ANNUAL REPORT 2008 **SINTEF** ENERGY **RESEARCH**





SINTEF

2008



This is SINTEF

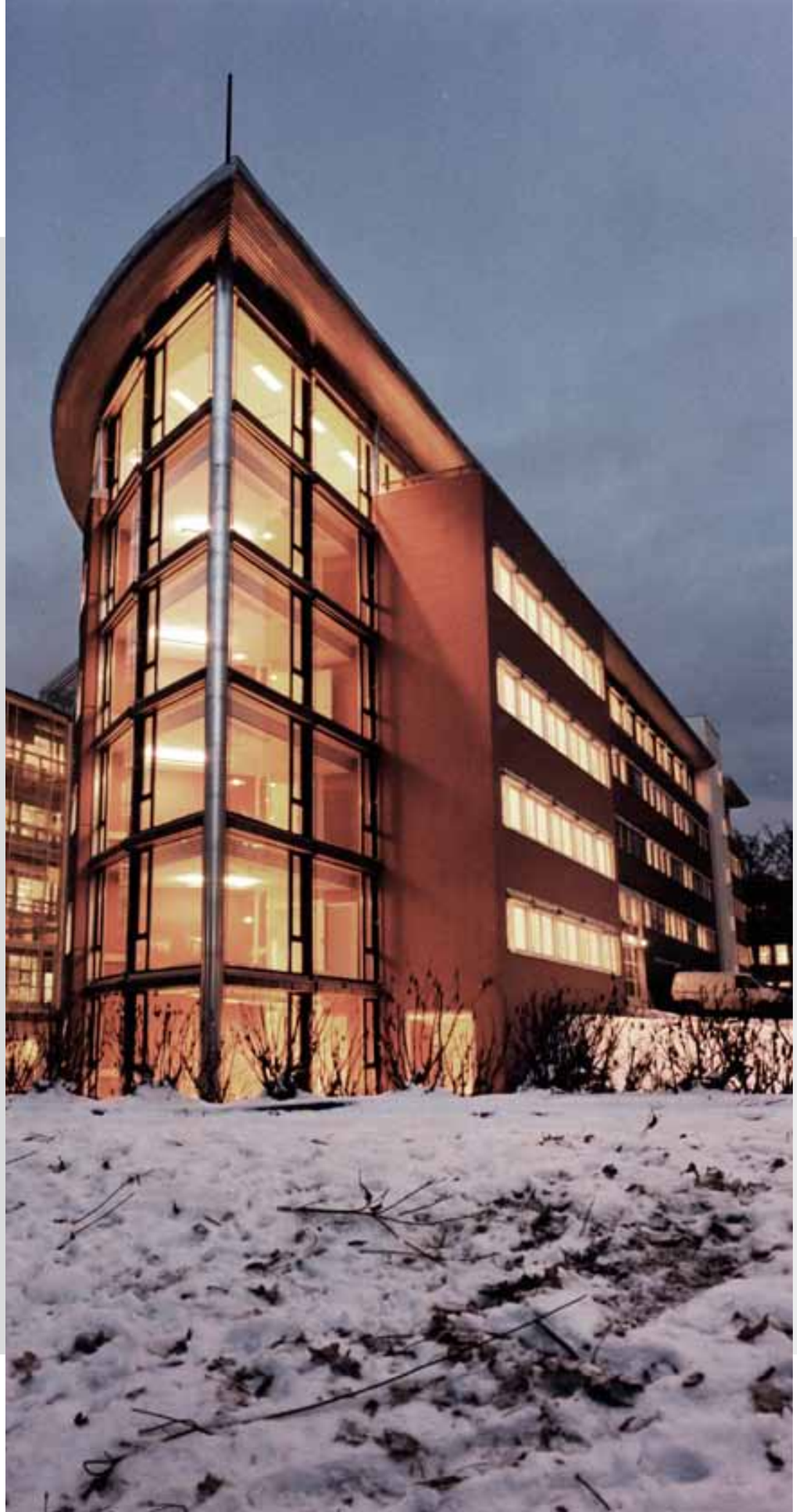
The SINTEF Group is the largest independent research organisation in Scandinavia. Every year, SINTEF supports the development of 2000 or so Norwegian and overseas companies via our research and development activity.

Business concept
SINTEF's goal is to contribute to wealth creation and to the sound and sustainable development of society. We generate new knowledge and solutions for our customers, based on research and development in technology, the natural sciences, medicine and the social sciences. Our vision is "Technology for a better society".

Our services
We solve our customers' problems through research contracts in the following fields: Health, information and communications technology, marine activities, materials science and applied chemistry, petroleum and energy, technology management and building/construction. SINTEF intends in this way to act as a driving force in the process of restructuring and developing Norwegian society.

In order to ensure that this research is available to society as a whole, we also operate units whose principal activity is consulting. We are also active in testing and certification in a number of areas, not only within the SINTEF Group itself, but also through companies in which we are shareholders and via cooperation with other organisations. These activities make significant contributions to creating added value from the knowledge and solutions produced by our researchers.

Locations
SINTEF has approximately 2000 employees, 1300 of which are located in Trondheim and 450 in Oslo. We have offices in Bergen, Stavanger and Ålesund, in addition to offices in USA, Republic of Macedonia, Brazil and Denmark. SINTEF's head office is in Trondheim.



This is SINTEF Energy Research

SINTEF Energy Research develops solutions for electricity generation and transformation, distribution and end-use of energy, onshore and offshore/subsea. We deal with everything from indoor climate and energy use in buildings to gas technology, combustion, bioenergy, refrigeration technology and thermal processing of foodstuffs.

At 31 December 2008 we had 200 employees. 151 of these were university graduates, including 65 with doctoral degrees. Our budgeted turnover for 2008 is NOK 299 million. The Institute has three research departments: Electric Power Technology, Energy Processes and Energy Systems.

Research departments
Electric Power Technology works on tasks related to the testing and development of electric power equipment, in collaboration with NTNU's Department of Electric Power Technology.

Energy Processes performs contract research on topics that range from the handling and use of hydrogen, natural gas and CO_2 to energy and heat supply, combustion, climate control of buildings, food technology and applied refrigeration engineering.

Energy Systems can boast of a unique combination of broad but in-depth expertise in energy system analysis. Formerly limited to a focus on electricity, all classes of energy carrier, as well as environmental considerations, can now be included in this department's analyses.

Laboratories
In cooperation with NTNU, we have 7000 square metres of modern laboratories available for research, development and education.

The Thermal engineering laboratory (VATL) is the largest laboratory for research work within the technologies of refrigeration, low temperature, combustion, thermal engineering, dewatering, food engineering, indoor energy and environment.

Special laboratories included in VATL: The Dewatering laboratories have a large diversity of measuring devices and its facilities have a complete line of heat pump and conventional dryers. The Energy and Indoor Environmental laboratory is equipped with several rigs, test facilities and climate rooms for research within indoor heating, ventilation and air conditioning. The Hydropower laboratory is equipped with three circulation systems which are very suitable for testing of small test rigs.

The Electrotechnical laboratories (ETL) comprise high voltage, high current and climate labs as well as a number of smaller labs for material testing and analyses. They also include special labs for hyperbaric testing of materials and components for sub-sea power and signal applications for the off-shore industries.

European Carbon Dioxide Capture and Storage Laboratory Infrastructure (ECCSEL)
SINTEF and the Norwegian University of Science and Technology (NTNU) have been appointed by ESFRI (European Strategy Forum on Research Infrastructures) to coordinate the construction of a Pan-European infrastructure within Carbon Dioxide Capture and Storage (CCS).

The core hub of ECCSEL will be in Norway with partner institutions from 10 European countries. The total investment costs will be approx. 80-100 million Euro of which 20 million Euro will be used in Norway for upgrading infrastructures within absorption technology, materials science, combustion technology, cryogenic processes and storage. ECCSEL will be open to researchers from EU/EEA through a joint management structure

Within the Scandinavian Association for Testing of Electric Power Equipment (SATS) and the Short-Circuit Testing Liaison (STL) SINTEF Energy Research cooperate with other laboratories on a global basis.

www.sintef.no/energy

Climate research that sets the pace

The Climate Agreement that was passed by the Storting has had a significant impact on public sector research funding in energy and climate research issues. The increase of NOK 300 in 2009 speaks for itself. We now hope that there will be an equivalent increase in 2010. It is satisfactory that the Norwegian authorities see how serious our climate challenges are and have implemented decisive measures that will help with sustainable developments. Now it is up to industry, the public sector and the research institutes to work towards the short term and long term solutions.

The Research Council of Norway has established eight new Centres for Environment-friendly Energy Research (CEERs). These will work for eight years and each centre has a financial framework of between NOK 160 to 320 million. SINTEF Energy Research has devoted a lot of work in becoming a central player in these new centres. Focus areas will be windpower, solar energy, bioenergy, environmental development of renewable energy, CO_2 treatment and environmentally friendly buildings. SINTEF and NTNU are involved in six of these eight centres. Efforts will be focused on domestic cooperation and strong ties to international research institutes.

SINTEF Energy Research has been extremely enthusiastic in working to establish these new centres. An important element will be the further education of young PhD candidates and assisting them to complete their doctorates. It is a wise long-term policy to allow some of the most talented students to take doctoral education and do research into the solutions of tomorrow while we wait for effects of the international financial crisis to diminish. I am convinced that we have a lot to offer young students in this area. Industry has become an active partner in these centres and has assumed 25 per cent of the investment costs. This ensures that there will be a productive dialogue between the research institutes and those who will put the new solutions into effect in society. This research will form the basis for innovative and improved solutions that will give the industrial partners a competitive advantage in the international energy market. We consider that our research work will help to give Norwegian industry significant innovative impetus.

As Norway only represents a small percentage of global research, it is important that our researchers establish contact networks with prominent researchers and institutes around the world. This has been done through our extensive cooperation the EU's framework programmes for research. The new centres will also have adequate status to help their international visibility. This will make us an attractive partner for international research institutes. Our partners already include leading institutes such as MIT, Stanford and UC Berkeley. In Europe there is the technical university in Munich and several other agreements are pending.

The Norwegian authorities have given us good framework conditions for research and we will do everything in our power to contribute towards sustainable solutions to energy and climate challenges in the future. I am convinced that we will be proud about how our work is evaluated in five to eights years from now. I assume that the new government in the autumn of 2009 will follow up the ambitions of its predecessors and invest a further NOK 300 in energy research from 2010 and onwards.

Sverre Aam
President

BIGCCS CENTRE – INTERNATIONAL CCS RESEARCH CENTRE

CO_2 AMBASSADOR

- Before we can reap the major environmental benefits that CO_2 management represents, the world must be prepared to work as a team in the same direction. It is impossible to tackle climate change problems individually in each country. This is why we have built such a broad international platform at the centre, says the director Nils A. Røkke.

The BIGCCS research centre encompasses the entire CO_2 chain, from capture to transport to storage. With long-term and basic research, the centre will help to achieve full-scale CO_2 management from power generation and industrial processes. BIGCCS is one of the newly appointed centres for environmental-friendly energy research (CEERs).

High level visibility in Brussels
Nils Røkke is an experienced researcher and head of the research centre. Over the years, he has spent a lot of time coordinating large projects and has formed European research consortia in connection with applications for EU-funded research. He is acknowledged as one of the world's foremost experts in this field of research.

Sound research groups
The centre will be based on the considerable activity and expertise that SINTEF and NTNU have built up in CO_2 management over a period of 25 years. Much of the expertise is the result of projects together with industry and the Research Council of Norway.

- We also see that Norway's pioneering role in CO_2 management of Statoil's Sleipner project has been important for establishing the research platform that we now have in Trondheim, said Nils Røkke.

The BIGCCS centre places equal emphasis on the importance of capture and transport/storage. The project partners cover the North Sea, Norwegian Sea and Barents Sea in a unique way when it comes to storage options. No other grouping has so much knowledge gathered in the areas that are appropriate for CO_2 storage.

Expertise from 26 partners, representing eight different nations, and an advanced education programme with 18 PhDs and 8 postdocs will ensure that education, innovation and value creation are handled in the scope of the centre.

Common European laboratories
Several of the participants in BIGCCS will also participate in the construction of the new common European laboratory facilities for CO_2 management (ECCSEL). Given this and the ongoing projects at the participating institutions, BIGCCS has the role as an international Centre of Excellence in research on CCS (Carbon Capture and Storage).

Norway is already heavily engaged in international research projects in the area and will now be the host country for building the common European CO_2 laboratories. Nils Røkke believes therefore the country has reached a point it is a major global player. Europe is committed to invest NOK 730 million in the common European laboratories for CO_2 management, and will use nearly a third of this in Norway.

NTNU and SINTEF will coordinate this effort, which involves the construction of five CO_2 laboratories at NTNU / SINTEF. Nils Røkke considers that this shows the faith the EU has in our ability to produce results.

-Action to redress global climate change is about more than CO_2 management. The world will also need a broad range of technologies to find solutions to climate problems, concludes Nils A. Røkke.

TITLE OF THE CENTRE: BIGCCS CENTRE – INTERNATIONAL CCS RESEARCH CENTRE
PROJECT RESPONSIBILITY: SINTEF ENERGY RESEARCH
HEAD OF THE CENTRE: NILS A. RØKKE nils.a.rokke@sintef.no WWW.BIGCCS.NO

PARTNERS: R&D PARTNERS: Norwegian University of Science and Technology (NTNU), Aker Clean Carbon, ALSTOM AG, ConocoPhilips Norge, Det Norske Veritas (DNV), Dong Energy, Gassco, Hydro ASA, Schlumberger, Shell, Statkraft SF, StatoilHydro, TOT AL E&P Norge AS, British Geological Survey (BGS), CICERO, Deutsches Zentrum für Luft und Raumfahrt (DLR), Geological Survey of Denmark and Greenland (GEUS), Norges geologiske undersøkelse (NGU), RFF, Sandia National Labs, Technische Universität München (TUM) and the University of Oslo (UiO)

CENTRE FOR ENVIRONMENTAL DESIGN OF RENEWABLE ENERGY (CEDREN)

ENVIRONMENTAL ANALYST

Renewable energy from water, wind, the sun and bioresources will be vital in helping Norway and the world to meet their targets for reduced emissions of greenhouse gases. Acceptance of large-scale development of renewable energy sources requires that the negative social and ecological impacts are as few and limited as possible. This is what Atle Harby is working to achieve.

- Now it is the environment that must be the focus and decide the framework for how we can obtain our power, says senior researcher Atle Harby. We must design our renewable energy so that we place least possible loads on the natural environment, he adds.

Atle Harby is the head of the Centre for Environmental Design of Renewable Energy (CEDREN), one of the eight new Centres for Environmental-friendly Energy Research (CEERs). The centre will work closely with two other CEERs involved in offshore wind power.

Hydropower and the environment
The EU has ambitious targets for large-scale development of renewable energy much of this is going to be windpower.

- With the increased capacity of power cables to the Continent, Norwegian hydropower can play an important role to balance windpower. In addition, we may also see a sharp increase in both onshore and offshore windpower in Norway. Taken together, this creates new demands for Norwegian hydropower, he states.

Local and global
Atle Harby considers that Norway is in the forefront, if not at the global leading edge when it comes to environmentally friendly hydropower projects. The knowledge and the methodology we have in this area, can be used and developed so that the future energy system also takes good care of nature.

- We believe it has a transfer value and we can use this experience for offshore wind turbines or other renewable projects, he says.

CEDREN should help to develop and disseminate sound designs for renewable energy, where environmental and social challenges on the local and global scales are taken into consideration.

New adaptation
A major challenge in the first phase is to determine how today's hydropower system can be extended and adapted to a new operating situation with large amounts of non-regulated windpower on land and offshore. The wind does not blow just when we need power. Hydroelectric power will provide the necessary reserve and be a stabilizing factor. But this must mean that we avoid excessive environmental loads such as unacceptable water level variations in the affected watercourses.

- Hydroelectric power is the only renewable energy form that can store energy, due to the reservoirs. Norway is in a unique position to be able to achieve this interaction between hydropower and windpower. I think there are very few other countries in the world that are in such a position. We must exploit it, concludes Atle Harby.

TITLE OF THE CENTRE: CENTRE FOR ENVIRONMENTAL DESIGN OF RENEWABLE ENERGY (CEDREN)
PROJECT RESPONSIBILITY: SINTEF ENERGY RESEARCH
HEAD OF THE CENTRE: ATLE HARBY atle.harby@sintef.no WWW.CEDREN.NO

PARTNERS: R&D PARTNERS: Norwegian Institute for Nature Research (NINA) and Norwegian University of Science and Technology (NTNU), LFI Oslo, UNIFOB, NIVA, Agder Energi, Eidsiva vannkraft, EBL, Hydro, Sira-Kvina Kraftselskap, Statnett and Statkraft.

NORWEGIAN RESEARCH CENTRE FOR OFFSHORE WIND TECHNOLOGY (NOWITECH)

WIND HUNTERS

The EU will invest about NOK 1000 billion up to 2020 to install 50 gigawatt (GW) of offshore windpower. This is 50 times the production capacity of all present-day offshore wind turbines in our part of the world. John Olav Giæver Tande is among those who will help Europe take this decisive step into the future.

Exploiting our competitive edge

- Norway is able to take a large share of the market, says John Olav Tande. He is a well-known wind researcher nationally and internationally and heads the Norwegian Research Centre for Offshore Wind Technology (NOWITECH) - one of the newly appointed national Centres for Environmental-friendly Energy Research (CEERs).

Europe is putting a lot of money into offshore windpower, primarily fixed installations in shallow water. About 1 GW of offshore wind power is now operative. The installations are mainly close to land and in reality they just use onshore windpower technology. But soon we will run out of suitable locations near the coast.

Environmental and resource conditions will mean that such facilities need locations further offshore.

- This is where Norway has an edge, and we must use it, says senior researcher John Olav Tande. We must seize the opportunity now; otherwise others will grab the chance.

Competitive advantages

Deep water wind turbines can give the world huge amounts of windpower, provided the costs are reduced to a competitive level. This requires the development of offshore technology, and this is a field where Norwegian industry and research are at the forefront. John Olav Tande points to examples such as the design and delivery of the concrete towers for fixed wind turbines in medium water depths, and the floating concepts HyWind, Sway and WindSea.

Invaluable know-how

It is an invaluable advantage to be able to apply the know-how gained in the offshore oil industry to the development of wind farms at sea. The goal is to develop new knowledge, methods and technology that will become the basis for the industrial development of offshore wind farms.

Strong partners

The centre will build on ongoing research and development, use the laboratories (including the ocean basin laboratory at MARINTEK), and the results from planned full-scale field trials, for example HyWind. Great emphasis will be placed on the education of PhD candidates and postdocs. The partners in the centre are at international leading edge in critical fields such as offshore technology and connection to the power grid.

- Norwegian offshore technology developed for the oil industry together with experience from the maritime industry will provide an advantageous stepping stone as we move towards offshore windpower, states John Olav Tande.

TITLE OF THE CENTRE: NORWEGIAN RESEARCH CENTRE FOR OFFSHORE WIND TECHNOLOGY (NOWITECH)
PROJECT RESPONSIBILITY: SINTEF ENERGY RESEARCH
HEAD OF THE CENTRE: JOHN OLAV GIÆVER TANDE john.tande@sintef.no WWW.NOWITECH.NO

R&D PARTNERS: Norwegian University of Science and Technology (NTNU), Institute for Energy Technology (IFE), MARINTEK, SINTEF Materials and Chemistry, SINTEF ICT
ASSOCIATED R&D PARTNERS: Risø DTU, The Massachusetts Institute of Technology (MIT), The National Renewable Energy Laboratory (NREL)
INDUSTRIAL PARTNERS: Aker Solutions, ChapDrive, ConocoPhillips, Devold AMT, Dong, Fugro Oceanor, Innovasjon Norge, Lyse, NTE (Nord-Trøndelag Elektrisitetsverk), ScanWind, SmartMotor, Statkraft, Statnett, StatoilHydro, SWAY, TrønderEnergi, Umoe Mandal, Veritas, Vestas, Vestavind
ASSOCIATED INDUSTRIAL PARTNER: NORWEA

PELLETS PATRIOT

By 2020, bioenergy use in Norway will be doubled. Led by Lars Sørum the CenBio research centre will develop the foundation for a sustainable and cost-effective bioenergy industry to meet this national goal.

Bioenergy is energy from biomass. The forests are the largest resource.

- We use the forest for firewood, pellet and wood chip boilers in advanced plants. This is the kind of bioenergy, we are talking about, explains Lars Sørum who will head the centre.

Modest growth
The centre will address some extensive challenges. The production and availability of biomass that can be used for energy must be increased significantly. At the same time, this must be done in a sustainable way. The efficiency of biomass production, energy conversion and use of bioenergy must be improved, so that the increase will require as limited amounts of raw material as possible.

Entire value chain
All parts of the chain are important. We must remove the biomass from the forest in a cost-effective and energy efficient manner, transport it, store and refine it so that as much as the potential energy content in the timber can be converted to heat and power. Competition concerning the use of land and the available biomass will become keener.

In Norway, we are only extracting about a third of what we could use for biomass without impairing natural new growth. This means that soon we will not be able to see the woods for the trees and our attractive cultural landscape will become forests.

- Removing more biomass therefore is also important for maintaining the cultural landscape. We are talking about extraction within the sustainable limits, we will not cut down all the forests in Norway, says Sørum.

Central resource for the industry
CenBio is one of the national Centres for Environmental-friendly Energy Research (CEERs). The centre will consist of leading research groups, eighteen large and medium-sized Norwegian bioenergy companies, sectoral organizations for bioenergy, and two major foreign companies. It will also be important to work with industry through the entire chain - the Norwegian forest owners' association with its clear area of interest, the industries that produce the technologies required and the energy companies that use the technology.

Recruitment appears to be secured through a researcher education programme for masters and doctoral students. It is this younger generation who want to adopt the technology.

If you think a little ahead, what is the most important source of bioenergy?

- It will undoubtedly be the forest, not just in Norway but also globally, says Lars Sørum.

TITLE OF THE CENTRE: BIOENERGY INNOVATION CENTRE (CENBIO)
PROJECT RESPONSIBILITY: NORWEGIAN UNIVERSITY OF LIFE SCIENCES (UMB)
HEAD OF THE CENTRE: LARS SØRUM lars.sorum@sintef.no WWW.CENBIO.NO

PARTNERS: R&D PARTNERS: Norwegian University of Science and Technology (NTNU), SINTEF Energy Research Technology, The Norwegian Forest and Landscape Institute, Bioforsk, and Vattenfall R&D (SE).
INDUSTRIAL PARTNERS: Arena Bioenergi Innlandet, Norwegian forest owners' association, NORSKOG , Agder energi, Eidsiva Bioenergi AS, Hafslund ASA, Trondheim energi fjernvarme AS, Vattenfall Heat Nordic (S), Norske skog ASA, Xynergo AS, Norsk Protein AS, Nord-Trøndelag Elektrisitetsverk Holding AS, Norges bondelag, Energigjenvinningsetaten i Oslo kommune, Avfal Energie Bedrijf (NL), Avfall Norge, Energos AS, Cambi AS, Jøtul AS, Bionordic AS, and Grant Kleber AS.
INTERNATIONAL PARTNERS: Stanford University (USA), US Forest Service (USA), University of Minnesota (USA), Finnish Forest Research Institute (FIN), Chalmers University of Technology (S), Åbo Akademi University (FIN), Technical University of Denmark (DK), University of Copenhagen (DK), Vienna University of Technology (A), and University TU Bergakademie Freiberg (D)

PHOTOGRAPHING DROPLETS

The oil industry likes large water droplets better than small ones, because the larger ones are easiest to remove from the crude oil that is recovered from an oil reservoir. Electric fields can make small water droplets merge, and images taken by Svein Magne Hellesø have provided important knowledge about the method.

Using a high-speed camera the researchers can see exactly what happens when two water droplets merge in opaque heavy oil.

- In a typical image, a drop of water is black and the surrounding grey-white media will be heavy oil that we cannot see through when we are using light, explains researcher Svein Magne Hellesø who operates the camera. The images produced by the new method show the clear interface between water droplets and we can thus see how the droplets are affected when an electric field is energized.

Separation
Whether it is on the Norwegian continental shelf, in Brazil or in Saudi Arabia, wellstream from oil reservoirs contains a mixture of oil, gas, water and sand. However the gas and oil must be separated and the water droplets removed from the oil, before natural gas can be sold for domestic use or fuel for gaspower plants, and the oil is refined into petrol or diesel.

Senior Researcher Lars Lundgaard is extremely interested in what are the fundamental properties and processes surrounding the merging (coalescence) of water droplets in oil, and how they are influenced by an electric field. He is the primus motor in the electrocoalescence project.

Electric field
- By introducing an electric field in the oil-water mixtures, small water droplets are attracted each other and merge into larger droplets, says Lundgaard. The process is called electrocoalescence. This means that the separation process between oil and water becomes more efficient because the large droplets are removed faster. Electrocoalescence is a method that is already used for separating water from oil, and Lundgaard and Hellesø are part of a research team that is helping to further develop and improve the method.

Special camera
In order to study the basic effects in such a process, high-tech devices are required, such as a high-speed camera. The researchers are using a Near InfraRed camera that was purchased specifically for these experiments. The images from the camera show effects that no one has previously been able to study in detail.

Stills
It requires a lot of preparation and work to obtain images where the droplets are measurable. Actually, Hellesø is recording a video. But to find the position of the droplets, still images are made. This enables the researchers to estimate the movement and acceleration of the droplets. The images have therefore given them new opportunities to compare theory with reality.

- The coalescence of the droplets is a quick process. We are talking in terms of milliseconds. We therefore need to invest in a faster camera that shows duration and development just before the coalescence of two droplets. This will bring us important step forward, says Svein Magne Hellesø.

The company has a pronounced research profile and is engaged in a number of advanced research programmes together with industry in the Research Council of Norway's large-scale initiatives in energy and climate research.

SINTEF Energy Research also enjoys a strong position within the EU's framework programmes for research with extensive activities in areas such as purification technology for gas and coal power, bioenergy and energy planning.

The ambitions for research stipulated by the Norwegian authorities in the Climate Agreement matches our corporate disciplinary profile extremely well. We have invested a lot of time and effort in being prepared to meet such challenges.

Technology for a better society
The company initiates R&D in order to promote cost-effective and environmentally friendly solutions for the supply of power and heat as well as energy consumption. This contributes to reducing environmental loads, increases value creation for industry and helps the end user by providing cheaper and better energy solutions.

We also make significant contributions towards increasing the development of Norwegian petroleum resources in an environmentally friendly and secure manner thanks to new technologies developed for oil companies and the service industry in that sector.

The company is a general research institute which cooperates with the Norwegian University of Science and Technology (NTNU) in research and teaching activities that are naturally associated with our range of operations. We enjoy close contact with the industrial interest groups and organizations in our area of activity.

The company does not declare dividends. The resources generated by our activities are allocated exclusively to realizing the corporate objectives and the purpose of SINTEF. The European Commission has given SINTEF Energy Research the status of a non-profit organization.

The company is located on the Gløshaugen university campus in Trondheim, and its registered address is Sem Sælands vei 11, NO-7465 Trondheim, Norway. The company is owned by the SINTEF Foundation (61%), EBL - Norwegian Electricity Industry Association (33.4%) and Norsk Industri - The Federation of Norwegian Industries (5.6%).

Customers
As a result of the Climate Agreement, The Storting (Norwegian parliament) will make considerable investments in energy research from 2009 and onwards. The Research Council of Norway has established eight new Centres for Environment-friendly Energy Research (CEERs). SINTEF Energy Research has devoted a lot of work in becoming a central player in these new centres. We will host for three of them and will participate as a partner in two of the others. These centres will bring industrial partners into direct contact with domestic and international research institutes.

The company has an extensive portfolio of activities with the Research Council of Norway. Their instrument, Knowledge-building Projects with User Involvement (KMB) is of great importance for our ability to acquire new skills and competencies. These projects include participants from industry and the public sector in order to ensure that the research being done is relevant.

We initiated two new KMB projects in 2008 and have been awarded 12 new contracts that will start in 2009. Central issues are bioenergy, the power grid, power markets, energy planning and political control, CO_2 transport, LNG, and energy savings.

The company puts emphasis on its participatory and coordinating role in EU research projects, both in order to acquire resources for skills development and to establish networks of customers and research institutes in Europe. We participated in 21 EU projects representing a turnover of NOK 12 million in 2007 and coordinated six of them. In addition, we actively participate in a number of EU's technology platforms which design the strategies related to our various disciplinary areas.

We are running a number of projects that involve international participants, among them EDF, ALSTOM, GE, ABB, Siemens, Vattenfall, Fortum, TOTAL, Petrobras, Shell, Saudi Aramco and UoP.

Disciplinary scope
We have broad disciplinary scope that covers numerous fields in energy supply, energy consumption and oil and gas technology. Our ambition is to become a leading player in CO_2 treatment, subsea power supply, LNG, and energy planning research. A brief description of two selected disciplinary activities follows.

The most promising solutions for the future gas and coal power plants with CO_2 capture requires the burning of hydrogen or the burning of oxygen surplus, both at high pressure. The company has one of the world's leading research groups in combustion technology and works closely with the world's largest manufacturers of gas turbines in order to meet the challenge of achieving controlled and complete combustion of gas mixtures without releasing pollutants.

Due to the climatic crisis, the EU wants a dramatic increase in the share of non-regulated renewable power in the energy system. This creates the need to balance the power supply and upgrade the distribution grid considerably. In addition, it will challenge the present-day decision-support tools for operations and investments and bring the need for optimal modelling of the network, thermal production and end use.

The cooperation with and close proximity to the Norwegian University of Science and Technology (NTNU) is among our key disciplinary advantages and both institutions share common resources such as laboratories, workshops and tool services, and are also involved in the some of the each other's research activities.

Employees
At 31 December 2008 we had 200 employees. 151 of these were university graduates, including 65 with doctoral degrees. There are 10 engineers and the rest are technical and administrative staff. The average age was 41. During last year we hired 19 new employees while 18 others left the company. We have contracts with 48 members of the staff at NTNU.

The Institute has 23 researchers on the permanent staff with foreign backgrounds. They are from Germany (5), Italy (1), France (3), Russia (2), Romania (1), Sweden (2), Finland (1), China (1), Poland (1), Lebanon (1), Denmark (1), the Czech Republic (1), Hungary (1), Congo (1) and the USA (1). These staff are in a particularly good position to establish links to their native countries.

In cooperation with NTNU, NVE, BKK Nett, Lyse Nett, Statnett and EBL we have established a trainee agreement through which we employ two new people every year. This has become a very popular arrangement with a high level of female participation that has received attention outside our company.

Code of Ethics
The SINTEF Group has developed a Code of Ethics manual which is available both on our Intranet and as a printed volume. The manual is a useful tool in our daily activities. Ethics are regularly discussed at meetings in the company.

The SINTEF Group has established an arrangement involving an Ethics Ombudsman who can be contacted for confidential discussion with staff who experience ethical issues that they wish to keep outside the line management.

Gender equality and family policy
The company management has a female share of 44 per cent. Altogether, 29 per cent of the staff are female. Among the scientific staff the percentage is 18 per cent. Increasing the female share of our employees is given high priority when new staff are recruited. There are also plans to expand the number of female senior researchers and managers. 33 per cent of the external representatives on the board and 50 per cent of the employees' representatives are female. The Institute has flexible arrangements with regard to working hours, welfare arrangements, etc., and the SINTEF Group also supports the operation of kindergartens through the Aurora Foundation.

An internal survey at SINTEF found that men and women had equal pay in the company.

Health, environment and safety (HES)
The absence due to illness amounted to 3.2 per cent, which represents an increase of 1.4 per cent compared to 2007.

The company has its own sports club which receives financial backing. The successful "Kom i Form" ("Get in Shape") project emphasizes knowledge related to health, a common "measurement" of fitness and individual coaching.

There are systematic efforts at the company to reduce accidents and unwanted incidents. Synergi is a database tool that is used for the registration of unwanted accidents and suggested remedial measures. In 2008, SINTEF Energy Research registered no accidents (compared with 5 in 2007). There were eight near-accidents accidents (compared with 16 in 2007) and 25 suggested remedial measures/observations in the HES module (compared with 5 in 2007) and16 non-conformances/suggested remedial measures/observations in the quality module (compared with 17 in 2007). Most of these have been concluded or approved during the year.

The company has active routines to ensure that our activities comply with external environmental considerations and include measures such as the treatment of different kinds of waste and hazardous waste. We carry out systematic risk assessments which take the external environment into account. Our activities do not lead to any pollution of the environment that conflict with legislation in force.

The working environment survey from 2008 has been followed up by measures implemented by each department.

Annual profit
The annual profit amounted to NOK 29.8 million before tax, which is NOK 7.5 million higher than in 2007. The net operational profit was NOK 20.6 million, which is NOK 6.0 million higher than the year before. Net operation income increased by 9.8 per cent compared to last year. The net financial profit was NOK 9.2 million.

The Board has no knowledge of conditions that may arise after the date the accounts were balanced which may be significant for the assessment of the Institute's financial position.

The Institute's equity of 31 December 2008 amounts to NOK 225.6 million this constitutes 55 per cent of the total capital of which the Institute's share capital is NOK 7.5 million. This is a good basis for continued operation, which is noted in the accounts.

The liquidity situation is satisfactory.

SINTEF Energy Research is to some extent exposed to fluctuations in the currency market as 2 per cent of the project income is linked to foreign currencies, while the project costs are calculated in Norwegian kroner. The exposure is primarily towards the EUR and USD and the Institute has set up forward contracts in the currency in question. Nevertheless, the Institute operates in an internationally competitive market where the competitors often tend to belong to the eurozone.

Along with the other members of the SINTEF Group, SINTEF Energy Research has developed a joint arrangement for pooling the group's significant liquidity reserves. The portfolio is subject to the "Rules for financial management" dated 11 June 2008.

The Board is of the opinion that the accounts presented here give a correct overview of the real financial development of SINTEF Energy Research per 31 December 2008.

Planning and organization
Since 1999, the company has been collaborating with Professor Per Morten Schiefloe in order to introduce value-based management techniques. Organizational development efforts are being made on a continuously ongoing at all levels of

the organization. Focus is put on developing the human capital of the company and at the core is the ability to build up networks and be continuously innovative.

The SINTEF Group has carried out a comprehensive review of its quality management system which was made available to all employees on the company Intranet in February 2007. The system was approved in June 2007 as a certified quality system in line with ISO 9001 and OHSAS 18001 of TI – Teknologisk Institutt Sertifisering AS. During 2008 the Group's Quality Forum which has a representative from each unit in the Group has worked towards continuously improving the management system.

Customer satisfaction surveys are carried out in connection with the completion of selected projects. The results generally show a high degree of satisfaction with our products and services.

All units in the SINTEF Group have introduced a system involving risk reporting each quarter. The reports to the Institute are discussed by the board and risk-reduction measurements are implemented. Important risk and uncertainty factors for the company are related to the market and the major customers, our cooperation with NTNU, the company's standing, the responsibilities related to major contracts, loss of key skills, recruitment and safety in laboratory and field work.

Future possibilities and challenges

Energy and environment are important topics nationally and internationally, and it must be expected that significant R&D resources will become available for this purpose in over the coming years. The Norwegian climate agreement is already a concrete manifestation of the ambition to promote R&D in renewable energy and CO_2 management.

Oil prices have fluctuated a lot during 2008 due to the prevailing market conditions. Although prices were rather low at the end of the year, a price rise is expected in the long term. This means that there is reason to expect that the oil industry will continue its high level of R&D activity.

The EU's dynamic initiatives in energy research provide a good foundation for international cooperation. It is positive that the new framework programme covers the range of activities in the energy sector in a balanced manner.

The global financial crisis may lead to a temporary reduction in research expenditure during the next two to three years. However, this is likely to be mitigated to some extent by the substantial public sector investments in energy and climate research. It is not clear how this will affect the company's activities but we will be in a position to sum up our experience during 2009.

In the future, adjustments will be necessary to focus on areas where the company already has or has to potential to be outstanding internationally. It is also crucial to develop useful alliances at the national and international levels. Our customers will increasingly turn towards the best international research groups. This entails both challenges and possibilities for the Institute.

Acknowledgements

The Board wishes to thank the management and employees for a successful year that has yielded good disciplinary and financial results.

Trondheim 2009-03-12

Sverre Aam

Reidar Bye

Grethe Høiland

Eileen A. Buan

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Einar Westre

Arne Sveen

Siri H. Blakstad

Petter NeksåNekså

Key financial figures for SINTEF Energy Research

MNOK	2004	2005	2006	2007	2008
Result					
Gross operating income	203	211	246	262	299
Net operating income	158	165	186	195	214
Operating result	**6**	**4**	**13**	**15**	**21**
Annual result	**9**	**17**	**28**	**27**	**30**
Balance sheet					
Fixed assets	39	56	50	61	70
Liquid assets	148	169	237	255	324
Sum of assets	**187**	**225**	**287**	**316**	**394**
Equity capital	129	46	1174	196	225
Debt	58	79	113	120	169
Sum of equity and debt	**187**	**225**	**287**	**316**	**394**
Profitability					
Operating margin %	3.8	2.6	7.0	7.5	9.8
Total profitability %	4.9	8.3	11.0	7.8	8.6
Profitability of equity capital %	7.6	12.3	17.5	14.7	14.4
Liquidity					
Net cash flow from operation	6	-9	53	35	22
Degree of liquidity	2.6	2.8	2.5	2.6	2.2
Solidity					
Equity capital %	69	65	61	62	57
Operating working capital	88	89	123	148	177

Employees

- Administration 29
- Technical personnel 10
- Engineers 10
- Researchers 151 *)

*) of whom 65 hold doctorates

Publishing and communication

- Scientific articles in journals, series or anthology 60
- Scientifics talks and posters 33
- Reports 164
- Popular science articles and talks 88

Rosenborg Reklame SIEN05, Photos: Thor Nielsen, Harald Danielsen, Mette Kjelstad Høiseth

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