas will be shared with the Technology Centre in case new equipment or methodologies could be developed in partnership with industry.

3.3. WP33 Innovation, Industry, agriculture

WP Leader: TC
Participants: Platforms, CH, DMC, ISC



Industry

Beyond academic collaborations, AnaEE, as integrated infrastructure with complementary services for climate change adaptation and mitigation, aims to offer services to industrial partners to find, develop and test adaptation measures applicable at continental level, or also to explore how to adjust them to specific climatic and soil conditions.

The AnaEE Technology Centre is in charge of developing and sharing new technology knowledge within AnaEE. It will connect the scientific demand for new technology related to ecosystem science instruments as well as green economy with the supply of innovative ideas.

Open access to data from AnaEE will provide further opportunities for industry to reuse data and make innovative analyses. AnaEE will also offer a gate for the industry to touch a wider user's community.

The demand driven innovation will be initiated at the technology foresight workshops where the most promising direction for innovative instruments will be determined. Active scouting will be performed to identify components that may fill an empty space in AnaEE technological capacities. The development of new instruments will be done either in national platforms or in partner labs where the technology is mastered and/or jointly with private companies. The technology centre will implement the needed technological developments by establishing contacts between relevant scientists, laboratories and industries, also in other markets and applications. AnaEE will provide a European-wide testbed for external innovations.

Agriculture and farming

As a Research Infrastructure whose aim is to forecast the evolution of ecosystems under the anthropic induced changes, and to propose, or assess, adaptation/mitigation/remediation measures, AnaEE has to establish links with the agriculture and forest management sectors. This will lead to rich exchanges in both direction, and common work.

As many open or enclosed platforms deals already with agriculture and forest management, AnaEE can test new methods, propose avenues for the reduction of the GHG emissions from the agricultural sector, propose also research for Carbon capture in soils, forests, and wetland, management methods for resilience agains pests, etc.

Beside fundamental research, an interesting way for collaborating with the agricultural and farming sector is through living labs, where both parties bring their knowledge and expertise that lead to new innovations and practices.

Develop industrial collaboration

AnaEE also takes part to ENRIITC, an EU-funded project aiming at establishing a European-wide network of industry liaison and industry contact officers to enhance the collaboration between RIs and the industry.

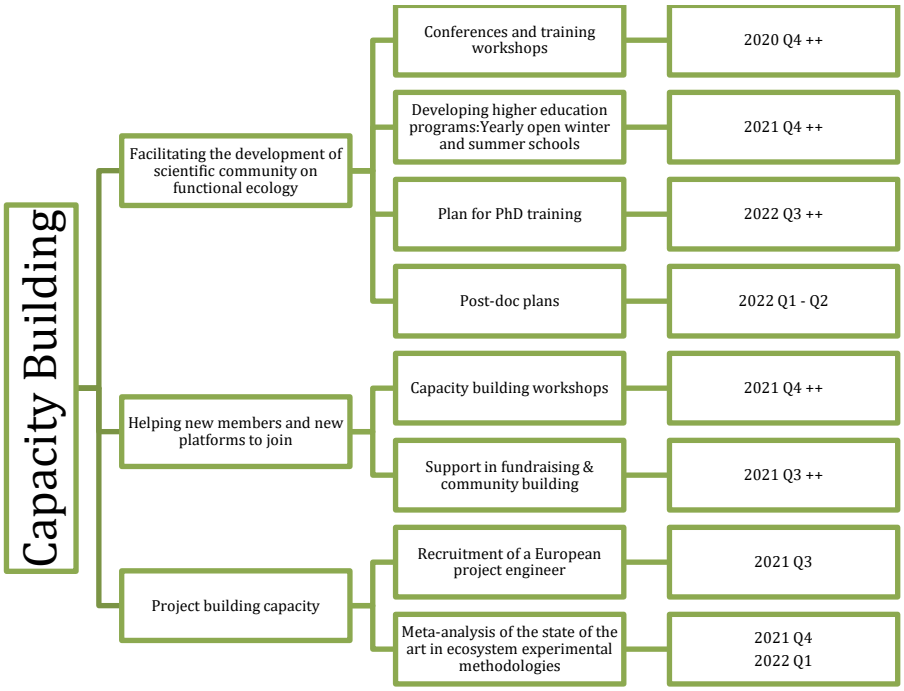
The center will assist AnaEE platforms in supporting innovative local SMEs and start-ups and will take part in negotiating consulting agreements.

AnaEE will work on scaling-up existing national industrial collaboration.

4- Work Area 4: AnaEE in the international research ecosystem

4.1. WP41 Capacity Building

WP Leader: ISC
Participants: Platforms, TC, DMC, CH



Facilitating the development of scientific community on functional ecology
In terms of capacity building, an important part of AnaEE's effort targets scientists and professionals in the fields of agriculture, forestry, water management, food production, remote sensing services, plant and animal breeding, production of instruments, sensors and technology for these sectors - namely people working with ecosystems on a daily basis. Activities are largely based on demonstration and pilot projects and events such as field days, living labs, technology demonstrations, technical workshops that will enable rapid transfer of knowledge into practice, in particular in the field of adaptation measures and technologies, through practical involvement and testing.

From Master to early stage researchers, AnaEE will focus on understanding the role of ecosystems in global biogeochemical cycles and increasing the contribution of ecosystems to mitigate climate change. To achieve this, AnaEE develops a higher education program that will consist of yearly open winter and summer schools for graduate students, early career researchers and professionals across Europe.
The winter or summer schools will be preceded by popular lectures especially for MSc. students focusing on introduction to experimental ecosystem research, its objectives and benefits for the wider society, including the presentation of the services offered by the AnaEE infrastructure for the implementation of Ph.D. projects and for the solutions of student's research questions.
On a longer-term perspective, a PhD school may be developed with partner universities.

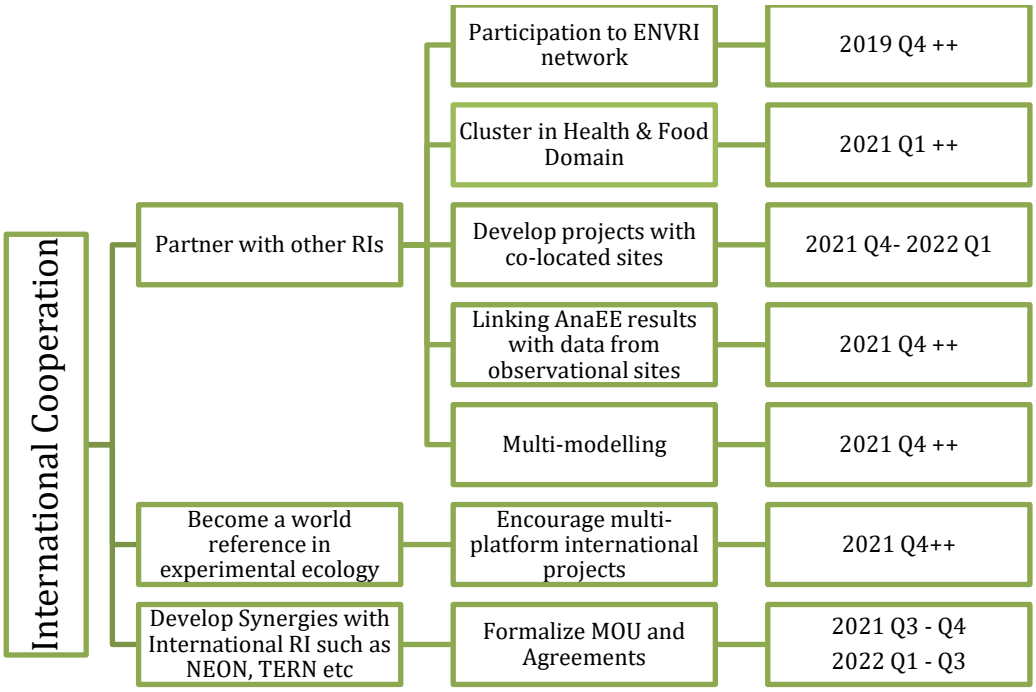
Community and Platform building capacity: helping new members and new platforms to join
AnaEE will provide capacity building to:
Prospective members countries that need to develop a scientific community on functional ecology

Prospective platforms that need to upgrade their facilities to be able to integrate AnaEE.
In the first case, AnaEE will develop partnerships in order to enlarge its community of users and experimental scientists in ecology, and to find the means to upgrade existing facilities or new ones. AnaEE will also offer training and guidance for platforms that need to upgrade facilities and would like to join AnaEE organization.

Project building capacity
A European project engineer will assist academic consortia in preparing proposals. In particular, the ISC will perform a meta-analysis of the state-of-the-art in ecosystem experimental methodologies, and of the services the experimental and analytical platforms provide for users, in order to determine the status of current scientific and technical capabilities. This will be used by AnaEE to help scientists to prepare large-scale projects combining a range of national platforms.

4.2. WP42 International Cooperation

WP Leader: CH
Participants: ISC



Synergies with EU RIs

AnaEE is one of the eight projects on the ESFRI Roadmap for the Health & Food domain. In this context, AnaEE has to develop and strengthen the cooperation with other RIs. AnaEE already displays strong complementarities with ICOS which provides scientific data on carbon cycle and greenhouse gas emissions and LifeWatch which provides access to biodiversity and ecosystem science data and data processing tools.

AnaEE will develop synergies with ACTRICS, DANUBIUS-TI, EMPHASIS, eLTER. To do so, AnaEE is an active participant of ENVRI, the community of environmental infrastructures (ENVRI Plus, ENVRI Fair). One of the first step to cooperation will be to link AnaEE results with data from observational sites across Europe (ICOS, eLTER for example) in order to allow models to be rigorously tested and scaled to larger geographical areas.

On a longer-term perspective SLAs may be signed with selected RIs.

Become a world reference in experimental ecology

There are already international collaborations, but at the moment, international users tend to make a stand-alone use of platforms, while trans-national projects using multiple platforms would create a new scale. What Anaee wants to increase is not only the number but also the scale of trans-national projects, moving from single-platform to multi-platform international projects.

Synergies with non-EU RIs

AnaEE will explore and develop links with international RIs such as NEON in the USA, TERN in Australia. As most of these research infrastructures are observational and provide only punctual activities in experimental ecology, AnaEE will discuss with them, as well as other partners, the possibility to have a network of experimental facilities either as part of an existing network, or following TBD modalities.