Skisser med relevans innenfor

Klima og miljø

Tabell: Oversikt over skisser med relevans for området **Klima og miljø**

Prosjekt nummer	Prosjekttittel	Søkerinstitusjon	Prosjektleder	Estimert søkt beløp fra NFR
315065	PLANKTONLAB-Mobile Benthos Plattform	SINTEF OCEAN AS (NTNU)	Gunvor Øie	22 200 000
316385	COAT Basic: Basic infrastructure functions of the Climate-ecological Observatory for Arctic Tundra (COAT)	UiT (NP, NINA, MET, UNIS)	Rolf Anker Ims	29 290 000
316408	Next generation risk assessment of chemicals – building in silico and in vitro platforms combined with Artificial Intelligence	FHI (NIVA, UiB, NVI)	Hubert Dirven	70 000 000
316413	Norwegian Fuel Cell and Hydrogen Centre - extension.	STIFTELSEN SINTEF (SINTEF, NTNU, IFE)	Magnus Skinlo Thomassen	51 000 000
316418	Sustainable infrastructure for scientific living plant collection and advanced greenhouse production	UiO (Trøndelag fylkeskommune - Mære landbruksskole – FoU (Trøndelag County), Norges Bondelag (Farmers Union), Gether AS)	Finn Ervik	18 700 000
316424	BIOSCAN Norway: Enabeling next generation biodiversity research	NTNU (UiB, UiO, UiT, NINA, NIVA, HI, SINTEF Ocean, University of Guelph (Canada))	Torbjørn Ekrem	49 783 500
316438	Aerosols, Clouds, and Trace gases Research InfraStructure in Norway	NILU (MET, CICERO)	Cathrine Elisabeth Lund Myhre	40 308 560
316440	Centre for Biodiversity genomics	UiO (NTNU, UiB, UiT, OUS)	Kjetill Sigurd Jakobsen	58 480 000
316444	National Surface and Interface Characterisation Laboratory-NICE II	SINTEF AS (NTNU, UiO)	Spyros Diplas	43 200 000
316447	The EMERALD Physically Integrated? eXperimEntal Landscape	UiO (UiB, NORCE, NINA, NIBIO, NILU)	John Faulkner Burkhart	54 072 000
316460	Troll Observing Network - skisse	NPI (UiO, UiB, UNIS, NILU, NORSAR, NORCE)	Christina Alsvik Pedersen	186 701 000
316461	CHABAT – Battery Characterisation	UiA	Bernhard Fäßler	5 025 000
316466	Norwegian Scientific Data Network - an extension	MET (USIT, MET, Nansensenteret, NILU, HI, NPI)	Øystein Arne Godøy	20 000 000
316467	Norwegian Infrastructure for Climate-smart Soil Management - CSM	NMBU (NIBIO, CICERO)	Peter Dörsch	79 000 000
316471	Autonomous Dynamic Integrated Ocean Observing System (ADIOOS)	NORCE	Rune Storvold	123 000 000
316478	Infrastructure for Norwegian Earth System modelling phase 2	NORCE (MET, Nansensenteret, NILU, UiB, UiO)	Mats Bentsen	105 000 000

316481	National Bioprocessing & Fermentation Centre - NBioC phase 2	**NORCE** (SINTEF, NOFIMA, UiT, UiB, UiS)	Catherine Boccadoro	69 000 000
316484	Norwegian Node of the Global Biodiversity Information Facility – GBIF-Norway 2022-2026	**UiO** (NBIC, NTNU Uni.Museum, NINA)	Dag Endresen	33 371 000
316485	National Geoscientific Data Infrastructure	**NGU** (UiT, NTNU, UiO, UiB, NP, HVL, UNIS, Store Norske Spitsbergen Kullkompani AS)	Johannes de Beer	45 000 000
316491	GeoCloud Research	**NGI** (NTNU, NGU)	Kristoffer Skjolden Skau	20 000 000
316492	Forskningsinfrastruktur for miljø- og ressursdata for bærekraftig innovasjon (LCA data)	**ØSTFOLDFORSKNING AS** (NMBU, PRé, NILU, NIFU, SINTEF, Treteknisk, IFE, Asplan Viak)	Ole Jørgen Hanssen	25 000 000
316493	Norwegian Marine Data Centre - Interoperable Infrastructure	**HI** (NERSC, NP, NIVA, MET, NORCE)	Helge Sagen	46 000 000
316499	COASTWATCH - the Norwegian coastal observing system of systems	**HI** (MET, UiB, NORCE, NIVA, APN, NERSC, NVE, RMS, UiO, NINA)	Frode Bendiksen Vikebø	115 000 000
316501	Living Norway Ecological Data Network	**NINA** (NTNU, UiO (NHM), UiB, NMBU, NIBIO, NIVA, NBIC)	Erlend Birkeland Nilsen	31 200 000
316504	National Platform for NanoSafety	**UiB (**NILU, STAMI, SINTEF Ocean, NMBU)	Mihaela Roxana Cimpan	111 600 000
316507	IOR and Subsurface Field Lab at Risavika	**UiS** (NORCE, IFE)	Ying Guo	100 000 000
316509	Digital extension of the Zero Emission Building and climate adaptation laboratories	**SINTEF AS** (NTNU)	Berit Time	19 400 000
316511	Design, prototyping, performance and reliability of solar photovoltaic/thermal components and systems	**SINTEF AS** (SINTEF Energy, SINTEF Digital, NTNU)	Martin Bellmann	90 000 000
316514	Norwegian Collections of Marine Life	**UiB** (NTNU)	Aino Hosia	43 117 000
316516	Research Centre for Climate-induced Geohazards	**NGI** (NVE, SVV, UiO, BaneNOR)	Peter Gauer	28 500 000
316518	Offshore Boundary Layer Observatory (OBLO) – Phase II	**UiB** (METCENTRE, MET, NORCE, NTNU, UiS)	Joachim Reuder	82 100 000
316523	ForskAir - Airborne infrastructure	**ANDØYA SPACE CENTER AS** (UiB, UiO, NMBU, UiT, MET)	Stine-Marie Andreassen	75 000 000
316525	Norwegian Chemical Palaeoecology Laboratory	**UiB** (NMBU)	Alistair Seddon	33 599 000

316528	NAMO: Norwegian Arctic Multi-disciplinary Ocean Observing System	**NERSC** (NPI, HI, UiB, FFI)	Hanne Sagen	90 000 000
316538	Norwegian Marine Robotics Facility II: Autonomous Underwater Vehicle (AUV)	**UiB** (FFI)	Rolf-Birger Pedersen	73 000 000
316541	European Plate Observing System - Norway (EPOS-N) Phase-II	**UiB** (NORCE, NORSAR, NGU, NMA, NGI, UiT)	Kuvvet Atakan	93 569 000
316549	Norweigan Telemetry Network	**NORCE** (NTNU, NMBU, NINA, UiB)	Robert Lennox	133 400 000
316550	Norwegian Research Infrastructure for studies of environmental contaminants	**NILU** (NIVA, UiT)	Aasmund Fahre Vik	85 000 000
316551	SUSTAINHEALTH-workflow, an Infrastructure for Food, Health, and Sustainability	**FHI** (NVI, SSB, UiO, NFSA)	Helle Margrete Meltzer	32 000 000
316554	Marine fish detection, fish behaviour observations and seabed Investigations package 2021-2025	**UiT** (HI, NPI, SINTEF Ocean, Fiskeridirektoratet)	Roger B. Larsen	16 250 000
316561	Earth Surface sediment Laboratory 2	**UiB**	Jostein Bakke	47 227 000
316564	The Norwegian Centre for Transmission Electron Microscopy II	**SINTEF AS** (NTNU, SINTEF, UiO)	Randi Holmestad	141 000 000
316565	Infrastructure for mobility and logistics research	**TØI**	Marianne Stølan Rostoft	50 000 000
316570	Norwegian Urban Observatory	**NILU** (Augment City/Offshore Simulation Centre AS, Oslo Kommune)	Leonor Encuentra Tarrason	75 500 000
316571	Geosystem 3D Seismic Imaging (G3) Upgrade	**UiT** (UiB, NGU, P-Cable 3D Seismic AS, VBPR AS, Geomar, NOC, BGS, Ifremer, ECORD, IODP)	Stefan Bünz	13 000 000
316575	Svalbard Integrated Arctic Earth Observing System -Knowledge centre, operational phase 2022	**SIOS SVALBARD AS** (UNIS, NPI, MET)	Heikki Lihavainen	59 622 000
316578	Basic funding of operational costs at Svelvik CO2 Field Lab	**SINTEF AS**	Cathrine Ringstad	8 000 000
316588	Research infrastructure for urban water transportation and management	**NMBU** (NVE, NIPH, NIVA, NGI, NIBIO)	Harsha Ratnaweera	79 000 000
316589	SIOS Infrastructure Development for Earth System Science	**SIOS SVALBARD AS** (NERSC, NIVA, MET, NPI, NORCE, UiT, UNIS, UiO)	Heikki Lihavainen	155 958 778
316590	Fault and fracture characterisation and testing laboratory	**NGI** (NORCE, NORSAR, UiO)	Luke Griffiths	39 970 000

316591	eInfrastructure for digital, user centric and sustainable digital transformation in urban smart cities	**IFE** (UiO, Østfold University College, Østfoldforskning, OsloMet, Smart Innovation Norway, NILU, Halden kommune, Logiq, ITS Norway, Halden næringsutvikling)	Petter Kvalvik	200 000
316593	World of Wild Waters – Virtual lab «WoWW-lab»	**NTNU** (Telenor, Offshore Sim Center)	Oddbjørn Bruland	45 100 000
316603	Microalgae platform for Norway	**NORD UNIVERSITET** (NIBIO, UiT, NIVA, VUC)	Kiron Viswanath	63 350 000
316607	Infrastructure for a sustainable ocean economy and conservation of the ocean genome	**NORCE** (UiS, UiB, IMR, UiA, SINTEF Ocean, NIVA, DNV GL, RevOcean, MBARI, IFREMER, DTU Aqua, Bremnes Seashore, Skretting AS)	Thierry Baussant	17 188 660
316608	Norwegian Biobank for Nature (NORBINA)	**UiO** (UiB, NTNU, UiT, NMBU, UiA, NIVA, NIBIO, NVI)	Arild Johnsen	53 117 000
316610	NIBIO-XCT - An integrated X-ray Computed Tomgraphy (XCT) facility for the Ås campus (NIBIO/NMBU/Veterinærhøgskolen)	**NIBIO** (NMBU, Veterinærhøgskolen, Kimen Såvarelaboratoriet AS)	Adam Vivian-Smith	40 973
316616	Norwegian Plant Phenotyping Platform	**NMBU** (UiO, NTNU, UiT, NIBIO)	Morten Lillemo	50 000 000

Project number: 315065
Title: PLANKTONLAB-Mobile Benthos Plattform
Applicant (partners): SINTEF OCEAN AS (NTNU)
Project Manager: Gunvor Øie

Short summary:
The RI "Norwegian Center for Plankton Technology - PLANKTONLAB" (245937/F50) was granted by the Research Council of Norway (RCN) in 2016. The overarching goal of the centre is to strengthen research and technological development on cultivation and use of planktonic organisms from lower tropic levels, to increase marine biomass production, address climate change mitigations and conduct environmental research. The research activities include various disciplines such as nutrition, physiology, ecotoxicology, biotechnology, ecology, and marine biology. This RI encompasses both cultivation and harvesting methods of planktonic marine biomass from lower trophic levels which can be used both as live feed organisms to serve early life stages of marine fish and crustaceans, or as high-value ingredients for extruded aquafeeds.
With the present RI proposal, the PLANKTONLAB will get an upgrade and extension with a Mobile Benthos Platform (MBP). The R&D activities of the new application encompassing benthic epi- and in-faunal organisms and meroplankton. The existing RI – PLANKTONLAB together with the new RI applied for in this application, the complete RI will include infrastructure that encompasses R&D-activities on both planktonic and benthic organisms on lower trophic levels. This will have huge prospects with regards to food and feed production and environmental monitoring activities. With this application Norway can take key steps to developing new biomarine industries targeting both planktonic and benthic organisms at lower trophic levels. The complete RI will be established at SINTEF and NTNU at Sealab. The benthic platform will be made mobile, that will ensure possibilities for conducting experiments outside the physical location at Sealab.

Project number: 316385
Title: COAT Basic: Basic infrastructure functions of the Climate-ecological Observatory for Arctic Tundra (COAT)
Applicant (partners): UiT (NP, NINA, MET, UNIS)
Project Manager: Rolf Anker Ims

Short summary:
Climate-ecological Observatory for Arctic Tundra (COAT) is a long-term research initiative that will enable real-time documentation of climate change impacts on terrestrial arctic ecosystems. COAT aims to provide an adaptive knowledge system and open access services that underpin rational management actions & policy decision and that shall inform the general society about the state of arctic ecosystems. As similar observatories are entirely lacking from the Eurasian Arctic, COAT will considerably strengthen Norway's position as an international leader in research and management of arctic environments. Thus, this enterprise is in accordance with the ambitions expressed in governmental white papers. COAT has received substantial funding from various sources that has enabled the development and establishment of its observation system; i.e. the infrastructure components that will facilitate the generation and storage of long-term time series of ecosystem and climate state variables from both high- and low-arctic Norway. Due to these investments, COAT is

ready to be operational towards the end of 2021. However, the costs associated with the operations to maintain the basic functions of the observation system will be higher than what is available from the COAT partners internal budgets - and presently from external funders - because: (1) COAT's geographically distributed infrastructure with the maintenance of a large number of sensors and experimental devises at remote Arctic locations, (2) the requirement of processing big and diverse raw data into operational ecosystem state variables for various users, and (3) the ambitions of maintaining an active user interphase. While other nations have established dedicated funding channels for long-term ecosystem observatories, Norway is in lack of such. These are the reasons for why COAT seeks partial funding of its operation cost from RCN-Infrastructure for the first 5 years of its operations (2022-2026).

Project number: 316408
Title: Next generation risk assessment of chemicals – building in silico and in vitro platforms combined with Artificial Intelligence
Applicant (partners): FHI (NIVA, UiB, NVI)
Project Manager: Hubert Dirven

Short summary:
Due to the large and growing number of chemicals in use, toxicological risk assessments and management are increasingly challenging. Only a small fraction of the chemicals on the market have been extensively characterized in terms of their toxicological properties or exposure scenarios, or are regularly monitored, while limited or no data are available for the overwhelming majority of chemicals1.

To deal with these challenges there will be more focus on grouping of chemicals based on chemical structures and similarities in biological effects based on understanding of the mechanisms resulting in adverse effects. There is an interest in application of New Approach Methodologies (NAMs) to study the hazard of chemicals and mixtures of chemicals based on in vitro and in silico testing. Knowledge based on the use of new and existing data can be expanded by machine learning and artificial intelligence. The One Health approach combining ecotoxicology, veterinary toxicology and human toxicology offers the opportunity to have a more holistic view on chemicals, their behavior in the environment, sources of exposure, hazards and risks.

Objective: to build a national infrastructure with in vitro and in silico platforms that will be applied in the next generation of risk assessment of chemicals. The platforms will allow closing mechanistic knowledge gaps in toxicological data, improve modeling and using machine learning and artificial intelligence technology to study the effects of chemicals on biological systems. Data and methods generated will be used to facilitate the transition to the next generation risk assessment to better protect human health and the environment, thereby supporting the EU commission ambitions for a non-toxic environment.

Project number: 316413
Title: Norwegian Fuel Cell and Hydrogen Centre - extension.
Applicant (partners): STIFTELSEN SINTEF (SINTEF, NTNU, IFE)
Project Manager: Magnus Skinlo Thomassen

Short summary:
The present proposal includes the extension of the already established Norwegian Fuel cell and hydrogen centre (NFCH) by adding two new nodes dealing with manufacturing infrastructure of fuel cell and electrolyser components and cells. The NFCH is a national infrastructure that was established in 2017 and consists of three main nodes; i.e. a low temperature node, a high temperature node and a system node. This existing infrastructure involves three major Norwegian R&D stakeholders (SINTEF, IFE and NTNU), engaged in Fuel Cells and Hydrogen (FCH) technology development. Cutting-edge equipment for testing of fuel cell and electrolyser components, cells, and small stacks have generated widespread national and international interest. During the establishment phase, as well as the first years of operation, the NFCH has already noticed the need for expanding present capabilities of the established nodes to accommodate a further increase in demand as well as introducing unique characterization techniques (inc. ex-situ and in-situ diagnostic equipment), essential for understanding and improving performance and longevity of fuel cells and electrolysers. In addition, there is a great need to strengthen the capability for Norwegian research institutions and industry for high quality research and innovation in the complete value chain of hydrogen technologies. Adding manufacturing capabilities of fuel cell and electrolyser components, stack assembly and infrastructure for utilization of liquid hydrogen will allow the centre and its users to provide capabilities that will be of great value in a number of projects, ranging from national and international researcher projects of fundamental and applied character to pilot projects for industry, and provide a breeding ground for innovation and spin-off activities.

Project number: 316418
Title: Sustainable infrastructure for scientific living plant collection and advanced greenhouse production
Applicant (partners): UiO (Trøndelag fylkeskommune - Mære landbruksskole – FoU (Trøndelag County), Norges Bondelag (Farmers Union), Gether AS)
Project Manager: Finn Ervik

Short summary:
In Norway, the botanical research on exotic plants as well as the production of important commercial crops like tomatoes and cucumbers rely on greenhouses. The technical energy-solutions of today's greenhouses render both the maintenance of scientific plant collections and the production of crops in greenhouses extremely energy consuming and therefore expensive and dubious from the point of view of sustainability. In order to improve these activities responsibly in the future therefore, we need to implement a technology that is reliable, radically less energy consuming and better serves the need of living plants.

The Natural history museum of Oslo has for the New Exhibition Greenhouse planned a modern energy- and climate-system. Part of this system is in use at Trøndelag County at Mære. It is indeed needed at the largest greenhouse, TØ08, to serve our most extensive and important scientific

collections and is needed at Mære to complete a modern R&D infrastructure. Trøndelag County has established «Landbrukets klima og energisenter» (agricultural centre of climate and energy) in Mære as an area for innovation, demonstration, and as a "living lab". The development of this centre occurs in close cooperation with the national agricultural organisations. As of 2017, the centre has a national role and is funded by the National Budget. Mære participates in more than 20 R&D projects in cooperation with NTNU, SINTEF, NIBIO, NMBU, and firms of relevance.

According to the UN sustainable development goal 13, we shall "ensure sustainable consumption and production patterns". The ecological footprint of food consumption is the result of the impacts from the production and transport of both the food and production inputs. In relation to other countries, Norway depends on a high percentage of import of both food and food production inputs, and the local production is often energy intensive. The ecological impact of this consumption and production pattern is high both in Norway and in the countries from which we import. Norway therefore should develop its potential for more local and sustainable food production. Through innovation of clean energy solutions that are transferable to most other commercial and scientific greenhouses as well as other buildings, this project targets the Research Council of Norway's main strategy, Research for Innovation and Sustainability 20152020 as well as the UN sustainable development goal 7: Affordable and clean energy.

Project number: 316424
Title: BIOSCAN Norway: Enabeling next generation biodiversity research
Applicant (partners): NTNU (UiB, UiO, UiT, NINA, NIVA, HI, SINTEF Ocean, University of Guelph (Canada))
Project Manager: Torbjørn Ekrem

Short summary:
BIOSCAN Norway will provide the infrastructure needed to meet present and future challenges of accurate and large-scale biodiversity research. BIOSCAN Norway will develop and test pipelines for unprecedented analysis of species interactions through the molecular identification of symbiomes in terrestrial, freshwater and marine organisms, as well as procedures for documentation and observation of species community change through time and space. Also, BIOSCAN Norway will implement robust protocols for curation of extracted DNA and reference voucher specimens in Norwegian natural history collections. By expanding and curating a reference library of DNA barcodes of the Norwegian biota, the infrastructure will facilitate species identification, discovery and inventory through DNA barcoding. A particular focus will be on marine biodiversity, and synergistic collaboration with existing and planned infrastructures and Norwegian Centres of Excellence will ensure maximal benefits for all participants. Together with collaborators in the International Barcode of Life (iBOL), BIOSCAN Norway will advance the development of the open access database Barcode of Life Data Systems (BOLD), with tools that enable analyses of species interactions and community change. Finally, the national infrastructure will secure a digital copy of the international BOLD database in Norway.

Project number: 316438
Title: Aerosols, Clouds, and Trace gases Research InfraStructure in Norway
Applicant (partners): NILU (MET, CICERO)
Project Manager: Cathrine Elisabeth Lund Myhre

Short summary:
ACTRIS-Norway is an essential contribution to the pan-European Research Infrastructure on Aerosols, Clouds, and Trace gases Research InfraStructure (ACTRIS). ACTRIS produce high-quality data for the understanding of short-lived atmospheric constituents and their trends, impact and interactions. These constituents have a residence time in the atmosphere from hours to weeks. The short lifetimes make their concentrations highly variable in time and space and involve processes occurring on very short timescales. These considerations separate the short-lived atmospheric constituents from long-lived greenhouse gases, and calls for a fourdimensional distributed observatory, covering Europe and even larger geographical scale. ACTRIS offers data from observational or exploratory National Facilities (NFs) complying with state-ofthe-art procedures to ensure adequate information to enable atmospheric research on climate, air pollution and health. The ACTRIS observational platforms are fixed ground-based stations that produce long-term data based on a regular measurement schedule and common operation standards. In addition to these, atmospheric simulation chambers serves as ACTRIS exploratory platforms. These chambers are among the most advanced tools for studying and quantifying atmospheric processes and are used to provide many of the parameters incorporated in air quality and climate models. All ACTRIS data are managed and made available to the user communities through the ACTRIS Data Centre, which combines several specialized topical data centres though a common interphase. This proposal is addressing required developments of the ACTRIS Data Centre, i.e. improvement, development, re-newel, and new functionalities, and builds on the long-term efforts NILU has offered internationally over many decades. With evolving scientific needs for observations and access to data and data products, the ACTRIS data centre and curation of data is a comprehensive and complex task that requires multidisciplinary expertise. The main objectives of ACTRISNorway are to: upgrade and re-new the core existing e-infrastructure for surface in situ observations, EBAS – http://ebas.nilu.no implement new the ACTRIS Data portal, the unique entry point to all ACTRIS data, and add new functionalities and ensure formal link to ACTRIS ERIC improve access to data, both through human and machine-to-machine interfaces, and ensure that data exchange is following FAIR1 principles across the ACTRIS infrastructure and beyond, including traceable data production, attribution and implementation of licenses. Develop tools required for science and policy-oriented use of data, for users in Norway and elsewhere, such as comprehensive trend tool where observational data are combined with model data.

Project number: 316440
Title: Centre for Biodiversity genomics
Applicant (partners): UiO (NTNU, UiB, UiT, OUS)
Project Manager: Kjetill Sigurd Jakobsen

Short summary:
The proposed Centre for Biodiversity Genomics (CEBIGEN) will deliver high quality reference genomes, population genomics data, transcriptome, metagenome and other relevant "genomics" services for all types of research associated with non-human samples. CEBIGEN will provide

consultation, run projects from biological samples to analysed genomic data using state-of-the-art pipelines. CEBIGEN will focus its services to all types of biodiversity research implying that it provides complete pipelines for analyses of all kinds of non-human biological samples - ranging from bacteria, microbial eukaryotes, algae, plants, invertebrates and

vertebrates. The ambition is to build a national genome centre specialized for the various and diverse needs of research on non-model organisms and non-human models. The need for such a genome centre is driven by threats to biodiversity, ecosystems, climate change as well as the great potential of exploiting genomic information for the benefit of mankind and for developing a sustainable blue-green economy in Norway. An additional driver is the fast emergence and progress of international projects such as the Earth BioGenome (E BP) and related projects aiming at sequencing all existing eukaryotic organisms on earth. Norway needs to relate to these transformative projects, and currently we do not have sufficient capacity regarding sequencing instruments, bioinformatics and computing to efficiently carry out a full-scale EBP-Norway effort.

Project number: 316444
Title: National Surface and Interface Characterisation Laboratory-NICE II
Applicant (partners): SINTEF AS (NTNU, UiO)
Project Manager: Spyros Diplas

Short summary:
NICE II is an expansion of the infrastructure project NICE based on a collaboration between SINTEF, NTNU and UiO which established a national laboratory for physical and chemical characterization of surfaces and interfaceshaving the ambition to be acknowledged as a world class competence cluster. NICE was established in 2009 with the support of the RCN in two nodes, Oslo and Trondheim. NICE-II seeks to expand capabilities of the infrastructure and to enrich the national research capacity within the nationally prioritized application areas. We apply for funding to ensure access for the national stakeholders to new, state-of-the-art surface analysis infrastructure enabling internationally leading research. The project aims to: (1) install the first Norwegian laboratory based XPS allowing for near ambient pressure (AP) analysis, and a modern multi-technique, user friendly UHV-XPS with high energy XPS capability, (2) integrate an XPS system into an operando STM allowing combined imaging and spectroscopy of surfaces in operando mode, (3) establish cutting-edge time-resolved APXPS experiments at MAXIV in conjunction with kinetic TAP experiments, (4) facilitate an integrated workflow among complementary instruments, (5) build competence, broaden national access, increase international networking and achieve data curation. These are expected to facilitate and secure a wide, open and effective use of the infrastructure within the research fields of catalysis, PV technology, H2 production, storage and transport, thermoelectric materials, Al alloys and processing, steels, Si, intermetallic and oxide powders etc. At the same time, it aims to solve industrial processing challenges via maintaining and advancing the surface science competence at high international standards. This will enable the national consortium and its end users to address current state-of-the-art research trends requiring rapid, real time, in situ, operando characterization to accelerate material development.

Project number: 316447
Title: The EMERALD Physically Integrated? eXperimEntal Landscape
Applicant (partners): UiO (UiB, NORCE, NINA, NIBIO, NILU)
Project Manager: John Faulkner Burkhart

Short summary:
The concept of a Physically Integrated Experimental Landscape (PIXEL) is introduced as a core infrastructure that specifically serves the remote sensing and land surface / earth system modeling communities. The EMERALD PIXELs will establish dedicated observational super sites for validation of Energy and Water Balance Exchange with an emphasis to measure variables across gradients and scales. The ambition is to be a catalyst for international partnerships working to develop a global network of `PIXEL' sites that may be used to develop high quality algorithms for both remotely sensed data and to improve Land Surface Model (LSM) parameterizations; both platforms which operation at the pixel scale rather than the point scale.
The EMERALD PIXEL (hereafter EPIX) will offer several services critical to enable high quality acquisition of fundamental parameters. These services include: novel data acquisition capabilities, communication and data dissemination services following the FAIR principles, and a substantial increase in the value of several nationally funded initiatives through the development of legacy "super sites" that will serve the remote sensing and land surface / earth system modeling communities. The unique services and capabilities will benefit the research community by significantly reducing a duplication of efforts related to field campaign observations, and by providing data and modeling services that will benefit experimental design.
EPIX is borne out of a well-established national network within the EMERALD project- a large, nationally coordinated RCN project led by the Department of Geosciences, UiO. The EPIX Research Infrastructure will further contribute to several International activities including GEOSS, GEWEX and the ESFRI Roadmap projects: ICOS and eLTER.

Project number: 316460
Title: Troll Observing Network - skisse
Applicant (partners): NPI (UiO, UiB, UNIS, NILU, NORSAR, NORCE)
Project Manager: Christina Alsvik Pedersen

Short summary:
The Troll Observing Network (TONe) is a comprehensive infrastructure centered around the Norwegian Troll Research Station (RS) in Dronning Maud Land (DML), and it will be an important element in global research efforts in this part of Antarctica. TONe will be developed as a state-of-the art observatory for environmental observations and will provide access to the long-term time series and shared services to attract new and existing users to the station. The infrastructure encompasses major fields within Antarctic research and aims at efficient use of the station, increasing the impact of the Norwegian polar research and strengthening the strategic role of the Norwegian station in Antarctica.

The research infrastructure provides access to data from, and shared services linked to, carefully selected instruments suited for studying and monitoring the atmosphere, terrestrial and marine environment. Overall it aims at closing the data gaps in Antarctic environmental observations in this

particularly data-sparse region of Antarctica. Users of the infrastructure, including the partners in the network, will contribute to answering questions relating to climate change and sea-level change (ia. knowledge gaps identified in IPCCs Special Report on Ocean and Crysosphere in a Changing Climate), atmosphere dynamics, space weather effects, robustness of communication networks, quality of weather and climate models, and the effects of global changes on marine ecosystems. The new instrumentation and shared services will complement and expand the existing observation infrastructure at and around Troll RS, and allow for more complete, environmentally friendly and state-of-the-art observations.

The in-situ shared research platforms include access to the observation platform provided by the Troll supply vessel, a state-of-the art drone service, new mobile laboratory facilities and access to field instrumentation for research campaigns. These platforms will open up for new and cross-disciplinary use of the infrastructure and the station. Environmental impact and management is in focus throughout the proposed project. TONe data will inform management of the area. New smart instruments and shared services will lessen the environmental footprint of research activities in the area. Shared logistics, field instruments utilizing renewable energy, and assessment and mitigation of environmental impacts when installing infrastructure will be the norm.

The partners involved in the project will bring in both their existing network and relevant experience from previous work in Antarctica, and together with the new users, the proposed new infrastructure will contribute to enhancing international research collaboration.

Project number: 316461
Title: CHABAT – Battery Characterisation
Applicant (partners): UiA
Project Manager: Bernhard Fäßler

Short summary:
The number of electric vehicles is increasing worldwide and lithium-ion battery waste is increasing as a result. Lithium-ion batteries are normally replaced when they reach 70-80% of their initial capacity or at vehicle endof-life. Due to Norway's high penetration of electric vehicles (EVs), at least 0.6 GWh of EV batteries will reach (primary) end-of-life (EOL) in 2025, and 2.2 GWh in 2030. It is therefore critical that we determine how this resource can be leveraged to create sustainable value in Norway. In addition, Norway has a responsibility to contribute to the develop of sustainable battery value chains and solutions, based on its first mover position.

The majority of EOL EV batteries still have enough remaining useful life for secondary use applications, such as stationary energy storage systems. It is important to characterise the "health" and suitability of each returned EV battery individually, as their remaining capacity and overall integrity will vary with their primary usage patterns (km driven, charging cycles, etc.). Determining which batteries are suitable and safe for use in secondary life applications will i) reduce the need for new critical raw materials, ii) increase the uptake of decentralised transient renewable energy sources with additional stationary energy storage capacity, and iii) aid in the transition towards a low-carbon competitive economy.

This characterisation and sorting step is critical as it allows us to dynamically determine the optimal reuse and recycling strategy for each used EV battery based on battery chemistry, second use demand, state of health parameters and indicators. Due to the sheer scale of the "battery wave" towards 2030, this system must be rapid, automatic, and robust. CHABAT will achieve this through non-destructive, in-line characterisation methods and state-of-the-art robotics infrastructure, allowing efficient battery sorting and triage.

To summarise: The CHABAT research infrastructure will help to characterise, sort, and group decommissioned electric vehicle batteries to allow to build safe and reliable second use storages. Thus, the research infrastructure allows to meet environmental and economic challenges by increasing the deployment of renewable energy sources which are dependent on local energy storage systems.

Project number: 316466
Title: Norwegian Scientific Data Network - an extension
Applicant (partners): MET (USIT, MET, Nansensenteret, NILU, HI, NPI)
Project Manager: Øystein Arne Godøy

Short summary:
The Norwegian Scientific Data Network (NorDataNet) is a distributed cross-disciplinary data management infrastructure providing the scientific community with integrated, cost-efficient and sustainable e-services for data management and publishing relying on established standards for data documentation, long term preservation, discovery and reuse. The main emphasis is on coordination of efforts and requirements across running data centres and infrastructures. This includes enhancing interoperability between these and NorDataNet, improving user interfaces for data search and retrieval, and development of toolboxes for data documentation to reduce technical and governance obstacles for data providers and consumers. The infrastructure provides online access to data and facilitates long term preservation, in order to maximise the benefit of public funds invested in the datasets. Existing institutional data management systems are linked through standardised discovery metadata and services enabling access to the relevant datasets regardless of location. While interoperability at the discovery level is achieved, interoperability at the data level is still pending for many datasets. The main priorities within this proposal for extension of NorDataNet are: (1) increased user interaction and education to increase the knowledge of FAIR data as concept, (2) enabling data providers to close gaps in FAIRness including data licenses, adequate metadata for reusability, use of standard vocabularies and correct implementation of standards, (3) showcasing the benefits of FAIR data and services for the scientific community through improved toolboxes and services integrating data with analysis tools, and (4) to prepare data repositories for integration with European services as developed through European Open Science Cloud and ENVRI.
Toolboxes and services will be based on open source software from the science community, and capitalize on mature development environments such as VREs and Docker. The proposal is rooted in geoscience, but is by approach interdisciplinary although focused on geolocated data with a temporal dimension. The approach is linked to the Open Data Directive and improved access to public sector data regardless of being research or management related.

Project number: 316467
Title: Norwegian Infrastructure for Climate-smart Soil Management - CSM
Applicant (partners): NMBU (NIBIO, CICERO)
Project Manager: Peter Dörsch

Short summary:

Norway's agricultural sector is under great pressure to reduce its greenhouse gas (GHG) emissions and has pledged itself to reduce 5 million tons of CO_2 equivalents by 2030, roughly the equivalent of one year's climate forcing by the Norwegian agricultural sector.[1] Despite much focus on how to estimate GHG emissions from agriculture and to make the sector's GHG savings visible[2], evidence-based approaches to curb nitrous oxide (N_2O) emissions and to increase soil carbon sequestration remain understudied and techniques to reliably document such mitigations are missing. This despite the fact that soils are anticipated to play an important role in combating climate change[3]. A national infrastructure on soil management seems timely, given soils' role for food security, renewable raw materials and as recipient of waste streams in a circular bioeconomy.

A major barrier for using soils more actively for GHG mitigation in Norway is the lack of data documenting management-specific effects on N_2O emissions and soil C sequestration under Norwegian conditions. While N_2O emissions are highly episodic, C sequestration and turnover in soils are slow processes, making it difficult to observe both processes at the same time. The CSM infrastructure is designed to overcome these limitations by providing a network of state-of-the-art research facilities across different scales, ranging from highly instrumented field-laboratories at campus Ås and NIBIO Apelsvoll to mobile GHG measurements units that will be deployed in a nation-wide network of agronomic and real-farm field sites to a data infrastructure integrating data for industrial and public stakeholders. Once established, this infrastructure can be used for developing and rigorously testing climate-smart soil management strategies and for deriving region- and management specific emission factors urgently needed to improve national emission inventories.

CSM directly addresses the bio-industry by aligning national agronomic GHG research with the needs of industries engaged in fertilizer production, mining, waste treatment and bioproduction. It serves the farming sector as a whole by providing data for disintegrating emission factors to be used to meet the sector's GHG targets. CSM is proposed jointly by NMBU, NIBIO and CICERO.

Project number: 316471
Title: Autonomous Dynamic Integrated Ocean Observing System (ADIOOS)
Applicant (partners): NORCE
Project Manager: Rune Storvold

Short summary:

ADIOOS is a new infrastructure for development of future in-situ observing systems using a breakthrough in adaptivity and efficiency by utilizing the latest technological breakthroughs in autonomous platforms, communication technology and computing power. A prototype observing system will be set up, designed to serve as a research platform to explore and develop future observing systems based on adaptable infrastructure that can be shaped to numerous applications.

ADIOOS will focus on three specific forecasting applications essential for the safe and sustainable exploitation the ocean space environment, these applications are meteorology, emergency response

(algae blooms, oil spills) and marine ecosystems (biomass). The infrastructure will contribute to development of new technologies and modeling systems using the latest development in computing power, communication systems, autonomy and artificial intelligence. Even though this is a proposal for a new infrastructure it will also serve as an development platform to established infrastructures where new technologies can be developed and tested before being adopted into regular use in observing systems vital to creating sustainable long term time series such as SIOS (Svalbard Integrated Earth Observation System) and GEOSS (Global Earth Observation System of Systems).

The uniquely new feature of this infrastructure is that it will be autonomous, which means operational models will determine where and when to sample and which resources should be allocated based on analysis of uncertainty and sensitivity to input data in the forecasting, thus reducing uncertainty by doing the sampling where it has the optimal cost benefit effect, thus being an self-optimizing observing system, maximizing benefit while minimizing cost.

The infrastructure will serve scientists within geosciences, oceanography, meteorology, marine ecosystems, engineering, cybernetics, information and communication technology, physics and technology. The relevance to this wide range of user groups is the inherent multidisciplinary nature of observing systems where science and engineering development is tightly coupled.

Project number: 316478
Title: Infrastructure for Norwegian Earth System modelling phase 2
Applicant (partners): NORCE (MET, Nansensenteret, NILU, UiB, UiO)
Project Manager: Mats Bentsen

Short summary:
In Earth System Models (ESMs) sophisticated individual climate system model components are coupled together, allowing for simulated climate feedbacks involving atmospheric chemistry and biogeochemistry. ESMs are the only means for aggregation and compression of all information necessary to quantify dynamics and impacts of ongoing climate change, including all relevant feedbacks. Infrastructure elements related to the Norwegian Earth System Model (NorESM) were established and brought together in the Infrastructure for Norwegian Earth System (INES) project. There are currently more than 50 national NorESM users covering a wide range of climate research interests, relying on a continually upgraded research tool to address current and emerging science questions. INES phase 2 will support a substantial upgrade by adhering to the following objectives:

- Upgrade and maintain a cutting-edge and verified ESM suitable for the national climate science community and participation in international model intercomparison projects.
- Provide an infrastructure for efficient model simulations, storage, analysis and validation available for the national climate science community and collaborating international groups.
- For efficient sharing of model data, provide an infrastructure that connects to international data grids and ensures that model data complies with established standards of the climate community.

National climate modelling is highly dependent on HPC and storage systems provided by

UNINETT Sigma2, and INES2 will ensure continuous and efficient utilization of these systems. The project is expected to have a high impact on the national research community as demonstrated by the current high involvement of NorESM in projects (13 EU, 26 RCN, 11 internal institutional, 3 Nordic), international model intercomparisons such as CMIP6 and climate change assessments.

Project number: 316481
Title: National Bioprocessing & Fermentation Centre - NBioC phase 2
Applicant (partners): NORCE (SINTEF, NOFIMA, UiT, UiB, UiS)
Project Manager: Catherine Boccadoro

Short summary:
This application is to establish the second phase of the scaling up and pilot Norwegian Bioprocessing & Fermentation Centre (NBioC), responding to the need for a unique national Research infrastructure (RI) for fermentation research, as described in the Norwegian research infrastructure road map. The implementation of phase 1 of NBioC is currently underway. This first phase is funded by the NFR through INFRA2016 grant (project 270048), with in-kind contributions and industry support, and establishes an infrastructure at NORCE for scaling up of fermentation using sugar-based and gaseous feedstocks. Phase1 covers part of the funding necessary to fulfil the ambition of NBioC and includes funds for establishing laboratories and enabling gas and other fermentation up to 150L scale, as well as securing access to infrastructure and data from an industry enzyme production line. The support sought in the current proposal is to extend this infrastructure to include a 1000L state-of-the-art reactor for fermentation on gas sources including necessary sensors and downstream equipment to enable process optimization, scaling up and product analysis and testing, as well as access and data collection for R&D projects in existing 1 500L reactor for sugar-based fermentation. In addition, a strong infrastructure network will be built between members of the consortium, in this process linking up and upgrading key existing facilities across Norway to boost R&D to higher TRL levels and develop a strong drive towards gas fermentation in Norway. The total budget amounts preliminarily to 89 MNOK of which 69 MNOK is sought funded by NFR. This will finance equipment investment, projects, operation and maintenance as well as development activities for new projects and the NBioC as a whole. The current consortium includes the NBioC partnership from phase 1 and the full application will most likely extend to other universities or infrastructures in Norway or internationally.
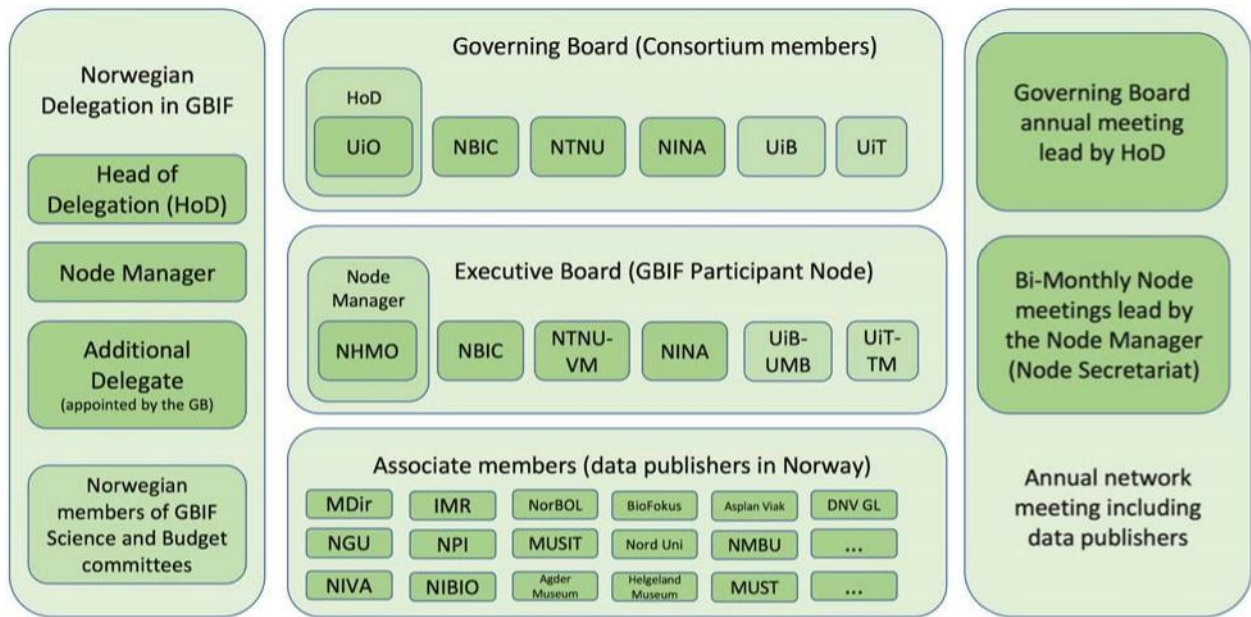
Project number: 316484
Title: Norwegian Node of the Global Biodiversity Information Facility – GBIF-Norway 2022-2026
Applicant (partners): UiO (NBIC, NTNU Uni.Museum, NINA)
Project Manager: Dag Endresen

Short summary:
This infrastructure application concerns a continuation of the Norwegian Participant Node in the Global Biodiversity Information Facility (GB IF) as a national research data infrastructure coordinated by the UiO Natural History Museum in Oslo (UiO-NHM), and operated through a consortium partnership with the Norwegian Biodiversity Information Centre (NB IC), the NTNU University Museum (NTNU-UM), and the Norwegian Institute for Nature Research (NINA).

Norwegian Delegation in GBIF

Head of Delegation (HoD)

Node Manager

Additional Delegate (appointed by the GB)

Norwegian members of GBIF Science and Budget committees

Governing Board (Consortium members)

HoD — UiO | NBIC | NTNU | NINA | UiB | UiT

Executive Board (GBIF Participant Node)

Node Manager — NHMO | NBIC | NTNU-VM | NINA | UiB-UMB | UiT-TM

Associate members (data publishers in Norway)

MDir | IMR | NorBOL | BioFokus | Asplan Viak | DNV GL
NGU | NPI | MUSIT | Nord Uni | NMBU | ...
NIVA | NIBIO | Agder Museum | Helgeland Museum | MUST | ...

Governing Board annual meeting lead by HoD

Bi-Monthly Node meetings lead by the Node Manager (Node Secretariat)

Annual network meeting including data publishers

The Global Biodiversity Information Facility (GBIF) is an international research infrastructure with the mission to facilitate free and open access to biodiversity research data online for anyone, anywhere. GBIF is funded and governed by national governments through a membership with a Memorandum of Understanding (MoU). GBIF is endorsed by the Convention of Biodiversity (CBD, 1993), the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES, 2012), and the Sustainable Development Goals (SDG) as the standard mechanism for providing biodiversity species data in response to these international agreements. The CBD, IPBES, and SDG are ratified by Norway, mandating Norway to report national biodiversity species data through GBIF. Addressing the urgent global loss of biological diversity and degradation of ecosystems is of global concern and adequate policy responses require access to harmonized data across country borders that would not be possible without international cooperation such as a Global Biodiversity Information Facility. GBIF enables international research and informs better decisions to conserve and sustainably use the biological resources of the planet that would not be possible without GBIF. GBIF provides an operational, effective and very cost-efficient mechanism to address this urgent global priority. GBIF operates through a network of national Participant Nodes (where GBIF-Norway provides this role for Norway) and an international secretariat hosted by Denmark and located at the University of Copenhagen.

GBIF-Norway (www.gbif.no) is the Norwegian Participant Node in the international GBIF research infrastructure (www.gbif.org) since 2005. Norway joined GBIF in 2004 and the Participant Node (GBIF-Norway) was established in 2005 at the UiO Natural History Museum as a project funded by the Research Council of Norway.

Project number: 316485
Title: National Geoscientific Data Infrastructure
Applicant (partners): NGU (UiT, NTNU, UiO, UiB, NP, HVL, UNIS, Store Norske Spitsbergen Kullkompani AS)
Project Manager: Johannes de Beer

Short summary:
"our habitable environment today depends on complex interactions between the surface and deep Earth, through rock, soil, rivers, oceans and atmosphere"[1]

The above quotation reflects on some of the core challenges of our time: climate change, sustainable resourcing of the world and preserving natural diversity and ecosystem services. Understanding the Earth System is a key to forming strategies and policies to face those challenges. The Earth Sciences collectively cover a broad area of relevance to the UN Sustainability goals and are crucial for providing research and data necessary for the transition to a more sustainable, low emission society, and for handling the risks and hazards paving the road toward such.

The Norwegian Geoscience community carries out research within the fields of understanding the deep dynamic processes in the earth; understanding the surface processes and landscape development; climate change and paleoclimate; primary and secondary (recycled) mineral resources; soils and agricultural resources; natural geochemical background and impact of anthropogenic pollution; groundwater; nature types and systems; marine geology and interactions with ecosystems; sea floor mineral resources; hydrocarbon resources and geohazards (in Norway: landslides and earthquakes). Collectively, this research has a steadily increasing impact on the choices we make to develop a society where the needs for human welfare are well integrated with a reduction of our environmental footprint. Through more than 100 years, millions of physical samples (rock specimens, fossils, drill cores, soil samples, etc.), geoscientific analyses and observations carried out by many institutions, have provided a large amount of data. The collective research potential provided by this geoscientific data is of national importance, both for scientific research and for applied research and development. Yet, there is a conspicuous lack of a nationwide infrastructure for both physical and digital storage of geoscientific data, including a national data management system. Absence of this infrastructure effectively hinders the findability, accessibility, interoperability, and reusability (FAIR-principles) of geoscientific data, one of the major pillars of the Norwegian Government's research strategy[2].

The National Geoscientific Data Infrastructure (NGDI) will provide the necessary e-Infrastructure to enable geoscientific research data to be managed and curated in such a way that full advantage of their potential for a wide range of applications can be achieved. NGDI will support and enhance the management and data sharing capabilities of research institutes, museums and universities that operate physical storage facilities and carry out geoscientific research. As recently commented in Nature: Store and share ancient rocks; geological samples must be archived for all if we are to solve the riddles of Earth's complex history[3].

Project number: 316491
Title: GeoCloud Research
Applicant (partners): NGI (NTNU, NGU)
Project Manager: Kristoffer Skjolden Skau

Short summary:
The field of Geotechnical engineering is fundamentally based on empirical data from field investigations and lab testing. Even though NGI, NTNU, NGU and other institutions has data stored in historical archives on paper and in digital format on file servers, the access to the data is cumbersome without a unified efficient data platform solution. With the evolvement of data driven science, there is an additional potential and growing interest for utilizing broader data sets for analyses and modelling. The geotechnical research community in Norway is currently suffering from the lack of well structure geotechnical data. The project proposed herein will turn the existing NTNU and NGI data archives into a structured unified data platform, and organize and store new data in present and future research projects. In addition, future data from consultancy driven geotechnical site investigations and laboratory testing will be fed into the data platform. These data have a great interest for researchers as the data volume outstrip the volume from research projects. This will require integration towards existing industry solutions such as GeoSuite, NADAG and Holebase. An important part of the project will be to the legal considerations and categorisation of intellectual property rights of the data. This is required to ensure sharing and to utilize the potential value in the data by making it available for the research community.

The data platform should be accessible for the geotechnical community in Norway. Geotechnical data should be stored at made accessible for research purposes across Norway. The data will also be utilized to public and private infrastructure developers in order to provide early phase information, promote re-use of data and reduce risk and cost in general.

Project number: 316492
Title: Forskningsinfrastruktur for miljø- og ressursdata for bærekraftig innovasjon (LCA data)
Applicant (partners): ØSTFOLDFORSKNING AS (NMBU, PRé, NILU, NIFU, SINTEF, Treteknisk, IFE, Asplan Viak)
Project Manager: Ole Jørgen Hanssen

Short summary:
The NorEnviro infrastructure project will be based in the infrastructure project proposal from 2018, with main focus on developing and implementing a research infrastructure for environmental and resource data (LCA data) of relevance for Norwegian research organizations, for the Norwegian business sector, business organisations and governmental authorities and for higher education. There is a strong need for making available high quality LCA data to support sustainable innovations in all sectors, where the food sector, the building sector, the energy sector, mineral and metal producers will be given high priority. The research infrastructure is of high relevance for future EU-funded research projects as well as national projects and is vital to change from a linear fossil-based economy, towards a circular and biobased economy. Compared with the proposal from 2018, there will some significant changes in this application, as Østfoldforskning in collaboration with PRé has moved on with development of stage I in the technology for data management and data sharing, as

well as with developing the systems and routines for data verification and meta data system, and started work to systemize existing data available in Østfoldforskning from some ongoing and newly finalised projects (e.g. Exilva project, Sustainable Biogas Systems etc). In collaboration with NMBU, data sharing is also tested at a stage I level for data from Norwegian livestock production, developed through the ongoing Livestock project financed by the Research Council.

Project number: 316493
Title: Norwegian Marine Data Centre - Interoperable Infrastructure
Applicant (partners): HI (NERSC, NP, NIVA, MET, NORCE)
Project Manager: Helge Sagen

Short summary:
"Seamless access to marine data" is the vision of the national research infrastructure Norwegian Marine Data Centre (NMDC) established in 2011. Marine research is by nature multi-disciplinary, combining physical, geological, chemical, and biological knowledge and data. High quality and efficient marine research require easy and rapid access to marine data across institutions and disciplines. Since the inception of NMDC, the volume, velocity and veracity of data captured by new sensors and observing networks have grown exponentially. In the same period, a need has emerged to support reproduceable science and provide a strong foundation for decision-making in public and private sector. To meet the new demands, NMDC will extend its capacity to operationalise the flow of measurements from the ever-increasing number and variety of instruments to quality-controlled datasets, following best practices for marine data and the widely accepted FAIR principles for data management.

Through the proposed extension, the NMDC infrastructure aims to give seamless access to marine data by delivering interoperability between distributed data centres, offering human and machine friendly interfaces for data processing and documentation, access and archiving. The infrastructure simplifies the technical obstacles scientists encounter when finding and using data from various sources. To provide a cost-effective solution for data providers NMDC is ensuring proper long-term stewardship for data, bridging the extensive knowledge of marine data providers with that of data managers. Documenting and storing marine data in a sustained infrastructure will contribute to uncovering information hidden in previously inaccessible historical datasets, allowing scientists, marine operators and decision-makers to analyse long time series of important ocean variables. NMDC will continue to mobilize data that was previously unavailable, in close collaboration with marine data providers to make their valuable datasets publicly available in a form that allows reuse in science, business and society. To increase the use and uptake of NMDC, an open call mechanism will be established where external parties can bid for funds to develop an application utilising NMDC datasets and services. These applications, which can also utilise data from other data infrastructures such as EOSC and SeaDataNet, will showcase how the marine community can benefit from a FAIR compliant national data infrastructure for marine data.

Project number: 316499
Title: COASTWATCH - the Norwegian coastal observing system of systems
Applicant (partners): HI (MET, UiB, NORCE, NIVA, APN, NERSC, NVE, RMS, UiO, NINA)
Project Manager: Frode Bendiksen Vikebø

Short summary:

Research and development associated with environmental monitoring, climate change, marine pollution, blue growth and ecosystem management greatly benefit from accurate descriptions of the physical, chemical and biological state of the ocean. The strongest currents and overall highest variability are found on the continental shelf and along the shelf break, while the complex geometry of the coastline leads to the creation of smallscale circulation features important for nearshore spreading and dispersion. Hence, the coastal regions and the shelf seas are particularly challenging to resolve in numerical models and observe in a representative way. However, increasing levels of activities at the interface between fjords and the coastal sea place a clear demand on the accuracy in predictions of e.g. marine ecosystem connectivity and pollutant exchange. Establishing a consistent research infrastructure enabling a coherent approach through combined coastal observations and ocean modelling is therefore imperative to secure a sustainable pursuit of the goals of the Norwegian government and international obligations, such as the UN Sustainability Development Goals (SDGs).

As a consequence, we propose an integrated coastal observing system COASTWATCH at key sites along the Norwegian coast as a much-needed infrastructure supporting research and knowledge-based management as well as Norway's contribution in the European integrated and multidisciplinary coastal observing system – JERICO (currently applying to enter the ESFRI roadmap). In order to adequately address the complex coupled processes inherent of coastal regions and delivering essential ocean variables, our infrastructure will implement a multiplatform-multi-sensor approach integrating observations from fixed platforms, HF radar systems, coastal gliders, ships of opportunity, surface AUVs and a framework for testing and utilizing other observation sources such as satellite-based remote sensing, connected into into Supersites of high societal relevance. This will provide Norwegian and international researchers and managers a permanent source of near real-time information of physical, biogeochemical and biological state of coastal and shelf regions, supporting an ecosystem approach for analytical studies of stressors and impacts. Furthermore, the infrastructure will represent a hub for easy integration of all observation sources in the area (e.g. salmon farms, national monitoring programs) and a model-based extrapolation beyond the key sites to the entire coast through data assimilation and data-driven machine-learning. We will stimulate technology development to better observe the biogeochemical processes and facilitate cross-disciplinary research on coastal processes and assessment of the combined climate change and human impacts.

Project number: 316501
Title: Living Norway Ecological Data Network
Applicant (partners): NINA (NTNU, UiO (NHM), UiB, NMBU, NIBIO, NIVA, NBIC)
Project Manager: Erlend Birkeland Nilsen

Short summary:
The accelerating degradation of our planet's ecosystems and the associated biological diversity is among the main present-day societal challenges, and cutting-edge ecological research is increasingly needed to describe, understand and mitigate these challenges. There is currently a severe mismatch

between data availability and research needs, and a general agreement within the environmental research sector that improved data management following FAIR principles would be greatly beneficial to the scientific progress. It is therefore a dire need for an infrastructure that mobilize data from research projects and monitoring programs collecting data about the state and functioning of our biosphere. Living Norway Ecological Data Network is a direct answer to this challenge, and will be in high demand by the research community. To this end, Living Norway Ecological Data Network will:

- Serve as the main data-infrastructure for ecological data, including software to prepare, map, publish and archive data through established e-infrastructures, retrieval of data relevant for state-of-the-art ecological research, and held desk services supporting the community.
- Serve as a hub facilitating the necessary cultural transformation and increasing the human know-how with respect to data sharing and FAIR data management in the ecology community.
- Contribute to continued development and implementation of open standards for ecological data, making them more widely applicable and used in ecological research.
- Work closely together with the Norwegian GBIF node, and serve as an extension for mobilizing new data types that are needed for state-of-the art ecological research.

The consortium consists of eight institutions that together represent the breadth in Norwegian ecological research. Our ambition for Living Norway is that this will be the core hub for Norwegian ecological data in science and society.

Project number: 316504
Title: National Platform for NanoSafety
Applicant (partners): UiB (NILU, STAMI, SINTEF Ocean, NMBU)
Project Manager: Mihaela Roxana Cimpan

Short summary:
Nanotechnology is one of the six Key Enabling Technologies, which are expected to address many societal challenges by providing new and innovative solutions. The aim of the National Platform for NanoSafety (NPNS) is to provide relevant stakeholders, e.g., industry, academia, research centres and institutions, and consumers with easy access to the expertise, state of the art instrumentation, infrastructure and methods to assess the exposure, hazards and risks associated with nanomaterials (NMs). It will provide a national hub for expanding insight into the impacts of NMs on humans and the environment, support the development of safe(r) NMs, facilitate application of nanosafety principles to products and industrial processes and inform regulatory decision-making bodies to ensure responsible research and innovation in nanotechnology . The platform will cover evaluation of the physico-chemical characteristics and biological effects of various types of NMs, from metal oxides to organics, including polymer-based 'nanoplastic' and complex composite nanostructures. We will especially address the real and urgent need for biological three-dimensional models and interference-free methods that mimic real-life exposure to NMs. There will be an emphasis on high-throughput testing. The NPNS addresses the international goal of ensuring that NMs are in compliance with the proposed principle of small, smart and safe (the 3 S´s).

The NPNS builds upon the SafeNano Norway Network and successful collaborations between Norwegian research centres in previous and current national and European projects focused on the safety assessment of NMs. The NPNS is strategically anchored in the prioritized research areas of the Research Council of Norway and of the host institutions, it will strengthen and expand the existing national and local networks and promote collaboration in the field.

*The National Platform for NanoSafety aims to provide industry, academia, research institutes and other relevant stakeholders a user-friendly, open test bed consisting of state of the art instruments and expertise for exposure, hazard and risk assessment of nanomaterials (NMs). The ultimate goal is to contribute to the development of **small, smart and safe(r) NMs.***

Project number: 316507
Title: IOR and Subsurface Field Lab at Risavika
Applicant (partners): UiS (NORCE, IFE)
Project Manager: Ying Guo

Short summary:
The planned infrastructure will be owned by the University of Stavanger who is the host of The National IOR Center of Norway in the period 2013-2021, in collaboration with its research partners Norwegian Research Center AS (NORCE) and the Institute of Energy Technology (IFE). The location of such a large scale infrastructure is currently planned at Risavika test center near Stavanger.

Norway has large oil and gas resources that remain in the reservoirs when production is shut down. Increasing the recovery rate of reservoirs in operation is therefore of great importance. This can be done, for example, by injecting water with compositions other than seawater used in Norwegian oil fields today. Current focus on CCS opens for another possibility to include CO_2 in the injection water for IOR in combination with permanent storage for CO_2.

Experimental studies in the laboratory show that different additions (salts, chemicals or CO_2) to the injection water can have positive effect on the recovery rate. The question is whether the IOR potential measured at core scale of a few centimeters in the current practice will work equally well in a reservoir that can be kilometers in extent. The investments for IOR projects are large, and it is therefore important to reduce uncertainties by validating results in relevant scale and realistic conditions such as temperature and pressure in the reservoir. In addition, adequate and well-calibrated modeling tools are needed to estimate improved recovery rate for different injection strategies. Such estimate and model validation from offshore pilot are costly and often inconvenient, therefore raise the need for a field-scale laboratory where test samples of several meters could be used to better represent flow from well into reservoir. Advanced instruments are included for data acquisition and analyzing the mineral rock surface, mineralogy, fluid composition and properties before, during and after experiments. The measurements from such a field lab can substitute costly field pilots for IOR and also for safe geological storage of CO_2. We believe that this infrastructure will bridge the pore, core and field scales, which today is a challenge both in industry and academia, to explore new ideas and open to interdisciplinary, multinational and cross-sectoral research.

Project number: 316509
Title: Digital extension of the Zero Emission Building and climate adaptation laboratories
Applicant (partners): SINTEF AS (NTNU)
Project Manager: Berit Time

Short summary:
Climate change is a grand challenge that has been referred to as a `super-wicked' problem, because of the scale, scope, and time horizon of which mitigation and adaptation efforts must take place. It requires a collective action among multiple and diverse organizations. Laboratory and field measurements, simulation techniques, semi-quantitative interviews and observation studies are all necessary to pave the way for new innovative solutions.
The ZEBextend research infrastructure aim to bridge interdisciplinary challenges regarding zero emission and climate adapted buildings and close-proximity infrastructure.

The ZEBextend research infrastructure will encompass physical and digital infrastructure consisting of

- An entry point for industry to the ZEBextend research infrastructure. This will enable design, development, testing, safety assessment, and upscaling of climate adapted, zero-emission solutions and components for buildings and adjacent infrastructure/power-grids. This will be done through front-end development and industry outreach which will provide industry a digital map with information and give easy access to the testing facilities they need for their specific purpose. Data analytics infrastructure and visualization will be included in this.
- A digital infrastructure comprising a dynamic and digital copy of the physical laboratories : a so-called constellation of "digital twins" (See Figures 1 and 2). This will strengthen cross-disciplinary coordination between laboratories and research communities and will support the industry into its digital transformation in the context of Internet of Things (IoT), Industry 4.0 and Industrial Internet of Things (IIoT).
- An extension of existing physical infrastructure for characterization of efficiency and climate-robustness of renewable energy harvesting (e.g. BIPV) and storage (electric/batteries) systems. This will support the industry into its green shift transition.

Within the research topic of energy use in buildings, an extensive physical infrastructure1 has been built up around previous and ongoing Research Centres for Environment-Friendly energy, FME ZEB (Zero Emission Buildings) and ZEN (Zero Emission Neighbourhoods in Smart Cities) and the Center for Research-Driven Innovation SFI Klima 2050 (Risk reduction through climate adaptation of buildings and infrastructure). Amongst them, the ZEB Laboratory is a full-scale commercial building for exploring individual components and materials in practical use that will be completed in 2020. All these physical labs will constitute the core of the ZEBextend laboratories.
Covid-19 measures
In light of the Covid-19 situation we see a risk for reduced willingness from industry to participate in research and innovation projects. This can lead to a critical reduction of industry projects related to the ZEB Laboratory. We also apply for funding for the basic operation of the ZEB Laboratory, due to these extraordinary circumstances.

Project number: 316511
Title: Design, prototyping, performance and reliability of solar photovoltaic/thermal components and systems
Applicant (partners): SINTEF AS (SINTEF Energy, SINTEF Digital, NTNU)
Project Manager: Martin Bellmann

Short summary:
Use of solar energy will be a cornerstone in the low-carbon energy system to be built by 2050 and is currently growing rapidly worldwide. In Norway, a rapid market growth has been seen especially over the last 3-4 years. In concert with these growth trends, a diverse ecosystem of Norwegian companies has emerged, ranging from technology providers, installers to park owners and operators. To continue and strengthen this development, there is a great need and potential for R&D along the downstream of the value chain. In this project we target three central infrastructure-needs to support increased R&D in solar energy. First, we will develop lab facilities to realise new product ideas (e.g. multifunctionality, complex shapes, integration of sensors, aesthetics, heating/cooling, etc.). Second, advanced lab infrastructure will be built for characterization as well as accelerated tests of such developed products and related materials. This is important to understand quality criteria and standardisation and innovate on how long-term reliability relates to differences in mounting, local climate, choice of technology. Third, we will develop lab facilities to test the developed products integrated at system level. This might include building integration, storage of electricity and heat, agrophotovoltaics, system level design and forecasting. The infrastructure will greatly strengthen the already cutting-edge Norwegian research environment for solar energy, and help this environment be a catalyst for Norwegian businesses to lead in innovation and seize new opportunities both nationally and internationally.

Project number: 316514
Title: Norwegian Collections of Marine Life
Applicant (partners): UiB (NTNU)
Project Manager: Aino Hosia

Short summary:
The Norwegian Collections of Marine Life (NorMa) encompass curated and continuously developed reference collections of physical specimens of multicellular marine organisms (fish, invertebrates and macroalgae), associated tissue and DNA samples, voucher photos, and corresponding metadata. Data on the collections will be aggregated in a collection database linked to relevant external data repositories, and made searchable and accessible through a public online portal providing a single point of access. In addition to the physical collections, data, and IT infrastructure, NorMa will constitute a hub for marine biosystematics expertise and promote taxonomic and systematic research based on the collections. The infrastructure will contribute to better utilization of the substantial resources used on marine research and monitoring through providing longterm storage, curation and research access for material collected by partners and stakeholders. NorMa will contribute to improved documentation, transparency and repeatability of biodiversity studies, including analysis of eDNA and metabarcoding applications, through providing comprehensive reference collections. NorMa will also offer dissemination and knowledge-transfer regarding the

collections and marine biodiversity in general to academia, research and industry stakeholders, as well as the general public.

Project number: 316516
Title: Research Centre for Climate-induced Geohazards
Applicant (partners): NGI (NVE, SVV, UiO, BaneNOR)
Project Manager: Peter Gauer

Short summary:
Vision for the ReCCiG facility: The Research Centre for Climate-induced Geohazards will be Norway's national experimental centre to improve (1) the assessment of potential natural hazards and associated risks, (2) the preparedness and response to natural geohazards, and (3) risk communication to enhance society's ability to protect itself. ReCCiG will enable concentrated, targeted and long-term research and innovation in climateinduced natural hazards, studying triggers, novel monitoring, early warning and risk communication.

Motivation: Geohazards include intense rainfall, floods, slush flows, avalanches (snow and rocks), rock falls and landslides and can have devastating impacts on society, affecting population, economy, industry and the environment. Climate change is amplifying the risks due to geohazards, with wetter and warmer weather and more intense, more frequent, short-lived, localized precipitation.

ReCCiG, a Centre for research organisations, government authorities, stakeholders and industry: ReCCiG will invite all stakeholders in Norway to participate in the research and use the centre to solve their challenges. The interaction of research, authorities, builders and industry will ensure robust, resilient, adapted and reliable risk-reducing solutions for society. ReCCiG will also focus on multi-disciplinary geohazards education with a new curriculum on risk, climate and sensing. ReCCiG will become not only a national competence centre but also an international focal point in geohazards risk mitigation. ReCCiG will address modelling, understanding of processes leading to climate-induced slides, development and testing of mitigation measures, solutions for emergency preparedness and training in avalanche safety and Search & Rescue operations.

Infrastructure investment: The proposal applies for a substantial upgrade to the current NGI avalanche testing facility and new investment for a significant broadening of the scope of research, with also the development of an infrastructure for data collection and sharing. ReCCiG will be anchored at the existing avalanche test site and expanded through new facilities (nodes) to cover the needs at other critical geohazards locations in Norway. ReCCiG will have capabilities and new facilities for slush flows (a type of debris flow), rock falls and rock slides and landslides. These nodes will also be equipped with novel sensing and sensemaking monitoring tools, capabilities for full scale models and technical infrastructure to test early warning and risk communication.

Project number: 316518
Title: Offshore Boundary Layer Observatory (OBLO) – Phase II
Applicant (partners): UiB (METCENTRE, MET, NORCE, NTNU, UiS)
Project Manager: Joachim Reuder

Short summary:
The appropriate characterization of the relevant environmental conditions in the atmospheric boundary layer (up to about 300 m for state of the art wind turbines) and the oceanic mixed layer (down to ca. 100 m for floating support structures of the Spar type) are of uttermost importance for the design, construction and operation of offshore wind farms. Corresponding measurements are up to date very sparse and involve high logistic efforts and deployment costs, as well as scientific and technical expertise in planning and execution that usually overshoot the capacity of single academic or industrial actors. Therefore, we propose OBLO-II as a national initiative of central Norwegian partners with a research focus on offshore wind energy, to provide an internationally unique measurement infrastructure for offshore wind energy research. With that we can ensure that Norwegian universities, research institutions and industry have access to a wide range of tools for future successful offshore wind energy research beyond the current state-of-the-art and to a high international standard.

The OBLO-II infrastructure application is an upgrade and extension of the existing OBLO infrastructure project, funded by the Research Council of Norway between 2010-2019 under project number 227777. The main components will be an upgraded instrument park of mobile instrumentation, including multiple wind lidar systems, a met-ocean buoy for a flexible and fast deployment of the instrumentation offshore on demand, meteorological masts at the coast for in-situ measurements of the approaching offshore wind field, and a world-wide unique wind-tunnel facility. The consortium will also offer expertise and consultancy with respect to the design, planning and execution of measurement campaigns and ensure high impact of the infrastructure by providing open access to highly required offshore data sets based on the FAIR principles. Beyond offshore wind energy research, the OBLO-II infrastructure will also serve a wide range of other relevant applications, including basic atmospheric and oceanic boundary layer research, structural engineering, aviation safety, and weather and climate research.

Project number: 316523
Title: ForskAir - Airborne infrastructure
Applicant (partners): ANDØYA SPACE CENTER AS (UiB, UiO, NMBU, UiT, MET)
Project Manager: Stine-Marie Andreassen

Short summary:
The "ForskAir" consortium, applies to establish an airborne research infrastructure, which comprises different manned and unmanned platforms. The type of airborne platforms and instruments are determined by user requirements. The platforms provide research, monitoring and testing:

- from the air, e.g. terrestrial features seen from the air on ground, or towards space
- of the air using in-situ or remote sensing technologies e.g. for trace gases and pollutants, dynamics and exchange processes

- in the air, using airborne platforms to test, qualify and certify industrial products, which require the ambient conditions of an airborne platform

The ForskAir proposal aims to provide an infrastructure, which incorporates a set of advanced services to Nordic universities, agencies and industrial clients. ForskAir is expected to generate unique opportunities for Nordic institutions and aims to stimulate in particular Arctic research, atmosphere and climate research, the use of airborne platforms within various kinds of field research as well as a better understanding of human factors in the cockpit. ForskAir will encourage multidisciplinary approaches and new solutions for the preparedness sector. On a European scale, airborne research infrastructures are already existing in e.g. Great Britain, France, Germany and Romania. These infrastructures use large aircrafts, suited for comprehensive campaigns with several institutions. Norwegian and Nordic research groups request a versatile infrastructure, applicable for a broad spectrum of science fields, for more individual flight planning and the Arctic expertise.

Project number: 316525
Title: Norwegian Chemical Palaeoecology Laboratory
Applicant (partners): UiB (NMBU)
Project Manager: Alistair Seddon

Short summary:
Palaeoecology uses the sub-fossilised plant remains preserved in sediments to reconstruct past ecosystem changes, and their responses to climatic variations and human activity, over thousands of years. Although keystone components of ecosystems (i.e. trees) can often have generation times spanning decades to centuries, standard Elong-term' ecological research projects only incorporate assessments of vegetation and other ecological changes spanning years-decades. Palaeoecological data are vital to fill the critical knowledge gap that cannot be addressed using traditional ecological techniques. Indeed, the information from sediment archives is the only way to obtain empirical information relevant for understanding long- term ecological dynamics and functioning.
Work by members of the Bergen Palaeoecology Laboratory and NMBU over the past 5 years has contributed to pioneering a new approach in palaeoecological research through the analysis of the chemical variations in the outer wall (exine) of the pollen grain, composed of a complex biomolecule known as sporopollenin. Sporopollenins are resistant to corrosion under anoxic conditions and can remain chemically stable for millions of years. Evidence is also accumulating that the chemical variations of sporopollenin, in addition to other components of the pollen grain, may vary as a result of both changing environmental conditions and phylogeny. As a result, the analysis of biomolecules in sporopollenin has the potential to revolutionise palaeoecological research- through new techniques in identification, and for the reconstruction of new environmental variables (e.g. UV-B radiation). However, the infrastructure and access to reproducible workflows is relatively underdeveloped for the application of pollen chemical techniques, both within Norway and internationally.
This infrastructure grant aims to develop Norwegian capacity for a fully integrated network of instrumentation and expertise to develop the application of chemical analysis of pollen grains for a suite of palaeoecological applications. The end result will be a world-leading centre providing access to the full spectrum of a state-of-the-art research tools to enable research projects based on (i) developing new chemical-based proxies for palaeoclimate reconstructions; (ii) developing new

workflows for chemical based analysis and identification of microfossils in sediments; and (iii) tools for the integration of multiple-sources of information (traditional light-microscopy methods; vibrational spectroscopy and py-GC-MS; ancient DNA; and other multi proxy information). In addition, much of the equipment purchased has widespread applications across numerous research themes relevant across Norway, specifically for research into environmental microplastics, biotechnology, microbiology and animal and veterinary sciences, and biomedicine.

Project number: 316528
Title: NAMO: Norwegian Arctic Multi-disciplinary Ocean Observing
Applicant (partners): NERSC (NPI, HI, UiB, FFI)
Project Manager: Hanne Sagen

Short summary:
The overarching aim of NAMO is to improve and fill gaps in the Arctic Ocean observation system, and sustain long-term observations of ocean and sea ice variables in the central Arctic. Such observations are needed over several decades to distinguish climate change signals from natural variability, but in situ observations from the central Arctic are few and lack long-term support. It is also important to have observing systems that can detect environmental changes including natural hazard events. NAMO will implement and operate a multidisciplinary network of bottom anchored moorings in the western Eurasian Basin. The network of moorings will integrate sea ice and ocean point measurements (physical and biogeochemical) with a multipurpose acoustic network for basin wide underwater geo-positioning, acoustic tomography and passive acoustics. The NAMO system will be part of a coordinated Pan-Arctic acoustic network in collaboration with US partners and complement existing ocean mooring systems in the Arctic. The acoustic network includes passive acoustics to monitor vocalizing marine life, acoustic impact of human activities, and geophysical hazards (e.g. earthquakes, landslides, tsunamis). In addition to the fixed moorings, NAMO will include icetethered platforms (Drifting Ice-Based Observatories) to collect atmospheric, sea ice and ocean data, which are transmitted in near-real time as they drift with the ice. To ensure that the observing systems can operate autonomously over long time, only well-proven instrumentation for the platforms will be used. Furthermore, NAMO will provide competence building in ocean engineering with focus on Arctic observing and geopositioning technologies, including sensors, platforms, logistics and data management. NAMO data will be made available through the Norwegian Marine Data Centre (NMDC) and Norwegian Polar Data Centre infrastructure.

Project number: 316538
Title: Norwegian Marine Robotics Facility II: Autonomous Underwater Vehicle (AUV)
Applicant (partners): UiB (FFI)
Project Manager: Rolf-Birger Pedersen

Short summary:
Cutting-edge, international marine research relies on the access to a multitude of high-technology equipment that includes remotely operated vehicles (ROVs), and autonomous underwater vehicles (AUVs). Funding for a ROV was granted in 2013 and it is now timely to develop an AUV that is specifically dedicated for marine research and to challenges in marine management. The AUV will be

fitted for operations over a range of ocean and coastal vessels - including the new polar research vessel. The infrastructure project is aiming to develop an AUV capable of imaging the seabed in unprecedented resolution, and detecting a wide-range of oceanographic parameters, beyond the present state-of the-art. The AUV will also be capable of diving to 6000 m depth, and it will have a range of close to 600 km. This opens new opportunities for marine research and management, and it will be an important step towards ship-independent marine monitoring. The AUV will be scalable and modular and capable of carrying a unique set of acoustic, optical, physical and geochemical sensor packages. We anticipate that the infrastructure will contribute significantly to national and international R&D framework, by delivering unique data for the following basic and applied marine research areas: 1) deep-sea geodynamics and hydrothermal activity, 2) marine mineral resources; 3) under ice and polar research, 4) marine geohazards, 5) ocean circulation, ocean mixing processes, air-sea interaction and ecosystem dynamics; 6) seabed fluid flow and future climate; 7) CO_2 capture and storage; 8) pelagic ecosystems and their resources, and 9) benthic ecosystems and environmental change. By linking excellent R&D groups across institutional, disciplinary and sector boundaries, we expect that the project will lead to new synergies and to marine technology development.

Project number: 316541
Title: European Plate Observing System - Norway (EPOS-N) Phase-II
Applicant (partners): UiB (NORCE, NORSAR, NGU, NMA, NGI, UiT)
Project Manager: Kuvvet Atakan

Short summary:
EPOS-Norway (EPOS-N: www.epos-no.org) is the Norwegian node of the European Plate Observing System (EPOS) ERIC (www.epos-ip.org) – a distributed research infrastructure for Solid Earth Science in Europe. The goal of EPOS-N is to gather all Solid Earth Science data in Norway and to make this data available and accessible to the full geoscience community and public through the newly developed EPOS-N Portal. The first phase (Phase-I) of the project is now in its final year (2016–2020). In this proposal, we apply for funding for a second phase (Phase-II), where we expand with new partners, new datasets, and a wider range of applications. The added expertice of these new partners along with new equipment will significantly enhance the monitoring capacity within Solid Earth Science in Norway and the Arctic. In this proposal we aim to address the increased political and economic interest in the Barents Sea, the Svalbard Archipelago, and the surrounding areas. In EPOS-N Phase-II, an enhanced solid Earth monitoring capacity, together with access to a national solid Earth science database, will allow to establish a baseline in the Arctic for studies on geohazards and georesources. This is especially important seen from environmental perspectives.

In Phase-II, we will improve the monitoring in the Arctic by procurement, installation, and facilitating data access from the following: Broadband Ocean Bottom Seismometers (OBS) for earthquake monitoring and subaerial slope instabilities in fjords (tsunami hazard), broadband seismometers for a new seismic array in Finnmark (seismic hazard) co-located with infrasound sensors for environmental monitoring, short-period seismometers for cryospheric research (climate change studies), magnetic observations and airborne electromagnetic instruments for a range of geoscience applications.

EPOS-N Phase-II involves new partners: The Arctic University of Norway (UiT), Norwegian Geotechnical Institute (NGI) and a new group from NORCE (formerly Norut). In addition to the seismological, geodetic and geological/geophysical databases implemented in Phase-I, extended data and services from the new partner institutions will include: Geomagnetic data (Tromsø Geophysical Observatory, UiT), rock physics laboratory data for Earth's internal and atmosphere processes (Rock Physics Laboratory, UiT), InSAR data – integrated InSAR/GNSS velocity datasets, gravimetry data (NGU), OBS data (mainly campaign-based data collection offshore, including submarine slope instability surveys to improve knowledge of the tsunami hazard potential), and borehole data (energy-related boreholes and shallow boreholes for groundwater, and NADAG – National Database). A particular focus is dedicated to developing eInfrastructure for providing access to tsunami hazard models (NGI) within Norwegian fjords – a major societal concern and interest.

Project number: 316549
Title: Norweigan Telemetry Network
Applicant (partners): NORCE (NTNU, NMBU, NINA, UiB)
Project Manager: Robert Lennox

Short summary:
The oceans are increasingly accessible due to the availability of new technologies that facilitate marine biological and oceanographic monitoring. Telemetry is a tool for animal monitoring that has greatly enhanced the capacity to observe processes within the ocean and understand drivers of change. Higher resolution data on the distribution, behaviour, physiology, and demography of marine animal communities contributes to better marine spatial planning including siting of aquaculture, fisheries policy, and marine industry operations. Because global positioning systems cannot penetrate through water, most aquatic telemetry uses acoustics, in which a tag emits a sound detected by a receiver, providing an indication of the tagged individual's position. The quality of data returned by acoustic telemetry is therefore highly dependent upon the distribution of the receiver array; an animal cannot be detected where there are no receivers. Large-scale telemetry networks have emerged in Canada, Australia, the United States, South Africa, Denmark, Belgium, Great Britain and other countries with coordinated marine tracking efforts. Norway is home to many economically important and vulnerable species that are tracked using acoustic telemetry, including salmon, trout, cod, eel, tuna, various sharks, and more. A coordinated effort to maximize the potential information can greatly enhance the information yielded by acoustic telemetry. A Norwegian Telemetry Network would be an array of fixed infrastructure available to aquatic researchers in Norway to investigate the patterns and drivers of animal movement. This proposal details an ambitious plan to combine the capacity of some of the country's most active and experienced telemetry users to establish an infrastructure project that will have long-term benefits to industry, policy, science, and society in Norway.

Project number: 316550
Title: Norwegian Research Infrastructure for studies of environmental contaminants
Applicant (partners): NILU (NIVA, UiT)
Project Manager: Aasmund Fahre Vik

Short summary:
Positioned at high latitudes, Norway is especially vulnerable to long-range transport of persistent contaminants and Norwegian authorities have thus decided to take a leading role internationally related to studies of chemical contaminants and regulation of emerging pollution. In addition to that, changes due to global warming are opening new areas for various industries (e.g. petroleum, shipping, mining), which requires research around potential environmental impacts of these activities in order to achieve sustainable management of the ecosystems.

Main goal:
- Establish a nationally coordinated and internationally leading research infrastructure network for environmental chemistry with a special focus on emerging pollution

Objectives:
- Provide cutting-edge research infrastructure for investigating the consequences of emissions and exposure of emerging environmental contaminants including microplastic and nanomaterials
- Develop advanced data management structure featuring front-line data treatment and storage tools
- Support national high-quality training of Master and PhD candidates with cutting-edge research infrastructure for environmental chemistry, epidemiology and ecotoxicology
- Bridge the gap between harmful exposures and chemical management strategies
- Evolve and consolidate the existing national collaboration on research related to environmental emissions, ecotoxicological impacts and human exposure to contaminants
- Contribute to the aim of a pollution-free environment and to lessen the impact and exposure on environment and human exposure

It is planned to develop a Norwegian component of the European NORMAN e-infrastructure through the currently proposed infrastructure.

Project number: 316551
Title: SUSTAINHEALTH-workflow, an Infrastructure for Food, Health, and Sustainability
Applicant (partners): FHI (NVI, SSB, UiO, NFSA)
Project Manager: Helle Margrete Meltzer

Short summary:
Worldwide, transforming food systems in the direction of sustainability with a high priority on health and food safety is getting increased attention, and in Norway, several projects are or will soon be addressing various issues in this respect. The work processes towards those goals are, however, not as efficient as they could and should be, and lack of infrastructures supporting the workflows needed is a major obstacle.

Currently, we lack many of the tools for the comprehensive research and development work needed for concerted attacks on these problems in an efficient, persistent and quality-assured way. We need efficient access to co-ordinated and updated databases and metadata, and tools to utilize the data. This project will provide the research community, actors in the food systems context, health authorities and general public with a data- and knowledge infrastructure that links diet, food, human and animal health, agricultural and environmental information and constitutes a basic element in a sustainability research and development toolset.

Overall aim: To build a data and knowledge infrastructure that supports transdisciplinary research and development, bridging food production, food security, food safety, health and sustainability.

Some of the specific aims:
1. Develop a distributed infrastructure in the form of an integrated network of services on both the provider and user side. A workbench approach will furnish users and developers/maintainers with tools for developing, maintaining and using the services provided.
2. Develop tools and methods to facilitate monitoring of the sustainability of food production and food consumption, in part based on a OneHealth approach, integrating and making optimal use of existing data sources and dataflows, e.g. Landbrukets dataflyt.
3. Provide necessary access to food production and composition data, facilitating the development and use of validated dietary and health assessment tools for diet and health connections, and consistent with national health and biomonitoring surveys.
4. Provide simple and standardized access to data on food production, composition and consumption for research, evidence-based advice, policy development and evaluation, in part supported by linkage with data on health outcomes.
The handling of sustainability will be based on the UN SDG indicator set and similar international initiatives. Being unique, scalable and internationally usable, this research infrastructure will facilitate high-calibre research and attract international partners, top researchers and students. The infrastructure will be useful for researchers within public health and health analysis and sustainability projects, and will be valuable to the public, health personnel, health authorities and a number of international bodies.

Project number: 316554
Title: Marine fish detection, fish behaviour observations and seabed Investigations package 2021-2025
Applicant (partners): UiT (HI, NPI, SINTEF Ocean, Fiskeridirektoratet)
Project Manager: Roger B. Larsen

Short summary:
It is our goal that the "Marine fish detection, fish behaviour observations and seabed Investigations package 2021-2025 (MARINVEST)" shall be of benefit for marine science and education in a broad perspective, i.e. enhancing our international position in marine science. UiT The Arctic University of Norway aims to provide state of the art infrastructure and electronic equipment for teaching and scientific purposes on board our research vessels. Apart from giving our own students and scientists good working conditions, UiT aims to offer national and international co-partners adequate technical resources for precise data-recording and observations in marine science. Despite the continuous

upgrading of infrastructure at UiT, including our research vessels[1], some of the basic electronics and associated software commonly used in education and the development of marine science needs to be upgraded. In particular hydroacoustic instruments used for the detection of marine organisms, biomass estimation of marine resources and trawl monitoring equipment must all be functional in order to meet high scientific requirements. The demand for improved and new scientific equipment is growing as new fields of interest for teaching and science emerge. An in-depth understanding of ecosystems and the growing interest for mesopelagic species, their locations and biomass assessments (and management) will demand improved technical instruments on our research vessels. An accurate positioning system for seabed operations and high precision instruments for close range study of life at large depths are requested by various research groups. Currently, the production and negative effects from plastic debris, micro-plastics and ghost fishing occurring as a result of lost and discarded fishing gears (LADFG) are the subject areas attracting obvious attention from students and many scientists. Studies on fish behaviour and locating lost equipment, lost fishing gears and various debris can be improved by the use of simple remote operated vehicles. UiT aims to equip our research vessels with state-of-the-art electronics in order to enhance teaching and improve knowledge-building in marine science. The equipment within the package we describe will be operated and maintained by UiT technicians.

Project number: 316561
Title: Earth Surface sediment Laboratory 2
Applicant (partners): UiB
Project Manager: Jostein Bakke

Short summary:
The Earth Surface Sediment Laboratory, EARTHLAB, is a national infrastructure established in 2014 for highfidelity analyses of sediment archives from different geological environments. Through targeted investment in new and innovative instruments, EARTHLAB has formed a strong strategic unit providing services for the international university sector, industry partners, EU and NFR projects. The success of EARTHLAB for the Norwegian geoscience community, and the University of Bergen in particular, is extraordinary. More than 40 master students and 18 PhD students have graduated from the lab over the last six years, and EARTHLAB has provided the necessary infrastructure for ground-breaking high-impact research. We have counted more than 80 papers in scientific journals from the lab: in 2019 alone, nine of these were high-impact (in Nature/Science family journals, PNAS and Geophysical Research Letters). With the perspective of renewed funding for the Bjerknes Centre for Climate Research (BCCR), one new centre of excellence (SapienCE) and a newly established Centre of excellence in education (iEarth), the Department of Earth Science can consolidate its position at the forefront of European earth science education and research. Now there is an urgent need for upgrading EARTHLAB as a national infrastructure and provide up-to-date services within education, R&D and industry to tackle first-order societal challenges related to climate change, geohazards, energy transformation, exploration of geological resources and global environmental problems (e.g. micro plastic pollution). We seek funding to expand EARTHLAB with state-of-the-art tools for advanced sediment analyses (WP1), field laboratory (WP2) and geoinformatics (WP3). This includes infrastructure for scanning (e.g. XRF and CT), field equipment (coring devices, platform, survey), tools for geophysical (ground penetrating radar) and geomatics (under water and airborne drones) exploration of earth surface and shallow seismic, in addition to tools for virtual reality visualization of

the data output from the lab. EARTHLAB 2 will be a very important resource for both national and international partners placing the sediment laboratory among the best in the world, and would arm University of Bergen researchers with the necessary tools to maintain their position of leadership in this evolving field over the coming decade. The envisioned unique analytical capabilities will be important when designing research projects and identifying potential collaborators, and EARTHLAB 2 would make the University of Bergen extremely attractive for future collaboration and funding.

Project number: 316564
Title: The Norwegian Centre for Transmission Electron Microscopy II
Applicant (partners): SINTEF AS (NTNU, SINTEF, UiO)
Project Manager: Randi Holmestad

Short summary:
The Norwegian Centre for Transmission Electron Microscopy (NORTEM) is a large-scale, national infrastructure organized by NTNU, UiO and SINTEF serving academia and industry with high level research in terms of education, use, and research project deliverables. The first NORTEM project, granted by RCN in 2011, opened new laboratories in two nodes (Oslo and Trondheim) in the second half of 2013. The establishing phase of NORTEM ended in 2016 when a world class TEM Centre offering access to a range of TEM techniques had been realized. Since then we become a successful, highly used and internationally recognized national infrastructure.

The NORTEM vision is to have 'A world-class TEM Centre providing access to expertise and state-of-the-art infrastructure for fundamental and applied research within the physical sciences in Norway'.

Since the investments became operative in 2013, there have been substantial technological developments within TEM and the needs of the Norwegian research environments have evolved. In addition, NORTEM has gained experience on how to run a national large-scale facility with this complexity and broad spectrum of applications. To fulfill the vision and needs of NORTEM, new investments are required. This outline describes the needs and the plans for the NORTEM II period from 2022 to 2026. The new investments will make Norway internationally competitive by offering new state-of-the-art detector technology to the Norwegian research environment, following the new developments in TEM on in-operando, multidimensional data acquisition, and in particular offer new possibilities in studies of advanced functional materials. With the new investments NORTEM will be able to give access to a unique national and world-class TEM infrastructure with state-of– the-art facilities and expertise.

Project number: 316565
Title: Infrastructure for mobility and logistics research
Applicant (partners): TØI
Project Manager: Marianne Stølan Rostoft

Short summary:
Together with Mobility Lab, TØI will establish a single-sited test arena for new mobility and logistics solutions. This proposal is related to the need to fund the research infrastructure within the test

arena and in line with national and EU policies within development of connected, cooperative and automated mobility (CCAM). The arena will contribute to the development of comprehensive transport solutions in order to help solve societal needs and challenges related to climate, the environment, road safety and business development. The logistics sector in particular is characterized by many small companies and low operating profits, and unfortunately the number of proper evaluations and analyses of the impact of new solutions are few. TØI will develop the research infrastructure to allow for better and more data-based evaluations in the future, enabling systematic assessment of the impact of new solutions.

The arena will be a living lab, where new transport solutions are tested and evaluated in an urban, real life environment. At the test arena, applied research into the effects and consequences of the new solutions will be conducted. Research will be user-centred by focusing on how road users perceive and use the solutions, how road users interact (safety), the flexibility, as well as the efficiency of the solutions. In addition, research will focus on the impact of the new solutions on greenhouse gas and local emissions, and the local environment (noise etc.).

In order to conduct this research, new research infrastructure is needed. The infrastructure will consist of equipment and facilities for collecting, handling, analyzing and storing relevant data, as well as making this data available for other users. Relevant data will be collected from vehicles and their interaction with the surroundings, other road users and the environment.

Project number: 316570
Title: Norwegian Urban Observatory
Applicant (partners): NILU (Augment City/Offshore Simulation Centre AS, Oslo Kommune)
Project Manager: Leonor Encuentra Tarrason

Short summary:
Urbanization is one of the main societal trends today, also in Norway, where urban growth is one of the highest in Europe. Urban pollution originates from many sources inside and outside cities, including exhaust and nonexhaust road traffic, residential and commercial sectors as well as energy, construction, waste and industrial activities. There are large uncertainties about which sources release pollution components in the urban environment, and how the different components affect human health, climate, and the environment. Strengthening the scientific evidence is needed to design sustainable urban areas. This requires above all, knowledge based on advanced measurements. The Norwegian Urban Observatory (By Observatoriet) will offer an infrastructure for urban experimentation and monitoring with measurements of urban pollution for researchers, policy-makers and the public. It will also provide scientific evidence and knowledge to support, simulate and monitor the transition to sustainable cities and urban communities.

The Norwegian Urban Observatory is a cutting-edge infrastructure to improve the understanding of urban pollution, its physical and chemical characterisation as well as to provide solid knowledge on its origins and impacts. It consists of three elements: 1) an advanced urban observational infrastructure, 2) a shared database system and 3) an urban planning virtual reality (VR) platform. The advanced observational infrastructure will include i) a supersite with high-end instrumentation for the physical and chemical characterization of the urban atmosphere, ii) a mobile unit for

characterizations in specific locations and iii) a platform for testing and calibrating of micro-sensor networks. The shared database system will allow access to the advanced data from the advanced observational infrastructure, as well as to information on urban pollution and its sources and additional relevant datasets to create specific services. The urban planning VR platform will be a Digital Twin City to engage transdisciplinary research and co-creation activities in support of sustainable urban planning and the testing of different urban environmental solutions. The Norwegian Urban Observatory is intended to guide the implementation towards urban sustainable futures addressing the challenges recognised under the UN Agenda 2030 Sustainable Development Goals (SDG11: Sustainable cities and communities), the Urban Agenda for the EU (UAEU) and support the required urban actions within the European Green Deal.

Project number: 316571
Title: Geosystem 3D Seismic Imaging (G3) Upgrade
Applicant (partners): UiT (UiB, NGU, P-Cable 3D Seismic AS, VBPR AS, Geomar, NOC, BGS, Ifremer, ECORD, IODP)
Project Manager: Stefan Bünz

Short summary:
In 2009, the Research Council of Norway granted the Geosystem 3D Seismic Imaging (G3) national infrastructure to a consortium of UiT the Arctic University of Norway, University of Bergen, Norwegian Geological Survey and P-Cable 3D AS (Project number 195379). The G3 infrastructure is hosted and maintained at the Arctic University of Norway. The G3 system includes a mobile compressor, deflector paravanes and a winch with a double drum. However, the central technology of the G3 infrastructure is the P-Cable high-resolution 3D seismic system (Planke and Berndt, 2003; Planke et al., 2004). The PCable technology is a 3D seismic acquisition principle co-developed in a cooperation between the Arctic University of Norway, VBPR AS, Geomar (GER) and NOC (UK) (Planke et al., 2009). Several prototype cable and connection solutions were tested over a period from 2001 to 2008. The development concluded with a fully integrated, digital system with cable solutions manufactured and delivered by Geometrics Inc. (USA). The infrastructure grant from NFR in 2009 allowed UiT to be the first institution in the world to purchase and operate a complete P-Cable 3D seismic system. Ten years later, the cable technology has significantly advanced providing much more flexible system setups, more robust connectors, improved digital communication, positioning control or troubleshooting options to name a few. Together with the wear and tear on the existing G3 system after 10 years of operation, we apply for an upgrade of the Geosystem 3D Seismic Imaging (G3) technology.

Project number: 316575
Title: Svalbard Integrated Arctic Earth Observing System -Knowledge centre, operational phase 2022
Applicant (partners): SIOS SVALBARD AS (UNIS, NPI, MET)
Project Manager: Heikki Lihavainen

Short summary:
SIOS is a Norwegian-initiated international cooperation to exploit Svalbard's research infrastructure for the purpose of increasing knowledge about global climate and environmental changes. Its

members are Norwegian and foreign institutions with research focus relevant to interdisciplinary earth system studies, that is, of the complex interrelationships between ocean currents, atmospheric and geological conditions, the extent of ice and snow, and plants and animals. The mission of SIOS is to develop an efficient observing system, share technology, experience and data, close knowledge gaps and decrease the environmental footprint of science. SIOS has currently 24 member institutions from 9 different countries. SIOS-KC is also active in pan -Arctic and European research infrastructure and data context.

As a holistic multidisciplinary research infrastructure, SIOS has huge potential to improve our understanding of the ongoing vast changes in Arctic environment and serve society. A huge potential means also a huge challenge. During the first years of the operational phase SIOS has taken a leap towards a unified observing system in Svalbard.

One of the main products of SIOS is data. SIOS has its own data policy that is in line with national and international guidelines. SIOS is working towards making data FAIR (findable, accessible, interoperability and reusable). The data is accessible through SIOS Data Management System. SIOS has defined the first set of SIOS Core Data, which are Earth System Science data critical to detect, attribute and describe the environmental change in and around Svalbard.

SIOS is coordinated by the so-called Knowledge Centre (SIOS-KC). SIOS-KC coordinates and optimises the access to research infrastructures and infrastructure initiatives. SIOS-KC provides various services to the SIOS members which all contribute to combined research efforts under common goals and enhance the quality and efficiency of earth system science research in Svalbard.

Project number: 316578
Title: Basic funding of operational costs at Svelvik CO2 Field Lab
Applicant (partners): SINTEF AS
Project Manager: Cathrine Ringstad

Short summary:
Svelvik CO2 Field Lab is a unique, small-scale test site for cost-efficient testing and development of subsurface monitoring techniques. The test site targets, first of all, monitoring of CO2 storage, but is also relevant for geothermal and geotechnical applications. It is owned and operated by SINTEF and has been operational since September 2019. The first experimental campaign was completed successfully by the SINTEF-coordinated Pre-ACT project in September and October 2019. As an ECCSEL infrastructure the test site is available to researchers world-wide. Svelvik CO2 Field Lab has therefore been presented at several national and international conferences and meetings over the two last years in order to attract projects to the test site. Even though this has created considerable interest and resulted in several applications (nationally and internationally), only a few projects have been granted, generating limited activity at the test site. As Svelvik CO2 Field Lab is now fully operational, with good results from a successful first experimental campaign (Pre-ACT project), and world-wide attention (active recent dissemination), we believe that the test site has momentum and will be included in several future applications. However, from experience, we expect a time lag of 1-3 years until new projects have been granted and are ready for experimental work at the test site.

Svelvik CO2 Field Lab has ongoing operational costs even without activity. This includes site lease, rental fee of the CO2 injection infrastructure, surveillance, control and maintenance of the test site and administration costs. In order to secure the infrastructure, its performance and use, we therefore apply for basic funding to cover these costs over a period of four years. Such funding will in addition lower the threshold significantly for future projects to include activity at the test site, as these costs no longer will be part of the test site's rental fee. Other positive side effects are that site visits (e.g. for school classes or decision makers) and other forms of dissemination activities can continue even in periods with less project activity.

Project number: 316588
Title: Research infrastructure for urban water transportation and management
Applicant (partners): NMBU (NVE, NIPH, NIVA, NGI, NIBIO)
Project Manager: Harsha Ratnaweera

Short summary:
Norwegian water distribution and wastewater transport (sewer) systems are in dire conditions. Leakage from water distribution systems are significantly higher in Norway compared to the European average, and there is significant risk related to contamination of drinking water from the environment. Additionally, the climate change has rapidly increased the frequency and intensity of precipitation, leading to unprecedented challenges regarding stormwater management, both in terms of quantity and quality. Resulting flash floods and overflows are leading to health, environmental and economical threats.

The National Centre for Water Infrastructure1 is under establishment at Campus Ås, spearheaded by Norwegian municipalities together with key stakeholders from the water industry. RIWER will be implemented along 5 pillars covering structural aspects of pipe networks, water quality within and outside the pipes, managing stormwater using blue-green solutions (BGS)2 and a data management hub. Taking advantage of the remarkable developments in the Data Sciences, the RIWER concept gives a unique opportunity to take the Norwegian research and innovation strengths and capacities in water transport and management to an internationally leading level. RIWER intends to innovate these systems with comprehensive real-time surveillance of water quality providing high quality spatial and temporal data for research and decision-making in public health and environmental management. The systems will be deployed with state-of-the-art process surveillance, predictions and control to increase the cost-effectiveness in network rehabilitation and to minimise negative consequences. This will be based on unparallelly comprehensive in depth understanding of the state and fate of infrastructure, pollution and actions to meet the challenges in the next decades, as the first facility worldwide combining all these inter-related aspects.

RIWER is a collaborative effort between NMBU3, NIPH, NVE, NIVA, NGI as well as several other stakeholders representing the existing and leading knowledge and facilities. Thus, RIWER is designed to be a powerhouse closely linked to the National Centre for Water Infrastructure with satellites and virtual nodes complementing it.

Project number: 316589
Title: SIOS Infrastructure Development for Earth System Science
Applicant (partners): SIOS SVALBARD AS (NERSC, NIVA, MET, NPI, NORCE, UiT, UNIS, UiO)
Project Manager: Heikki Lihavainen

Short summary:

SIOS coordinates the majority of science infrastructure on and around Svalbard. The suggested new infrastructure will provide coordinated data input to Earth System Science on both long and short timescales under the SIOS umbrella. Current infrastructure gaps are defined in the context of SIOS Core Data and highlighted in SESS reports. SIOS includes infrastructure collecting physical, chemical and biological data from the lithosphere of the Earth through the water column, land surface, cryosphere, atmosphere to the boundaries of space. This multitude of scientific disciplines leads to a diverse ensemble of infrastructure needs. This application covers major infrastructure needs of Norwegian SIOS members closely coordinated with international SIOS partners. The suggested infrastructure is to have a real-time data transfer where possible to enhance the opportunity to utilise data in operational forecasting models and monitoring efforts. Thematically the application covers:

1. Infrastructure to expand the knowledge and understanding of the water cycle and its current changes due to climate change, since the water cycle strongly influences the environment and society.
2. Development of a local radar and optical technology to make Svalbard a leading spot to acquire information of the middle to upper atmosphere.
3. Develop Svalbard Rock Vault enabling scientific utilisation of available and new rock cores from Svalbard, to provide basic data for improving our understanding of long-term climatic variations as recorded in the geological record.

Emphasis is made to make essential data FAIR and available in real time in order to facilitate operational use of data, which will have local and regional benefits (SIOS Data Management System, NorDataNet). Relevant system components will incorporate appropriate use of remote sensing, for validation and extension of the spatial coverage and to reduce the environmental footprint. The proposed infrastructure will, as part of the SIOS collaboration, establish Svalbard as a leading Cal/Val reference site for high Arctic Earth observation. In particular the extended availability of ground truthing instrumentation on Svalbard in general and specifically around Longyearbyen and Ny Ålesund is essential. This way the SIOS observation network will serve as a reference site and laboratory for observing and understanding the larger trends in Arctic changing climate, as well as regional and local impacts on Svalbard. Through SIOS the infrastructure will be closely linked to the activities in Hornsund and extended collaboration with Barentsburg. We will work very closely with local authorities and other institutions ensuring essential societal use of the SIOS observations, thus directly impacting societal ability to handle the changing climate. SIOS InfraESS is a continuation to the InfraNOR programme and they are complementing and contributing to integrating SIOS towards a holistic observing system. The total cost of the infrastructure is indicated to be 179 million NOK (156 million NOK from RCN) over the 5-year period.

Project number: 316590
Title: Fault and fracture characterisation and testing laboratory
Applicant (partners): NGI (NORCE, NORSAR, UiO)
Project Manager: Luke Griffiths

Short summary:
Understanding fracture processes within the subsurface, and their influence on geomechanical, geophysical, and fluid transport properties is vitally important for oil & gas production, geological carbon storage, geothermal energy storage and production, slope stability, groundwater resources and seabed installations. Laboratory testing of rock and soil under controlled and realistic stress and fluid pressure conditions allows us to understand the influence of fractures on such properties. However, it is difficult to observe local deformation mechanisms and structures as they occur, and instead we often rely on post-test analysis. Recent advances in CT scanning technology allow for rapid, ultra-high-resolution, multi-scale imaging—ideal for characterisation and time-lapse imaging of laboratory samples of rock and soil during advanced testing. At the same time, fluid flow within fractures and the associated chemical and thermal processes have strong—yet poorly understood—implications for the geomechanical properties and behaviour of fractured rock. There is a lack in dedicated national infrastructure to address this topic, and we envisage that simultaneous flow and mechanical experiments, combined with high-resolution CT imaging, can lead to unique datasets shining a spotlight on such complex processes. To extend this knowledge to the field requires upscaling, and borehole geophysics and measurement of the hydraulic properties of fractures has been identified as a key tool to calibrate the detailed models developed in the laboratory and transfer knowledge across scales.

NGI has a long history of laboratory testing of geomaterials and has recently developed a strong expertise in 3D microCT-imaging and developing CT-transparent testing equipment, as well as monitoring laboratoryscale microseismicity to understand failure processes. NORCE has state-of-the-art laboratories dedicated to investigation of multiphase and multicomponent fluid flow in porous media. A combined infrastructure, integrating our complementary expertise in both laboratory and field investigations, would provide a unique opportunity for directly observing fracture and fault formation within rock and soil and linking complex mechanical, thermal, and chemical processes to geoengineering parameters of interest. As such, we propose a Fracture & Flow Lab. Infrastructure improvements across these two laboratories will include: a new micronano-CT scanner with moving source and imager; mechanical testing equipment (shear box and high temperature triaxial and tensile loading apparatus) and advanced geophysical instrumentation; and borehole logging equipment for measurement of field-scale hydraulic properties. Importantly, this infrastructure will require a dedicated data management system. This e-infrastructure will leverage competence and software solutions from NORCE to provide an interactive and robust access to the generated data, thus facilitating data reuse, visualization, analysis and promoting collaboration.

Project number: 316591
Title: eInfrastructure for digital, user centric and sustainable digital transformation in urban smart cities
Applicant (partners): IFE (UiO, Østfold University College, Østfoldforskning, OsloMet, Smart Innovation Norway, NILU, Halden kommune, Logiq, ITS Norway, Halden næringsutvikling)
Project Manager: Petter Kvalvik

Short summary:
Our future cities need not only to be smart but also sustainable. Infrastructure that allows to collect data, share, store and analyse data is fundamental to achieve a smart and sustainable city. For this to work, initiatives needs to be citizen centric and ensure trust as well as handling privacy, reliability, equity and security. At the same time, it should be smart in utilise big data to drive toward UN sustainability goals. Currently, we are far from this, much applied research and research-based innovation is needed.

Here, we need to go through a digital transformation to understand how to use digital technology to do more with less effort and get it done quicker, safer, and cheaper. This requires setting up city laboratories that involves all stakeholders: the public sector, academe, businesses and the research institutes. Infrastructure is fundamental to allow for applied research and research-based innovation on large scale architectures and ecosystems that holds extraordinarily amounts of diverse data. This path is well aligned with the Norway's digitalisation strategy for the public sector[1] as well as EU's Digital Single Market strategy[2] and Research and innovation for the European Green Deal[3].

Halden Living Lab (HLL) is our joint large effort to a sustainable smart city. Living Labs are defined as usercentred, open innovation ecosystems based on systematic user co-creation approach, integrating research and innovation processes in real life communities and settings. HLL will connect with other national and European Living Labs e.g. European Network of Living Labs (ENoLL)[4]. HLL target the following characteristics and factors of a smart city: (1) people, (2) environment (3) economy, (4) mobility, (5) governance and (6) standard of living. Founding members are Institute for Energy Technology, Halden kommune, Østfold University College, Smart Innovation Norway, Østfoldforskning, eSmart systems, Halden næringsutvikling and Logiq. First new members that joined for this application are UiO, OsloMet, NILU, ITS Norway. More invitations are lined up before the full application is submitted.

The national eInfrastructure shall support multiple living labs, but will be shaped in the context of HLL, to acquire the necessary knowledge required to extend and integrate with other infrastructures and for managing the infrastructure and the data located in heterogeneous sources across the smart city.

Project number: 316593
Title: World of Wild Waters – Virtual lab «WoWW-lab»
Applicant (partners): NTNU (Telenor, Offshore Sim Center)
Project Manager: Oddbjørn Bruland

Short summary:
The digital and physical world are merging. Simulations and presentation of results are materialized in digital twins and through VR and AR tools. This increases the understanding of both problem and the consequence and the ability to communicate with problem owners and decision makers. This is a key objective in the WoWW project, one of nine of NTNU's strategic digital transformation projects. Through gamification of natural and man-made hazards, we facilitate the testing of solutions and visualization of effects in a digital twin of the built environment. Sensor technology, IoT and AI open new opportunities for monitoring and operating community infrastructure. Visual solutions are required to make this information intuitively understandable. The virtual laboratory will be used for R&D on topics that provide a highly improved basis for planning and operating such infrastructure. It will lay important groundwork for the development of future infrastructure operating centres. NTNU has one of Europe's largest hydraulic laboratories. Physical modelling, digital simulations and digital 3D visualization opens up for cost-efficient opportunities to test a considerable broader range of scenarios than physical models alone offer. A virtual laboratory will help in dissemination of basic research results and documentation to clients and society in general. It will also provide new opportunities in the education sector and will contribute to accelerating the transformation towards and increased interactive and participation-based teaching. Digital twins contain information about the physical world and physical objects and through IOT and sensors connect to the real world in real time. This opens opportunities to test ideas and new development on real data in real time in a virtual, but real world. Additionally, this can be utilized in the development of prototypes for control centres for municipalities. Integration of simulation programs with digital twins facilitates new possibilities for optimizing physical infrastructure. This is highly relevant for instance for Hydropower plants, for testing consequences of changes in the design phase, as well as for contingency planning and exercise in the operational phase. Consultants and contractors have completely transformed their processes into Building Information Modelling (BIM) based on digital twins. To be in the position to lead in the development, through education and research, it is essential and urgent to build labs for visualization and use of digital twins. The combination of physical and virtual laboratory has a great potential for multi-disciplinary use and to be unique in an international context.

Project number: 316603
Title: Microalgae platform for Norway
Applicant (partners): NORD UNIVERSITET (NIBIO, UiT, NIVA, VUC)
Project Manager: Kiron Viswanath

Short summary:
The potential of microalgae as a driver of a biotechnology-based industry is well recognized now. Many varieties of microalgae are among the fast-growing photosynthetic organisms on the planet. Although these microorganisms represent the largest biomass in the ocean, they are minimally tapped for industrial purposes including for food or as sources of high-value products. Phototrophically grown microalgae can outcompete traditional food crops due to their high

productivity per surface area, potential for cultivation in the sea or onshore and high nutrient value suitable for use in food and feed, without compromising the use of agricultural land and freshwater. On the other hand, the use of microalgae for carbon capture and bioremediation is another interesting industrial application – not only can they help reduce industrial emissions, but also produce valuable biomass. Norway has not made significant strides in establishing microalgae-based ventures, even though there is an understanding of the vast industrial potential for these microorganisms. Significant progress can be achieved in microalgae biotechnology only if there is an established applied research in this field. Though there are groups in different Norwegian institutions that perform research on microalgae, remarkable breakthroughs can be achieved only through trans-disciplinary collaborative efforts. This infrastructure project proposal aims to bring together research environments that study microalgae so that their pooled scientific expertise can be utilized by exploiting the newly acquired research infrastructure and generating knowledge that can be easily adopted directly or indirectly by the industry. The proposed infrastructure investment will act as a springboard for the success of microalgae-based industrial initiatives.

Project number: 316607
Title: Infrastructure for a sustainable ocean economy and conservation of the ocean genome
Applicant (partners): NORCE (UiS, UiB, IMR, UiA, SINTEF Ocean, NIVA, DNV GL, RevOcean, MBARI, IFREMER, DTU Aqua, Bremnes Seashore, Skretting AS)
Project Manager: Thierry Baussant

Short summary:
This research infrastructure will aim at 1) addressing the urgent need for increased ocean monitoring capacity using advanced genomic-based digital technologies and gene-sequencing monitoring tools to responding to the demand for sustainable ocean resources for the world and 2) mitigate the increasing cumulative impact of human activities indicated by ocean genome erosion on a variety of marine life i.e. biological diversity (or biodiversity).

The ocean genome, or the ensemble of genetic material present in all marine biodiversity, including both the genes and the information they encode (Blasiak et al., 2020), is the key to marine ecological population resilience and plasticity that drives adaptability to anomalous conditions such as climate change. It also sustains major commercial industries such as marine fisheries and aquaculture, but as well other growing needs of pharmaceuticals as currently exemplified with the worldwide COVID-19 situation. Yet, ocean genome is threatened by overexploitation, habitat loss and degradation, pollution, impacts from a changing climate, invasive species and other pressures, as well as their cumulative and interacting effects in the Anthropocene time. While Norway is gradually transitioning into a blue/green energy, the expansion of existing uses of the ocean and emerging new ones – including offshore energy, ocean farming, and ocean mining –also requires a quick understanding of the consequences on the ocean genome to mitigate gradual erosion and loss of diversity, and a drastic loss of biodiversity in marine life with unknown consequences for marine life and ecosystems. The scarcity of quantitative data on biological baselines in many parts of the ocean—including the current status of organisms and ecosystems and their trends over time—undermines our ability to respond effectively to these threats to allow proactive responses, rather than the current reactive responses. According to a recent review (Duarte et al., 2020), the investment needed to rebuilding damaged marine life worldwide is estimated to billions of US dollar per year to extend protection

actions but the economic return from this commitment will be considerable for the society and nations, not the least the genetic diversity of marine life. Rapid advances in sequencing technologies and bioinformatics have enabled exploration of the ocean genome. This is the future means to informing innovative approaches to conservation and a growing number of commercial biotechnology and industrial applications. Currently this requires manual labor combined with advanced instruments and lab processing tools. To address the near future challenges, less intervention and manual labor is required as new technologies and sensors will enable more granular data collection across a wider coverage area, so that we can move the laboratory from the ship into the environment itself and send data, not samples, back to centralized facilities.

For this research infrastructure, a significant increase of the capacity to monitor the ocean genome using a fleet of state-of-the-art technologies complementing to existing oceanographic monitoring efforts, is requested. While several instruments and automated sampling technologies to capture the ocean genome exist (see for example Ottensen et al., 2016), they remain in the prototype stage and mainly the MBARI Environmental Sample Processor (ESP) is currently available commercially, with a wider use and prospect in research and industry application (Scolin et al., 2018). Further development of MBARI's ESP offers one way to fully automate new DNA analytical procedures in situ, which could be used to create the equivalent of DNA "weather maps" that showing areas of high/low target abundance as well as changes in species assemblages over time and exploratory genome research.

Project number: 316608
Title: Norwegian Biobank for Nature (NORBINA)
Applicant (partners): UiO (UiB, NTNU, UiT, NMBU, UiA, NIVA, NIBIO, NVI)
Project Manager: Arild Johnsen

Short summary:
The use of genetic resources is ubiquitous in biological research today, and there is an urgent need to implement the FAIR principles (findable, accessible, interoperable, reusable) to the archiving of biological material used in both Norwegian and international research. So far, the FAIR principles have been adopted to facilitate open access to research results, raw data, metadata, analysis code, software, and scientific publications through various research infrastructures and data repositories. In contrast, the archiving of the physical samples, such as tissues, DNA extracts, whole specimens and environmental samples, have not been structured in the same way. Here, we propose a national infrastructure for archiving non-human biological samples in a distributed biobank, making cryopreserved samples and associated data available for biological research institutions that use biological samples in genetic, genomic and other molecular research, also embracing the One Health perspective and the UN sustainable development goals. The infrastructure will have nodes at each of the four largest university museums (Oslo, Bergen, Trondheim, Tromsø), and each node will serve biology/biodiversity institutions in its region. There will also be affiliated biobank facilities at institutions outside of the university museums. In order to establish the biobank module nationally, there is a need for investing in storage facilities (-80°C freezers and containers with liquid nitrogen), DNA extraction robots, development of a database infrastructure, and personnel. The new infrastructure will complement several existing and planned infrastructures for Norwegian

bioresources, DNA sequencing and bioinformatics, and improve their impacts and synergies through a collaborative and interactive network.

Project number: 316610
Title: NIBIO-XCT - An integrated X-ray Computed Tomgraphy (XCT) facility for the Ås campus (NIBIO/NMBU/Veterinærhøgskolen)
Applicant (partners): NIBIO (NMBU, Veterinærhøgskolen, Kimen Såvarelaboratoriet AS)
Project Manager: Adam Vivian-Smith

Short summary:
Nano- and micro-scale X-ray Computed Tomography (XCT) has become an exceptionally important tool for the non-invasive visualization of complex specimens in both materials science and in biology. This offers a non-destructive method to probe both living and fixed material from a variety of sources and resolve their internal structures, often in stunning detail, resolution and depth (ie. to micrometer and sub-micrometer scale). Examples include (1) visualizing soil porosity and measuring the fine root structure, (2) imaging modifications to woody tissues, (3) imaging plant development like enclosed buds and (4) in the anatomical visualization of living insect specimens. Several international institutes are also now using nano- and micro-XCT for whole plant phenotyping, in time-series, using instruments that have a scanning deck large enough to accommodate whole plants and with specific environmental conditions. Plant biomass can now be evaluated above and below ground.

We require and propose a facility for 3D X-ray Computed Microtomography (XCT) facility at the Ås NIBIO/NMBU campus to service the imaging of life science subjects, soils and materials science. The equipment and location at Ås campus is ideal for servicing the Life Science cluster and augmenting augmenting advances in the Bioeconomy. This facility will have a small set of four controlled environmental rooms alongside two XCT instruments to provide broad control over the parameters such as light, temperature and humidity. A bank of smaller cabinets will be provided for holding samples, or culturing growth. The facility will have a computing equipment to reconstruct, segment and analyse the data offline. That equipment will be a GPU accelerated and be capable of visualization with Virtual Reality (VR). The facility will be run together with a dedicated technical staff member. Two other pieces of equipment a standard 2D x-ray (eg Facitron Multifocus, for seeds, leaves) and a handheld X-ray fluorescence spectrometer (XRF) for the elemental analysis of different materials (eg. in soil)

Project number: 316616
Title: Norwegian Plant Phenotyping Platform
Applicant (partners): NMBU (UiO, NTNU, UiT, NIBIO)
Project Manager: Morten Lillemo

Short summary:
A stable Norwegian food production based on national resources is important for food security and supported by governmental policies. The Norwegian food production is currently challenged by changing climatic conditions and technological developments that call for faster and more effective development of new cultivars and production systems in order to meet current and future

challenges. The aim of this proposal is to build a national platform for plant phenotyping (PheNo) to serve the research needs in the "green" sector. State-of-the-art research facilities will be established at the Norwegian University of Life Sciences (NMBU), the University of Oslo (UiO), the Norwegian University of Science and Technology (NTNU), The Arctic University of Norway (UiT) and the Norwegian Institute of Bioeconomy Research (NIBIO) in close collaboration with the agricultural, horticultural and plant breeding industry. PheNo will serve as a Norwegian node in the ESFRI roadmap project EMPHASIS.

High-throughput and high precision platforms for phenotyping of plants in controlled conditions and relevant production environments (fields, polytunnels and greenhouses) will be established as a distributed national infrastructure building on the complementary strengths and unique competences brought in by the collaborating research partners: Field-based plant phenotyping and robotics at NMBU (robotic and UAV-based plant phenotyping, digital field trial operations, polytunnels for creating semi-controlled field conditions, multispectral laser scanner for field and greenhouse), basic plant research at UiO (advanced growth chambers and small plant phenotyping system, multispectral laser scanner for greenhouse phenotyping), Internet of things (IoT), data science and machine learning at NTNU (field and plants conditions sensing/monitoring using IoT, vision sensors and computational resources), data storage and data management at UiT and applied plant production across the whole country by NIBIO (Robotic and UAV-based plant phenotyping, multispectral laser scanner for field and greenhouse).
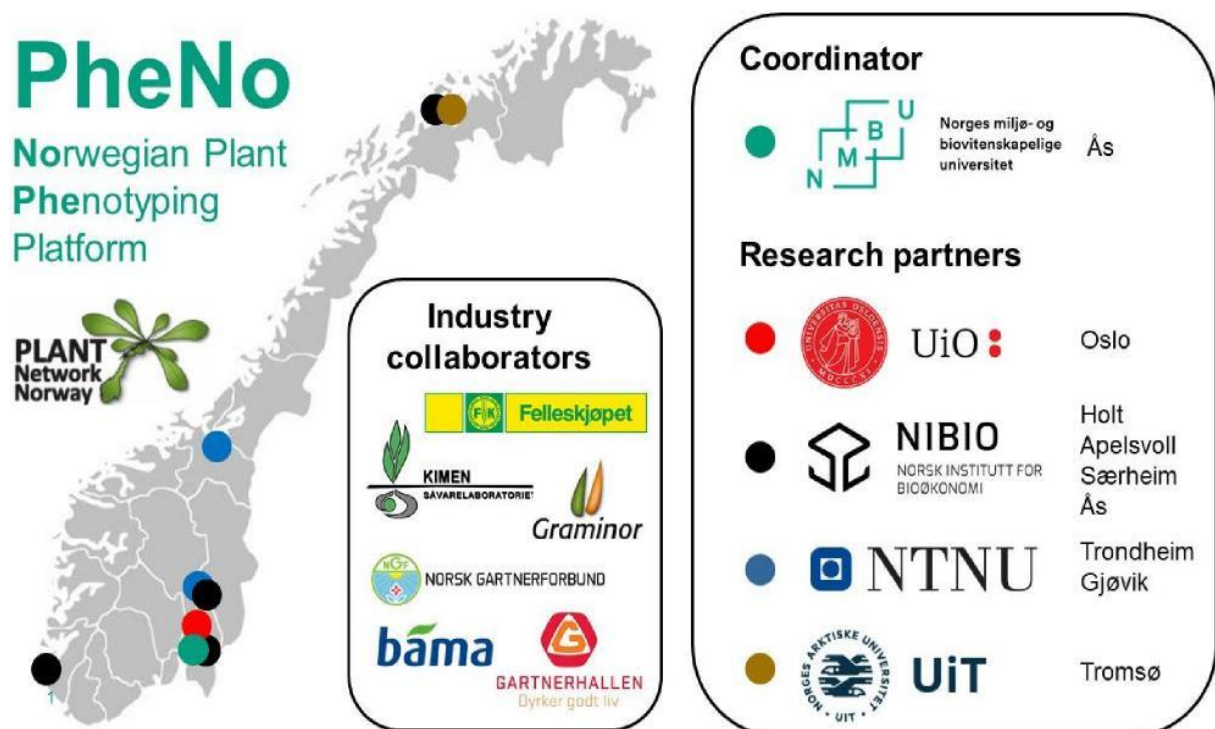

Figure 1 Overview of partners and locations of the distributed **No**rwegian Plant **Phe**notyping Platform (*PheNo*).