



Research

for a

**BETTER**

**future**



Institute for Energy Technology



Our vision

**IFE shall  
be a**

**leading  
international**

**energy technology  
research institute**

## ► The institute for energy technology

IFE is an independent, international institute for energy technology research. The institute prioritizes major research programmes that make significant contributions to industrial and technological innovation.

IFE's research activity targets solutions to central energy and environmental challenges we face globally. This includes development of profitable, safe and environmentally friendly technology for energy production, energy use and petroleum extraction. IFE's ambition is the gradual conversion of energy supplies towards renewable energy sources, low-emission technologies and cleaner energy carriers. IFE shall also further develop national competence in nuclear reactor safety, protection against radiation and nuclear technology based on the research reactors in Halden and in Kjeller.

### → BRIEF HISTORY

IFE was founded in 1948 as The Institute for Atomic Energy (IFA). The first reactor, JEEP I, went into operation in 1951. IFA eventually built a larger research reactor in Halden. It was opened in 1959 and has been operated since that time under a broad international cooperative agreement under the auspices of the OECD. During the years up until the mid-1960s, IFA developed into Norway's largest research institute.

In 1980 IFA changed its name to the Institute for Energy Technology – IFE. Since that time, the institute has further developed and become a leading inter-

national, experimental research institute in the field of renewable energy, petroleum and nuclear technology.

### → THE HALDEN PROJECT

IFE operates the international project called The OECD Halden Reactor Project (the Halden Project). Approximately 20 nations and 100 organizations participate in this joint research program. The objective is to develop key information for safety assessment and reliable operation of nuclear power plants and other complex industrial facilities.

### → WORLD-CLASS RESEARCH TOOLS

The Halden reactor is the essential requisite for IFE's activity in Halden. It provides Norway with national competence in the field of radiation protection, preparedness and reactor technology. In addition, the Halden facilities comprise the simulator-based control room HAMMLAB (Halden Person-Machine Laboratory) and the Halden VR-centre with its advanced visualization technology (virtual reality).

The JEEP II reactor at Kjeller is a central component in IFE's research activities. It provides stable access to neutrons, which are becoming increasingly more important in the area of advanced material research and nanotechnology. The reactor is considered today to be a

unique, world-class research tool and is the basis for IFE's leading, international position in the field of hydrogen storage research. Competency associated with the JEEP II reactor will also be crucial in the Norwegian effort to develop the European Spallation Source (ESS) in Lund. ESS will be the world's largest «neutron microscope», and nearly 5000 researchers from all over Europe will be affiliated with activities involving the ESS reactor. IFE has a comprehensive cooperative agreement with ESS, which is the European Union's largest research project ever.

### → NATIONAL TASKS IN THE FIELD OF NUCLEAR TECHNOLOGY

Every year one to two percent of Norway's population undergoes a medical assessment using radioactive pharmaceutical products. The isotope laboratories at Kjeller are the Norwegian control organ for radioactive medicines. The laboratories are organized as a pharmacy and provide advice and guidance on the use of the products. The majority of radioactive medicines used in Norway are controlled at IFE before they are sent out to Norwegian hospitals. IFE is also a partner in the production of new radioactive pharmaceuticals under development in Norway. Large investments have been made in new laboratories, and significant growth in the area of radioactive pharmaceuticals is expected in the coming years. ●

## ► Examples of research

IFE is working to meet a number of the world's greatest challenges in the field of energy and the environment. You can find examples of our research activities at [www.ife.no](http://www.ife.no)



### → SAFE NUCLEAR POWER

There is increasing interest in and commitment to nuclear power internationally. IFE is contributing to improve the safety of nuclear power plants throughout the world. IFE leads the international Halden Project, which is the largest international research project in Norway. Stakeholder members in the project are safety authorities, research centres, the supply industry and energy companies. A broad range of fuel- and material tests are conducted under realistic conditions in the Halden reactor. These provide important data for use in safety assessments and for reliable operation of nuclear power plants and other complex industrial facilities.



### → PETROLEUM TECHNOLOGY

The remaining oil and gas resources on Norway's continental shelf are located farther from land and at greater ocean depths than previously. IFE contributes advanced technology that makes it possible to extract these resources without large field installations at sea. IFE is developing advanced simulators for multiphase flow distribution in processing equipment and long transport pipes, new methods for corrosion protection inside pipes, and environmentally friendly trace elements to survey oil reservoirs. IFE is also contributing to increased oil extraction. The «Horizon» research project, in which IFE collaborates with the SPT Group and the world's largest oil companies, has the objective to maintain the program tool OLGA as the leading simulation tool for multiphase transport.

### → OFFSHORE WIND

In the years to come, large quantities of offshore wind power will be generated in the world. Norway has expansive ocean territories that are well-suited for wind turbines, and already enjoys a leading international position in the field of offshore technology. These factors make offshore wind power particularly attractive to Norway. IFE is focusing on its wind power activities in the field of offshore wind, and in particular turbine designs. IFE cooperates with all of the major Norwegian participants in the offshore wind power technology.



#### → CO<sub>2</sub> MANAGEMENT (CCS)

IFE's goal is to develop technology that can remove or sequester CO<sub>2</sub> emissions so that they do not contribute to global warming. The technology needs to be inexpensive and easy to implement in order to attract an international market.

IFE has a cross-disciplinary approach to the transport and storage of CO<sub>2</sub> and the effort is coordinated by IFE's CO<sub>2</sub> Centre. IFE is also studying the possibilities for use and storage of CO<sub>2</sub> in industrial processes, for development of new materials that are able to capture CO<sub>2</sub>, and for analysis of the entire value chain of energy, CO<sub>2</sub>-capture and storage.

IFE has also participated in the development of a concept for gas power that is entirely free of undesirable CO<sub>2</sub> emissions. The technology is called ZEG – Zero Emission Gas power – and is still undergoing testing. The results so far show a great potential for effective production of energy at a competitive price.



#### → NANOTECHNOLOGY

Scandinavia's first nanoreactor was opened at IFE in 2003. The company n-Tec AS produces carbon nano tubes and works closely with IFE. These tubes are made of the strongest material known today, ten times as strong as steel at a tenth of the weight. With the help of the JEEP II reactor at Kjeller, IFE is capable of investigating and better understanding the qualities of nano-materials. IFE also uses nanotechnology, among other applications, in research on solar cells and materials for hydrogen storage.

#### → HYDROGEN RESEARCH

IFE plays a leading international role in hydrogen storage. The institute is the leader for both the largest EU projects in the field and the largest project in IEA's hydrogen program in the area of materials suitable for hydrogen storage. IFE's hydrogen activities include research on production, storage and total systems designed to use hydrogen as an energy carrier. At Kjeller, IFE has developed an «independent power system» of which the main components are windmills, solar cell panels, electrolyzers, fuel cells, hydrogen storage and batteries. Excess energy is stored as hydrogen. When needed, for example under overcast skies or windless conditions, the hydrogen reserves are converted into electricity.

#### SOLAR ENERGY

The demand for solar energy is increasing on a global basis, and the Norwegian solar cell industry has a strong position in the market. IFE cooperates with leading Norwegian industrial participants to improve current solar cell technology and to investigate new possibilities for the use of solar energy. IFE has state-of-the-art, modern laboratories and represents the leading research community in Norway in the field of solar cell technology.

#### → MTO TECHNOLOGY (MAN – TECHNOLOGY – ORGANIZATION)

Control room operators must be capable of handling a variety of situations and elements of danger. In the MTO laboratories at Halden, studies are being conducted on the factors that influence human reliability, grasp of the situation at hand, and the ability to handle unforeseen occurrences. The results are used, among other things, to improve safety conditions in the areas of nuclear power, petroleum and transport. Remote control of offshore platforms from shore, so-called Integrated Operations (IO), are now a crucial topic. IFE's MTO technology, such as widescreen design and innovative user interface, are more and more used by the oil industry to increase safety. The MTO laboratories also include IFE's VR-centre, which is used for experiments, demonstrations and interactive project work based on virtual reality and expanded reality technology. ●



## ► Facts about IFE

IFE is an independent foundation with headquarters at Kjeller, and research activities at Kjeller and Halden. The annual turnover is approximately 90 mill. € and the number of employees is approximately 600.

### → FINANCING AND CLIENTS

IFE's activity is primarily client-financed, supplemented by a modest, basic grant from The Research Council of Norway. The percentage of client-based financing is approximately 85%. About 45% of the income comes from international clients in more than 30 countries. Clients include oil and energy companies, the supply industry, IT companies, public authorities and the European Union's research programmes.

### → RESULTS

IFE's research and development is expected to provide results that can be taken into use and create value for IFE's clients. The institute contributes to business development and innovation, among other ways through its subsidiary IFE Venture, which works to commercialize ideas developed by IFE. IFE establishes about two to three new companies each year.

### → HES AND THE ENVIRONMENT

IFE places great emphasis on an optimally functioning HES system. The institute has a separate staff division with the independent responsibility for supervising and carrying out HES activities, ensuring radiation protection for the institute's personnel, control of radioactive emissions and radioactivity on IFE's premises. IFE's environmental policy is to plan and operate the institute's efforts with the least possible negative impact on the environment. Respect for the environment is a crucial factor in decisions. IFE's nuclear facility entails minor emissions of radioactive materials. These emissions are in compliance with the licences and limitations issued by Norwegian authorities. IFE places great emphasis on openness towards and contact with the local community. Information on IFE's website is continuously updated concerning the institute's emissions, and each year a separate environmental report is released. ●

## Organization

IFE is organized in five sectors. The sectors are financially independent units with their own requirements for earnings and results.



### NUCLEAR TECHNOLOGY AND PHYSICS

Total number of employees: 100  
Annual turnover: 22 mill. €  
Location: Kjeller

- > responsibility for the JEEP II reactor
- > conducts research on new materials and nanotechnology
- > carries out national-level tasks in conjunction with radioactive pharmaceuticals

### ENERGY AND ENVIRONMENTAL TECHNOLOGY

Total number of employees: 80  
Annual turnover: 14 mill. €  
Location: Kjeller

- > focus on renewable energy sources such as solar and ocean wind power
- > development of various technologies for handling of CO<sub>2</sub>
- > development of hydrogen as the energy carrier of the future

### (MAN - TECHNOLOGY - ORGANIZATION)

Total number of employees: 85  
Annual turnover: 13 mill. €  
Location: Halden

- > studies the interplay of people and various technologies and organizational forms
- > contributes to safe and efficient operation of complex processing facilities such as nuclear power plants, other energy and processing facilities, and transport systems
- > uses VR technology (virtual reality) in design, maintenance and training

### NUCLEAR SAFETY AND RELIABILITY

Total number of employees: 150  
Annual turnover: 21 mill. €  
Location: Halden

- > national competency centre for reactor technology and safety
- > focus on safety and reliability of reactor fuels, as well as radiation effects on materials
- > The Halden Reactor Project is the largest international R&D project in the world on nuclear safety

### PETROLEUM TECHNOLOGY

Total number of employees: 90  
Annual turnover: 20 mill. €  
Location: Kjeller

- > develops cost-effective search and extraction technology
- > leading solutions for corrosion control in oil and gas pipes
- > improves and develops multiphase simulators and calculating tools for operation of petroleum fields

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IFE's main office is located at Kjeller, near Lillestrøm. Kjeller is about 20 minutes from Oslo and 20 minutes from Oslo Airport Gardermoen.

IFE is located in downtown Halden. The distance from Halden to Oslo is approximately 1 hour and 15 minutes by car.

IFE is associated with the research community in Lillestrøm «The City of Knowledge». The association includes some 100 member companies representing more than 6000 employees and 5000 students. Lillestrøm «The City of Knowledge» collaborates in business- and knowledge-related urban development in one of the country's strongest growth regions. Read more at [www.kunnskapsbyen.no](http://www.kunnskapsbyen.no)