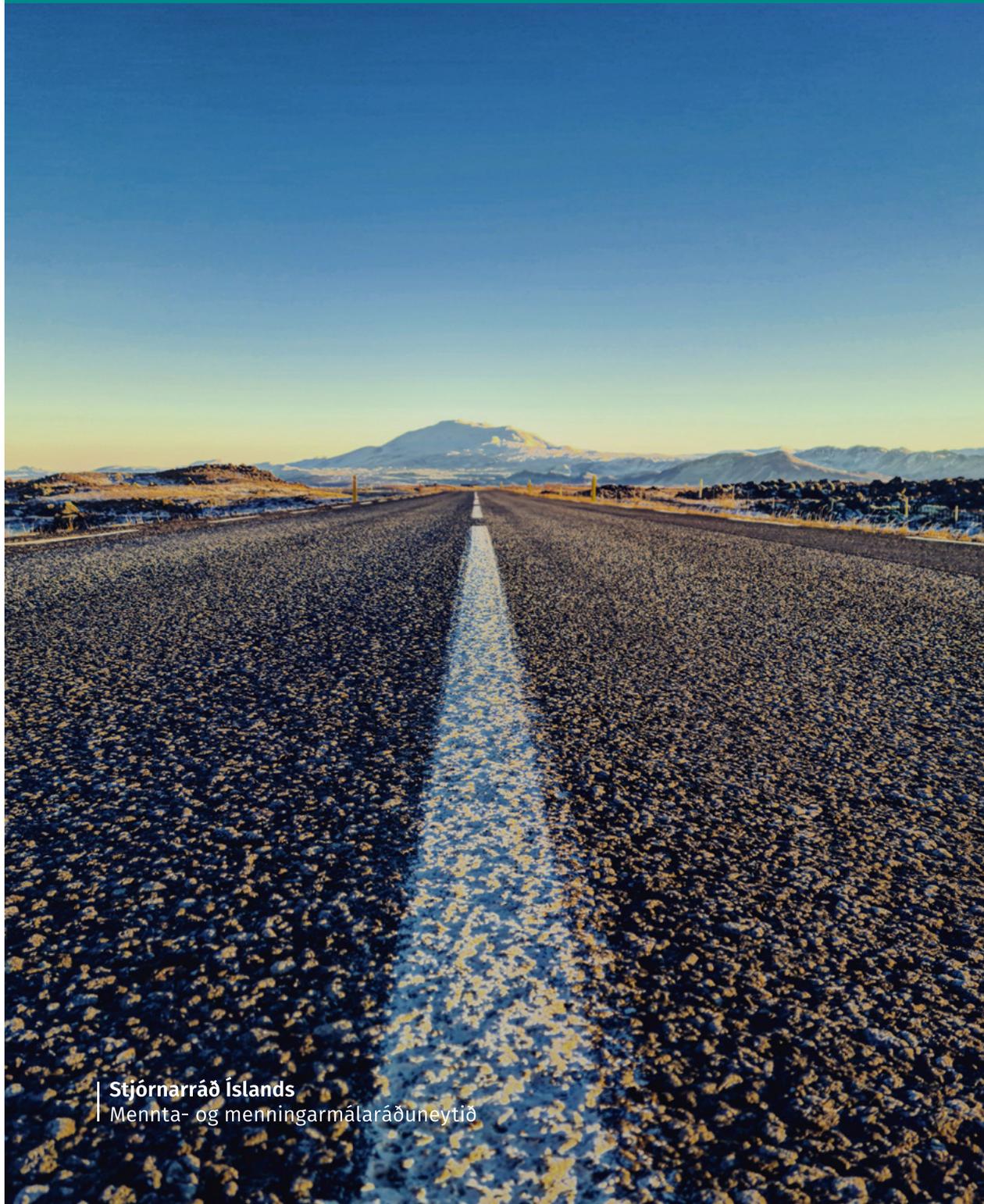


June 2021



# Icelandic Roadmap for Research Infrastructures 2021



Stjórnarráð Íslands  
Mennta- og menningarmálaráðuneytið



**This report is made in cooperation between the board of the Infrastructure Fund, The Icelandic Center for Research and the Ministry of Education, Science and Culture.**

**Ministry of Education, Science and Culture**

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## Foreword from the Minister

The Icelandic government seeks to construct an environment where progressive and internationally competitive research institutes and universities can create knowledge that leads to results based on ingenuity, innovation, and research. The policy marks our emphasis on securing that those activities in Iceland provide a strong foundation for our economy in the future.

Icelanders have achieved significant results in various fields of science, but in order to promote further development of research and innovation, researchers in Iceland need to have easy access to excellent research infrastructures; for instance equipment, databases or electronic infrastructure. The development of such infrastructure must consider the needs of both scientists and society and be based on strategy and strong investment priorities. With the introduction of a roadmap for research infrastructure, a systematic step has been taken to improve priorities in the development of this field in Iceland.

In a small community, co-operation and integration in the development of research facilities is of great importance in order for people to enjoy good access to high-quality infrastructure and for investment in them to be both efficient and effective. Therefore, in the development of this roadmap report, emphasis is placed on the infrastructure chosen for it being at the same time addressing the societal challenges that Iceland faces now and in the future, and the collaborative projects of different research groups and institutions. The infrastructure that has been chosen for this first roadmap is internationally competitive and is based on a solid foundation of the scientific work that has been done by our leading innovators in recent years and decades. The development of the research infrastructure specified in the roadmap will further ensure that research and innovation work



flourishes under optimal conditions and attracts outstanding students and researchers to Icelandic scientific work, both within and outside Iceland.

This report has been in preparation for quite some time and many people have joined forces in making it. I would especially like to thank the Science and Technology Policy Council and its subcommittees for highlighting the importance of policy-making and prioritization within the issue, as well as the board of the Infrastructure Fund for developing and leading the process around the roadmap. The Icelandic Center for Research (Rannís) also supported the process from beginning to end.

The government's vision for science and technology is that by 2030, Iceland will be a country that uses its small size as a strength and offers an interesting environment for creative and talented people, where research and innovation have strong economic and international significance. With a roadmap for research infrastructure, we are taking another step in making this vision a reality. The priorities in the issue that appear in this roadmap mark an investment plan, for the benefit of science and society as a whole.

**Lilja D. Alfreðsdóttir,**  
*Minister of Education, Science and Culture*

# Introduction

One of the mainstays for outstanding success in science and research-related innovation is good access to research infrastructures, and their development and collaborative use have greatly increased in recent years. It is now important to do even better, by formulating a comprehensive overview of research infrastructures and ensuring that as many as possible can benefit from them. Research infrastructures and their operation involve considerable levels of investment, and it is vital that investment in infrastructures is based on professional decision-making, a comprehensive overview and policy within and across organisations. It is important that universities, institutions and businesses further strengthen cooperation in developing extensive research infrastructure, so as to increase momentum. Publication of this roadmap is intended to promote research infrastructures and establish an overall policy for their development in Iceland.

At the same time as we build up infrastructure for research here in Iceland, it is necessary to participate in and have access to the important infrastructure development that has occurred in neighbouring countries in recent years. Research infrastructure collaboration is not limited to individual countries, and there is enormous potential for cross-border collaboration. By enhancing researchers' access to high-quality research infrastructures, both domestically and internationally, the goal is to enhance the quality of research and strengthen Iceland's competitiveness in the international scientific community. In this way, we create a strong research environment that includes desirable conditions for research studies, attracts talented researchers and promotes international scientific collaboration and innovative business activities. All this strengthens Iceland's ability to address the great changes and societal challenges facing the world.

The roadmap identifies significant infrastructures and infrastructure hubs that fulfil requirements for supporting quality in research in Iceland and harmonise with the priorities of the Science and Technology Policy Council. The term infrastructure hub refers to research infrastructures that can beneficially work together in utilisation and operation. In defining such hubs, and attending to future development, the aim is to advance and increase the utilisation and impact of the research infrastructure that is developed in this country.

## **Priorities for research infrastructure development:**

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- **Promote development and operation of research infrastructure with a clear future vision**
  - **Open up access to research infrastructures and maximise their utilisation**
  - **Support domestic and international collaboration involving research infrastructure**
-



## History of the Icelandic research infrastructure roadmap

In the past 15 years, there has been substantial development of research infrastructure in Europe, and many EU countries have devised a research infrastructure roadmap to support the future direction and prioritisation within the field of infrastructure development. In Iceland, the formulation of a roadmap for research infrastructure has been on the agenda for some time. The first steps were taken on 2 June 2008, when a meeting of the Science and Technology Policy Council resolved that a committee should be appointed to prepare a research infrastructure roadmap for Iceland until 2020. The Prime Minister appointed the committee on 5 September the same year. However, the emerging national and global financial crisis curtailed the committee's work. The following year, 2009, the committee's report was published, [Vegvísir um innviði til rannsókna](#) (e. A roadmap for research infrastructure (report in Icelandic)) (Infrastructure commission of the The Science and Technology Policy Council, 2009). It contains many valuable suggestions for strengthening the field of infrastructure here in Iceland, for example the legal framework and services, although circumstances did not allow for the formulation of a roadmap in line with the scope of other European roadmaps. The main emphasis was on preserving and strengthening various basic infrastructure and support services, such as national access to journals and the academic and scientific community's high-speed internet connection with the world. Among other things, the committee's work resulted in the Equipment Fund becoming the Infrastructure Fund, with an expanded role. Emphasis was also placed on analysing and increasing participation in international research infrastructure collaboration.

In the autumn of 2014, the Science and Technology Policy Council appointed a working group for research infrastructure and monitoring, which was to make policy recommendations in these areas. The group's 2017 report [Uppbygging rannsókna-  
innviða á Íslandi til framtíðar](#) (e. Report on the Future of Research Infrastructure in Iceland (report in Icelandic)) (Working group on research infrastructure and monitoring, appointed by the Science and Technology Council, 2017) proposed to strengthen research infrastructure policy-making in Iceland. The working group proposed that there should be a second attempt at making a research infrastructure roadmap, which would include prioritisation in the field of infrastructure and a strategy for future development.

Subsequently, special steps were taken for the preparation of a research infrastructure roadmap, and the promotion of international participation in infrastructure was defined in [Stefna og aðgerðaáætlun Vísinda- og tækniráðs 2017-2019](#) (e. Policy and action plan 2017-2019) (Science and Technology Policy Council, 2017). The research infrastructure roadmap is also one of the important projects included in the [2017 agreement](#) between the Progressive Party, the Independence Party and the Left Green Movement as the basis of their coalition government (Government of Iceland, 2017).

In early 2018 a working group started work on the preparation of a research infrastructure roadmap. It included representatives from the Ministry of Education and Culture, the Ministry of the Environment and Natural Resources, the Icelandic Centre for Research – Rannís, the Marine Research Institute, the Icelandic Innovation Center, the Árni Magnússon Institute for Icelandic Studies, the University of Iceland and Reykjavík University. The group submitted the report [Drög að ferli vegvísis um rannsóknarinnviði og úthlutunarstefnu Innviðasjóðs](#) (e. Draft process guide for a research infrastructure roadmap and the allocation policy of the Infrastructure Fund) (Working committee for the preparation of a national roadmap on research infrastructure in Iceland, 2019) in July 2019.

In May 2019, amendments to the [Act on Public Support for Scientific Research](#) (No. 3/2003) were approved, including the amendment that an independent board was to be appointed for the Infrastructure Fund, whereas previously it had been under the aegis of the board of the Research Fund. In October 2019, the new board took office. The Science and Technology Policy Council commissioned it to publish a research infrastructure roadmap for Iceland, and the first such roadmap is now being published.



# 1. Developing the research infrastructure roadmap

The first step in developing the roadmap was to advertise for proposals for infrastructure projects to be included in the roadmap, and the deadline was 10 June 2020. This was not a formal application process; rather the intention was to elicit wishes and needs from the scientific community in the field of infrastructure development. Participation in this step was excellent and 52 proposals were received, which were published on the Infrastructure Fund's website. Subsequently, the proponents of the proposals were encouraged to seek to collaborate with each other as far as possible, with a view to increasing collaboration on infrastructure and promoting strong applications in the roadmap process. Later, when infrastructure projects for the roadmap were advertised, in November 2020, 28 applications were received. And it was clear that the scientific community had responded well and that further collaboration had been established between infrastructure projects.

**In evaluating the roadmap applications, the following aspects were considered:**

## **A) Iceland's internationally competitive research environment:**

- **How does investment in research infrastructure promote higher quality research?**
- **How will investment in infrastructure lead to recruitment in science and innovation?**
- **How does the infrastructure promote international scientific collaboration?**
- **Where applicable: is the infrastructure linked to international infrastructure collaboration, e.g. through a project that is part of the EU's roadmap for research infrastructure, issued by the *European Strategy Forum on Research Infrastructures (ESFRI)*?**

## B) Tackling societal challenges:

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- Does the infrastructure have societal importance for Iceland?

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  - How will the infrastructure be used to tackle the societal challenges that have been defined by the Science and Technology Policy Council?

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  - Does the infrastructure promote valuable training of human resources for innovation-related business opportunities?

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  - Where applicable: does the infrastructure support development of a knowledge-based industry with collaboration with business and innovation?

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## C) Open access and collaboration:

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- Are realistic plans in place for access to the infrastructure by users outside the institution that houses the infrastructure?

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  - How well will the infrastructure make use of the research capabilities existing in Iceland and support domestic collaboration?

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## D) Future development and operation of infrastructure:

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- Is the infrastructure part of a larger infrastructure hub?

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  - Does the infrastructure support the policy of the institution(s) on the development and operation of research infrastructures and infrastructure hubs?

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  - What is the interaction between new infrastructures and existing ones?

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  - How clear is the responsibility for the management, development and operation of the infrastructure?

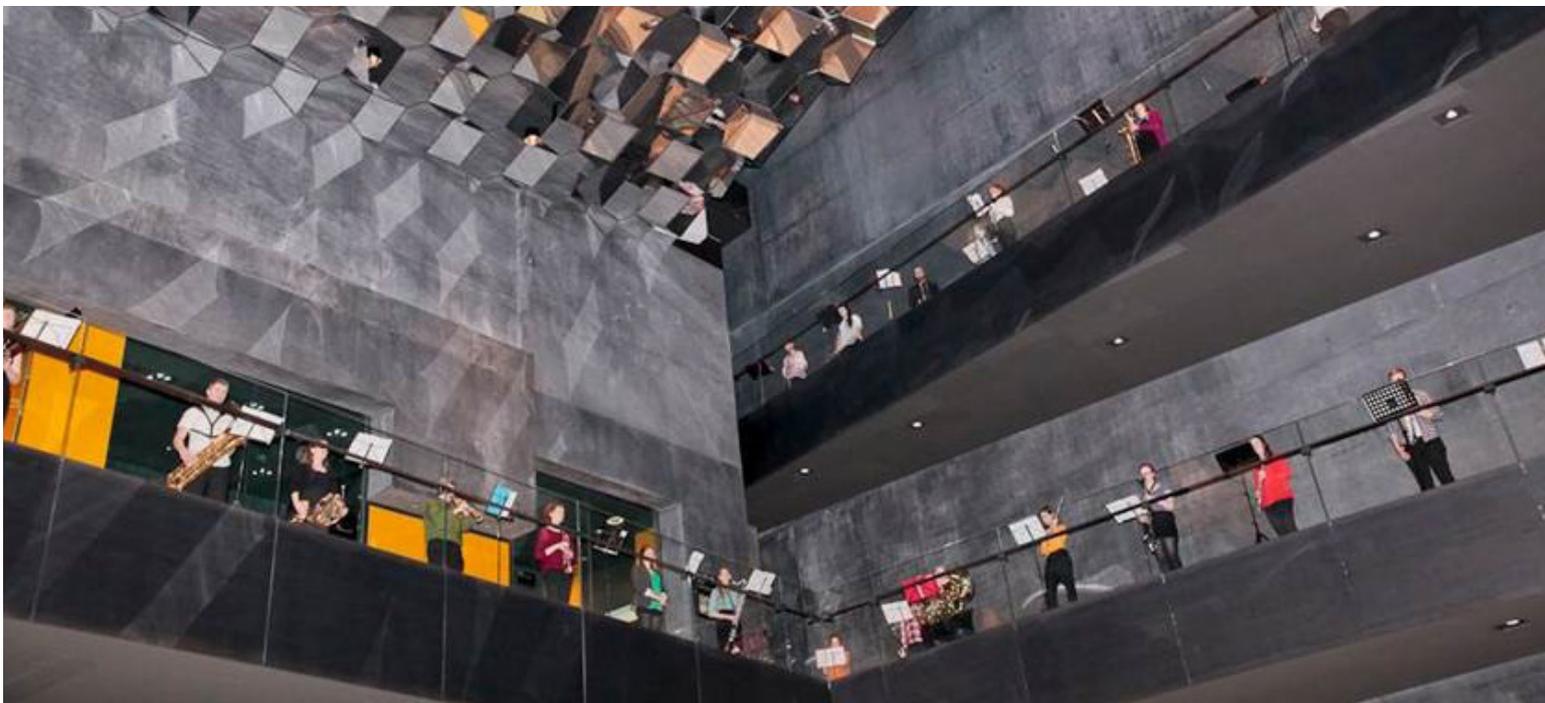
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  - Are there plans for financing operations after the project period ends?

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For this first Icelandic research infrastructure roadmap, six proposals were selected that are considered to excel in terms of scientific and professional strength, broad and well-defined collaborations in infrastructure development with open access to research infrastructure and a clear vision for the future. All the proposals are compatible with the Science and Technology Policy Council's emphases in the field of societal challenges, which are published as science and technology policy in [Vísinda- og tæknistefnu 2020-2022](#) (Science and Technology Policy Council, 2020). The Infrastructure Fund received many other strong applications that were not included in the roadmap as, in the judgement of the board, they did not meet all of the criteria. Development of strong infrastructure collaboration in Iceland is a long-term project. Given that the intention is to update the roadmap in the coming years, advocates for proposals included in this roadmap, as well as proposals that were not selected, are encouraged to continue developing the proposals, with a view to further strengthening collaboration on research infrastructure, future visions and accessibility.

Inclusion in the roadmap does not automatically entail the allocation of funding, nor a willingness by the Fund to allocate funding, but the projects will generally be given priority in funding allocation from the Fund in the coming years. In evaluating applications, professional quality continues to be considered, and all applications that receive funding must meet professional standards for quality, in competition with other submitted applications.



## 2. Infrastructures on the research infrastructure roadmap 2021

### Chemical analysis – from atoms to biomolecules (EFNGREIN)

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**Proposers:**

University of Iceland, the Science Institute

**Other interested parties:**

Landspítali – National University Hospital of Iceland, Icelandic Food and Biotech R&D (Matis), Reykjavík University, other businesses

**Contact:**

Óttar Rolfsson, ottarr@hi.is

**Description:**

Infrastructure for chemical analysis is essential for both basic and applied molecular sciences. The EFNGREIN project aims to advance, maintain and improve access to infrastructure that is necessary for carrying out chemical analysis on a wide variety of molecules. Thus EFNGREIN will support research and development in Icelandic universities, research institutions and industry, within the fields of medicine, pharmacy and pharmaceutical sciences, the molecular life sciences, biotechnology, medical and chemical engineering, nutrition and chemistry.

**Activities:**

Analytical chemistry is central to molecular research and extends across multiple research disciplines. Analytical chemistry can broadly be divided into qualitative screening of complex chemical mixtures, targeted quantitative analysis and structural analysis. It is used to analyse small molecules, active pharmaceutical ingredients, toxins, lipids, carbohydrates, DNA, proteins, nutrients, metabolites and other analytes. Rapid technological advances in analytical chemistry in the past decade have played a central role in transforming Icelandic academia and industry. The principal aim of EFNGREIN is to secure access to state-of-the-art infrastructure for analytical chemistry for the Icelandic research community at large. EFNGREIN will serve both research and development activities within the diverse disciplines that are reliant upon elemental and molecular analyses.

**Impact:**

The EFNGREIN project will enable Iceland's research community to address societal challenges. Analytical chemistry is central to the monitoring of Iceland's biosphere and facilitates knowledge-based policy making with regard to the environment and sustainability. EFNGREIN will support medical and biomolecular research groups within the University of Iceland, Reykjavík University, Landspítali – National University Hospital of Iceland and numerous companies that work within the health sector. EFNGREIN will provide a research environment for diverse multidisciplinary research projects and thereby support the education and training of individuals to be better equipped to address future challenges. The demand for employees with relevant understanding of analytical chemistry will continue to increase with investments in chemical and biochemical innovations. Many opportunities are on the horizon for innovation in the fields of chemical and biosciences, as well as biotechnology, which will strengthen the Icelandic economy going forward. Advances in these fields will rely upon improving the analytical infrastructure and the training of students and individuals within companies as well as educational and research institutions.

$$\frac{\partial p}{\partial t} + \frac{\partial}{\partial x}(pu) = 0$$

$$\frac{\partial u}{\partial t} + u \frac{\partial u}{\partial x} = -\frac{1}{\rho} \frac{\partial p}{\partial x}$$

$$\frac{\partial}{\partial t} \left( \frac{p}{\rho} \right) + u \frac{\partial}{\partial x} \left( \frac{p}{\rho} \right)$$

Bookmarks

## Materials Science & Engineering Centre (Efnis-setur (MSE-Lab))

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**Proposers:**

Science Institute, Innovation Center Iceland, Reykjavik University, University of Iceland

**Other interested parties:**

ON Power, ISOR – Icelandic Geosurvey, Grein Research, Atmonia, Gerosion, Reon, DT Equipment, Nordic Nanolab Network, GeoHex project (EU Consortium), GeoDrill project (EU Consortium), MEET project (EU Consortium), Geo-Coat project (EU Consortium), Iceland University of the Arts.

**Contact:**

Unnar Arnalds, uarnalds@hi.is

**Description:**

Fundamental to research and development of new materials is the capability for high level fabrication, detailed characterisation and real-world testing. The objective of this project is to build up the necessary infrastructure to strengthen this capability and create new possibilities for research and development within materials science and materials engineering in Iceland. The proposed infrastructure will facilitate synergy between fields, and through that new possibilities, research directions and development in numerous fields including materials science, nanotechnology, solid state physics, advanced manufacturing, large scale production and biomedical technology, and will bring research and development capabilities in Iceland up to high international standards.

**Activities:**

The proposed infrastructure investment targets all aspects of the development and research of new materials and their utilisation. The materials fabrication includes instrumentation for additive manufacturing and production processes as well as materials development at the nano-scale for high-tech applications and research. The analytical instrumentation will facilitate materials research from atomic dimensions up to large-scale testing in industrial applications such as within the energy and energy-intensive production sectors. This comprehensive implementation will

create a direct path from materials development to industrial-scale applications and bring Iceland to the forefront in new industrial developments and research topics. This in turn will increase collaboration opportunities between universities, research institutes and companies within Iceland, as well as increasing the possibilities for international collaboration.

**Impact:**

Additive manufacturing (3D metal printing) has the potential for replacing various existing manufacturing processes, saving material, creating new geometries and much more. 3D metal printing capabilities will open new possibilities in design and innovative thinking, kick-starting an emerging technology in Iceland. Combining 3D metal printing with other advanced manufacturing equipment and analysis instrumentation will bring Iceland to the frontline of high-tech manufacturing and design. Nano-fabrication and the development of new materials are at the core of new research and technological advancement, and evolving at an enormous pace. This new investment will support new research and development in new materials, devices, solid state physics and functional thin films and surfaces – creating a world-leading hub for nano-materials science. High level analytical instrumentation lies at the heart of materials science, where detailed characterisation of composition, crystal structure, morphology, and electrical, magnetic and optical properties is vital and creates a foundation for understanding their properties and utilisation in technological applications. Systematic creation, analysis and material testing of mechanical properties and durability is crucial for the development of new materials which are capable of withstanding mechanical wear and harsh conditions such as superhot, geothermal and corrosive environments. Research and development on high temperature production processes has the potential for reducing greenhouse gas emissions and energy consumption in the energy-intensive production industries. As these industries contribute a large portion of greenhouse gas emissions, development within this field is vital for achieving carbon neutrality and a greener future.

## EPOS Ísland

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**Proposers:**

Icelandic Met Office, University of Iceland, National Land Survey of Iceland, Icelandic Institute of Natural History, ISOR - Iceland Geosurvey

**Other interested and potentially interested parties:**

Landsvirkjun - National Power Company of Iceland, Krafla Magma Testbed (KMT) Project, ISAVIA, ICAO, OR - Reykjavík Energy, Reykjavík University, international institutions of geoscience- and volcanic monitoring

**Contact:**

Kristín S. Vogfjörð, vogfjord@vedur.is

**Description:**

*EPOS Iceland* is a collaborative project on construction of Research Infrastructures in the Earth Sciences to enable FAIR (*Findable, Accessible, interoperable, Re-usable*) open access to geoscientific data and services from Iceland. The project is linked with the EPOS ERIC organization (European Plate Observing System), which started as an ESFRI project on the European roadmap for research infrastructure and Iceland has participated in the construction of EPOS from the beginning. The purpose of EPOS is to strengthen the competitiveness of European Geosciences through improved access to multidisciplinary data, e-infrastructures, computation centers, and to research infrastructures at research and monitoring institutions. The goal of EPOS Iceland is to construct e-infrastructures in Iceland in the form of powerful data services directly linked into the Integrated Core Services of EPOS ERIC. The e-infrastructure will provide direct access to important multidisciplinary data from Iceland and will allow processing and joint analysis (interoperable) with the other pan-European data in the other EPOS ERIC services.

**Activities:**

The construction of EPOS Ísland is to open access to multidisciplinary Earth Science data and corresponding metadata, including data from the national seismic (SIL) and GPS (ISGPS) networks, as well as derived products like earthquake catalogues of all recorded earthquakes in Iceland. Also, various volcanic data, like ash- and gas measurements, radar measurements from volcanic plumes and collections of photographs and web-camera images for all main eruptions of the last two decades. Other infrastructures planned to be connected include the tephra database ASKA, the Icelandic

Catalogue of volcanoes, geological maps of Iceland, metadata from petrological and rock samples to name a few, as well as other geophysical raw data, metadata and products connected to geothermal areas, such as at Krafla volcano and data from other European and international collaborative projects, like for example the Krafla Magma Testbed (KMT) project.

Execution of the project includes two main activities:

1. Quality review of geoscience data and their conformation to FAIR open access standards.
2. Installation and testing of data services to verify they can meet requirements to withstand expected load from users accessing and downloading data, for the service response time to be within reasonable limits, and they can interact with the EPOS ERIC Integrated Core Service and other Thematic Core Services.

### **Impact:**

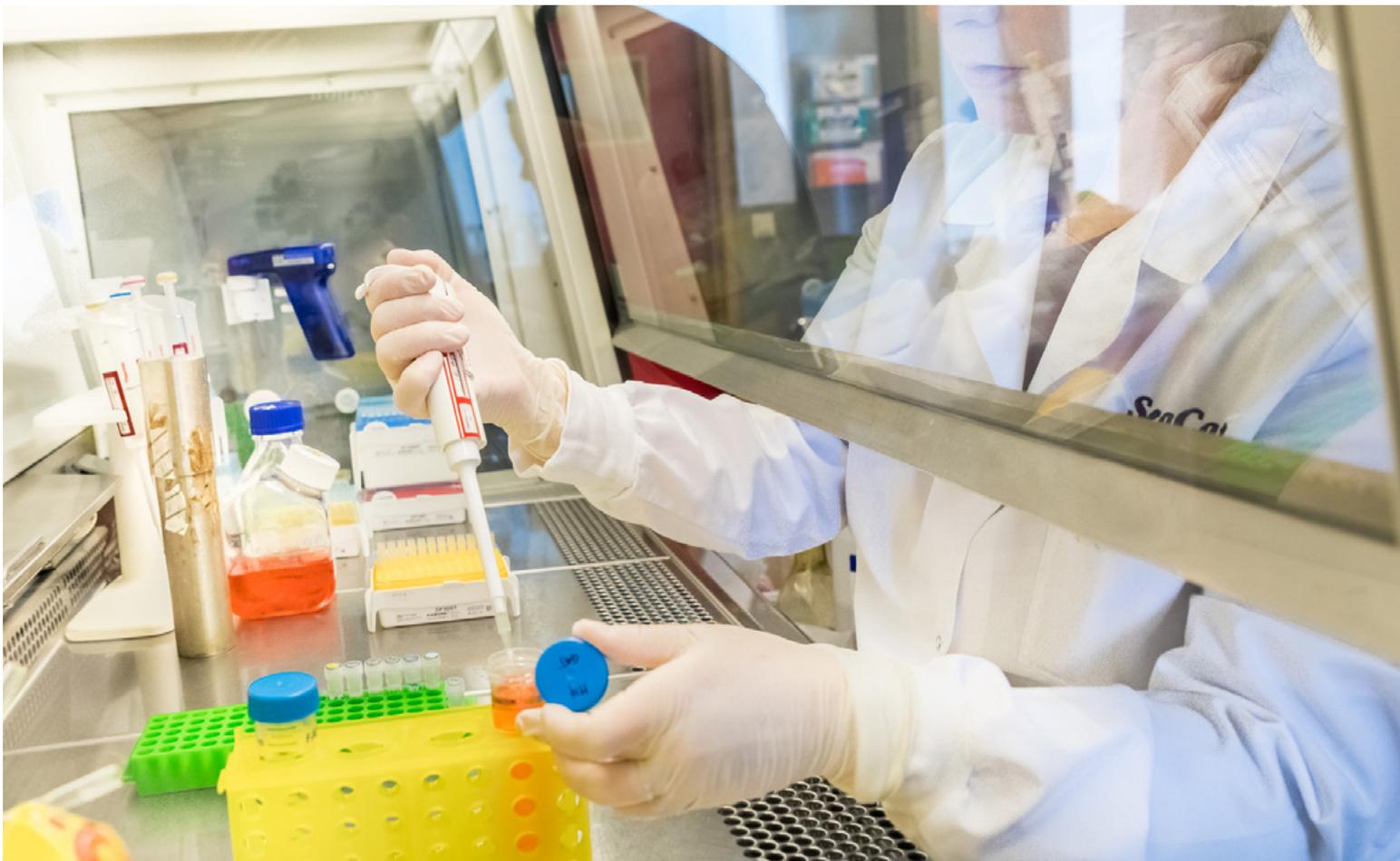
The existence of the multidisciplinary infrastructures of *EPOS ERIC* and *EPOS Ísland*, providing *FAIR* open access to hitherto inaccessible data and research laboratories widely distributed over Europe, creates new opportunities for cross-disciplinary scientific research connecting all the different disciplines within the Earth sciences, including both basic and applied research, student projects, collaborative projects, national and international projects. Possibilities for connecting with other scientific disciplines will also open up; disciplines like biology, geography, meteorology, and social sciences, which also involves research on various kinds of natural hazards, like earthquake and volcanic hazard for example.

Construction of the *EPOS Ísland* research infrastructures will facilitate access by Icelandic scientists to multidisciplinary geoscience data and products from Iceland and other European countries, which will strengthen their competitiveness for international research funding. The increased access will also enable Icelandic universities to utilize the valuable Earth science data, collected during all main seismic and volcanic events of the last decades in Iceland, for the education of new generations of Earth scientists.

Four volcanic eruptions have occurred in Iceland in the last decade, and in general 2-3 eruptions happen each decade and many large earthquakes each century. When a large earthquake or an eruption occurs near habited areas or important community infrastructures and threatens their existence, the response of monitoring institutions, civil protection agencies and government authorities will rely on the analysis and research of previous events. *EPOS Ísland* will make the data from these events

accessible to scientists of all national research institutions, as well as to those of other countries, and will therefore contribute to the development of new knowledge, which can be used to mitigate the societal risk and damage resulting from these events.

The *EPOS Ísland* data services will be valuable to energy companies and consulting companies in their applied research on the utilization of the country's natural resources, and as possible means to distribute their own data. Furthermore, the Volcano Observations Thematic Core Services are highly important to national and international civil aviation authorities, such as *ISAVIA* and *ICAO*, in assessing and managing hazard to aviation in the vicinity of a volcanic eruption. Last, but not least, the project will enable the participating Icelandic institutions to open access to their valuable data bases containing data collected over the last several decades, thus helping them meet national and international regulations for providing open access to data.



## From molecules to precision medicine (SAMSNIÐ)

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### Proposers:

University of Iceland, Landspítali – National University Hospital of Iceland, Keldur – Institute for Experimental Pathology, Akureyri University, ArcticLAS and Vísindagarðar – science park

### Other interested parties:

Reykjavík University, Akthelia, ArcticMass, Capretto, EpiEndo Pharmaceuticals and BioCule

### Contact:

Hans Tómas Björnsson, htb@hi.is

### Description:

The SAMSNIÐ proposal aims to build up an excellent infrastructure for biomedical sciences. We believe that a potent technical infrastructure will enhance biomedical sciences in fields ranging from basic sciences to translational medicine.

### Activities:

SAMSNIÐ aims to build up four support facilities for Icelandic biomedical sciences:

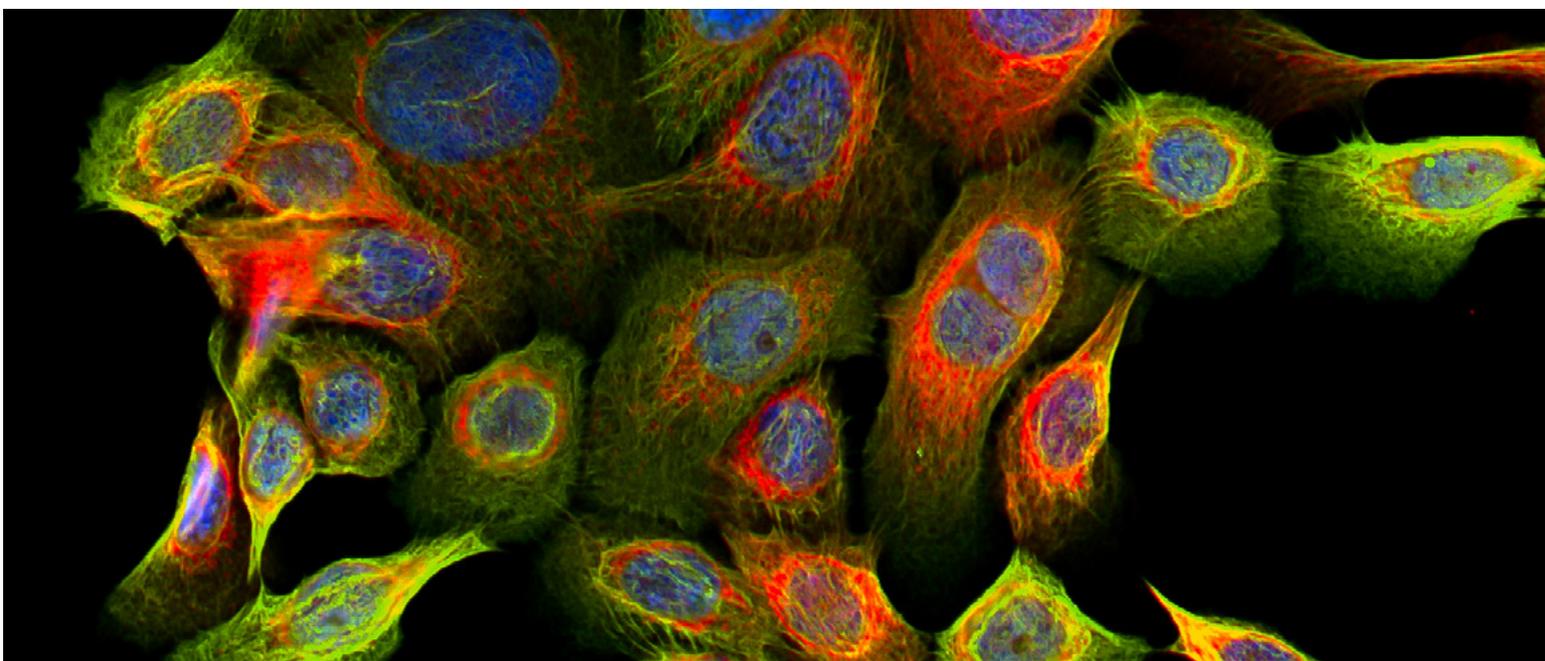
- i. Cell analysis and sorting facility.** In recent years, methods that allow phenotyping of cells have become even more important to understand sub-populations and interactions among cells. Major progress has been made and now instruments have been developed that allow analysis of over 20 molecules per cell. This technology is a real necessity for diverse fields of biosciences, from basic science to the identification of cells needed for cellular therapy.
- ii. Imaging facility.** Microscopy and imaging have undergone major improvements in the last few years. In addition to constant improvements in conventional, fluorescent, confocal and electric microscopy, now newer instruments have been developed such as multi-photon, light sheet and super-resolution microscopes.
- iii. Small animal facility.** The University of Iceland Biomedical Center and ArcticLAS have been building a modern infrastructure for small animal experiments. The long-term goal is to move this infrastructure into academic surroundings, improve and expand it.

**iv. Genomics facility.** Major improvements have occurred in genomic technology, and these techniques are used in more and more bioscience fields. We aim to build a sequencing facility that allows for long range sequencing as well as single cell sequencing approaches.

In addition to these four support facilities we want to create infrastructure accessible for startup companies in biotech and pharma. Iceland has many biotech and pharma companies, several of which have emerged from academia. Very few startups have research facilities and the equipment needed to develop their products. SAMSNID will develop infrastructure that allows these companies to use the biomedical science facilities to develop their products. Finally, we aim to build a setup for precision medicine. Cellular treatment is becoming a new field within medical science, and Landspítali – National University Hospital of Iceland is working on setting up a new site to transplant cells into patients. SAMSNID will participate in setting this up.

#### **Impact:**

The infrastructures that will be built up by SAMSNID are essential support facilities for the biomedical sciences, and they will be useful for most people working within biomedicine in Iceland. These facilities are necessary for Icelandic research to be internationally competitive, and to allow Icelandic researchers to participate in the current biotechnology revolution. Biotechnology and pharma are becoming important industries in Iceland, and it is likely that this industry will play an important role going forward. Thus, it is important to continue building infrastructure for this field, with collaboration between universities, organisations and businesses.



## Centre for Digital Humanities and Arts (CDHA, MSHL)

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**Proposers:**

University of Iceland – School of Humanities, Reykjavík University, National and University Library of Iceland, Iceland University of the Arts, National Gallery of Iceland, Reykjavík Art Museum, Icelandic National Broadcasting Service, Árni Magnússon Institute, National Museum of Iceland and National Archives of Iceland

**Contact:**

Guðmundur Hálfðánarson, ghalfd@hi.is

**Description:**

The Centre for Digital Humanities and Arts (CDHA) is a platform for construction, hosting, consultation about development and access to digital databanks in the humanities and arts, and for research based on digital databanks. The databanks cover both language resources, i.e. texts and languages, and resources in other formats, such as images, videos, 3D models, sounds and visual arts in digital formats. CDHA will coordinate international collaboration in digital research infrastructure in humanities and arts, and work in the spirit of providing open access to research data.

CDHA is based on a collaboration between ten Icelandic institutes, around a central research infrastructure in humanities and arts. Digital humanities (DH) is a rapidly growing research field at the intersection of humanities and information technology (IT). DH applies IT methods to research subjects in the humanities and arts, opening opportunities for new interdisciplinary research and research topics, and for new opportunities for the dissemination of research. CDHA is intended to support access to, and development of, research infrastructures in DH, and link Icelandic research to international developments in the field. CDHA will become a research infrastructure hub, operated by a network of leading universities and institutes working in the humanities and arts and with data about history, culture and languages in Iceland.

**Activities:**

CDHA will:

1. Strengthen collaboration between Icelandic institutes that host databanks within the humanities and arts, and conduct research based on them.
2. Support the development of new databanks and the updating of existing databanks to meet international standards on meta-data.
3. Lead the development of technical solutions for databanks and the purchasing of available solutions, as required.
4. Give researchers access to data and databanks suitable for their research.
5. Give researchers access to specialised equipment and technological solutions to conduct research based on digital databanks.
6. Assist with disseminating content suitable for different audiences.
7. Host training and education in the methods of DH.

All major Icelandic institutes in the humanities and arts are partners in the CDHA. The centre will serve all researchers in the humanities and arts in Iceland, and other researchers interested in working with Icelandic data. Open access to high quality research data is one of the main objectives of the CDHA, and the centre will be useful to anyone with an interest in working with data from the humanities and arts. This applies to some of the social and pedagogical sciences as well as other research fields that work with historical and cultural data. CDHA will give educational institutes, at all stages of education, better access to data and solutions to work with historical and cultural information. CDHA will cooperate with similar international institutes, both in the Nordic and other neighbouring countries, and participate in developing new solutions in DH.

**Impact:**

CDHA will support and develop research on big societal challenges. It will enable research on life and work in a changing world, as the databanks contain varied information about demographical changes, equality, diversity, culture, attitudes and changes over a long period. The centre will also facilitate research linked to health and well-being, as the databanks include valuable information about health, welfare and private life. In addition, the centre will facilitate research relating to environmental issues and sustainability, where information about climate change and its effect on individuals and societies is of vital importance.

## Icelandic Research e-Infrastructure (IREI)

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**Proposers:**

University of Iceland, Reykjavík University, ISOR – Icelandic Geosurvey, Icelandic Food and Biotech R&D (Matis), Icelandic Met Office

**Other interested parties:**

Various businesses

**Contact:**

Guðmundur H. Kjærnested, ghkjaerne@hi.is

**Description:**

The purpose of the Icelandic Research e-Infrastructure (IREI) project is to build a powerful, scalable and unified IT platform for scientific work (e-science) in Iceland, a platform needed by active research groups in Icelandic universities and research institutions. The IREI is built on four service supports: consultancy, storage, processing power and sharing.

**Activities:**

IREI activities are about creating a suitable IT platform and services and initiating provision of IT consultancy for scientists.

The creation of the IT platform will be divided into two major phases: a startup phase and an expansion phase. The startup phase relates to procurement and implementation of HPC hardware, storage systems, backup and sharing solutions and firewall security. It also includes appliances for specific projects: Heilsbrunnur and Mímir II.

In the expansion phase, more resources will be added to the core systems, such as computing resources, HPC nodes, storage, servers and networks. Necessary add-ons will be implemented for integration to other systems outside of the core systems. For example, for sharing data and integrating with cloud service providers.

Initially, IT consultancy services will be focussed on the health sciences. Implementation of Heilsbrunnur will have priority, and later improvement of the Mímir platform for bioinformatics.

**Impact:**

Modern scientific research makes ever greater demands on information technology. Disciplines that have no obvious connection to information technology still rely on accessible and powerful information technology infrastructure. At the same time, technology has become more complex. It is a challenging gap for individual science projects to span.

The vision of a unified e-infrastructure for science has been gaining growing support for some time. The need for a powerful, scalable and unified IT platform designed for universities and research institutions has become more evident every year: a platform that can provide for consultancy, storage, secure data discovery, searching and collection, including scientific feasibility of studies, data organisation, processing power and sharing services. Research projects in every scientific discipline need cost-effective and accessible data storage for research data, processing power for modelling, sharing services for cooperation and publication and high-quality consulting to make all of this work together in the confines of a specific project.

Facilities and platforms are available today, that are used with great success to address a portion of these information technology demands. Yet scientists and researchers still spend time and effort outside their area of expertise, meeting information technology demands. A large portion of science projects could benefit greatly from better access to an e-infrastructure that readily provides relevant information technology solutions, freeing up resources for the research subject at hand. The proposed e-infrastructure platform is envisioned as meeting those demands and enabling researchers to focus on valuable research. It should also be flexible to support future information technology demands. The e-infrastructure project will provide opportunities for higher learning and expert knowledge and make Iceland more viable in international science collaboration.



### 3. Icelandic membership of ESFRI/ERIC

The Notes to the Act on European Research Infrastructure Consortium no. 66/2019 (Alþingi, 2019) which was approved in May 2019 state:



A European Research Infrastructure Consortium (ERIC) is a means for cooperation on the operation of large, expensive research infrastructure in Europe. An ERIC allows the establishment of research infrastructure of a scale too large for a single country to finance and operate. An ERIC research infrastructure must be necessary for carrying out European research programmes and projects, represent added-value in the development of the European Research Area (ERA) and strengthen the international position of the relevant scientific and technological fields, be open to scientists from the EU and associated countries, contribute to the mobility of knowledge and/or researchers within the ERA and contribute to the dissemination and optimisation of results and technological advancements, among other things.

It is Iceland that participates in an ERIC, not individual organisations. However, Ministries entrust organisations to manage the participation and execution of a project. The following are brief introductions to the four European Strategy Forum on Research Infrastructures/ European Research Infrastructure Consortium (ESFRI/ERIC) projects in which Iceland is a participant.

#### EPOS-ERIC

The Icelandic Met Office leads Iceland's participation in the European Plate Observing System (EPOS), which began as an ESFRI project included in the European roadmap for research infrastructures, and Iceland has been a participant in the development of EPOS since the start. EPOS ERIC will promote geoscientific research in Europe by developing a pan-European research infrastructure for geoscience and improving access to databases and the infrastructure of research and regulatory bodies. Participation in EPOS ERIC has already led to research projects and infrastructure development in volcanology in Iceland, but participation also creates new opportunities for interdisciplinary research, including research that is important for civil protection in Iceland, such as earthquakes and volcanic eruptions. Research infrastructure from the Icelandic Met Office, the University of Iceland and the National Land Survey of Iceland has already been made available within EPOS-ERIC, contributing to additional research on natural hazards in Iceland.

[EPOS-ERIC website](#)

## CLARIN-ERIC

Iceland joined CLARIN ERIC on 1 February 2020, after having been an observer since 2018. The Ministry of Education, Science and Culture assigned the Árni Magnússon Institute for Icelandic Studies the role of leading partner in the Icelandic National Consortium. The main goal of CLARIN is that digital language resources from all European countries and the software needed to work with them will be easily accessible, for use in research in the humanities and social sciences, and for use within language technology. CLARIN is a platform to share experience, knowledge, databases and tools between participating countries.

Most of the relevant Icelandic institutions participate in the national consortium CLARIN-IS. The Árni Magnússon Institute has already established a repository (<https://repository.clarin.is/>) which houses Icelandic language resources and makes them accessible and distributes their metadata through the virtual language observatory which CLARIN ERIC operates. Under the Ministry of Education, Science and Culture's agreement with Almannarómur and the Icelandic language technology partnership SÍM, all products of the government's language technology programme are entered into the CLARIN repository in Iceland and are accessible to anyone working on research, development projects and infrastructure development, domestically and internationally.

[CLARIN ERIC](#) website

[CLARIN-IS](#) website

## CESSDA-ERIC

The Icelandic Social Science Data Service (DATICE), which was established in 2018 by the University of Iceland School of Social Sciences and is run by the Social Science Research Institute, is a participant in the Consortium of European Social Science Data Archives (CESSDA). The CESSDA ERIC leads the way in coordinating how databases are made available in open access, including by collaborating with the European Open Science Cloud (EOSC), which is a cloud solution for open access to research data. The goal of the consortium is to increase visibility of and access to research data in this field and promote international collaboration.

[CESSDA-ERIC](#) website

## ESS-ERIC

The Social Science Research Institute at the University of Iceland participates in the European Social Survey (ESS) on Iceland's behalf. The European Social Survey is a social science survey conducted every two years, and Iceland has participated in the survey in 2004, 2012, 2016, 2018 and 2020. Data on the ESS ERIC database are collected using very strict comparable methods and are published in open access. By charting stability and change in social structure, conditions and attitudes in the participating countries, the database has not only benefitted a broad group of scientists in their research, but also governments in their policy making and decision making, and in comparisons between countries.

[ESS-ERIC](#) website



## 4. Continued development of a roadmap for research infrastructure

The roadmap development is a long-term project, built on ongoing dialogue about collaboration and advancements within the scientific community. Transparency and visibility are key issues when it comes to building such a partnership. Projects included in the roadmap will be required to have their infrastructure visible on a website, which will also display publications and other products generated by the infrastructure. Access to the infrastructure must be open and must be conducive to cooperation. Following the publication of this roadmap, a process will be formulated for the assessment of roadmap projects, to evaluate whether they should retain their inclusion on the roadmap: it is of paramount importance that utilisation of the infrastructures leads to the advancement of quality research in Iceland.

The research infrastructure roadmap is to be reviewed regularly, based on the government's priorities in science and technology as they appear in the Policy and Action Plan of the Science and Technology Policy Council, fiscal policy and state budget. The process will be based on a professional assessment of the projects and the needs and opportunities of the research community in Iceland.

Within a few years there will be an advertisement for new projects for an updated roadmap, and the scientific community is encouraged to work towards continued collaboration on research infrastructure, by making changes within the projects currently included in the roadmap or by the development of new projects.



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