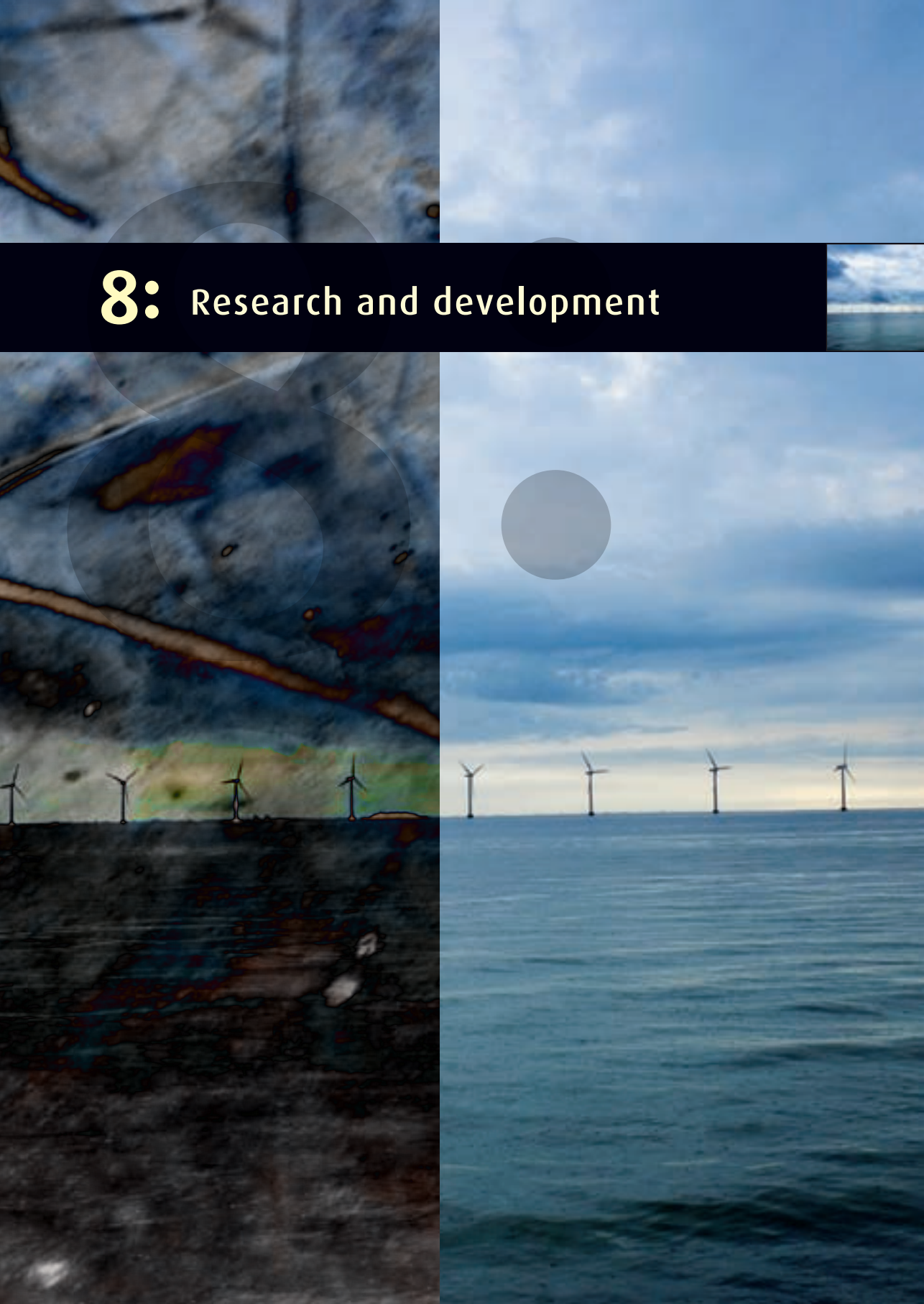
8: Research and development



8.1. Research and development

The energy sector confronts a series of challenges related to security of supply, power and energy balance and greenhouse emissions. Public research efforts are necessary in all these fields to ensure satisfactory developments and value creation for the sector through technological and organisational solutions. In addition, research and development are also of critical importance for business development within this sector.

With limited resources available, both financial and in terms of researcher capacity, priorities must be set for research efforts. Norway focuses in particular on areas in which Norwegian research institutions have specialist expertise and standing, in which Norwegian businesses and others have special competencies in applying the research results, in which Norwegian energy resources provide us with a special standing in the long term, and in which there are particular Norwegian research needs.

The Research Council of Norway is responsible for administering most of the public funding available for energy research. The funds are used for basic research, industrial research and social science research. Basic strategic research is intended to lay the basis for more market-related projects in cooperation with industry and other users. The commercially orientated research is user-managed to ensure that the results can be adopted if they are technically successful. Users also contribute the bulk of project financing. Social science research focuses more on energy policy and international agreements.

Part of Norway's research efforts in the energy sector is the responsibility of the Norwegian Water Resources and Energy Directorate (NVE). This primarily concerns activities relating to energy and watercourse management.

In addition to the national research activities, Norway and Norwegian research institutions participate actively in a series of international energy research collaborations.

For more information about the Research Council of Norway's and the NVE's energy research programmes, see www.forskningsradet.no and www.nve.no.

8.2. Research programmes

8.2.1 RENERGI – Clean energy for the future

The major part of energy research is organised within the Research Council of Norway's program RENERGI – Clean energy for the future (2004–2013). In terms of subject area, the RENERGI programme covers most of the energy-related research sponsored by the Research Council. This programme covers a wide range, from basic research and expertise development, applied research and technological development, to social science research as a basis for policy formulation.

The main aim of the programme is to develop knowledge and solutions as the basis for environment-friendly, economically rational and safe management of Norway's energy resources, and internationally competitive industrial development relating to the energy sector. Emphasis is placed on building up competent and robust R&D institutions which can serve industry and the authorities in a satisfactory way.

RENERGI is to follow up the priorities of the Energi21 strategy (see Appendix 2) The programme will be aimed at the selected

thematic areas that Energi21 is addressing in its strategy, while also ensuring the general approach that Energi21 is committed to. It is crucial for RENERGI also to work closely and coordinate its activities with the Research Council's initiative focusing on research centres through the CEER scheme – Centres for environment-friendly energy research (see discussion in 8.2.2 below).

The specialist areas that RENERGI covers are described below.

Renewable energy production

Research in the area of renewable energy production is largely aimed at areas in which Norway has natural advantages. The biggest areas in renewable energy production are wind power, particularly offshore solutions, and solar cells. Other key technology areas are bio energy and ocean energy (wave power, tidal energy and salt power, i.e. utilisation of the pressure differential between salt and fresh water). Offshore wind power is a particularly interesting focus area for Norway. What lends particular support for this are the vast wind resources in Norwegian marine areas, in addition to the fact that it can be based on the expertise Norwegian researchers have in the petroleum and maritime sectors. In the hydropower area, too, Norwegian energy companies, the supplier industry and research institutions are strongly positioned. The expertise in this area needs to be developed further with a view to future operation of and improvements in the system. At the same time, this research is intended to support

export opportunities available to Norwegian industry.

Natural gas

Natural gas is an energy resource which puts Norway in a special position internationally through production solutions and exports. Very little domestic use is made of natural gas. RENERGI will focus on new possibilities for energy production and industrial development in connection with increasing domestic use of natural gas, for example related to new technology for direct use of natural gas including fuel cells and decentralised cogeneration (combined heating and power production).

Hydrogen

Currently, there is an extensive and growing worldwide focus on hydrogen as an energy carrier. This is being driven primarily by considerations of energy security, the environment and business development opportunities. The visions described for hydrogen concern the relatively longer term. For that reason the efforts in hydrogen in the RENERGI will be long-term, with an emphasis on amassing basic expertise. Initially, the programme will give priority to projects which build on existing Norwegian knowledge. It will be important to prioritise areas where research in Norway can contribute to broader international collaboration, especially in the areas of storage and production of hydrogen.

The energy system

Further development and integration of power system planning to embrace the energy system as a whole will be key. This includes better coordination between technical and economic planning models, and the inclusion of thermal energy. Further progress also needs to be made on the coordination between energy planning and other physical and public planning at the local and national level. Possible research topics could, for example, be within system analysis, security of supply, energy planning and power transmission.

The energy market

Norwegian specialists and institutions have a strong position in the energy market and in its development. Further improvements in knowledge and analysis of experience in areas such as market integration and market regulation will allow that position to be retained in the future as well. Ensuring that the signals sent by the power market are sufficient to provoke long-term decisions on constructing new generating capacity is important. So is ensuring that the market encourages efficient energy use.

Energy use

An increased focus on end use and on reducing energy consumption, both for households and industry, is important in reducing environmental impacts and ensuring energy security. The goal for developing new technologies is that they must be competitive in the market. Research will be directed on the one hand at possible suppliers of such products and services. On the other hand, both the authorities and the public at large will need to possess good expertise, both on framing efficient policy instruments and on their own investment.

Energy policy and international agreements

Extensive energy policy changes have occurred in most countries over the past decade. The growing attention being paid to such issues as environmental problems, primarily climate change, competitive conditions and a focus on the market, have stimulated international agreements and directives designed to identify suitable tools for regulating such conditions. Environmental and other international agree-

ments have significantly altered the framework conditions for developing energy systems. Developing the regimes established by international pacts creates a big demand for multidisciplinary expertise in such areas as framing agreements and determining their impact.

8.2.2 Centres for environment-friendly energy research (CEER)

A new support scheme has been set up for establishing centres for environment-friendly energy research. The aim of the CEER scheme is to establish research centres with a concentrated, long-term commitment at a high international level. A CEER is to raise the quality of Norwegian research and generate applied knowledge and solutions in certain thematic areas.

At such centres selected research environments will team up, geographically or virtually, on a focus on technology in certain thematic areas. Support for a centre will be awarded on the basis of application rounds, and the extent of support will depend on the centre's profile.

A centre for environment-friendly energy research shall:

- stimulate partners to innovate in the relevant thematic area by focusing on long-term research and make it attractive for companies with international operations to do research in Norway.
- foster binding collaboration between innovative industries, administrative agencies and prominent research environments.
- foster user-oriented research environments at the forefront internationally and that are linked up to strong international networks
- encourage researcher training in the various thematic areas

It is the Research Council of Norway that is in charge of this centre programme. Selection of centres for specific technologies and specialities will take place in early 2009.

The choice of research centres will be based on the priority selected areas in Energi21 (see Appendix 2). Furthermore, the selection will take place on the basis of scientific quality, relevance and potential for innovation and value-added. User partners (industry or public administration) are also required to participate in the centres.

8.2.3 CLIMIT

The CLIMIT programme is a national programme for research, development and demonstration of technologies for fossil-fuel-fired power generation that includes carbon capture and storage (CCS). The programme is co-funded by the Research Council of Norway and Gassnova SF. The Research Council funds the R&D portion of the programme, while Gassnova SF funds the demonstration and commercialisation portion. The programme previously focused on gas-fired power, but starting in 2009 has been expanded to include fossil-fuel-fired power generation in general. The reason for the expansion is that despite the Norwegian commitment to CCS, especially to gas-fired power plants with carbon sequestration, carbon emissions from coal-fired power plants are the biggest challenge internationally. An enlargement of the scope for CLIMIT increases the market potential for Norwegian technology.

The project portfolio will focus particularly on carbon capture technologies that are as cost-effective as possible. A further priority is the development of know-how and solutions for safe and reliable carbon storage in geological formations. This effort is to be aimed at technology development, but there will also

be an emphasis on finding opportunities for future industry development and value-added in Norwegian industry.

In the short term the challenges are:

- improving the quality and lowering the costs of carbon capture from gas-fired power stations, and
- establishing methodologies and building trust in secure geological storage of CO_2.

In the longer term the challenges are:

- Improving or developing technologies with a potential for significant improvements in the effectiveness and profitability of power generation using CCS, and
- developing a robust methodology for carbon sequestration that meets the requirements for approval as a climate measure pursuant to international agreements.

8.2.4 Government-administration-related energy and water resources research

Government-administration-related energy and water resource management research is under the NVE. These activities are intended to support the directorate's work and help it to develop and disseminate knowledge which improves the basis for its regulatory activities. Activities include relevant issues related to cost-benefit analyses of energy projects, and focus on water resources, hydrology, the environment, climate, potential studies and river system security. The work supplements programmes pursued by the Research Council of Norway, and is coordinated with the latter. In

addition, the NVE collaborates closely with the Norwegian Electricity Industry Association (EBL), the Directorate for Nature Management (DN) and Enova SF.

8.3. International research and development

Participation in international R&D collaboration in the energy field has high priority and represents an important supplement to national research. Collaboration across national boundaries is crucial not only for maintaining high scientific standards at Norwegian research institutions but also for strategic reasons in establishing contacts and alliances with other countries. Participating in international projects builds expertise and provides both scientific and economic assistance for solving key research problems. International cooperation also helps to showcase Norwegian technology and knowledge providers. Norway collaborates in the energy area primarily in the EU system, with the International Energy Agency (IEA) and at the Nordic level.

8.3.1 The EU 7th Framework Programme for Research

Through the European Economic Area (EEA) agreement, Norway participates as a full member of the EU's seventh framework programme for research, technological development and demonstration activities (2007–2013). The programme has an overall budget of EUR 50.5 billion. One of its priority thematic areas is 'Energy', which has a budget over the programme's lifetime of EUR 2.3 billion. The energy programme can deploy a variety of instruments, which range from support for thematic networks and coordination activities to support for R&D and demonstration projects. The programme's objective is to help to move current energy systems in a more sustainable direction by developing alternative energy sources and energy carriers and boosting the efficiency of energy systems. Furthermore, carbon capture and storage (CCS) is a key theme. Another objective of the commitment to new energy technology is to boost the competitiveness of European industry.

The energy programme is divided into two sections, whereby short-to-medium-term activities are followed up by DG TREN (transport and energy) in the European Commission and are focused on demonstration projects, while medium-to-long-term activities are followed up by DG RTD (research) and focus on research and development. The activities in the programme focus on the following technologies:

- hydrogen and fuel cells
- renewable energy
- carbon capture and storage (CCS)
- clean coal technologies
- transmission of energy / grids
- energy efficiency and energy saving
- knowledge for formulating energy policy

The Research Council of Norway is the coordinator for the Norwegian activities.

8.3.2 The International Energy Agency

The International Energy Agency (IEA) has set up a number of collaborative programmes in research and development and market introduction of energy and petroleum technologies through Implementing Agreements. Norway belongs to 24 of these. The pro-

grammes cover areas such as end-user technologies, renewable energy technologies, petroleum technology and the sharing of information. Participants from Norway may be from industry, from research institutions or the government, depending on programme activities. The Research Council of Norway is the coordinator for the Norwegian activities.

8.3.3 Nordic Energy Research

Nordic Energy Research is an institution under the Nordic Council of Ministers which aims to promote and extend regional cooperation in the field of energy research. It is intended to strengthen national energy research programmes and institutions in the Nordic area and to contribute to a joint strategy for research and development in those parts of the energy sector which are of common Nordic interest. The institution also pursues strategy work and provides advice on projects under the Nordic Council of Ministers. The institution is funded by the Nordic countries.

A strategy and action plan for the period 2007–2010 have been formulated. Their main activities will be:

– contributing to amassing expertise and know-how,
– increasing innovation and economic development in the Nordic countries,
– supporting Nordic energy agencies in formulating policies and
– helping to build international networks

The effort is concentrated on thematic areas intended to support core areas in Nordic cooperation in the energy areas. These are the Nordic collaboration on electricity, climate issues and regional cooperation. On the basis of this, five thematic areas have been chosen:

- energy market integration
- renewable energy
- energy efficiency
- the hydrogen society
- the consequences of climate change in the energy sector

8.3.4 Other international collaborations

Norway also participates in bilateral collaborations, primarily with the US and Russia, and in various multinational collaboration venues. The most relevant are:

The International Partnership for the Hydrogen Economy (IPHE), which aims to help organise, coordinate and initiate international R&D and demonstration projects relating to hydrogen as an energy carrier and to fuel cells.

Carbon Sequestration Leadership Forum (CSLF), which aims to promote cooperation of research and further development of technologies relating to the separation, storage, transport and use of CO_2, and which aims to facilitate profitable utilisation of CO_2.

MoU (Memorandum of Understanding) between Norway and the US, a bilateral research cooperation on energy related research and technology. Relevant topic areas are oil and gas production, carbon capture and storage, hydrogen research and new renewable energy sources.