ROADMAP 2016

European Strategy Forum
on Research Infrastructures

ESFRI

Research e-Infrastructures
and
e-Infrastructures for Research

Giorgio Rossi, e-IRG workshop, Amsterdam, 9 March 2016

ESFRI

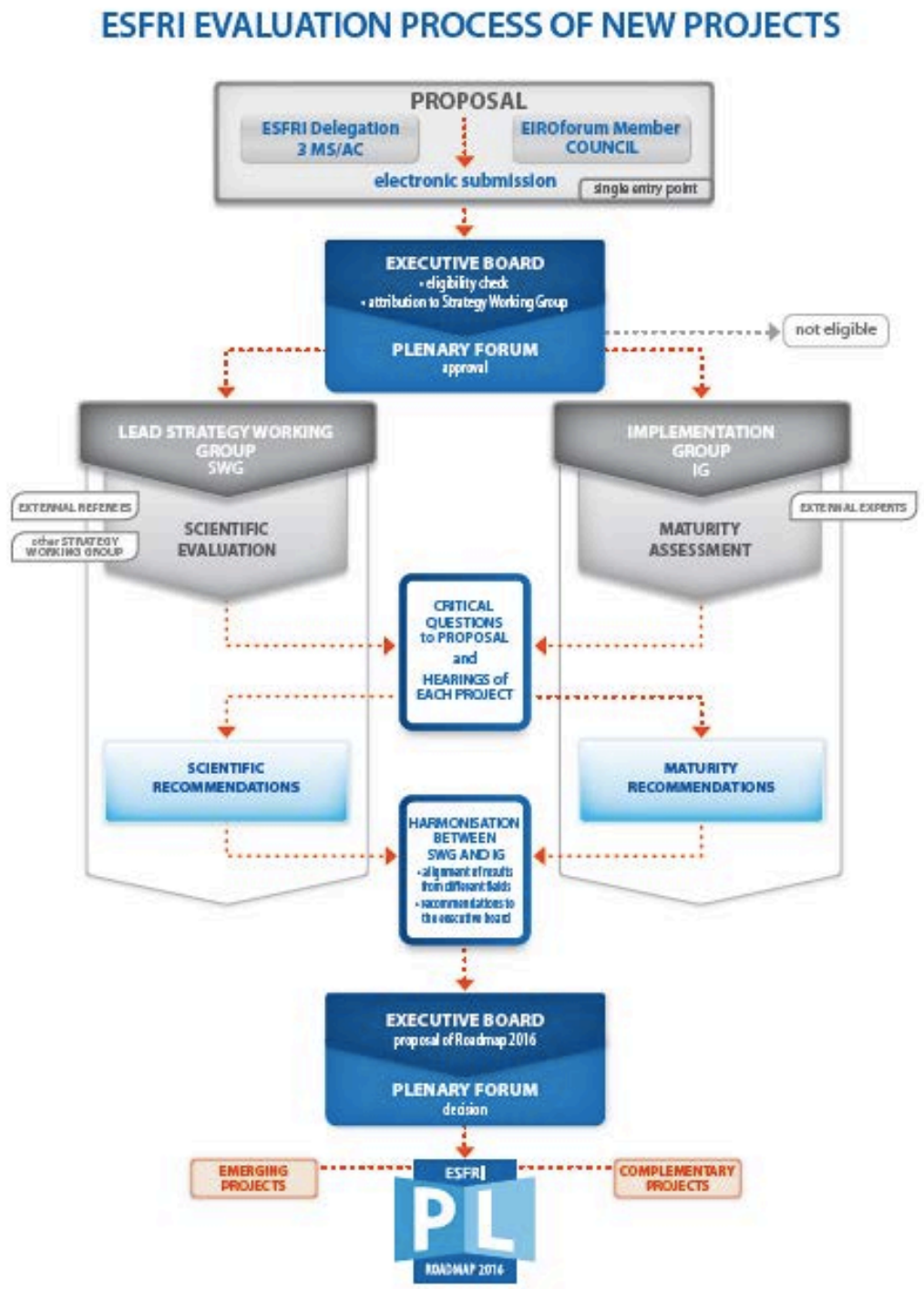
P Projects L Landmarks

ROADMAP 2016

- The Roadmap 2016 identifies 29 Landmarks (2 new) and 21 Projects (6 new)
  - All new entries have been evaluated also for e-needs
  - All the Roadmap Projects are monitored also for e-infrastructure aspects
  - The Landscape Analysis has been carried out for all thematic areas (ENE, ENV, H&F, PSE, SCI) and for the transversal e-INFRASTRUCTURES (provided by e-IRG)

- ESFRI has recently received a specific mandate on optimization of strategy on e-Infrastructure

- The RI system is a test-bed for advanced solutions impacting science and innovation at local, pan-European and global lelevs



The evaluation process for new proposals followed:

Assessed both scientific merit and project maturity:

1) SWG were integrated by e-IRG **experts**

2) IG also considered e-**needs** as elements of organizational and financial plan

3) External referees and hearings

The e-infrastructure aspects, internal to the projects, external, commonalities in the field, interfaces to the e-space were analysed and evaluated as key aspects of the new ESFRI RI Projects, and new ESFRI Landmarks

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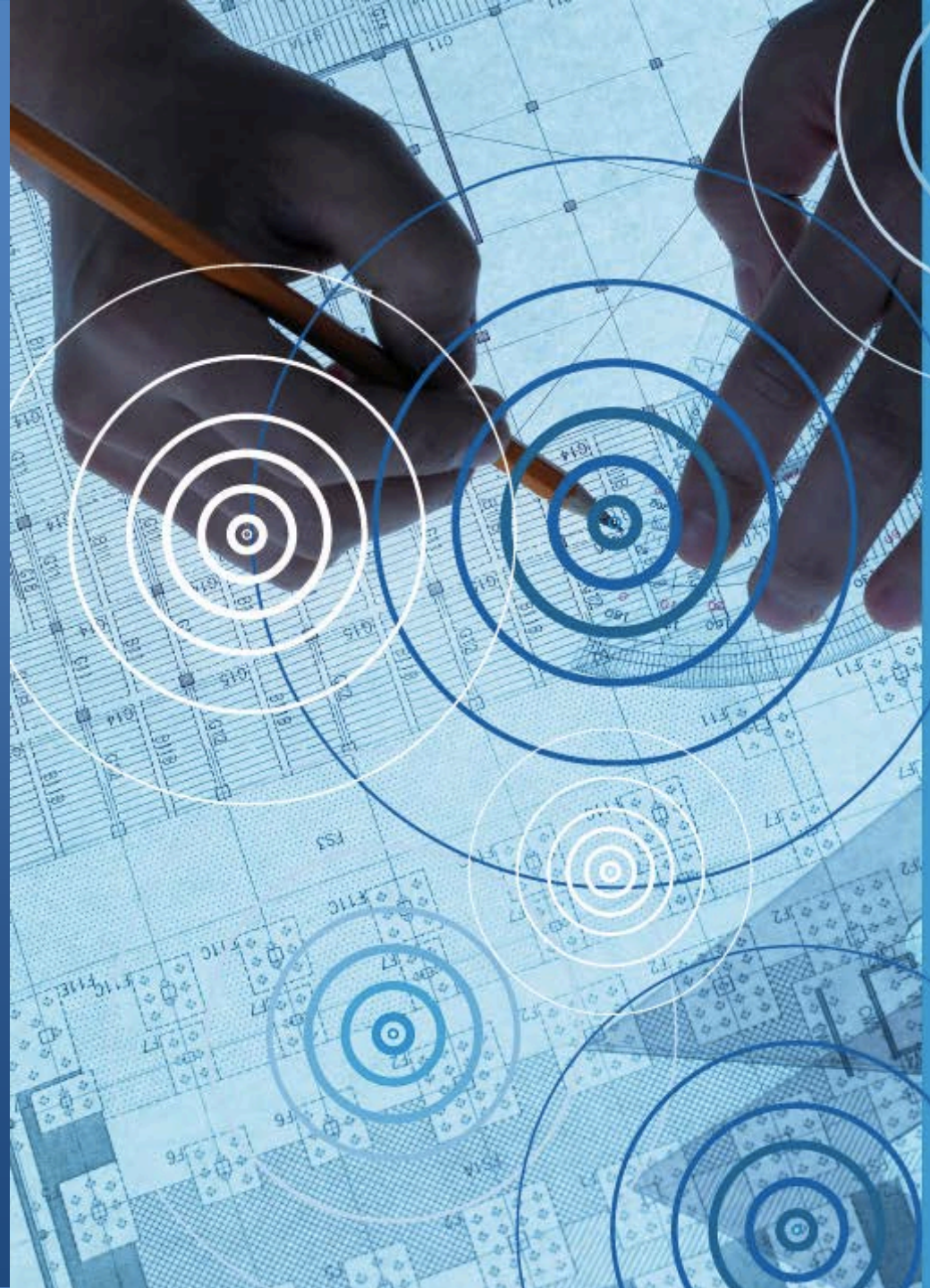
Projects Landmarks

ROADMAP 2016



part 2

ESFRI PROJECTS

The ESFRI Projects listed in **Part 1** are individually described in the following pages. They were selected for scientific excellence and maturity and represent strategic objectives for strengthening the European Research Infrastructure system.

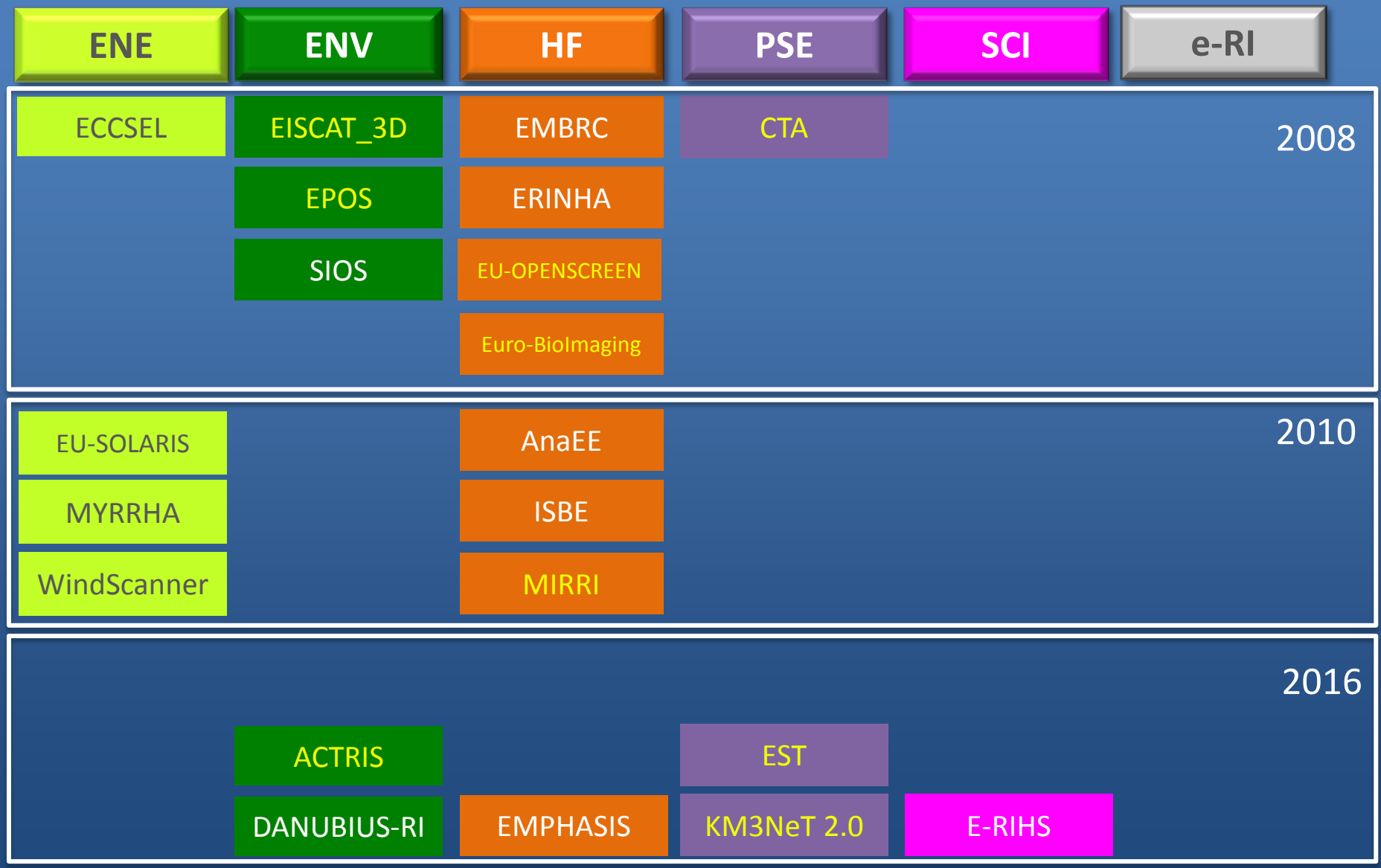
Fifteen projects were listed in previous editions of the ESFRI Roadmap – nine in the 2008 update, and six in the 2010 update. Five new entries and one reoriented project integrate the Roadmap 2016. They were selected among the 20 eligible proposals through the evaluation procedure outlined in **Part 1**.

The ESFRI Projects have a maximum term of "residency" on the Roadmap of 10 years. After that term the fully implemented projects may become Landmarks. Non-implemented projects leave the Roadmap: if desired they can be re-submitted with a revised programme and will compete with other new projects.

21 ESFRI Projects

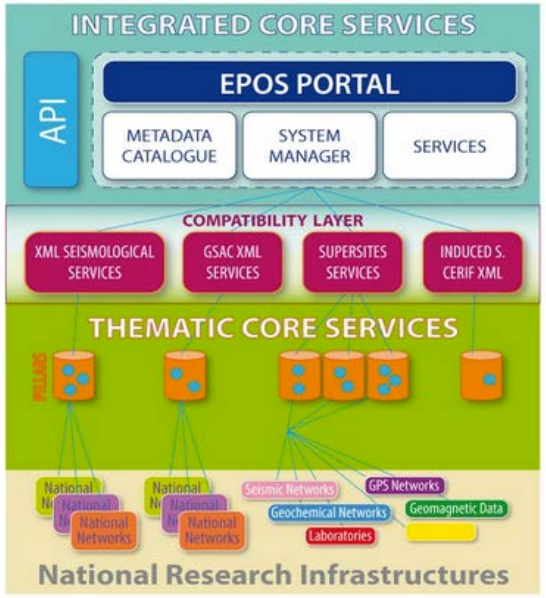
15 + 6 new

Several are Data Intensive Projects with special e-needs



Examples of Data Intensive RI Projects

a complex functional architecture has been designed to enable users to discover and select the data, download or visualize them, and perform processing over distributed resources in Europe. The EPOS functional architecture is composed of three connected technical and organizational elements: *NRIs, TCS, ICS*.



Environment

ESFRI PROJECTS 2

EPOS

European Plate Observing System

A long-term plan for the integration of national and transnational facilities and resources for solid Earth science

Description

The European Plate Observing System (EPOS) aims at creating a pan-European infrastructure to monitor and unravel the dynamic and complex solid Earth System, by integrating the diverse and advanced research facilities and resources for solid Earth science and relying on new e-science opportunities. EPOS will enable innovative multidisciplinary research for a better understanding of the Earth's physical and chemical processes that control earthquakes, volcanic eruptions, ground instability and tsunami as well as the processes driving tectonics and Earth's surface dynamics. Through integration of data, models and facilities, EPOS will allow the Earth science community to make a step change in developing new concepts and tools for key answers to scientific and socio-economic questions concerning geo-hazards and geo-resources as well as Earth sciences applications to environment and to human welfare.

Background

Solid Earth science is concerned with the internal structure and dynamics of planet Earth, from the inner core to the surface; it deals with physical and chemical processes covering wide temporal and spatial scales, from microseconds to billions of years and from nanometres to thousands of kilometres. Integration of data and services from different disciplines in Earth science is an essential step to unravel and monitor these processes with the final goal of forecasting their impact on the environment. Indeed, the solid Earth science community has chosen to establish an all-encompassing framework including all the different solid Earth disciplines: seismology, near-fault observatories, geodetic data and products, volcanic observatories, satellite data and products, geomagnetic observatories, anthropogenic hazards, geological information and modelling, multi-scale laboratories and geo-energy test-beds for low-carbon energy.

EPOS is developing such a holistic, sustainable, multidisciplinary research platform to provide coordinated access to harmonized and quality controlled data from diverse Earth science disciplines, together with tools for their use in analysis and modelling. EPOS brings together 25 European nations and combine national Earth science facilities, the associated data and models together with the scientific expertise into one integrated delivery system for the solid Earth. This infrastructure will allow the Earth sciences to achieve a step change in our understanding of the planet; it will enable us to prepare for geo-hazards and to responsibly manage the subsurface for infrastructure development, waste storage and the use of Earth's resources.

Steps for implementation

The EPOS implementation phase builds on the achievements of the EPOS Preparatory Phase and will last from 2015 to 2019. During this phase two key outcomes will be achieved: the implementation of the community and integrated services – Thematic Core Services (TCS) and Integrated Core Services (ICS) – and the legal establishment of the EPOS European Research Infrastructure Consortium (ERIC). EPOS will build the new research platform by ensuring sustainability, governance and integration within the whole EPOS delivery framework of the community services (TCS), by developing the integrated services (ICS) for interoperability and data management, by creating optimal conditions for the central coordination as well as designing the access to distributed computational resources, and by ensuring long-term financial and legal sustainability through the harmonization of the EPOS research infrastructure with national priorities and strategies.
With an ERIC to be located in Rome (Italy), EPOS will provide an opportunity for Europe to maintain world-leading European Earth sciences and will represent a model for pan-European federated infrastructure.

TYPE: distributed
COORDINATING COUNTRY: IT
PROSPECTIVE MEMBER COUNTRIES:
CH, CZ, DK, EL, ES, FI, FR, IE, IS, IT, NL, NO, PL, PT, RO, SI, SK, TR, UK

PARTICIPANTS: AT, BE, BG, DE, HU, SE

TIMELINE
- ESFRI Roadmap entry: 2008
- Preparation phase: 2010-2014
- Implementation phase: 2015-2019
- Construction phase: 2019-2022
- Operation start: 2020

ESTIMATED COSTS
- Capital value: 500 M€
- Preparation: 4,5 M€
- Implementation: 32 M€
- Construction: 53 M€
- Operation: 15 M€/year

HEADQUARTERS
Istituto Nazionale di Geofisica e Vulcanologia-INGV
Rome
Italy

WEBSITE
http://www.epos-eu.org/

ITALY

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ESFRI

PL Projects Landmarks

ROADMAP 2016

Environment

Ground-based stations to understand past, current and predict future evolution of the atmosphere

ACTRIS

Aerosols, Clouds and Trace gases Research Infrastructure

TYPE: distributed
COORDINATING COUNTRY: FI
PROSPECTIVE MEMBER COUNTRIES: CH, CZ, EL, ES, FI, FR, IT, NL, PL, RO, UK

PARTICIPANTS: BE, BG, CY, DE, DK, EE, HU, IE, NO, SE

TIMELINE
- ESFRI Roadmap entry: 2016
- Preparation phase: 2016-2019
- Construction phase: 2019-2021
- Pre-operation start: 2021
- Operation start: 2025

ESTIMATED COSTS
- Capital value: 450 M€
- Preparation: 6 M€/year
- Construction: 190 M€
- Operation: 50 M€/year

HEADQUARTERS
University of Helsinki and Finnish Meteorological Institute
Helsinki, Finland
&
Consiglio Nazionale delle Ricerche-CNR
Rome, Italy

WEBSITE
http://www.actris.eu

FINLAND

Description

The Aerosols, Clouds and Trace gases Research Infrastructure (ACTRIS) is a distributed infrastructure dedicated to high-quality observation of aerosols, clouds, trace gases and exploration of their interactions. It will deliver precision data, services and procedures regarding the 4D variability of clouds, short-lived atmospheric species and the physical, optical and chemical properties of aerosols to improve the current capacity to analyse, understand and predict past, current and future evolution of the atmospheric environment. ACTRIS serves a vast community of users working on observations, experiments, models, satellite data, analysis and predicting systems and offers access to advanced technological platforms for exploration of the relevant atmospheric processes in the fields of climate change and air quality.

Background

Short-lived atmospheric components – aerosols, clouds, trace gases – have a residence time in the atmosphere from hours to few weeks, which differentiates them from long-lived greenhouse gases. The short lifetimes make their concentrations highly variable in time and space and involve fast processes. They are recognised to be among the most significant anthropogenic pollutants affecting Earth's radiation balance and the largest source of uncertainty in terms of radiative forcing impact. In parallel, short-lived atmospheric compounds have recognized adverse health effects at concentrations typically found across Europe and potentially lead to more than 400.000 premature deaths annually in the EU28. Information on concentrations and distributions of aerosols and trace gases is therefore required to reduce air pollution and related adverse effects on health and ecosystems.
ACTRIS addresses these challenges by operating at National Facilities via a combination of near-surface and remote-sensing systems and include: near-surface measurements of aerosols and short-lived trace gases, vertically resolved measurements of aerosols, vertically resolved measurements of clouds and precipitation, profile and column observations of short-lived trace gases and ancillary measurements of meteorological and radiation quantities. ACTRIS also includes exploratory platforms at the national level. The observation platforms are often components of European or international networks. ACTRIS relies on appropriate Central Facilities – Calibration Centres, Data Centre, Head Office – that ensure compliance with standard operating procedures and/or quality protocols to provide harmonized, reliable, and documented observational data. The data curation and storage services are handled by a dedicated Central Facility, the ACTRIS Data Centre. Central Facilities are fundamental to provide the access to the ACTRIS services, organising the right level of training and education, both within and outside the RI, and delivering tailored services for various users, scientific community, space agencies, COPERNICUS and the private sector.

Steps for implementation

ACTRIS is a new ESFRI project but it results from long-term collaborative work of the atmospheric science community through a series of INFRA projects that started in 2000. ACTRIS complements the environmental research infrastructure as it contributes data and services with its National Facilities and Central Facilities on atmospheric composition changes. Aims of the full implementation plan is to set up a research infrastructure service system for the complex data-stream that starts at the National Facilities and goes through quality screening and higher level data products made available through the data centre, and finally to the repositories that will secure long-term access by a very large community of users, globally. ACTRIS enters now in the preparation phase. The gradual shift towards the construction phase is foreseen in 2019-2021 planning the commissioning phase in 2021-2022. ACTRIS will be fully operational in 2025.

Social & Cultural Innovation

An infrastructure for heritage interpretation, preservation, documentation and management

E-RIHS

European Research Infrastructure for Heritage Science

TYPE: distributed
COORDINATING COUNTRY: IT
PROSPECTIVE MEMBER COUNTRIES: BE, CZ, DE, EL, ES, FR, HU, IT, NL, PT, UK

PARTICIPANTS: BG, BR, CY, DK, IE, IL, PL, SE, SI

TIMELINE
- ESFRI Roadmap entry: 2016
- Preparation phase: 2016-2019
- Construction phase: 2020-2021
- Operation start: 2022

ESTIMATED COSTS
- Capital value: Not Available
- Preparation: 2 M€/year
- Construction: 4 M€ (Central Hub)
- Operation: 5 M€/year

HEADQUARTERS
Proposed in Florence, Italy. To be finalized in the Preparatory Phase with possibly the involvement of ICCROM-International Centre for the Study of the Preservation and Restoration of Cultural Property

WEBSITE
www.e-rihs.eu

ITALY

Description

The European Research Infrastructure for Heritage Science (E-RIHS) will support research on heritage interpretation, preservation, documentation and management. It will comprise: E-RIHS Headquarters and National Hubs, fixed and mobile national infrastructures of recognized excellence, physically accessible collections/archives and virtually accessible heritage data. Both cultural and natural heritage are addressed: collections, buildings, archaeological sites, digital and intangible heritage. E-RIHS will provide state-of-the-art tools and services to cross-disciplinary research communities advancing understanding and preservation of global heritage. It will provide access to a wide range of cutting-edge scientific infrastructures, methodologies, data and tools, training in the use of these tools, public engagement, access to repositories for standardized data storage, analysis and interpretation. E-RIHS will enable the community to advance heritage science and global access to the distributed infrastructures in a coordinated and streamlined way.

Background

Heritage Science has brought about the need of structuring the net of infrastructures operating throughout Europe. Fragmentation, duplication of efforts, isolation of small research groups put at risks the competitive advantage of European heritage science research, promoted so well by the unique cultural heritage. The long-term tradition of this field of research, the ability to combine with innovation, and the integration promoted by EU-funded projects such as EU-ARTECH, CHARISMA and IPERION CH in conservation science, and ARIADNE in archaeology represent the background of E-RIHS.
E-RIHS exploits the synergy of the cooperation among the academy, research centers and cultural institutions. The global lead that the EU holds in this research field, so precariously supported by a combination of national and EU measures, requires a joint and resolved effort. This has been fully recognized by the European Union with the continuous and reiterated support of initiatives aimed at integrating existing Heritage Science infrastructures, as well as, with a focus on Member States' national research programs, the JPI on Cultural Heritage, coordinating efforts of 17 EU national funding bodies supporting heritage science. The enthusiastic reviews of these initiatives testify the success of their action to advance knowledge and to establish a research community, acknowledged as "advanced" in official EU documents concerning conservation, or quickly growing in the field of archaeology as shown by the performance indicators of the relevant project ARIADNE.
This demonstrates beyond any doubt both the scientific and the socio-economic importance connected with Heritage Science: it is a sector and a research community that has achieved the maturity necessary to make the leap towards a permanent European Research Infrastructure that will impact broadly on society and economy.

Steps for implementation

E-RIHS is expected to lead a Preparatory Phase in the years 2016-2019 which will be used to address legal status and governance/management organization. This will lead to application to ERIC (or to other suitable legal form). The establishment of a legal structure and governance and the refinement of the business plan for long-term sustainability will be the three most important deliverables, together with demonstrators of users access as implemented by the consortium availing of the existing infrastructure projects.
Preliminary work will also be done in the framework of the H2020 IPERION-CH project started in May 2015.
E-RIHS will be launched as a stand-alone RI in 2020. Further developments are planned for connecting and including partners and facilities outside EU, and gradually reaching the status of a global distributed research infrastructure.

ESFRI

PL Projects Landmarks

ROADMAP 2016

part 2

ESFRI LANDMARKS

The ESFRI Landmarks listed in **Part 1** are individually described in the following pages. These are former ESFRI Projects that have reached the implementation stage and are now established as major elements of competitiveness of the European Research Area.

Most of the Landmarks were first identified as ESFRI Projects in the Roadmaps 2006 and 2008. Two Landmarks were selected among the 20 eligible proposals through the evaluation procedure outlined in **Part 1** recognizing that their implementation is underway.

The ESFRI Landmarks need continuous support for successful completion, operation and upgrade in line with the optimal management and maximum return on investment criteria. Periodic review of the Landmarks will be carried out by ESFRI in order to verify the continuous fulfilment of the reference role in their respective domains.

29 ESFRI Landmarks

27 + 2 new

Several are leaders in e-infrastructure development

ENE	ENV	H&F	PSE	SCI	e-RI	
JHR	EMSO	BBMRI ERIC	E-ELT	CESSDA	PRACE	
	EURO-ARGO ERIC	EATRIS ERIC	ELI	CLARIN ERIC		
	IAGOS	ECRIN ERIC	European Spallation Source ERIC	DARIAH ERIC		
	ICOS ERIC	INFRAFRONTIER	Eu-XFEL	ESS ERIC		
	LifeWatch	INSTRUCT	FAIR	SHARE ERIC		
		ELIXIR	ILL			
			SKA			
			SPIRAL2			2006
			EMFL			2008
			ESRF-EBS			
			HL-LHC			2016

Examples of Data Intensive Landmarks

HPC sustainable strategy

The top level of the European High Performance Computing ecosystem

PRACE

Partnership for Advanced Computing in Europe

TYPE: distributed
COORDINATING ENTITY: PRACE-AISBL

PARTICIPANTS: AT, BE, BG, CH, CY, CZ, DE, DK, EL, ES, FI, FR, HU, IE, IL, IT, LT, NL, NO, PL, PT, RO, SE, SI, SK, TR, UK

TIMELINE
- ESFRI Roadmap entry: 2006
- Preparation phase: 2010–2013
- Construction phase: 2011–2015
- Operation start: 2010
- Legal status: AISBL, 2010

ESTIMATED COSTS
- Capital value: 500 M€
- Operation: 120 M€/year

HEADQUARTERS
PRACE-AISBL
Brussels
Belgium

WEBSITE
http://www.prace-ri.eu/

Description

The Partnership for Advanced Computing in Europe (PRACE) is a pan-European supercomputing RI providing access to computing and data resources and services for large-scale scientific and engineering applications at the highest performance level.

It enables high impact scientific discovery and engineering research and development across all disciplines by offering world-class computing and data management resources and services through a peer-review process. PRACE also seeks to strengthen the European users of High Performance Computing (HPC) in industry through various initiatives. PRACE has a strong interest in improving energy efficiency of computing systems and reducing their environmental impact.

PRACE is established as an International not-for-profit Association under Belgian Law (AISBL) with seat in Brussels. It has 25 member countries whose representative organizations create a pan-European supercomputing infrastructure. A total of six supercomputers and their operations accessible through PRACE are provided by four hosting members – France, Germany, Italy and Spain.

Activity

The four hosting members – BSC representing Spain, CINECA representing Italy, GCS representing Germany and GENCI representing France – committed a total funding of 400 million € for the initial PRACE systems and operations. In pace with the needs of the scientific communities and technical developments, systems deployed by PRACE are continuously updated and upgraded to be at the apex of HPC technology. Currently, the Fourth PRACE Implementation Phase is coordinated by Forschungszentrum Jülich (DE). PRACE-4IP is designed to start new innovative and collaborative activities including: assisting the transition to PRACE 2, strengthening the internationally recognized PRACE brand, preparing strategies and best practices towards Exascale computing, coordinating and enhancing the operation of the multi-tier HPC systems and services and supporting and educating users to exploit massively parallel systems and novel architectures. PRACE is evolving from the business model used in the initial period (2010–2015) that deployed the existing petaflop/s systems made possible by the strong engagement of four hosting partners towards a long-term sustainable configuration that will promote and consolidate Europe's leadership in HPC applications. The novel application codes for PRACE need to prepare for future system architecture embodied in accelerators or co-processors, by investigating new programming tools and developing suitable benchmarks. PRACE Advanced Training Centres (PATCs), target both the academic and industrial domains aiming to increase European human resources skilled in HPS applications. New services are being developed, including "urgent computing", the visualization of extreme size computational data, and the provision of repositories for open source scientific software libraries. Links will be strengthened with other international e-Infrastructures and Centres of Excellence. Energy-efficiency and lower environmental impact throughout the life cycle of Exaflop/s HPC RIs and best practices for prototype planning and evaluation are being addressed.

Impact

European scientists and engineers need to exploit more broadly high-end HPC and connection with many ESFRI RIs is to be strengthened to maximize the impact on the ERA and on broad applications in industry and services. PRACE actively interfaces with XSEDE – the Extreme Science and Engineering Discovery Environment (USA), RIKEN (Japan) and Compute Canada, and also with GÉANT – the pan-European data network for the research and education community, EGI – the European Grid Infrastructure, EUDAT– the European data infrastructure and HBP – the Human Brain Project.

PRACE-AISBL

ESFRI

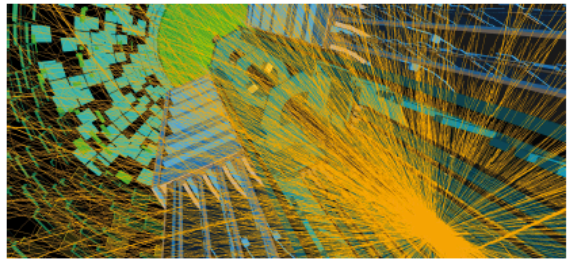
P Projects L Landmarks

ROADMAP 2016

HL-LHC

High-Luminosity Large Hadron Collider

An upgrade of the highest-energy particle collider in the world for exploring new physics



TYPE: single-sited
COORDINATING ENTITY: CERN
MEMBER COUNTRIES: AT, BE, BG, CH, CZ, DE, DK, EL, ES, FI, FR, HU, IL, IT, NL, NO, PK, PL, PT, RO, RS, SE, SK, TR, UK

PARTICIPANTS: See
ACCELERATOR COLLABORATION
ATLAS COLLABORATION
CMS COLLABORATION

Description

The Large Hadron Collider (LHC) at CERN is the highest-energy particle collider in the world. The ATLAS and CMS experiments at the LHC have provided the breakthrough discovery of the so-called Higgs boson. This discovery is the start of a major programme to measure this particle's properties with the highest possible precision for testing the validity of the Standard Model and to search for further new physics at the energy frontier. To extend its discovery potential, the LHC will be upgraded to High-Luminosity LHC (HL-LHC).

The HL-LHC will be implemented over the next decade in order to increase the data sample for ATLAS and CMS by an order of magnitude compared to the integral collected by the end of 2022. For the full development of the physics programme also the experiment's detectors require upgrade as well as the computing infrastructure that will need to handle the substantially increased data rates. The full exploitation of the LHC, including the HL-LHC, was identified as the highest priority for European particle physics, in the update of the European Strategy for Particle Physics approved by CERN Council in May 2013. This recognition has also been adapted in the National Roadmaps of countries all over the world including the USA.

Activity

The accelerator and experimental systems for the HL-LHC project will take a decade to complete. The HL-LHC accelerator relies on a number of innovative technologies including a combination of cutting-edge superconducting magnets, ultraprecise superconducting RF cavities for beam rotation, as well as high-power superconducting links with zero energy dissipation. In addition, the higher luminosity sets novel constraints on vacuum, cryogenics and machine protection, and will require new concepts for beam collimation and diagnostics to maximize the physics output of the collisions. The success of experiments at the HL-LHC relies on innovative instrumentation (radiation-hard detectors, high-granularity calorimeters, and large-area silicon trackers), state-of-the-art infrastructures and large-scale data-intensive computing.
The main physics goals are clear. The first goal is to push further the validation of the Standard Model at the energy frontier, in particular by measuring the properties of the newly discovered Higgs particle and of the longitudinal components of the massive vector bosons with the highest possible precision, and with the aim of establishing whether there are any deviations from the Standard Model predictions. The second goal is to check whether the Higgs particle is accompanied by other new particles at the TeV energy scale, which could play a role in the global picture of electroweak symmetry-breaking or in the solution of the dark matter puzzle.

Impact

The LHC is a unique international infrastructure to study the fundamental constituents of matter and their interactions. The HL-LHC is an upgrade to this already existing facility which will allow the full exploitation of its scientific potential. It defines a long-term programme for at least the next two decades until 2035. The scientific community at CERN consists of over 11.500 users from around the world, the significant majority of whom work on the LHC.
The HL-LHC and its surrounding facilities will require a constant stream of supplies and services. These include civil engineering work and the systems and equipment needed to build and operate the accelerator and the experiments. The HL-LHC will collaborate with many types of industries and businesses to pursue its goals. Knowledge and technology to be developed during the HL-LHC project will make a lasting impact on society. Many young physicists and engineers trained during the project will transfer their expertise to society and industry. The HL-LHC is for all the three aspects – accelerator, detector and computing – a major upgrade of LHC of CERN and will impact the corresponding technologies that are of quite general relevance for other research infrastructures and for the big data and computing paradigm.

TIMELINE
- ESFRI Roadmap entry: 2016
- Preparation phase: 2014-2017
- Construction phase: 2017-2025
- Operation start: 2026

ESTIMATED COSTS
- Capital value: 1.370 M€
- Operation: 100 M€/year

HEADQUARTERS
CERN
Geneva
Switzerland

WEBSITE
http://home.cern/

CERN

Examples of Data Intensive RI Projects:

Detector Front End: efficient trigger and DAQ systems

Offline: World Wide LHC Computing Grid

Skills retention. (www.hepsoftwarefoundation.org)

Cost/Sustainability : 100 MCHF/year (in-kind WLCG MoU)

Model: a hybrid model with a mix of public and private (commercially procured) resources. (Test: HNSciCloud EC funded PCP project at the 5% level of today's WLCG.

Open access: Data from LHC experiments (year 2010) already made publicly available

ESFRI

P Projects L Landmarks

ROADMAP 2016

Examples of Data Intensive RI Projects:

ESRF EBS will lead to higher yield of thick-data (e.g. CDI images)

Real Time Analysis: The IT infrastructure needs to enable assessing data quality in quasi real-time and first data reduction and analysis synchronously with the experiments

On-line data visualisation: first analysis will allow to store only useful data

Offline: Advanced data analysis services and reduction to transportable formats

Storage: Data will be stored on-site in a High Performing Computing environment providing local and remote access for typically up to one year, and on robotic tape media for longer-term access and archival

Broader community: strong collaboration among all European light and neutron sources

"cloud infrastructure" and "data analysis as a Service" : PaNDaaS

ESRF UPGRADES

Phase II: Extremely Brilliant Source

A unique Synchrotron Radiation Facility to the benefit of science and innovation in condensed and living matter fields

TYPE: single-sited
COORDINATING ENTITY: ESRF
MEMBER COUNTRIES: BE, CH, DE, DK, ES, FI, FR, IT, NL, NO, RU, SE, UK

PARTICIPANTS: AT, CZ, HU, IL, PL, PT, SK, ZA

TIMELINE
- ESFRI Roadmap entry: 2006, 2016
- Preparation phase: 2012-2015
- Construction phase: 2015-2022
- Operation start: 2022

ESTIMATED COSTS
- Capital value: +150 M€
- Operation: 82 M€/year

HEADQUARTERS
European Synchrotron Radiation Facility-ESRF
Grenoble
France

WEBSITE
http://www.esrf.eu

Description

The European Synchrotron Radiation Facility (ESRF) is the world-leading source of synchrotron X-rays operating 43 beamlines with state-of-the-art instrumentation for imaging and studying the structure of matter at the atomic and nanometric scale in all fields of research: it is a truly European facility and a key component of the ERA. The ESRF initiated an Upgrade Programme in 2009, and has completed the initial phase with 19 new and rebuilt beamlines, mostly in the domain of imaging and structural studies, enabling a 3 orders of magnitude gain in performance of X-ray microscopy and imaging experiments.

The ESRF-EBS is the new planned major upgrade project (~150 M€; 2015-2022). Centred on rebuilding the ESRF storage ring by adopting an all-new hybrid multi-bend achromat lattice design, it will deliver unprecedented source brilliance and coherence (~100x). The EBS project also includes the construction of four new state-of-the-art beamlines, a scientific instrumentation programme with ambitious detector projects and a data management and analysis strategy. An instrumentation upgrade is also planned for some more beamlines including the "national beamlines" operated by Collaborating Research Groups. Due to the very high brilliance of the EBS, methods developed also at Free Electron Laser (FEL) facilities, such as serial crystallography, will be used in the new experimental infrastructures, thus expanding the capabilities for structural biology and material science in Europe.

Activity

The ESRF started operations in 1994 and construction was completed in 1998. Every year, more than 8,000 scientific users across all disciplines of natural sciences use the ESRF and their work generates ~2.000 peer-reviewed publications annually. ESRF has delivered up to now ~254.000 instrument-shifts (i.e. ~17.000 8-hour-shifts per year). Approximately 98% of the beam time at the ESRF is granted through peer-reviewed scientific excellence based access and 2% is acquired for proprietary research. Approximately 30% of all projects submitted to the ESRF involve innovation/industrial technology developments. A transparent scheme monitors beam time distribution among the scientists' countries and aims for a "juste retour" with respect to the shareholders' contributions.
A programme of continuous review and upgrade or replacement of beamlines has been implemented since the beginning. The ESRF provides scientific support to users and carries out the necessary research and development work in synchrotron techniques enabling, among others, Nobel Prizes in Chemistry in 2003, 2009 and 2012. The ESRF has created, together with the ILL and EMBL, a hub of excellence that has stimulated co-location of specialist laboratories such as the Institute for Structural Biology, the Partnership for Structural Biology, the Partnership for Soft Condensed Matter and Industrial research collaborations.

Impact

The new ESRF-EBS will enhance the ESRF's impact on science and on partner countries. After a shutdown in 2018-2020, the ESRF-EBS will be the global reference for at least one more decade. Services and contracts placed by the ESRF in member and associated states help secure follow-on industrial benefits. The engineering challenges of the ESRF-EBS will boost industrial capacity in areas such as magnet and detector technology, nano-manipulation, control systems, vacuum technology, precision mechanics and high power radiofrequency technology for accelerators. Developments in data management, analysis tools and open access repositories will further impact science and technology at European and global levels with an impact in the broader field of analytical science and facilities. It is therefore vital that the ESRF continues to be supported to carry on these capabilities as a driving force in the ERA.

ESRF

ESFRI

Projects Landmarks

ROADMAP 2016

LifeWatch

e-infrastructure for Biodiversity and Ecosystem Research

An e-Infrastructure to support research for the protection, management and sustainable use of biodiversity

TYPE: distributed
COORDINATING COUNTRY: ES
PROSPECTIVE MEMBER COUNTRIES: BE, EL, ES, IT, NL, PT, RO

PARTICIPANTS: FI, FR, HU, NO, SE, SI, SK

TIMELINE
- ESFRI Roadmap entry: 2006
- Preparation phase: 2008-2011
- Construction phase: 2011-2016
- Operation start: 2016

ESTIMATED COSTS
- Capital value: 66 M€
- Operation: 10 M€/year

HEADQUARTERS
Statutory Seat: ES
Common facilities: ES-IT-NL

WEBSITE
http://www.lifewatch.eu

Description

The e-Infrastructure for Biodiversity and Ecosystem Research (LifeWatch) is a distributed RI to advance biodiversity research and to address the big environmental challenges and support knowledge-based strategic solutions to environmental preservation. This mission is achieved by providing access to a multitude of data sets, services and tools enabling the construction and operation of Virtual Research Environments.

Activity

LifeWatch is an e-Infrastructure of distributed nature, composed by Common Facilities and other Distributed LifeWatch Centres.
Common Facilities are located in Spain (Statutory Seat and the ICT e-Infrastructure Technical Offices), Italy (Service Centre) and The Netherlands (Virtual Laboratories and Innovations Centre).
The *Statutory Seat and the ICT e-Infrastructure Technical Offices* will jointly assist to the coordination and management of the day-to-day institutional relationships, administrative, legal, and financial issues. Those include, among others, technology transfer, procurement and IPR matters, and the formal agreements with all the external data and e-Services suppliers, and the Service Legal Agreements (SLA) with local, regional, national and international entities, including decision makers and environmental managers. Also, they will coordinate and manage the ICT e-Infrastructure distributed construction, maintenance and deployment operations, including coordination of the design and implementation of e-Services demanded by the Service Centre, the Virtual Laboratories and Innovations Centre, as well as other Distributed Facilities.
The *Service Centre* will provide the interface with the Biodiversity Scientific Community, identify the needs of the multiple users groups from different domains and areas of interest and coordinate the development and operation of those Services related. Also, they will assist in deploying the Services provided by the LifeWatch Research Infrastructure, including those enabling discovery, visualization, and download of data and applications for analysis, synthesis and modelling of Scientific topics. Thus the Service Centre will identify new data resources, incorporate vocabularies, semantics and Services to aggregate larger typologies of data. It will also provide the optimization of the access and use of Service Centre facilities as a whole, and offer web-based tools to facilitate Social Networking and Social Learning (including e-Learning). Finally it will promote the awareness of LifeWatch for users and general public, and the enhancing the visibility of LifeWatch scientific outcomes, by publicizing and disseminating them.
The *Virtual Laboratories and Innovations Centre* will coordinate and manage the requirements and needs analysis, design and implementation of the scientific case studies and productions of the LifeWatch Virtual Laboratories. These e-Labs will be implemented and deployed through the LifeWatch ICT distributed e-Infrastructure facilities, and made accessible through the Service Centre to the Biodiversity Scientific Community. This procedure will guarantee the overall coherence of the Research Infrastructure by promoting synergies in regards to the semantic interoperability among data, services and their final users.
Distributed Facilities - Member countries of the LifeWatch ERIC and scientific networks are encouraged to establish LifeWatch Centres to serve specialized facilities in the framework of the LifeWatch services, in accordance with it overall architectural scheme.

Impact

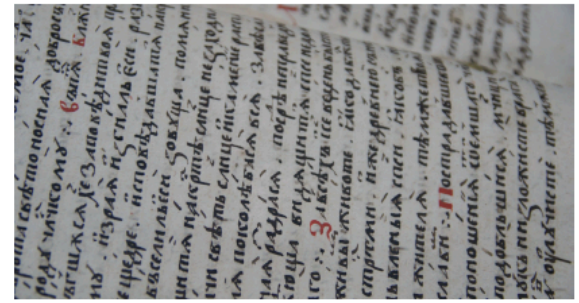
LifeWatch will allow its users to enter new research areas supported by its e-Infrastructure, which represents a structuring tool for the ERA and a significant progress at international level. It will build capacity to foster new opportunities for large-scale scientific development; to enable accelerated data capture with new technologies; to support knowledge based decision making for the management of biodiversity and ecosystems; and to support training programs.

SPAIN

DARIAH ERIC

Digital Research Infrastructure for the Arts and Humanities

A network to enhance and support digitally enabled-research and teaching across the humanities and arts



TYPE: distributed
COORDINATING COUNTRY: FR
MEMBER COUNTRIES: AT, BE, CY, DE, DK, EL, FR, HR, IE, IT, LU, MT, NL, RS, PL, PT, SI

PARTICIPANTS: ES

TIMELINE
- ESFRI Roadmap entry: 2006
- Preparation phase: 2008-2011
- Construction phase: 2014-1018
- Operation start: 2019
- Legal status: ERIC, 2014

ESTIMATED COSTS
- Capital value: 4,3 M€
- Operation: 0,6 M€/year

HEADQUARTERS
DARIAH ERIC
c/o TGIR Huma-Num
Paris
France

WEBSITE
http://www.dariah.eu

Description

The Digital Research Infrastructure for the Arts and Humanities (DARIAH) aims to enhance and support digitally-enabled research and teaching across the humanities and arts. DARIAH is a network of people, expertise, information, knowledge, content, methods, tools and technologies from various countries that develops, maintains and operates an infrastructure in support of ICT-based research practices and sustains researchers in using them to analyse and interpret digital resources. By working with communities of practice, DARIAH brings together individual state-of-the-art digital arts and humanities activities and scales their results to a European level. It preserves, provides access to and disseminates research that stems from these collaborations and ensure that best practices, methodological and technical standards are followed.

DARIAH-EU has been established as a European Research Infrastructure Consortium (ERIC) on August 2014 to facilitate the long-term sustainability for the European arts and humanities research community and beyond.

Activity

DARIAH integrates national state-of-the-art digital arts and humanities activities across Europe, and enables new kinds of transnational research in the arts and humanities using digital means. It will operate through its European-wide network of Virtual Competency Centres (VCCs). Each VCC is cross-disciplinary, multi-institutional and international and centred on a specific area of expertise: i) the e-Infrastructure, to establish a shared technology platform for arts and humanities research; ii) the Research and Education Liaison, to expose and share research and education work in the digital humanities; iii) the Scholarly Content Management, to facilitate the exposure and sharing of scholarly content; iv) Advocacy, Impact and Outreach to interface with key influencers in and for the arts and humanities.
DARIAH has over 20 dynamic working groups to integrate national services under specific operational categories. DARIAH is advising and supporting for preservation and curation of digital arts and humanities research collections with a focus on particular challenges including diversity, provenance, multimedia collections and granularity. It promotes the further development of research methods in the digital arts and humanities by delivering use-case focussed provision as well as documenting what is state-of-the-art in the field. A core component of DARIAH is community integration and coordination; it provides seminars and also research and education activities such as summer schools. DARIAH undertakes horizon-scanning work with specific scientific themes annually on emerging topics such as Open Humanities and Big Data.

Impact

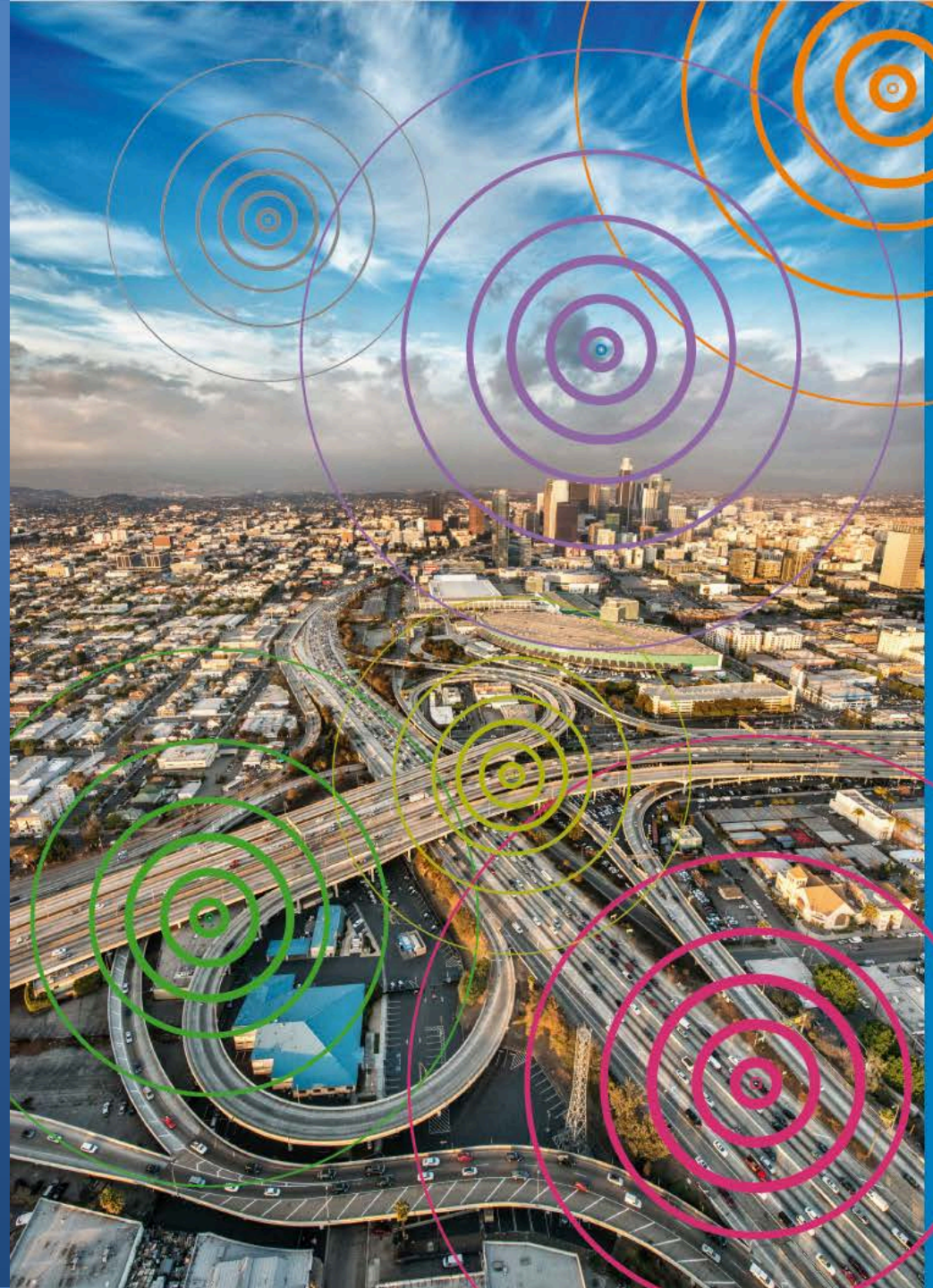
DARIAH has impact on three interconnected domains: research, education and economy. The consortium supports the sustainable development of digitally enabled research in the arts and humanities by building services for researchers working with ICT-based methods. It helps them to further advance their research and ensures the long-term accessibility of their work, thus directly contributing to the understanding of the cultural, economical, social and political life in Europe and beyond. In addition, it offers teaching material as well as teaching opportunities to develop digital research skills.
DARIAH will have impact on the existing knowledge discovery market. The consortium possesses significant strength in this field through its academic partners (CNRS, DANS-KNAW). DARIAH will also demonstrate how traditional humanities research skills play a prominent role in the digital age, and how such skills can be deployed in a commercial setting. Within the scope of its Humanities at Scale project, DARIAH will set up an Innovation Board to develop this facet of its activity.

FRANCE

ESFRI

PL Projects Landmarks

ROADMAP 2016



Part 3

PL

LANDSCAPE ANALYSIS

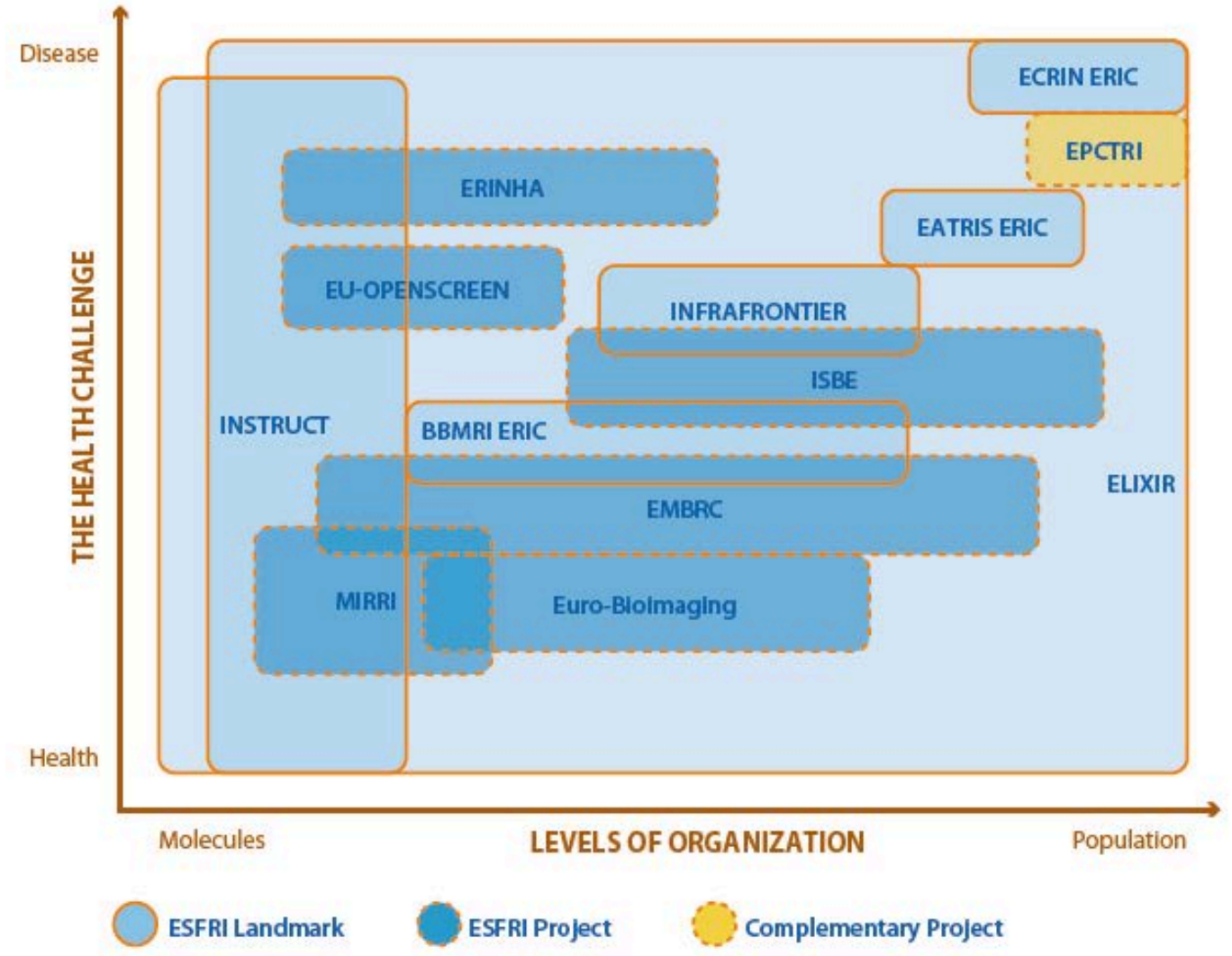
The Landscape Analysis provides the current context, in each domain, of the operational national and international research infrastructures open to European scientists and technology developers through peer-review of competitive science proposals. It represents an impression of the European RI ecosystem. This responds to the invitation by the Competitiveness Council to broaden the view of ESFRI beyond the Roadmap list of projects. It has been produced by the five Strategy Working Groups (SWGs) of ESFRI that are composed of well-recognized scientists and are coordinated by a member, or a permanent expert, of the ESFRI Forum. The e-infrastructures landscape, transversal to all domains, has been elaborated by the e-Infrastructure Reflection Group (e-IRG). The Landscape Analysis is a key ingredient of the new ESFRI evaluation methodology as it supports the understanding of the impact of new projects. It does not represent in any way the view or prioritization of ESFRI or of any Member State for commitments or future investments. ESFRI in no case acts as an advocate of specific potential future projects. ESFRI and its Member States have taken note of it.

P and **L** highlighted marks in the text are toggles for direct access to the relevant cards of **Part 2**.

THE HEALTH CHALLENGE : data collection and stewardship for precision medicine faces the pan-European infrastructures, including ethical, legal and social implications.

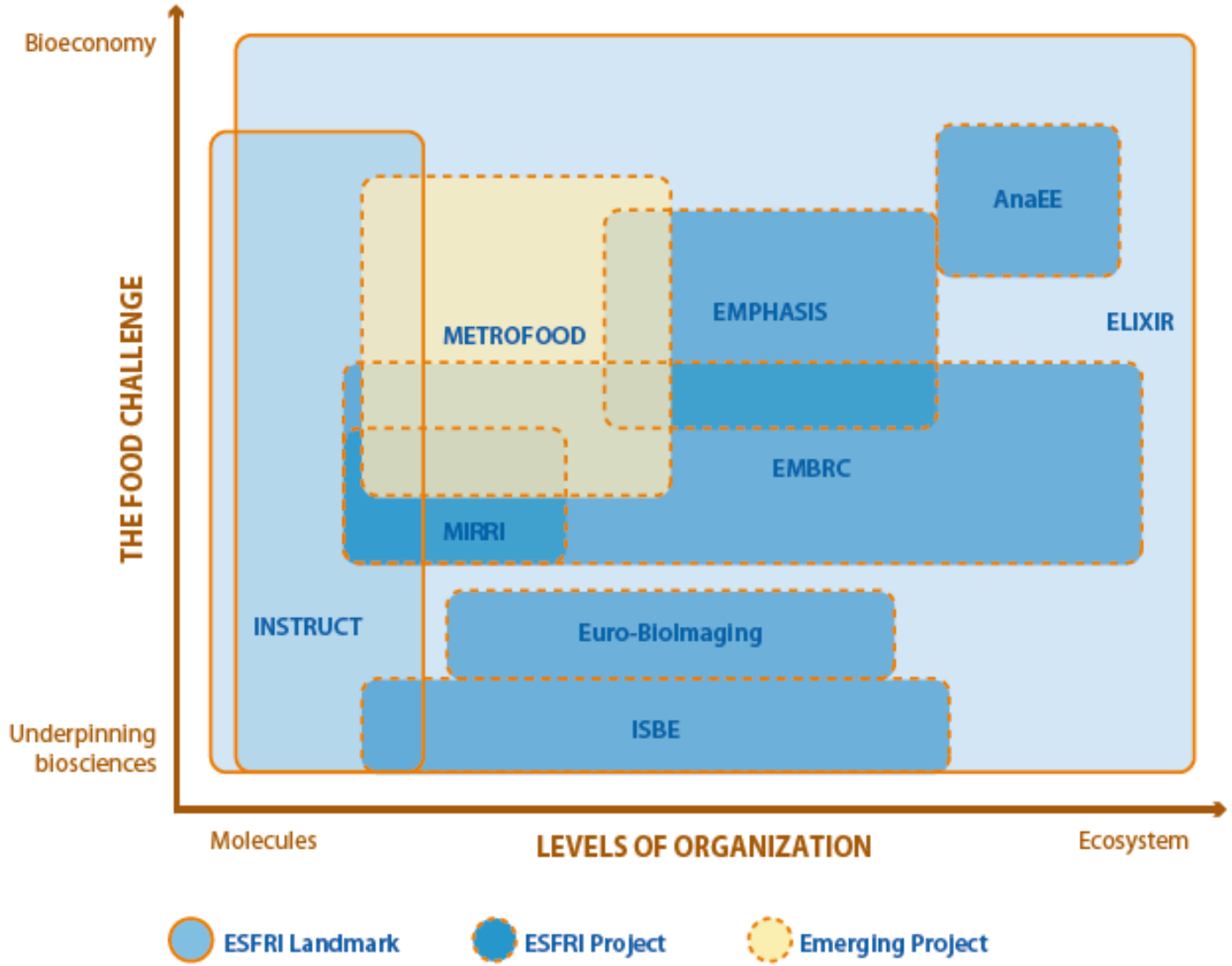
ICT for health is indispensable for proper storage and smart retrieval of these data and knowledge. Data for precision medicine are not only generated in the laboratory and clinic.

Citizens and patients are increasingly users of social media and app technologies to share information about their own health and lifestyle: citizen-networkingcan serve to accelerate clinical research.



THE FOOD CHALLENGE :

The Ris on the Roadmap are the starting point to face the 100% increase in food demand by 2050. The ESFRI Project **AnaEE** on experimental manipulation of managed and unmanaged ecosystems, **EMBRC** on marine biological resources, **ICOS ERIC** on high precision monitoring of greenhouse gas fluxes, **MIRRI** on microorganisms-oriented services to biotechnology and food production, **Euro-BioImaging** on integrating imaging technologies and crop phenotyping), **ECRIN ERIC** on clinical trials and nutritional trials, **INSTRUCT** on the use of structural biology to support plant and animal sciences, and **ELIXIR** on life sciences large-scale data and knowledge management (applied to agriculture and bioindustries), must be linled, nd also to other multidisciplinary RIs.



ESFRI

Projects Landmarks

ROADMAP 2016

interconnections of Health and Food with other domains.

ENERGY SWG

Bioenergy & biorenewables

PHYSICAL SCIENCES & ENGINEERING SWG

Land use and biodiversity

Seas, oceans, aquatic ecosystems & climate change

Biological sciences

Biological resources & processes

Big machines, platforms & technologies - molecular to field system - x-ray to satellites

HEALTH & FOOD SWG

Climate change and agri-ecosystem

Agri-food Sciences

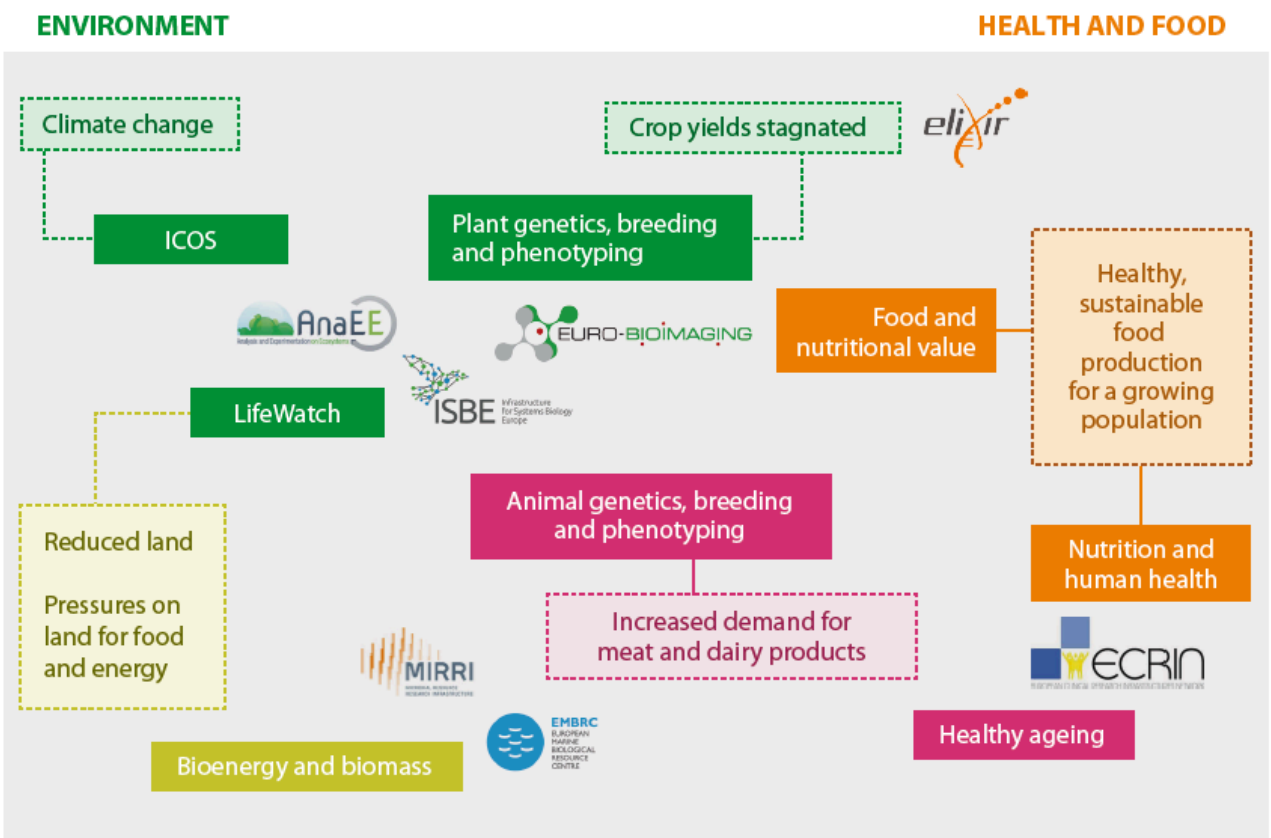
Data protection & ELSI

ENVIRONMENT SWG

Food value chain, farm to consumer

Food systems, consumer demand & behaviour

SOCIAL & CULTURAL INNOVATION SWG



interconnections among Health and Food RIs

A section has been contributed by e-IRG addressing to overall landscape and the key issues

- HPC, big data and ultra-fast internet access are enabling technologies for all European economy sectors and society.

- Europe's competitiveness depends critically on strenghtening its HPC technology, Big Data and Applications both in terms of capacity and original capabilites.

ESFRI will play a role in addressing some of the challenges of HPC/Data/Network as RIs of diverse scientific areas and with different kinds of data and use

- Investments in "e-RI" may need pooling resources (competences, financial)

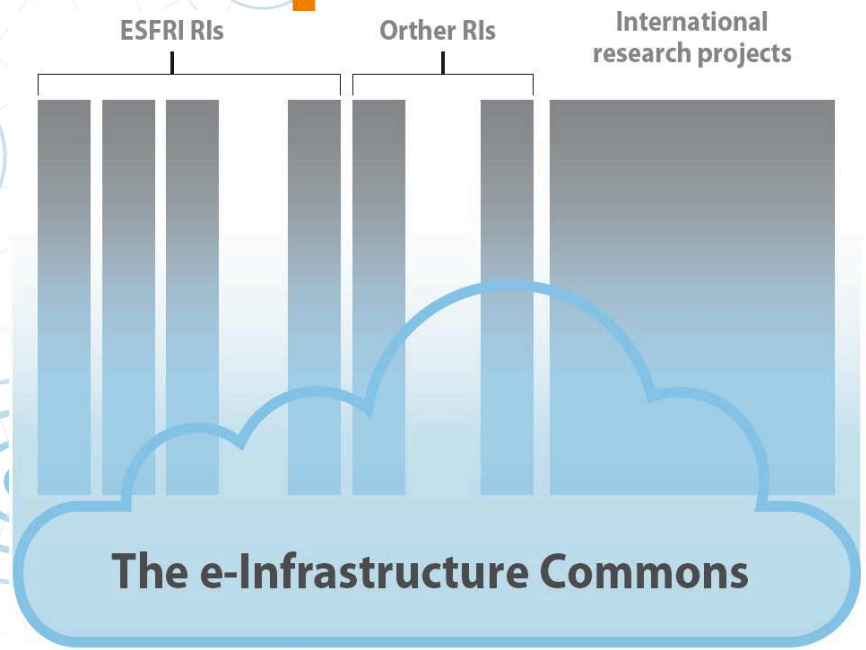
- HPC and HTC must bridge between science, industry and the public sector.

- Medium term sustainability (10-years) is the common minum goal for RI data

ESFRI

P Projects L Landmarks

ROADMAP 2016



- HPC infrastructure for research and innovation should extend to all Member States to
  help the development of strategic sectors;

- Storage infrastructure for research data accessible by diverse thematic software;

- Data infrastructure for data processing, open access, curation, certification and sustainable preservation strategies;

- Fast and Secured transport of data via European data networks.

- Training of Data Practitioners for research, development, industry and services.

ESFRI mandate on e-RI

Working Group on investment strategies in e-infrastructures - ToR

The Competiveness Council of May 28-29 2015 adopted conclusions on: *"open, data-intensive and networked research"* **and** *"invited ESFRI to explore mechanisms for better coordination of Member States' investment strategies in e-infrastructures, covering also HPC, distributed computing, scientific data and networks."*

The Working Group Mandate

ESFRI decided to draw also on the competence of the e-IRG and create an *ad-hoc working group* that will report to the ESFRI Forum. The WG shall provide input and draft recommendations to ESFRI how to address the Council conclusions.
http://data.consilium.europa.eu/doc/document/ST-8970-2015-INIT/en/pdf