National Research, Development and Innovation Office
Hungary

National Research Infrastructure Roadmap

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Background

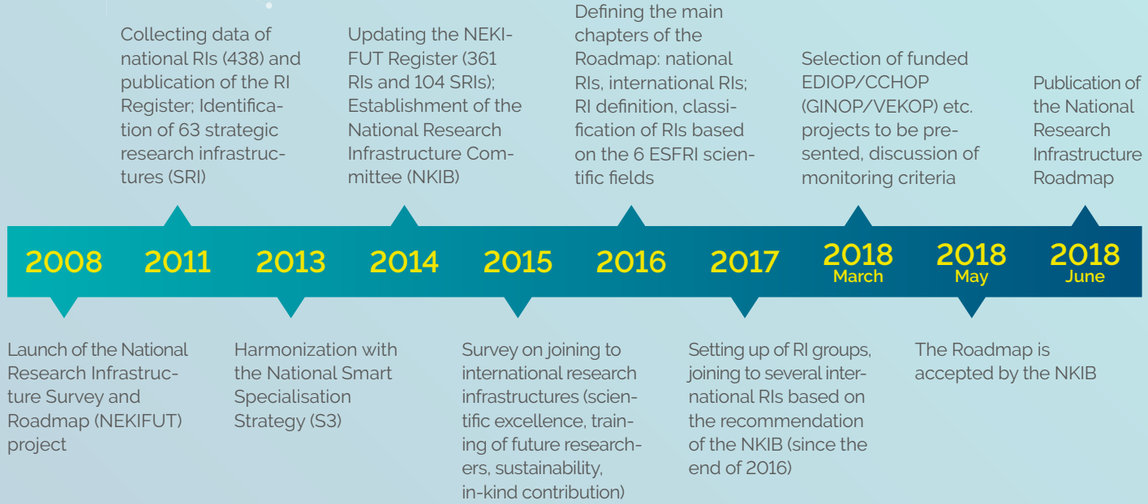
Drafting the National Research Infrastructure Roadmap became more pressing than ever after the publication of the ESFRI Roadmap 2016. It has become a key interest in science and innovation policy to map domestic research infrastructures (RIs), identify their development needs and use the results as a basis for creating a national research infrastructure development programme. The decision on joining foreign infrastructures made it possible to draft the National Research Infrastructure Roadmap. The Roadmap features two types of infrastructure. The first ones include those which are important for participating in foreign infrastructures either as members of a network or as domestic infrastructures necessary for the use of a foreign infrastructure. The second type comprises infrastructures that are important due to certain national characteristics, are not available elsewhere and are significant in a Hungarian context (e.g. data banks). Research infrastructures should be considered as units that are integral parts of the domestic and European innovation system, serving as a kind of 'network' for the stakeholders of the system, such as researchers, students and enterprises.

Today world-class research increasingly demands world-class research infrastructures. Cutting-edge research infrastructures can only be established and operated effectively in international cooperation in terms of assets, equipment, data and human resources, and such cooperation relationships can only be selected and created by adopting a coordinated strategic approach (i.e. a roadmap) at European level. This process is coordinated by the European Strategy Forum on Research Infrastructures (ESFRI).

Process of creating the National Research Infrastructure Roadmap

1. Surveying and integration of infrastructure data	2. Selection of infrastructures to be included in the Roadmap	3. Selection of RI groups and classification of the individual RIs into them	Landscape of domestic RIs	Next steps
Source of data: ▸ Hungarian ESFRI memberships ▸ RIs developed from domestic and EU funds (GINOP/VEKOP etc.) ▸ List of SRIs (NEKIFUT database)	**Selection criteria:** ▸ Open access and capacity ▸ International connection ▸ Uniqueness and scientific excellence ▸ National strategic relevance ▸ Upgrading options	**Grouping principles:** ▸ Presentation of scientific diversity with the whole spectrum of national infrastructures ▸ Correspondence with ESFRI thematic fields ▸ Sustainability ▸ Professional aspects represented by the NKIB members ▸ Selection of coordinator institutions	With thematic introduction of international (EU) connections	▸ Monitoring and evaluation of RI groups (paying special attention to the sustainability criteria) ▸ Foster the implementation of strategic goals through RI groups (e.g. networking, increased use of capacity, international cooperation, memberships etc.)

Stages and milestones of developing the National Research Infrastructure Roadmap



ESFRI has long been encouraging EU member states to prepare their own national research infrastructure roadmaps in relation to the strategic European roadmap. The first preparatory works of the Hungarian National Research Infrastructure Roadmap dates back to 2008 with the following aims:

- to map major research infrastructures in Hungary and provide an insight into their operation;
- to present the excellence of domestic research communities, and the nature and diversity of capacities;
- to make Hungarian research capacities and opportunities attracting to the domestic and international research community;
- to provide background information for identifying potential further development directions for domestic research infrastructures; and
- to list the connection points to European research infrastructures and cooperation opportunities.

The research infrastructures

- provide a basis for scientific discoveries and for expanding our knowledge of the world;
- determine the international scientific competitiveness of a country;
- facilitate the reinforcement and expansion of human research capacities;
- strengthen cooperation and networking between researchers and research groups;
- promote knowledge-sharing between the research community and the business sector;
- provide answers to global challenges;
- generate significant socio-economic effects.

Hungary's participation in European research infrastructures

Hungary has long-established and internationally recognised traditions in the field of research and development, which is also demonstrated by the country's scientific achievements and extensive international relations. Hungary has long been participating in the research projects of certain international, European research infrastructures, but since 2015, as a result of a comprehensive survey (which focused not only on scientific excellence but also on the training of future researchers, sustainability and the possibility of providing in-kind contribution to certain foreign research infrastructures), this cooperation has extended to many other foreign research infrastructures.

The NRDI Office spends around HUF 3.25 billion (EUR 10 million) on Hungary's participation in international research infrastructures annually, making it possible to join several international research projects.

Hungary is currently a full-fledged member of the following international research infrastructures:

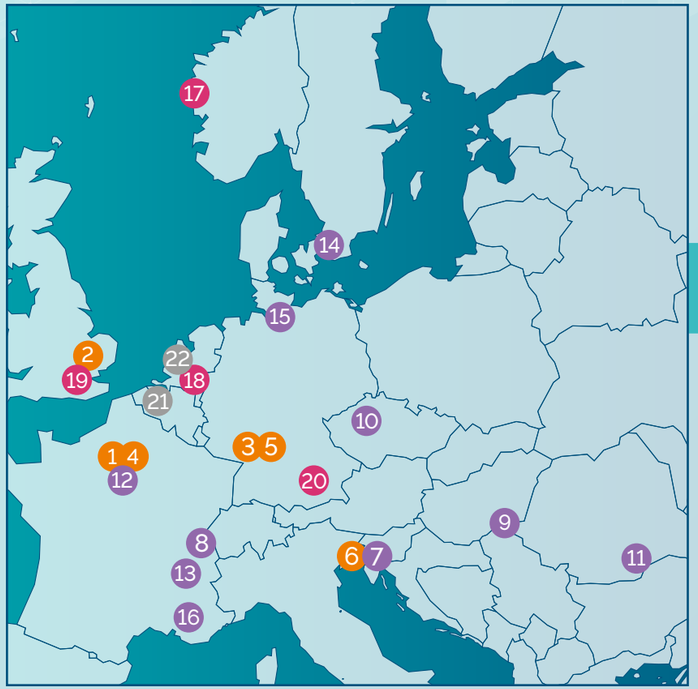
RI short name	RI full name	Brief description
	Health & Food	
ECRIN-ERIC	European Clinical Research Infrastructure	Supports the creation of a high quality, transparent, multinational system of clinical trials by mitigating the drawbacks of the fragmented clinical trial environment and poor interoperability.
ELIXIR	A distributed infrastructure for life-science information	This European initiative connects and integrates into a single infrastructure the major bioinformatics resources of national centres, hubs and services providers. It supports many fields of life sciences, including research in the field of agriculture and medicine.
EMBL*	European Molecular Biology Laboratory	One of the leading European laboratories in life sciences. It has 80 independent member research institutions covering the full spectrum of molecular biology from the molecule to the organism, including the fields of system biology and bioinformatics.
ERINHA	European Research Infrastructure on Highly Pathogenic Agents	Infrastructure network studying and analysing the properties and spread of photogenic microscopic organisms in humans and animals and the public health, social and economic consequences of contagious diseases.
EuBI ERIC	European Research Infrastructure for Imaging Technologies in Biological and Biomedical Sciences ERIC	Provides access to a wide range of state-of-the-art technologies in biological and clinical imaging. It aims to connect the specialised, geographically fragmented national hubs to reach all European researchers in the member states.
ICGEB*	International Centre for Genetic Engineering and Biotechnology	Every year, the ICGEB announces an open call for cooperative biotechnology research projects, for PhD and Postdoctoral fellowship applications, and for proposals relating to the organisation of conferences and training courses.
	Physical Sciences & Engineering	
CERIC-ERIC*	Central European Research Infrastructure Consortium, European Research Consortium	The multidisciplinary research infrastructure integrates research projects in 7 European countries in the fields of materials science and nanotechnology at market price. The main focus of the consortium is open access (researcher exchange). Access is free of charge for commercial and industrial research projects.
CERN*	The European Organization for Nuclear Research	The European Organization for Nuclear Research (CERN) is one of the most prestigious research centres in the world. Its main mission is basic research in particle physics with an aim to better understand the properties of basic interactions and the relationships of the universe. It designs, builds and operates complex particle accelerator equipment.

RI short name	RI full name	Brief description
CERN HL-LHC (ALICE, CMS)	High-Luminosity Large Hadron Collider (CERN)	The Large Hadron Collider (LHC) operated by CERN is going to be upgraded to increased intensity between 2019 and 2026. The detectors are also being upgraded: this work has already started in 2018. Of the four large detectors of LHC, Hungary participates in the experiments of ALICE and CMS. The CMS (and Atlas) project contributed to the discovery of the Higgs boson. The ALICE project recreates the primary matter through heavy-ion collisions.
ELI-ERIC	Extreme Light Infrastructure ERIC	The primary mission of the ELI Attosecond Light Pulse Source (ELI-ALPS) research infrastructure in Szeged is to provide access to a wide range of ultra-short light pulses sources for various user groups of the international scientific community. Another main element in the facility's mission is to promote the scientific and technological developments necessary for delivering lasers with high peak intensity and high average performance.
ESA*	European Space Agency	ESA is an international organization with 22 member countries, including Hungary. It is responsible for the planning and implementation of Europe's space programme. ESA programmes are designed to collect more information about the Earth and its immediate space environment, the Solar System and Space. It also develops satellite-based technologies and services, supports the space industry and facilitates the on-Earth application of technologies developed in space.
ESRF UPGRADES	European Synchrotron Radiation Facility (ESFR) Upgrades, Phase II: Extremely Brilliant Source	The world's leading X-ray source. A state-of-the-art equipment enabling the atomic and nano-scale examination of matter in various fields of science: solid-state physics, medicine, pharmacy, earth sciences, environmental science and archaeology. There are many synchrotron sources across the world, but the ESRF is unique in terms of test beam parameters and the number of measurement channels.
ESS-ERIC	European Spallation Source ERIC	ESS is the world's first so-called long-pulse spallation neutron source. Its mission is to build and operate a world leading facility for neutron research. The world's highest intensity neutron source enables the examination of systems which has never been possible due to the small size of the sample or the small intensity of the examined signal. The equipment gives a great boost to domestic research in physics, chemistry and materials science.
European XFEL	European X-Ray Free-Electron Laser Facility	This facility is unique in Europe and is used for ultra-short (27 thousands/sec) and very bright X-ray experiments. With such parameters the facility opens up entirely new opportunities for scientific and industrial research. Researchers can map viruses at the atomic level, understand the molecular structure of cells, create 3D images of the nano-world etc.
ITER/ EURO-fusion*	International Thermo-nuclear Experimental Reactor	The ITER aims to demonstrate that nuclear fusion can be used on Earth for energy purposes and testing technological solutions. ITER is considered unavoidable by competent researchers on the way to creating a fusion energy. Fusion related research and development is performed by EUROfusion programme which integrates all member states' research projects in this field.

RI short name	RI full name	Brief description
	Social & Cultural Innovation	
CESSDA-ERIC	Consortium of European Social Science, Data Archives	The only virtual research infrastructures which provides a single interface to the social scientific databases of all EU member states and associated members. It is essential for the access and use of comparative social scientific databases for administrative and scientific purposes.
CLARIN-ERIC	Common Language Resources and Technology	A research infrastructure that provides advanced digital language resources and tools– primarily for scholars and social scientists. The CLARIN-ERIC was created by the merger of three ESFRI language technology initiatives. One of the founding parties was the Research Institute for Linguistics of the Hungarian Academy of Sciences, which still plays and played a leading role in the preparatory project as well.
ESS-ERIC	European Social Survey	ESS provides biannual comparative data about the demographic and social conditions of European societies, the changes in political and public preferences of citizens, and changes in social attitudes and action-guiding values. Data may significantly contribute to understanding changes in social behaviour taking place in Europe.
SHARE-ERIC	Survey of Health, Ageing and Retirement in Europe	SHARE is a multidisciplinary panel database of information on the health, use of the healthcare system, financial status and income, socio-economic background and social and family networks of more than 30,000 individuals aged 50 or older. The aim is to build up a database that allows for high-quality, fact-based decisions on issues related to aging.

RI short name	RI full name	Brief description
	E-infrastructure	
PRACE	Partnership for Advanced Computing in Europe	PRACE is an international non-profit association. It comprises 24 member countries participating in the development of a super computer infrastructure. It provides world-class computing and data resources and services for large-scale scientific and engineering research projects.
GÉANT*	Pan-European data network for the research and education community	GÉANT connects national research and education networks across Europe. It provides a high-bandwidth, high-capacity network with an ever-expanding service, which enables the strengthening of cooperation between researchers. It gives highly reliable, unlimited access to calculations, analyses, storage, applications and other resources to ensure that Europe remains at the forefront of research.

* Research infrastructure not related to ESFRI



1. ECRIN-ERIC – Paris, France
2. ELIXIR – Hinxton, the United Kingdom
3. EMBL – Heidelberg, Germany
4. ERINHA – Paris, France
5. EuBi ERIC – Heidelberg, Germany
6. ICGEB – Triest, Italy
7. CERIC-ERIC – Triest, Italy
8. CERN – Geneva, Switzerland
9. **ELI ERIC – Szeged, Hungary**
10. **ELI ERIC – Prague, Czech Republic**
11. **ELI ERIC – Bucharest, Romania**
12. ESA – Paris, France
13. ESRF – Grenoble, France
14. ESS ERIC Spallation – Lund, Sweden
15. European XFEL – Schenefeld, Germany
16. ITER – St. Paul-lez-Durance, France
17. CESSDA ERIC – Bergen, Norway
18. CLARIN ERIC – Utrecht, the Netherlands
19. European Social Survey ESS – London, the United Kingdom
20. SHARE ERIC – Munich, Germany
21. PRACE – Ixelles, Belgium
22. GEANT – Amsterdam, the Netherlands

The ELI-ALPS as a new European large research facility on the ESFRI Roadmap

The ELI (Extreme Light Infrastructure) high-power laser based research infrastructure is being established in European cooperation, with the involvement of the international scientific community. The laser research centre is built on three sites in Hungary, the Czech Republic and Romania at the same time, subject to joint coordination and a harmonised research strategy. The ELI Attosecond Light Pulse Source (ELI-ALPS) research institute (Szeged, Hungary) hosts experiments on extremely short processes unfolding in atoms and molecules; the ELI-beamline (Czech Republic) focuses on generating short-pulse X-rays and on particle acceleration; and the ELI-NP (Romania) examines fundamental nuclear questions with ultra-powerful optical and gamma pulses.

The three pillars are integrated by ELI-ERIC into a unique, international, multi-site facility. The ELI is the world's first facility to enable the examination of interaction between light and matter at unprecedented intensities. The research infrastructure indicated in the ESFRI Roadmap is being commissioned continuously from the end of 2017.

The development and funding of domestic research infrastructures

Since 2015 many funding programmes have been launched to enhance the RDI activity in Hungary most importantly with the aim of facilitating the development of research infrastructures for the benefit of research institutes, higher educational institutions and businesses.

The following major funding programmes provided budget for the extension and development of research infrastructure capacities:

- R&D projects financed from the NRDI Fund:
  number of funded projects: 41, total awarded funding: HUF 50,928 million (EUR 159.1 million)
- R&D projects financed from the Structural Funds:
  number of funded projects: 131, total awarded funding: HUF 162,230 million (EUR 507 million)
- Projects financed by the Hungarian Academy of Sciences:
  HUF 5,983 billion (EUR 18.7 million) in 2015–2018
- Projects financed from the EU Horizon 2020 Framework Programme:
  number of funded projects: 29, total awarded funding: EUR 5.2 million (HUF 1,658 million)

Presentation of the domestic research infrastructure groups

In the following, the ESFRI thematic areas will be used to present the domestic RI groups which involve several research groups and are thus especially important in the given field of science, enable international-level research, contribute to solving strategic problems, perform internationally outstanding research activities, and actively take part in European initiatives and cooperation projects.

The individual RI groups were created according to specific research fields and related areas. This means that individual RIs were classified into the same group based on their cooperation, and their possession of relevant infrastructure and research community. Another major factor considered in creating the groups was the support of development directions and priorities specified in the National Smart Specialisation Strategy (S3).

ESFRI classification by scientific field	Research infrastructure networks (groups)	Name of coordinator institution	Contact person's email, website
ENERGY	Energy research	HAS Centre for Energy Research	Tamás Belgya belgya.tamas@energia.mta.hu http://www.bnc.hu
ENVIRONMENT	Atmosphere	University of Pannonia	András Gelencsér gelencs@almos.uni-pannon.hu https://levegokemia.uni-pannon.hu
	Hydrosphere	Eötvös Loránd University	Gyula Záray zaray@chem.elte.hu http://kkkk.elte.hu
	Geosphere	HAS Research Centre for Astronomy and Earth Sciences	László Szarka Szarka.Laszlo@csfk.mta.hu http://csfk.mta.hu
	Biosphere, ecology and agriculture	HAS Ecology Centre for Natural Sciences	András Báldi baldi.andras@okologia.mta.hu http://okologia.mta.hu
HEALTH AND FOOD SCIENCES	Biobanks and animal houses	Semmelweis University, Institute of Genomic Medicine and Rare Diseases	Mária Judit Molnár molnar.mariajudit@med.semmelweis-univ.hu http://semmelweis.hu/genomikai-medicina
	Clinical Medicine Research HECRIN Network	University of Pécs, Szentágothai Research Centre	Gábor Kovács L. kovacs.l.gabor@pte.hu http://szkk.pte.hu

ESFRI classification by scientific field	Research infrastructure networks (groups)	Name of coordinator institution	Contact person's email, website
HEALTH AND FOOD SCIENCES	Medical imaging research; Euro-BioImaging Network	University of Debrecen	György Vámosi vamosig@med.unideb.hu http://biophys.med.unideb.hu
	Bioinformatics; ELIXIR-HU Network	HAS Research Centre for Natural Sciences, Institute of Enzymology	László Patthy patthy.laszlo@ttk.mta.hu http://www.ttk.mta.hu
	Biomolecular interactions, structural biology and molecular imaging	HAS Research Centre for Natural Sciences, Eötvös Loránd University	Attila Reményi remenyi.attila@ttk.mta.hu http://ttk.mta.hu
	Agriculture and food research	HAS Centre for Agricultural Research	Ottó Veisz veisz.otto@agrar.mta.hu www.agrar.mta.hu
PHYSICAL SCIENCES AND ENGINEERING	Particle physics	HAS Wigner Research Centre for Physics	Péter Lévai levai.peter@wigner.mta.hu https://wigner.mta.hu/hep
	Nuclear physics, atomic physics and their applications	HAS Institute for Nuclear Research	Zsolt Dombrádi domb@atomki.mta.hu http://atomki.mta.hu
	Astronomy, space research	HAS Research Centre for Astronomy and Earth Sciences, Research Centre for Astronomy and Earth Sciences	László Kiss kiss@konkoly.hu http://konkoly.hu

ESFRI classification by scientific field	Research infrastructure networks (groups)	Name of coordinator institution	Contact person's email, website
PHYSICAL SCIENCES AND ENGINEERING	Materials science research	Eötvös Loránd University	István Groma groma@metal.elte.hu http://wigner.hu
	Solid state physics research	HAS Centre for Energy Research	Levente Tapasztó tapaszto.levente@ek.mta.hu http://www.mfa.kfki.hu/hu
	Laser-based research	HAS Wigner Research Centre for Physics	Péter Dombi dombi.peter@wigner.mta.hu https://wigner.mta.hu
	ELI-ALPS	ELI-HU Nonprofit Ltd.	Károly Osvay karoly.osvay@eli-alps.hu https://www.eli-alps.hu
	Vehicle and transportation engineering	Budapest University of Technology and Economics Department of Automotive Technologies	Zsolt Szalay zsolt.szalay@gjt.bme.hu http://www.gjt.bme.hu
	Industry 4.0	HAS Institute for Computer Science and Control	László Monostori monostori.laszlo@sztaki.mta.hu www.sztaki.hu
SOCIAL AND CULTURAL INNOVATION	ESS-HU Network (European Social Survey)	HAS Centre for Social Sciences	Vera Messing messing.vera@tk.mta.hu http://ess.tk.mta.hu

ESFRI classification by scientific field	Research infrastructure networks (groups)	Name of coordinator institution	Contact person's email, website
SOCIAL AND CULTURAL INNOVATION	SHARE HU Network (Survey of Health, Ageing and Retirement in Europe)	HAS Centre for Economic and Regional Studies	Anikó Bíró biro.aniko@krtk.mta.hu www.krtk.mta.hu
	CESSDA HU Network (Consortium of European Social Sciences Data Archives)	HAS Centre for Social Sciences	Péter Hegedűs peter.hegedus@tarki.hu http://tarki.hu/adatbank
	HUNCLARIN Network (Common Language Resources and Technology Infrastructure)	HAS Research Institute for Linguistics	Tamás Váradi varadi.tamas@nytud.mta.hu http://clarin.hu
E-INFRA-STRUCTURES	E-infrastructure	Government Information Technology Agency	KIFÜ, Vice-Presidential Organisation for Infrastructure, Research and Development Department intproject@niif.hu; www.niif.hu
	5G	Budapest University of technology and Economics, Centre for Higher Education and Industrial Cooperation	Charaf Hassan hassan@aut.bme.hu https://www.bme.hu/FIEK

Further RI development directions and strategic objectives

- boost the competitiveness of research infrastructures, with particular focus on the priority areas specified in the strategies and on European research directions
- promote the domestic networking of R&D infrastructures
- facilitate joining to major international infrastructures and networks
- improve the utilisation and openness of RI capacities through cooperation
- strengthen the multidisciplinary approach
- make the register of research infrastructures public and ensure access to free capacities
- support open access to the results
- stimulate predictable long-term funding and performance-based operation
- strengthen the management approach
- encourage RIs to participate in education and take social responsibility
- enhance policy coordination

The infrastructures included in the Roadmap should be regularly assessed in accordance with participation in foreign infrastructures. The National Research Infrastructure Roadmap, created in collaboration with the domestic scientific community, is not meant to be an end but rather the starting point of a planning, monitoring and implementation process, where the active contribution of domestic researchers and all relevant stakeholders is greatly expected.

The National Research Infrastructure Roadmap 2018 document in full is available at:
nkfih.gov.hu/infrastructure-roadmap

The ESFRI Roadmap 2018 website:
www.roadmap2018.esfri.eu

www.nkfih.gov.hu