



Annual Report 2011

Gas Technology Centre
NTNU-SINTEF

Strategic partner:



Preface



Maria Barrio



Hilde J. Venvik

Dear reader,

2011 was an active year for the Gas Technology Centre (GTS). The GTS organization saw some changes, and Torstein G. Skarsgard was appointed as coordinator, replacing Astrid Lilliestr le. We acknowledge her impacts and are grateful for her contributions.

Considerable efforts were put into *"Visibility of R&D"*, with the organizing of the 2nd Trondheim Gas Technology Conference being the greatest. Increased international visibility has been emphasized through presentations and promotional articles. In addition, we prepared and distributed the NTNU-SINTEF Gas Technology Activities report 2010-2011 to provide an overview of the ongoing research and educational activities in gas technology at NTNU and SINTEF, with special focus on the main achievements in 2010-2011. The report has been very well received by our external partners and proved to be a useful tool for promotion of our competence.

Closer contacts with national and international companies, R&D institutions and universities have been established through visits, information exchange and participation in meetings. Initiatives have been taken towards CO₂ storage, biogas and small scale LNG. In addition the EU Commission has selected Oslo as a pilot city for the next generation of hydrogen electric vehicles. Thus GTS has through its hydrogen initiative continued the support to research and demonstrations.

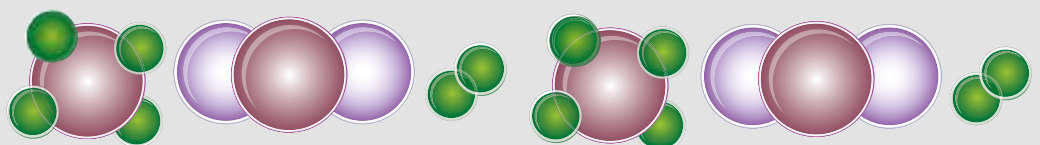
In our *"Education"* strategy, the main effort was the student excursion to Statoil's LNG plant in Hammerfest. About 80 students from NTNU applied for the 12 available seats, and we received highly positive feedbacks from Statoil and the students after the visit.

The energy situation is a complex issue and most analysis show that the energy demand worldwide cannot be covered solely by renewable energy. GTS has submitted input to both the OG21 strategy and to Energi21 regarding the role of gas. We believe further development of natural gas technologies is crucial in the transition towards a sustainable energy system, thus a national collaboration has been initiated and will be further developed in 2012.

A high level of competence is vital for developing environmentally friendly and economical solutions for Norwegian natural gas resources in the future, in particular as the exploration of these resources becomes increasingly challenging in terms of climate, environment and distance to market. NTNU and SINTEF will therefore continue and strengthen even further our efforts within education and research along the natural gas value chain. The 5-year period 2008-2012 of GTS is coming to an end, and the centre has started the planning of a new strategy for the period 2013-2017.

Finally, we want to thank Statoil, NTNU and SINTEF for their support to the GTS, without which our work would not be possible.

Maria Barrio and Hilde J. Venvik
Co-directors of the Gas Technology Centre NTNU-SINTEF



The Gas Technology Centre NTNU-SINTEF

The Gas Technology Centre NTNU-SINTEF (GTS) was established in 2003. Being the largest centre for gas technology research and education in Norway, GTS acts as a common interface in gas technology R&D between NTNU/SINTEF and the market.

The GTS facilitates new knowledge and technology for efficient, environmentally friendly and profitable utilization of natural gas. The synergism of multidisciplinary research based on NTNU and SINTEF's broad knowledge base, which encompasses the entire value chain from the energy source to the end user, is exploited.

More specifically, GTS will:

1. Increase the visibility of gas technology R&D at NTNU/SINTEF, both externally and internally.
2. Promote new R&D opportunities and initiatives
3. Influence Norwegian national priorities
4. Ensure top quality education and recruitment of students and researchers
5. Be active in networking and internationalization activities
6. Promote internal coordination and synergism in gas technology R&D at NTNU/SINTEF

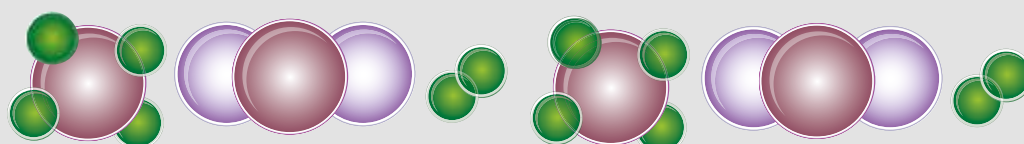
1. Visibility	2. New R&D initiatives
3. National priorities	4. Education
5. Networking and internationalization	6. Internal coordination

GTS Strategy

Main achievements in 2011

- The 2nd Trondheim Gas Technology Conference
- Student excursion to Melkøya
- The Gas Technology Activities 2010-2011 report
- Development of a platform of industrial actors with interest in gas technology

CCS	Carbon dioxide Capture and Storage
EUROSCOOPS	European Sizeable CO ₂ Storage Pilots
FCH JU	Fuel Cells and Hydrogen Joint Undertaking
GTS	Gas Technology Centre NTNU-SINTEF
LNG	Liquefied Natural Gas
N.ERGHY	New European Research Grouping on Fuel Cells and Hydrogen
NFR	Research Council of Norway
NTNU	Norwegian University of Science and Technology



Activities in 2011

1. Visibility

2nd Trondheim Gas Technology Conference (TGTC-2011)



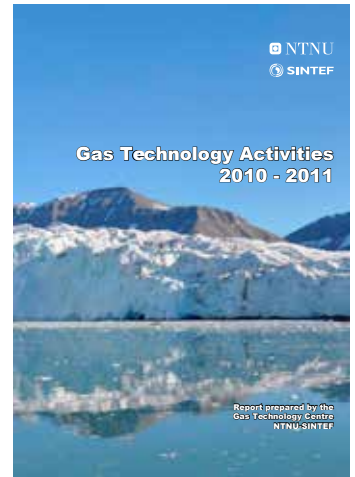
From left: Rob Klein Nagelvoort, Sigurd Gaard, Anders Holmen
www.sintef.no/tgtc2011

TGTC-2011 was organized by GTS on 2-3 November with 69 participants from R&D institutions, universities and industry. Basic and applied research within a broad range of gas technology was covered through 30 oral presentations and a poster session. The keynote speakers were CEO and Principal Adviser at LNG Tech Consult, Rob Klein Nagelvoort, from The Netherlands, Technology Manager Sigurd Gaard from Genesis Oil & Gas and Professor Anders Holmen from NTNU. Sponsors were Gassco and Snøhvit Future Development. The TGTC International Advisory Committee clearly supported a third conference in 2013, and preparations are starting soon.

Gas Technology Activities 2010-2011 report

GTS produced the Gas Technology Activities 2010-2011 report. The report provides an overview of on-going activities within gas technology at NTNU and SINTEF, and is being widely distributed to promote the NTNU/SINTEF gas community.

www.ntnu.no/gass
www.sintef.no/gass



Barents Sea Conference

www.barentshavkonferansen.no

Barents Sea Youth Conference

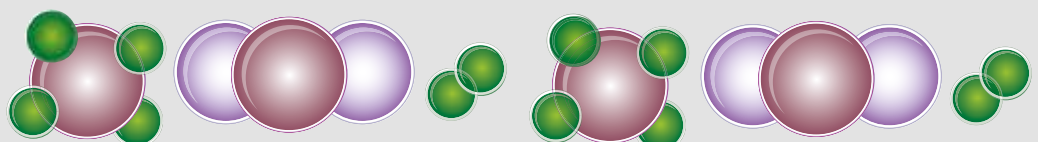
PhD fellow Hamidreza Bakhtiary-Davijany represented GTS at the Barents Sea Youth Conference in Hammerfest on 2-3 April. His presentation entitled *Future Opportunities for Remote Natural Gas* dealt with gas conversion to fuels and chemicals, and was well received by the young participants from the Arctic (Norway, Russia, and more).



www.gasskonferansen.com

Support to a presentation at Gasskonferansen in Bergen

With support from GTS, Professor Edd Blekkan represented the NTNU-SINTEF gas technology research community at Gasskonferansen in Bergen on 4-5 May. He held a presentation on the technological challenges related to the conversion of Gas-/Biomass-to-Liquids (GTL/BTL) based on the Fischer-Tropsch synthesis, as well as possible synergy effects by combining GTL and BTL technologies.



Presentation at the 26th edition of Gastech Conference & Exhibition

Maria Barrio, co-director of GTS, held a presentation at Gastech 2011 Amsterdam on 21-25 March with the topic CO₂ separation from natural gas. Gastech is one of the major gas events at international level. The opportunity to hold a presentation in one of the technical sessions of Gastech for several industry key players gave GTS high visibility.



www.gastech.co.uk

Presentation at the 6th LNG TECH Global Summit in the Netherlands

GTS was invited for a keynote speech on the 6th Annual LNG Tech Global Summit in De Doelen, Rotterdam, 3-5 October. With support from GTS, Geir Skaugen from SINTEF Energy represented the NTNU-SINTEF gas technology research community with a lecture entitled *Liquefaction of Natural Gas - How can fundamental R&D help the industry?*



www.lngsummit.com

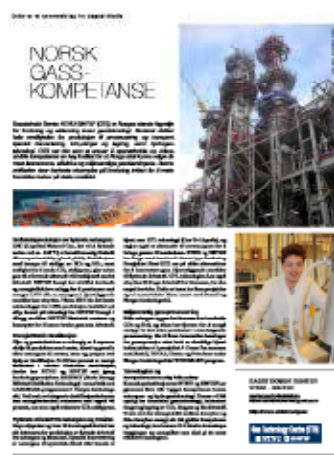
Presentation at BIOGASS11

GTS, represented by co-director Maria Barrio, held a presentation at the national conference on biogas and environment, BIOGASS11, at Ørland, Sør-Trøndelag, on 8-9 March. The presentation from Barrio provided information about the upgrading options for biogas, the end applications and the technology implications for each option. An additional presentation from SINTEF focused on the liquefaction of biogas for small scale applications. The conference was arranged by Fosen Næringsshage and main topics were *Biogas and politics, Biogas – status in the North and Europe, and Biogas as fuel in Norway.*

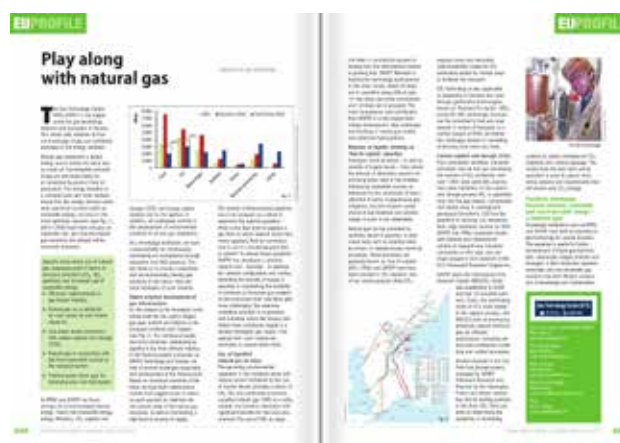


www.biogass11.eventweb.no

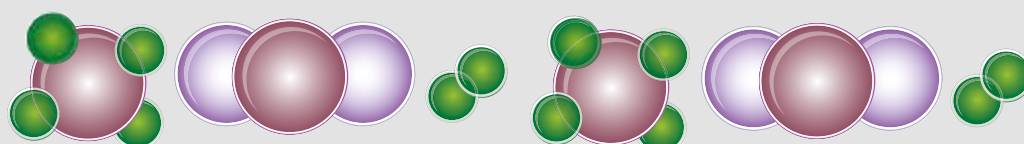
Promotional articles in Public Service Review and in a supplement to Dagens Næringsliv



GTS prepared an article for Public Service Review: European Union, issue 22, in September with the title *Play along with natural gas*. In addition a similar article was prepared in Norwegian for the magazine *Verdier i gass*, an attachment to Dagens Næringsliv on 25 October.



www.publicservice.co.uk
www.sintef.no/Projectweb/GTS/Documents



Representation on the International Hydrogen Energy Development Forum

GTS' H₂ initiative responsible, Steffen Møller-Holst, was invited speaker at the International Hydrogen Energy Development Forum held in Fukuoka, Japan, on 2-3 February. He presented the Norwegian Hydrogen Strategy as Chairman of the Norwegian Hydrogen Council. Possible bilateral R&D projects between Kyushu University and NTNU/SINTEF were discussed. The

International Hydrogen Energy Development Forum 2011

www.congre.co.jp/hydrogen2011/english

forum had 500 participants from all over the world and has been an annual event since 2007.

Hosting a Norwegian Hydrogen Forum Members' meeting

GTS hosted the members' meeting in the Norwegian Hydrogen Forum on 3 March in Trondheim. The GTS management representatives gave an overview of the on-going EU-projects within hydrogen technology at SINTEF/NTNU as well as a summary of the activities at the centre with emphasis on GTS view on the importance of succeeding with the Norwegian hydrogen demonstration activities.



www.hydrogen.no

Poster on GTS' Hydrogen Initiative at the Nordic Hydrogen Conference in Malmö

The Nordic Hydrogen Conference was arranged in Malmö 25-26 October, with a majority of the around 100 participants from the Nordic countries, but also some from other European countries. *Market roll out of fuel cell and hydrogen technologies* was the focus of this year's conference. GTS's Hydrogen Initiative was presented as a poster and GTS contributed to cover travel costs for PhD candidates and Post docs, as this conference is especially aiming at letting young scientists presenting their R&D-work.

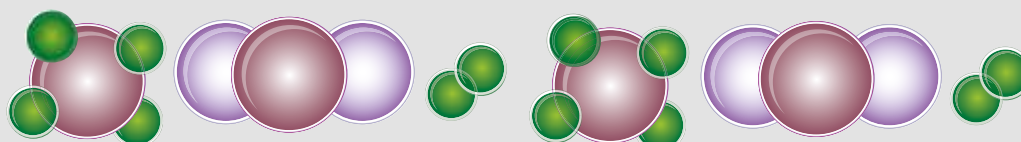
www.hfcnordic.se



Contribution to Fuel Cells and Hydrogen Joint Undertaking (FCH JU) and N.ERGHY

N.ERGHY's 7th General Assembly and a Brokerage Event for the 2011-call of the FCH JU-program were arranged in Berlin on 18 and 19 May, respectively. Moreover, the Review Day for FCH JU, the Stakeholders General Assembly (FCH JU) and the 8th General Assembly for N.ERGHY were held in Brussels in the period of 22-24 November. GTS contributed to preparations and chairing sessions at these events, through Steffen Møller-Holst's role as Chair for Application Area Transportation and Refuelling Infrastructure. A total of 3-400 participants took part at the Stakeholders General Assembly, which represents the key annual event in Europa within hydrogen technology R&D and demonstration.

www.fch-ju.eu
www.nerghy.eu



2. New R&D opportunities and initiatives

The role of GTS is to support the development of new projects and initiatives, with special focus on topics requiring close cooperation between different scientific expertise and groups within NTNU and SINTEF.

During 2011, GTS's support has been materialized in different ways:

Development of industrial network

GTS has established closer contact with TOTAL, GDFSuez, Repsol, CIUDEN, Gassco, Petrobras, Bioforsk, BioPower, through visits, information exchange and participation in meetings around specific project proposals.

Project proposal preparation

GTS personnel has contributed to proposal elaboration within the following topics:

- Rapid phase transition phenomena in LNG (Predict-RPT)
- Pilot demonstration of CO₂ storage (EUROSCOOPS)
- CCS feasibility at the Norwegian Continental Shelf (NCS study)
- Design, fabrication, and characterisation of H₂-selective Pd-alloy membranes for application in pre-combustion CO₂ capture cycles (Pre-memCO₂)

Facilitator of meetings and seminars

- Natural gas utilization in metallurgical processes
- MiniLNG
- Biogas processing and utilization
- CO₂ chemistry

Strategic competence development

GTS has supported knowledge building activities related to:

- Acid gas removal (course)
- Small scale LNG (workshop)

Some more explanations about these activities are given below:

Biogas and small scale LNG

Expertise within gas separation (through membranes, for instance) and small scale gas liquefaction (MiniLNG) can be applied for biogas utilization. Gas liquefaction opens for a broader use of biogas as it makes feasible larger transport distances.

There is also a growing interest in ship applications of the small scale LNG technology developed at SINTEF. GTS has supported the preliminary dialogue with several actors such as Bioforsk, Hamworthy, BioPower, Ecologic Bioproducts (Ecopro), Innovasjon Norge and the Trondheim local government. GTS has also supported the participation of NTNU and SINTEF personnel in relevant seminars to this topic.



TOTAL

GDF SUEZ



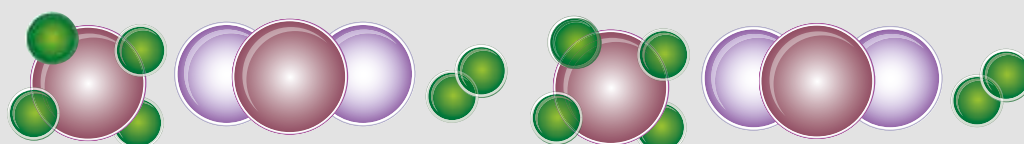
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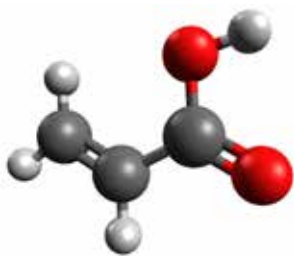
BR PETROBRAS

Bioforsk



Photo: shutterstock





Acrylic Acid
Figure: Richard Heyn/SINTEF

CO₂ chemistry

GTS arranged a seminar on *The potential of CO₂ chemistry for optimization of CO₂ capture processes* that took place on 17 June in Trondheim. The seminar was attended by representatives from Statoil, Azko Nobel, Ekornes and Instituto Superior Tecnico (Portugal). Some cases showing the potential of CO₂ chemistry as a complement to CO₂ capture initiatives were identified, and opened for discussion around the future challenges within this topic.

Project proposal EUROpean Sizeable CO₂ Storage PilotS (EUROSCOOPS)

GTS contributed to the development of a project proposal addressing the EU call for projects within the topic "Sizeable CO₂ storage pilots", through the 7th Framework Programme for Research. The overall objective of EUROSCOOPS is to enable permanent geological CO₂ storage at an industrial scale by closing critical knowledge gaps through a pilot test program. This is an international collaboration between R&D, industry and the member state governments. The project will develop and validate knowledge and technology on safe, longterm CO₂ storage by conducting sizeable field campaigns on at least five existing, complementary sites for CO₂ storage demonstration and field testing. The total budget of the project will be about €70 million (including all shares of financing). The EUROSCOOPS proposal passed the first stage evaluation in December 2011.

Preparations and successful opening of hydrogen refuelling station at SINTEF in Oslo



Major of Oslo County, Fabian Stang, and SINTEF's Director, Unni Steinsmo, are cutting the ribbon during the inauguration of the hydrogen refuelling station at SINTEF in Oslo on 21 November.

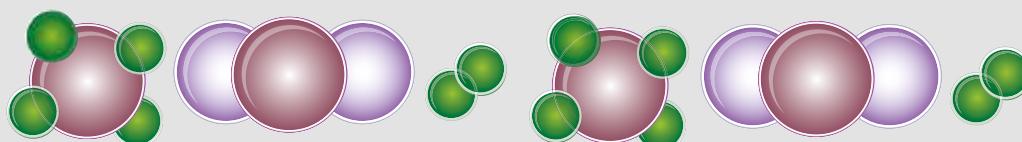
Photo: Werner Juvik/SINTEF
www.transnova.no/project/h2-moves-oslo

GTS's Hydrogen Initiative Responsible, Steffen Møller-Holst, has with wide support from colleagues at SINTEF in Oslo contributed significantly to the establishment of the hydrogen refuelling station at SINTEF in Oslo. SINTEF has coordinated the Transnova-supported part of this project, which was primarily devoted to establishment of the new refuelling station. An initiative is taken to increase the visibility of relevant R&D activities at NTNU/SINTEF in relationship to this demonstration project. SINTEF will, after contract amendment during 2011, enter as Full Partner in H2movesScandinavia as of 1 January 2012.

Hydrogen and fuel cell proposals and projects in 2011

Through the Hydrogen Initiative, GTS has supported and facilitated the establishment of project proposals towards the European Fuel Cells and Hydrogen Joint Undertaking (FCH JU) program. Moreover, GTS has contributed to secure national co-financing (up to 75%) from the Research Council of Norway RENERGI Programme. In 2011 the FCH JU projects and initiatives include:

- IDEALHY - More efficient H₂-liquefaction processes, SINTEF Energy Research
- KEEPMEALIVE - Degradation of fuel cells, SINTEF Materials and Chemistry
- ReforCELL - Multifuel Reformer for fuel cells, SINTEF
- NOVEL - next generation PEM water electrolyzers, SINTEF Materials and Chemistry
- STAMPPEM - Bi-polar plates for PEM fuel cells, SINTEF Materials and Chemistry



3. National priorities

Input to Energi21 and the new RENERGI Programme (NFR)

Energi21 is the Norwegian strategy for energy research, development, demonstration and commercialization of industrial solutions. GTS submitted input to Energi21 regarding the role of gas, emphasizing the importance of facilitating knowledge transfer and technological synergies between renewable and non-renewable energy.



www.energi21.no

GTS has given input to the Research Council of Norway in forming its new energy program to follow RENERGI after 2013. The following was emphasized:

- The potential synergisms between natural gas and renewables
- The importance of hydrogen technologies in an EU energy context
- The importance of gas technologies in bioenergy and biofuels development

Input to OG21 and the new PETROMAKS Programme (NFR)

The new strategy for OG21 has reduced the number of Technology Target Areas (TTA) from eight to four. Unfortunately, Gas technology is not any longer a separate TTA. It is of vital importance for GTS that gas technology still remains as an important topic in the relevant TTAs in the new strategy.



www.og21.org

GTS has been active in providing input to the OG21 strategy and in particular to the development of the dedicated strategy for TTA 4, *Future technologies for production, processing and transportation*, in order to secure gas technology as a topic.

The role of gas in the new PETROMAKS Programme (NFR) has also been discussed with the Research Council of Norway and further efforts are foreseen in 2012 to this respect.

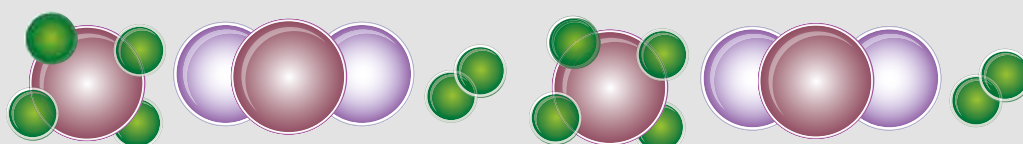
Cooperation with the Centre for Sustainable Energy Studies (CenSES)

An initiative for cooperation between CenSES and GTS has been established. GTS aims to use the outcome of this collaboration in communication with politicians and the public about the role of natural gas. Further work is to be developed through identification of research topics and submission of joint project proposals.



Focus of the FCH JU program on hydrogen and fuel cells

This was influenced through NTNU's and SINTEF's engagement in the Research Grouping N.ERGHY. During the fall of 2011, the Topic List for the 2012-call was developed securing high relevance for Norwegian R&D institutions, including NTNU/SINTEF.



4. Education

Student excursion to Statoil Melkøya



GTS in cooperation with Statoil organized a student excursion to Statoil's LNG plant in Hammerfest on 17-21 October. There were about 80 applicants, and out of these 12 students were selected. GTS has only received positive feedbacks from Statoil, which was impressed over the engagement of the students.

Students at Melkøya. Photo: Eirik Soland Thu

www.sintef.no/Projectweb/GTS/Education

EnergiCampus Nord (ECN)

The cooperation with EnergiCampus Nord has continued and GTS participated in a meeting in Hammerfest on 30 August. As a result of this meeting, two project proposals were submitted in October 2011 to the regional research fund (NFR) focusing on energy systems and reliability of wind energy supply.



<http://energicampus.no>

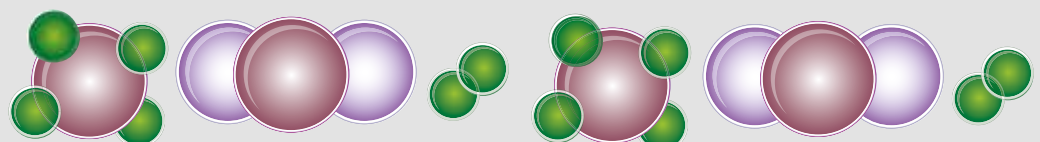
PhD candidates and Post doc candidates

There are around 150 PhD and 45 Post doc candidates within gas technology at NTNU/SINTEF. Most of the doctoral and postdoctoral work is affiliated with larger research projects or ongoing activities within established research groups and centres.

GTS financed PhD candidate Magnus Jacobsen who successfully defended his PhD thesis on 18 November, entitled *Identifying active constraint regions for optimal operation of process plants - With application to LNG and distillation processes* (NTNU 2011 ISBN 978-82-471-3138-1). The work was supervised by Professor Sigurd Skogestad, Department of Chemical Engineering. GTS congratulates Dr. Jacobsen, now employed at ABB, on the work.

GTS currently fully finances the following PhD fellowships:

- Ezequiel Manavela Chiapero, PhD project: *Two phase flow instabilities and flow maldistribution in parallel channels*. Supervisor: Associate Professor Maria Fernandino, co-supervisor: Professor Carlos A. Dorao, Dept. Energy and Process Engineering.
- Tom-Gøran Skog, PhD project: *Development of polymeric hollow fiber membranes for removal of CO₂ from high-pressure natural gas*. Supervisor: Professor May-Britt Hägg, Dept. Chemical Engineering.
- Andreas Helland Lillebø, PhD project: *Conversion of synthesis gas from biomass to liquid fuels by the Fischer-Tropsch synthesis*. Supervisor: Professor Edd A. Blekkan, co-supervisor: Professor Anders Holmen, Dept. Chemical Engineering.



GTS is also providing a complimentary scholarship to:

- Luis Castillo, PhD project: *Multi-objective optimization of LNG processes*. During 2011 he was working on the development of a consensual decision-making model based on game theory for LNG processes. Supervisor: Professor Carlos A. Dorao, Dept. Energy and Process Engineering.

GTS has also partially financed four PhD candidates and one postdoctoral fellowship through the PhD pool funded by the Research Council of Norway RENERGI Programme. These include:

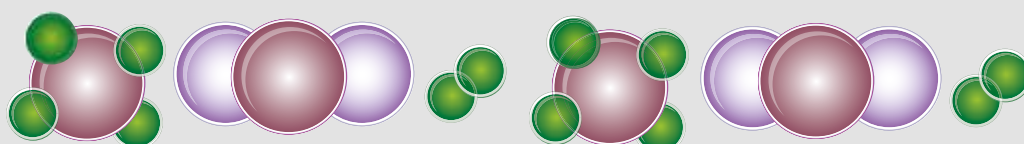
- Isabella Inzoli, PhD thesis 2008: *Coupled transports of heat and mass at the surface of and inside silicalite* (NTNU 2008 ISBN 9788247112281). Supervisor: Professor Signe Kjelstrup, Dept. Chemical Engineering.
- Astrid Lervik Mejdell, PhD thesis 2009: *Properties and application of 1-5 μm Pd/Ag23wt.% membranes for hydrogen separation* (NTNU 2009 ISBN 978-82-471-1530-5). Supervisor: Professor Hilde J. Venvik, Dept. Chemical Engineering.
- Liyuan Deng, PhD thesis 2009: *Development of Novel PVAm/PVA Blend FSC Membrane for CO₂ Capture* (NTNU 2009 ISBN 978-82-471-1664-7). Supervisor: Professor May-Britt Hägg, Dept. Chemical Engineering.
- Bjørn Lilleberg: PhD thesis 2011: *On Mathematical Modeling and Numerical Simulation of Chemical Kinetics in Turbulent Lean Premixed Combustion* (NTNU 2011 ISBN 978-82471-2966-1). Supervisor: Professor Ivar Ståle Ertesvåg, Dept. Energy and Process Engineering.

Professorship

GTS is funding the position of Adjunct Professor in LNG technology held by Dr. Geir Owren. The position is affiliated with the Department of Energy and Process Engineering, NTNU. Geir Owren is Senior Advisor at the Statoil Research Centre in the field of gas processing and LNG.



Photo: NTNU SA/Kim Nygård



5. Networking and internationalization



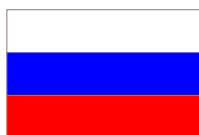
Workshop at Shanghai Jiao Tong University (SJTU)

China is an important country in the context of gas, and GTS participated on the workshop at SJTU on 3-5 May. The workshop acted as an arena for collaboration based on common fields of interest. GTS was again represented when the Joint Research Centres, Shanghai Jiao Tong University (SJTU) and Tsinghua University (THU), visited Trondheim on 19-21 September.



Good contacts established with Brazil

Brazil is a growing oil and gas producer, with large technological challenges. There is a common interest from Norwegian and Brazilian authorities to establish a R&D link between universities and R&D institutions in both countries. GTS has reinforced the existing contact with Petrobras and establish new contacts with BG Group Brazil, Repsol Brazil and GTC Quimica (gas conversion).



Ill: Shutterstock

Cooperation with Russia

GTS has supported the visit from Professor V.V. Teplyakov and Professor V.S. Khotimskii from A. V. Topchiev Institute of Petrochemical Synthesis - Russian Academy of Sciences (TIPS RAS) in Moscow to Trondheim in March 2011. TIPS RAS is a well-known institution with many years expertise within membranes for gas separation. The seminar was attended by several researchers working on the same topic at NTNU and SINTEF. The activities arranged during 2011, where cooperation with Russia has been a topic, points out that GTS should pursue further efforts towards Russia, focusing on educational activities.

Networking at several conferences

GTS attended the Barents Sea Conference on 4-6 April in Hammerfest, where the main topic was to analyse the progress of petroleum related activities in Northern Norway. On 21-22 November GTS visited the Zero Conference (ZERO11) in Oslo, where among others EU climate commissioner, Connie Hedegaard, and former governor in California, Arnold Schwarznegger, talked about opportunities for natural gas. GTS was also represented at Polymerdagene, *Gi gass – Industrimuligheter og vekst gjennom nasjonal foredling og bruk av naturgass (- Industry potential and growth through a long value chain)*, on 8-9 November in Oslo.



Participation on the European Gas Technology Conference 2011 (EGATEC 2011)

EGATEC 2011 took place in Copenhagen, Denmark, on 12-13 May. This is an annual event and the 2011 edition was organised under the joint auspices of Marcogaz (Belgium) and the European Gas Research Group (GERG). Together they represent the complete technological arm of the European gas industry. EGATEC 2011 was hosted by the Danish Gas Technology Centre (DGC). The conference provided an opportunity to open the communication between GTS and DGC. Even if the missions of the organisations are quite different, there are some topics of common interest.



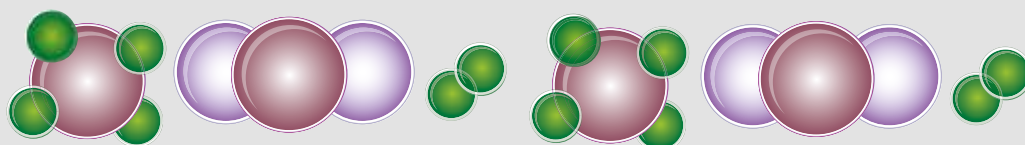
www.egatec2011.dk



www.uvic.ca

Internationalization grants from GTS

GTS supported a four-week visit by Professor Henning Struchtrup from Department of Mechanical Engineering, University of Victoria, Canada. During his stay he occupied a position as visiting professor at the Department of Chemistry, NTNU. He also held a seminar in the GTS on macroscopic modelling of rarefied and vacuum gas flows.



6. Internal coordination

Invited lecturer - Sverre Diesen

Sverre Diesen, Senter for Strategiske Studier (SEFOSS), was invited by GTS and held a open presentation on the topic *Ambisjoner, aktivitet og aktører - Den strategiske balansen i nordområdene i bevegelse* (*Ambitions, activities and actors - the strategic balance in the northern areas in motion*) on 27 October. Subsequent was a strategic discussion between Sverre Diesen and invited guests from NTNU, SINTEF and Statoil.

Technical seminar series 2011

Energy from the couch: Consumers' views on energy technology.

Henrik Karlstrøm, NTNU, 16 March

Macroscopic Modelling of Rarefied and Vacuum Gas Flows.

Henning Struchtrup, University of Victoria, Canada, 7 September

Gas fuelled ships.

Dag Stenersen, SINTEF Marintek, 28 September

Progress and Challenges in Discrete and Continuous Optimization for Process Systems Engineering.

Advances in Generalized Disjunctive Programming for Process Systems Engineering.

Ignacio E. Grossmann, Carnegie Mellon University, USA, 5 December

The seminars were attended by 30-50 scientists and students from NTNU and SINTEF as well as representatives from industry working with gas technology R&D.

www.sintef.no/Projectweb/GTS/
Seminar-Series

Åpent foredrag med Sverre Diesen

"Ambisjoner, aktivitet og aktører - den strategiske balansen i nordområdene i bevegelse"

27. oktober kl. 11¹⁵-12 i Auditorium KJL 1

Har tidligere forsvart og nåværende direktør for Senter for Strategiske Studier, Sverre Diesen, betraktninger over spørsmålet

"Hvilken betydning har økt tilgang til energi, råvarer og transportruter for strategiske forhold i nordområdene?"

Gas Technology Centre
NTNU SINTEF
www.sintef.no/gts

GTS Technical Seminar Series

High ranked Professor to NTNU

December 5th

R9, Realfagsbygget, Gløshaugen

Professor Ignacio E. Grossmann, Center for Advanced Process Decision-making, Department of Chemical Engineering, Carnegie Mellon University, Pittsburgh, USA is believed to be **nr. 1** within the area of **Mathematical Programming**; at least there is no one who covers this wide area in the same way he does (MILP, NLP, MINLP). Despite his background within Chemical Engineering he enjoys respect within the mathematical areas which cope with optimization.

His applications cover a wide specter; design, analysis, optimization and planning of both continuous and batch process plants. He makes use of optimization in all imaginable levels, from design of heat exchanger networks to Enterprise-wide Optimization. Grossmann has a range of examples of use in the oil and gas sector, including planning of infrastructure with uncertainty, operation of oil refineries and so on.

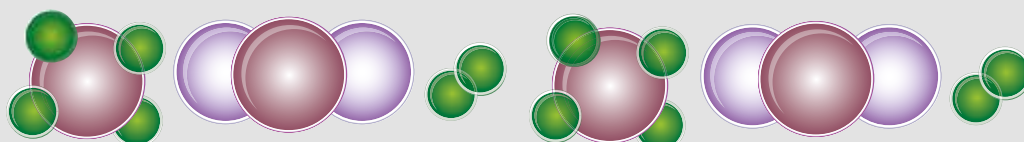
Grossmann will have two seminars on December 5th:

Kl. 11.00 -12.00
Progress and Challenges in Discrete and Continuous Optimization for Process Systems Engineering

Kl. 12.15 -14.00
Advances in Generalized Disjunctive Programming for Process Systems Engineering

Abstracts at www.ntnu.no/gts -> Seminar Series

Gas Technology Centre
NTNU SINTEF



Scientific equipment

The following proposals received funding for scientific equipment. Total budget 500 kNOK.

Name	Scientific equipment	GTS funding (NOK)
Edd A. Blekkan, NTNU	Mass spectrometer for corrosive gasses applied to biomass to liquid fuels	300 000
Federico Zenith, SINTEF	System for logging of key variables of a 10 kW fuel cell system and system for automatic hydrogen refuelling	65 000
Karl Anders Hoff, SINTEF	H ₂ S and hydrocarbon safety alarm and one year licence for ProTreat	70 000
Margrethe Nergaard, Jens-Petter Andreassen, NTNU	Watson-Mørlov 323/D peristaltic pumps, 313X pump heads, Multiscale MEG addition licence	65 000

GTS strategic seminar

The GTS team arranged an internal strategy seminar on 4 November at Britannia Hotel in Trondheim. During the seminar the strategy for 2012 was established and the focus for the period 2013-2017 was discussed. One of the main topics for 2012 is to position gas technology among national priorities.



From left: Steffen Møller-Holst, Maria Barrio, Torstein G. Skarsgård and Hilde J. Venvik Photo: Britannia Hotel

Development of strategic R&D interaction

Cooperation with strategic partner

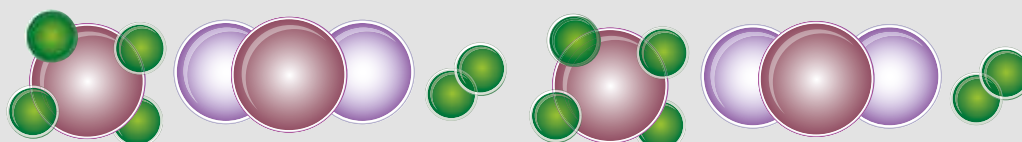
Statoil is an integrated oil and gas company with substantial international activities and is a strategic partner of GTS. The resources from Statoil finance cooperation projects and activities relevant for realizing the New Energy strategy of Statoil. The resources fund PhD and post-doctoral fellowships, laboratory equipment, network building and management of the GTS. During 2004-2009 a full professorship in hydrogen technology was funded by Statoil under the GTS cooperation. The position was held by Professor Hilde J. Venvik, Department of Chemical Engineering, NTNU. The agreement aimed to further develop the cooperation between NTNU/SINTEF and Statoil.

New partners and sponsors

The working period (2008-2012) is coming to an end, and GTS is open for new partners and sponsors to join the strategic R&D interaction for the period 2013-2017.



www.statoil.com



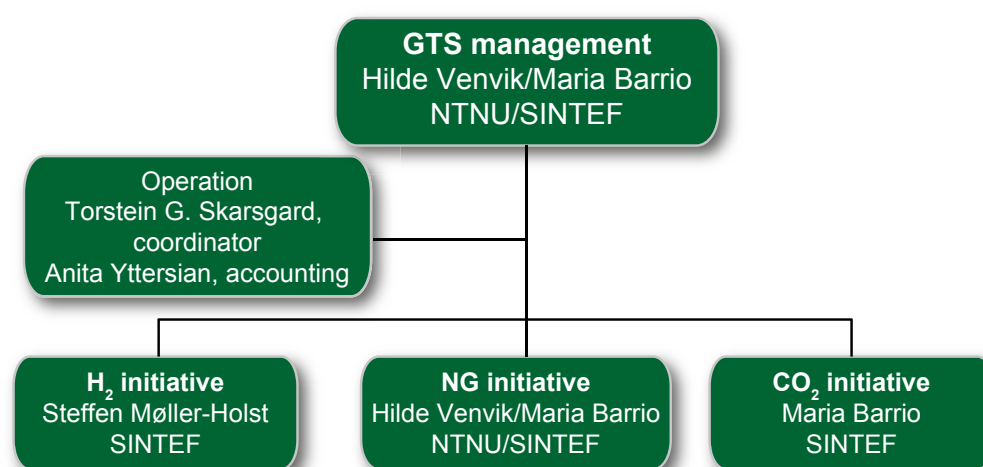
GTS in short

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- Chairman: Director Sverre Aam, SINTEF Energy Research
- Department Manager Gas Conversion Morten Rønnekleiv, Statoil
- Research Director Ole Wærnes, SINTEF Materials and Chemistry
- Professor Arne M. Bredesen, NTNU Director of the Strategic Area, Energy and Petroleum – Resources and Environment
- Professor May-Britt Hägg, NTNU Department of Chemical Engineering

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- SINTEF's director of GTS, Vice President, Dr. Maria Barrio
- NTNU's director of GTS, Professor Hilde J. Venvik



Maria Barrio



Hilde J. Venvik



Steffen Møller-Holst



Torstein G. Skarsgard

GTS Organization chart

Staff

Approximately 75 professors/associate professors, 10 adjunct professors, 150 PhD candidates, 25 Post Doc researchers at NTNU and 200 research scientists at SINTEF are associated with GTS.



Anita Yttersian

Norwegian University of Science and Technology (NTNU)

NTNU 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.



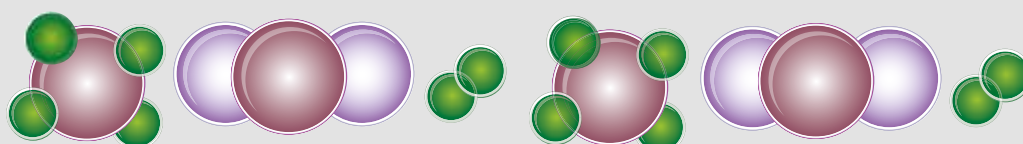
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SINTEF

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Strategic partner:

