

 NTNU

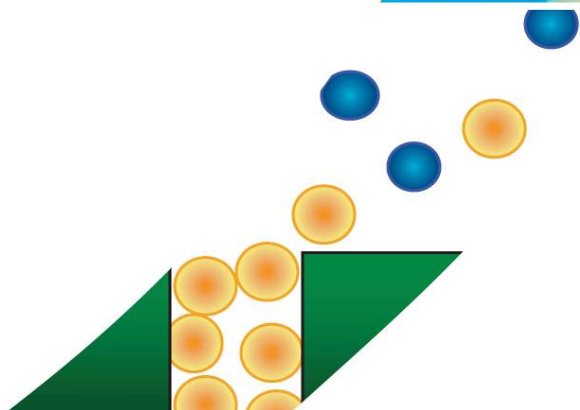
 SINTEF



The Gas Technology Center

NTNU – SINTEF

**Annual Report
2006**



The Gas Technology Center was established in 2003 and is the largest center for gas technology research and education in Norway. The Center provides new knowledge and technology which will contribute to efficient, value creating and environmentally friendly utilization of natural gas.

The strategic cooperation between NTNU and SINTEF will ensure top quality education, research, innovation and development. Approximately 300 people (researchers, professors, Post Docs and PhD students) are involved in natural gas-related R&D at NTNU and SINTEF. The operational budget of the Gas Technology Center is six million NOK per year.

Gas Value Chain R&D

The Center focuses on exploring the synergism of multidisciplinary research into the natural gas value chain. The Gas Technology Center has expertise in the entire value chain from the source to the end-user.

Main activities in 2006

Some of the main activities for the Gas Technology Center in 2006:

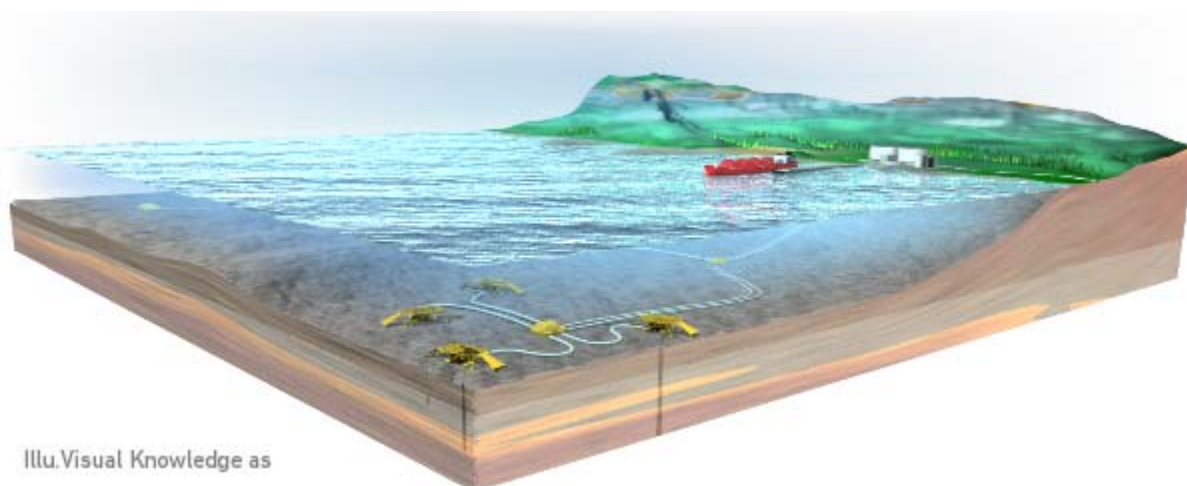
- Established a **Norwegian Centre of Excellence (CoE)** and / or a **Centre for Research-based Innovation (CRI)**.
- Hosted the international conference **GHGT-8** in Trondheim.
- Contributed to developing the downstream gas research program **GASSMAKS**.
- Preparation for the **Seventh Framework Programme**, including involvement in the Technology platform "Zero Emission Fossil Fuel Power Plants".
- Further development of **international relations**.
- Contributing towards the definition of **Arctic Gas Technology**.
- Developed **strategic R&D interaction** with our main partners.
- Continued to be a driving force in **national coordination** of natural gas R&D.
- Finalized a Research council-funded Strategic University Program: *PSE – from Natural Gas to Energy and Materials Products (2002 – 2006)*. The project was a catalyst for establishing the Gas Technology Center.

More details of our activities and the results in 2006 are described in this annual report.

The objective of the Gas Technology Center, NTNU-SINTEF is to increase the quality, efficiency and scope of gas technology education, research, development and innovation in Norway. This is to be achieved by coordinating and establishing new activities in the area at NTNU and SINTEF.

This includes the following actions:

- Contribute to strategies and interaction for value creation and innovation in Norway, and for the international business development of Norwegian companies based on natural gas.
- Work for larger programs for knowledge development and innovation in the natural gas sector.
- Coordinate the strategic objectives, resources and activities at NTNU and SINTEF.
- Increase the visibility, cooperation and market orientation of in the Norwegian gas cluster both domestically and internationally.



Results in 2006

The main results of the Gas Technology Center, NTNU-SINTEF in 2006, are described in this report. There are also other activities related to the Center that are not described in the report.

The Research Council of Norway: Applications and new projects

New projects where the Center has contributed include:

New Centre for Research-based Innovation (CRI) for e-field and Integrated Operations

NTNU, SINTEF and the Institute of Energy Technology (IFE) together with several oil companies and service companies have been awarded a Centre for Research-based Innovation (CRI) for e-field and Integrated Operations (IO). The IO Center was awarded by the Research Council as one of the 14 national CRI, with a governmental support of NOK 10 million per year over a 5 year period from 2006. The total budget of the Center is annually NOK 40 million.



Jon Lippe, the
Operational
Manager of CRI
(Photo: B. Hernes)

The vision of the Center is to be a major international provider of knowledge and technology within Integrated Operations in the oil and gas sector.

Jon Kleppe is the Center Manager of the CRI, and Jon Lippe is the Operational Manager. The Gas Technology Center has contributed to the development of this Center, and NTNU Center Director Bjarne A. Foss is heavily involved in the CRI.

The Center is divided into four main programs:

- Drilling and Well Construction
- Reservoir Management and Production Optimization
- Operation and Maintenance
- Integration across Disciplines

More information: www.ntnu.no/io

BIGCO2

The project BIGCO2 has the objective of building knowledge and promote the development of technologies for CO₂ capture from natural gas-fired power plants. The Climit-project started in 2001, and a continuation of the project, from 2007 to 2011, was granted in 2006. The project is coordinated by SINTEF Energy Research, with project director Nils A. Røkke. NTNU, Cicero and the University of Oslo are R&D providers, and there are several industrial partners involved.

BIGH2

An application has been submitted to Climit, targeting R&D in the field of enabling technologies for pre-combustion CCS power plants.

Massachusetts Institute of Technology (MIT)

MIT and NTNU signed a formal agreement in Gas Technology research in August 2006. Hydro and Statoil are industrial partners in the project.

The cooperation is divided into three research fields:

- Integrated design and operation of production- and transport structure for natural gas (Professor Barton, MIT, and Assoc. Professor Tomasgard, NTNU).
- Advanced catalysis for production of synthesis gas and hydrogen in membrane reactors (Professor Green, MIT, and Professors De Chen/Holmen, NTNU).
- Evaluation methodology for power plants with CO₂ capture (Professors McGrae/Herzog, MIT, and Professor Bolland, NTNU).

Another project in cooperation with MIT is the CLIMIT-project *Evaluation Methodology for Power Plants with CO₂ capture*.

RegionGass

Multi-level governance and regional development and the politics of natural gas are being studied in a new project, led by Marit Reitan. The Research Council is funding the program from 2006-2009, by NOK 5.1 million (approx.) in total.

Competence building: Energy Production from the North

Energy Production from the North is one of the areas in a proposed *ISP-project (institutional based strategic project)*, accepted by the Research Council. The overall objective of the ISP project is to strengthen the basic research in engineering science and technology at NTNU within areas of national strategic importance, and bring this research up to a level of international excellence. Research is planned in the form of PhD studies, Post Doc scholarships, and international conferences.

Towards a CO₂-free society in Svalbard

The University Centre in Svalbard (UNIS) is exploring the possibility of reaching a CO₂-free society in 2025. A pre-project is currently running, and SINTEF and NTNU are involved in the project. Also other projects based in Svalbard are addressing clean energy production in the arctic environment. The Gas Technology Center is cooperating with UNIS and Professor Bjarne A. Foss visited the university centre in 2006.

Innovative Research for Arctic Gas processing – Arctic Gas Technology

Excelling LNG technology for the Arctic is an initiative for gas technology research, but was unfortunately not funded in 2006. There are particular gas technology challenges in the Arctic Region, which involves increased attention to minimum environmental impacts. Plant construction and plant operation need to accommodate Arctic weather conditions and permafrost areas.

A strategic cooperation agreement was signed between Gubkin University and the Gas Technology Center NTNU-SINTEF, in relation to the joint Arctic Gas applications.

The project targets cooperation with Russia, and the partners were SINTEF, NTNU, Gubkin University, Statoil, RCN, VNIIGAZ and Gelyimash.



Gubkin University, NTNU and SINTEF meeting in Moscow October 2006 (Photo: SINTEF)

The Arctic gas objectives are:

- To develop knowledge and tools enabling innovative, environmentally safe, cost effective, and energy efficient LNG plants.
- To enable the partner enterprises to take roles in developing gas reserves and operating gas processing plants in the Arctic.
- To educate 10 PhD candidates and 10 Post Doc candidates within the field.

The Arctic gas initiative will be followed up in applications for 2007.

Relevant CoE-applications

Two of the 26 Centre of Excellence (CoE) applications going to the second selection in the Research Council were relevant to the Gas Technology Center:

Trondheim Center for CO₂ Capture - Enabling Research and Technology

- Vision: The Center will produce scientific breakthroughs that make CO₂ capture affordable to the world.
- Prospective Center Manager: Professor Hallvard Svendsen, NTNU.

Centre for Energy and Environmental Catalysis

- Vision: New catalysts and processes for clean energy: A multidisciplinary approach.
- Prospective Center Manager: Professor Anders Holmen, NTNU.

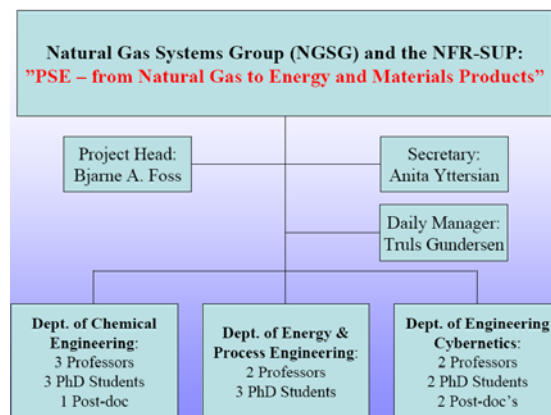
The applications were unfortunately not funded by the Research Council (decision made in December 2006).

Strategic University Program finalized

In 2006 a Research Council-funded Strategic University Program was finalized: *PSE – from Natural Gas to Energy and Materials Products* (2002 –2006). The project was a catalyst for establishing the Gas Technology Center in 2003.

Professor Truls Gundersen has been the Daily Manager of the project, and Professor Bjarne A. Foss has been the Project Director.

The total PhD funding of the project has been 350 months.

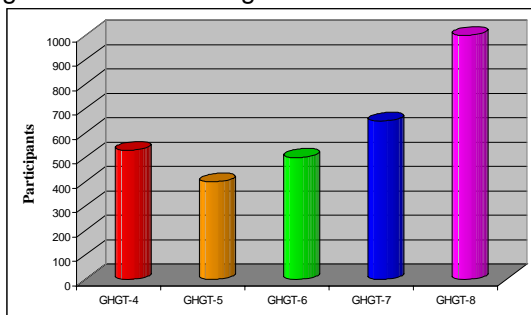


Conferences, workshops and seminars

GHGT-8

The Gas Technology Center NTNU-SINTEF hosted the IEA GHG-conference GHGT-8 in Trondheim, June 19-22, 2006. During these 4 days approximately 230 technical papers were presented and approximately the same number of posters displayed for discussion. Nearly 1000 participants from 47 countries attended the conference, which makes the event the world's largest Carbon Capture and Storage (CCS) conference to date.

The aim of the conference was to provide a forum for the discussion of the latest advances in the field of greenhouse gas control technologies.



The Greenhouse Gas Control Technologies (GHGT) conference series has established itself as the foremost conference bringing together the international community to discuss greenhouse gas control technology issues. This series of conferences strives to promote international research and development collaborations and encourage an exchange of ideas on future directions in this field.

Organizing Committee

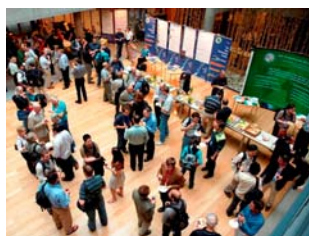
Chairman Nils A. Røkke, The Gas Technology Center NTNU-SINTEF
 Olav Bolland, NTNU
 John Gale, IEA Greenhouse Gas R&D Programme
 Denis O'Brien, European Commission (EU)
 Lars Ingolf Eide, Hydro Oil & Energy
 Geir Haug, Shell
 Bjørn-Erik Haugan, Gassnova
 Trygve Riis, Research Council of Norway
 Trude Sundset, Statoil

Programme Committee

Olav Bolland, NTNU (chairman)
 John Gale, IEA Greenhouse Gas R&D Programme
 Hallvard Svendsen, NTNU
 Peter Zweigel, SINTEF/Statoil

Opening, Keynote and Plenary Speakers

Odd Roger Enoksen, Minister of Petroleum and Energy, Norway
 Kelly Thambimuthu, Chairman, IEA GHG
 Pablo Fernandez-Ruiz, Director Energy Research, European Commission
 Barbara McKee, Director, Office of Coal & Power Import & Export, DoE-USA
 Pål Prestrud, President CICERO
 Bert Metz, Netherlands Environmental Assessment Agency and co-chair IPCC Working group III
 Margareth Øvrum, Executive Vice President, Statoil
 John Gale, IEA Greenhouse Gas R&D Programme
 Graeme Sweeney, CEO Shell Renewables and President, Shell Hydrogen
 Julia Lindland, Senior Technology Advisor, Gassnova
 John Gale, IEA Greenhouse Gas R&D Programme
 Nils A. Røkke, The Gas Technology Centre NTNU-SINTEF
 Olav Bolland, NTNU



(Photo: Roger Bjerkan)

The organizing committee of GHGT-8 was the prime mover behind realizing the conference, where Statoil, Hydro, Shell, the Research Council of Norway, Gassnova and the European Commission gave valuable contributions. The program committee members from NTNU, SINTEF and IEA GHG were instrumental in the development of the technical program for the conference supported by a large team of peer-reviewers. Nils A. Røkke, SINTEF Director Gas Technology Center, was the GHGT-8 Chairman.

The Minister of Petroleum and Energy, Odd Roger Enoksen, opened the Conference, followed by Kelly Thambimuthu, Chairman IEA GHG, and Pablo Fernandez-Ruiz, Director Energy Research, European Commission.



(Photo: Roger Bjerkan)

More information:
www.ghgt8.no

Poland 2006

The seminar “Energy Supply and Mitigation of Environmental Impacts” was arranged on October 18, as a part of *Poland 2006* (A 10-day program for academic and scientific cooperation between Norway and Poland). CO₂ capture and storage was discussed both during the plenary session and during the parallel session *Gas Technology*, and possibilities for cooperation between Norway and Poland were discussed.

Nils A. Røkke presenting the Energy Outlook of Norway
(Photo: A. Sørensen / Gas Technology Center)



Student excursion to Statoil Tjeldbergodden

Statoil and the Gas Technology Center have established a project where 12 NTNU students are invited to spend one week at Tjeldbergodden, following a program arranged by Statoil. Half of the students were offered Master’s thesis work related to Statoil Tjeldbergodden.

This was the second time the excursion was arranged, and the program has received positive response from the students, NTNU and Statoil.

More information:
www.ntnu.no/gass/tjeldbergodden
(Norwegian)

The students were recruited from the following departments:

- Chemical Engineering
- Energy and Process Engineering
- Production and Quality Eng.
- Industrial Economics and Technology Management
- Engineering Cybernetics
- Petroleum Engineering

(Photo: Statoil)



PhD-pool seminar with the Research Council

The Gas Technology Center NTNU-SINTEF and the Centre for Renewable Energy, NTNU – SINTEF – IFE, had a seminar with all the PhD students involved in the pilot project *PhD-pool* March 2006. Hans Otto Haaland and Trond Moengen from the Research Council attended the seminar.

The Gas Technology Center has 4 PhD students and 1 Post Doc student in the PhD-pool, funded by Renergi. The focus of the Center has been membranes and combustion.

<i>Subject</i>	<i>Name</i>	<i>Supervisor</i>
Development of electrolyte material for proton solid oxide fuel cell	Ms. Fride Vullum (Post Doc)	Professor Tor Grande
New Techniques for Preparation of CO ₂ Separation Membranes	Ms. Liyuan Deng (PhD)	Professor M.B. Hägg
Advanced computational modeling of non-conventional, lean premixed gas-turbine combustors	Mr. Bjørn Lilleberg (PhD)	Professor I. Ertesvåg
Pd-based membranes for novel hydrogen production and separation technologies	Ms. Astrid Lervik Mejdell (PhD)	Ass. Prof. Hilde J. Venvik
Thermal osmosis in membranes	Ms. Isabella Inzoli (PhD)	Professor Signe Kjelstrup

The two centers presented the PhD-pool, and strategies for funding of PhD-scholarships in general, at the Board meeting of Renergi in September.

Exhibition during E-World in Germany

The Gas Technology Center was presented during the International Energy Fair *E-World Energy & Water 2006* in Essen in February. NTNU and SINTEF were exhibitors at the Norwegian stand, coordinated by Innovation Norway. Norway was the Partner Country of the Fair, which had 12,500 visitors. The Crown Prince of Norway attended the opening ceremony of E-World.



(Photo: Gas Technology Center)

1st International Arctic LNG Conference

The Norwegian Petroleum Society (NPF) arranged the 1st annual International Arctic LNG Conference in March 2006. The conference is a result of the increasing gas activities in the Arctic region and the program has been established in close cooperation with the authorities, organizations, institutes and companies being active in the development. SINTEF Center Director Nils A. Røkke was a Member of the Programme Committee.

10th Nordic Filtration Symposium

The 10th Nordic Filtration Symposium, Gas Cleaning and Filtration, took place in Trondheim in September 2006. The Gas Technology Center supported the Symposium financially.

EU Research Framework Programmes

Towards the Seventh Framework Programme

NTNU and SINTEF are involved in about 100 projects in the Sixth Framework Programme. Preparation for the Seventh Framework Programme is a priority for the Gas Technology Center. This includes involvement in the European Technology Platform on Zero Emission Fossil Fuel Power Plants (ETP ZEP).



ETP ZEP aims at coordinating the establishment and implementation of a strategic research agenda to meet the needs of European Citizens and industry by 2020. In line with the proposed priority for "Near Zero Emission Power Generation" in FP7, the technology platform will identify and remove the obstacles to the creation of highly efficient power plants with near-zero emissions which will drastically reduce the environmental impact of fossil fuel use, particularly coal. This will include CO₂ capture and storage, as well as clean conversion technologies leading to substantial improvements in plant efficiency, reliability and costs.

www.zero-emissionplatform.eu

ETP ZEP is established by the European Commission and the European energy industry, research community, non governmental organizations and other key partners.

Norway is strongly represented in the Technology Platform, with involvement from SINTEF, NTNU, Bellona and Statoil.

Initiative towards a new technology platform: Sustainable Arctic energy

The Center is involved in an initiative for establishing a new Technology Platform within Sustainable Arctic energy. Sustainable Exploration, Field Development, Operations, Logistics and Transportation, Environmental Issues and Interaction with Biomarine Resources are all possible areas for a prospective Platform.

European Commission Projects: Dynamis

SINTEF is coordinating the first phase of the project Hypogen, an EC project generating fossil-based electricity and hydrogen incorporating CO₂ management.

In the ongoing launch phase, which has been given the name Dynamis, scientists and industrialists from eleven European nations will evaluate where this unique plant should be built, among other issues, and which technology should be utilized.

More information:

www.dynamis-hypogen.com

Dynamis has a total budget of about NOK 60 million. Nils A. Røkke is the Dynamis coordinator. Five Norwegian companies and institutions are taking part in the project. Apart from SINTEF, the members include Statoil, Hydro, Store Norske Spitsbergen Grubekompani and NTNU. Twenty-eight European companies and institutions make up the total membership of the project.

European Commission projects in the Sixth Framework Programme

NTNU and SINTEF are involved in many international energy research projects, including the following European Commission research programmes within sustainable energy:

- DYNAMIS Towards Hydrogen and Electricity Production with CO₂ Capture and Storage (Coordinator)
- ENGAS Environmental Gas Management Research Infrastructure (Coordinator)
- ENCAP Enhanced Capture of CO₂ (Project manager)
- CO2Remove Geological storage of CO₂
- COACH Co-operation Action within CCS EU-China
- CASTOR CO₂ from Capture to Storage
- ULCOS Ultra Low CO₂ Steelmaking
- INCACO2 International Co-operation Actions on CO₂ Capture and Storage
- CO2GeoNet Network of Excellence in Geological Storage of CO₂
- NATURALHY Preparing for the hydrogen economy by using the existing natural gas system as a catalyst
- ZEP The Technology Platform for Zero Emission Fossil Fuel Power Plants (two members)

International relations

Contact with international partners has been an important issue in 2006. The GHGT-8 conference hosted in Trondheim in June and the involvement in the EC's Framework Programmes and Technology Platforms have resulted in a large network of essential international partners. The partners mentioned below are therefore not exhaustive.

IEA GHG

The Gas Technology Center enjoyed a close cooperation with the IEA Greenhouse Gas R&D Programme during the arrangement of the GHGT-8 conference, and intends to continue regular contact.

CO2NET

The Gas Technology is a member of the Carbon Dioxide Knowledge Transfer Network (CO2NET). CO2NET was initially set up under the European Commission's FP5 Programme, and the Network comprises over 50 companies or organizations, covering 18 countries.

The key drivers for CO2NET are the development of CO₂ Capture and Storage (CCS) as a safe, technically feasible, socially acceptable option to help reduce the effects of human influenced climate change and meet the CO₂ emission reduction target set by the Kyoto agreement with a view to even greater emission reductions across Europe and beyond.

More information:
www.co2net.com

China

Together with the Strategic Research Area *Energy and Petroleum - Resources and Environment*, the Center has developed cooperation with Shanghai Jiao Tong University and Tsinghua University in 2006. Gas Technology is the area of cooperation, where Professor Arne M. Bredesen is the contact person.

Collaboration between Universidad Simon Bolivar, NTNU and Statoil in the field of Natural Gas Technology

A delegation of three professors from Universidad Simon Bolivar (USB) in Venezuela visited Trondheim for 9 weeks from February 2006. The intention of the visit was to transfer skills and expertise to prepare a graduate program and an industry specialization program entitled "Natural Gas Technology for Offshore Environment" in Venezuela. Statoil is supporting the project, and Statoil Research Centre in Trondheim is involved.

The Department of Petroleum Engineering and Applied Geophysics, NTNU, is planning and managing the collaboration on behalf of NTNU and the Gas Technology Center. Professor Michael Golan is the project manager.

Curtin University, Perth, Australia

In March 2006 associate professors Asgeir Tomasgard and Stein-Erik Fleten from the Gas Technology Center, NTNU-SINTEF visited Curtin Business School (CBS) in Perth, Australia. Western Australia has significant gas resources that will be extracted over the next few decades. In anticipation of this, the Curtin Business School, together with the University of Western Australia, has created a Center of Research Excellence to support research on business subjects related to gas management.

Increased value creation and innovation from natural gas R&D

National research program: GASSMAKS

GASSMAKS is a new research program addressing industrial value creation from natural gas. The first call in the research program is announced, with deadline in February 2007. The program is financed by the Ministry of Trade and Industry (NOK 25 million in 2007).

The Gas Technology Center has been involved in initiating and developing the program, which was fronted by the Confederation of Norwegian Enterprise (NHO), the Norwegian Confederation of Trade Unions (LO) and Norsk Gassforum.

OG21

OG₂₁ is a Task Force established by the Ministry of Petroleum and Energy, Norway in 2001 to help the petroleum industry to formulate a national technology strategy for added value and competitive advantage in the oil and gas industry. The objective is to develop a more coordinated and focused approach to research and development throughout the oil and gas industry.

The Gas Technology Center is communicating views for the national gas technology research to the strategy of OG₂₁, and has been an active member in TT8 – Gas Technologies.

Green Innovation (*Grønn innovasjon*)

Together with the Strategic Area, the Gas Technology Center contributes to structure a scientific orientated program named *Green Innovation*. Dr. Harald Gether is directing the program. The goals of the program are:

- Innovation for increased value creation and sustainability within energy, petroleum and environment.
- Scientific activity addressing:
 - Development of knowledge about how to develop innovation and creation of workplaces.
 - Study of barriers and driving forces to achieve a comprehensive change towards a more sustainable energy system.
- To use a multidisciplinary approach. The group started in 2004, with the goal of being a group of 5-8 people within five years.

Development of strategic R&D interaction

Cooperation with strategic partner

Statoil, the Norwegian State Oil Company, is Strategic Partner of the Gas Technology Center. Statoil is an integrated oil and gas company with substantial international activities.



The resources from Statoil finances cooperation projects and activities relevant for realizing the "New Energy" Strategy of Statoil. The resources fund PhD- scholarships, Post Doc scholarships, a professorship within hydrogen technology, laboratory equipment, network building, as well as management of the Gas Technology Center. Additionally, the agreement assumes a further development of the cooperation between NTNU-SINTEF and Statoil.

Liquefied natural gas (LNG)

For the budget years 2005-2009 the intention of Statoil is to cooperate with the Gas Technology Center within natural gas, with emphasis on LNG and gas processing. The goal is to contribute to establish an expert group within LNG in close cooperation with the Strategic Partner and others.

Energy in the north

NTNU is involved in a network of educational institutions, aiming to increase the competence within energy and environment in the northern areas. The network is connected to Snøhvit, and natural gas technology is a key issue. An important goal of the project is positive energy related spin-off effects in the region, and Municipality of Hammerfest is involved.

At NTNU Professor Arne M. Bredesen is leading the work, where Åse Sørensen from the Gas Technology Center is involved. Professor Bredesen is also leading a working group consisting of members from all the institutions that cooperate in this team; the universities of Tromsø and Stavanger, the university colleges in Finnmark, Tromsø and Narvik, and NTNU.

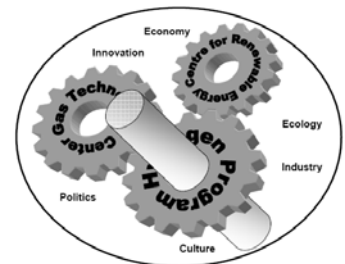
The efforts in the north have to be seen in relation to the Center's initiatives for Arctic gas technology, where also cooperation with the University Centre in Svalbard is relevant.

The Gas Technology Center is announcing a project manager position to follow up the opportunities in Hammerfest and Svalbard, as well as develop a new international master's degree in gas technology at NTNU.

Hydrogen

The hydrogen activities at NTNU and SINTEF are coordinated by an NTNU group, managed by Hilde Venvik, and a SINTEF group, managed by Øyvind Langørgen.

A hydrogen seminar for NTNU and SINTEF was arranged in April 2006.



Positions funded by the Gas Technology Center

The Gas Technology Center funds the following scientific staff and PhD students:

- PhD-students
 - o Petar Aleksic: Investigation of transient thermal behavior in hydrogen cryo-adsorption onboard storage system.
 - o Sissel Øksnevad Martinsen: Climate Gas & VOC Emissions from Oil Cargo Tankers.
 - o Arjun Singh (partial funding): Dynamic Modelling and Control of Liquefied Natural Gas Plants.
 - o Zhengjie Zhu (partial funding): Population balance modeling of bubbly flow column.
 - o David Grainger (partial funding): Development of carbon membranes for hydrogen recovery.
 - o Inge Saanum (partial funding): Combustion of hydrogen/natural gas mixtures as a transition from the use of natural gas to the use of hydrogen.
 - o Sverre Gullikstad Johnsen (partial funding): An Analytical Mathematical Theoretical Study of Single-Well Push-Pull "Echo" Tests.
 - o Thorleif Weydahl (partial funding).
- Hilde Venvik: Associate professor position within hydrogen technology.
- Harald Gether (partial funding): Senior researcher on Innovation in energy research.

- Kaare Gether (partial funding): Research focusing on the interplay and competition among energy related industries.
- Ulrich Büngrer / Erling Næss / Otto Sønju: PhD-student Petar Aleksic's experimental work.
- Geir Owren: Adjunct professor, LNG.

Laboratory equipment

The possibility for funding of laboratory equipment was announced by the Gas Technology Center in February. NOK 300 000 was allocated to equipment, and three of the eight applications that were submitted were approved:

- Gas Chromatograph, Hallvard Svendsen and Karl A. Hoff, NTNU
- Gas analyser, Morten Grønli, NTNU
- High temperature rig for testing of fuel cells and membranes, Anita Fossdal and Ann Mari Svensson, SINTEF



Eli Børresen and the Gas Chromatograph
(Photos: B. Hernes / Gas Technology Center)



Morten Grønli and the Gas analyser



Magnus Thomassen and the High temperature rig for testing of fuel cells and membranes

National coordination within natural gas R&D

A Norwegian gas R&D network

The Gas Technology Center has annual meetings with Institute for Energy Technology (IFE), International Research Institute of Stavanger (IRIS) and Christian Michelsen Research (CMR), to discuss common initiatives and challenges within gas technology. The institutes met last time at IFE in November.



(Photo: IFE)

Gassnova

Sverre Aam, Managing Director of SINTEF Energy Research and Chairman of The Gas Technology Center, NTNU-SINTEF's board, is also a member of Gassnova's board. The Center has had several meetings with Gassnova during 2006.

Presentations and participation

The Gas Technology Center has activities and contact with the political authorities and industry.

Examples of such activities are participation in:

- FoU Team Norway.
- TTA8 in OG21's work with new strategy
- CO₂ Value Chain meeting, Gassco (February 2006)
- Presentation for the Norwegian Commission on Low Emissions (Lavutslippsutvalget).
- Norsk Gassforum.
- Presentation for the Norwegian parliamentary Energy- and environmental committee in March (Professor Bolland).
- CASTOR – Inauguration of the world's largest pilot CO₂ plant in Esbjerg, Denmark, March 2006.

Numerous presentations of gas technology research activities are held, as well as about the Gas Technology Center. Staff involved in the Center have also contributed with articles and chronicles in the media, such as Cicerone, PETROMagasinet, Dagens Næringsliv and Adresseavisen.

Overview of project portfolio

Staff associated to the Gas Technology Center

The Center updates each year an overview of NTNU staff associated with the Gas Technology Center. Approximately 75 professors / assoc. professors, 10 adjunct professors, 150 PhD-students and 25 Post Doc researchers are registered in the overview. This is available on the homepage of the Center.

Contact meetings

The Gas Technology Center arranges open meetings for staff associated with the Center, where relevant activities are presented. In 2006 two meetings were arranged, May 15 and December 14. Presentations from the meetings are available on the homepage of the Center.

Laboratory facilities

The Environmental Gas Management Research Infrastructure in Trondheim (ENGAS) involves 14 state-of-the-art laboratories. ENGAS is recognized as a large-scale research infrastructure in the EU and open for applicants outside Norway for research purposes.

ENGAS is a joint effort between NTNU and SINTEF and involves the following R&D topics:

- Multiphase flow transportation of oil and gas
- Liquefied gas technology
- Combustion of hydrogen and methane
- Absorption of CO₂
- Membranes for hydrogen and CO₂ separation
- Conversion of hydrocarbons to hydrogen
- Fuel cell technology
- Hydrogen production and storage

More information:
www.ntnu.no/engas

Information Material

Information about activities related to the Gas Technology Center is available in leaflets, Newsletters and Homepages (www.ntnu.no/gass and www.sintef.no/gass). The web pages of the Center have been an active source of information during the year, with approximately 24 000 visits.

In 2006 the Center has published three Newsletters. These are available on the homepage of the Center:

[Newsletter N°2, April 2006](#)

(Norwegian)

[Newsletter N°3, September 2006](#)

(Norwegian)

[Newsletter N°4, December 2006](#)

(English)



Organization

The agreement between NTNU and SINTEF for the Gas Technology Center was signed on January 27, 2004. The agreement lasts for five years, with evaluation after three years.

The Board of Directors

The Gas Technology Center NTNU-SINTEF has the following Board of Directors:

- Board Director: President Sverre Aam, SINTEF Energy Research
- Director Svenn Ferry Utengen, Statoil R&D
- Vice President Aage Stori, SINTEF Materials and Chemistry
- Prof. Arne M. Bredesen, Director Strategic Area, Energy and Petroleum – Resources and Environment
- Professor May-Britt Hägg, Department of Chemical Engineering, NTNU

The Board of Directors had three meetings in 2006.

Management

The Gas Technology Center is managed by SINTEF Center Director Nils A. Røkke and NTNU Center Director Bjarne A. Foss. The management has regular meetings, together with Secretary Bjørg Hernes and Coordinator Åse Lekang Sørensen. These have part time positions in the Gas Technology Center.

SINTEF

The SINTEF Group is the largest independent research organization in Scandinavia. SINTEF's goal is to contribute to wealth creation and to the sound, sustainable development of society. SINTEF generates new knowledge and solutions for its clients, based on research and development in technology, medicine, the natural sciences and the social sciences.

SINTEF has established a strategic corporate project within CO₂, with a duration of three years, 2006 to 2008. Petter Egil Røkke is leading the project, and SINTEF Petroleum and Energy, SINTEF Materials and Chemistry, SINTEF Marine, and SINTEF Technology and Society are involved. The Center is an integrated part of this effort.

NTNU

NTNU, the Norwegian University of Science and Technology in Trondheim represents academic eminence in technology and natural sciences as well as in other academic disciplines. Its academic scope ranges from technology, the natural sciences, the social sciences, the humanities, medicine, architecture to fine art. Cross-disciplinary cooperation at NTNU results in innovative and creative solutions.

Energy and Petroleum - Resources and Environment is a Strategic Research Area at NTNU. Professor Arne M. Bredesen is the director of the Strategic Research Area. The Gas Technology Center has a close cooperation with other centers and groups within the Strategic Research Area, such as Centre for Renewable Energy, NTNU-SINTEF-IFE, and the BRU Project.

Collaboration with the Centre for Renewable Energy, NTNU-SINTEF-IFE:

- Professor Johan E. Hustad, NTNU, is the Director of the Centre. Deputy Directors are Ann Mari Svensson from SINTEF and Øystein Ulleberg from IFE. More information: www.sffe.no.
- The Strategic Research Area has regular meetings for the Centers.
- The Gas Technology Center and the Centre for Renewable Energy arranges meetings to coordinate and initiate joint activities, for example for Hydrogen research and for the PhD-pool.
- Åse Sørensen is working for both the Gas Technology Center (30 %) and the Centre for Renewable Energy (70 %).

Cooperation with the BRU-Project (up-stream activity):

- Professor Jon Kleppe, NTNU, is the manager of the project.
- The Strategic Research Area has regular meetings for the Centers.
- Participation in Centre for Research-based Innovation (CRI) for e-field and Integrated Operations.

Contact Information for the Gas Technology Center, NTNU-SINTEF:

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