Skisser med relevans innenfor miljøvennlig energi

Tabell: Oversikt over skisser med relevans for området **Miljøvennlig energi**

Prosjekt-nummer	Prosjekttittel	Søkerinstitusjon	Prosjektleder	Estimert søkt beløp fra NFR
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
316428	The Norwegian X-ray Diffraction and Scattering Resource Centre (RECXII)	**UiO** (NTNU)	Helmer Fjellvåg	30 000 000
316431	Hydrogen Links Research Infrastructure	**SINTEF ENERGI AS** (NTNU)	Petter Nekså	48 400 000
316436	Norsk geotermisk laboratorium	**IFE** (SINTEF)	Sissel Opsahl Viig	30 000 000
316439	Wind Power Operation and Control Laboratory	**SINTEF ENERGI AS** (NTNU)	Karl Merz	50 000 000
316442	Norwegian Laboratory for Minerals and Materials Characterisation – II (MiMaC-II)	**NTNU** (SINTEF Industri, NGU)	Yanjun Li	48 300 000
316447	The EMERALD Physically Integrated? eXperimEntal Landscape	**UiO** (UiB, NORCE, NINA, NIBIO, NILU)	John Faulkner Burkhart	54 072 000
316459	National Laboratories for an Energy Efficient Industry, Phase II	**SINTEF ENERGI AS** (NTNU, SINTEF Industri)	Petter Egil Røkke	90 000 000
316461	CHABAT – Battery Characterisation	**UiA**	Bernhard Fäßler	5 025 000
316463	Norwegian Micro- and Nanofabrication Facility IIIb	**NTNU** (UiO, USN, SINTEF)	Peter Köllensperger	32 000 000
316479	Electric Future Accelerator Initiative? Laboratory	**SINTEF ENERGI AS** (NTNU)	Christian André Andresen	72 000 000
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
316501	Living Norway Ecological Data Network	**NINA** (NTNU, UiO (NHM), UiB, NMBU, NIBIO, NIVA, NBIC)	Erlend Birkeland Nilsen	31 200 000
316502	Norwegian Biorefinery Laboratory III	**RISE PFI AS** (SINTEF Energy, SINTEF Industy, NTNU, NIBIO, NMBU)	Øyvind Eriksen	50 000 000
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
316513	Coastal and Offshore Geotechnical Structures Testing Centre (COGSTEC)	**NGI** (NTNU)	Kristoffer Skjolden Skau	40 000 000
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
316524	Hydrogen and fuel cell safety research infrastructure	**UiT** (NTNU, USN)	Mohamad Mustafa	63 000 000
316526	Smart Mobility	**NTNU** (NORD Unviersitet, SINTEF, Trøndelag County council, Stjørdal municipality)	Frank Lindseth	50 000 000
316545	ECCSEL Virtual laboratory	**SINTEF ENERGI AS** (SINTEF Industri, IFE, NORSAR, ECCSEL ERIC)	Francesco Finotti	120 000 000
316550	Norwegian Research Infrastructure for studies of environmental contaminants	**NILU** (NIVA, UiT)	Aasmund Fahre Vik	85 000 000
316553	Norwegian Digital Subsurface Lab	**SINTEF AS**	Ane Elisabet Lothe	75 000 000
316556	Development Lab for Renewable High Voltage Energy Components	**SINTEF ENERGI AS**	Oddgeir Kvien	16 500 000
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
316572	Hydrogen Safety Laboratory	**UiB** (USN, UiS)	Trygve Skjold	27 263 000
316576	Floating solar energy test centre	**SINTEF OCEAN AS** (NTNU, IFE)	Øyvind Hellan	85 000 000
316578	Basic funding of operational costs at Svelvik CO2 Field Lab	**SINTEF AS**	Cathrine Ringstad	8 000 000
316580	Power-to-X systems lab at Tiller	**SINTEF AS** (SINTEF Ocean AS, SINTEF Energy AS, NTNU)	Kyrre Sundseth	42 500 000
316593	World of Wild Waters – Virtual lab «WoWW-lab»	**NTNU** (Telenor, Offshore Sim Center)	Oddbjørn Bruland	45 100 000

316594	Norwegian Advanced Battery Laboratory	IFE (UiO, FFI)	Hanne F. Andersen	60 800 000
316598	Smart Buildings Energy and Indoor Air Quality e-infrastructure	STIFTELSEN SINTEF (SINTEF Digital, SINTEF Energi, NTNU Ingeniørvitenskap og NTNU Arkitektur og Design)	Karen Byskov Lindberg	32 700 000
316611	National Battery Development and Test Lab	SINTEF AS (NTNU, SINTEF Energy, FREYR)	Paul Inge Dahl	140 000 000
316612	PreMechatronics Lab	UiA	Kjell G. Robbersmyr	38 300 000

Prosjektnummer: 316413
Tittel: Norwegian Fuel Cell and Hydrogen Centre - extension.
Søkerinstitusjon/partnere: **STIFTELSEN SINTEF** (SINTEF, NTNU, IFE)
Prosjektleder: Magnus Skinlo Thomassen

Kort sammendrag:
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.

Prosjektnummer: 316418
Tittel: Sustainable infrastructure for scientific living plant collection and advanced greenhouse production
Søkerinstitusjon/partnere: UiO (Trøndelag fylkeskommune - Mære landbruksskole – FoU (Trøndelag County), Norges Bondelag (Farmers Union), Gether AS)
Prosjektleder: Finn Ervik

Kort sammendrag:
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.

Prosjektnummer: 316428
Tittel: The Norwegian X-ray Diffraction and Scattering Resource Centre (RECXII)
Søkerinstitusjon/partnere: **UiO** (NTNU)
Prosjektleder: Helmer Fjellvåg

Kort sammendrag:
X-ray diffraction and scattering are essential tools for structural science, used in everything from batteries to biology. Recent developments in X-ray sources, detectors and optics are bringing experiments previously only possible at large-scale facilities like synchrotrons to the home laboratory. We will harness the latest instrumentation to bring new experimental capabilities to the highly successful Norwegian National Resource Centre for X-ray Diffraction and Scattering (RECX). The investments proposed will also extend user base of the centre, making what is already a valuable resource for inorganic materials science, analytical chemistry, and soft matter in Norway more relevant for the life science and operando communities. The investments in Oslo will focus on two new instruments, a dedicated “BioSAXS” small angle scattering system and an operando specific powder X-ray diffractometer. Both machines will be equipped with the latest 2 D detector technology, high intensity X-ray sources and optics. To deliver maximum utility to the user community from the instrument platform we will invest heavily in sample preparation, process automation and sample environment equipment. This will create a lab where users from a range of disciplines can carry out very advanced experiments: examining the structure of working materials and devices, following biological processes in real time and studying samples available only in tiny volumes. The investments in Trondheim will also focus on two new instruments, where the first instrument will be dedicated to characterization of thin films and texture and strain in bulk materials, while the second instrument will focus on non-ambient X-ray diffraction under controlled atmosphere. Both instruments will be equipped with state-of-the-art detector technology, X-ray source and optics optimised for the purpose. The instruments will be configured to cover and promote expanding demand in the user community. RECX-II will, like RECX, act as a focus for X-ray based science in Norway. It will bring cutting-edge experiments from the large-scale facilities to a wider user base in the home laboratory, allow users to arrive well prepared for experiments at advanced large-scale facilities (in which Norway has already made significant investments), and act as a gathering point for the X-ray scattering and diffraction communities.

Prosjektnummer: 316431
Tittel: Hydrogen Links Research Infrastructure
Søkerinstitusjon/partnere: **SINTEF ENERGI AS** (NTNU)
Prosjektleder: Petter Nekså

Kort sammendrag:
The Hydrogen Links research infrastructure (RI) will enable research on topics that are necessary for efficient use of hydrogen as an energy carrier, and thereby accelerate the transition towards a low carbon society. The elements of the research infrastructure will cover gaps in the national and international R&D environment, especially related to storage, transport and use of liquefied hydrogen (LH2); as well as large-scale end-use of hydrogen for power generation in gas turbines. The knowledge Hydrogen Links will bring forward is essential for utilisation of hydrogen, especially in energy intensive areas, such as utilising hydrogen as fuel for the maritime sector and in order to decarbonise offshore power production. Hydrogen Links will contribute to maintaining value creation in important sectors for Norway as well as supporting value creation through new product developments and industries supplying national and global markets.

Prosjektnummer: 316436
Tittel: Norsk geotermisk laboratorium
Søkerinstitusjon/partnere: **IFE** (SINTEF)
Prosjektleder: Sissel Opsahl Viig

Kort sammendrag:
The transfer of technology and knowledge from the petroleum sector to renewable sectors is in focus in IFE's strategy. Experience in reservoir characterisation, flow assurance and materials technology are used to gain new experience and knowledge about geothermal reservoirs and energy production. Participation in several projects related to deep geothermal energy has led to establishing research infrastructure suitable to handle conditions relevant to geothermal applications. At present time IFE participates in the RCN funded project DeepScale (RCN contract no: 295007) and the H2020 projects GECO and REFLECT. In the project DeepScale SINTEF and IFE are research partners. SINTEF also has a focus on transferring competence from oil and gas to the geothermal industry and is therefore a natural cooperation partner when it comes to improvement of research infrastructure for deep geothermal applications in Norway. To strengthen the opportunity for Norway to be a preferred research partner in future EU projects, it is important to further improve such infrastructure. This proposal describes an upgrade to the geothermal energy facilities at IFE and SINTEF, where the joint infrastructure will have the acronym NORGEL (Norsk geotermisk laboratorium).

Prosjektnummer: 316439
Tittel: Wind Power Operation and Control Laboratory
Søkerinstitusjon/partnere: **SINTEF ENERGI AS** (NTNU)
Prosjektleder: Karl Merz

Kort sammendrag:
The Wind Power Operation and Control Laboratory (Wind Power Lab) is a large wind power plant, recreated at laboratory scale. Figure 1 shows a sketch of the idea. The facility fills a critical R&D gap between wind tunnels, or simulations, and full (multi-MW) scale wind plants. The key motivations are: there are a sufficient number of turbines to create the atmospheric boundary layer effect, over and beyond a simple superposition of the individual turbine wakes; the laboratory can be used to test and demonstrate advanced (low-TRL) ideas in wind plant design, operation, and control, which could never be implemented in a commercial plant due to insurance, warranty, and financial reasons; the facility will be accessible to students, researchers, and industry, and will be a sought-after infrastructure for national and EU projects on wind energy and renewables-dominated electrical

grids. The Wind Power Lab is unique in the world; there is no existing site of this sort, with a sufficient number of turbines to reproduce real large-scale wind plant layouts.

Prosjektnummer: 316442
Tittel: Norwegian Laboratory for Minerals and Materials Characterisation – II (MiMaC-II)
Søkerinstitusjon/partnere: **NTNU** (SINTEF Industri, NGU)
Prosjektleder: Yanjun Li

Kort sammendrag:

- The proposed infrastructure, MiMaC-II, is aimed at further development of a world-leading national laboratory for multiscale (atomic to micron) and multi-dimensional (from 1D to 3D) structure characterization and high-sensitivity (down to ppb level) chemical analysis of minerals, metals and advanced nanomaterials. This is going to be achieved by further upgrading and coordination of the existing laboratories of national infrastructure, MiMaC, funded by RCN. The consortium members of MiMaC II are the same as in MiMaC, NTNU, NGU and SINTEF. The partners have identified following state-of-the-art equipment either complimentary or supplementary to the instruments in MiMaC:
- Dedicated field emission gun scanning electron microscopy, FEG-SEM, for characterization of crystallography and chemistry of large solar cell Si-wafer samples
- Soft X ray Emission Spectrometer (SXES), used in SEM for detection of ultralight elements down to lithium, as well as atomic bonding in materials and minerals.
- Inductively Coupled Plasma Time-of-Flight – ICP TOF, for fast and full-spectrum element mapping with sensitivity down to ppb and ppt level.
- In-SEM Raman System, for characterization of band shift of minerals Up-grading of an existing focused ion beam (FIB) microscopy for preparation of special atom probe tomography (APT) samples AxioScan – automated scanning petrographic microscope, for automated characterization via machinelearning from thin section of geological materials
- Hyper spectral cathodoluminescence (CL) spectrometer, used in EPMA for high resolution trace element analysis.
- in-SEM μXRF – a specialized X-ray source to induce X-ray fluorescence of the specimen inside the SEM instrument, for in-situ low-level detection of heavy elements difficult to excitate by e-beam.

Prosjektnummer: 316447
Tittel: The EMERALD Physically Integrated? eXperimEntal Landscape
Søkerinstitusjon/partnere: **UiO** (UiB, NORCE, NINA, NIBIO, NILU)
Prosjektleder: John Faulkner Burkhart

Kort sammendrag:
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.

Prosjektnummer: 316459
Tittel: National Laboratories for an Energy Efficient Industry, Phase II
Søkerinstitusjon/partnere: **SINTEF ENERGI AS** (NTNU, SINTEF Industri)
Prosjektleder: Petter Egil Røkke

Kort sammendrag:
HighEFFLab Phase II is an extension of the previously granted HighEFFLab, whose purpose is to provide the advanced research facilities required to fulfil the goals of FME HighEFF1 - Centre for an Energy Efficient and Competitive Industry for the Future. In line with the first phase of HighEFFLab, the Phase II will be a joint national laboratory between the various departments at SINTEF and NTNU. The facilities will be located at the Varmeteknisk Laboratory (VATL) at NTNU Gløshaugen campus in Trondheim, ensuring close collaboration between students and researchers coupled to the university and enabling the education of future experts in energy efficiency. Similarly, the research infrastructure (RI) in Phase II will be easily accessible for all the partners in FME HighEFF, covering renowned international research groups and the main Norwegian industry sectors: metal and materials; oil, gas and energy; as well as food and chemical. As a national research infrastructure, HighEFFLab Phase II infrastructures will be available for all Norwegian industries and academia, in addition to those mentioned above. The required extension for HighEFFLab is based on the demands that have arisen from the industry and the research partners during the first four years of operation of FME HighEFF. In particular, not covered by the first phase, is the demand for more profound experimental research on thermal energy storage (TES), as well as dedicated laboratories for high-temperature heat pumps (HTHP) and natural working fluids. Phase II is a response to these demands, an includes with 8 main RIs of which of two are new installations. HighEFFLab Phase II includes; 1) Thermal energy storage laboratory, 2) High temperature heat pump laboratory, 3) Natural refrigerants laboratory, 4) Expander test laboratory, 5) Heat exchanger laboratory, 6) Computing /Process simulation laboratory, 7) Calibration /Portable laboratory and 8) Local infrastructure.

Prosjektnummer: 316461
Tittel: CHABAT – Battery Characterisation
Søkerinstitusjon/partnere: **UiA**
Prosjektleder: Bernhard Fäßler

Kort sammendrag:
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.

Prosjektnummer: 316463
Tittel: Norwegian Micro- and Nanofabrication Facility IIIb
Søkerinstitusjon/partnere: **NTNU** (UiO, USN, SINTEF)
Prosjektleder: Peter Köllensperger

Kort sammendrag:
The NorFab III proposal submitted in 2018 sought 186 MNOK for a five-year period of funding from 20202024, continuing the ambitious development track we have been on so far. As per the NFRs request, a minimal version was also submitted, consisting of four years of operational support and just two years of investment funding, and this is the version NFR has funded. The minimal version represents the maintenance of current capabilities, with a few reinvestments to upgrade to state-of-the art. In order to maintain the infrastructure as a state-of the art national facility and replace critical aging equipment, we are now applying for funding for the two remaining years of NorFab III, 2022-2023, as indicated during the NorFab III contract negotiations. The investment plan requires 32 MNOK in order to keep our current capabilities updated. NTNUs main investment will be the replacement of an aging Focused Ion Beam system that is at the end of its life cycle. This represents one of the most heavily used pieces of equipment at NTNU NanoLab. Several groups, including national infrastructures such as NorTEM and the MiMaC 3D Atom Probe Tomography system recently installed at NTNU are fully dependent on our FIB systems in order to operate. UiO MiNaLabs investments will be focused on replacing two aging instruments, namely a Scanning Probe Microscope and a Hall-effect instrument. These instruments are key to characterize thin films produced in the cleanroom and essential part of the thin-film production line. Furthermore, they ensure continued ability of localized (nm-scale) topographical and electrical characterization. Both current instruments have a large and increasing user base, and with the larger sample out-put obtained by the installed beyond-state-of-the-art cluster system, the more frequent need for maintenance creates critical bottlenecks in the infrastructure. USN MST lab in Horten planned with the original ambitious budget to invest in a SOA AlN deposition tool along with several upgrades of older tools. With the current minimum budget option, USN will upgrade the Wafer level bonder for 150mm wafers, Ultrasonic welder, Interferometer and Profilometer. SINTEF MiNaLab will focus its investment on a tool opening for new opportunities and offering new capabilities to our "tool box". We plan to invest in a submicron fine line lithography tool to bridge the gap between standard lithography with micron-resolution and nanolithography with <100 nm resolution. It is anticipated that such a tool will have an impact on all our research areas (radiation sensors, piezoMEMS, BioMEMS and Optical MEMS).

Prosjektnummer: 316479
Tittel: Electric Future Accelerator Initiative? Laboratory
Søkerinstitusjon/partnere: **SINTEF ENERGI AS** (NTNU)
Prosjektleder: Christian André Andresen

Kort sammendrag:
The vision of a zero-emission society is materializing in national and international policies and initiatives such as the EU Green Deal1 . Strategy documents such as Energi212 and Digital213 outline the power system as a key component for the Norwegian transition towards such a society. A robust power system is critical to progress in the electrification of Norway. The future power system will also need to evolve according to present development trends often summarized through the 4 D's (Decarbonization, Digitalization, Decentralization and Democratization). In order to meet the ambitious goal of a zero-emission society, it is essential to research and develop technologies for operating the future energy infrastructure considering faster dynamics, tighter market interaction, a larger degree of atomization, higher variability in both production and consumption patterns and a fundamentally increase in the level of digitalization in every part of the power system. ElectriFAI LAB will provide a research infrastructure to research, develop, test and demonstrate solutions for the future operation of the power system. The infrastructure will encompass the present needs for educational purposes (e.g. study programs in Digital Electrical Energy) and for research and development covering the TRL levels from prototyping to full-scale testing. The ElectriFAI LAB is a collaboration between NTNU and SINTEF, supported by major industry actors. The new infrastructure will partly build on existing laboratories as the National Smartgrid Laboratory4 and the ElPowerlab5 , and partly develop new research facilities. The infrastructure project is organized in 5 infrastructure groups spanning from grid emulations to market simulators to Human-Machine-Interaction facilities all interacting to make one integrated laboratory environment. A national infrastructure covering these focus groups is identified to be needed to enable the development that makes the operation of the future power system robust and efficient.

Prosjektnummer: 316492
Tittel: Forskningsinfrastruktur for miljø- og ressursdata for bærekraftig innovasjon (LCA data)
Søkerinstitusjon/partnere: **ØSTFOLDFORSKNING AS** (NMBU, PRé, NILU, NIFU, SINTEF, Treteknisk, IFE, Asplan Viak)
Prosjektleder: Ole Jørgen Hanssen

Kort sammendrag:
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.

Prosjektnummer: 316501
Tittel: Living Norway Ecological Data Network
Søkerinstitusjon/partnere: **NINA** (NTNU, UiO (NHM), UiB, NMBU, NIBIO, NIVA, NBIC)
Prosjektleder: Erlend Birkeland Nilsen

Kort sammendrag:
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.

Prosjektnummer: 316502
Tittel: Norwegian Biorefinery Laboratory III
Søkerinstitusjon/partnere: RISE PFI AS (SINTEF Energy, SINTEF Industy, NTNU, NIBIO, NMBU)
Prosjektleder: Øyvind Eriksen

Kort sammendrag:
Norwegian Biorefinery Laboratory - NorBioLab is a national biorefinery research infrastructure, which has gathered the key research groups within the biorefinery area in Norway; RISE PFI, SINTEF Energy Research, SINTEF Industry, Norwegian University of Science and Technology (NTNU), Norwegian Institute of Bioeconomy Research (NIBIO) and Norwegian University of Life Sciences (NMBU). The existing and future infrastructure is well aligned with the strategies of the involved partners and will enable an even stronger cooperation of the partners in joint national and international projects. These projects are aligned with the coming EU New Green Deal and the UN sustainability goals for affordable and clean energy (Goal 7) and climate actions (Goal 13). Since the establishment in 2014, NorBioLab has evolved into the most advanced and versatile infrastructure in Norway for valorization of biomass and other renewable feedstocks. The key elements for the success of NorBioLab are the high competence, the well-established cooperation and well-developed relations between the NorBioLab partners. The competence of the partners within biomass- and biotechnology-related topics has enabled the development of a highly advanced infrastructure sought after both by research groups and industrial stakeholders. The importance of the NorBioLab infrastructure with equipment for analysis and conversion of biomass to green chemicals and biofuels is further

emphasized by its use; more than 80 different research projects benefitted from the infrastructure in 2019. Some of the projects are integrated or support large prestigious Center-type national projects such as Bio4Fuels (an “FME”), Foods of Norway (an “SFI”), iCSI (Industrial Catalysis Science and Innovation, an SFI) and the Norwegian Seaweed Biorefinery Platform (SBP-N). Norwegian land-based and sea-based industries, including the bio-based industries, are facing an important transformation. We must create more value out of our bio-produced feedstocks, and we need to reduce the environmental impact and carbon footprint from the use of fossil raw materials by developing more sustainable processes. Thus, the need for NorBioLab the coming years is undeniable, including the development of existing infrastructure and installation of new, advanced research tools. There is a continuing requirement to strengthen all areas of NorBioLab to maintain its relevance for both researchers and industry.

Prosjektnummer: 316507
Tittel: IOR and Subsurface Field Lab at Risavika
Søkerinstitusjon/partnere: **UiS** (NORCE, IFE)
Prosjektleder: Ying Guo

Kort sammendrag:
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 CO2 in the injection water for IOR in combination with permanent storage for CO2. Experimental studies in the laboratory show that different additions (salts, chemicals or CO2) 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 CO2. 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.

Prosjektnummer: 316509
Tittel: Digital extension of the Zero Emission Building and climate adaptation laboratories
Søkerinstitusjon/partnere: **SINTEF AS** (NTNU)
Prosjektleder: Berit Time

Kort sammendrag:
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 infrastructure[1] 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.

Prosjektnummer: 316511
Tittel: Design, prototyping, performance and reliability of solar photovoltaic/thermal components and systems
Søkerinstitusjon/partnere: **SINTEF AS** (SINTEF Energy, SINTEF Digital, NTNU)
Prosjektleder: Martin Bellmann

Kort sammendrag:
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.

Prosjektnummer: 316513
Tittel: Coastal and Offshore Geotechnical Structures Testing Centre (COGSTEC)
Søkerinstitusjon/partnere: **NGI** (NTNU)
Prosjektleder: Kristoffer Skjolden Skau

Kort sammendrag:
Future research and technology development in Norway and in Europe will have a strong focus on safely utilizing ocean and coastal space. Oceans and coasts will be an arena to produce food, harvest energy, support transport infrastructure, and to address housing and other industry needs. Sustainable development and the green shift require different structure types, which must be safe for people and the environment, and economically viable. To achieve this requires a transformation of the seabed engineering technology that underpins this infrastructure. The proposed Coastal and Offshore Geotechnical Structures Testing Centre (COGSTEC, Figure 1) will unlock the necessary innovation, through new insights, technology development and rapid prototyping. COGSTEC will allow researchers and designers to simulate and verify whole life soil, ice and infrastructure behaviour, and inspire innovation. COGSTEC is timely, since engineering testing is being transformed by new advances in sensing, control, imaging and robotics, as well as hybrid physical-numerical simulations. COGSTEC will form a national platform that will harness these technologies, across facilities from the scale of a soil and ice element in the laboratory to a large-scale structure in the field. This will achieve a major advancement in the accuracy and realism of physical testing in civil and offshore engineering. COGSTEC complements the Ocean Space Centre and in combination they will provide a complete infrastructure for determination of loads, structural response and soil reactions. COGSTEC will be available for use by the industry and academia, accelerating industry-driven innovation and research (and complements EnergiX and MAROFF) and will boost the collaboration across Norwegian academia and industry

Prosjektnummer: 316518
Tittel: Offshore Boundary Layer Observatory (OBLO) – Phase II
Søkerinstitusjon/partnere: **UiB** (METCENTRE, MET, NORCE, NTNU, UiS)
Prosjektleder: Joachim Reuder

Kort sammendrag:
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.

Prosjektnummer: 316523
Tittel: ForskAir - Airborne infrastructure
Søkerinstitusjon/partnere: **ANDØYA SPACE CENTER AS** (UiB, UiO, NMBU, UiT, MET)
Prosjektleder: Stine-Marie Andreassen

Kort sammendrag:
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.

Prosjektnummer: 316524
Tittel: Hydrogen and fuel cell safety research infrastructure
Søkerinstitusjon/partnere: **UiT** (NTNU, USN)
Prosjektleder: Mohamad Mustafa

Kort sammendrag:
We identify that hazards and risks associated with land and marine vehicles/ vessels powered by hydrogen, as well as hazards associated with climatic conditions and technical design of hydrogen infrastructure, need further research and understanding and it would be ideal to study those hazards under the climatic conditions of the subarctic region. The proposed research infrastructure will be an integral and complementary part of the national hydrogen and fuel cell infrastructure. NHFC but with more focus on safety in hydrogen and fuel cell technologies. The major areas of safety

to be investigated are based on current gaps in knowledge in which minor safety research is being implemented. Among others, the following areas of research will be investigated:

1. Hydrogen production and utilisation

- Hazards associated with hydrogen production from wind and hydroelectric energy
- Liquefaction of hydrogen

2. Hydrogen for Marine and FCEVs

- Fuelling of ferries, fishing vessels and land vehicles
- H2 in tunnels with focus on explosions: Studies on hydrogen ignition, deflagration and detonation properties and behaviour in confined spaces such as ship hulls.
- Liquid hydrogen application
- Investigating the effect of different refuelling conditions on high pressure components
- Development of hydrogen refuelling design and protocols

3. Industrial applications

- Safety issues in Hydrogen direct reduction (H-DR) for fossil-free steelmaking, Reduction process at (LKAB). Assessment of associated risks and system safety analysis
- Development of Designs and materials that improve hydrogen safety.
- Performance analysis of hydrogen safety sensors – establishing rules and guidelines
- H2 embrittlement: Applicable to hydrogen transport in metallic pipes and cylinders
- Destructive and non-destructive testing of hydrogen tanks and high-pressure vessels; fire resistance and thermal protection of high-pressure gaseous storage.
- Performance testing of individual high pressure components

Prosjektnummer: 316526
Tittel: Smart Mobility
Søkerinstitusjon/partnere: **NTNU** (NORD Unviersitet, SINTEF, Trøndelag County council, Stjørdal municipality)
Prosjektleder: Frank Lindseth

Kort sammendrag:
The infrastructure Smart Mobility aims to become an innovative and forward-looking testing arena and research centre for regional, national and international players in the future car and transport system. The key focus areas and associated infrastructure will be concerned with R&D in modern vehicle technology using alternative fuel (such as electricity), intelligent transport systems (ITS), traffic safety, new charging technologies (such as inductive charging), automated driving processes and fully autonomous driving (self-driving). The infrastructure aims to become the world's first test laboratory that can offer "four seasons" testing opportunities on the same day. The infrastructure will contribute in achieving goals within transport safety, increased efficiency and sustainability, and big data analysis.

Prosjektnummer: 316545
Tittel: ECCSEL Virtual laboratory
Søkerinstitusjon/partnere: **SINTEF ENERGI AS** (SINTEF Industri, IFE, NORSAR, ECCSEL ERIC)
Prosjektleder: Francesco Finotti

Kort sammendrag:
ECCSEL V-lab aims to help tackle the remaining gaps towards large-scale deployment of CCS and realise the RCN's vision of ensuring that resources are opened to all relevant research institutions and industries in the country. It will do so by guaranteeing high-quality, industrially

relevant data generation from national research infrastructures and ample data sharing both nationallyand internationally, levering on international research cooperation entities from NCCS and ECCSEL ERIC.

ECCSEL V-lab responds to (a) the need for coordination and integration of existing ECCSEL infrastructures, (b) the need to improve access to the RIs and enable an integrated approach to the EU FAIR (Findable, Accessible, Interoperable, Reusable) data policy, and (c) the need to ensure the competitiveness of Norwegian industry towards a sustainable future. ECCSEL V-lab is composed of two parts: (a) a digital infrastructure to provide a unified approach in sharing, processing, storing, and interpreting data generated from the activities of ECCSEL Research Infrastructures (RI); and (b) the first step towards Tiller Sustainability Lab, a National industrial-scale Research park for emission-free and competitive industry and energy processes. The digital infrastructure is divided into four user cases (UC), each addressing a specific portion of the CCS value chain (Figure 1). The UCs are designed to integrate relevant partner institutions, thus enhancingcross-institutional cooperation. The physical infrastructure addresses the vision of a national, industrial-scale research infrastructure for a sustainable industry.

Prosjektnummer: 316550
Tittel: Norwegian Research Infrastructure for studies of environmental contaminants
Søkerinstitusjon/partnere: **NILU** (NIVA, UiT)
Prosjektleder: Aasmund Fahre Vik

Kort sammendrag:
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

Prosjektnummer: 316553
Tittel: Norwegian Digital Subsurface Lab
Søkerinstitusjon/partnere: **SINTEF AS**
Prosjektleder: Ane Elisabet Lothe

Kort sammendrag:
Norway's O&G technology strategy for the 21st century calls for “Technologies and Innovation for a Competitive Norwegian Petroleum Sector”, and the “Roadmap for Research Infrastructure” mentions digitalization of all petroleum industry disciplines and a need for infrastructure for improved subsurface understanding as priorities. The Rystad Energy Report quantifies the huge potential in value creation related to improved subsurface understanding. At the same time, the Norwegian government and European Commission underline the importance of a transition to a greener economy and sustainability, and we are at a point where a digital transformation and transfer of know-how and technology from oil and gas to more environmental-friendly, sustainable geoscience applications (e.g., geothermal energy, hydrogen/CO2/gas/heat storage, and water resource mapping) could help combat climate change and support UN sustainability goals. The Norwegian Digital Subsurface Lab (NorDigS Lab) targets all the above-mentioned challenges and opportunities by providing eInfrastructure for quality-assured subsurface data and interoperable open-source software. With NorDigS Lab, we want to establish a national arena for building expertise, sharing crossdisciplinary knowledge and data, and stimulating innovation related to digitalization in a range of subsurface applications. The goals of the infrastructure will be achieved by offering Norwegian scientists and students a unified platform for rapid/remote access to subsurface data and software, and tools for machine learning and big data. In this way, the platform will support digitalization of the petroleum industry, transfer of knowledge from oil and gas to more sustainable and environmental-friendly subsurface disciplines, and it will be an asset for researchers/students in everything from small to major research efforts within a range of application areas. The initiative consists of: 1) establishing a new Digital Subsurface Data Platform following the Open Subsurface Data Universe standard and providing unified access to key data sets from, e.g., industry, NPD's Diskos database, and partners' proprietary databases; 2) establishing a new Digital Subsurface Software Platform, communicating with the Data Platform and offering a range of open(-source) interoperable subsurface software and standard libraries for big data handling and machine learning; 3) upgrading NORCE' web-enabled software infrastructure OpenLab and integrating this with the Data and Software Platforms.

Prosjektnummer: 316556
Tittel: Development Lab for Renewable High Voltage Energy Components
Søkerinstitusjon/partnere: **SINTEF ENERGI AS**
Prosjektleder: Oddgeir Kvien

Kort sammendrag:
To enable the future's carbon-free energy supply, a significantly increased renewable energy generation is required. This will provide a secure, sustainable, competitive, and affordable future supply of energy. The future large-scale renewable energy generation from e.g. high power floating windfarms needs to be transported over a long (subsea) distance, which calls for very high voltages to obtain low-loss systems. To facilitate this, superior service performance, high reliability, and significantly increased voltage ratings of the electrical components are essential. In addition, the technology has to be more cost-effective compared to existing solutions. To lower the cost, the electrical power industry has to simplify the designs without compromising the reliability and expected service life. An example is the replacement of the commonly used lead sheath for high voltage subsea cables with alternative environmental friendly outer water barrier sheath solutions. Simultaneously, the voltage rating for subsea cables needs to be significantly increased resulting in much higher electrical stress on the electric insulation systems. Research, development, and long-term testing at this high voltage level is very challenging and no such independent facility exists

today in Norway. This represent a significant obstacle for further development of the next generation electrical components for the renewable energy system. The RECLab infrastructure will provide the needed facility, and includes a concept consisting of both advanced high-performance high voltage sources and advanced non-destructive sensing equipment for online quality assessment during research, development, and testing of electrical components. RECLab will be highly compatible to existing laboratory resources, and in particular the new ElPowerLab1 . Significant synergies with the existing laboratory infrastructure at SINTEF and NTNU are expected, strengthening the general research and development capabilities and possibilities to build the future high voltage renewable power grid infrastructure together with the Norwegian electrical power industry.

Prosjektnummer: 316570
Tittel: Norwegian Urban Observatory
Søkerinstitusjon/partnere: **NILU** (Augment City/Offshore Simulation Centre AS, Oslo Kommune)
Prosjektleder: Leonor Encuentra Tarrason

Kort sammendrag:
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.

Prosjektnummer: 316571
Tittel: Geosystem 3D Seismic Imaging (G3) Upgrade
Søkerinstitusjon/partnere: **UiT** (UiB, NGU, P-Cable 3D Seismic AS, VBPR AS, Geomar, NOC, BGS, Ifremer, ECORD, IODP)
Prosjektleder: Stefan Bünz

Kort sammendrag:
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.

Prosjektnummer: 316572
Tittel: Hydrogen Safety Laboratory
Søkerinstitusjon/partnere: **UiB** (USN, UiS)
Prosjektleder: Trygve Skjold

Kort sammendrag:
The vision for the Hydrogen Safety Laboratory (HySALA) project is to establish state-of-the-art laboratory facilities that will allow researchers to investigate safety-critical properties and phenomena involving hydrogen and hydrogen-based fuels, as well as to test and verify the performance of equipment, solutions and models for fire and explosion protection under conditions, and at spatial scales, that resemble actual industrial applications. The foreseen research activities will be highly relevant for a wide range of practical applications, ranging from energy production to safety and security in industry and society. The infrastructure will support internationally cutting-edge research in areas that are of critical importance to Norway as an energy nation: efficient, sustainable and safe conversion, transport, storage and use of hydrogen and hydrogen-based fuels. The HySALA facility includes two installations that complement each other with respect to spatial scale and applications. The first installation is a state-of-the-art laboratory facility that will allow researchers to investigate physical and chemical phenomena related to ignition and combustion phenomena in hydrogen-airmixtures. This facility will include two small explosion chambers and a unique wind tunnel for investigating safety-critical phenomena related to ignition and flame propagation in established flow fields, with or without congestion. The second installation will be a large-scale explosion chamber, dimensioned to withstand detonations and constant volume deflagrations. The infrastructure will be unique for Norway and Europe, and will allow researchers to develop, verify and validate strategies and solutions for explosion protection of industrial facilities, such as electrolysers, hydrogen refuelling stations, fuel preparation rooms and fuel cell rooms in ships, etc. The ambition is to establish unique installations that can be operational on short notice, be flexible and easy to operate, and produce state-of-theart results. The infrastructure will be available for researchers that complete mandatory (site-specific) safety training, with differentiated

pricing for industry and academia, sponsors vs. regular users, etc. As such, the HySALA facility will facilitate high-quality research, including national and international cooperation.

Prosjektnummer: 316576
Tittel: Floating solar energy test centre
Søkerinstitusjon/partnere: SINTEF OCEAN AS (NTNU, IFE)
Prosjektleder: Øyvind Hellan

Kort sammendrag:
Floating solar energy (FPV) is in rapid development, with close to 2 GWp of capacity deployed based on existing technological solutions. FPV represents a niche in which Norwegian industry has natural advantages through a strong technology base in solar cell technology, materials technology in general, offshore structures, marine operations and power grids. There is a growing Norwegian industry, with companies such as Ocean Sun, Moss Maritime, Sunlit Sea, Current Solar, Equinor and Glint Solar developing new, improved technologies and solutions for FPV. Several large Norwegian energy companies are also considering investments in the technology in their projects, including Statkraft, Hydro and Scatec Solar. To support this emerging industry in its innovation process, there is a need for an industrial scale test area to test full scale operations of FPV systems. Such test sites will complement the use of numerical models and laboratory experiments with scaled models, allowing for more costeffective development of new mooring, floater, mounting and interconnect solutions and demonstrate the performance and resilience of the FPV power plants, SINTEF, NTNU and IFE wish to establish a test centre for FPV with two nodes: one for sheltered environmental conditions in the Grenland area and one for exposed marine environment on the Trøndelag coast. The objective is to establish an infrastructure that puts Norwegian industry, Norwegian research and education in a unique position internationally. The infrastructure will provide important information on the properties of floating solar energy systems but will also be adapted to support experiments and development of other types of ocean renewable energy. It will provide both design and operational experience for product development and will help to demonstrate and qualify technology and installations for an international market. The aim is to combine innovation and concept development with theory, method development, laboratory studies and full-scale data collection and measurement. This, in a wide range of scientific fields, i.e. (1) performance and reliability of solar modules in marine environments, (2) impact on the marine ecosystem of structures covering large sea surfaces, (3) development of next generation marine structures (lightweight, massively modular structures) and (4) control system and digitization of marine and maritime structures (digital twin). Full-scale test installations like this form a central element in the plans for the upcoming Ocean Space Center and will also support the SFI Blues (next generation of marine structures), FME SUSOLTECH and other national research programmes. The initiative is supported by the Norwegian Solar Energy Cluster and their member companies, including Equinor, Scatec Solar, Ocean Sun, Moss Maritime.

Prosjektnummer: 316578
Tittel: Basic funding of operational costs at Svelvik CO2 Field Lab
Søkerinstitusjon/partnere: **SINTEF AS**
Prosjektleder: Cathrine Ringstad

Kort sammendrag:
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.

Prosjektnummer: 316580
Tittel: Power-to-X systems lab at Tiller
Søkerinstitusjon/partnere: SINTEF AS (SINTEF Ocean AS, SINTEF Energy AS, NTNU)
Prosjektleder: Kyrre Sundseth

Kort sammendrag:
The use of hydrogen and hydrogen-based energy carriers are gaining momentum both nationally and internationally, as a pillar to decarbonize transportation and the energy system towards 2050. Recently, GWscale hydrogen initiatives have been taken by several countries in Europe, boosted by the upcoming Covid19 EU Recovery Plan. Norway has world leading industry and research institutions with vast potential for value creation from development and future export of hydrogen technology and hydrogen and H2-energy carriers. This proposal outlines a Power-to-X (P2X) pilot-scale systems infrastructure at Tiller in Trondheim for hydrogen and ammonia. The proposed infrastructure will facilitate for pilot-scale (100 – 1 000 kW) testing of electrolysis systems, ammonia and bio-oil processing, and end-use of hydrogen and ammonia in fuel cells and gas turbines. The proposed infrastructure will thereby complement existing infrastructure to create full test facilities along the entire value chains for hydrogen and ammonia. The value chains are carefully selected in dialogue with Norwegian industry to ensure the relevance and future utilization of the facilities. The proposed infrastructure will allow Norwegian research institutions and industry to reduce costs, and to improve technology performance and lifetime of P2X systems. Focus is put on strategically important areas where Norwegian industry has competitive advantages, such as electrolyser technologies, ammonia, and systems engineering. Currently, there is no such pilot infrastructure available, neither in Norway nor in Scandinavia. Even in the European domain such infrastructure is fragmented. While proof of concept has been demonstrated in most relevant technology areas, pilot scale validation and system optimization are crucial to provide for eventual market implementation. As an integral part of the proposed P2X-infrastructure, education of Master and PhD candidates (primarily linked to NTNU) is foreseen. Through open access, the infrastructure will be pivotal for generating innovation projects, increasing competence levels and boosting the industry's competitiveness.

Prosjektnummer: 316593
Tittel: World of Wild Waters – Virtual lab «WoWW-lab»
Søkerinstitusjon/partnere: **NTNU** (Telenor, Offshore Sim Center)
Prosjektleder: Oddbjørn Bruland

Kort sammendrag:
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.

Prosjektnummer: 316594
Tittel: Norwegian Advanced Battery Laboratory
Søkerinstitusjon/partnere: IFE (UiO, FFI)
Prosjektleder: Hanne F. Andersen

Kort sammendrag:
The Norwegian Advanced Battery Laboratory (NABLA) aims to link the research infrastructure to emerging industrial initiatives by providing the Norwegian research community with the state-of-the-art research tools essential for battery research and development. NABLA will enable creation of new future-oriented solutions necessary for the transition to the society powered by the renewable energy and will allow to position Norwegian research internationally. The foundation for NABLA is in the development of more efficient Li-ion batteries while providing the necessary infrastructure for the development of the next generation of batteries. The infrastructure is a collaboration effort between institutions that already have a large research portfolio within the field of battery technology and the Mobility Zero Emission Energy Systems (MoZEES) research centre. The participants have a long history of collaboration with the Norwegian companies ranging from material producers (e.g. Elkem and Cenate), to emerging battery cell producers (e.g. FREYR and Beyonder), battery system developers (Corvus and ZEM) and end users (e.g. Equinor and ABB). NABLA will be organized as a virtual laboratory accessible to all users. The infrastructure will also ensure internationally recognized research and will also focus on reproducibility, easy access, international attractiveness and will promote open research and collaboration.
The battery technology is an area where there is a strong demand for technology development at different levels. Therefore, the proposed infrastructure will meet variety of needs for users originating from research and business. The infrastructure will also play an important role in recruiting and training new scientists and engineers to the field. Overall, NABLA will enable expertise

and technology to deliver the zero-emission transport on land and at sea. This is an area of strong growth industrially and will have a major impact on reducing greenhouse gas emissions in the nearest future. Furthermore, the advanced and emerging battery technologies will greatly contribute to the stationary energy storage technologies – another rapidly growing area. The infrastructure will therefore have a great commercial and societal significance.

Prosjektnummer: 316598
Tittel: Smart Buildings Energy and Indoor Air Quality e-infrastructure
Søkerinstitusjon/partnere: **STIFTELSEN SINTEF** (SINTEF Digital, SINTEF Energi, NTNU Ingeniørvitenskap og NTNU Arkitektur og Design)
Prosjektleder: Karen Byskov Lindberg

Kort sammendrag:
SmartBuildingHub will contribute to merging the gap between R&D on energy-efficient & flexible buildings and R&D on Smart Grids. To achieve this, it is crucial to have well organized and interlinked databases consisting of detailed measurements (sub-metering beyond the main meter) with high time resolution (hourly data and even minute data in some cases) of electricity use, heat use, onsite energy generation, occupancy, and indoor climate parameters, as well as electric mobility. Currently, there is no infrastructure in Norway, giving access to researchers and solution developers for deep insight into the energy and indoor climate in buildings. Further, SmartBuildingHub will also contain hardware and software for stationary and portable equipment to conduct detailed sub-metering in selected pilot buildings, to enable detailed analyses of the indoor climate and energy use of buildings. In the e-infrastructure, the data will be organized per building category, e.g., small house, apartment block, office, school, hotel, and geographical location. The business model for SmartBuildingHub consists of two levels of access for external users: free access, with summarized and average annual values to give an overview of the key indicators, and paid access, containing high-resolution values, parameters distributions, and correlations between variables for detail analysis such as planning, sizing, etc. The e-infrastructure of SmartBuildingHub will be linked to the national e-infrastructure of Sigma2/NORID. For the sensor data collection, SmartBuildingHub will acquire additional edge and sensororiented data storage and processing support.

Prosjektnummer: 316611
Tittel: National Battery Development and Test Lab
Søkerinstitusjon/partnere: **SINTEF AS** (NTNU, SINTEF Energy, FREYR)
Prosjektleder: Paul Inge Dahl

Kort sammendrag:
Through the National Battery Development and Test Lab (BATTLAB), SINTEF and NTNU aim to link the proposed Norwegian research infrastructure to emerging industrial initiatives in the field of batteries. The foundation for the infrastructure is based on a battery production concept line to be applied for; i) investigation and optimization of various battery chemistries, ii) validation of battery materials from providers, iii) evaluation of various battery cell concepts, iv) variation of battery production processes, and v) prototyping of batteries produced from the beforementioned points (i-iv) or combination thereof. The concept line will be implemented directly at an industrial site in Mo Industripark by SINTEF and FREYR, an emerging company with intentions to build up battery production facilities in 3 levels in Mo i Rana; Concept line(s), 2 GWh brownfield factory, 32 GWh greenfield factory. Both SINTEF and FREYR have established premises in Mo i Rana, in close vicinity to Mo Industripark. The concept line will provide access for both industry partners and the R&D community. The proposed infrastructure links the concept line (Node 1) to more fundamental battery chemistry research on material development, characterization/validation (Node 2), battery electrode design and production process optimizations (Node 3), investigation of battery and

durability, including thermal management, degradation mechanisms, lifetime prediction and post-mortem analysis (Node 4), as well as advanced battery cell/pack testing, including battery management systems (BMS) (Node 5). Through this approach the whole "R&D value chain" from academia, via research institutes to industry is covered.

Prosjektnummer: 316612
Tittel: PreMechatronics Lab
Søkerinstitusjon/partnere: **UiA**
Prosjektleder: Kjell G. Robbersmyr

Kort sammendrag:
Top Research Centre Mechatronics (TRCM) at University of Agder was established in 2019 and will develop the next generation mechatronics systems for selected fields to contribute to the competitiveness and sustainability of the industry. Today TRCM collaborates extensively with the world leading offshore oil drilling industry. The SFI offshore mechatronics is a leading research center in its field with close collaboration with the international offshore oil industry. Now we see a growing interest in other offshore industries like offshore wind energy, offshore mining, aquaculture, and marine harvesting. These industries meet challenges similar to what the oil industry has experienced regarding deploying, operating and maintaining offshore installations. We will use the expertise and experience from the oil industry to develop mechatronics concepts and technology for other offshore applications.