European Strategy Forum
on Research Infrastructures

ESFRI

Strategy Report on Research Infrastructures
ROADMAP 2018

ESFRI ROADMAP 2018 and future update

21 November 2018, Budapest

Giorgio Rossi, Chair

RESEARCH INFRASTRUCTURES

- **RIs attract and support frontier research and contribute to pursue *excellence through curiosity-driven research* efforts that push the current limits of knowledge in a discipline.**

- **In doing so, RIs address and solve many technological, scientific and organizational issues that *create additional value and knowledge at non primary levels in the disciplinary paradigm*.**

- **Coordinating *ESFRI and the national facilities* is an asset for the users and for the ERA, enhancing both aspects.**

COORDINATED RESEARCH INFRASTRUCTURES

- RIs can network (***thematic clusters or technology-driven***) to strengthen the science case and increase overall capacity and complementarity, to share technological efforts, ***data management*** methods and policies, also opening beyond the own reference science community/ies. This is happening more and more at EU level.
- If the RIs share common science drivers and concurrent technologies, coordination can **enhance the effectiveness** in fostering new science and knowledge, but it also enhances synergies and **secondary benefits like organization, optimization of services delivered, overall impact of society and economy** reaching the ***critical mass*** of a multi-national economic undertaking with **human resources at the high-end of the spectrum of competences and skills**
- Coordination among Research Infrastructures involves ***many types of direct and indirect target groups***/ stakeholders - researchers, instrumentation business, general public, international agreements and can contribute strengthening the ***ERA***

THE CONTEXT ANALYSIS

For the Pan-European RIs as well as for the national RIs open to international use the *context is multi-level*:

local/national -> as described by the choice of smart specialization and national roadmaps

European -> as described by the ERA objectives and in the ESFRI Landscape Analysis, and initiatives to foster INNOVATION (social and economic)

e.g. strategic Coordination among Analytical Large Scale Facilities

International/global -> as described by OECD, GSO, GSF etc. to address global challenges

THE FIFTH ESFRI ROADMAP AND STRATEGY REPORT

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STRENGTHENING THE LANDMARKS PORTFOLIO

- The **Roadmap 2018 consolidates the Landmarks** list as a core element representing the ensemble of implemented Research Infrastructures that emerged from the ESFRI process.

- The **eight new Landmarks** reinforce the **Energy**, **Environment**, **Health & Food**, and **Physical Sciences & Engineering** domains with strategic long-term investments in research capability and capacity.

BENEFITS:

- The ensemble of ESFRI Landmarks is an **important contribution to the European Research Area**; it complements – and intersects with – the EIROforum to form a full pan-European portfolio of long-term undertakings in excellent science and innovation, thus also creating unique opportunities for further internationalization.

- The ensemble of Landmarks, having developed through ESFRI unifying criteria and commons – e.g. on data analysis open-tools and **FAIR data management and policy** – support advanced interdisciplinary research therefore providing unique resources to address the frontiers of knowledge, innovation and societal needs.

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LANDSCAPE ANALYSIS AS A KEY INGREDIENT

SECTION1 – SCIENTIFIC DOMAIN

SECTION2 – INTERCONNECTIONS

SECTION3 – CROSS-CUTTING ASPECTS

The Landscape Analysis is an indicative reference document and does not represent, in any way, the view and prioritisation of ESFRI, nor any national financial and political commitment.

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NEW PROJECTS FILLING GAPS

The **International Fusion Materials Irradiation Facility - DEMO Oriented NEutron Source (IFMIF-DONES)** will play a strategic role in the Energy (ENE) domain for the implementation of nuclear fusion solutions to the massive production of energy, as well as for the role of Europe as an active actor in the development of nuclear fusion technologies. The consolidation of the technical design of IFMIF-DONES will take place during the Preparation Phase as well as the potential internationalization of the project that will play an important role in the global effort for fusion technologies.

The **Distributed System of Scientific Collections (DiSSCo)** will play a strategic role in the Environment (ENV) domain aiming at unifying European natural science collections, effectively transforming the currently dispersed and fragmented access to the resources into an integrated data-driven pan-European Research Infrastructure of broad international interest.

The **Long-Term Ecosystem Research in Europe (eLTER)** is filling a major gap in the Environment (ENV) domain for a pan-European Infrastructure addressing long-term multi-disciplinary ecosystem studies integrating observatories that individually provide and manage time serial observations and offering physical access to sites for ecological experiments.

The **Industrial Biotechnology Innovation and Synthetic Biology Accelerator (EU-IBISBA)** will play a strategic role in the Health & Food (H&F) domain as a distributed RI supporting research on several bio-economy areas: energy (liquid biofuels), chemicals (organic acids), materials (bio-plastics) and ingredients for the food, feed, cosmetics and pharma sectors (enzymes, anti-oxidants, antibiotics).

The **Infrastructure for promoting Metrology in Food and Nutrition (METROFOOD-RI)** clearly fills a gap in the Health & Food (H&F) domain by proposing a distributed RI aiming at providing high quality metrology services in food and nutrition. It comprises an important cross-section of highly interdisciplinary and interconnected fields throughout the food value chain, including agro-food, sustainable development, food safety/quality/traceability/authenticity, environmental safety, and human health.

The **European Holocaust Research Infrastructure (EHRI)** will play a strategic role in the Social & Cultural Innovation (SCI) domain as it represents a unique access point to the historical documents and human resources for research on the Holocaust. The project will represent a unique asset for international research.

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18 PROJECTS

ESFRI PROJECTS

	NAME	FULL NAME	TYPE	LEGAL STATUS (Y)	ROADMAP ENTRY (Y)	OPERATION START (Y)	CONSTRUCTION COSTS (M€)	OPERATION COSTS (M€/Y)
ENERGY	EU-SOLARIS	European Solar Research Infrastructure for Concentrated Solar Power	distributed		2010	2020*	6	0.2
	IFMIF-DONES	International Fusion Materials Irradiation Facility - DEMO Oriented NEutron Source	single-sited		2018	2029*	420	50
	MYRRHA	Multi-purpose hYbrid Research Reactor for High-tech Applications	single-sited		2010	2027*	1.352	74
	WindScanner	European WindScanner Facility	distributed		2010	2021*	6.1	2
ENVIRONMENT	ACTRIS	Aerosols, Clouds and Trace gases Research Infrastructure	distributed		2016	2025*	190	50
	DANUBIUS-RI	International Centre for Advanced Studies on River-Sea Systems	distributed		2016	2022*	222	28
	DiSSCo	Distributed System of Scientific Collections	distributed		2018	2025*	69.4	12.1
	eLTER	Long-Term Ecosystem Research in Europe	distributed		2018	2026*	94	35
HEALTH & FOOD	AnaEE	Infrastructure for Analysis and Experimentation on Ecosystems	distributed	ERIC Step1 2018	2010	2019*	1.1	0.8
	EMPHASIS	European Infrastructure for Multi-scale Plant Phenomics and Simulation	distributed		2016	2021*	73	3.6
	EU-IBISBA	Industrial Biotechnology Innovation and Synthetic Biology Accelerator	distributed		2018	2025*	11	65.1
	ISBE	Infrastructure for System Biology Europe	distributed		2010	2019*	10	5.2
	METROFOOD-RI	Infrastructure for promoting Metrology in Food and Nutrition	distributed		2018	2019*	78.8	31
	MIRRI	Microbial Resource Research Infrastructure	distributed		2010	2021*	0.8	0.7
PHYSICAL SCIENCES & ENGINEERING	EST	European Solar Telescope	single-sited		2016	2029*	200	12
	KM3NeT 2.0	KM3 Neutrino Telescope 2.0	distributed		2016	2020*	151	3
SOCIAL & CULTURAL INNOVATION	E-RIHS	European Research Infrastructure for Heritage Science	distributed		2016	2025*	20	5
	EHRI	European Holocaust Research Infrastructure	distributed		2018	2022*	0.8	2
DIGIT								

NA=Not Available

*expected

37 LANDMARKS

ESFRI LANDMARKS

NAME	FULL NAME	TYPE	LEGAL STATUS (Y)	ROADMAP ENTRY (Y)	OPERATION START (Y)	CAPITAL VALUE (M€)	OPERATION COSTS (M€/Y)
ECCSEL ERIC	European Carbon Dioxide Capture and Storage Laboratory Infrastructure	distributed	ERIC, 2017	2008	2016	1.000	0.85
JHR	Jules Horowitz Reactor	single-sited		2006	2022*	1.800	NA
EISCAT_3D	Next generation European Incoherent Scatter radar system	single-sited	EISCAT Scientific Association, 1975	2008	2022*	123	5.1
EMSO ERIC	European Multidisciplinary Seafloor and water-column Observatory	distributed	ERIC, 2016	2006	2016	100	20
EPOS	European Plate Observing System	distributed	ERIC Step2, 2018	2008	2020*	500	18
EURO-ARGO ERIC	European contribution to the international Argo Programme	distributed	ERIC, 2014	2006	2014	10	8
IAGOS	In-service Aircraft for a Global Observing System	distributed	AISBL, 2014	2006	2014	9.2	7
ICOS ERIC	Integrated Carbon Observation System	distributed	ERIC, 2015	2006	2016	116	24.2
LifeWatch ERIC	e-Infrastructure for Biodiversity and Ecosystem Research	distributed	ERIC, 2017	2006	2017	150	12
BBMRI ERIC	Biobanking and BioMolecular Resources Research Infrastructure	distributed	ERIC, 2013	2006	2014	195	3.5
EATRIS ERIC	European Advanced Translational Research Infrastructure in Medicine	distributed	ERIC, 2013	2006	2013	500	2.5
ECRIN ERIC	European Clinical Research Infrastructure Network	distributed	ERIC, 2013	2006	2014	5	5
ELIXIR	A distributed infrastructure for life-science information	distributed	ELIXIR Consortium Agreement, 2013	2006	2014	125	95
EMBRC ERIC	European Marine Biological Resource Centre	distributed	ERIC, 2018	2008	2017	164.4	11.2
ERINHA	European Research Infrastructure on Highly Pathogenic Agents	distributed	AISBL, 2017	2008	2018	5.8	0.7
EU-OPENSCREEN ERIC	European Infrastructure of Open Screening Platforms for Chemical Biology	distributed	ERIC, 2018	2008	2019*	82.3	1.2
Euro-BioImaging	European Research Infrastructure for Imaging Technologies in Biological and Biomedical Sciences	distributed	ERIC Step2, 2018	2008	2016	90	1.6
INFRAFRONTIER	European Research Infrastructure for the generation, phenotyping, archiving and distribution of mouse disease models	distributed	GmbH, 2013	2006	2013	180	80
INSTRUCT ERIC	Integrated Structural Biology Infrastructure	distributed	ERIC, 2017	2006	2017	400	30
CTA	Cherenkov Telescope Array	single-sited	gGmbH, 2014	2008	2024*	400	20
ELI	Extreme Light Infrastructure	distributed	AISBL, 2013	2006	2018	850	80
ELT	Extremely Large Telescope	single-sited	ESO#	2006	2024*	1.120	45
EMFL	European Magnetic Field Laboratory	distributed	AISBL, 2015	2008	2014	170	20
ESRF EBS	European Synchrotron Radiation Facility Extremely Brilliant Source	single-sited	ESRF#	2016	2023*	128	82
European Spallation Source ERIC	European Spallation Source	single-sited	ERIC, 2015	2006	2025*	1.843	140
European XFEL	European X-Ray Free-Electron Laser Facility	single-sited	European XFEL#	2006	2017	1.490	118
FAIR	Facility for Antiproton and Ion Research	single-sited	GmbH, 2010	2006	2025*	NA	234
HL-LHC	High-Luminosity Large Hadron Collider	single-sited	CERN#	2016	2026*	1.408	136
ILL	Institut Max von Laue-Paul Langevin	single-sited	ILL#	2006	2020*	188	97
SKA	Square Kilometre Array	single-sited	SKAO, 2011	2006	2027*	1.000	77
SPIRAL2	Système de Production d1ons Radioactifs en Ligne de 2e génération	single-sited	GANIL	2006	2019*	281	6
CESSDA ERIC	Consortium of European Social Science Data Archives	distributed	ERIC, 2017	2006	2013	117	39
CLARIN ERIC	Common Language Resources and Technology Infrastructure	distributed	ERIC, 2012	2006	2012	NA	14
DARIAH ERIC	Digital Research Infrastructure for the Arts and Humanities	distributed	ERIC, 2014	2006	2019*	NA	0.7
ESS ERIC	European Social Survey	distributed	ERIC, 2013	2006	2013	NA	2.5
SHARE ERIC	Survey of Health, Ageing and Retirement in Europe	distributed	ERIC, 2011	2006	2011	250	18
PRACE	Partnership for Advanced Computing in Europe	distributed	AISBL, 2010	2006	2010	500	60

NA=Not Available

*expected
EIROforum member

LIFECYCLE APPROACH

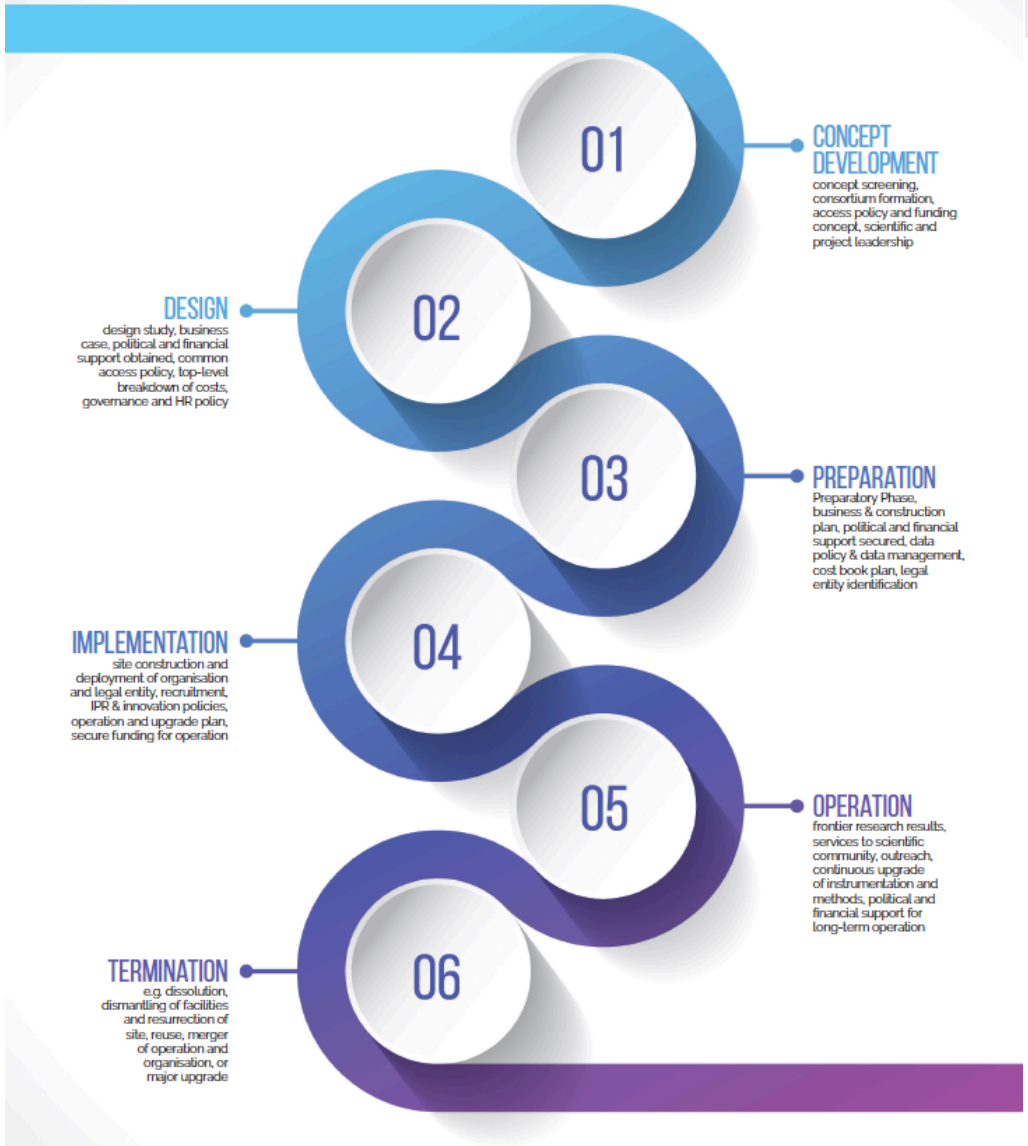


FIGURE 1.
Lifecycle approach

The evolution in time of **ESFRI Projects** and **ESFRI Landmarks** and the needs and targets of the RI implementation are understood as a sequence of phases from the **CONCEPT** to **OPERATION** and to **TERMINATION**

All stages generate BENEFITS at variable scale

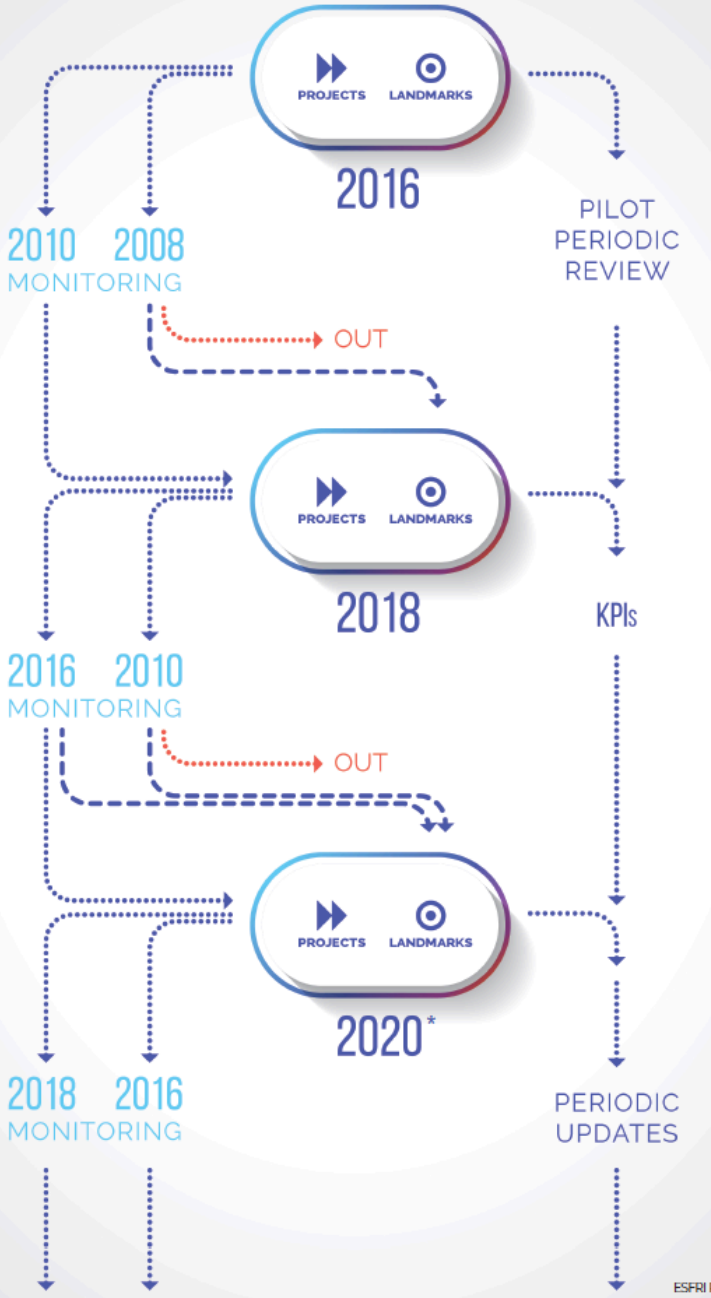


FIGURE 2.
ESFRI Roadmap Dynamics

*according to the ten-year rule the ESFRI Projects 2010 will be monitored in view of next Roadmap update that will be carried out in 2020.

MONITORING OF ESFRI PROJECTS

- Projects have ten years of residency on the Roadmap to reach implementation: those that do not meet this goal are removed from the Roadmap
- Check of the overall progress towards implementation according to the fulfilment of minimal key requirements as defined in the ESFRI Roadmap Guide
- Advices to the Projects and recommendations to the Forum, including the possible promotion of Projects to the status of Landmark

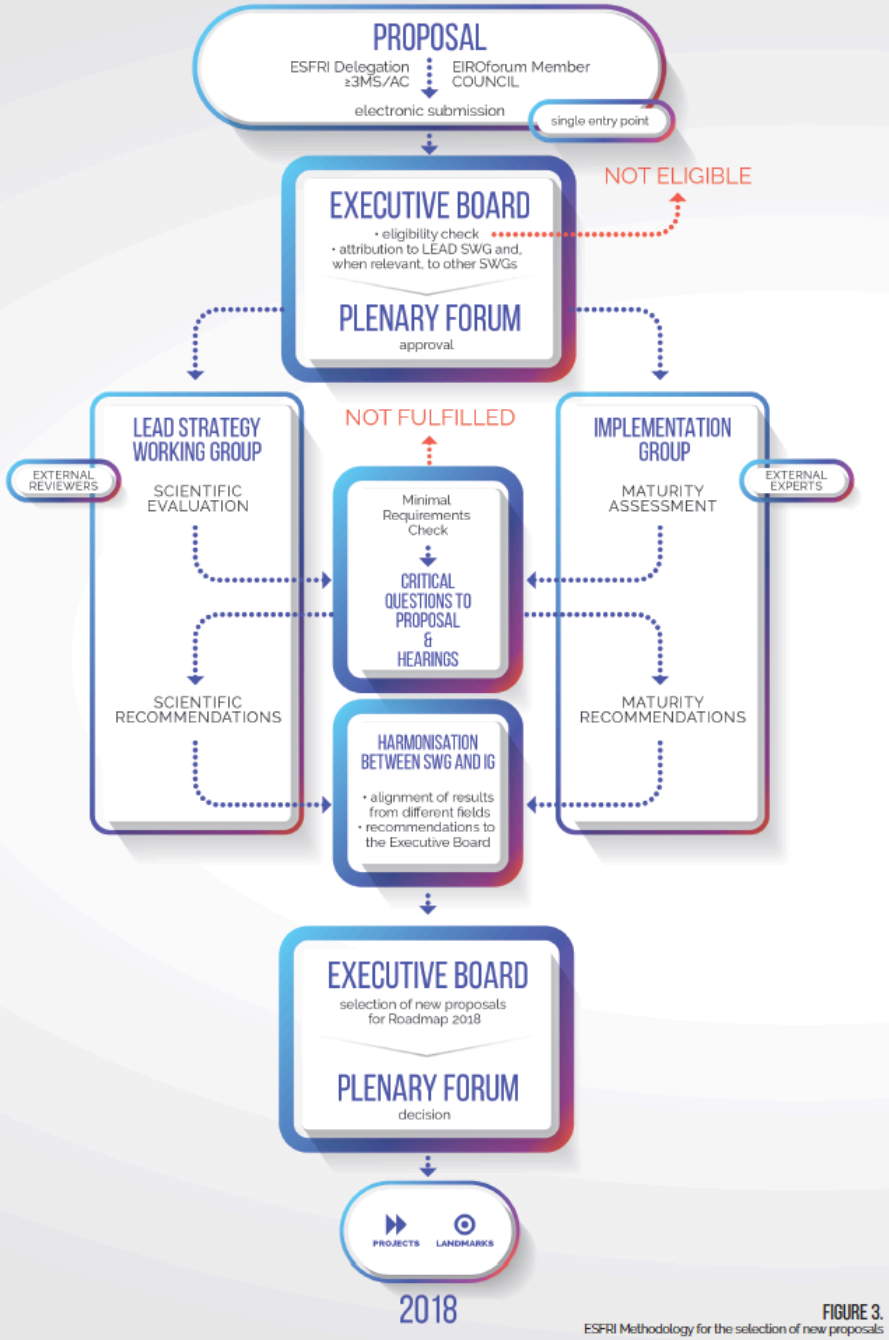


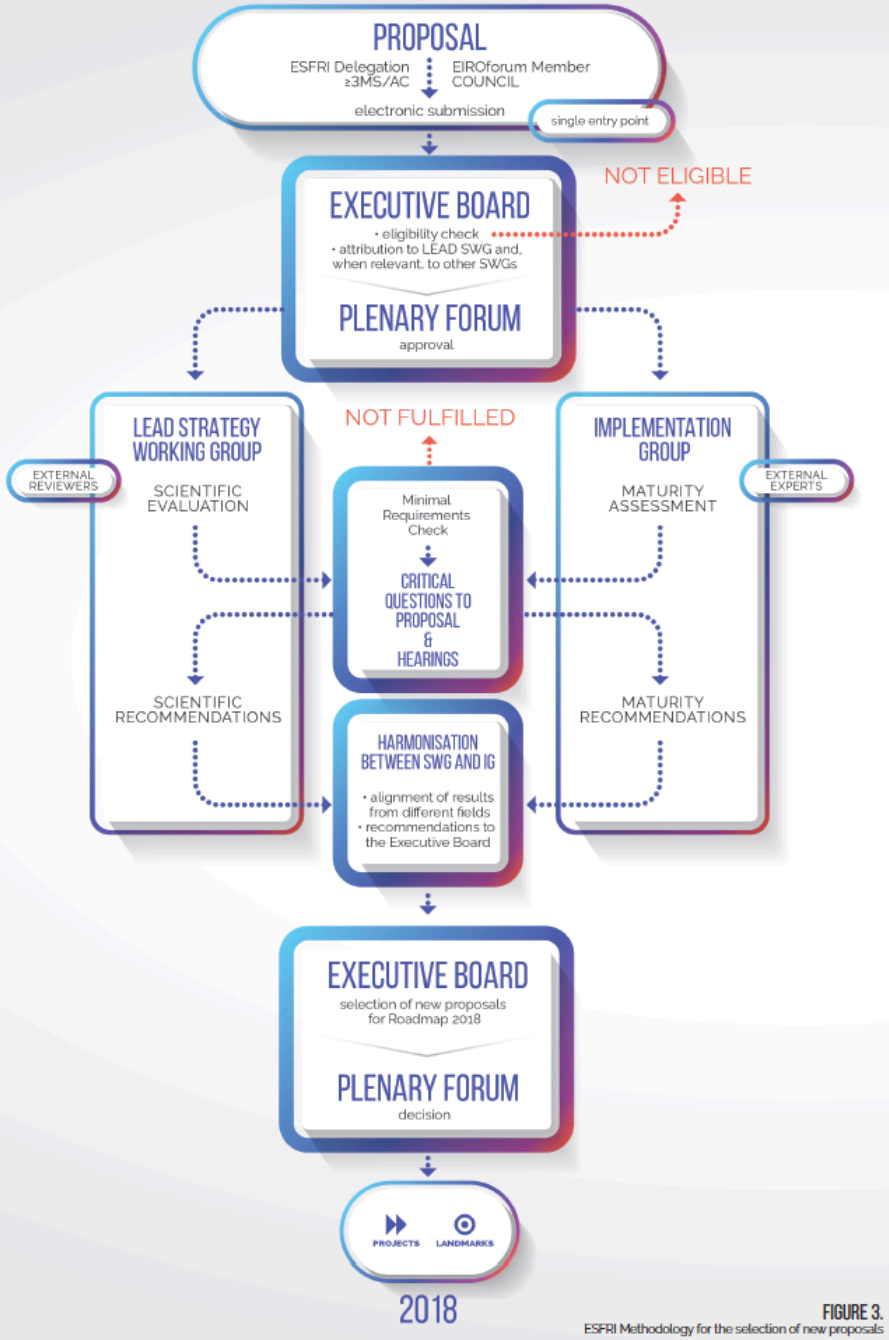
FIGURE 3.
ESFRI Methodology for the selection of new proposals

EVALUATION AND ASSESSMENT OF NEW PROPOSALS

i. Twelve submitted proposals (all eligible) underwent the two parallel and independent evaluation processes run by SWGs and IG, also involving independent external experts

ii. The SWGs and IG identified several critical questions about each proposal, and then liaised to achieve a common list of issues

iii. Eleven proposals that met minimal requirements to be considered for the Roadmap, were invited to dedicated hearing sessions



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ESFRI Methodology for the selection of new proposals

EVALUATION AND ASSESSMENT OF NEW PROPOSALS

iv. The harmonisation of the results on scientific excellence and maturity by WG Chairs and EB and subsequent strategy analysis by the EB led to **the recommendation of 6 proposals for inclusion in the Roadmap** while 5 did not meet the minimal requirements

v. Among the projects not being ready for inclusion, areas of research of High Strategic potential in the field of Social & Cultural Innovation were identified, as it is described in the Landscape section

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THE EVOLVING ROLE OF RESEARCH INFRASTRUCTURES

The RI ecosystem yields a **high return on investment** under conditions that finances and human resources are assured through the full lifecycle, and optimization of the European landscape is sought.

The question of **Long-Term Sustainability** has been at the core of the work of ESFRI, upon a specific mandate, in close dialogue with the European Commission and national roadmapping exercises. **ESFRI SCRIPTA Vol.2**

The aspect of **open innovation and knowledge exchange** between economic activities and research at RIs is also a subject that required an analysis by ESFRI. **ESFRI SCRIPTA Vol.3**

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CHALLENGES AND STRATEGY FOR THE FUTURE

- Excellent research is becoming more and more ***multi-messenger*** – i.e. based on diverse data sources oriented to study the same phenomena. *Accelerator-based analytical infrastructures allow to explore the energy, space and time domains with a range of set-ups.*

- Research often occurs at the interfaces among domains: ***ex ante*** **interdisciplinarity** or **multidisciplinarity**, indicating that new knowledge is pursued beyond disciplinary methods and limits.

- ***High-quality research data sets*** are produced at RIs, which are documented by advanced-level metadata to **potentially enable interoperability, i.e. the *ex post* interdisciplinary** use of the data.

- **Internationalization of RIs** must be advanced through the development of *compatible access modes* to resources and data.

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CHALLENGES AND STRATEGY FOR THE FUTURE

Multi-messenger can become a general paradigm also developed in ENV and H&F RIs as it is described in the LA.

We expect that it will further expand in many other fields of research.

RIs belonging to the same domain are developing efficient interfaces and are natural facilitators of the ***multi-messenger*** **approach,** enabling interdisciplinary research.

The **Section2** of the Landscape Analysis gives evidence of the interconnections among the RIs contributing new knowledge in a complementary way. The RIs, while maintaining their own disciplinary-rich diversity portfolio, have a high potential to horizontally coordinate on science topics that can be addressed only by adopting multiple diverse complementary techniques.

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CHALLENGES AND STRATEGY FOR THE FUTURE

Part of the effort towards a more efficient ***knowledge-based society*** and economy is being addressed by the **open data concept.**

The broad debate and high expectations about the EOSC demonstrated that there is a widely shared aim to make the overall information contained in **(high) quality-controlled data – FAIR and Reproducible** – readily accessible also to users working in different disciplinary domains with respect to the researchers who originated the data.

ESFRI will supply the EOSC with original high quality data from the RIs and will strategically orient the investments in RIs to cover the whole data cycle.

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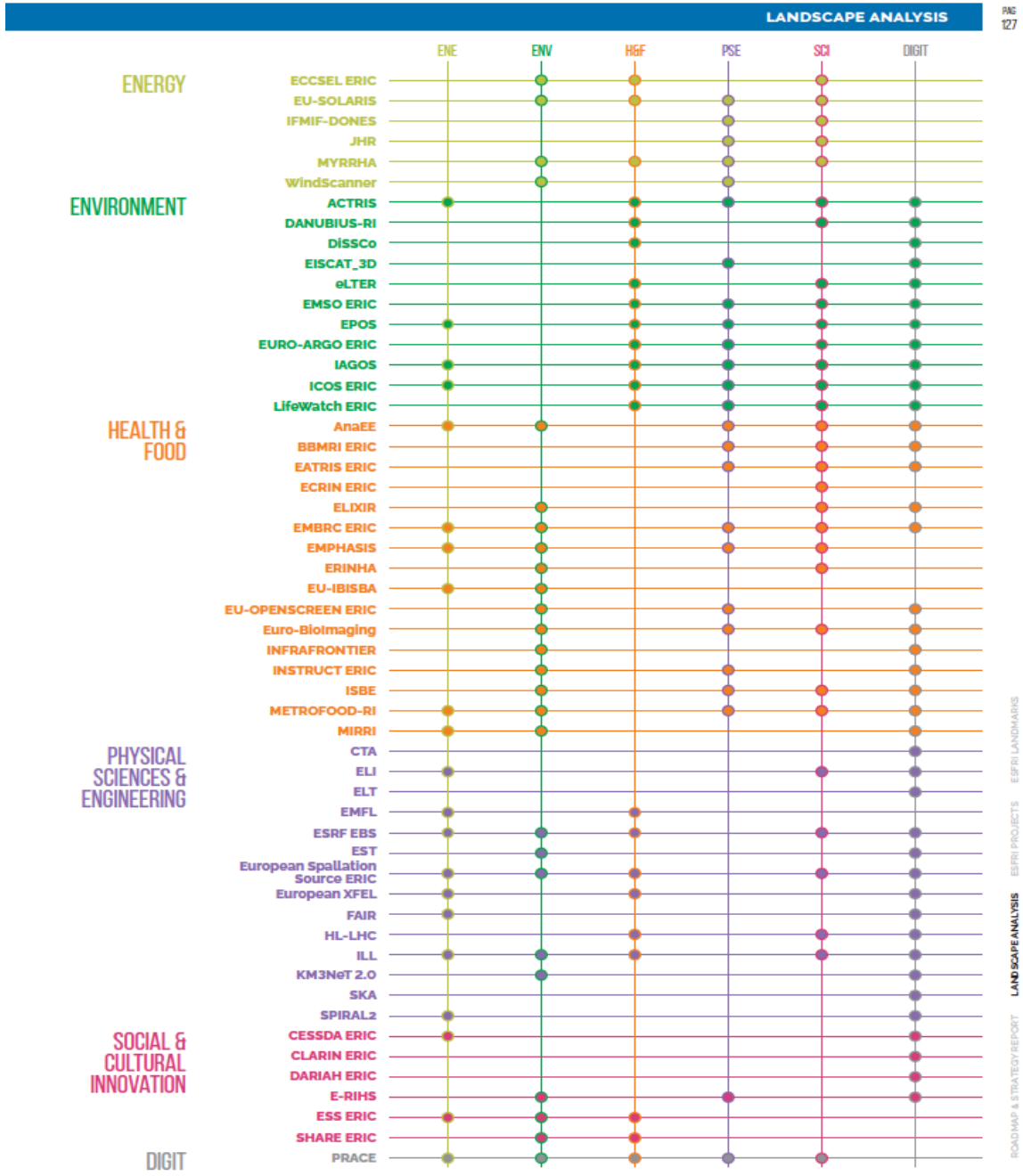
PART2

LANDSCAPE ANALYSIS

INTERCONNECTIONS BETWEEN ESFRI RIs AND SCIENTIFIC DOMAINS

The Landscape Analysis gives evidence of the interconnections among the RIs contributing new knowledge in a complementary way.

The RIs, while maintaining their own disciplinary-rich diversity portfolio, have a high potential to horizontally coordinate on science topics that can be addressed only by adopting multiple diverse complementary techniques.



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SECTION 1

Six chapters – one per scientific domain – describes the state of play of all the Research Infrastructures in the corresponding thematic area.

Each domain is structured in areas or subdomains of research, and the interfaces of the RIs belonging to the same disciplinary area are captured by plots with the relevant dimensions.

The gaps, challenges and future needs are analysed for each group of thematic RIs and summarised.

Research develops both within disciplinary domains and across disciplinary borders so that the needs for competitive research imply to enable a smooth access to multiple and diverse RIs.

In addition, the Section1 indicates *high strategic potential areas of research in the field of Social & Cultural Innovation,* that resulted form the Roadmap preparation work.

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ENERGY

The energy sector is key to social and economic development. Especially in some non-OECD countries the energy sector sees very high growth rates due to rising GDP. However, it contributes significantly to global CO2 emissions. For the EU, the reduction of CO2 emissions in a sustainable framework is a major driver of its energy policy. This provides opportunities for new technologies both for application within and outside of the EU.

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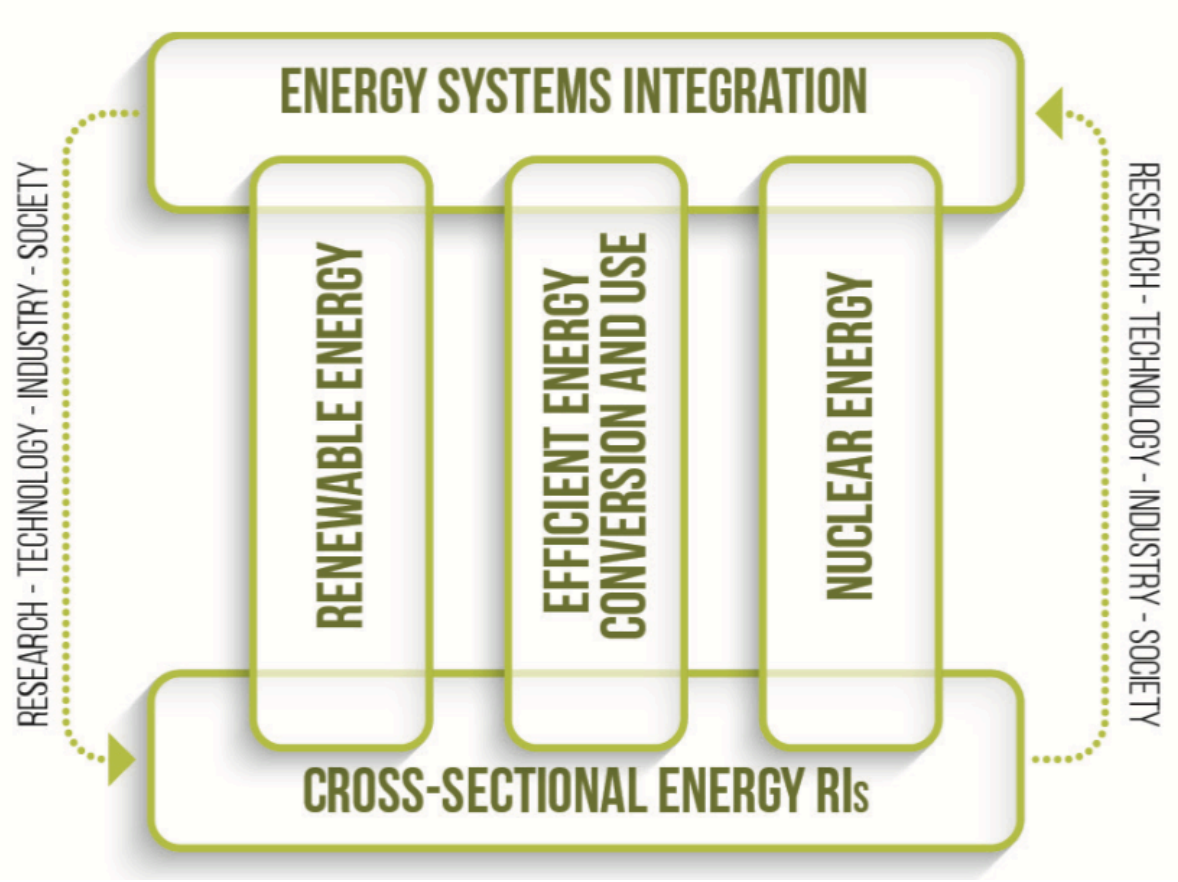
ENERGY SYSTEMS INTEGRATION – networks, transport, storage and smart cities/ districts; **RENEWABLE ENERGY** – solar, renewable fuels,wind, geothermal, ocean; **EFFICIENT ENERGY CONVERSION AND USE** – energy in buildings and industry, Power-to-X, CCSU; **NUCLEAR ENERGY** – fusion and fission; and **CROSS-SECTIONAL ENERGY RIs** – materials and data, simulation and modelling.



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ENVIRONMENT

There is an urgent need to sustain, integrate and further develop a diverse set of Environmental RIs in a way that Europe can address both the key societal and economic challenges as well as improve our basic scientific knowledge.

Environmental sciences are traditionally divided into four research and study domains: **ATMOSPHERE**, **HYDROSPHERE**, **BIOSPHERE** and **GEOSPHERE**. These different *spheres* are closely interlinked, and therefore environmental sciences can also be presented according to *Grand Challenges*, such as loss of biodiversity, pollution, depletion of natural resources, risks, hazards and climate change.

Atmosphere, hydrosphere, biosphere and geosphere are closely interlinked spheres of environmental sciences responding to big human challenges from loss of biodiversity to climate change.

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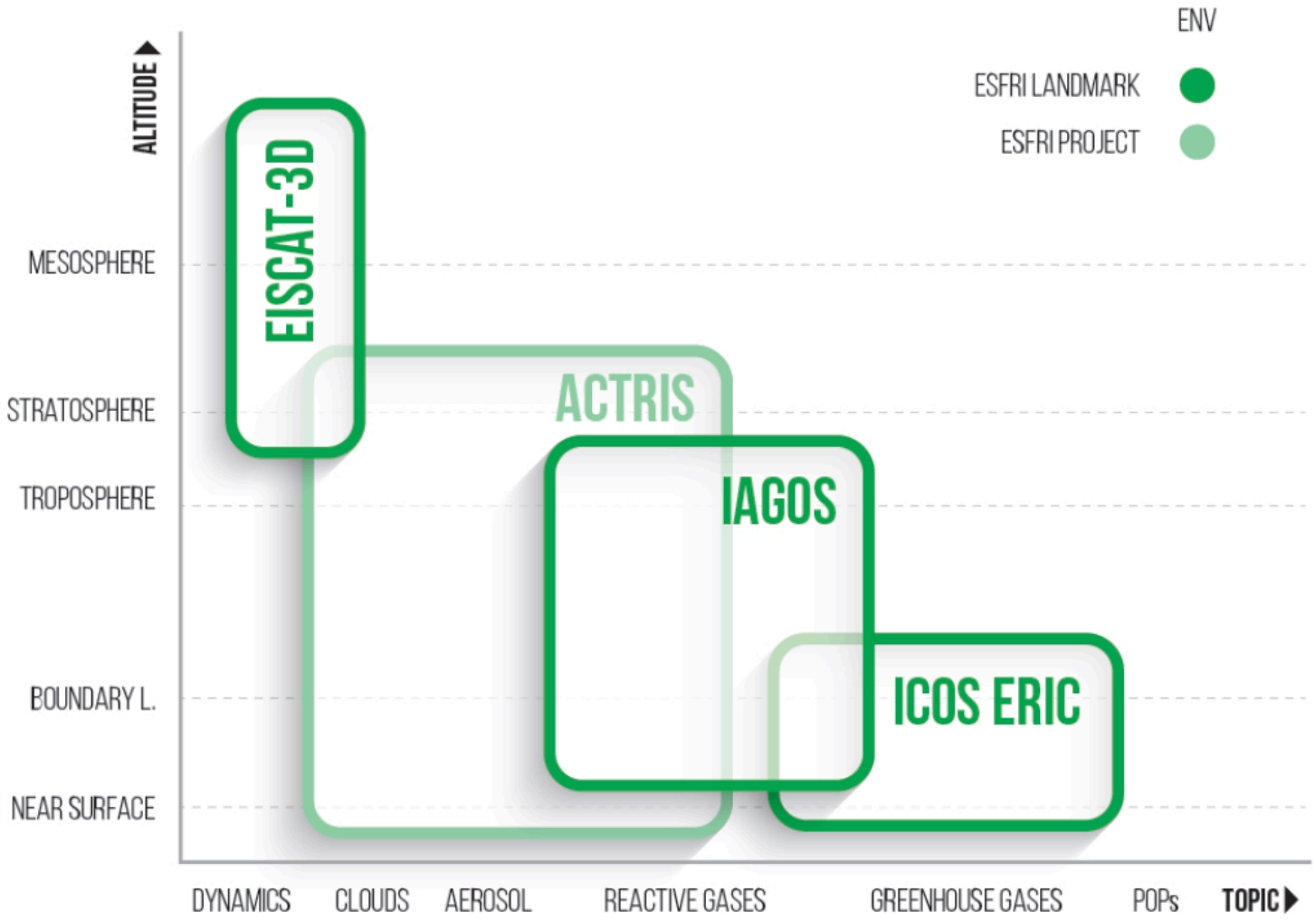
ATMOSPHERE: FROM NEAR GROUND TO THE NEAR SPACE ATMOSPHERE



Perturbation of the atmosphere impacts on different thematic areas like climate change, air quality, environmental hazards, environmental risks, food security and the water cycle.

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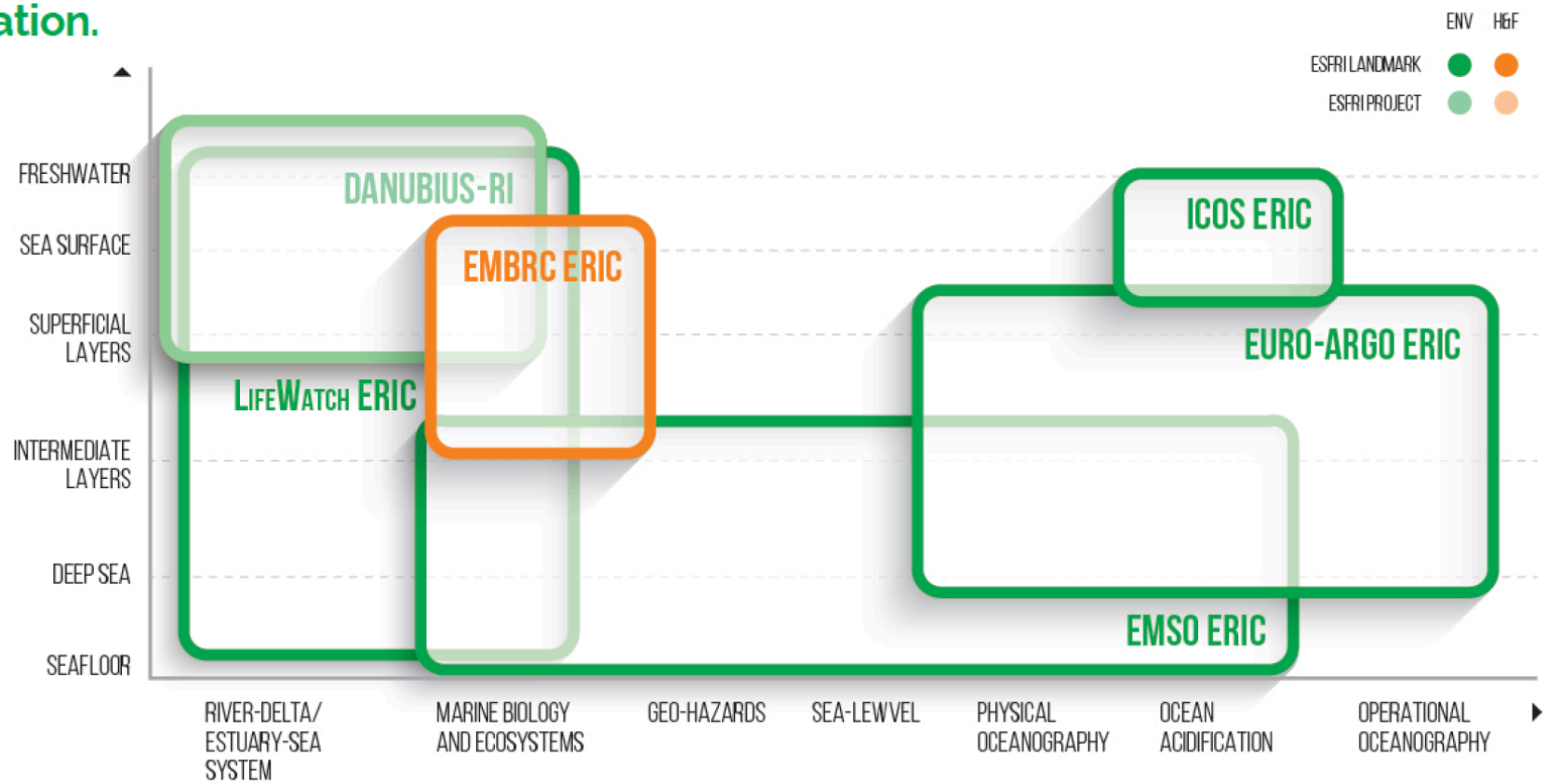
HYDROSPHERE

Water is of huge global geopolitical importance and is central to all the key, current environmental issues: climate change, biodiversity, natural hazards, pollution, ecosystem services, and desertification.



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BIOSPHERE: BIODIVERSITY AND ECOSYSTEMS

A better understanding of the interconnections, including quantitative relations, between biodiversity and ecosystem services will allow a better response to *Grand Challenges*, namely those included in the Sustainable Development Goals.

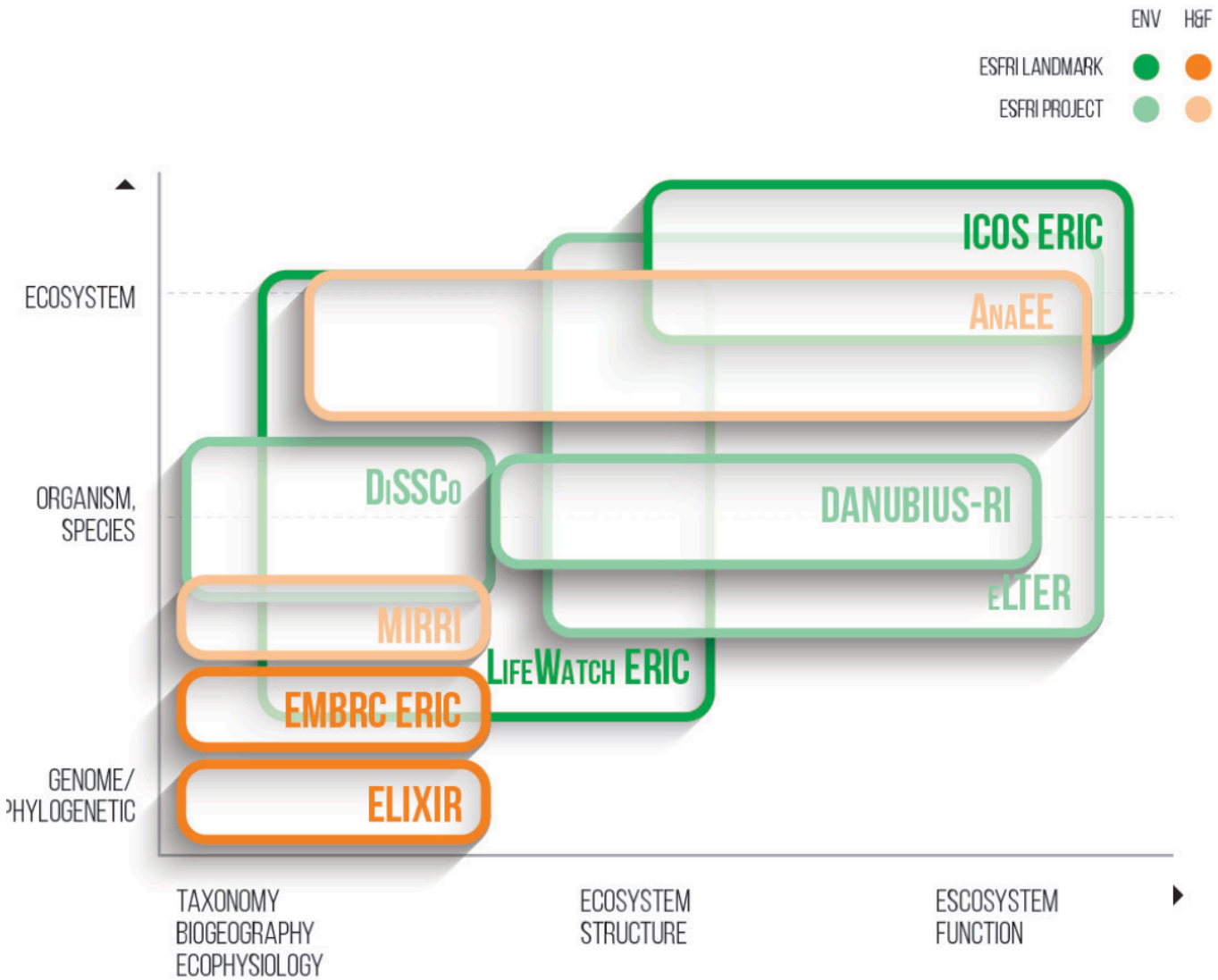

FIGURE 3.
Schematic landscape of biodiversity and ecosystem ESFRI Research Infrastructures.

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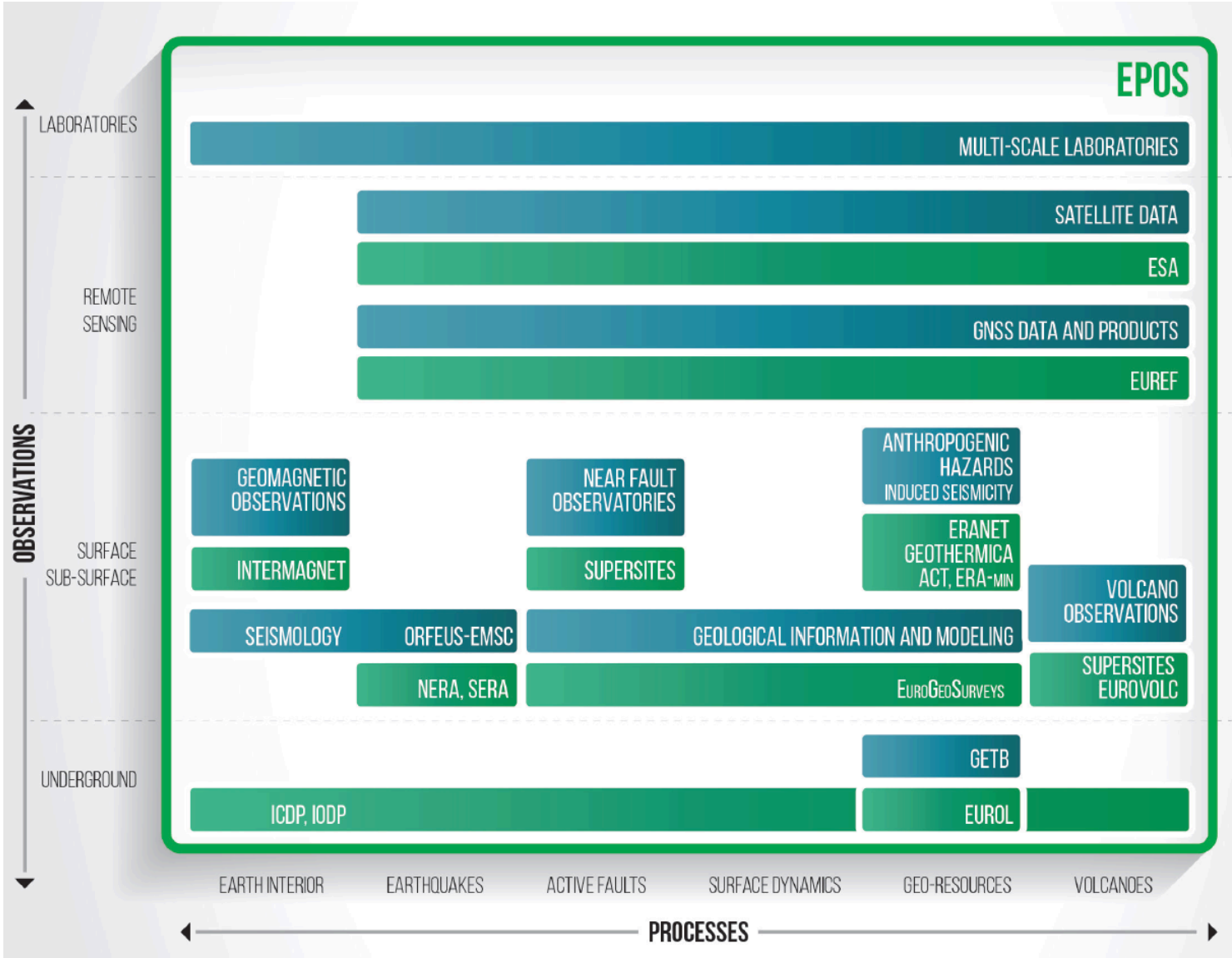
GEOSPHERE: FROM THE SURFACE TO THE INTERIOR OF THE EARTH, FROM GEOHAZARDS TO GEORESOURCES

Geology, natural hazards, natural resources and environmental processes, in general, do not respect national boundaries, therefore seamless, trans-national integration of measurements and calibrated data is crucial to enable research and societal applications.



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HEALTH & FOOD

There is a broad consensus that future competitiveness in a globalised knowledge economy depends on research capability. Research Infrastructures (RIs) in the Biological, Agri-Food and Medical Sciences – i.e. Health & Food – continue to establish themselves as research, innovation and skills hubs and as a motor for economic impact. This is reflected in increasing levels of industrial access to RIs, and in their European and global positioning.

KEY MESSAGES

The Health & Food RIs landscape is consolidating firmly in the European Research Area with now 10 Landmarks and 6 Projects covering the vast remit of health, agri-food and the bioeconomy.

To generate readiness to meet current challenges and demands, the Health & Food RIs need to continue cementing their efforts and connecting between them using their different competences and technologies at the service of the user community.

Gaps in the Health & Food landscape can be identified at many levels and it will also be important to connect infrastructure efforts with other domains, as significant innovations and new developments often occur at the boundaries of research areas.

In the field of data, further efforts are required to promote and facilitate the interaction between domains and to avoid fragmentation of the data continuum.

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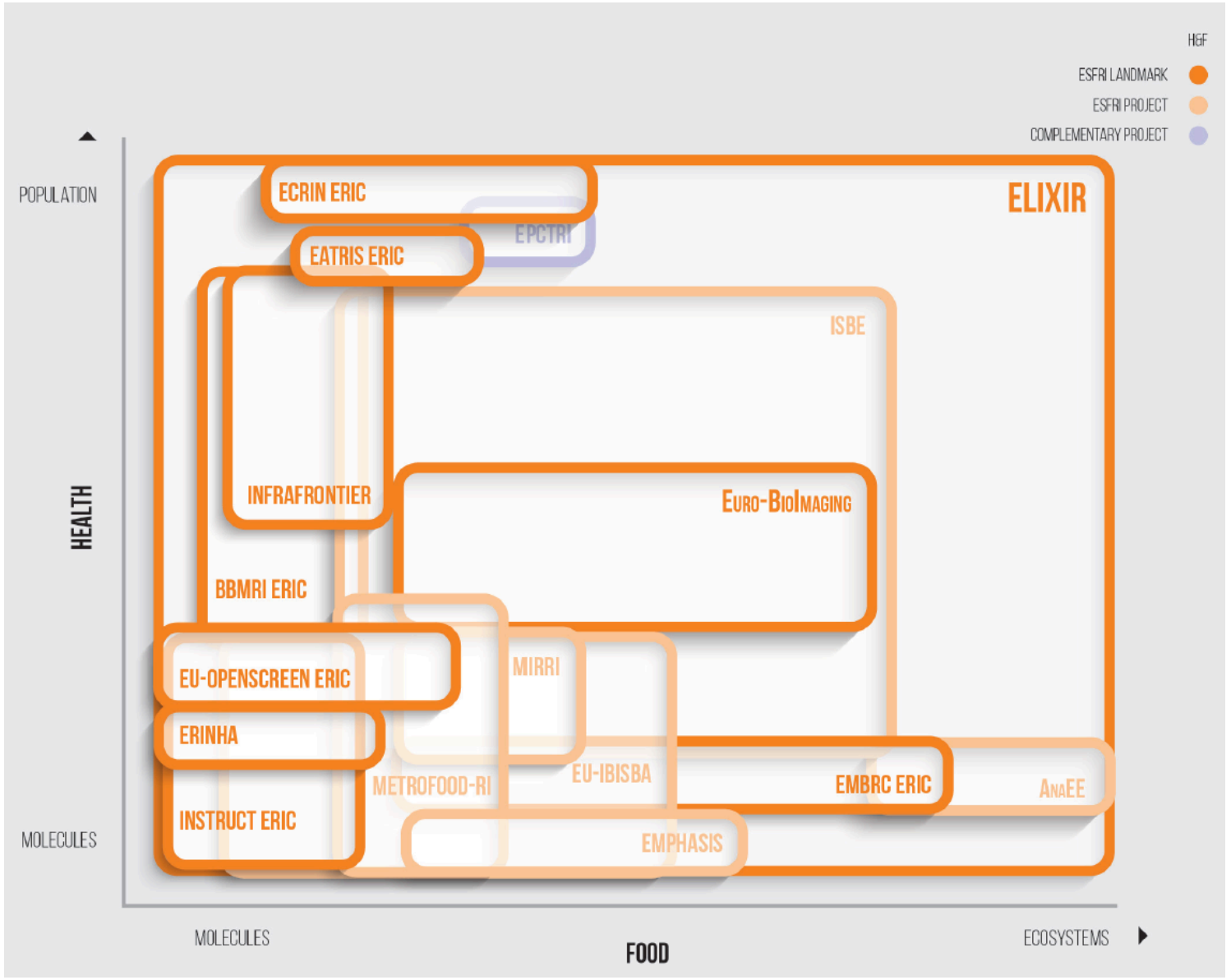
HEALTH & FOOD



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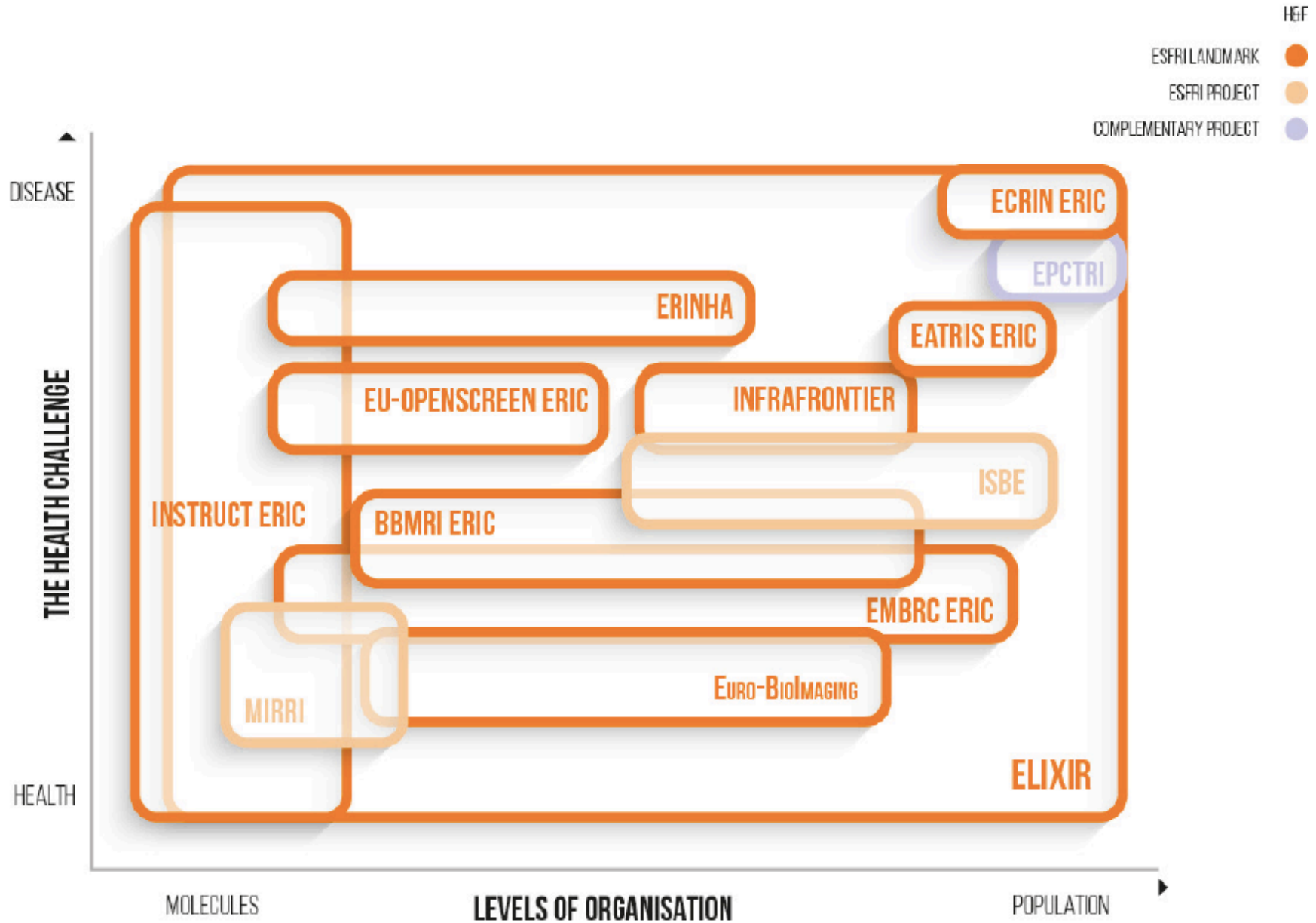
THE HEALTH CHALLENGE



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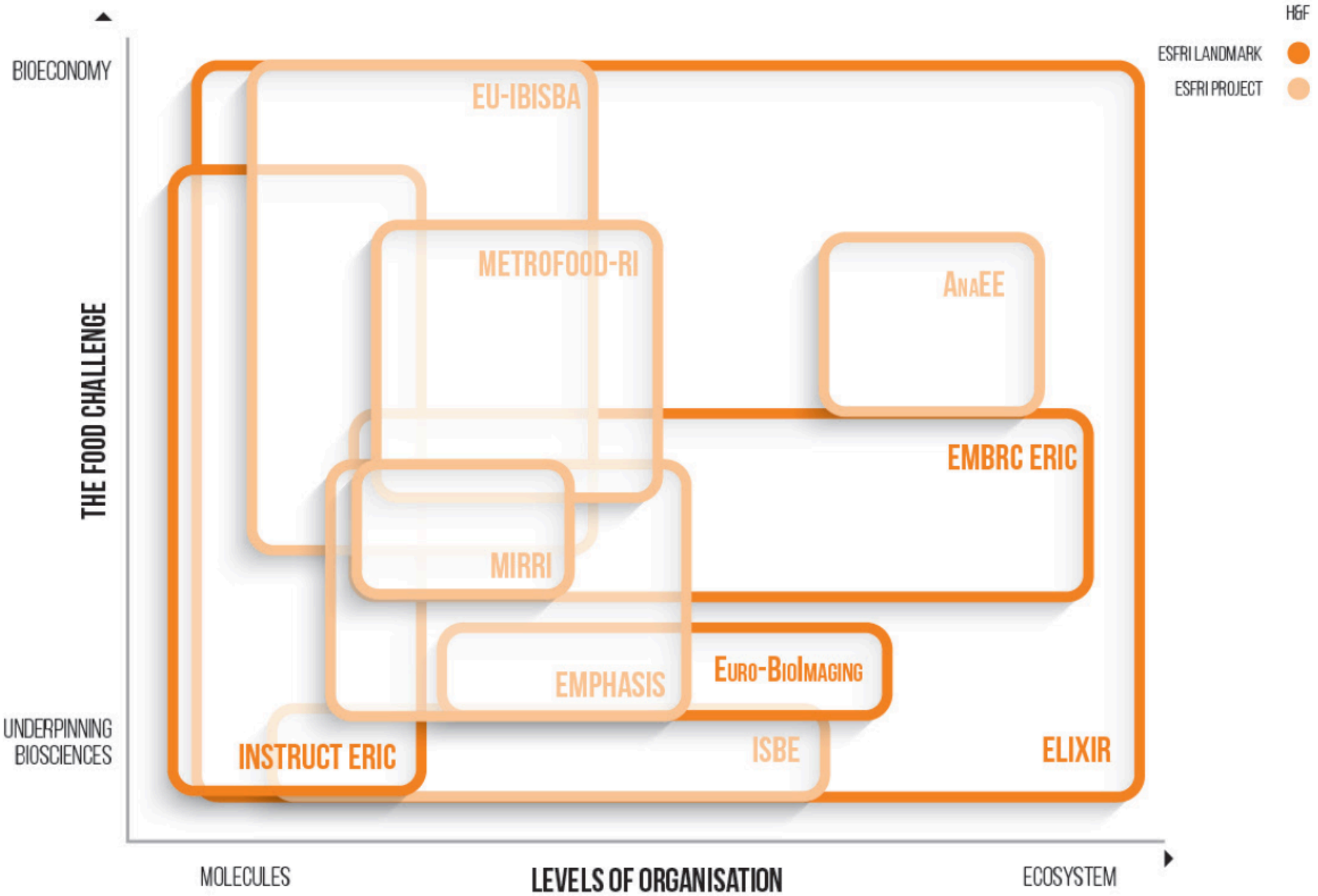
THE FOOD CHALLENGE



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PHYSICAL SCIENCES & ENGINEERING

Research Infrastructures are integral part of the day-to-day activity of Physical Sciences & Engineering. Historically and today the PSE RIs are integrated in the way research is done in these disciplines, and major advances in knowledge are achieved by the research performed at RIs. However, the RIs are much more than research tools; they are truly *Hubs of Knowledge & Innovation* with a complete multidisciplinary approach and a systematic impact on many areas beyond Physical Sciences and Engineering.

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ASTRONOMY AND ASTROPARTICLE PHYSICS

GROUND-BASED TELESCOPES

GAMMA RAY
HESS MAGIC CTA

VISIBLE/INFRARED
LSST ELT VLT

RADIO
ALMA VLBI-JIVE SKA
LOFAR-ILT

NEUTRINO
KM3Net 2.0 IceCube

SOLAR
EST

SPACE-BASED TELESCOPE

VISIBLE
HUBBLE KEPLER EUCLID
PLATO

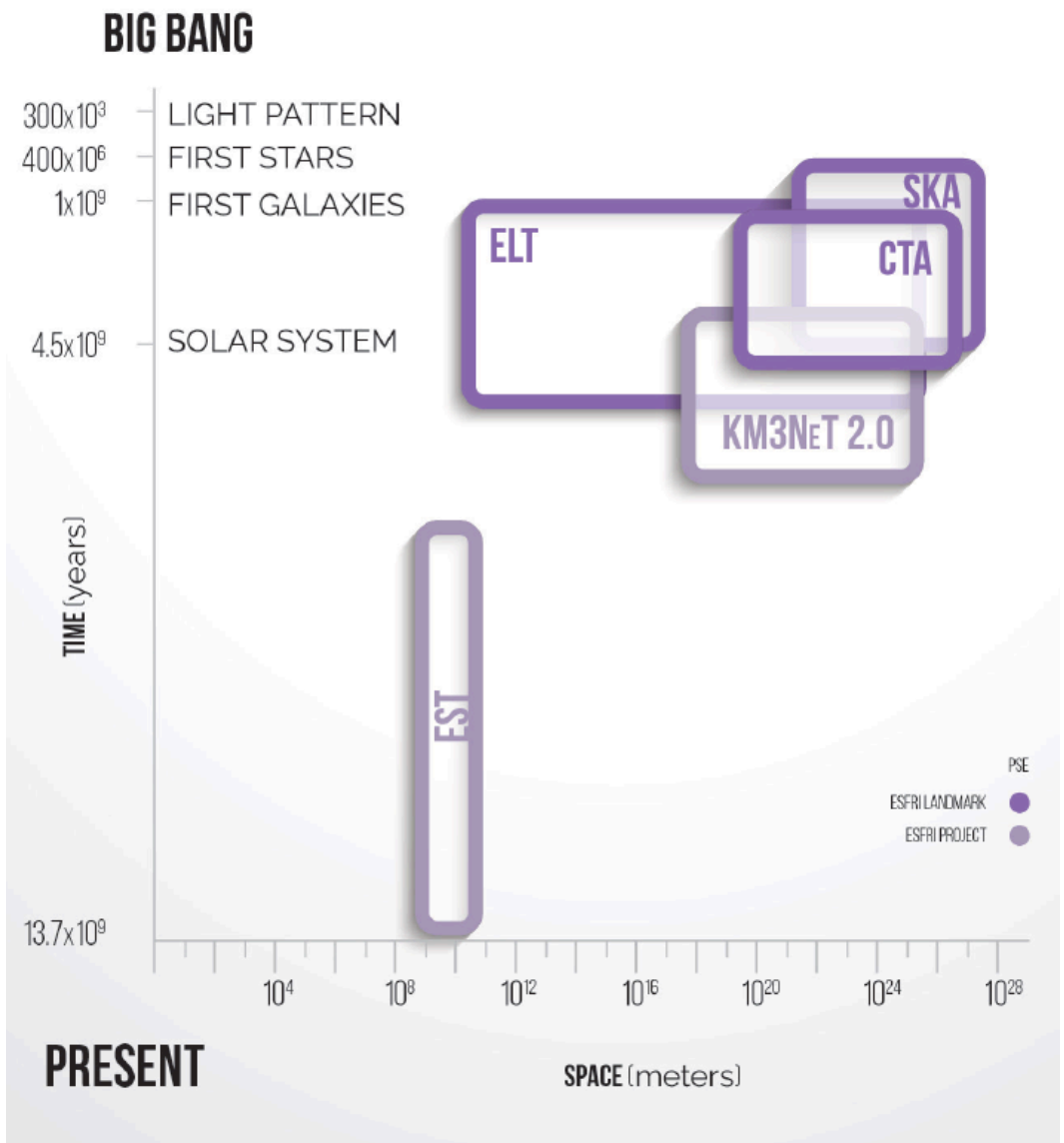
INFRARED/SUB-MILLIMETRE
WEBB/JWST

X-RAY
ATHENA

SOLAR SYSTEM
Solar Orbiter BepiColombo
Exomars Juice

GRAVITATIONAL WAVES INTERFEROMETERS

GROUND- AND SPACE-BASED
LIGO VIRGO KAGRA INDIGO LISA



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ROADMAP 2018

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PARTICLE AND NUCLEAR PHYSICS

PARTICLE PHYSICS

COLLIDERS

HL-LHC FNAL
FCC ILC

PLASMA WAKEFIELD ACCELLERATORS

SACLAY STFC-Daresbury Uni-Glasgow
INFN-Frascati GSI DESY MPI-Munich ELI-Beamline

LHC Atlas, Alice, CMS FAIR RHIC NICA

LEPTON/PHOTON

COMPASS HIPA DAΦNE-INFN Frascati
MAX-lab ELI-NP ELSA MAMI

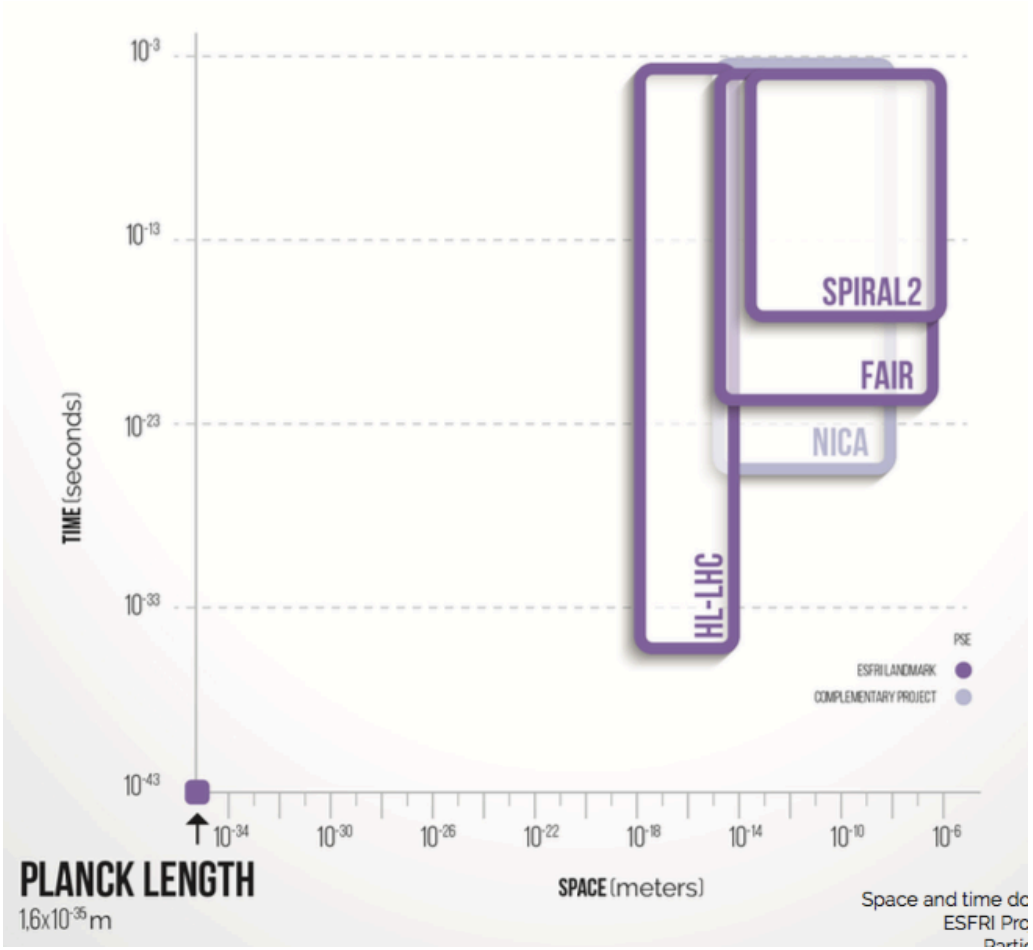
HADRON BEAMS

HIPA DAΦNE-INFN Frascati
COSY Antiproton decelerator-CERN GSI

HEAVY ION BEAMS

ESS JST GNAIL ALTO
ISOLDE SPIRAL2 ECT* FAIR-GSI
INFN-Legnaro JYFL SHE Factory

NUCLEAR PHYSICS



Space and time do
ESFRI Pro

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ANALYTICAL PHYSICS

ANALYTICAL FACILITIES

SYNCHROTRON RADIATION

ESRF PETRA III
ALBA Diamond MAX IV SOLEIL SLS
Elettra Bessy II SOLARIS ASTRID MLS

NEUTRON SCATTERING

ILL ISIS Orphée-LLB FRM-II/MLZ ESS
BER II SINQ JEPPII KJELLER
BNC RI-Delft RPI-Sacavem REZ
VIENNA REACTOR

HIGH PERFORMANCE LASERS

ELI PFS-Petawatt NFFA-SPRINT
ARTEMIS FORTH CFEL T-REX
Laser Majoule HiPER Vulcan

FREE-ELECTRON LASERS

European XFEL Swiss-FEL FERMI@Elettra
FLASH CLIO FELBE FELIX TARLA

OUTSIDE EUROPE
SACLA LCSL PAL

ELECTRON MICROCOPY

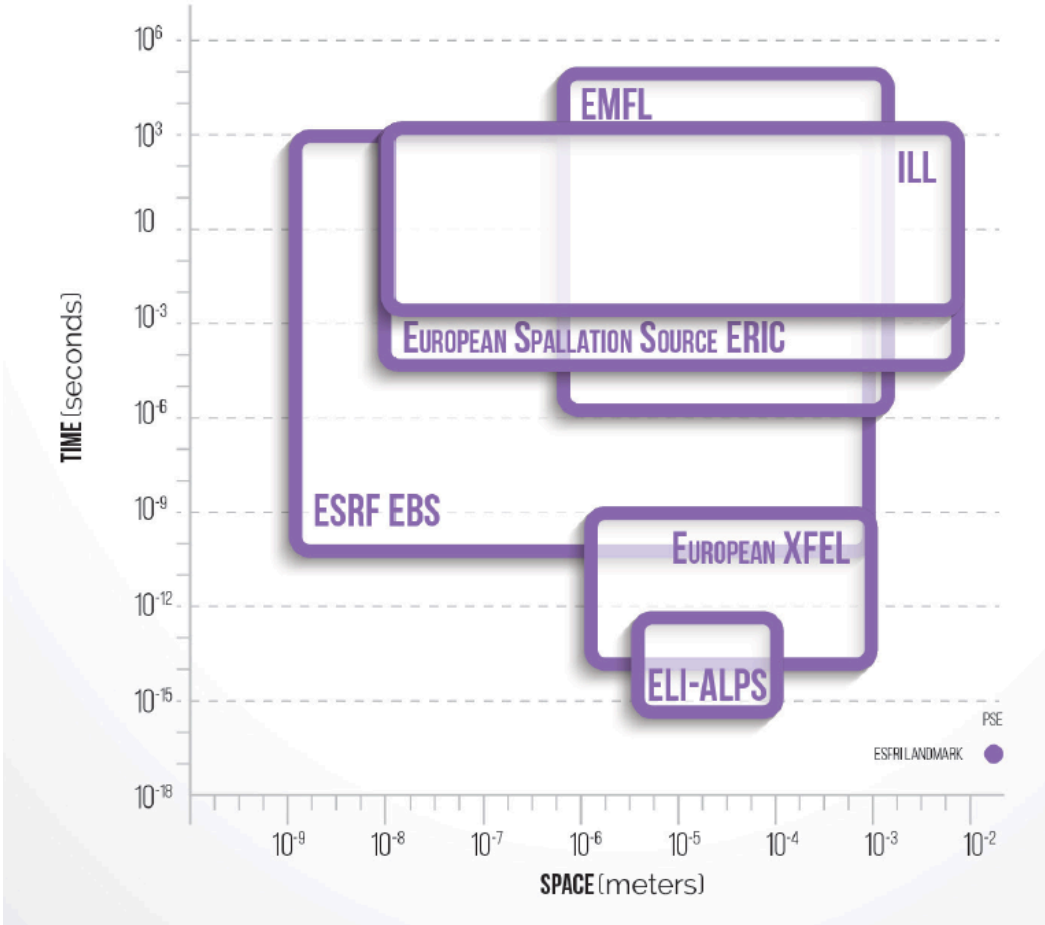
Juelich Harwell
SuperSTEM-Daresbury LPS-Orsay

OUTSIDE EUROPE
SACLA LCSL PAL

HIGH MAGNETIC FIELDS

EMFL

OUTSIDE EUROPE
WHMFC HHMFL NHMFL-MagLab



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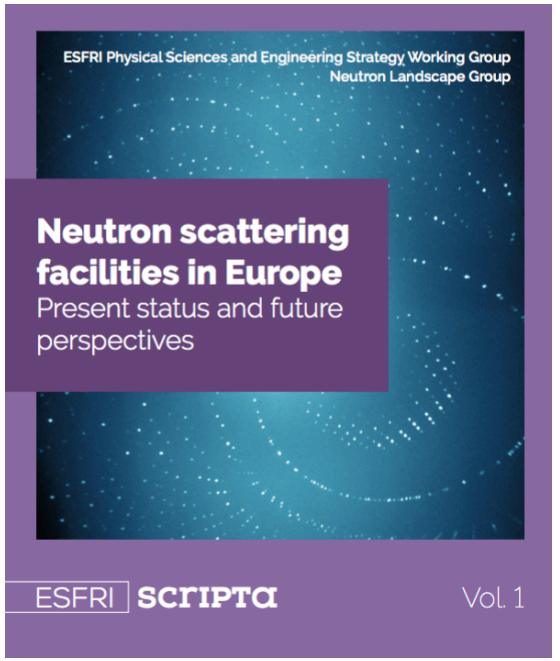
ANALYTICAL PHYSICS

STRUCTURING BENEFITS

Analytical Infrastructures are those that have ***catalysed most clusters*** for the broad scope (science of matter at all scales from atoms to complex materials to living matter and heritage) And large, diversified, user community

New large undertakings, like the ESS, have prompted a general European RI strategy update as reflected in the ESFRI Scripta-1 on Neutron Scattering facilites in Europe and management of their lifecycle



New national efforts have clustered in a coordination effort through the ***LEAPS*** and the new ***LENS*** and perhaps also in Electron Microscopy etc.

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SOCIAL & CULTURAL INNOVATION

Research Infrastructures that support research across and within the Social & Cultural Innovation domain are among the first known infrastructures: libraries, museums and archives are the most obvious examples of this legacy. In today's digital age, Research Infrastructures in the Social Sciences and Humanities (SSH) enhance research into the historical, social, economic, political and cultural contexts of the European Union, providing data and knowledge to support its strategies.

HIGH STRATEGIC POTENTIAL AREAS OF RESEARCH IN THE FIELD OF SOCIAL AND CULTURAL INNOVATION

RELIGIOUS STUDIES

Religious studies have become very relevant not only for researchers, but also social actors and decision makers since positive knowledge on religions is a prerequisite to develop informed dialogue and effective policy in the evolving multicultural society. The economic and demographic crisis affecting Europe, as well as the concurrent immigration from other parts of the world, destabilizes the perception of the European society also in terms of an evolving religious landscape. New forms of orthodoxy appear and social discontent and radicalism are expressed frequently in religious terms which is also a threat to social cohesion in the EU. At the same time, religion has played a central role in social integration throughout the history of humankind and it is important to understand its evolution in a changing European society. In this context, specialized research in the broad field of religious and related sociological studies is of high potential strategic value for addressing the challenges of the evolving European societal landscape and dialogue with the neighbouring countries. To effectively address these challenges, scholars and other users who deal with issues related to religions need open access to libraries, archives, human and digital resources, as well as the dedicated services, at a higher level than typically available today at the existing national research centres and laboratories, or at excellence clusters. Cooperation of scholars in religious studies like in the H2020-funded *Research Infrastructure on Religious Studies initiative* (RelReS)[1] can be of high potential strategic value for creating a diachronic understanding of the historical development of religions and for enabling the appropriate elaboration of tools to manage inter-religious stress.

DIGITAL SERVICES FOR OPEN SCIENCE

Scholarly communication practices in the social sciences and humanities need to be reinforced in order to implement Open Science principles. There is a fragmented and generally sub-critical level of activity corresponding to traditional university presses, other scholarly-led publishers, publication platforms, libraries, service providers and research networks that limits the high innovative potential of this area and its contribution to the effective implementation of the goals of Open Science. Specific challenges of the social sciences and humanities domain need to be addressed: publication typologies – research monographs, critical editions – multilingualism, strong connections of research with local communities. This generates a need of advanced interoperability across the sector and its perspective integration into the EOSC. The need of creating a robust open scholarly communication system capable of contributing to Open Science is evident as well as the opportunity to build it on existing know-how, technologies, infrastructures, business models and funding streams. Cooperation on the development of pan-European services in this field, like in the H2020-funded Design for Open access Publications in *European Research Areas for Social Sciences and Humanities* (OPERAS-D)[2] project, can be of high potential strategic value for promoting better accessibility and interoperability of SCI data and services.

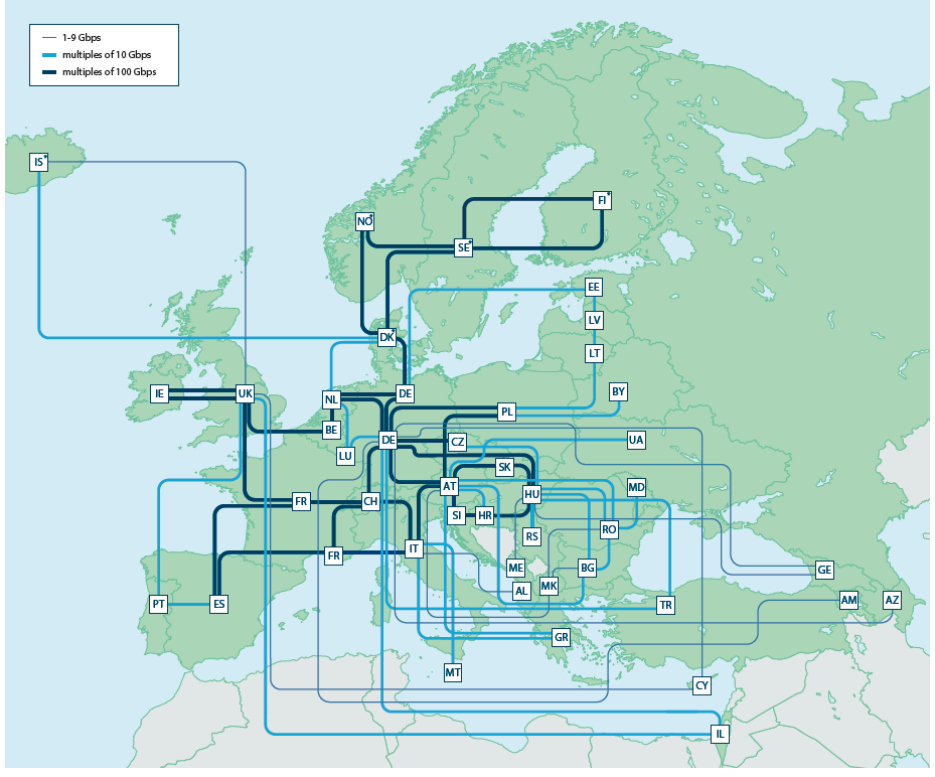
Strategy Report on Research Infrastructures
ROADMAP 2018

ESFRI

DATA, COMPUTING AND DIGITAL RESEARCH INFRASTRUCTURES

In research, as in all fields of society, Information and Communications Technology (ICT) has become a key enabling factor for progress. ICT is also changing the *modus operandi* of research by providing new possibilities for geographically distributed collaboration and sharing. Data-driven science, as well as more and more open access to data and scientific results, is transforming not only how research is conducted, but its overall reach.

GÉANT's pan-European **research and education network** interconnects Europe's National Research and Education Networks (NRENs).
Together we connect over **50 million users** at 10,000 institutions across Europe.



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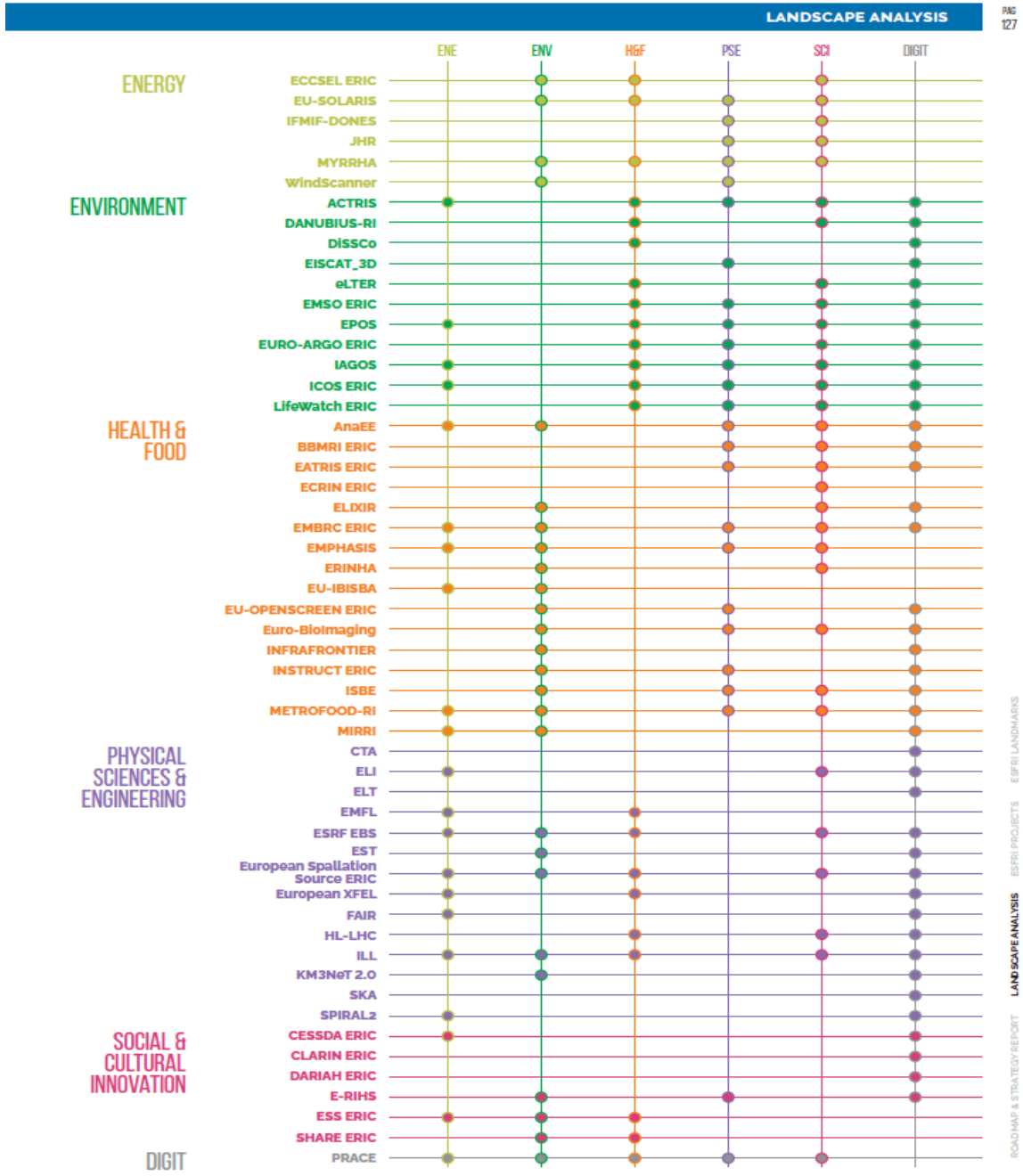
PART2

LANDSCAPE ANALYSIS

INTERCONNECTIONS BETWEEN ESFRI RIs AND SCIENTIFIC DOMAINS

The Landscape Analysis gives evidence of the interconnections among the RIs contributing new knowledge in a complementary way.

The RIs, while maintaining their own disciplinary-rich diversity portfolio, have a high potential to horizontally coordinate on science topics that can be addressed only by adopting multiple diverse complementary techniques.



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CROSS-DOMAIN IMPACTS

ESRF EBS

European Synchrotron Radiation Facility Extremely Brilliant Source

ENE — **Synchrotron radiation facility in energy materials**
Development and optimization of energy materials and components: analysis of materials in extreme conditions and *in operando* conditions

ENV — **Synchrotron radiation facility in spectroscopy and analysis of contaminant components**
Reflectometry on the interactions on contaminants in the atmosphere and liquid systems. Analytical tools

H&F — **Synchrotron radiation facility in heath and food**
Protein crystallography and spectroscopy; high resolution structural biology, X-ray imaging, mammography

SCI — **Synchrotron radiation facility in social and cultural sciences**
Materials structure, spectroscopy, imaging: analysis of samples of the cultural and natural heritage

DIGIT — **Open data resources and management for synchrotron radiation facility**
Large sets of metadata and data on physics, chemistry, material science, life sciences, heritage science, palaeontology, nanotechnology, engineering; data analysis tools

European XFEL

European X-Ray Free-Electron Laser Facility

ENE — **X-ray Free Electron Laser facility in energy processes and materials**
Development and Optimization of Energy Materials and Components: analysis of materials in extreme conditions and *in operando* conditions, time resolved methods

H&F — **X-ray Free Electron Laser facility in heath and food**
Protein crystallography and spectroscopy: single-protein X-ray diffraction, time resolved spectroscopy

DIGIT — **Open data resources and management for X-ray Free Electron Laser radiation facility**
Large sets of metadata and data on physics, chemistry, material science, life sciences, heritage science, palaeontology, nanotechnology, engineering; data analysis tools

Strategy Report on Research Infrastructures ROADMAP 2018

ESFRI

SECTION3

Describes the state of play of the Research Infrastructures in addressing *transversal issues* like **education and training, needs for digital infrastructure, contribution to innovation** along with the *horizontal analyses* like **socio-economic impact, territorial impact, pan-European and global dimensions** that are carried out by all RIs.

The impact of RIs on European research, innovation, culture and society is reflected in training to research and higher education, transfer of disruptive knowledge and refinement of technical understanding to the economy sector of production and services.

The prime role of RIs in generating high-quality data for enabling a knowledge-based economy is transversal to all disciplines and research practices. The analysis of the impact is conducted for all areas with consistent methodology and gives evidence of the contributions and challenges in generating innovation and socio-economic benefits at national, European, and global levels.

Strategy Report on Research Infrastructures
ROADMAP 2018

ESFRI

A Research Infrastructure for Holocaust Research and Remembrance

TYPE
distributed

LEGAL STATUS
pending

POLITICAL SUPPORT
lead country: NL
prospective member countries:
AT, CZ, DE, IL, RO, SK, UK
The full list of research institutions involved must be found in the website of the RI

ROADMAP ENTRY
2018

TIMELINE
- 2010-2019 Design Phase
- 2019-2021 Preparation Phase
- 2021-2022 Implementation/Construction Phase
- 2022 Operation Start

ESTIMATED COSTS
capital value: 15 M€
design: 15 M€
preparation: 3 M€
construction: 0.8 M€
operation: 2 M€/year

HEADQUARTERS
to be defined

WEBSITE
www.ehri-project.eu

EHRI
European Holocaust Research Infrastructure

Description
The European Holocaust Research Infrastructure (EHRI) is a new pan-European distributed RI that supports the Holocaust research community. It provides access to information about dispersed sources, and develops tools and methods that enable researchers and archivists to collaboratively work with such sources. It thereby seeks to overcome one of the hallmark challenges of Holocaust research – the wide dispersal of sources across Europe and beyond, and the concomitant fragmentation of Holocaust historiography. By integrating sources and research, EHRI enables the study of the Holocaust as a European phenomenon.

Providing access – both online via the EHRI Portal and physical via fellowships and training – is vital for the innovation of Holocaust research and for the training of the next generation of Holocaust researchers and archivists. Through its outreach and public history activities, EHRI further ensures the meaningful remembrance of the Holocaust as a formative European experience.

Background
Holocaust archives are an important part of European cultural heritage. The availability and accessibility of property contextualised and researched documentation are vital to enable transnational research on the Holocaust as a local, European and universal phenomenon. Until 1989, Israel, the United States and Western Europe were the main centres for Holocaust research. Locating and researching Holocaust documentation in other parts of Europe is still difficult due to the wide dispersal of the archival source material in national, regional and local research infrastructures. As a result studying the Holocaust from a truly European perspective remains challenging.

By facilitating an extensive network of researchers and archivists, EHRI initiates new transnational and collaborative approaches to the study of the Holocaust. From the beginning, EHRI has invested in the integration of multiple disciplines – history, archival science and digital humanities. The development of innovative approaches to deal with digital content facilitates the processing of large amounts of data, which is conducive for new and enhanced research. By establishing working relationships with archivists and researchers active in related fields – Nazi crimes against non-Jewish victims' groups, Genocide Studies – EHRI will maximise its reach and impact, and ensure that it benefits from insights gained in related fields.

EHRI particularly focuses on increasing visibility of local, peripheral and hidden archives, thereby facilitating local research into Jewish life during the Holocaust. This focus enables the study of the Holocaust from below, contributes to the strengthening of local community consciousness, and others educational opportunities at a local level. All these aspects are important given the increasing challenges to the memory of the Holocaust in Europe.

Online availability of Holocaust sources and research has relevance well beyond the walls of academia. The Holocaust continues to have enormous social, cultural and political resonance, and EHRI supports the democratisation of knowledge about the Holocaust, thereby contributing to the fight against Holocaust denial and ensuring that its lessons will never be forgotten.

Steps for implementation
EHRI has been working on integrating Holocaust-related sources and research documentation since 2010. The first phase was funded under FP7 and the current project is supported under Horizon 2020. More than twenty organisations – research institutions, libraries, archives, museums and memorial sites – form a core working group, but EHRI equally relies on the support of many other individuals and organisations in the broad fields of Holocaust studies and digital humanities.

By bringing together experts from different fields, and by building an innovative digital infrastructure supported by a large community, EHRI is a flagship project that showcases the opportunities for historical research in the digital age. EHRI aims at a relatively short Preparation Phase to prepare the financial, legal and the remaining technical aspects of the permanent RI. The Implementation Phase is foreseen in 2021 with the Operation Phase starting in 2022.

A multi-scale phenotyping platform for food security in different agro-climatic scenarios

TYPE
distributed

LEGAL STATUS
pending

POLITICAL SUPPORT
lead country: DE
prospective member countries:
BE, CY, CZ, FR, IE, IT, NL, UK
The full list of research institutions involved must be found in the website of the RI

ROADMAP ENTRY
2016

TIMELINE
- 2017-2020 Preparation Phase
- 2020-2021 Implementation/Construction Phase
- 2021 Operation Start

ESTIMATED COSTS
capital value: 160 M€
design: Not Available
preparation: 4 M€
construction: 73 M€
operation: 3.6 M€/year

HEADQUARTERS
Forschungszentrum Jülich
Jülich, Germany &
Institut National de
la Recherche Agronomique-INRA
Montpellier, France

WEBSITE
https://emphasis.plant-phenotyping.eu/

EMPHASIS
European Infrastructure for Multi-scale Plant Phenomics and Simulation

Description
The European Infrastructure for Multi-scale Plant Phenomics and Simulation (EMPHASIS) is a distributed Research Infrastructure to develop and provide access to facilities and services addressing multi-scale phenotyping in different agro-climatic scenarios. EMPHASIS will establish an integrated European phenotyping infrastructure to analyse genotype performance under diverse environmental conditions and quantify the diversity of traits contributing to performance in diverse environmental scenario – plant architecture, major physiological functions and output, yield components and quality. EMPHASIS aims to address the technological and organizational limits of European Phenotyping, for a full exploitation of genetic and genomic resources available for crop improvement in changing climate.

Inserted in the ESFRI Roadmap in 2016, EMPHASIS is expected to enter the Implementation Phase in 2020 and become operational in 2021.

Background
Sustainable intensification of crop production is a major challenge to ensure amount and quality of biomass for nutrition and industry. Designing high yielding crop varieties adapted to contrasting environmental conditions, climate change and management, is a priority. Technological advancements have boosted the characterisation of genomes, without sufficient development in phenotypic characterisation. The mission of EMPHASIS addresses an important bottleneck in sustainable and improved crop production in different, current and future, agro-climatic scenarios: how to translate from high-throughput genotypic analysis of crop variants to high-throughput and high-resolution phenotyping in order to identify high-yield crop varieties for defined environmental conditions. To achieve this, EMPHASIS proposes a major upgrade/reorientation of existing European Research Infrastructure by linking and developing national initiatives, amongst which are national platforms with (semi)-controlled conditions for high-resolution phenotyping and high-throughput phenomics, experimental fields with control of rainfall and CO2 highly-equipped with phenotyping devices, a coordinated network of field experiments in distributed sites with lighter but efficient phenotyping close to practical breeding set-ups and modelling platforms to test existing and virtual combinations of alleles in different climates and management practices. Some methods used will include sensors and imaging in plant architecture and dynamics, consistent distributed information system, and statistics and dynamic modelling.

EMPHASIS can test genotypes in current and future agro-climatic scenarios and provide community access to controlled and field conditions; link data acquisition to a European data management and to crop models simulating performance in current and future climates; develop, evaluate and disseminate novel technologies and provide new opportunities to European companies and make infrastructures and concepts accessible to academia and industry in Europe.

Steps for implementation
The Preparatory Phase of EMPHASIS started in 2017 to bring the project to the level of legal, financial, and technical maturity required for implementation. EMPHASIS PP provide the basis for the establishment of the legal framework, the business plan and the preparation of an information system for a sustainable and innovative pan-European infrastructure for plant phenotyping. Actually, political support and commitment to EMPHASIS has been expressed by nine European countries in the form of previous investments and an additional investment from Germany. EMPHASIS has already committed 49 M€ (67%) of the total cost until full establishment in the next five years. EMPHASIS is already placing Europe in a leading position via the International Plant Phenotyping Network, and has already engaged further Member States in their current plans. It is timely that this is secured in a long-term, sustainable pan-European Research Infrastructure filling an important gap in the Health & Food landscape.

Strategy Report on Research Infrastructures
ROADMAP 2018

ESFRI

CHERENKOV TELESCOPE ARRAY FOR HIGH-ENERGY GAMMA-RAY ASTRONOMY TO PROBE A NON-THERMAL UNIVERSE

CTA
Cherenkov Telescope Array

TYPE single-sited

LEGAL STATUS gGmbH, 2014

POLITICAL SUPPORT
lead country: IT
member countries: AT, AU, CH, CZ, DE, ES, FR, JP, SI, UK
The full list of research institutions involved must be found in the website of the RI

ROADMAP ENTRY 2008

TIMELINE
2011-2016 Preparation Phase
2017-2018 Interim/Transition Phase
2019-2024 Implementation/Construction Phase
2024 Operation Start

ESTIMATED COSTS
capital value: 400 M€
design: Not Available
preparation: 8 M€
construction: 297 M€
operation: 20 M€/year

HEADQUARTERS
CTAO gGmbH
Heidelberg, Germany

WEBSITE
www.cta-observatory.org

DESCRIPTION
The Cherenkov Telescope Array (CTA) is a Research Infrastructure for ground-based very high-energy gamma-ray astronomy. With two host sites in the southern and northern hemispheres – on the European Southern Observatory (ESO) at Paranal grounds in Chile and at the Instituto de Astrofisica de Canarias (IAC) in Roque de los Muchachos Observatory in Spain – it will extend the study of astrophysical origin of gamma-rays at energies of a few tens of GeV and above, and investigate cosmic non-thermal processes. CTA will provide the first complete and detailed view of the universe in this part of the radiation spectrum and will contribute towards a better understanding of astrophysical and cosmological processes, such as the origin of cosmic rays and their role in the Universe, the nature and variety of particle acceleration around black holes and the ultimate composition of matter and physics beyond the Standard Model.

In the ESFRI Roadmap since 2008, CTA became a gGmbH in 2014 and is actually striving to establish the European Research Infrastructure Consortium (ERIC) with operations expected to start in 2024.

ACTIVITY
High-energy gamma-rays probe a non-thermal Universe because, apart from the Big Bang, there is nothing hot enough in the known Universe to emit such gamma-rays. These gamma-rays can be generated when highly relativistic particles collide with ambient gas, or interact with photons and magnetic fields (bottom-up process). By studying their energy and flux spectrum, it is possible to trace these cosmic rays and electrons in distant regions of our own Galaxy or even in other galaxies. High-energy gamma-rays can also be produced in a top-down fashion by decays of heavy particles such as the hypothetical dark matter particles. Therefore, gamma-rays provide a window to the discovery of the nature and constituents of dark matter, relics which might be left over from the Big Bang. The present generation of imaging atmospheric Cherenkov telescopes (H.E.S.S., MAGIC and VERITAS) has in recent years opened the realm of ground-based gamma-ray astronomy in the energy range above a few tens of GeV. The Cherenkov Telescope Array will explore our Universe in depth in Very High Energy (VHE, E>10 GeV) gamma-rays and investigate cosmic non-thermal processes, in close cooperation with observatories operating at other wavelength ranges of the electromagnetic spectrum, and those using other messengers such as cosmic rays and neutrinos.

CTA will consist of arrays of Cherenkov telescopes that will be built at two separate sites, one in the southern hemisphere with wide gamma-ray energy range and high resolution to cover the plane of the Milky Way, and the second in the northern hemisphere specialised for lower energies, which will focus on extragalactic and cosmological objects. The array will allow the detection of gamma-ray induced cascades over a large area on the ground, increasing the number of detected gamma rays dramatically, while at the same time providing a much larger number of views of each cascade. The design foresees an improvement in sensitivity of a factor of 5-10 in the current very high-energy gamma ray domain from ~ 100 GeV to some 10 TeV – and an extension of more than three orders of magnitude in the accessible energy range, up to above 100 TeV.

IMPACT
CTA has broad social and economic impact. In social dimension, being a world-wide RI, CTA fosters international collaboration and mobility across not only Europe but also Americas, Asia, Africa and Australia requiring people from different cultures work together. It also creates a unique network of researchers in academia and in industry giving a new dimension to the publicly funded basic science.

CTA telescopes demand forefront research and their large number implies that technologies involved cannot remain at laboratory scale but need to scale up to large deployment of products useful for commercialisation and application in other areas – e.g. photosensors with vastly improved characteristics may find application in medical imaging. SMEs in different countries are already involved in production of CTA components, and various aspects of operation and maintenance of CTA will be outsourced to local industry. The array sites, headquarters and data management centre will attract skilled individuals who will directly contribute to the local economy and training of local technicians and engineers in an intellectually challenging environment.

EPOS
European Plate Observing System

A LONG-TERM PLAN FOR THE INTEGRATION OF NATIONAL AND TRANSNATIONAL RESEARCH INFRASTRUCTURES FOR SOLID EARTH SCIENCE

TYPE distributed

LEGAL STATUS ERIC Step2, 2018

POLITICAL SUPPORT
lead country: IT
member countries: DK, FR, NO, PT, SI, UK
***observers:** CH, EL
prospective member countries: AT, BE, ES, FI, IE, IS, NL, PL, RO
The full list of research institutions involved must be found in the website of the RI

ROADMAP ENTRY 2008

TIMELINE
2000-2010 Design Phase
2010-2014 Preparation Phase
2015-2022 Implementation/Construction Phase
2020 Operation Start

ESTIMATED COSTS
capital value: 500 M€
design: 30 M€
preparation: 45 M€
construction: 32 M€
operation: 18 M€/year

HEADQUARTERS
Istituto Nazionale di Geofisica e Vulcanologia - INGV
Rome, Italy

WEBSITE
www.epos-eu.org

DESCRIPTION
The European Plate Observing System (EPOS) aims to create a pan-European infrastructure to monitor and unravel the dynamic and complex solid Earth system by integrating the diverse and advanced Research Infrastructures for solid Earth science 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 tsunamis 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 for a safe and sustainable society.

EPOS is currently in the Implementation Phase. The establishment of the European Research Infrastructure Consortium (ERIC) is foreseen in 2018.

ACTIVITY
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. Geology, natural hazards, natural resources and, in general, environmental processes do not respect national boundaries, therefore seamless, transnational integration of measurements and data is often vital for optimal research and related activities. 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 observations, satellite data and products, geomagnetic observations, 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 combines 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.

IMPACT
The data and services made available by EPOS are of interest to academy, industry and society. Understanding how the Earth works as a system is critically important to modern society. Society requires resources to support home life, industry and business and it needs security in the face of natural hazards. Volcanic eruptions, earthquakes, floods, landslides and tsunamis are all Earth phenomena impacting on society. Solid Earth science by bringing together many diverse disciplines such as geology, seismology, geodesy, volcanology, geomagnetism as well as chemistry and physics, is the place where to find answers on how to maintain the Earth a safe, prosperous, and habitable planet. Combining a sound physical understanding of natural hazards with the means to monitor and forecast their occurrence will mitigate their effects increasing public awareness of natural risks.

Strategy Report on Research Infrastructures ROADMAP 2018

ESFRI

6. NEXT ROADMAP UPDATE

RATIONALE

- ESFRI needs time to respond effectively to the new mandates from the Council. This work would then feed into the next Roadmap process.
- Taking into account lessons learnt from the Roadmap 2018, there is a need for reflection on the Roadmap Methodology – e.g. concerning cost analysis, monitoring, specific/flexible grid of criteria for different type of RIs.

Adoption of the Roadmap can be scheduled for March 2021 or June 2021, so that the Launch event will occur during the Slovenian Presidency late in October.

Strategy Report on Research Infrastructures
ROADMAP 2018

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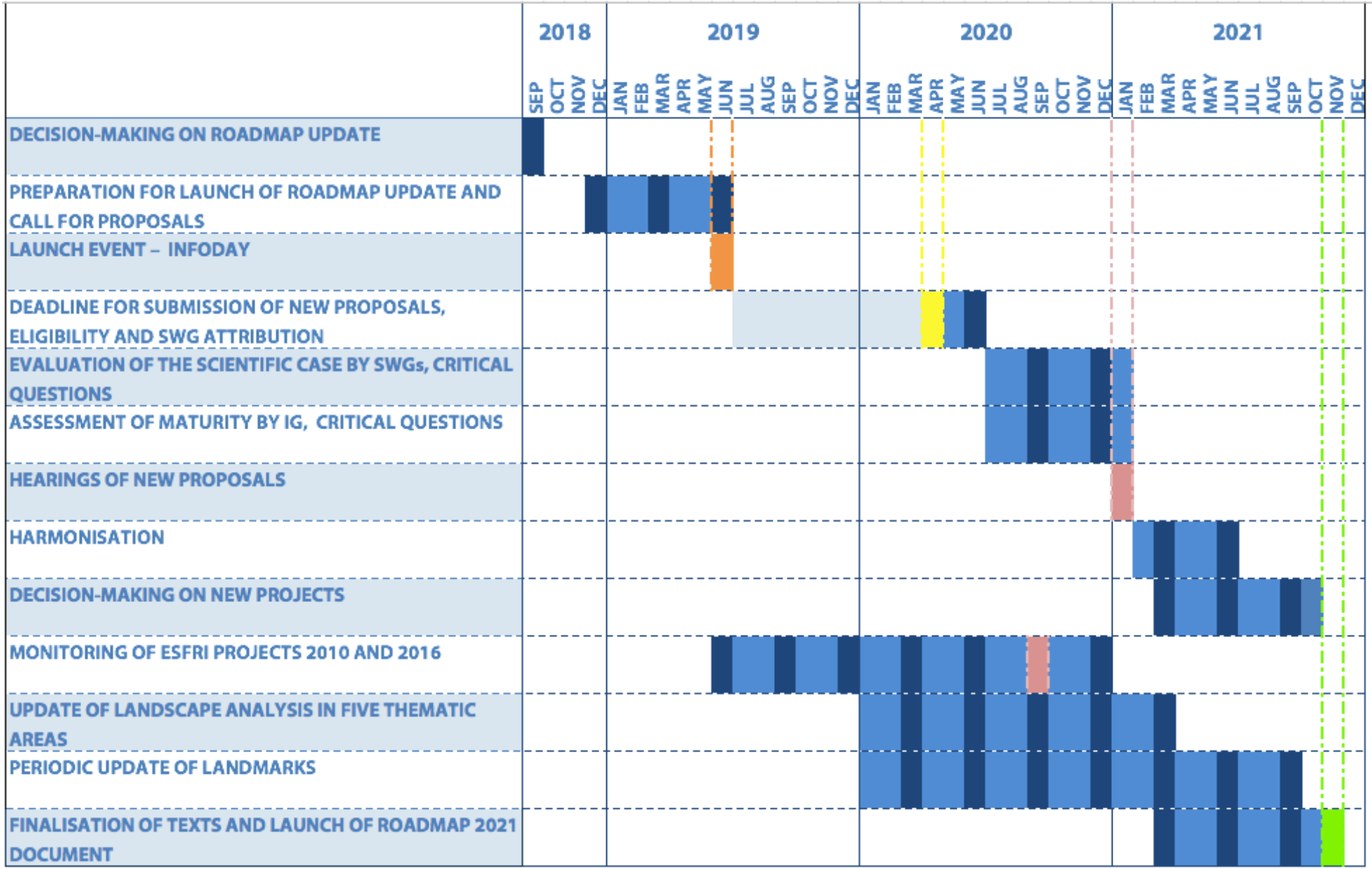
NEXT ROADMAP UPDATE – TIMELINE

TIMELINE



ESFRI

European Strategy Forum
on Research Infrastructures

ESFRI WORKSHOP
MONITORING OF RIs, PERIODIC UPDATE OF LANDMARKS, USE OF KPIs
way forward

19-20 NOVEMBER 2018

Palazzo delle Stelline - Milano

THE LANDMARK DYNAMICS

UPDATING OF LANDMARKS

1. LANDMARKS HAVE LONG TERM RESIDENCY ON THE ROADMAP TO PERFORM OPERATION AT THE TOP LEVEL IN THEIR DOMAIN AND AS REFERENCE RESEARCH INFRASTRUCTURES THAT NEED CONTINUOUS SUPPORT
2. PERIODICALLY THE EVIDENCE OF THE LANDMARK STATE OF PLAY (PERFORMANCE) MUST BE UPDATED IN A NON-INVASIVE, BUT FULLY TRANSPARENT WAY
3. A SUSTAINABLE CYCLE (FOR RIS AND FOR ESFRI) OF UPDATE CYCLE (5-7 YEARS, 5-6 LANDMARKS/YEAR) MUST BE ESTABLISHED, INDEPENDENT OF THE PERIODICITY OF THE ROADMAP UPDATES

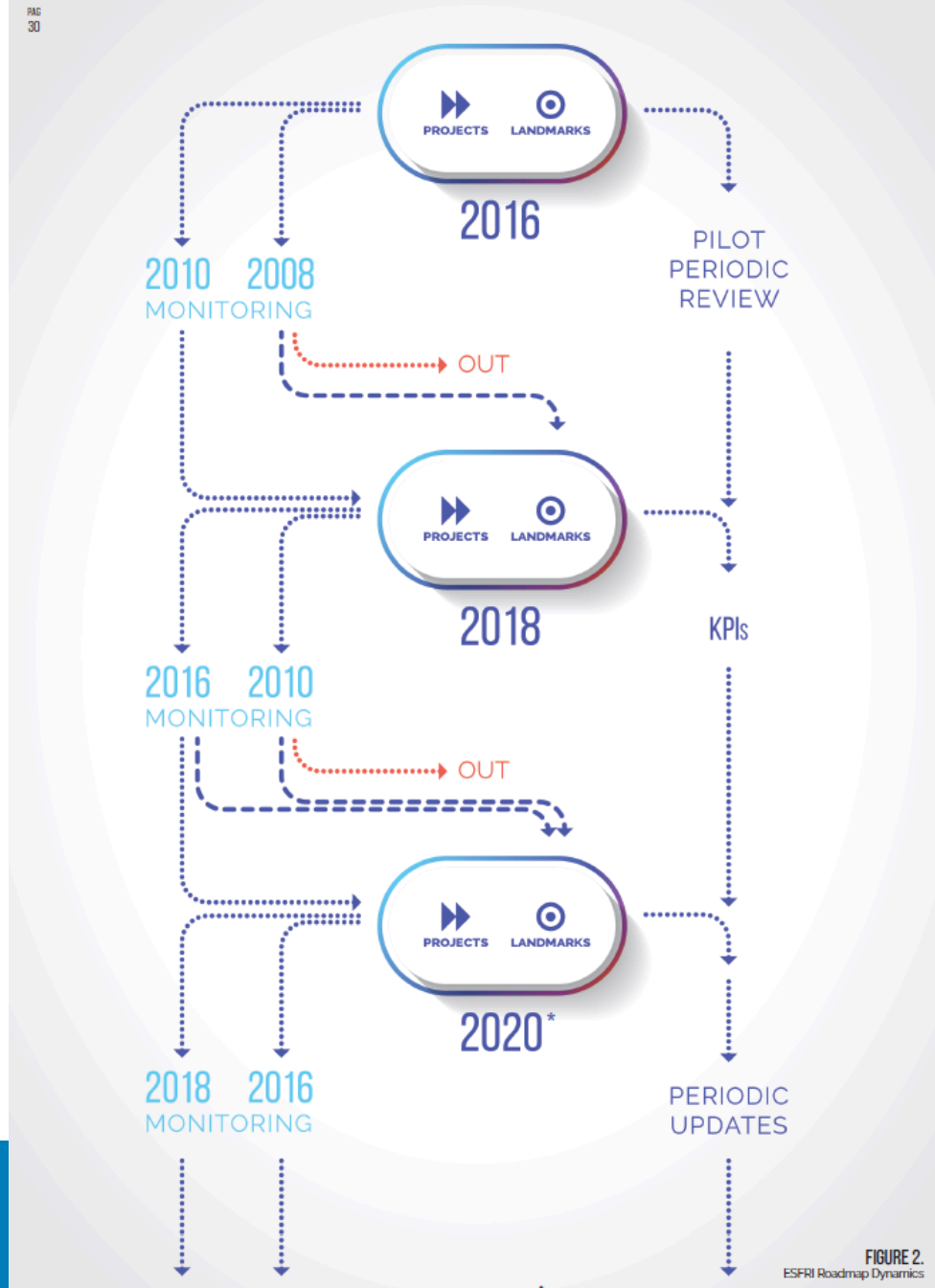


FIGURE 2.
ESFRI Roadmap Dynamics

*according to the ten-year rule the ESFRI Projects 2010 will be monitored in view of next Roadmap update that will be carried out in 2020.

ESFRI

Ideas from the workshop

UPDATING OF LANDMARKS

LANDMARKS AND RIS ARE RESEARCH AMPLIFIERS THEY ENABLE MORE RESEARCH TO BE DONE FOR THE BUDGET SHARE DEDICATED TO THEM

THIS IS SOMETHING TO BE MEASURED WITH THE HELP OF DELEGATIONS AND RIS

IMPACT IS ON THE SCIENCE COMMUNITY AND ON THE ORGANIZATION OF RESEARCH INCLUDING INDIRECT FUNDING TO RESEARCH BY USERS

SCOPE OF UPDATE IS NOT RANKING RIS BUT KNOWING THEIR STATE OF PLAY

MONITORING OF RIs

NEW MANDATE

EU COUNCIL CONCLUSIONS OF 29 MAY 2018 ON ACCELERATING KNOWLEDGE CIRCULATION IN THE EU

"*Stresses the importance of human resources and training skills as key factors in the success for Research Infrastructures and ACKNOWLEDGES the need for Research Infrastructures to strengthen a service-driven approach; INVITES Member States and the Commission within the framework of ESFRI to develop a common approach for monitoring of their performance and INVITES the Pan-European Research Infrastructures, on a voluntary basis, to include it in their governance and explore options to support this through the use of Key Performance Indicators*".

THESE RECOMMENDATIONS INSPIRE THE FORMULATION OF THE

PERIODIC UPDATES OF LANDMARKS, and the work TOWARDS A FEW GENERIC KEY PERFORMANCE INDICATORS.

European Commission

StR ESFRI

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