

Infrastructure and core facilities for Life Science at the University of Oslo



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Introductory comment

In this document, we summarize existing infrastructure and operational core facilities at the University of Oslo (UiO). The information is extracted from the current Roadmap for infrastructure at UiO, limited to the life sciences and recently updated. Because a significant number of facilities are involved, they are grouped on the basis of technological relatedness. This has been chosen rather than a categorization based on line structure divided by the units that own the infrastructure. Likewise, we have not chosen to categorize based on subject areas. Life sciences are technologically highly related across academic focus. For example, proteomics analyzes of patient material or of material from fish will technologically be the same.

The following division of infrastructures for life sciences has been chosen.

- A. Technologies for determination of 3D structure of biomolecules
- B. Imaging technologies - on many levels
- C. Global analyzes of biomolecules, «-omics»:
- D. Different analytical technologies
- E. Model organisms and infrastructure for biological material
- F. Various special laboratories

In the overview, we have included facilities with different statuses and different obligations regarding service. Some are defined as national infrastructure on the basis of funding from the Research Council, some are Health South-East regional core facilities financed from there but with a large user base at UiO, but others again have the status of UiO-approved core facilities based on an internal selection process. **Core facilities are marked in red.** We have also included particularly advanced equipment on some units, although these do not have a formal service obligation, but can be contacted regarding cooperation. Finally, we have also included relevant international infrastructures where UiO has a formal connection as partner or member.

Below, the various categories are reviewed in each chapter.

A. Technologies for determining the 3D structure of biomolecules

Determining the 3D structure of biomolecules requires heavy instrumentation. X-ray crystallography and NMR (Nuclear Magnetic Resonance) are central, established technologies, but in recent years we have seen a rapid emergence of structure determinations based on "single-particle cryo-electron microscopy" (cryo-EM). Cryo-EM is an example of a converging technology, which can just as easily be classified under this chapter due to its relevance for structural biology as under the next chapter because it belongs together with other EM technology. We have chosen to place cryo-EM here (see A2b). Recently, AI-based prediction of 3D structure based on protein sequence has also become an increasingly important element within structural biology. For all the technologies, the main focus has been on determining the 3D structure of proteins. Structural provisions contribute to, among other things, to a basic understanding of molecular functions, to functional elucidation of mutations for implementation in individually tailored treatment and to "drug design".

A1. Existing infrastructure at UiO

The five registered infrastructures within this category are:

- **BMX – X-ray:** a **core facility** for crystallization and structure determination of proteins and biological macromolecules, approved as a UiO core facility. The facility is located at the Institute of Chemistry, MN. Of the larger equipment units, the X-ray diffractometer and crystallization unit ("crystal hotel") can be mentioned. For detailed info, see <https://www.mn.uio.no/kjemi/english/research/infrastructure/facilities/life-science/biostructure-analysis/bmx-xrd/BMX%20-%20Rontgen>
- **Core facility for structural biology** offers services for crystallization and structure elucidation of proteins and protein complexes, production and purification of recombinant protein and characterization of proteins and protein interactions. Help with structure modeling and structure-activity analyzes is also offered. The facility is a Health South-East regional core facility and an approved UiO core facility. It belongs to Klinmed and OUS and is based at OUS-Rikshospitalet. Of greater equipment units can be mentioned crystallization robot (OUS), "Formulator liquid handling robot" (NFR/UiO), "Formulator crystallization hotel" (NFR/UiO), "Surface Plasmon Resonance" (NFR/UiO), 2x Thermophoresis (OUS/UiO) and SwitchSense heliX+ (UiO). For detailed info, see <https://ous-research.no/structuralbiology/> or <https://www.med.uio.no/forskning/kjernefasiliteter/strukturbiologi/>
- **NMR 800 Mhz infrastructure** is equipment for structure determination by nuclear magnetic resonance (NMR) and part of the national infrastructure NNP - Norwegian NMR platform (<http://nmr.uib.no/>). The facility belongs to the Department of Chemistry, MN. The most advanced piece of equipment here is the NMR Spectrometer AV III HD 800. For detailed info, see <http://www.mn.uio.no/kjemi/english/research/about/infrastructure/nmr/index.html>
- **NMR machine park**, consisting of a number of somewhat smaller NMR spectrometers (from 600 MHz and below) belong to the same environment, but are registered as separate infrastructures.
- **Hydrogen-deuterium exchange (HDX)** is a technology that can provide answers to questions related to protein conformation and is relevant for basic research as well as applied areas related to the mechanism of drugs and the way proteins work. The instrument, an Acquity M-Class HDX from Waters, is the only one of its kind in Norway, and it has a dedicated research group that operates and uses it in its own research. The group is based at the Norwegian Center for Molecular Medicine, NCMM, MedFak.

For an overview of the structural biology environment at UiO, see also:

<https://www.mn.uio.no/kjemi/english/research/groups/bio3%20-%20Chemical%20Lifesciences/px-oslo>

A1b. National and international infrastructure within structural biology

Determining the 3D structure of biomolecules requires heavy infrastructure beyond what UiO itself has at its disposal. The following infrastructures, where Norway or UiO have a formal connection, are therefore used in the work of UiO's structural biology researchers:

- **National infrastructure - NORCRYST** – The National Crystallography Consortium is a national infrastructure funded by the Research Council. NORCRYST is led by the National Center for Structural Biology at UiT - the Arctic University of Norway, but is a consortium of four partners, each with its own node, including UiO. The consortium offers instrumentation and expertise within crystallization, structure determination and analyzes of biologically relevant macromolecules. For detailed info, see <https://site.uit.no/norcryst/>
- **International infrastructure - ESRF** - The European Synchrotron Radiation Facility - serves researchers in both materials science and life science with the world's strongest synchrotron-generated X-rays. The ESRF is located in Grenoble, France, and is organized as a collaboration between 22 partner nations, of which 12 are members and 9 associates. Norway is a member of the ESRF and UiO's structural biology researchers use this facility. See <https://www.esrf.eu/home.html>
- **International infrastructure – MAX IV** The laboratory in Lund is another world-leading synchrotron source for X-rays that was opened in June 2016. Norway does not currently participate formally or with funding, but the facility is mentioned here as UiO researchers use the facility.
- **International infrastructure – ESS** - The European Spallation Source is a "European Research Infrastructure Consortium" (ERIC), a research facility based on the world's most powerful neutron source. ESS is currently under construction in Lund, Sweden. ESS is expected to become an important tool within a number of research fields, such as materials and nanoscience, life sciences, medicine and pharmacy, as well as industrial applications. Norway is a member of ESS and has contributed financially. ESS has a large network of laboratories to exchange knowledge, personnel and experience with. Many of these contribute directly to the project through In-Kind Contributions (IKCs). Among these is also UiO. For more info, see <https://europeanspallationsource.se>
- **National infrastructure - NNP - Norwegian NMR platform** (<http://nmr.uib.no/>). NNP is a national platform for nuclear magnetic resonance (NMR), led by UiB and where UiO is a partner. Allocated NOK 51.3 million in 2013, and additional funds were allocated for various upgrades in 2021. NNP is a UiO-approved **core facility**.

B. Imaging technologies

Being able to obtain images at the microscopic level of biological material is crucial for understanding both normal function and disease-related abnormalities at the cellular or subcellular level. In recent years, we have seen a rapid development both in the physical processes that underlie image formation and in the resolution that can be achieved. Acronyms such as MRI, CT and PET have become well known.

B1. Existing infrastructure at UiO

We have chosen to place the infrastructure units here in four subcategories of imaging technologies:

Electron microscopy

- **The core facility for advanced electron microscopy** has two nodes, one at OUS-Radiumhospitalet and one at OUS-Rikshospitalet. The core facility offers training and access to advanced equipment for electron microscopy. Of the larger equipment units, microscopes of the type 120 kV TEM (JEOL-JEM1230) and 200 kV Talos (TM200C) at the Radium node can be mentioned. For detailed info, see <https://www.med.uio.no/english/research/core-facilities/advancedelectron-microscopy/>
- **The electron microscope laboratory** at the Department of Basic Medical Sciences, MedFak, is a UiO-approved **core facility**. The laboratory has two 120 kV Transmission Electron Microscopes (TEM, Tecnai G2 Spirit BioTwin and Tecnai 12 BioTwin). The unit has specialist expertise in electron microscopic immunohistochemistry and EM analysis of the central nervous system and provides service to international partners and national academic and commercial companies, as well as users at UiO and OUS. For detailed info, see <https://www.med.uio.no/forskning/kjernefasiliteter/elektronmikroskopisk-laboratorium/>
- **The electron microscope lab (EM lab)** at the Department of Biosciences, MN, is a UiO-approved **core facility**. The laboratory has two TEM microscopes (JEOL TEM 1400 and JEOL TEM 1400 plus) and an SEM microscope (Hitachi Scanning-EM SEM S-4800 and FEG-SEM, Zeiss). The unit has special expertise in TEM, SEM and cryo-EM. For detailed info see <https://www.mn.uio.no/ibv/english/research/sections/fyscell/infrastructure/em/>

Light microscopy

- **The core facility for advanced light microscopy (ALM)** has three nodes, one at OUS-Radiumhospitalet, one at OUS-Rikshospitalet and one at OUS-Ullevål, all under the Department of Clinical Medicine, MedFak. The core facility offers relevant training and access to state-of-the-art confocal and super-resolution microscopes and image analysis systems. They also provide access to widefield microscopes, high-content imaging systems and microscopes with 7-plane illumination and patch-clamp. The three facilities have a significant instrument park of various microscopes. For more detailed info, see <https://ous-research.no/home/advancedlightmicroscopy/home/18898>
- **NorMIC Oslo at IBV - Advanced Light Microscopy Imaging platform** at the Department of Biosciences, MN, is a UiO-approved **core facility**. The facility is a specialized microscopy unit for subcellular studies of live or fixed cells. The instrument park includes several confocal microscopes, a "total internal reflection" (TIRF) microscope, and a "wide-field fluorescence" microscope. For more detailed info, see <https://www.mn.uio.no/ibv/english/research/infrastructure/facilities/life-science/imaging/normic/>
- **NorMIC Oslo** consists of two platforms, NorMIC IBV and NorMIC Radiumhospitalet, and is qualified as a node in ESFRI's EuroBioImaging (EuBI), first as a node candidate in 2014 and as a full-fledged node in 2019

B. Imaging technologies

when EuBI was recognized as ERIC (European Research Infrastructure Consortium). NorMIC Oslo has twice received support from NFR's INFRASTRUCTURE program (in 2011 support for NorMIC Oslo, and in 2014 support as platforms within NALMIN, (see below). As a node in EuBI, NorMIC Oslo gives access to researchers from all member countries in EuBI. For further information about NorMIC Oslo in EuBI

<https://www.eurobioimaging.eu/nodes/normic-oslo---advanced-light-microscopy-node-oslo> and EuBI: <https://www.eurobioimaging.eu>. A basic prerequisite for support from NFR's INFRASTRUCTURE program for NALMIN is that NorMIC Oslo is a node in an ESFRI structure. Norway represented via NFR is a member of EuBI and with two nodes, (NORMOLIN (molecular imaging) in addition to NorMIC Oslo). NorMIC Oslo organizes several annual advanced international user courses which are important for further training of personnel and create cohesion between the platforms.

- **Imagestream X MkII** is an instrument for image-based flow cytometry that is used in studies of intracellular localization of molecules/structures. The Department of Basic Medical Sciences, MedFak, is responsible for the equipment
- **Elyra System with Structured Illumination** is equipment that enables fast and gentle super-resolution microscopy of living cells. Responsible for the equipment is MIP (see below), at the Department of Basic Medical Sciences, MedFak.
- **The Dragonfly microscope** is a so-called "Spinning disc microscope" for super-resolution microscopy of living cells (SRRF stream super resolution imaging and TIRF microscopy). Responsible for the equipment is the Department of Basic Medical Sciences, MedFak, via MIP (see below).
- **MolMed Imaging Platform (MIP)** at IMB. Towards the end of 2020, various advanced microscopes at the Institute for Basic Medical Sciences (IMB) were merged into a local microscopy platform, MIP. Currently, MIP supports a large and growing user base (>60 active users from 20 research groups, >5500 user hours in 2021) with a spectrum of fixed-cell (Zeiss 710 Elyra S.1 SIM, Zeiss AxioObserver Z1 high-throughput) and live- cell microscopes (Andor Dragonfly 505 spinning disk (SRRF, FRAP, TIRF), GE Deltavision, and EssenBio Incucyte S3). In addition, MIP provides its user base with specialized additional equipment that links cell manipulation to live-cell microscopy. Since its establishment, MIP has developed a professional infrastructure with dedicated staff and management, website, booking system and a centralized payment system. MIP provides local and external infrastructure and advice for advanced data analysis to users, partly as a founding member of the BioImagingHub (collaboration with NorMIC nodes). MIP has integrated itself into the regional network of core microscopy facilities and is working towards core facility status to ensure professional service to its large user base in the future as well. For more information, see <https://med.uio.no/imb/english/research/about/infrastructure/mip>
- **Imaging instrumentation in IBV's animal department** (rodents) has - and must have - within the facility's barrier, the following imaging equipment: i) in vivo scanning confocal microscopy, ii) in vivo bioluminescence imaging and iii) in vivo two-photon microscope (see category E below).

MR, PET and CT

- **The Regional Core Facility in Translational MR Neuroimaging** is a UiO-approved core facility and a Health South-East regional core facility that offers modern facilities and expertise for the recording and analysis of advanced MR neuroimaging data for all types of human brain disorders. The facility is located at OUS-Ullevål. Of the larger equipment units, a GE Premier 3.0T MRI scanner can be mentioned. The scanner is equipped with i.a. 21- and 48-channel head coils. For more detailed info, see <https://www.med.uio.no/english/research/core-facilities/translational-mri-neuroimaging/>
- **Oslo Preclinical MR Core Facility** is an HSØ core facility for preclinical MR consisting of two nodes, one at OUS-Ullevål and one at OUS-Radiumhospitalet, under the Department of Clinical Medicine. The core facility offers non-invasive imaging and high-resolution magnetic resonance spectroscopy linked to animal testing. Of the larger equipment units, an Agilent 9.4 T MR scanner reserved for animal experiments at OUS-Ullevål and a Bruker 7T MR scanner at OUS-Radiumhospitalet can be mentioned. The facility is part of Normolim, an NFR national infrastructure which is a Euro-BioImaging node. For more detailed info, see <https://www.med.uio.no/english/research/core-facilities/preclinical-mr/>
- **MRI for non-invasive imaging of animals** is equipment being procured by the Department of Nutritional Sciences, Department of Basic Medical Sciences. The equipment (Compact High-performance 1T MRI system) is expected to be in place and in operation by Q4 2022. The facility is located in the Department of Comparative Medicine, Domus Medica (Department of Basic Medical Sciences, MedFak).
- **The core facility for preclinical PET** recently entered into a collaboration on new equipment with NMS (Norsk Medical Cyclotron Center - a company at UiO, OUS and Akershus Hospital) and BAYER Norway AS. A new PET-SPECT-CT scanner (with three integrated multimodal imaging systems) was then installed. Use of the equipment officially started September 2021. PET is a functional imaging technology used to observe metabolic processes in tissues and is based on the use of a positron-emitting radioligand (F-18, Ga-68, Zr89, or Tc-99 isotopes) which is connected to a biologically active molecule called a radioactive tracer. The facility offers advice, assistance, planning and execution of small animal PET experiments and help with post-processing and image analysis. The facility is located in the Department of Comparative Medicine, Domus Medica (Department of Basic Medical Sciences).
- **Micro-CT** (micro-computed tomography system): A SkyScan 1276, purchased in 2021 and operational in 2022, allows scanning of whole animals with "step-and-shoot" and "continuous gantry rotation" with the scan's shortest cycle down to less than 4 sec and the possibility of to identify object details (e.g. bone, fat, muscle, etc.) of 5-6 µm. Because it does not require the injection of radiolabeled tracers, this micro-CT provides a practical low-threshold and versatile option for *in vivo* animal research. Its use is exclusively for non-radioactive experiments. The facility is located in the Department of Comparative Medicine, Domus Medica (Department of Basic Medical Sciences, MedFak).
- **NEXT** is a hub at UiO in the Norwegian Center for Nanoscale X-ray Tomography network. NEXT also includes similar groupings at UiB, NTNU and ISN University in South-Eastern Norway. The main goal of NEXT is to provide access for Norwegian researchers and businesses to micro & nano x-ray imaging. UiO's hub is equipped with several CTs, including a SkyScan 2211 (multiscale CT) with a resolution of down to 100 nm for small samples. The instrument can scan a wide range of samples with sizes from <1 mm up to 200 mm. The geolaboratory at the Museum of Natural History (NHM-UiO) is equipped with a

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Nikon XT H225 ST microcomputer tomography (micro-CT), installed in 2016. The areas of use for these instruments range from geophysics, via nanodevices and components, materials science, forensics and archaeology, to dentistry, medicine and biotechnology. For more info, see <https://next-centre.com>.

- OD, Department of Geosciences and KHM (and others) are nodes in DIRE, which develops VDI solutions for sharing data. Competence is provided in the visualization and processing of large 3D data sets from e.g. micro/nanoCT, without collocation (<https://www.odont.uio.no/om/aktuelt/aktuelle-saker/2021/tildeling-pa-25-millioner-til-forskningssamarbeid-.html>). See also info about the EU-funded infrastructure project EXCITE (<https://www.odont.uio.no/iko/forskning/aktuelt/aktuelle-saker/2020/et-unikt-europeisk-forskningssamarbeid-vil-gi-tekn.html>).

Neuroimaging

- **The NORBRAIN-node** at UiO is a UiO-approved **core facility** and part of the national infrastructure for neuroscience research. The Oslo node belongs to the Department of Basic Medical Sciences. Arranges microtomes for section production and associated microscopy (Zeiss AxioScan Z1); NAVIGATOR3 image service system for organization in brain atlas; serial 2-photon tomography (STPT) combined 2-photon microscopy with automatic vibratome microtomy; 2-photon microscope and Nipkow spinning disk; mass spectrometer (Thermo Scientific Q Exactive Hybrid Quadrupole- Orbitrap Mass Spectrometer); super-resolution microscope (Zeiss ELYRA PS.1 SIM/STORM/PALM super-resolution microscope). For more detailed info, see <https://www.med.uio.no/forskning/kjernefasiliteter/to-fotonmikroskopi/> or <https://www.med.uio.no/imb/forskning/om/infrastruktur/norbrain/>
- **2PScope** is a new generation adaptive optics microscope, optimized to image large populations of brain cells in awake trained mice. The microscope provides 2-photon Ca²⁺ imaging using genetically encoded Ca²⁺ indicators. Responsible is the Department of Basic Medical Sciences.
- **nTMS-hdEEG** is equipment for "navigated transcranial magnetic stimulation" (nTMS) combined with "high density electroencephalography" (hdEEG) for studies of brain signals and consciousness in humans and animals. The equipment belonging to the Department of Basic Medical Sciences is located at the Intervention Centre, OUS. See <https://www.med.uio.no/imb/english/research/groups/brain-signalling/>

B1b. Infrastructure in this category available through national and international platforms where UiO is a partner or member

- **Nasjonal infrastruktur: NALMIN** - Norwegian Advanced Light Microscopy Imaging Network (<http://nalmin.no/>) is a national infrastructure network led by UiO with OUS as a partner. NALMIN, which consists of 6 national platforms (three in Oslo), is a member of NorBioImaging (<https://www.norbioimaging.no>) which is managed from NTNU. NALMIN was awarded NOK 55.7 million in 2015 and NOK 71.5 million in 2021. NALMIN nationally funded six new microscopes with extremely good image resolution in 2015, while the 2022 grant is providing the platforms with equipment of further improved quality and complexity. NALMIN's vision is to offer Norwegian researchers the most advanced light microscopy of biological and biomedical material. NorMIC Oslo (see above) is the international node within EuroBioImaging.
- **Nasjonal infrastruktur: NORBRAIN - Norwegian Brain Initiative: a Large-scale Infrastructure for 21st Century Neuroscience.** Led by the neuro-environment at NTNU, UiO is a partner. NORBRAIN is a large-scale national infrastructure project for neuroscience research. The aim is to generate new knowledge about complex mental functions and dysfunctions, such as

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Alzheimer's and Parkinson's. The infrastructure consists of advanced electrophysiological equipment, high-resolution microscopes and other imaging technologies. NORBRAIN has been built up in several phases. Phase 1 was established in 2011-2012, with a focus on the acquisition of technology for basic neurobiological research where complementary infrastructures were set up at UiO and NTNU (80 MNOK). Phase 2 was launched in 2015, with the aim of linking the basic research in phase 1 to human and clinical research. The primary investment in phase 2 was a 7T MRI scanner (76.3 MNOK). The NORBRAIN consortium also received support for phase 3, where the upgrading of outdated basic neurobiological equipment from phase 1 will be combined with the acquisition and development of next-generation neurotechnology for high-resolution molecular biological imaging as well as new equipment for registration and high-speed imaging from very large populations of nerve cells in the cortex . Phase 3 will also include the University of Bergen.

- **International infrastructure: EMBL** is a molecular biology laboratory in Heidelberg with a high international profile. A number of countries in Europe, among them Norway, contribute with funding. EMBL offers training, services and infrastructure to life science researchers at all levels. EMBL runs a number of laboratories for microscopy, genomics and proteomics, as well as bioinformatics. As part of its strategy, EMBL has development and participation in national and European research infrastructures in several of these fields, including imaging technologies. For more info, see <https://www.embl.de>. EMBL also runs a Nordic network for molecular medicine, where one of the nodes is located at UiO (NCMM, see <https://www.med.uio.no/ncmm/>)
- **International infrastructure: Euro-BioImaging** is a European research infrastructure (ERIC) for imaging technologies in biological and medical sciences on the ESFRI roadmap, providing open physical user access to a wide range of modern imaging technologies in biological and medical imaging for life science researchers in Europe . NorMIC Oslo is a Norwegian node in Euro-Bioimaging for light microscopy and Norway also contributes with NORMOLIM - Norwegian Molecular Imaging Infrastructure within molecular imaging. See <https://www.eurobioimaging.eu>
- **International infrastructure: EBRAINS** is a European research infrastructure for neuroscience research. Main base in Belgium (EBRAINS AISBL); the services are available in the EBRAINS web portal (<https://ebrains.eu/>). The infrastructure has participation from 11 countries represented by 32 institutions (9 with full membership, 23 with associate membership). UiO is a full member and represented on the Board of Directors. UiO leads the development of the infrastructure for "FAIR neuroscience data" (EBRAINS Data and Knowledge services) for sharing and publishing neuroscientific data and models and contributes with services for navigation and analysis of data connected to the brain atlas. Other areas in the infrastructure: modeling and simulation, neurorobotics, medical informatics, neuromorphic computing. The infrastructure is built by the EU Human Brain Project (HBP) and is financed by a number of different EU projects, of which 3 projects have recently been awarded to UiO.
- **International infrastructure: BIOMATDB+** makes available results from biomaterials research in a database, with the aim of providing access to a complete overview of biomaterials with health applications. The infrastructure is under construction. In addition to the overview of metadata for the biomaterials and their properties, the database contains information about which tissues the biomaterials are compatible with, and an overview of response and safety in connection with use in patients. The infrastructure is coordinated from Austria and UiO leads the demonstration, validation and test phase which will ensure that results as well as the finally developed technical solutions (database and marketplace) meet the requirements of the relevant user groups.
- For relevant **ESFRI facilities**, see <https://instruct-eric.eu/platform-type/electron-microscopy>

C. Global analyzes of biomolecules, «-omics»

The term "-omics" refers to several technologies such as genomics, proteomics or metabolomics. What these have in common is that they aim at global analyzes of biomolecules, i.e. characterization and quantification of the complete collection of biological molecules in a sample, whether it is DNA (genomics), proteins (proteomics), metabolites (metabolomics) or lipids (lipidomics). . Functional genomics aims to identify the functions of as many genes as possible for a given organism. It combines different "-omics" techniques such as transcriptomics and proteomics. Bioinformatics and biostatistics are central analytical tools in the various "-omics" technologies.

C1. Existing infrastructure at UiO

a. Genomics technologies for sequencing DNA and RNA

- **Norwegian Consortium for Sequencing and Personalized Medicine – NorSeq** is the national infrastructure for sequencing. The Norwegian Sequencing Center (NSC) is part of NorSeq. For more detailed info, see <http://norseq.org>
- **Norwegian Sequencing Center (NSC)** is a national sequencing platform established in 2010 with two main nodes, one at the Department of Medical Genetics (AMG, OUS and UiO) and one at the Department of Biosciences, Center for Ecological and Evolutionary Synthesis (CEES, UiO). The two main nodes have complementary strengths and research interests. While the CEES node has a particular focus on *de novo* sequencing, "genome assembly" and non-human sequencing, the AMG node has specialized in whole-genome human resequencing (WGS), amplicon sequencing and epigenetics. Both nodes also have considerable expertise in transcriptomics and metagenomics. State-of-the-art equipment includes NovaSeq 6000, NextSeq 500 & MiSeq instruments from Illumina, Sequel and Sequel II from Pacific Biosciences and 10x Genomics (single cell applications). For more detailed information, see <https://www.sequencing.uio.no>. Below, these are described in more detail individually.
- **Norwegian Sequencing Centre - (NSC) - IBV/CEES node** is one of two nodes of a national research infrastructure (NSC) and a UiO-approved **core facility**. NSC-UiO offers long-read sequencing (3rd generation): (DNA, RNA seq, amplicon, metagenomes, de novo genomes, pop sequencing) – at PacBio. Consultations are also carried out for project planning and bioinformatics service - such as de-multiplexing and quality control, but also "genome assembly" linked to PacBio HIFI. In connection with HIFI, HiC is also carried out for "long range scaffolding". At NSC-UiO there is also equipment for drop technology for single cell sequencing (10x Genomics and Nadia Innovate) (acquired with UiO AVIT funds).
- **Norwegian Sequencing Centre - AMG node**. In addition to being part of a national sequencing platform, this node also functions as a UiO-approved **core facility** and a Health South-East regional core facility for DNA sequencing, supported by Health South-East. The AMG node is located at OUS-Ullevål. The node is planned to be moved to the Life Sciences building as part of KLM, OUS.
- **Genomics Core Facility** is a Norseq node located at OUS-Radiumhospitalet. This acts as a cancer-specialized node. The Genomics Core Facility together with the AMG node operates Helse Sør-East's regional core facility for DNA sequencing. The Genomics Core Facility is approved as a UiO core facility and belongs to Klinmed, MedFak.
- Both Klinmed facilities (NSC-AMG node and Genomics Core Facility) offer high-throughput analyzes for genomics, transcriptomics and epigenomics of bulk and single cells. For detailed info, see <https://www.med.uio.no/forskning/kjernefasiliteter/sekvensering/>, and <http://oslo.genomics.no> eller <http://www.sequencing.uio.no>
- **aDNA-lab** is a UiO-approved **core facility** and a special laboratory for "ancient DNA" at the Department of Biosciences. The laboratory is equipped for the isolation

of ancient DNA from historical samples such as sediments, seeds, museum skins and bones from all types of organisms, including humans. Isolated DNA is sequenced at NSC. As of today, no service offers. For detailed info, see

<https://www.mn.uio.no/ibv/english/research/about/infrastructure/facilities/life-science/sequencing/adna/>

- **DNA-lab NHM.** The DNA laboratory at the Natural History Museum (NHM) is equipped with modern instruments for genetic research and has separate sections for DNA/RNA extractions, pre-PCR and post-PCR work and also stations for working with old material, especially from samples from scientific collections (sensi lab). In addition to a local sequencing platform, DNA-lab NHM focuses on the generation of specially adapted genetic libraries for sequencing on NSC's platforms. Data on scientific samples stored in NHM's DNA bank is published in accordance with international data standards freely available in GBIF. For more info, see <https://www.nhm.uio.no/english/research/infrastructure/dna-lab/>

b. Proteomics

- **Proteomics core facility** at the Department of Biosciences, MN, is a UiO-approved core facility that offers a range of services in proteomics such as protein identification, protein quantification, analysis of phosphoproteins and glycoproteins. The core facility has particular expertise in the analysis of various PTMs including phosphorylation, N- and O-glycosylation and methylation. The core facility is part of the NAPI consortium (see below) which in 2020 was awarded a larger grant from the Research Council's Infrastructure Programme, and which has consequently recently invested in new "state-of-the-art". The core facility is planned to be moved to the Life Sciences building. For detailed info, see <http://www.mn.uio.no/ibv/english/research/sections/bmb/research-groups/enzymology-and-protein-structure-and-function/proteomics-thiede/proteomics-service/>
- **Proteomics core facility** at OUS-Rikshospitalet and Department of Clinical Medicine, UiO, is a combined UiO/Health South-East regional core facility that offers a wide range of services within mass spectrometry-based proteomics. This includes sample analysis, as well as training of users and advice to research groups. The core facility focuses its efforts primarily through research projects to ensure a thorough build-up of expertise. In addition, a number of standard analyzes are delivered as a full service. The core facility is the coordinator of the NAPI consortium (see below) which in 2020 was awarded a larger grant from the Research Council's Infrastructure programme, and which has consequently recently invested in new "state-of-the-art" equipment. The core facility is planned to be moved to the Life Sciences building. For detailed info, see <https://www.ous-research.no/proteomics/>

c. Metabolomics

- **The Laboratory for Analytical Chemistry / Metabolomics** at the Department of Nutritional Sciences, Department of Basic Medical Sciences, performs a wide range of analyzes of metabolites, of both a qualitative and quantitative nature. The facility has advanced equipment for the purpose: an HRMS (Q Exactive™ Hybrid Quadrupole-Orbitrap™ Mass Spectrometer), an LCMS (Applied BioSystems 5500 QTRAP triple-quadrupole) and an HPLC (Agilent 1290 UPLC system, with diode array and fluorescence detector), as well as a GC-MS (Agilent Intuvo 9000 GC system). The laboratory is part of a national consortium (NorMet), i.a. together with the Mass Spectrometry Laboratory, Department of Chemistry. See <https://www.med.uio.no/imb/english/research/about/infrastructure/metabolomics-lab/>. The mass spectrometry laboratory, Department of Chemistry will collaborate with the Department of Nutritional Sciences on building a joint unit for metabolomics in the Life Sciences building.
- **The Department of Clinical Medicine/KLM** has the Orbitrap Fusion Mass Spectrometer instrument for global metabolomics/lipidomics analyses.

d. Screening of chemical libraries

- **High-Throughput Chemical Biology Facility** at the Norwegian Center for Molecular Medicine (NCMM), MedFak, is a UiO-approved **core facility**. The facility offers screening of small molecules in chemical libraries and gives access to EUOPENSCREEN's collections of chemical compounds (18.3 MNOK European investment), including a "diversity collection" of 96,096 structurally very diverse compounds, in addition to an in-house chemical library (68,000 connections). The aim is to discover molecules with a specific effect on given biological systems. A large number of biochemical and cell-based methods are available, and the analyzes are carried out using recognized software and according to industry standards. The facility has solid experience with modulating protein-protein interactions, intracellular flow cytometry and GPCR screening using FLIPR. For more detailed info, see <https://www.med.uio.no/english/research/core-facilities/chemical-biology-screening/>

e. Bioinformatics

- **The core facility for bioinformatics/Helpdesk for ELIXIR** is a UiO-approved core facility at the Department of Informatics, MN, supported by the Department of Chemistry, the Department of Biosciences and the Department of Pharmacy. The core facility is also a Health South-East regional core facility at the Department of Clinical Medicine, located in the OCC built at Radiumhospitalet. This is a hub for bioinformatics and computational biology with expertise ranging from precision medicine in all aspects of genomics, regardless of species and populations, to protein structure. The center also has an ELIXIR help desk. For info see: <https://www.mn.uio.no/sbi/english/about/>, <https://www.ous-research.no/bioinformatics/>.

C1b. Infrastructure in this category available through national and international platforms where UiO is a partner or member

Global analyzes of biomolecules require a heavy infrastructure, but in this area UiO/OUS is a national hub and largely disposes of "state-of-the-art" instruments thanks to larger grants from the Research Council. The following national infrastructures, where UiO has a formal connection, have been established within this field of technology:

- **National infrastructure: NorSeq – national consortium.** While the Norwegian Sequencing Center originally consisted of the two main nodes in Oslo described above, the Research Council gave a Phase II grant in 2015, where NSC became a "hub" in an expanded national consortium with new partners from the University of Bergen, Haukeland University Hospital, NTNU and St Olav's hospital. In addition to offering cost-effective DNA sequencing to researchers, the aim is also to facilitate the development and implementation of personalized medicine in Norway. In addition to the funding from the Research Council, NorSeq receives funds to support the day-to-day operations from the regional health authorities and the universities and university hospitals in Oslo, Bergen, Trondheim and Tromsø.
- **National infrastructure: NAPI - Network of Advanced Proteomics Infrastructure** is a national technological and scientific infrastructure for research within proteomics. NAPI will expand the capacity and the opportunity for advanced proteomics in Norway through an upgrade to the next generation of mass spectrometry instruments. These advanced instruments will make it possible to characterize proteomes faster and more precisely than before. NAPI is coordinated by UiO and has participants from the universities of Bergen, Trondheim, Tromsø and Ås. Together, the infrastructure will cover all main areas within proteomics.

- **National and European infrastructure: NOR OPENSREEN - The Norwegian EU OPENSREEN node** (<http://www.openscreen.no/>). UiO leads the Norwegian node. Allocated funds from the Research Council's INFRA program in 2016 (NOK 33.3 million). The Norwegian node is part of the EU-OPENSREEN network, which is the European research infrastructure for screening platforms and chemistry environments with open access to chemical biology and early drug discovery. In addition to frontline technologies for screening, the infrastructure includes large libraries of molecular substances and a database of screening results and protocols for running specific tests.
- **National and European infrastructure: ELIXIR Norway - A Norwegian's ELIXIR Node** (<https://elixir-europe.org/>). Led by UiB, UiO is a partner. Allocated funds from the Infra program in the Research Council in 2010 (50 MNOK), in 2017 (86 MNOK) and in 2021 (ELIXIR3, 95 MNOK). ELIXIR is a European infrastructure for biological data that coordinates data resources for the life sciences. The resources include databases, software tools, educational offers, and storage and analysis resources for big data. ELIXIR.NO is the Norwegian node in ELIXIR, coordinates the development of Norwegian bioinformatics and offers services to research and industry related to finding, analyzing and sharing data.

D. Different analytical technologies

In this category, infrastructure for various analytical methods is gathered, divided into five subgroups.

D1 Existing infrastructure

a. Surface characterization

- **QCM-D** (quartz crystal microbalance with dissipation technology) is a real-time nanoscale technique for analyzing surface phenomena including thin film formation, interactions and reactions at the interface between liquid and solid. QCM-D determines bonds between substances in liquid phase with a surface in real time, the surface can be of different materials, but also cells. The equipment (Q-Sense E4) is part of a technological platform at the Department of Clinical Dentistry, OD. For more info, see <https://www.odont.uio.no/iko/english/about/organization/units/biomaterials/Capacities/qcm-d/>

b. Cell separation (flow)

- **Flow Cytometry Core Facility (FCCF)** OUS at the Department of Clinical Medicine is a UiO-approved core facility and a Health South-East regional core facility. The facility is spread over three nodes, at Montebello, Gaustad and Ullevål, and offers training in the use of and access to flow cytometers, mass-spec cytometers and sorters. For more info, see <https://www.med.uio.no/english/research/core-facilities/flow-cytometry/>
- **Section for pharmacology and pharmaceutical biosciences, Department of Pharmacy**, offers cell sorting of bacteria using a Moflo Astrios Eq instrument for competent users. Cell sorting is included as part of a rental site that also disposes of a beta counter, an AFM microscope (Atomic Force Microscope), and a confocal microscope, all with the possibility of training.

c. MS-based analyses

- **Joint facility for bioanalysis and bioanalytical technology and method development** at the Department of Pharmacy and the Department of Chemistry. At the Department of Pharmacy (Bioanalysis), advanced sample processing technologies are developed to determine both drugs and biologically active proteins (biomarkers) in blood, serum, plasma, urine and other biological matrices. Bioanalysis disposes of three LC-Triple-Q MS systems (different types), an ion trap LC-MS/MS and an HRMS. For more information, see <https://www.mn.uio.no/farmasi/english/research/groups/sampleprep-uio/> and <https://www.mn.uio.no/farmasi/english/research/groups/smart-protein-analysis-uio/index.html> At the Department of Chemistry (Bioanalytical Technology), advanced chromatographic and spectrometric techniques are developed for the determination of organic compounds in samples such as cancer cells, stem cells, blood, water, soil and air. A specialty is liquid chromatography columns coupled with mass spectrometry, which are very sensitive. The facility has three different MS instruments (LC-Orbitrap MS (Q-Exactive), LC-Triple-Q MS (Vantage), and LC-Triple-Q MS (Quantiva). For more information, see <https://www.mn.uio.no/kjemi/english/research/groups/bio3%20-%20Chemical%20Lifesciences/bioanalytical-chemistry/>
- **The mass spectrometric laboratory** at the Department of Chemistry is a UiO-approved **core facility**. This is a service and research laboratory for mass spectrometric determination of organic compounds. The laboratory has several MS instruments (Bruker Apex 47e (FT-ICR-MS), Micromass Prospec Q, Micromass QTOF 2 W). For more information, see <http://www.mn.uio.no/kjemi/forskning/om/infrastruktur/ms/instrumenter/>
- **Environmental Lab and Environmental Analysis** at the Department of Chemistry. This is a laboratory with instrumentation for the analysis of environmental samples

D. Analytical technologies

(air, soil, water). Mass spectrometric instruments are central (specially built PTR-TOF-MS, Varian Vista ICP-OES and NexION 300D ICP/MS). For more information, see <https://www.mn.uio.no/kjemi/forskning/grupper/miljovitenenskap/>

- **Isotope lab (CLIPT)** at the Department of Biosciences. The laboratory has a dedicated MS instrument (ThermoFisher DeltaV stable isotope mass spectrometer with Flash Elemental Analyzer and LC-Isolink) which allows high-precision analysis of stable isotopes of carbon, nitrogen, oxygen and hydrogen. For more information, see: <https://www.med.uio.no/imb/om/hms/avfall/isotop-lab.html>
- **Section for pharmaceutical chemistry**, Department of Pharmacy, is a rental site that focuses on medicinal chemistry, medicinal and bioanalysis and pharmacognosy. Central equipment is LC-MS/MS. For more information, see <https://www.mn.uio.no/farmasi/om/organisasjon/seksjon-farmasoytisk-kjemi/>

d. Spectroscopic analyses

- **RECX** at the Department of Chemistry is a UiO-approved **core facility** and an advanced research and service laboratory for X-ray diffraction and scattering. The laboratory has eight modern XR instruments, including a SAXS (low-angle) instrument for biomolecules and materials. RECX received 14 MNOK from the INFRA program of the Research Council in 2014. For more information, see <https://www.mn.uio.no/smn/english/research/about/infrastructure/recx.html>
- **RAMAN/Vibrational spectroscopy** is an analytical technology that is carried out at the Department of Chemistry and which has a broad user base. RAMAN spectroscopy allows the characterization of inorganic as well as organic and biological materials and macromolecules. A central instrument is a "state-of-the-art" RAMAN Spectrometer (Horiba Jobin-Yvon T64000). For more information, see <http://www.mn.uio.no/kjemi/english/research/about/infrastructure/raman>

e. Calorimetry

- **Calorimeter** (ITC/DSC) is included in the rental site Section for galenic pharmacy and community pharmacy at the Department of Pharmacy. Here the focus is on drug formulation, drug technology and community pharmacy. Key technologies are particle size characterization, 3D printing of pharmaceuticals, tablet manufacturing (formulation), tablet characterization, and polymerization characterization. For more information, see <https://www.mn.uio.no/farmasi/om/organisasjon/seksjon-farmasi/>

E. Model organisms and infrastructure for biological material

This category includes infrastructure that houses various experimental animals, model organisms and biological material used for research. The facilities here include special rooms for living organisms, and to an increasing extent also advanced scientific equipment where the legislation requires that the equipment must be within enclosed facilities. The category is divided into five subgroups.

E1a. Existing infrastructure

Biobanks

- IBV (together with NIVA) hosts the **Norwegian microalgae collection (NoRCA)**; approx. 1,000 strains) as part of the national infrastructure for participation in ESFRI:EMBRC (European marine biological research centers). This unit can be considered to be linked to the Plantelaboratoriet/Plantlab: UiO in order not to duplicate facilities.
- **The NHMO DNA Bank** at the Natural History Museum (NHM) is the largest Norwegian DNA bank for species other than humans. The facility consists of freezers (-80°C and -20°C), cold rooms and dry storage, as well as a specially developed database system (Corema). The collection contains several hundred thousand tissue samples and DNA extracts, mainly of vascular plants and birds, but with growing collections also of lichens, fungi, invertebrates and other taxa. International, national and UiO strategy for implementing the FAIR principles makes this function essential. Digital research data in biology and geology must be linked to physical objects, such as DNA samples, tissue samples and museum collections, to make data FAIR. Data on scientific samples stored in NHM's DNA bank is published in accordance with international data standards freely available in GBIF (Global Biodiversity Information Facility) and GGBN (Global Genome Biodiversity Network). For more info, see <https://www.nhm.uio.no/english/research/infrastructure/dna-bank/>

Large animals - pigs, etc.

- **Core Facility for Large Animal Research**, Department of Clinical Medicine, is a regional technological core facility supported by Health South-East. The facility has two nodes, at Rikshospitalet and Helse Sør-East-Ullevål, respectively. Both are fully equipped for large animal trials. The facility offers use of facilities (operating room with equipment), and can contribute expertise and help for planning and carrying out experiments on pigs, including piglets, rabbits and dogs. For more information, see <https://www.med.uio.no/forskning/kjernefasiliteter/stordyrforskning/>

Mus og gnagere

- **Department of Comparative Medicine (KPM)** (Laboratory Animal Department) at the Department of Basic Medical Sciences. This is a facility for housing and breeding experimental animals with associated equipment. Housing rodents (mice/rats) can be done at different cleanliness levels: SOPF (specific and opportunistic pathogen free), SPF (specific pathogen free), MDU (minimal disease unit), and conventional (not pathogen-protected). The department has its own barrier unit which is particularly suitable for keeping core breeding herds. Technical research infrastructure includes, among other things IVIS (for non-invasive imaging), PET/CT, ultrasound, irradiator, various multiphoton microscopes, metabolic cages, flow cytometers, various equipment for behavioral studies, etc. The department offers technical services from qualified personnel to internal and external users. More info can be found here: <https://www.med.uio.no/imb/tjenester/komparativmedisin/index.html>

- **The Norwegian Transgenic Center (NTS)** at the Department of Basic Medical Sciences helps with the production of new genetically modified (GM) mouse models as well as maintenance and various forms of phenotypic characterization of genetically modified mice. The repertoire of techniques offered includes a wide range of technically challenging, advanced transgenic techniques, such as genome editing in embryos with CRISPR-Cas9, embryo and sperm cryopreservation. The services are offered to user groups at an affordable price. An important factor for the technologies offered is up-to-date knowledge about the production of transgenic / GM mice. The center has extensive experience with genetically modified animal models and possesses expertise that is unique in Norway in this area. For more information, see <https://www.med.uio.no/forskning/kjernefasiliteter/norsk-transgensenter/>
- **Metabolism platform.** At the Institute for Basic Medical Sciences, there is advanced equipment for determining energy metabolism in mice under normal housing conditions (Phenomaster, TSE Systems). The infrastructure consists of 20 cage units placed in climatic chambers, where O₂/CO₂ gas exchange, movement, food and liquid intake can be recorded automatically for the individual individual without the animals being disturbed, possibly under deviant light, temperature and humidity conditions. The platform is also equipped with equipment for determining body composition (muscle/fat mass, minispec LF 90II). The platform is made available to users through the core facility NTS.
- **Telemetry.** The Department of Basic Medical Sciences has telemetry equipment for measuring biological parameters in rats and mice. The equipment is located at the Department of Comparative Medicine, IMB.
- **The In Vivo section** at the Department of Life Sciences is a facility for the housing and care of experimental animals (mice, rats, fish). The facility provides assistance with applications to the Norwegian Food Safety Authority for experiments on animals. Technical assistance is offered for experiments and the department is responsible for the practical training part for candidates to get the necessary approval to carry out experiments on animals. The rodent department and a satellite area on the 3rd floor of KB-hus have GMO class II approval. The department has IVC cage systems for housing mice and rats, LAF cabins and operating tables. Laboratory animal activity in the department is mainly focused on *in vivo* measurements of physiological processes. In this connection, much advanced scientific equipment is located in the department and includes a two-photon microscope, confocal laser scanning microscope, fluorescence microscope, myograph, as well as various special setups for behavioral studies of rodents and setups for *in vivo* electrophysiology. For more information, see <https://www.mn.uio.no/ibv/tjenester/infrastruktur/In%20Vivo-avdelingen/>

Zebrafish and aquarium facilities

- **The Zebrafish Core Facility** is located at the Norwegian Center for Molecular Medicine, NCMM. The facility has tanks for fish keeping and tanks for use when generating/regenerating fishing lines. These can be rented out to researchers at UiO and other research institutions. The facility has associated mating tanks, iSpawn for large-scale production of eggs, as well as a well-equipped laboratory with instrumentation for various analyzes of zebrafish. The facility advises and assists researchers and has a dedicated research group associated with it, which uses and develops it in its own research. For info, see <https://www.med.uio.no/forskning/kjernefasiliteter/sebrafisk/>

- At IBV's *in vivo* department, there is a facility with **aquarium facilities** for fish that do not need continuous monitoring of oxygen in the water. For larger quantities of fish and other types of fish, e.g. salmon, other facilities are used (see F). The department is also responsible for a satellite facility for eggs and embryos of hens in the ZEB building, which is operated by staff at the Department of Pharmacy. This includes incubators and equipment necessary for monitoring and testing embryos. The *in vivo* department at IBV assists with applications for approval from the Norwegian Food Safety Authority and follow-up of approved projects.

Plants

- **The plant laboratory/PlantLab:UiO** at the Department of Biosciences is a UiO-approved **core facility** that is critical for key research activities at the department and at the Museum of Natural History, and also for other users. Here you will find plant laboratories with climate-controlled daylight rooms, climate-controlled phytotron rooms and climate cabinets, GMO containment level S3. A total of 16 phytotron rooms (160m²) and 6 daylight rooms (180m²). Fully covered by internal research and teaching activity. For more info, see <https://www.mn.uio.no/ibv/english/research/infrastructure/facilities/life-science/plant-culture-laboratories/phytotron/index.html>
- **The National Seed Bank** at the Museum of Natural History (NHM) is a national seed bank for wild, Norwegian endangered plant species. The National Seed Bank is a collaboration between all six botanical gardens in Norway and NHM runs it. NHM annually seeks funding from the Norwegian Environment Agency for collection trips and parts of operations. Seeds from the National Seed Bank can be used for re-establishment in the wild and for research purposes. The seed bank is part of the international cooperation Millenium Seed Bank Partnership. NHM is a member of ENSCONET, and conservation of cultivated plants' wild relatives at the Nordic Gene Resources Center (Nordgen) under national coordination from the Norwegian Gene Resources Center at NIBIO. For more info, see <https://www.nhm.uio.no/forskning/samlinger/botanikk/botanisk-hage/ex-situ/>

Other model organisms

- Other model organisms such as *Drosophila* and *C. elegans* have significant strengths in strategically important areas such as functional genomics, phenomics and connectomics, but do not need further elaboration beyond the downstream analyzes available in the form of core facilities. Incidentally, *Gallus gallus* (chicken) is also a suitable alternative model organism in human toxicology.

Stem cells

- **The core facility for human pluripotent stem cells** is part of the National Center for Stem Cell Research and is located at the Department of Basic Medical Sciences. The facility is a national core facility for the production and characterization of human pluripotent stem cells that supplies researchers across the country with human ES and iPS cell lines. For info, see <https://www.med.uio.no/forskning/kjernefasiliteter/humane-pluripotente-stamceller/>
- **Closed-cell oxygen incubator BioSpherix X3 Variable Oxygen Cell Culture Unit** is a registered facility from the Department of Basic Medical Sciences, which appears to be part of the offer from the Core Facility for human pluripotent stem cells (see above).

E1b. Infrastructure in this category available through national and international platforms where UiO is a partner or member

The following infrastructures, where Norway or UiO have a formal connection, are therefore included in the overview of existing infrastructure in this category:

- **National infrastructure: Biobank Norway** - A national biobank infrastructure. NTNU-led, UiO partner and OUS partner. Allocated funds from the Infra program in the Research Council in 2010 (80 MNOK), in 2015 (85.3 MNOK) and in 2021. Biobank Norway is one of the world's largest existing biobank resources that covers both population-based biobanks with consent and disease-specific clinical biobanks. Biobanks in Norway also have access to health data, non-parallel time studies, which give Norway a unique tool for global research and innovation projects in life sciences, disease prevention and treatment.
- **National and European infrastructure: EMBRC Norway - The Norwegian node of the marine biological Research center.** (<http://www.embrc.eu>) Led by UiB, with UiO as a partner. Was awarded 3.5 MNOK in 2017 from the Infra program in the Research Council. Norwegian membership in ESFRI cooperation on marine resources. A goal for a Norwegian node in the collaboration is to strengthen research into the consequences of environmental changes in marine ecosystems and the conditions for sustainable exploitation of marine resources. The node will integrate seven Norwegian institutions that carry out research on various marine ecosystems, and will in particular offer facilities where you can test how different marine organisms react to changes in biological, physical and chemical conditions under conditions that are very similar to those the organisms encounter in nature. Existing infrastructures at the institutions must be coordinated and upgraded.
- **National infrastructure: NMD Norwegian Marine Data Center.** (<https://www.hi.no/en/hi/forskning/research-groups-1/the-norwegian-marine-data-centre-nmd>) Led by the Institute of Marine Research, UiO is a partner. The Research Council allocated NOK 48 million to the project in 2013. The Norwegian Marine Data Center (NMD) at the Institute of Marine Research has been established to be a national data center for the professional handling of marine environmental and fisheries data and for the production of data products. NMD maintains the largest collection of marine environmental and fisheries data in Norway.
- **National and international infrastructure: NORBOL Norwegian barcode of life network.** (<http://www.norbol.org/>) Awarded NOK 25.6 million in 2013 from the Research Council's infra programme. Led by the Science Museum NTNU, and UiO at NHM is a partner. The international database Barcode of Life Data Systems (BOLD) is a world library for biological barcodes for all species. As of 2017, the database contains over 5.8 million barcodes from almost 650,000 species. NorBOL, the Norwegian network, aims to bring 20,000 species from Norway by barcoding 90,000 samples from 20,000 Norwegian and Arctic species. By the end of 2017, more than 15,500 of the species had received their genetic signature. DNA barcoding can be used, among other things, to detect pests and alien species, and is used to monitor biological diversity. The business world can also greatly benefit from the technology and the database: Importing food, as well as buying and selling organic products, becomes safer if you know with certainty which species they contain. The Norwegian oil industry can use the technology to map the ecosystems on the seabed before and after oil drilling.

- **European infrastructure - DiSSCo - Distributed System of Scientific Collections** (www.dissco.eu) - is a new research infrastructure for scientific natural history collections that was included in ESFRI in 2018 with the ambition of establishing an ERIC from 2025. DiSSCo establishes a joint coordinated virtual platform for all Natural History collections in Europe with common harmonized routines and mechanisms for access and lending, curation and preservation, and FAIR data handling and data sharing. UiO Natural History Museum leads the Norwegian national participant node in DiSSCo (www.dissco.no). DiSSCo already includes over 100 institutions in Europe, including the four university museums at UiO, UiB, UiT and NTNU.
- **International infrastructure: GBIF – Global Biodiversity Information Facility** (www.gbif.org) – is an international network and infrastructure for biological research data funded by national member states that provides free and open access to information on biodiversity from around the world. The UiO Museum of Natural History leads the Norwegian participating node in GBIF (www.gbif.no). The GBIF Norway node is funded by NFR INFRA and is organized as a consortium (consisting of UiO, NTNU, UiB, UiT, the Species Data Bank, and NINA) and provides services to Norwegian researchers and other users for the preparation and publication of Norwegian species data as well as help with access to and application of species data from around the world.

F. Various special laboratories

This category includes infrastructure in the form of dedicated, often advanced, laboratories set up for specific purposes with many types of equipment.

F1. Existing infrastructure

- **NorMIT (Norwegian center for Minimally invasive Image guided Therapy and medical technologies)**, Department of Clinical Medicine, is a UiO/OUS node of a national infrastructure (see below). NorMIT is a collaboration between the Operating Room of the Future (FOR) at St. Olav's Hospital in Trondheim and the Interventional Center at Oslo University Hospital (OUS), and the operating theaters are physically located in Trondheim and Oslo. Of particularly relevant equipment, two MR instruments can be mentioned: 3 T MR Achieva (Phillips, 2007 funded by the Institute of Psychology, SV faculty and Institute of Clinical Medicine) and 3 T MR (Siemens, 2017, funded by the Institute of Psychology). For more information see <http://normit.no/>
- **SERIT (South-Eastern Regional Infrastructure for Clinical and Translational Research)** Department of Clinical Medicine. SERIT was established in 2016 to provide the best possible methodological assistance to the clinical research environment in Health South-East. SERIT offers analyzes for the functional interpretation of patient genotypes to better understand the genotype-phenotype gap and disease mechanisms. Furthermore, a goal of SERIT is to promote innovation in life sciences. The laboratory has a collection of equipment including various microscopes, also confocal microscopes and microscopes for microdissection, equipment for immunohistochemistry and DNA sequencing. For more info, see <https://www.med.uio.no/klinmed/english/research/about/serit/services/>
- **Infrastructure for precision diagnostics (OUS)** has been newly established at the department of pathology (OUS-Radiumhospitalet) as a result of the allocation of research funds from Health South-East 2019. The infrastructure fulfills a need that is essential for more clinical cancer studies to be established. The main purpose is to offer tailor-made solutions by ensuring feasibility, predictability and secure diagnostic routines for non-established diagnostics needed in clinical cancer studies. The infrastructure also supports biobanking. The development of the infrastructure is planned over two years and has close interaction with the Genomics Core Facility (OUS Radium) for the establishment of new analysis methods. In addition, the environment has expertise in "liquid biopsies", both detection of cancer cells and free nucleic acids in blood, bone marrow and fluids. The laboratory has a collection of equipment: Nanostring nCounter Dx, Qiacube, CellSearch, DepArray as well as microscopy for single cell selection by micromanipulation.
- **Core facility for clinical nutrition studies**, Department of Basic Medical Sciences, has facilities and infrastructure for clinical nutrition studies on patients and healthy volunteers, and for translational research. The center enables anthropometric measurements, blood sampling and minor interventions such as fat tissue biopsy and muscle biopsy in close combination with significant laboratory facilities. These include 3 indirect calorimetry rooms, DXA scan, devices for measuring energy turnover by indirect calorimetry (COSMED Fitmate) and advanced bioimpedance equipment. The center is a collaboration between OUS and UiO, and is located at Domus Medica in Gaustad. For more information, see <https://www.med.uio.no/imb/forskning/sentre/klinisk-ertering/>
- **eColab**, Department of Health and Society, MED, is a research laboratory for the primary healthcare service, for hire for research projects in Norway. The infrastructure allows researchers to test proposals for practices and the best possible health care where doctors, nurses and other health personnel collaborate with both patients, relatives and hospitals. The laboratory consists of a consultation room

- (doctor's office) and a treatment room (nursing home), where various actors can set up controlled studies to find out how healthcare personnel handle new technology and how they interact with each other in teams, and with patients, relatives or hospitals. For information, see <https://www.med.uio.no/helsam/tjenester/kunnskap/ecolab/>
- **BMF (Biophysics and Medical Physics - Cell Lab and EPRLab)**, at the Institute of Physics, MN, are fully equipped laboratories for two types of main activity: (1) Cell laboratory which is approved by the Norwegian Directorate of Health as a classified level 2 lab for work with genetically modified microorganisms (GMM), fully equipped laboratories for the cultivation of cancer cells and normal cells, an X-ray laboratory and a laboratory for studies of hypoxia. This cell lab includes infrastructure for proton irradiation of cells at the Oslo Cyclotron Laboratory, Department of Physics. (2) EPR: Electron Paramagnetic Resonance. Only "state-of-the-art" EPR equipment in Norway (EPR spectrometer-1 (X-band), EPR spectrometer-2 (X- and Q-band)). Detection and qualitative/quantitative analysis of free radicals in all possible systems from crystals to biological matrices. For info, see <http://www.mn.uio.no/fysikk/forskning/grupper/biofysikk/> and <https://www.mn.uio.no/fysikk/english/research/about/infrastructure/epr-lab/>
 - **BioSoft** is a special laboratory at the Department of Chemistry for the characterization of biological macromolecules and polymers using equipment for light scattering, AFFF (Asymmetric Flow Field Fractionation), GPC – Chromatograph, NanoPhox Photon cross-correlation sensor, densiometer and rheometer.
 - **fourMs-lab (movement lab, MoCap-lab)**, Department of Musicology, HF, is a UiO-approved **core facility** and a special laboratory linked to SFFet RITMO. "fourMs" stands for "Music, Mind, Motion, Machines" and contains the best in advanced systems for motion tracking and playback of sound in rooms. For more information, see <https://www.hf.uio.no/imv/om/rom-og-utstyr/fourMs-lab/index.html>
 - **The Cognitive and Translational Neuroscience Cluster (CTNC)**, Department of Psychology, SV, supports an extensive and heavy environment at the research front in cognitive, clinical and social neuroscience. CTNC is an established UiO **core facility** that operates advanced infrastructure and laboratories to manipulate and record behavior and cognition under controlled conditions. The laboratories include modern equipment to measure and map the brain's function and structure, including several EEG laboratories, eye tracking equipment, transcranial magnetic stimulation (TMS) and joint ownership of MRI machines at OUS. CTNC has facilities for recording and analyzing audio and video recordings of therapy sessions. CTNC supports the lab activities of SFFs (RITMO, NORMENT), world-leading environment (LCBC), UiO Life Science Convergence Environments (4MENT, ConsciousBrainConcepts), and ERC projects. CTNC has great potential as a technological and scientific national hub for research in human cognitive and clinical neuroscience. CTNC is co-located at PSI, with nodes v/OUS (MR). The organizational and geographical coordination of expertise and advanced equipment for human neuroscience is unique, and makes CTNC/UiO a sought-after collaboration partner both nationally and internationally. For more information see: https://www.uio.no/english/for-employees/unitpages/sv/psi/research-support/research-infrastructure/laboratories/ctnc_core/
 - **Oslo Assessment, Intervention and Learning Lab (O-AILL)**, Department of Special Education, UV, offers infrastructure and research support to researchers in special education. The lab has 2 EEG devices (32-channel ActiChamp Plus, Brain Products), 1 eye-tracker (Eye-Link 1000 Plus, SR Research), 1 audiometry lab, and a large battery of cognitive ability tests, vascularization tools, intervention programs and the like. The creation of an electronic register of voluntary subjects with and without special educational difficulties is underway, and a teaching clinic is being investigated. For more information see <https://www.uv.uio.no/isp/om/oslo-assessment-intervention-and-learning-lab-o- aill/index.html>.

F1b. Infrastructure in this category available through national and international platforms where UiO is a partner or member

Although this category is relatively heterogeneous, the following infrastructures, where Norway or UiO have a formal connection, are presented as part of the portfolio of existing infrastructure in this category:

- **National infrastructure: NorMIT - Norwegian Center for Minimally Invasive image guided therapy and medical technology** (<http://normit.no/>) Led by St Olavs Hospital in Trondheim, and with UiO and OUS as partners. The Research Council's infrastructure program allocated funds in 2014 (53.9 MNOK) and came on the reserve list in 2021. NorMIT offers a wide selection of modern operating theaters with advanced medical-technological equipment to anyone with a relevant research project. Here, researchers from all over the country can help develop tomorrow's diagnostics and treatment. NorMIT is an infrastructure that will contribute to increased research and innovation within medical technology with particular emphasis on minimally invasive and image-guided treatment. Here, investments have been made in the very latest imaging technologies, navigation technology and robot technology which will give patients better and safer treatment. Shorter hospital stays and reduced rehabilitation time will save society large sums of money.
- **National and European infrastructure: EATRIS** - A Norwegian node for the European Advanced Translational Research Infrastructure in Medicine. The infrastructure is led by UiO, including OUS as a partner, and was awarded funds from the Research Council's Infrastructure program in 2015 (NOK 2 million). Norway became a full member in 2016. The annual membership fee is covered by the universities at the medical faculties and health regions for the first six years, and core facilities and researchers from all Norwegian universities provide research services under the EATRIS umbrella. The membership fee is under negotiation between the partners and will be covered by UiO for 2023. EATRIS is a non-profit European Research Infrastructure Consortium (ERIC) that offers a unique "one-stop shop" access to scientific expertise and advanced technologies required to develop new products via translational processes from validation of "targets" to early clinical trials. The infrastructure is open to both scientific researchers and companies that need support to develop advanced biomedical innovations. EATRIS focuses on preclinical and early clinical development of medical products and diagnostics and offers solutions within five expertise platforms - Advanced Therapy Medicinal Products (ATMPs), Biomarkers, Imaging and tracking, Small molecules and vaccines. EATRIS also provides regulatory expertise for translational research and help with matchmaking and consortium building for EU and other international grant applications. The aim of the Norwegian EATRIS membership is to increase access for Norwegian researchers to cutting-edge research facilities as well as expertise in translational research in the European network EATRIS.
- **International infrastructure: EBRAINS** is a European research infrastructure for neuroscience research. The infrastructure currently has participation from 11 countries, including Norway. Main base in Belgium (EBRAINS AISBL) has been established and the first services are available in the EBRAINS web portal (<https://ebrains.eu/>). See B1b for more details.