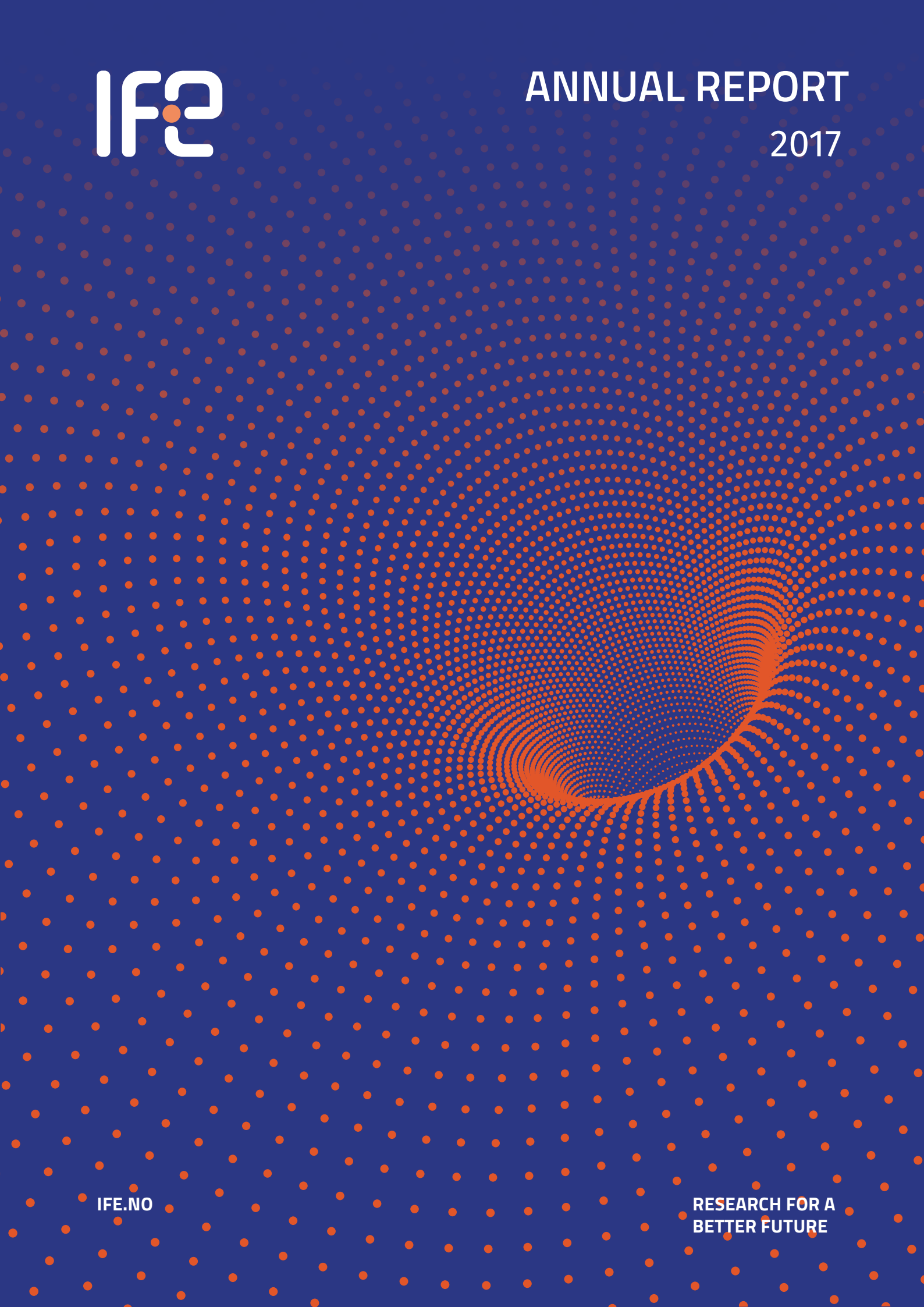
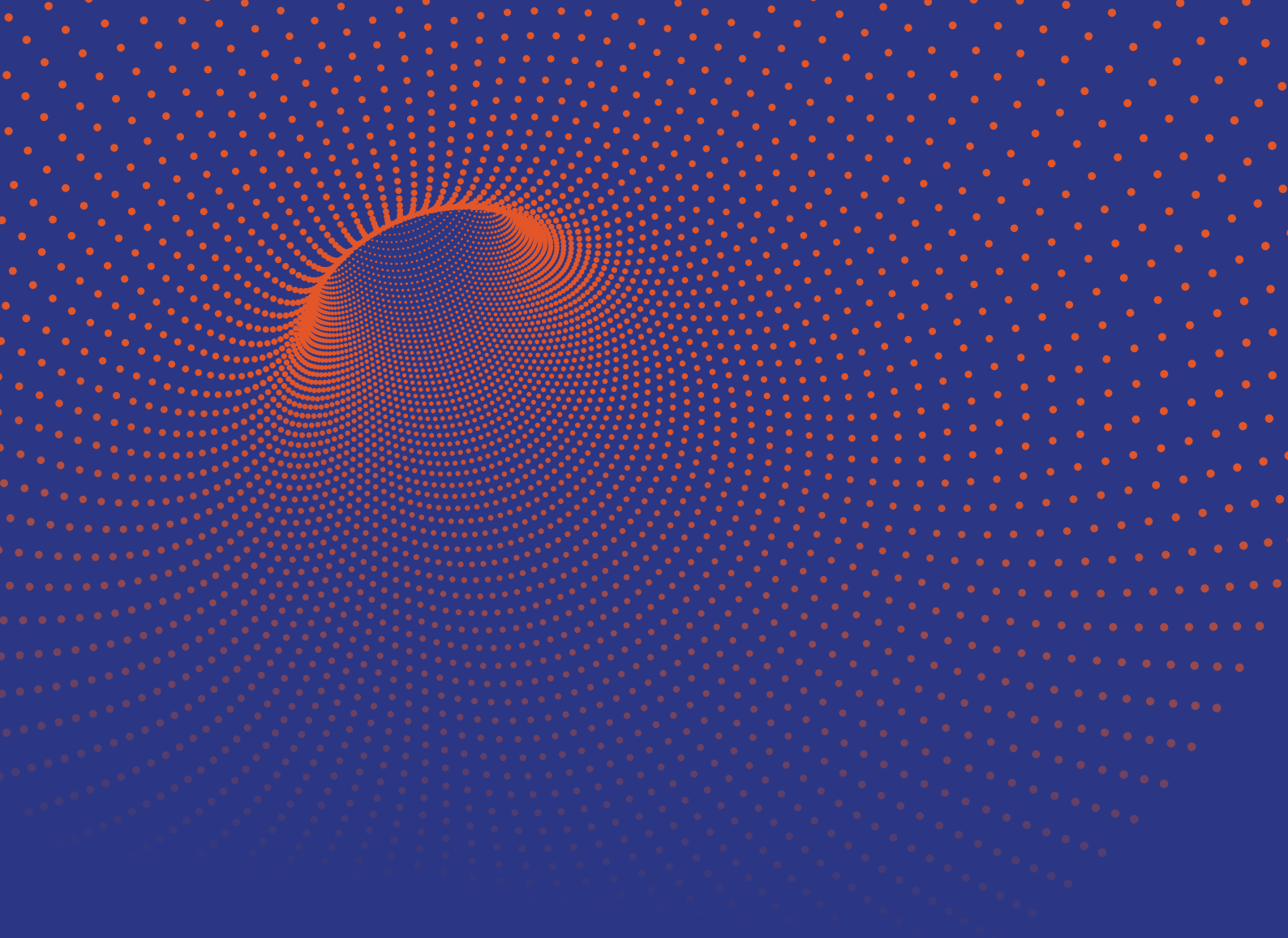
ANNUAL REPORT

2017



IFE.NO

RESEARCH FOR A
BETTER FUTURE



Annual report for The Institute for Energy Technology.
Graphic design: CopyCat AS
Photo: Mick Tully, Image Communication

Contents

About IFE

The Institute for Energy Technology (IFE) conducts research for a better future. Since 1948, we have been an international leader in energy research. The knowledge we have developed has saved the petroleum industry several hundred billion kroner. We have contributed to the development of ground-breaking cancer medicine, new solutions in renewable energy, more energy-efficient industrial processes, zero-emission transport solutions and future-oriented energy systems.

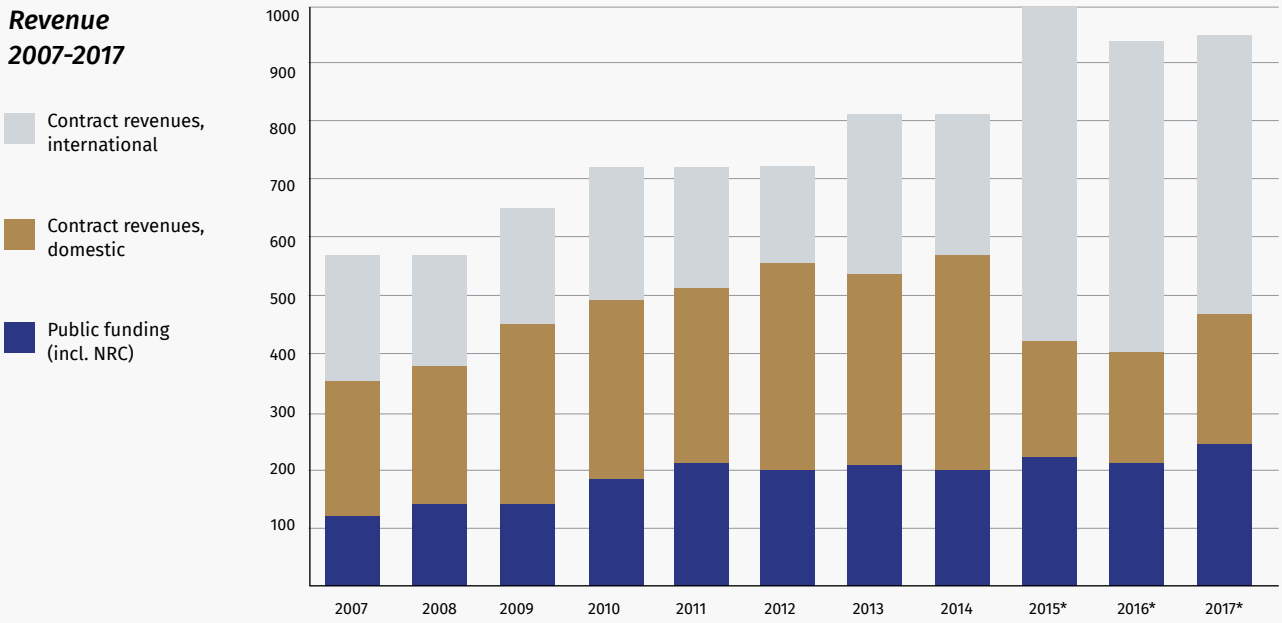
Our research and expertise have led to safer use of nuclear power, and we have developed methods for verifying the disarmament of nuclear weapons. The research at IFE has created jobs in Norway, facilitated business development and generated important expertise for the Norwegian trade and industry sector.

At IFE, we build bridges between research, education and industry. We have extensive infrastructure and full-scale laboratories where theoretical models are transformed into commercial activities. IFE has unique expertise and systems within radiation protection and environmental monitoring of radioactive and chemical emissions. This makes us an important partner for companies that want to research, develop and produce new solutions for renewable energy and medicine using radioactive sources.

The digitalisation of society is seeing the emergence of a new era. When the next chapter in Norway's history is written, it will be about how we adapt. We must create new and sustainable jobs. At IFE we have already begun – we are conducting research for a better future.

Key figures

Revenue 2007-2017



	2007	2008	2009	2010	2011	2012	2013	2014	2015*	2016*	2017*
Contract revenues, international	201	210	202	233	243	229	267	324	571	522	484
Contract revenues, domestic	213	224	287	307	303	355,6	324,5	367	191	199	212
Public funding (incl. NRC)	149	158	167	184	211	201	217	210	231	225	243

** The change in domestic and international revenues from 2014 to 2015 is due to the reclassification of revenues from the Xofigo® production. In 2015 and subsequent years, approximately 200 MNOK related to Xofigo® was classified as international contract revenues instead of domestic revenues.*

IFE´s vision:

a leading international research institute

1 billion

Turnover

Annual scientific publications

120

1948: IFA

1980: IFE

No. employees

600

Nationalities: 37

Researchers: 218

PhDs: 105

24

Advanced laboratories

2

Centres for Environment-friendly Energy Research (FME)

International projects

>120

14.000

Visitors annually

New course with ambitious focus areas

In 2017, we were busy setting a new course for IFE. We sharpened our strategic focus into three main areas: renewable energy, digitalisation and health. These are IFE's strategic institutional focus areas for the years ahead. Through these priorities, we will respond to society's need to develop new, sustainable solutions to meet global societal challenges in energy, health, transport and infrastructure.

In the autumn of 2017, we restructured our activities, resulting in a more suitable configuration of the focus areas. We are a multi-faceted organisation, with various business logics and needs, ranging from research and development in energy and health to the production of radiopharmaceuticals and the safe operation of nuclear facilities. There was a need to concentrate activities in these areas by introducing an organisational structure that would better meet their different needs.

The work involved all parts of the organisation and was carried out in close cooperation with employee representatives. I am very grateful for the involvement and participation from all of our employees and employee representatives in shaping IFE's new organisation.

The result was a new configuration of our focus areas, with a more suitable organisation of our activities. As from 2018, IFE is organised into three business areas, consisting of research and development (R&D), radiopharmaceuticals and nuclear technology, with shared staff and support functions. Implementation of the new organisation will continue in 2018.

Major need for renewable solutions

Norway and the world around us are experiencing a major shift towards more sustainable solutions. Strong growth is being seen in the demand for our renewable energy and energy systems research. In this context, we are the proud hosts of two new Centres for Environment-friendly Energy Research (FME), which we opened in spring 2017. These are the flagships of our research; long-term and large-scale collaborations in which Norway's research efforts in key areas of society are coordinated. One of the centres is MoZEES – Mobility Zero Emission Energy Systems – where partners in R&D, industry and public sector agencies will work together to develop zero-emission solutions for road, water and rail transportation. The other centre is

SUSOLTECH – Research Centre for Sustainable Solar Cell Technology – which aims to develop the world's most environmentally friendly and efficient solar cells, in close cooperation with the Norwegian solar industry. I strongly believe that these centres will prove to be fruitful for the industry partners, public sector agencies and research communities involved.

We are also proud that IFE researchers are contributing their expertise in the international partnership to build the world's most powerful neutron source, the European Spallation Source (ESS) in Lund, Sweden. The Norwegian Centre for Neutron Research (NcNeutron) is currently being developed at the JEEP II Reactor at Kjeller, and will be fully operational by 2020, with seven state-of the-art instruments.

Strained financial situation continues

The IFE foundation reported a loss of NOK 25.6 million in 2017, mainly due to the challenges associated with the Halden Reactor. This is significantly lower than the target operating margin of 5–7 per cent and is not a situation that is sustainable in the long term. Lower activity levels in the petroleum industry have led to weaker results in several of IFE's areas.

However, we must also emphasise that a number of IFE's activities are going well. Renewable energy and radiopharmaceuticals continued to post good results in 2017 and have ambitious growth targets for 2018. IFE has a very good partnership with Bayer for the contract production of the cancer medicine Xofigo®, which we produce for the global market at the Kjeller site. We are also working with Bayer and other stakeholders on more innovations, and plan to strengthen our focus on radiopharmaceuticals in the future.

Halden Reactor challenges

At the Halden Reactor, research is conducted into safe nuclear fuel and the safe operation of nuclear reactors. Since 1958, the reactor has hosted the Halden Reactor Project, which is an international research project under the auspices of the OECD/NEA (Nuclear Energy Agency). The financial results continued to be very weak for the activity linked to the Halden Reactor in 2017. The nuclear activity is experiencing a reduction in contracts due to a number of changes in the market and in the licensing conditions introduced by Norwegian authorities in 2015. Overall, these circumstances have led to a major weakening in the research market for the Halden Reactor and large deficits for several years.

In the autumn of 2017, we initiated a comprehensive market study and analysis in order to clarify the long-term market for the Halden Reactor. The findings will be concluded in spring 2018, and IFE's Board will decide in mid-2018 whether there is a basis for applying for an operating licence from 2020.

Focus on safety and safety culture

In 2017, IFE carried out targeted efforts to improve safety and the safety culture. IFE's activities require a high standard of safety and a good safety culture, and we will always seek to improve and to align ourselves with best practice and to draw on the experience and knowledge of international leaders in the field.

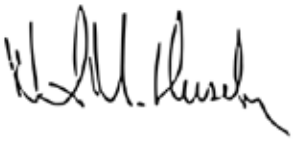
Norway was the sixth country in the world to establish a nuclear reactor, and has conducted research on nuclear fuel since the 1950s. Management of the waste from this activity is a very complex task since the waste consists of many different types of radioactive materials with a variety of compositions. A total of almost 17 tonnes of spent fuel has been produced in Norway. At the start of 2017, an additional four tonnes of other radioactive waste was stored at IFE. This is waste that cannot be deposited in the National Combined Disposal and Storage Facility (KLDRA) at Himdalen in Aurskog-Høland municipality.

In 2017, IFE investigated and planned several activities in relation to the continued clearing up of nuclear waste, and projects were initiated in a close dialogue with the Ministry of Trade, Industry and Fisheries. Preparing for the permanent disposal of Norway's nuclear waste is a very comprehensive and complex task, and Norway will be dependent on IFE's expertise, experience and infrastructure within this area for many decades to come.

IFE has received extraordinary state funding to the tune of NOK 50 million from the central government budget in 2018 towards the operation of the Halden Reactor, with a view to helping us retain critical reactor expertise for the forthcoming clear-up at the nuclear facilities. We believe that the Norwegian government wants a close cooperation with IFE as we move forward and is committed to protecting IFE's expertise in nuclear waste management and future decommissioning of the reactors.

IFE's nuclear activities afford us a special position in Norway. We therefore consider transparency and openness surrounding our activities to be an important aspect of our social mission and crucial to IFE's reputation. In 2017, we strengthened the work within communication and public relations. We are now more active in the media and on social media, which enables us to disseminate and explain our research and nuclear activities.
In 2017, we increased our innovation and market development activities, with good results. Over the years, IFE has established a number of new businesses and jobs on the back of our research. In 2017, we further strengthened our focus on innovation and commercialisation. We also created a new position to head IFE's EU-related activity, with a view to strengthening and coordinating our work with the EU. Within a short period of time, this activity has yielded good results in the form of more EU application approvals.

We are also pleased to note that IFE is a desirable workplace for students. In 2017, IFE climbed to 11th place in the Career Barometer's listing of the most attractive employers in Norway. With a more targeted strategy and an improved organisational structure, we have set a steady course for our anniversary in 2018 when we mark 70 years since inception and 60 years of work in the Halden Reactor Project – a whole generation's worth of excellent research! IFE has been conducting research for a better future since 1948, and never before has our research been more relevant to society than it is now.



Nils M. Huseby, CEO

Organisation chart

as of July 2018

CEO
Nils Morten Huseby

SERVICES & INFRASTRUCTURE
Atle Valseth

HES & SECURITY
Helena Broberg

STRATEGY, ORG. DEV. & COMMUNICATION
Silje Aspholm Hole

Divisions

RESEARCH AND DEVELOPMENT

RADIOPHARMACY
Erik Flatmark

NUCLEAR TECHNOLOGY

Sectors

DIGITAL SYSTEMS
Tomas Nordlander

FLUID FLOW & ENVIRONMENTAL TECHNOLOGY
Martin Foss

MATERIALS & PROCESS TECHNOLOGY
Arve Holt

RADIOPHARMACEUTICAL PRODUCTION
Kari Harbak

RADIOPHARMACEUTICAL WHOLESALER
Silje Sivesind

RADIOPHARMACEUTICAL R&D*
Bente Tange Harbø

NUCLEAR TECHNOLOGY, PHYSICS AND SAFETY
Even Solbakken

NUCLEAR WASTE MANAGEMENT & DECOMMISSIONING
Henning Refshauge Vahr

** Radiopharmaceutical R&D is organized under both division Research and Development and Radiopharmacy.*

IFE's strategic research focus

Strategic focus: **Renewable energy**

The global energy market is in transition. We are moving away from centralised energy supplies from nuclear, gas and coal power, towards more distributed energy production based on renewable energy sources such as hydro, solar, wind, bio and geothermal energy. This shift is leading to a major upward trajectory in megatrends in all these areas, particularly in wind and solar energy, as well as energy storage using batteries and hydrogen. All global trends in renewable energy point towards an upward development for a long time to come. This is supported by the IEA's World Energy Outlook, Statoil Energy Outlook, the EU's Energy Roadmap 2016–2050 and the Norwegian National Transport Plan.

IFE has a strong position in solar energy, renewable energy systems, batteries and energy storage. The institute has considerable growth potential in bioenergy, hydrogen systems, wind and, to some extent, geothermal energy. We are developing new solutions and products for the private sector, mainly within the renewable energy market segments, as well as in the materials and process industries.

Strategic focus: **Health**

Menon has examined the added value in Norway's healthcare industry, and documented that this industry is experiencing strong growth in terms of turnover and R&D activity. Total revenue growth was 11 per cent between 2015 and 2016. In 2015, total turnover was NOK 52 billion, increasing to NOK 57 billion in 2016. The revenue in 2017 is estimated to be in excess of NOK 61 billion.

The healthcare industry yields export revenues. In 2016, the export value was NOK 21.5 billion and the development is moving at a high speed. This is the most research-intensive industry in Norway, with an annual R&D value of at least NOK 2.25 billion.

IFE's position in the healthcare industry
IFE has operated within the field of radioactive medications since the 1950s. IFE is the sole distributor of radiopharmaceuticals to the Norwegian market. We serve as a central 'isotope pharmacy' for Norway, and control all radiopharmaceuticals and distribute them directly to Norwegian hospitals. The import and distribution of short-lived products that are not yet produced in Norway is another important task.

The research reactors and 70 years of experience from nuclear research are an enormous resource. We work in partnership with the Institute for Cancer Research at the Norwegian Radium Hospital, where we use the reactors to produce radionuclides, which can be used to make new types of medicines that can remove small tumours whilst sparing the healthy cells. This form of treatment is gentler and can be administered with greater precision than other treatments, and can improve quality of life for the large numbers diagnosed with cancer every year.

We are part of the Oslo Cancer Cluster, where we help to initiate clinical trials of pharmaceuticals. We are part owners of Catapult Life Science and share their ambition to aid the development of new pharmaceuticals through our expertise in process, production, analysis, quality assurance and regulatory issues.

IFE also has good working relationships with key industry players such as Bayer, Nordic Nanovector, Oncoinvent and Scatec/Thor Energy.

In addition to the unique expertise gained through the radiopharmaceutical activity, parts of the energy research can be applied to the area of health. For example, the calculations used in complex piping systems for the oil industry provide the basis for applications that involve the human body and blood circulation. IFE's researchers who have worked on petroleum extraction are now involved in activities where hospitals and the pharmaceutical industry are customers and partners.

IFE possesses extensive expertise in materials and particles, which has so far been used in solar cell technology. These are research areas that can also be applied to the development of pharmaceuticals.

Our ambitions with the focus

IFE wants to help 'close the gap' between academia, hospital researchers and industrial production, and in doing so create new jobs and contribute to the new approach needed in Norwegian industry.

Our ambition is to aid the development of new pharmaceuticals through the expertise we have in process, production, analysis, quality assurance and regulatory issues. We also aim to apply more of the energy research to the field of health care.

Strategic focus:

Digitalisation

Developments in energy storage, access to large amounts of data due to cheap sensors, the Internet of Things, data analysis, machine learning and learning algorithms create potential for disruptive innovation in digitalisation. IFE has a strategic focus on digitalisation, Dig IFE, with a view to becoming the leading research institute in this area.

IFE was a pioneer in Norway within IT and has been supplying IT solutions to Norwegian industry since the late 1960s. IFE is probably one of the largest research communities in digitalisation today. IFE's experts have extensive expertise in major, important international growth areas such as wind technology, solar technology, process industries and fluid flow technology. In addition, we have extensive experience in the practical application of new digital technology. Through the OECD's Halden Reactor Project and bilateral projects, IFE has been providing IT solutions to the international nuclear power industry for almost 60 years. On the Norwegian continental shelf, IFE has supplied control room systems for a number of offshore platforms.

IFE aims to be a desirable partner for industry and academia, but also as an employer that recruits and retains the best talent. This will put us in an even stronger position to exercise influence and define areas for Norway's adaptation towards greater digitalisation. Our ambition is to better equip Norwegian industry to thrive in the new digital world.


Oculus

Sector

Materials and Process Technology

Through research and development, this sector will contribute to a better society and cleaner environment by serving as a leading resource centre within renewable energy and environmentally friendly industrial processes. We will achieve this by enabling IFE's customers and spin-off companies to apply improved or new processes and methods. We develop new solutions and products for the private sector, mainly within renewable energy and materials and process industries.

Materials and Process Technology has around 60 employees (researchers, engineers and coordinators), as well as approximately 20 doctoral and postdoctoral researchers. Turnover is in the region of NOK 150–160 million. The sector consists of six departments:

- Solar energy
- Battery technology
- Renewable energy systems
- Neutron materials characterisation
- Computational materials processing
- Environmentally friendly industrial processes

The sector is currently conducting research in renewable energy systems, solar energy, batteries and hydrogen as future energy carriers, new energy materials and nanotechnology, advanced neutron materials characterisation, and environmentally friendly industrial processes.

Our main revenue is generated from research and development of new solutions and products for both the private and public sectors. Most of our expertise and innovation projects are co-funded through the system of policy instruments in the Research Council of Norway, ENOVA, Innovation Norway, the EEA and Horizon 2020, together with the business sector.

To aid our research, we have an advanced infrastructure that includes, for example, laboratories that undertake the following:

- Production of silicon-based solar cells, with the associated characterisation and analysis equipment
- Production of materials for use in solar cells and batteries
- Production of materials for CO_2 capture for use in hydrogen and energy production processes
- Development and testing of batteries
- Production of hydrogen through reforming or electrolysis
- Development of the hydrogen systems of the future
- Advanced neutron materials characterisation (the JEEP II Reactor at Kjeller)
- Advanced simulation and modelling platform for use in the development of new kinds of materials processing

The sector hosts two of Norway's eight new Centres for Environment-friendly Energy Research (FME): FME Research Centre for Sustainable Solar Cell Technology (SuSolTech) and FME Mobility Zero Emission Energy Systems (MoZEES).

We are partners in three other FME centres: one in bioenergy (Bio4Fuels) and two within the social sciences (CenCes and CREE). In addition, we are involved in over 100 other ongoing projects with external partners, typically to the tune of NOK 0.5–10 million.

Highlights in 2017

In a project partly funded by the Research Council of Norway's FORNY programme, Kjeller Innovation, IFE and Kiwa have developed a solution to address the problems related to the joining of materials. We have released complex mathematical software – which was developed at IFE over a period of more than 20 years – as a cloud-based web service that provides support for making decisions about complex issues. We have created a user-friendly website, weldsim.com, where welding coordinators can obtain decision-making support when devising welding procedures. We are also developing other solutions within robotisation and automated decision-making that can be used in a digitalised industry.

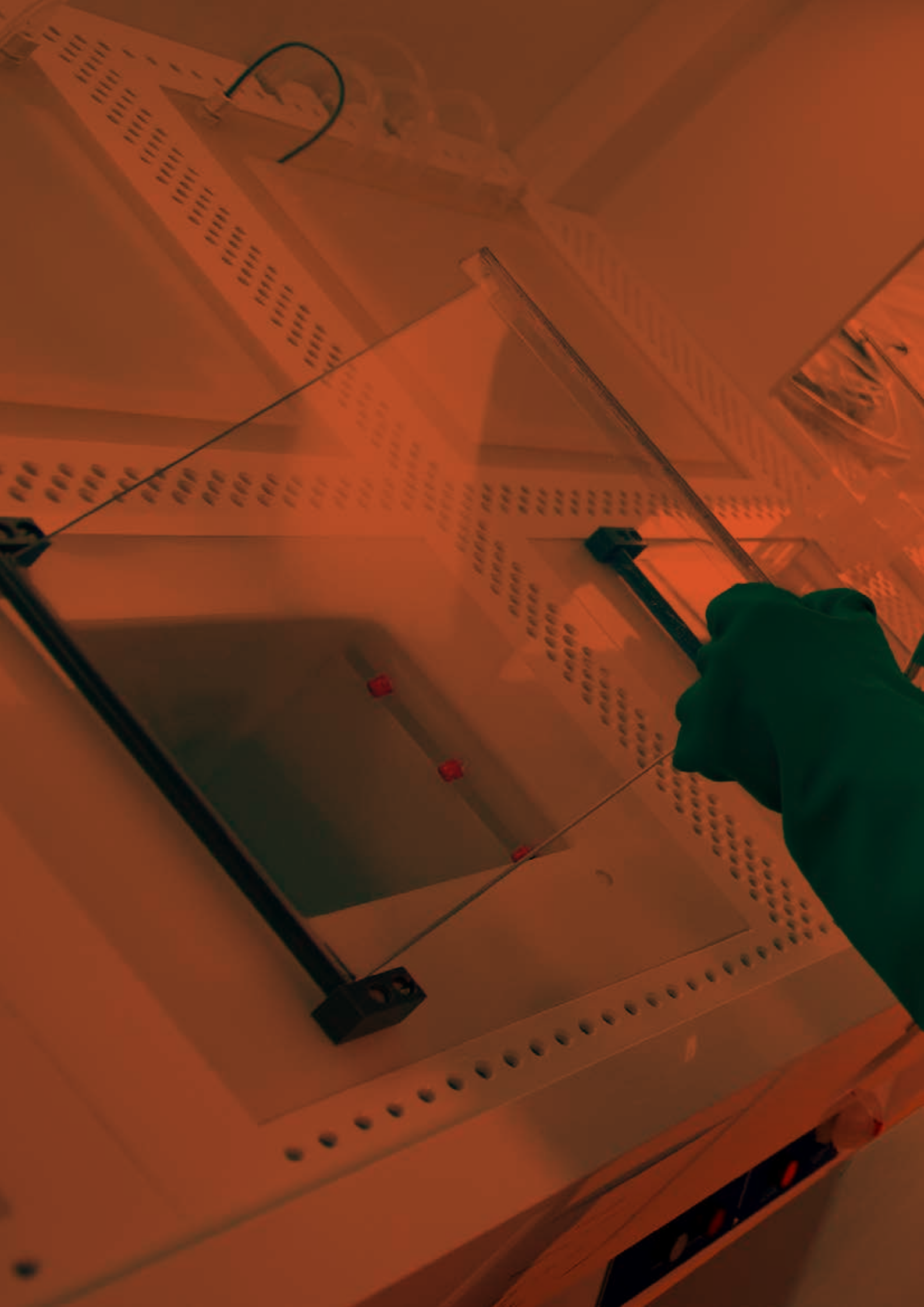
Through our focus on innovative environment-friendly processes, the sector is working with EU and Norwegian projects on the development of new low-emission technologies and materials for manufacturing and power production. Our project portfolio includes several projects that deal with SER technology, which is technology for hydrogen and power production with integrated CO_2 capture. We are also working on a new project to further develop the SER technology TechnoSER, where we are optimising and escalating the production of synthetic CO_2 sorbents. Our CO_2 sorbents are materials that capture CO_2 while hydrogen is being produced.

We have had a strategic focus on solar energy systems in recent years, and at the end of 2017 we received approval for several major Research Council projects where the use of solar energy is a core component. The areas covered include the use of big data to analyse operating conditions at large photovoltaic power stations (commonly referred to as solar parks) and optimal utilisation of solar power combined with local energy storage in batteries. Norwegian industry stakeholders in the national construction industry and in the global solar park industry are partners in these projects. Due to the growing need for expertise in this field, we plan to expand the research group with more researchers who will focus on these areas.

Market outlook

The global energy market is in the midst of a major shift away from centralised energy supplies using nuclear, gas and coal power towards a more distributed energy production based on renewable sources such as hydro, solar, wind, bio and geothermal energy. This shift is leading to a major upward trajectory in megatrends in all these areas, particularly in wind and solar energy, as well as energy storage using batteries and hydrogen. IFE is well positioned to take part in this growth.

In the materials and process industries, there will always be a need for materials with new types of properties. IFE is well positioned within this segment due to our powerful simulation and modelling tools, our expertise in producing brand new materials based on our nanotechnology know-how, and our capabilities in industrial processes.



Centres for Environment-friendly Energy Research (FME)

IFE hosts two FME centres: **MoZEES** and **SuSolTech.**

MoZEES - Mobility Zero Emission Energy Systems

The purpose of MoZEES is to contribute to the development of new battery and hydrogen materials, components and systems for existing and future use in the transport sector on roads, rails and seas. The research centre will contribute to the design and development of safe, reliable and cost-effective zero-emission transport solutions. There will also be a strong focus on education: 13 doctoral students and 5 postdoctoral students are working at the centre.

The focus areas for the research are as follows:

- New materials and processes for industrial niche markets for batteries and hydrogen
- Battery and hydrogen components and technologies for products aimed at the export market
- Battery and hydrogen systems for application in existing and new transportation markets (road, rail and sea), with a special focus on maritime applications
- New systems solutions and services, with a focus on sustainable and techno-economic navigable roads and zero emissions in the transport sector

The centre is a collaboration between four research institutions: IFE (host), SINTEF, the Institute of Transport Economics (TØI) and the Norwegian Defence Research Establishment (FFI), in addition to three universities (UiO, NTNU and USN), seven public sector partners, three private interest groups and 23 business and industry partners, including suppliers of materials, key components, technology and systems within batteries and hydrogen.

Highlights in 2017

MoZEES was officially opened by the Minister of Transport and Communications, Ketil Solvik-Olsen, on 20 March as part of a two-day kick-off seminar at IFE Kjeller. The centre's first general meeting was also held on this date, where the Board of Directors was established. MoZEES has its own website (www.mozees.no) and a Facebook page, as well as a SharePoint project room that all partners in the centre actively use.

An important part of MoZEES is to set the agenda for zero emissions in transport. In 2017, participants from the centre were therefore involved in organising several open seminars and workshops; MoZEES also helped to arrange three national seminars. In addition, the Centre Director, research directors and other MoZEES partners have given talks and presented posters at a number of national and international conferences and open meetings on batteries, hydrogen and transport. Long-term collaboration agreements with international research partners are also starting to be formed, including with Uppsala University (Sweden), VTT (Finland), the University of Cape Town and the University of Western Cape (South Africa), RWTH

CENTRE FOR ENVIRONMENT-FRIENDLY ENERGY RESEARCH
The Research Council of Norway

Aachen University and the Jülich Research Centre (Germany).

In 2017, a total of five PhD positions were created, where the main focus is on battery technology. An additional four doctoral students are planned for 2018. The research partners have started publishing relevant findings from MoZEES, on topics such as Li-ion batteries, Ni-metal hydride batteries, and battery and hydrogen safety. These areas also had the most research activity in 2017.

SuSolTech - Research Centre for Sustainable Solar Cell Technology

SuSolTech was established in 2017 and brings together leading research groups in Norway with major players in the solar cell industry from home and abroad. The centre was opened by the Minister of Climate and Environment, Vidar Helgesen, during the Norwegian Solar Cell Conference held in Son, Akershus county, in May. The centre has launched its website www.susoltech.no and a Facebook page.

Today, the solar cell industry is completely dominated by silicon-based solar cells, which we believe will continue to be the case for many years to come. A shift to a more sustainable energy system based on renewable resources will therefore depend on access to an increasing volume of sustainable silicon materials, ingots and wafers that enable the production of ever-more efficient solar cells, solar panels and solar power systems.

The anticipated further growth in the solar cell industry represents a huge commercial opportunity, including for Norwegian companies. Silicon materials for global use in industry are a Norwegian industrial speciality. The centre helps to strengthen these companies in a competitive industry through the development of new production processes that enable cleaner production, lower costs and a higher quality of materials. The centre achieves this through research along the entire value chain.

The centre monitors the production in solar cell plants in order to demonstrate the effect of the planned development of materials and processes on both the environmental footprint and the cost. The activity in solar cell plants supports a rapidly expanding industry in Norway within the field of installation and operation. This industry is expected to grow further in the years ahead.

The centre is also partnered with companies that are not currently considered to be part of the solar cell industry, such as organisations, architectural firms and energy companies. These draw on the centre's broad expertise in order to develop new business opportunities. The FME SuSolTech centre will be the main national focal point for expertise and innovation within the growing solar power industry in Norway up to 2025.


% H2O
% CaCl2
% NaAcet
5% CaCl
20% NaAcet
±5% H2O + ME

Sector

Fluid Flow and Environmental Technology

This sector uses its research expertise in a variety of market areas with overlapping technology needs. Through our focus on the specialist knowledge in the departments, we work in a wide range of markets, such as wind energy, oil and gas, health and environmental technology. Turnover is approximately NOK 80 million, and the sector has 63 employees in a total of five departments:

- Corrosion technology
- Flow engineering
- Wind energy
- Tracer technology
- Environmental analysis

Much of the research in this sector is linked to the oil and gas industry, and knowledge from this area is used as a basis for forming interdisciplinary groups in other areas of IFE. With its in-depth knowledge of areas such as fluid dynamics, chemical analysis and material selection, the sector is well placed to conduct research in which digitalisation, interdisciplinarity and innovation are core components. This amply covers Norway's research needs as we move towards a more sustainable society where the goals include reducing the environmental footprint and implementing a circular economy.

The sector has expert competence in chemical analysis and the interpretation of how chemical components and other pollutants move in the ground. This ability to trace and find chemical components is used in fields such as hydrogen research and research on pollutants and repositories. A large part of the sector's work is linked to IFE's key focus on health, digitalisation and renewable energy.

The sector's researchers have been developing digital tools for Norwegian industry for more than 30 years, and the development of OLGA symbolises what is perhaps the most important innovation in the Norwegian research industry ever. OLGA is a modelling tool for the transportation of oil, gas and water in the same pipeline, known as multi-phase transportation. The name is an abbreviation of 'oil and gas simulator'. The multi-phase technology was voted by the newspaper Aftenposten as the most important Norwegian invention since 1980. The technology has made it possible to develop fields that are situated further from land and at greater depths, and has saved the oil industry billions of kroner.

The sector previously hosted an SFI within fluid flow technology. Today the sector is no longer dominated by major projects, but is instead made up of a number of smaller projects. A strong commercial focus prevails and many of the projects are bilateral with international customers. Together with the University of Stavanger and IRIS, the sector is a partner in one of the Centres for Research-based

Innovation (SFI) – the National IOR Centre of Norway. Most of the revenues stem from Research Council projects. Within corrosion technology, environmental analysis and flow engineering, significant revenues are generated from bilateral projects with industry where no funding is provided by the Research Council.

Statoil is the sector's most important customer – both in renewable energy and in oil and gas – and participates in project proposals in the areas of geothermal energy, wind energy, corrosion and flow engineering.

The sector helps Norwegian industry to be more competitive in a globalised market and to develop more sustainable solutions. Our focus is on the environmental monitoring of repositories and landfills with a view to developing expertise that is in demand by local authorities and the Norwegian government. We also focus on health, and want to help Norway develop the best flow models for blood circulation in the world. Norwegian companies will thus be world leaders in the usage of medicines and the customised treatment of patients.

In addition to these new initiatives, our corrosion laboratories are world class in terms of experimental work. This means that we can assist industries worldwide to build their facilities at the lowest cost possible through optimum material selection.

Highlights in 2017

In 2017, there was a general trend towards a more positive outlook in the oil market, and more contracts were entered into compared with the preceding years. Activity linked to the market in Brazil increased in 2017, and the corrosion activities in particular have been a source of great interest, with new contracts being signed in 2017.

The strategic focus in the field of health also began to bear fruit in 2017. Calculations in complex piping systems for the oil industry provide the basis for application to the human body and blood circulation. IFE's researchers who have worked on petroleum extraction are now involved in initiatives where hospitals and the pharmaceutical industry are customers and partners, including in an innovation project in collaboration with Oslo University Hospital, Rikshospitalet, where we use the expertise from oil flows to research cardiac blood flows.

Offshore wind turbines are exposed to the wind and sea, and loads they are subjected to by the sea impact on their design, behaviour, reliability and cost. The wind energy researchers at IFE have developed the 3DFloat software, which is used to simulate the challenging conditions that offshore wind turbines need to withstand at sea. In a new project that was completed in 2017, the DIMSELO project, researchers focused on developing

knowledge and simulation tools for engineers to replicate the wave forces that offshore wind turbines are exposed to in shallow and medium depths. This enables more realistic calculations of wave loads, reduces uncertainty and reduces the cost of offshore wind power. The project covered simulations of the waves themselves and the effect of wave loads on offshore wind turbines.

The most exciting innovations from DIMSELO are two new methods that enable more realistic computer simulations of waves. The first innovation is a new method that allows engineers to conduct more realistic simulations of extreme waves. The second innovation is a new method that enables engineers for the first time to simulate medium-sized waves both quickly and without simplifications.

IFE entered into a strategic partnership with BI Norwegian Business School in 2017. IFE and BI submitted several joint project applications, and together with the group from the Executive Master of Management in Energy, BI took part in various visits and tours in order to familiarise itself with IFE. The goal is to strengthen the research collaboration in Greater Oslo within energy technology and management.

Market outlook

The sector faces a number of challenges that must be solved in order to achieve a healthy economy going forward. The departments in the sector were previously closely linked to activities in the oil industry and have therefore strongly felt the effects of the significant change in this industry. Following the drop in oil prices in 2013, fewer contracts were signed than in previous years, which has been reflected in the lower levels of activity in recent years. The trend towards smaller oil and gas projects continues, and the future strategy for this sector will therefore be to maintain a strong focus on expanding the areas in which the departments are engaged.

Despite the ongoing challenges brought about by the falling oil prices and the phasing out of the fossil-driven society, the departments still have a huge potential for future growth. By focusing on the knowledge we possess, we have initiated the diversification that will lay the foundation for a future healthy economy. The sector will increase its focus and turnover in projects such as repositories, which are relevant to public sector agencies and companies. We will increase our renewable energy turnover, where wind and geothermal energy are the key focus areas, and we will supply specialist services in hydrogen technology. Our substantial focus on health will form the basis for exciting projects in 2018 and the years ahead. In all of these areas, we aim to produce solutions that will serve to underpin new companies that IFE can support.

In addition to this, we will provide R&D in oil and gas to Norwegian and international stakeholders, and will be a leader in this area for as long as the Research Council of Norway prioritises this industry.

Sector

Digital systems

This sector researches areas that are complex and of critical importance to society in relation to digitalisation, with a special emphasis on the digital transformation of organisations. Turnover is approximately NOK 117 million, and the sector has 66 employees in six departments:

- Risk, safety and security
- Virtual and extended reality
- Intelligent systems
- Control rooms and interaction design
- Human-centred digitalisation
- Automation and user monitoring

IFE hosts the Halden Reactor Project for the OECD/NEA, and 52 per cent of the sector's revenue stems from these projects. The sector handles all projects that involve interaction between people, technology and organisation, and safety in the complex process industries. In addition, we generate revenues from international and national contracts. The sector is working strategically to increase the proportion of research projects (EU, Research Council of Norway, etc.) in the project portfolio. In addition, it is seeking to boost expertise from areas such as intelligent systems, machine learning, visualisation and big data, which has been gained from the Halden Reactor Project, and to use this in areas other than nuclear power.

Highlights in 2017

New technology and digitalisation are leading to fundamental changes in all industries and activities, both in the public and private sectors. There is a growing need for digital solutions and services, and IFE has been working hard to develop its strategy to identify in which areas of digitalisation we want to strengthen our focus.

In 2017, the sector entered into several new, strategically important contracts, such as a framework agreement with Bane Nor for the development of new traffic management exchanges and a new collaboration with the Norwegian Directorate of Public Construction and Property in a project that deals with efficient energy use in buildings. The sector has also held a number of workshops, both internally and externally, with a focus on the safe decommissioning and dismantling of nuclear power plants, for example.

Market outlook

The Digital Systems sector designs efficient control rooms for a number of different clients, including nuclear power stations, the railways and remote-controlled control towers. One example is our design of control rooms for the European Spallation Source (ESS) in Lund, Sweden, which is one of the world's largest scientific and technological infrastructures currently under construction. We develop software, such as VR software, for the

design of control rooms and software that is used for the safe decommissioning of nuclear power plants in several countries. We assist businesses with risk, safety and security needs. We use machine learning and big data to assist companies with condition monitoring, maintenance, automation and user monitoring. We assist contractors with organisational design, enabling them to effectively implement digital technology and analysis tools that provide support in complex decisions.

For many years, around half of the sector's turnover has been generated from the Halden Reactor Project. This has enabled us to develop skills that are highly relevant – and often unique – for helping organisations with their digital adaptations. This is one of our strengths. However, over a longer period of time this revenue has made us less dependent on submitting research applications. In addition, the Halden Reactor Project's publications are in the form of reports that are reserved for member organisations. This means that, despite the extent of our work, we have little experience in writing research applications, and our research is less visible than that of other research institutes.

The sector is now putting considerable efforts into writing applications in order to increase the proportion of funds from the EU and the Research Council of Norway, and to increase the frequency of publication. We believe that we have a strong basis for succeeding, since our research has for many years been highly relevant to the digital shift in the private and public sectors – an area of ever-increasing demand. Our unique expertise in some areas of digitalisation, such as human-centred organisational design, IT risk and security, design of control rooms and alarm systems, automation and machine learning, means that we are better positioned in this area than other research institutes. We also have extensive experience in complex processes within nuclear activities, where safety requirements are very strict. This gives us a competitive edge when meeting new industrial clients.

Division

Radiopharmaceuticals

This division works with radioactive medications (radiopharmaceuticals) and has the following key areas:

- Contract production of radioactive medications
- Distribution of radiopharmaceuticals in Norway and internationally
- Research and development in radiopharmaceuticals

In 2017, the division had approximately 140 employees and a turnover of NOK 341 million.

The division plays an important role in the health industry and its development in Norway, particularly within radiopharmaceuticals. IFE has the expertise to assist researchers and new start-ups with the pharmaceutical development of new medications in areas such as process development, analysis, quality assurance, production and distribution. In doing so, IFE can help ensure that development work, commercial production and the creation of new jobs all take place in Norway.

Distribution activities safeguard access for patients in Norway to radiopharmaceuticals that are of the right quality and supplied at the right time through controls, traceability and validated and efficient transport chains. The division is also a resource centre for the development and use of radiopharmaceuticals. IFE has been producing radiopharmaceuticals since 1953 and has served as a national pharmacy for radioactive medications since that time. The institute intends to continue its important social role as an 'isotope pharmacy' for Norway. The import and distribution of short-lived products which are not yet produced at Norwegian PET centres is another important aspect of IFE's social mission.

The division's most important customers are Bayer AG – where Bayer AS in Norway is the main point of contact – Nordic Nanovector and Norwegian hospitals. To date, the main sources of income for the Isotope Laboratories have been development work and contract production for Bayer and other new start-ups within radiopharmaceuticals. The wholesale activity to Norwegian hospitals and the global distribution to clinical trials has been and remains a stable source of income for the division. In 2018, the business area will be named 'Radiopharmaceuticals', and will be divided into three sectors:

Radiopharmaceutical Production
This sector will be responsible for the production of radiopharmaceuticals for late-phase clinical trials and contract production of Xofigo® for Bayer. Xofigo® is a medication used to treat prostate cancer patients.

Radiopharmaceutical Wholesaler
This sector will serve as a wholesaler and retailer of radiopharmaceuticals in Norway. All radiopharmaceuticals to Norwegian hospitals are controlled and distributed through the Isotope Laboratories at Kjeller. The sector will

also be responsible for the distribution of radiopharmaceuticals for clinical trials, nationally and globally, as well as the distribution of self-produced products.

Radiopharmaceutical Research and Development (R&D)
This sector will aid the development of radiopharmaceuticals for clinical trials, including process development, analysis development and studies that are needed to document stability, robustness and reproducibility. Production of radiopharmaceuticals for early-phase clinical trials is an important task.

In the satellite in the Oslo Cancer Cluster Incubator (OCCI), the sector is involved in the development of cell labelling, and the labelling and bonding (chelation) of radioactive nuclides. The research communities at Oslo University Hospital (OUS) and the University of Oslo (UiO), as well as smaller new start-ups are all important partners. There are currently two master's students and a doctoral student funded by the Research Council of Norway. The sector will constitute the hub of IFE's focus on health going forward and will form collaborations with the other research sectors at the institute. The three new sectors will have a close cross-disciplinary collaboration. The R&D sector will eventually be able to hand over new production projects to the production sector, and the wholesale sector will have distribution expertise that can be used by both of the other sectors. The three sectors will form part of a division, with a division director who will coordinate the collaborative efforts.

Highlights in 2017

2017 has been a good year for the division, with a high level of activity and regularity in production. The good working relationship with Bayer has been expanded both in terms of Xofigo® and other products planned by the company, while the growing cooperation with other Norwegian pharmaceutical industries has also been positive. The cooperation with Nordic Nanovector, primarily in relation to the production for a major clinical trial programme and several developmental tasks, looks particularly promising.
In 2017, the division was approved for participation in two BIA projects (the Research Council's User-driven Research-based Innovation programme) in production technology and automation, together with other stakeholders in the field of pharmaceuticals. The project 'Development of new production technologies for biopharmaceuticals', which entails the production of biopharmaceuticals and radiopharmaceuticals in Norway, is made up of a consortium headed by Diatec Monoclonals. Catapult Life Science, IFE, Norsk Medisinsk Syklotronsenter AS, Nordic Nanovector, Prediktor Instruments and Mektron, as well as the research and development partners SINTEF Materials and Chemistry, SINTEF Raufoss Manufacturing and the University of Oslo are also participants. The other important BIA project is 'Novel technology for production of alpha-emitters for radionuclide

therapy', which involves the development of new production technology for radionuclides that is newer, less expensive and more environmentally friendly than the current technology. This research-based project is investigating whether the radioactive isotope Terbium-161 is suitable for medical purposes. Participants are Thor Medical, Oncoinvent and Reetec, with IFE in the role of research and development partner.

The division has also further developed the distribution expertise for radiopharmaceuticals and medications in general with a view to controls and traceability, validation of transported items and transport routes, and the handling of hazardous goods.

Radiopharmaceuticals is currently a booming field in Norway, and a number of new start-ups have been established. An exciting cluster has been formed, where the research communities in cancer treatment and product development at the Oslo Cancer Cluster and Oslo University Hospital work together with new entrepreneur communities. IFE and the new sectors within Radiopharmaceuticals are, and endeavour to remain, a crucial part of this forward-looking industry cluster and will contribute to the social mission to create new jobs and develop a viable health industry in Norway.

IFE's nuclear research activities

Nuclear research activities comprise the Kjeller JEEP II research reactor, the Halden Reactor and the Nuclear Waste Management and Decommissioning Sector, in addition to Nuclear Material Technology, Electron Beam Welding and Workshops department.

IFE has a turnover of NOK 284 million, and 170 employees in its nuclear research activities.

The JEEP II Reactor at Kjeller

The reactor makes it possible to 'see into' different materials in order to find out how atoms organise themselves. The main purpose of the Kjeller JEEP II Reactor is to produce and make neutrons available for research on new functional materials based on metals, composite materials and biological materials.

The JEEP II Reactor has been in operation since 1967 and forms part of the national research infrastructure for basic physics research and materials technology. Research on materials and nanotechnology requires experimental facilities, where different types of materials can be subjected to fundamental studies of atomic and molecular structure. In such a facility, information about the different materials can be obtained by beaming light or particles into the materials. Neutrons are unique in this context, and they provide information that is impossible to acquire in any other way. JEEP II is the only experimental facility at the Norwegian Centre for Neutron Research (NcNeutron) and the only facility in the Nordic region of this type. NcNeutron is part of the national infrastructure of research under the auspices of the Research Council of Norway, and SINTEF, the University of Stavanger, the University of Oslo and NTNU are all participants. IFE hosts NcNeutron and is a national resource centre for neutrons and fission, and an international partner for R&D projects in this field.

Since the reactor is easy to start up and shut down, it is suitable for the production of various isotopes for medical research or industrial purposes. The reactor is therefore important for IFE's research and development activities in areas such as medicine, oil and gas, and Norwegian industry's ability to use radiation sources. A reactor also provides a complete infrastructure for radiation protection and safety that is unique to IFE.

Part of the European research infrastructure

Neutrons remain a key part of international materials research. The world's largest spallation source is being built in Lund, Sweden (ESS). ESS is the EU's largest research project, and when completed in 2023 will cost approximately NOK 20 billion. NcNeutron has a strategic partnership with ESS regarding the use of JEEP II as a test facility for instrumentation for ESS, student training and preparation of experiments that are subsequently carried out at ESS. ESS management regard the JEEP

II Reactor as a key partner. Hence the JEEP II Reactor is also important as an 'admission ticket' for Norway to what will become the world's largest materials technology research community.

Since fission is central to neutron production, JEEP II is also important in understanding fission, reactor safety and nuclear disarmament. Over the past ten years, several exercises have been conducted regarding the verification of nuclear weapons disarmament in cooperation with national agencies such as the Norwegian Ministry of Foreign Affairs and the Norwegian Armed Forces.

Highlights in 2017

In October, a team of eight reactor experts from the International Atomic Energy Agency (IAEA) reviewed the operational safety of the JEEP II Reactor at Kjeller. Feedback was good and the team of experts concluded that the IFE places great emphasis on safety efforts in its work.

In 2017, JEEP II also performed advanced services in relation to the establishment of a zero emissions society as well as basic research projects. The development of new and improved electric vehicles requires advanced electronics, particularly in the transition between direct current and alternating current systems, and the doping of such semiconductor systems takes place in research reactors worldwide – including JEEP II. The Kjeller research reactor is particularly well suited for such tasks since it is a heavy-water moderated reactor, such that the quality of the doping is equal to that of the world's leading facilities. IFE's customers come from all over the world, with the bulk of them from the Japanese electronics industry.

Nuclear research activities in Halden

IFE has comprehensive nuclear research activities in Halden in connection with the reactor and through the Halden Reactor Project, which is an international research programme on nuclear safety under the auspices of OECD-NEA (OECD Nuclear Energy Agency).

Twenty countries and more than 100 organisations currently participate in the Halden Reactor Project, which was established in 1958 and is the oldest and largest project in OECD/NEA's portfolio. The OECD/NEA emphasise the importance of the Halden Reactor Project for global nuclear safety work. There has been a steady increase in new countries joining the project, including China, the United Arab Emirates (UAE) and the Netherlands.

The Halden Reactor is the test facility for the Halden Reactor Project in the field of reactor fuel and reactor materials. Bilaterally commissioned research is also carried out. The reactor has been in operation since 1959 and is situated 100 m inside Månefjellet. The Halden Reactor (HBWR) is a 25

MW heavy water reactor of the BWR type (Boiling Water Reactor), but it is not a power reactor. The energy produced is delivered as steam through heat exchangers and pipelines to Norske Skog's factory in Halden, where it is used in paper production.

The sector has highly developed mechanical workshops and machines for electron beam welding that in addition to supplying the sector's own projects, are also used in assignments for the petroleum sector and other industries.

In addition, the sector has the broad expertise needed to handle Norwegian nuclear waste in a safe and effective manner. This expertise also comes into play in the planning and future decommissioning of the Halden Reactor.

Highlights in 2017

The Halden Reactor Project regularly arranges project meetings referred to as 'Enlarged Halden Programme Group Meetings', (EHPG). The most recent meeting, which was the 40th in the series, was held at Lillehammer in September. A total of 230 participants from 22 countries took part. The EHPG is the most important meeting place for the member organisations of the Halden Reactor Project and IFE's researchers in Halden. It is estimated that approximately 10 000 of the world's leading experts on nuclear safety have participated in these meetings since the first one was held in 1966.

The Lillehammer conference was a great success and confirmed the project's major importance and relevance for international collaboration on nuclear safety. International support for the project was also clearly in evidence at the board meeting (Halden Board) in Paris in December, where the participating countries supported an extension of the project for a further three-year period (2018–20).

Nuclear power can be a long-term component of the global energy mix. The UN's Intergovernmental Panel on Climate Change points out that nuclear power is part of the solution for achieving the 2 degrees goal. The IEA estimates that in 2040, nuclear power will contribute approximately 10 per cent of electricity production globally.

Through the Halden Reactor Project, the IFE has good contact with the market's most important stakeholders – authorities, power producers, supplier industries, research institutions – and the IFE is known in the market as a reliable supplier of safety data.

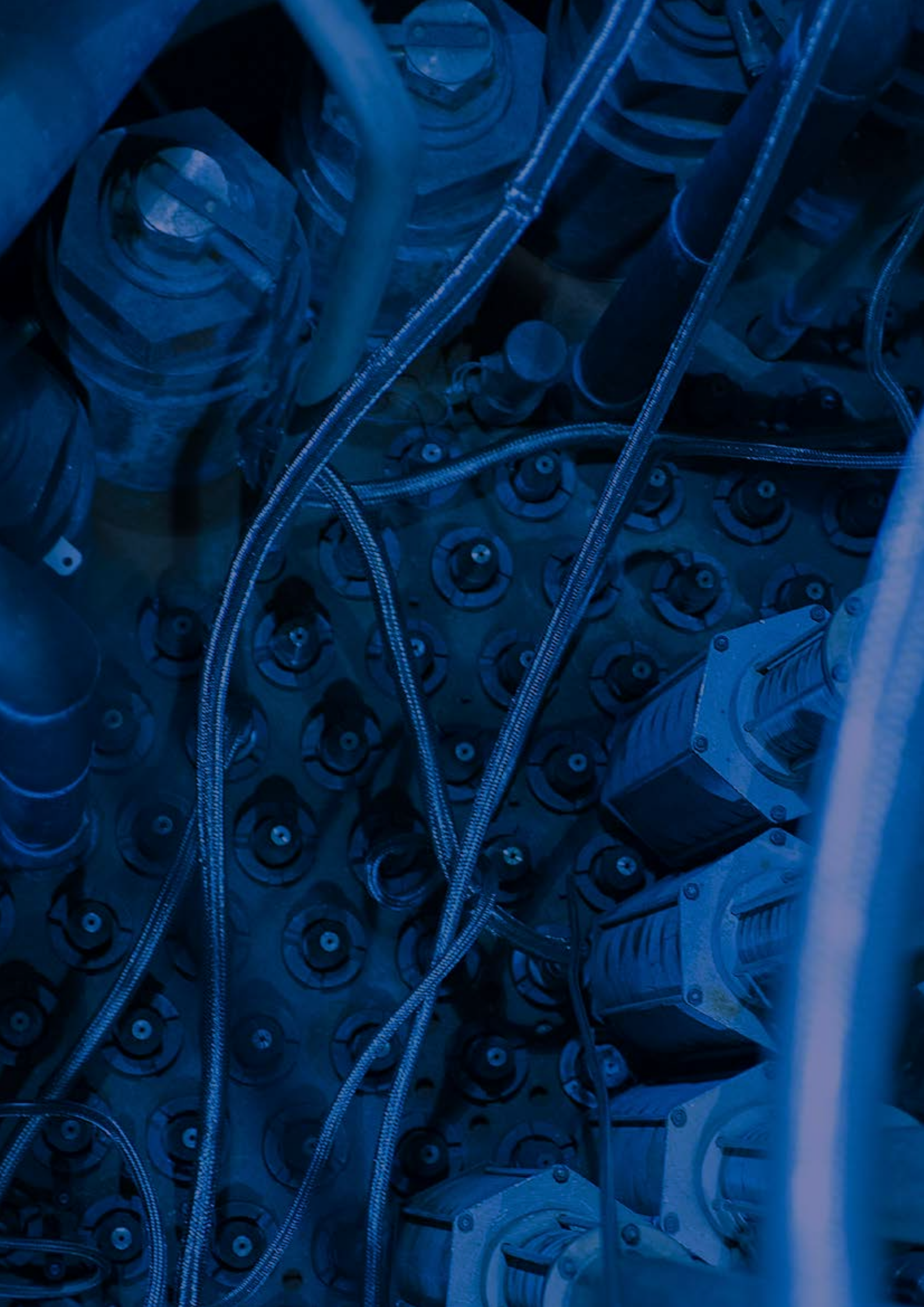
IFE works in conjunction with the OECD/NEA to establish new research areas and strengthen those recently established, such as the effect of neutron radiation on concrete, for example.

Market outlook

The bilateral market has changed in recent years. Research on traditional fuel and material types is declining because of the expertise the authorities and industry have already gained, and because the development of data codes has reduced the need for experiments.

The market has changed following the Fukushima accident in 2011, with a number of countries reducing their nuclear programmes. There is a need for research on new types of fuel, and it is uncertain whether this can be carried out in the Halden Reactor. When IFE's licence was renewed in 2015, new requirements were imposed for fuel that is tested and spent to be returned to the customer. This is a complex, demanding and costly process. Consequently, it has been extremely difficult to sell new projects.

The Norwegian authorities prioritise the processes of ensuring safe handling of nuclear waste and preparing for future decommissioning. Together with major financial challenges for IFE's nuclear research sector, this makes the Halden Reactor's future uncertain.



Sector

Nuclear Waste Management and Decommissioning

This sector is one of three sectors in IFE's nuclear research activities.

The Nuclear Waste Management and Decommissioning sector was established on 1 January 2017 with a view to addressing the recommendations made in official reports (concept studies, 2015 and 2016) on solutions for Norwegian nuclear waste and future decommissioning of nuclear facilities in Norway. The reports clarified the need to initiate efforts to find final disposal solutions for the historical nuclear waste stored at IFE's nuclear facilities at Halden and Kjeller. The nuclear waste comprises spent fuel from the operation of IFE's research reactors, the remains of experiments on the handling of spent fuel, and long-lived radioactive waste from hospitals for which there are no final disposal solutions at present. Storage is regarded as only a temporary solution and a final solution would either be the recycling of waste where possible or depositing it in a satisfactory manner.

The Norwegian government has assumed joint responsibility for clearing up nuclear waste, and the sector's work is governed by the letter of allocation from the Ministry of Trade, Industry and Fisheries. Activities are mainly funded through government grants via the central government budget.

Sector organisation

The sector is divided into three departments and has a programme dealing with activities related to waste management and the future decommissioning of Norway's nuclear facilities.

The ***Historical Nuclear Waste and Decommissioning Programme*** was established to ensure overall follow-up of the main recommendations made in the official reports mentioned above. The overarching recommendations cover all tasks that must be accomplished in order to find short-term and long-term solutions for nuclear waste, and to ensure a good combination of solutions for storage of nuclear waste and decommissioning plans.

The programme consists of a total of nine sub-programmes in addition to programme management. The sub-programmes are headed by a sub-programme manager with responsibility for one or more sub-programmes. Each sub-programme includes a number of projects that form part of an established project structure. A dedicated planner has been engaged for the programme. The IFE is particularly involved in some programmes, while in other sub-programmes stakeholders such as the Norwegian Radiation Protection Authority, the Ministry of Trade, Industry and Fisheries, and the Norwegian Directorate of Public Construction and Property play a central role.

The ***Nuclear Technology Department*** is a technical department that shall mainly contribute resources to the Historical Nuclear Waste and Decommissioning Programme. In addition, the department is responsible for facilitating the process of establishing agreements with other sectors for technical assistance in connection with programme tasks. The number of employees in this department is expected to increase in order to secure essential skills and resources for key technical roles in the programme's projects.

The ***Project Management Department*** is responsible for developing the necessary methods, systems and tools for carrying out the programme projects. The department consists of just one permanently employed department manager at this phase. Our strategy is to secure essential competence in project management by hiring professional project managers to develop the programme and ensure adequate progress and quality. Hired project resources will be part of programme management. A further upscaling of the department with permanently employed project managers will depend on the design of the solution for transferring tasks from IFE to the Norwegian Nuclear Decommissioning Authority (NND).

Both the Nuclear Technology Department and the Project Management Department contribute resources and technical expertise to the programme. The sector is thus defined as a matrix organisation.

The ***Radwaste Department*** receives, handles and stores solid and liquid radioactive waste from IFE's own activities and also from external activities in the trade and industry sector, defence, the public health service and research. IFE's facilities constitute the national centre for these services. The aim of the technical processes at the facility is to reduce the volume of waste so that the amount to be stored is as small as possible. Thereafter, the waste is encapsulated so that it is suitable for long-term storage. The purpose of encapsulation is to prevent the release of radioactive materials into the environment.

The department is responsible for the operation of a combined deposit and storage facility for low- and intermediate-level radioactive waste (KLDRA) in a rock cavern in Himdalen in Aurskog-Høland municipality. The Norwegian government, represented by the Norwegian Directorate of Public Construction and Property, is the owner of the Himdalen facility.

Highlights in 2017

In 2017, activities in the Historical Nuclear Waste and Decommissioning Programme have largely focused on developing plans for the solutions needed to secure appropriate storage of spent fuel and facilitate the export of unused fuel that IFE itself will be unable to use in the reactors.

However, the greatest challenge for the sector is a type of fuel stored at IFE's nuclear facility that is chemically unstable and cannot be deposited. This type of fuel constitutes two-thirds of the total volume of fuel, and reprocessing (recycling of uranium and plutonium for the production of new

reactor fuel) at ORANO (formerly AREVA) in France is the main solution for this fuel. In 2017, the sector had a wide-ranging dialogue with ORANO about such a solution. An alternative to this method is also being discussed by Studsvik in Sweden.

Activities related to this sub-programme will primarily be linked to spent fuel characterisation. This will be done at a level of detail and a scope not previously experienced at IFE. The requirements for spent fuel characterisation are mainly guided by ORANO's needs regarding information about the fuel they may receive. If all spent fuel can be sent to ORANO, and Norway can receive a type of waste in return that does not require a deep geological depository, this might reduce the cost of a depository in Norway. Such a solution would also require suitable final disposal solutions for other long-lived radioactive waste that is not spent fuel and which cannot therefore be sent to ORANO or deposited in KLDRA.

In 2017, a study was also conducted of the possibility of changing the encapsulation material for spent fuel from the JEEP II Reactor from aluminium to a material that allows the deposit of spent fuel from the reactor. Both internal resources and external support were used in this work.

The JEEP I rod wells for radioactive waste including fuel from the first reactor, JEEP I, which started up in 1951, are located at Kjeller. The JEEP I rod wells consist of 97 wells. The condition of this storage facility has proved to be unsatisfactory, and damp and rust have been detected. When the work on examining the condition of the fuel rods began, 18 containers were found to be firmly lodged in the wells. Using considerable operational skill and a range of special tools designed, constructed and produced by IFE, the sector succeeded in autumn 2017 in carefully retrieving all 18 containers.

As an overarching plan, the Historical Nuclear Waste and Decommissioning Programme remains at the concept development phase. This will require work to be carried out in parallel on several possible solutions. In 2018, various detailed scenarios will be developed for the storage of spent fuel and the type of facility that must be established for prior treatment of the spent fuel before being transported out of IFE's nuclear areas.

In 2017, the programme had a turnover of NOK 30 million, and for 2018, NOK 67 million has been allocated via the central government budget, of which NOK 27 million is funding rolled over from 2017. Tasks representing funding of NOK 100 million have been identified in relation to ensuring the necessary progress in the programme. Applications for extra funding have therefore been made via the revised national budget for 2018.

Transfer of tasks from the sector to the Norwegian Nuclear Decommissioning Agency

The Norwegian Nuclear Decommissioning Agency (NND) was established on 1 January 2018, and is planned to be fully operative by 2021. A prime task for IFE and the Nuclear Waste and Decommissioning sector will be to find a way of transferring tasks from the sector to NND whilst simultaneously safeguarding IFE's research community during the transitional phase.

Environment and safety at IFE

IFE is subject to a strict body of regulations on safety and emissions. Our safety is closely monitored both nationally and internationally. In the case of emissions, the Norwegian Radiation Protection Authority sets limits for how much we are allowed to discharge to air and water. The emissions licence sets specific emission limits. In addition, limits are set for the maximum dose of radiation to which individuals in the most vulnerable population group can be exposed. The limits are very low since this is a question of safety. Nevertheless, the emissions are kept far below the limits set. In 2017, radioactive emissions to air and water from the Kjeller facilities amounted to 1.99 per cent and 0.008 per cent of the applicable dose limit, and for Halden 1.97 per cent and 0.09 per cent of the limits set.

Ongoing surveillance of radioactivity

The Health and Safety Department at Kjeller and the Radiation Protection Department in Halden have wide-ranging expertise in radiation protection, radioecology and radioactive waste, and play a key role in Norway's nuclear emergency preparedness. We conduct research and provide assistance to industry, the public health service, the authorities and research institutes using expertise developed at IFE. IFE has laboratories for measuring radioactivity in a variety of sample types, for dosimetry and calibration of radiation protection instruments in addition to its own electronics laboratory.

The responsibility of the Radiation Protection Department is to ensure that all use of radioactive sources and materials is in accordance with national laws, regulations and guidelines. Moreover, the department evaluates and follows up the recommendations of international organisations. The aim is to limit and reduce any radiation doses for employees at work, and check that emissions during normal operations do not exceed the emission limits. The Radiation Protection Department plays an important role in IFE's emergency preparedness should unforeseen events occur.

IFE's environmental monitoring ensures that we have a full overview of our total footprint. This takes place through the environmental monitoring programmes at Kjeller and in Halden. Every year, IFE issues a report on the environment with a detailed environmental audit and a description of IFE's work with health, safety and the environment.

Focus on safety culture

Safety always comes first at IFE. We therefore make constant efforts to improve our safety and safety culture. As part of this work, IFE invited the International Atomic Energy Agency (IAEA) to conduct an independent safety evaluation of the facilities at Kjeller in 2017. The expert group concluded that IFE strongly prioritises safety work in its activities, and highlighted IFE's continued improvement in this respect. IFE received a report with suggestions for improvement, and has invited the expert team to return in 2018 in order to evaluate the measures that IFE has put in place.

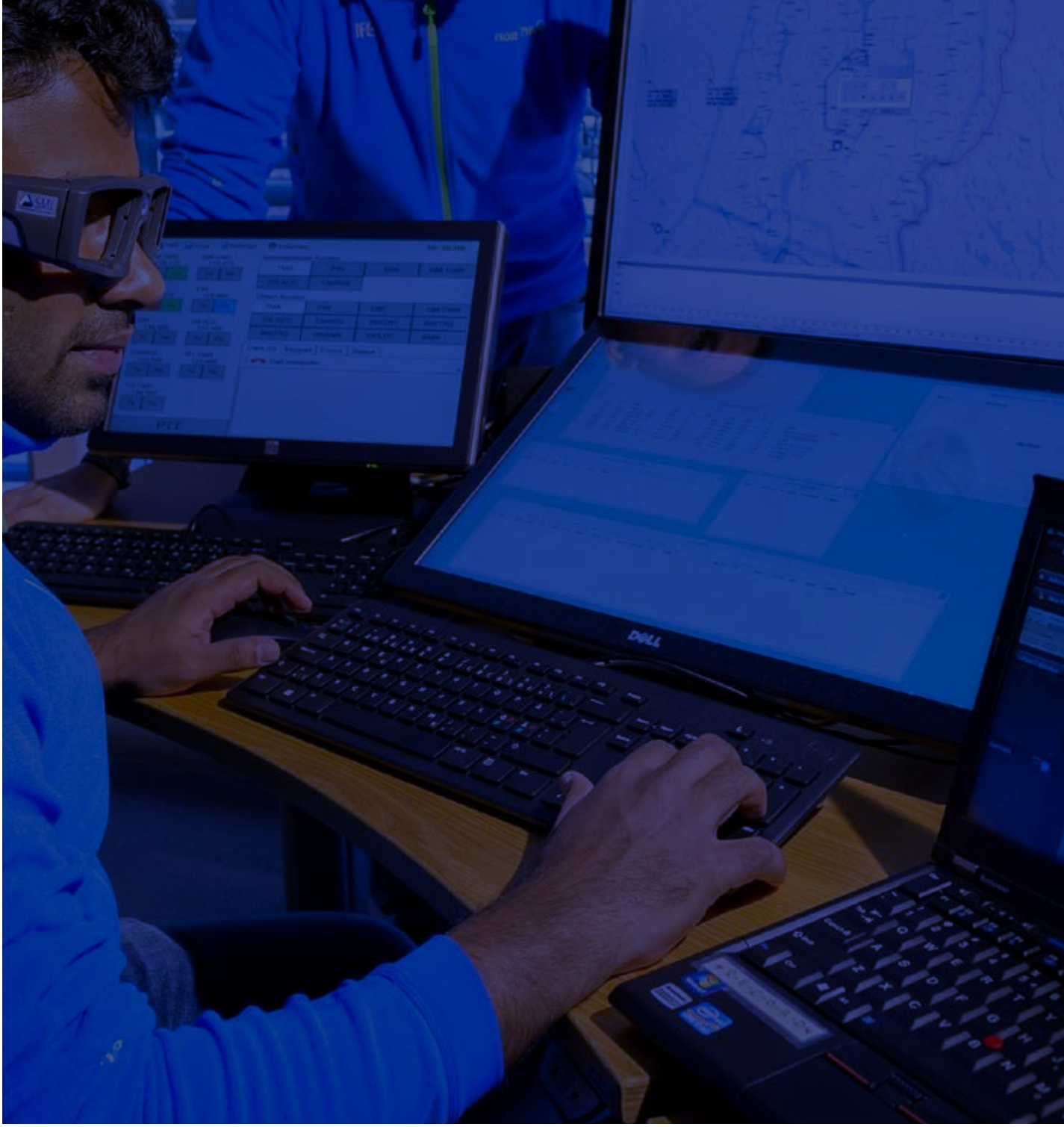
Greater EU drive

Up to 2017, IFE's EU activity was characterised by the interest and involvement of individual departments in EU projects. Since 2017, its EU-related activity has been more coordinated and strategically anchored. In 2017, IFE took major steps to increase this, including creating a new position to head the EU-related activity in August. This entails being a driving force in developing new applications to EU and EEA programmes as well as actively building networks with Norwegian and international communities. In connection with the launch of the new H2020 programmes in autumn, this coordination role has resulted in a strong growth in project applications.

Efforts to map the potential of IFE's various competence areas for future EU projects are also an extremely important part of the initiative. In order to secure our position in the future EU research arena, it is vital to work in a coordinated and strategic manner and to look to the future with the aim of identifying the areas IFE wants to be involved in. Since the platform for the content of the EU's new framework programme 'FP9' (2021-2024) will be established in 2018, we are also working in a coordinated manner through various networks and channels to convey IFE's understanding of what future research should focus on.

As of today, IFE has ten ongoing EU projects: five Horizon2020 projects and five projects in other EU programmes (NATO, EMPIR and M.ERA-NET). IFE has participated in fifty-four H2020 applications and has been the coordinator for six of these, preparing the application for the most part. One of these applications has been granted. IFE has traditionally hosted EU projects in the following areas:

- Solar energy
- Environmental technology, carbon capture, transport and storage
- Neutron characterisation
- Energy safety
- Tracer technology
- Geothermics
- Magnetism



The list of partners in these projects comprises more than 190, since EU projects have roughly twenty partners on average.

For H2020, we have identified many calls for proposals that are relevant for IFE's strategic research initiatives. They represent the three main pillars of H2020 (Excellent Science, Industrial Leadership and Societal Challenges).

Innovation and commercialisation

IFE has a long tradition of commercialising ideas from research and has garnered different experiences. Some commercialisation initiatives have become successful companies, including Scandpower, Kjeller Vindteknikk, SPT, Resman, Visavi, Apt and Zeg Power. In other cases, such as the multi-phase technology project OLGA, licensing has generated good revenues for many years.

IFE is an active partner in the innovative environment at Kjeller, which probably represents Norway's most complete innovation system alongside the NTNU and SINTEF environment in Trondheim. IFE has a 10 per cent ownership share in Kjeller Innovasjon AS, which is the technology transfer office for the Kjeller institutes. Akershus county municipality and Siva are also key owners. The business developers at Kjeller Innovasjon assist IFE to develop ideas, establish and develop companies, and apply for funding from the range of instruments.

In 2017, IFE created a position for an innovator who could drive IFE's innovation process and establish processes and systems from the initial development of ideas to realisation. Moreover, the postholder must convene meetings and arenas for innovation efforts, and act as IFE's contact vis-à-vis commercial stakeholders such as IFE Invest and Kjeller Innovasjon.

In 2008, IFE Venture AS was established as a fully owned subsidiary with the aim of increasing the commercialisation of IFE's research. The company changed its name to IFE Invest AS in 2017 and since autumn 2017, the former chief financial officer of IFE, Jørgen Lundberg, has held a full-time position in the company. IFE Invest AS develops companies and as an active owner follows them up with support for daily management, further market development, upscaling and capital injections. Investment capital totals approximately NOK 17 million and there are currently six companies in the portfolio. In addition, IFE Invest administers IFE's assets in the NIK III fund and IFE's Boligselskap AS. IFE has had access to a certain amount of early phase capital via IFE Invest AS, Akershus Technology Fund and Norsk Innovasjonskapital (NIK).

Income statement

Parent company *Figures in NOK thousand*				Group *Figures in NOK thousand*	
2017	**2016**	**Income statement per 31.12.**	**Note**	**2016**	**2017**
710,653	702,573	Contract revenues	12	721,949	735,427
137,544	141,653	Government subsidies	11	141,653	137,544
91,782	98,329	Contributions from international partners at Halden		98,329	91,782
2,736	3,253	Other operating income		5,838	3,445
0	0	Profit on disposal of fixed assets		133	0
942,715	**945,809**	**Total operating revenues**		**967,902**	**968,198**
501,065	491,588	Wages and social benefits	13	506,427	515,804
53,005	64,399	Pensions	13	64,669	53,468
70,399	63,917	Cost of sales		65,115	71,821
318,956	275,197	Other operating expenses	13, 14, 20	284,618	327,972
23,433	27,753	Depreciation, fixed and intangible assets	2	28,035	24,036
966,858	**922,854**	**Total operating expenses**		**948,863**	**993,101**
-24,143	**22,954**	**Operating profit/loss**		**19,039**	**-24,903**
1,644	17,532	Financial income	15, 16	7,535	3,038
3,145	7,015	Financial expenses	15, 16	16,968	7,094
-1,501	**10,517**	**Net financial items**		**-9,434**	**-4,056**
-25,644	**33,472**	**Profit before tax**		**9,605**	**-28,959**
0	0	Tax	9	-2,117	-642
-25,644	**33,472**	**Net profit/loss for the year**	**18**	**11,722**	**-28,317**
		Minority´s share of profit		-1,334	148
		Majority´s share of profit		13,055	-28,464
		Allocation of net profit/loss for the year			
-25,644	33,472	Other equity/uncovered losses	18		
-25,644	**33,472**	**Total available for allocation**			

Report of the Board of Directors

With a turnover of around NOK 1 billion and 600 employees, IFE is Norway's second largest research institute. The foundation's main offices are at Kjeller in the municipality of Skedsmo. The business is run from dedicated premises at Kjeller and in Halden.

The institute's three business areas are: i) research on energy, digital systems and health; ii) radiopharmaceuticals in our roles as development partner, producer and distributor; iii) nuclear technology involving IFE's two research reactors and extensive infrastructure tailored for nuclear activity, including radiation protection.

The JEEP II research reactor at Kjeller is an important part of the national research infrastructure. This is where IFE, in partnership with universities and research institutes at home and abroad, conducts research into physics, materials technology, radiopharmaceuticals, energy storage, CO_2 management and hydrogen technology.

The Halden Reactor is designed for research on safe fuels and safe reactor operation. Since 1958, the reactor has hosted the Halden Reactor Project, which is an international research programme run by OECD/NEA (Nuclear Energy Agency).

Challenging financial situation

The financial results for several of IFE's focus areas were weak in 2017. Due to market fluctuations and the introduction of new licensing conditions in 2015, our nuclear activity level fell as a result of fewer contracts. Since the Fukushima accident in Japan in 2011, the market for nuclear waste testing has been contracting. We have also noticed that the market has veered towards new materials and so-called 'accident tolerant fuels', but these do not necessarily lend themselves to testing in the Halden Reactor. Another important factor is the new licensing conditions that were introduced when our licence was extended in 2015. IFE can no longer store waste from bilateral projects in Norway, but has to return this waste to the client, or to a third country for storage. Moreover, it is hard to sign new contracts, because our operating licence runs out in 2020 and IFE cannot therefore guarantee that that projects will be completed by the end of the current licence period. In combination, these circumstances have resulted in significant weakening of the research market for the Halden Reactor and have led to considerable losses.

The autumn of 2017 saw the start of a comprehensive market study and analysis project that seeks to clarify the long-term market for the Halden Reactor. IFE will draw its conclusions from the study in the spring of 2018, and IFE's Board of Directors will decide by the middle of 2018 whether there is a sufficient financial basis to apply for a further operating licence from 2020.

A lower level of activity in the petroleum industry has led to weaker profits in a number of IFE's focus areas, such as petroleum research, the welding and engineering workshops, and the Man-Technology-Organisation activities that involve research on and the design of control rooms. IFE noticed the impact of the slump in oil prices in 2016 and implemented considerable cost-reducing measures, including layoffs that lasted into the first quarter of 2017.

Several of our business activities are going well. Radiopharmaceuticals delivered good results in 2017 and its growth targets for the remainder of 2018 are ambitious. From our premises at Kjeller, IFE works in close partnership with Bayer on contract production of the cancer drug Xofigo® for the global market. IFE also works with Bayer and other companies on a number of innovations, and we are currently considering expanding our radiopharmaceutical production capacity.

There are promising developments with respect to renewable energy and energy systems. The Digital Systems sector (formerly MTO) has succeeded in securing new contracts and the outlook for 2018 has improved. The activities associated with the management of historic nuclear waste will increase considerably in the years ahead. Safety and security is a field set to grow in the time ahead due to the expansion of the security regime imposed on IFE by national authorities.

The IFE foundation incurred a loss of NOK 25.6 million in 2017, largely due to the challenges encountered in relation to the Halden Reactor. This is considerably below our target operating margin of 5-7 per cent and is not a viable situation in the longer term. The Board has commissioned a number of investigations in order to establish the long-term market potential and the funding situation for the Halden Reactor's continued operation. It is also important to obtain clarification from the government in respect of the funding situation for the decommissioning of nuclear facilities and the clearing up of Norwegian nuclear waste.

Leaders in renewable energy

There is considerable growth in demand for our research within renewable energy and energy systems. In the spring of 2017, two new Centres for Environment-friendly Energy Research (FME) were opened with IFE playing host. One of them is MoZEES – Mobility Zero Emission Energy Systems, which involves 40 partners from R&D, industry and public sector agencies such as the Norwegian Public Roads Administration and the Norwegian Railway Directorate. The partners are working together to develop zero emission solutions for roads, waterways and railways. The other centre is SUSOLTECH – Research Centre for Sustainable Solar Cell Technology – whose ambitious plan is to develop the world's most environmentally friendly and effective solar cells, working in close liaison with the Norwegian solar industry.

IFE benefited considerably from the Research Council's ENERGIX programme and is now the lead partner in a total of 11 new projects. This reinforces IFE's position as a leading research institute within renewable energy and energy systems. We have also signed a three-year research and innovation contract with the Norwegian Directorate of Public Construction and Property for the monitoring of energy consumption and indoor climates via wireless meters and the use of apps. Comprehensive data capture and analysis based on artificial intelligence will be used to innovate project planning and the rehabilitation of buildings in the future.

Strategic investment in health research

In 2017, IFE strengthened its position within health research by being awarded BIA funds (User-driven Research-based Innovation) from the Research Council of Norway. One project involves the production of biological drugs and radiopharmaceuticals in Norway. A second project involves the development of an innovative production technology for radio nuclides that is newer, cheaper and more environmentally friendly than today's technology. Another innovative project is run in partnership with Oslo University Hospital, Rikshospitalet. With funding made available from South-Eastern Norway Regional Health Authority this project applies research from fluid flow technology in the petroleum industry to blood circulation in the human body.

Renewable energy, digitalisation and health are IFE's strategic areas of investment for the years ahead; they match the need to develop new, sustainable solutions to global social challenges within the areas of energy, health, transport and infrastructure.

IFE has set up a number of new businesses through the years, offering jobs based on research. In 2017, we further strengthened our investment in innovation and commercialisation by creating an innovation driver position. We have also recruited a full-time manager for our subsidiary IFE Invest AS.

IFE's contribution to European Spallation Source (ESS)

IFE's expertise and activities are important to the international partnership which is constructing the world's most powerful neutron source, the 'European Spallation Source' (ESS) in Lund, Sweden. The national research infrastructure NcNeutron (Norwegian Centre for Neutron Research) is currently being built at the JEEP II Reactor at Kjeller. This will be fully operational in 2020 with seven state-of the-art instruments.

Until the planned start-up for external users at ESS in 2023, NcNeutron is the only facility for neutron-based materials research in the Nordic region. It is therefore of key importance to IFE's national and international collaborations. Thanks to funding from ESS and the Research Council, the Kjeller Reactor is used for testing and optimisation of ESS equipment. IFE is contributing to the development of two of the fifteen instruments planned for ESS, working with other European research institutes in doing so. Furthermore, IFE carries the main responsibility for the design and installation of the ESS control room and several of its important control systems.

Scientific publishing

The production of scientific articles has fallen slightly compared with 2016 (figures in brackets). In 2017, a total of 107 (117) scientific articles were published in international journals and other publications approved for the Norwegian Science index. The Board considers it important that IFE maintains its ambition to publish at a high international level.

Health, safety and the environment

In 2017, IFE's activities gave rise to incidents that could potentially have impacted on the environment, health or safety. The situation was handled in a way that ensured any such impact was avoided. The incidents were reported to the Norwegian Radiation Protection Agency (NRPA).

IFE has previously received feedback from the NRPA that the institute's reporting of incidents and nonconformances has been inadequate, as in the case of the Halden Reactor incident in 2016. This feedback has caused us to lower our reporting threshold to the NRPA. As a result, we now report a larger number of non-routine matters, including matters of no consequence to the environment or to the health and safety of the population or our staff. We understand that the local community may become anxious when we report incidents to the NRPA, and when it appears that the number of incidents at IFE is greater than before. This is not the case. The change is only procedural and relates to our reporting routines.

IFE's Board and management have been working to enhance safety and safety culture within the organisation. These efforts continue on an ongoing basis and must be constantly improved. IFE's activities put great demands on the safety and safety culture requirements that we impose on ourselves. We will always seek to improve and to conform with best practice, and we will seek to learn from the experience and knowledge found in leading international circles.

In 2017, IFE invited a group of experts from the International Atomic Energy Agency (IAEA) to conduct a so-called 'Integrated Safety Assessment of Research Reactors' (INSARR) which involves a review of all reactors based on IAEA's safety standards. The group of experts concluded that IFE's safety work demonstrated continuous improvement, for example with respect to the efforts of the in-house Safety Committee, our emergency preparedness planning and the implementation of maintenance programmes for reactor safety. IAEA also highlighted IFE's work on a national strategy for the management of nuclear waste, as well as our plans for decommissioning, which comply with IAEA's safety standards.

In terms of areas for improvement, the group of experts highlighted the need for clearer roles and responsibilities for reactor staff, and a dedicated in-house safety committee for the JEEP II Reactor. They pointed to the need for further development of an integrated control system to support continual development and maintaining a strong safety culture, the introduction of a formal training programme for certain categories of reactor personnel, and a strengthening of the radiation protection work at the facility. IFE has adopted an action plan for the implementation of INSARR's recommendations and the Board of Directors keeps a close eye on this work. IFE has invited the IAEA to conduct a review of the organisation's safety culture in March 2018.

In 2016, IFE's safety classification was changed, and in June 2017 we were informed of the implications. The new classification will involve a considerable increase in the number of measures introduced to improve physical safety and information security in the years ahead. We have been working continuously to strengthen physical safety at IFE. Among other initiatives in 2017, IFE has improved the organisation's access control, commenced building works for a new security monitoring facility and introduced a new resource and damage assessment system.

IFE monitors the working environment by means of regular HSE surveys and reports. Sick leave in 2017 stood at 3.4%, down from 4.2 % in 2016. A total of nine personal injuries were recorded in 2017. No one was exposed to a radiation dose rate that exceeded the occupational exposure limit of 20 mSv/year. No serious accidents or near misses were reported in 2017. The Board considers that IFE fulfils its HSE targets.

Personnel

In the autumn of 2016, IFE was forced to lay off a number of employees following reduced activity levels and a fall in revenue. The institute laid off 127 employees on 25 October. Staff members were recalled to work over the winter, and all had returned to work by 25 April 2017. The Board, management and employee representatives worked well together in a constructive partnership throughout 2017.

IFE works actively, methodically and systematically to promote equality, safeguard equal opportunities and rights, and prevent discrimination based on gender, ethnicity, religion and faith. There must be no discrimination due to disability and the institute works actively and systematically to design and adapt the physical environment to ensure that our premises are accessible to as many as possible. Work areas and tasks are adapted to suit individual employees or job applicants with disabilities.

IFE employs staff from 37 different nations. The resulting diversity enriches the organisation both professionally and socially. The mix of nationalities makes it easier for new staff with less experience of Norwegian culture to adapt to working life in Norway. IFE has found that this is a competitive advantage when it comes to recruitment.

In 2017, IFE climbed to 11th place on the list of Norway's most desirable employers, a marked improvement from being ranked 30th in 2016. The Career Barometer provides a ranking of the most popular employers among engineering students, based on an annual student survey.

As at 31 December 2017, the institute's permanent staff included a total of 594 employees, compared with 608 in 2016. Of these, 219 (216) have a higher education, and 55 per cent of these are women. A total of 108 hold a PhD, which is an increase from 104 in 2016, and 29 of these are women. Four of eleven members of the current management team are women, compared with three in 2016. The Board attaches great importance to IFE's prioritisation of equal opportunities work throughout the organisation.

IFE in the media and in the community

IFE's nuclear activities put us in a special position in Norway. Transparency and openness about our work are important to IFE's reputation and impact significantly on the role we play in society. In 2017, we enhanced our efforts relating to communication and public relations. We are more active in the media and we use social media to disseminate and explain our research and nuclear activities. We write feature articles and make other contributions to national and local newspapers, assist the media with expertise within our fields of research and provide speakers for a number of national and international conferences.

In 2017, IFE strengthened in-house communications in a number of ways, for instance by holding regular and frequent staff meetings at Halden and at Kjeller. Throughout this autumn's reorganisation, all personnel received weekly briefings.

Reorganisation

In the course of 2017, IFE has reorganised its activities. We are a multi-faceted business, with each sector operating under a different commercial logic – R&D, the production of radiopharmaceuticals and nuclear activities. There was a need to concentrate activities within each of these sectors by adjusting our organisation to reflect their distinctiveness.

IFE's working environment survey was conducted in May 2017 and demonstrated a need to improve the way we organised our business in the interest of clearer distribution of roles and responsibilities, greater cross-

disciplinary collaboration and better coordination of market and project work, and to ensure that IFE remains a desirable partner for major international customers and in international research consortia.

The result is a more focused organisation of IFE's activities. As of 2018 they are grouped in three different business areas: R&D, radiopharmaceuticals and nuclear activities, all backed up by shared staff and support functions.

The government assumes joint responsibility for nuclear waste

Since IFE's formation in 1948, the institute has been operating under licences and permissions granted by the Norwegian government as represented by the Norwegian Radiation Protection Agency, the Norwegian Environment Agency and other bodies that regulate our activities and monitor compliance with current rules and guidelines for the management and storage of Norway's nuclear waste.

Because Norway was one of the first countries to have a nuclear reactor, we were an early producer of nuclear waste. In total, Norway has produced almost 17 tonnes of spent reactor fuel. At the start of 2017, a further four tonnes of other radioactive waste was stored at IFE's premises. This is waste that cannot be deposited in the National Combined Disposal and Storage Facility (KLDRA) at Himdalen in Aurskog-Høland municipality.

The rules for managing nuclear waste have changed since the reactor was commissioned in the early 1950s. The requirement for detailed specifications of the stored waste was far less stringent at the time. The storage facilities that were constructed in Halden and at Kjeller were never intended to house nuclear waste over many decades.

For many years, IFE has been working to persuade the government to assume shared responsibility for Norway's nuclear waste and to contribute to the clear-up and permanent storage of the waste. Over the years, the government has set up a number of committees with a remit to investigate intermediate storage of spent fuel. In July 2016, the Minister of Trade and Industry announced that the government accepts shared responsibility for funding the future decommissioning of Norwegian nuclear facilities and for the storage of Norwegian radioactive waste. The government budget for 2017 proposed a payment of NOK 28 million to IFE for commencing work on finding permanent solutions for the nuclear waste. After the parliamentary budget debate this was increased to NOK 48 million. In 2017, IFE was therefore able to establish a Nuclear Waste and Decommissioning sector, carry out the necessary recruitment and start planning for the extensive work of finding a permanent solution for Norway's nuclear waste.

In the course of 2017, IFE has drawn up specific plans for this work and has initiated projects in close liaison with the Ministry for Trade, Industry and Fisheries. The turnover for 2017 was close to NOK 30 million. The programme's 2017 activities have largely focused on drawing up plans for what solutions will be required to guarantee safe storage of spent fuel, and to facilitate the export of spent fuels that IFE will be unable to use in its own reactors. Additionally, the focus has been on conducting the technical studies required to establish how the various types of Norwegian nuclear waste can be managed, as well as fuel inspections in Halden and at Kjeller. Preparing for the permanent storage of Norway's nuclear waste is an extremely wide-ranging and

complicated task, and Norway is dependent on IFE's expertise, experience and infrastructure in this respect for many years ahead.

The government assumes an active role in the management of nuclear waste

The Ministry of Trade, Industry and Fisheries has been given responsibility for the government's liaison with IFE. The circumstances surrounding nuclear waste and the financial challenges at the Halden Reactor have led to regular and constructive dialogue between the ministry and IFE. In 2017, when the Research Council changed its policy of appointing the Board of Directors for the Norwegian research institutes, it was decided that the Ministry of Trade, Industry and Fisheries should appoint IFE's Board of Directors as of 2018.
The central government budget for 2018, as presented in October 2017, proposed the setting up of an administrative body for the winding up of all nuclear facilities and the safe management of nuclear waste. This budget proposal sets out the way ahead for future work on waste management and the decommissioning of Norway's nuclear facilities.

The central government budget allocated NOK 50 million to necessary clear-up activities, including the formation of a government agency for the safe management of Norwegian nuclear waste and nuclear facilities, further investigations into the handling of spent fuels with poor storage properties, safe intermediate storage in Norway, and the planning of future decommissioning of reactor facilities.

In 2018, IFE received an extraordinary government grant of NOK 50 million for the operation of the Halden Reactor. This is to help ensure that IFE retains its critical reactor competence for the forthcoming clear-up operation at the nuclear facilities. We believe that the government wants to liaise closely with IFE on the way ahead and is committed to retaining IFE's nuclear expertise for the management of nuclear waste and the future decommissioning of the reactors.

The annual financial statements

The group's consolidated turnover for 2017 is on a par with last year's, at NOK 968.2 million. The IFE foundation's turnover accounted for NOK 942.7 million, which is NOK 3.1 million up from 2016. However, the bottom line at year-end shows a considerably weaker position than the year before. The group's consolidated loss is NOK 28.3 million, while the foundation's loss amounts to NOK 25.6 million. This reflects a considerably weaker position for our nuclear activities, which generate insufficient income to cover the associated operating expenses. The foundation's year-end result in the petroleum market is also weaker, due to fewer new contacts. The pharmaceutical production shows a positive result, as in 2016.

The costs associated with R&D at both corporate and foundation level have been entered as gross amounts in the income statement. This is reflected in the operating revenues, a considerable share of which stems from grants and subsidies from the public purse, as well as contributions received from participants in the Halden Reactor Project.

As at 31 December 2017, the group's consolidated equity amounted to NOK 333.9 million (NOK 384.2 million in 2016), while the foundation's equity amounted to NOK 270.6 million (NOK 318.3 million in 2016). The drop is due

to the loss for the year, combined with a one-off capitalisation of accounting liabilities at NOK 22.0 million. These liabilities are associated with employment costs such as flexi-leave and holiday pay carried forward to the next year.

As a consequence of the year-end loss in the consolidated group accounts as well as in the foundation's accounts, the net cash flow is negative. The cash position has decreased by NOK 58.6 million at group level and by NOK 44.9 million at foundation level. After deducting the undistributable reserves, the group's liquid funds stand at NOK 43.9 million, the foundation's at NOK 19.3 million.

Financial risk

Liquidity risk

The negative cashflow in 2017 has meant that the cash position at the end of the financial year is not as good as we would have liked with regard to the need to cover day-to-day operations and the cost of future investment etc. However, the foundation's bank overdraft facility is considered sufficient to cover the short-term cash requirements. In addition, the foundation has a cash pool agreement with IFE Invest AS as well as IFEs Boligselskap AS, and this provides flexibility with regard to short-term liquidity fluctuations.

Market risk

The market risk to which the group and the foundation are exposed is principally associated with currency, partly from income in foreign currencies and partly from costs in foreign currencies. Measures to reduce exposure to currency risks are implemented with regard to any large individual transaction, but there are no ongoing hedging transactions because the risk is considered to be low.

Credit risk

Both the group and the foundation are exposed to credit risks associated with accounts receivable and lending. The group has made provisions for bad debts to the sum of NOK 13.0 million, and the corresponding sum in the foundation is NOK 10.4 million. There is also a potential credit risk associated with advance payment to suppliers, but such transactions are subject to the provision of a supplier's performance bond.

Outlook

The foundation's financial situation worsened in 2017, mainly because of reduced incomes from the Halden Reactor. IFE is looking at considerable investment in safety and security in the years ahead as a consequence of our new safety classification. Moreover, we have uncovered an investment and maintenance backlog in large parts of our infrastructure and in many of our buildings and laboratories. IFE is working systematically to increase revenues and reduce costs.

A considerable portion of the work carried out by the group and the foundation is associated with the Halden Reactor. In connection with routine maintenance work carried out in March 2018, a faulty valve was discovered. This has stopped the reactor from being re-commissioned as planned, and a restart in 2018 is considered unlikely. Investigations are ongoing to establish how the fault can be repaired, and a thorough root cause analysis is being carried out. IFE is meanwhile reviewing the condition control programme. It is expected that this will lead to a considerable drop in revenues from external contracts associated with the Halden Reactor in 2018.

The Board is keen to increase the profitability of IFE's research activities. In 2017, we developed the organisation's commercial culture through increased market activity and clearer priorities. This is paying off.

The outlook is good for the institute's activities in R&D and radiopharmaceuticals, as well as for the research conducted at the Kjeller Reactor. It is important that the potential of these business areas is fulfilled in the time ahead as our task here is to deliver new and sustainable solutions that address global societal challenges. IFE is a desirable partner to Norwegian industry, international industrial collaborators like Bayer, and R&D groups at home and abroad. IFE has been conducting research for a better future since 1948 and never before has our work been more relevant to society and industry than it is now.

The Board of Directors confirms that the criteria for continued operation are present, subject to state subsidies and close monitoring by government agencies. The Board has prepared the annual accounts for 2017 on a going concern basis.

Olav Fjell
Chairman

Anne Harris
Deputy Chairman

Kerstin Dahlgren Persson
Board Member

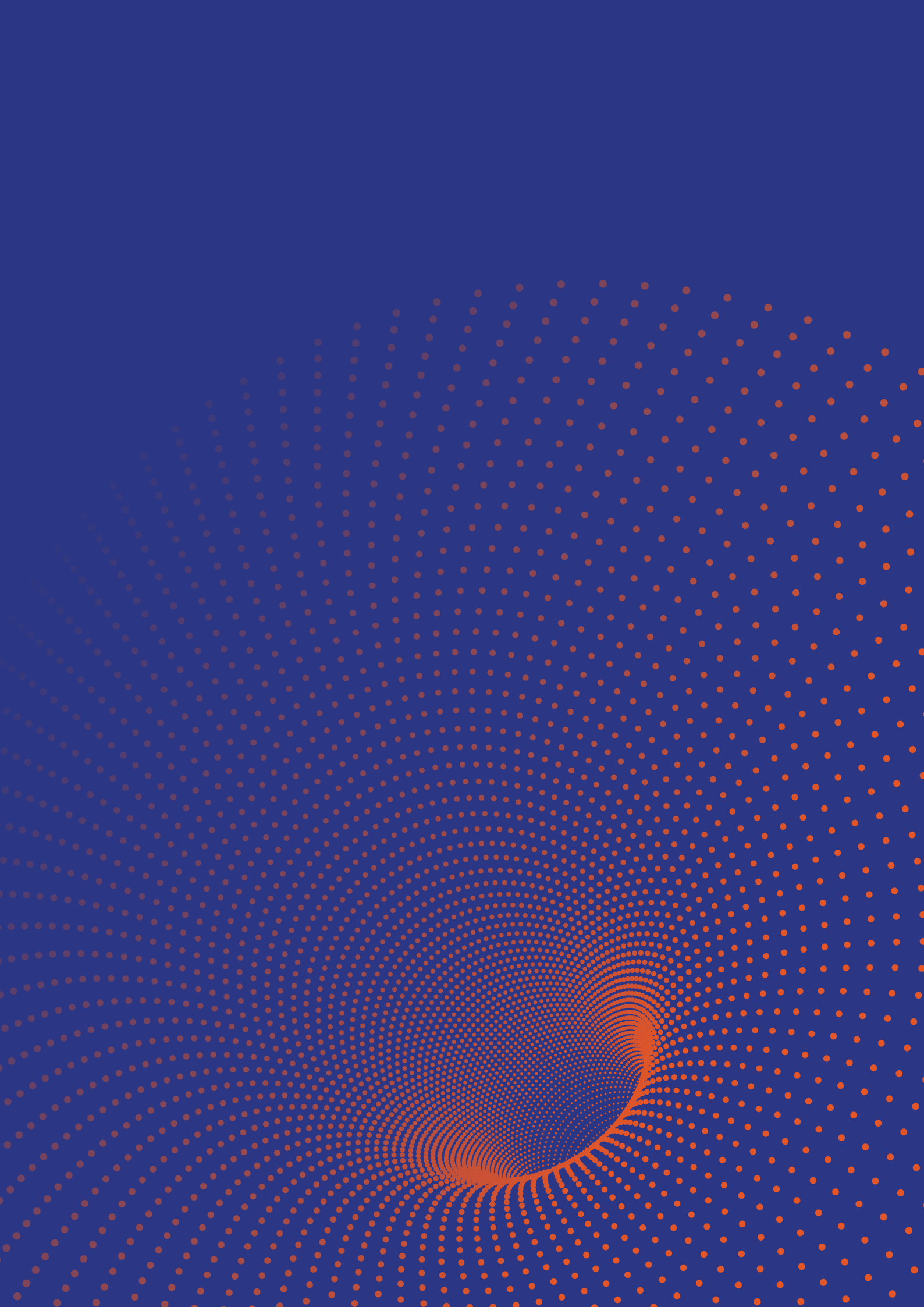
Jo Døhl
Board Member

Johan Hustad
Board Member

Camilla Tveiten Engeland
Board Member

Terje Bodal
Board Member

Nils Morten Huseby
President



KJELLER
P.O. Box 40, NO-2027 Kjeller, Norway

Office address
Instituttveien 18, Kjeller

Tel.: (+47) 63 80 60 00

HALDEN
P.O. Box 173, NO-1751 Halden, Norway

Office address
Os allé 5, Halden
Office address, reactor facility:
Tistedalsgata 20, Halden

Tel.: (+47) 69 21 22 00

firmapost@ife.no • www.ife.no

facebook.com/energiteknikk
@energiteknikk
Institute for Energy Technology
@humansofife