NTVA Review 2013

NORWEGIAN ACADEMY OF TECHNOLOGICAL SCIENCES

NTVA **IN BRIEF**

The Norwegian Academy of Technological Sciences (NTVA) is an independent organization founded in 1955. NTVA is a member of the International Council of Academies of Engineering (CAETS) and of the European Council of Applied Sciences and Engineering (Euro-CASE).

The objectives of NTVA are:

- to promote research, education and development of technology and natural sciences
- to stimulate international cooperation within these fields
- to promote the understanding of technology and natural sciences among the authorities and the public to the benefit of Norwegian society and industrial development in Norway.

NTVA is an organization whose members are distinguished scientists and industrial leaders recruited from academic institutions and from industry in Norway and abroad. Individuals who have made significant contributions to the technological sciences or in related areas, or whose professional work has contributed significantly to the realization of advanced technology in practice, are eligible for membership. The total number of members is 541.

NTVA has an Industrial Council consisting of representatives of the top management of leading industrial companies and institutions in Norway. The purpose of the council is to support NTVA in fulfilling its missions, and to strengthen the relations between the academy and society. In 2013, the Council had 39 members.

The main activities

NTVA had 34 arrangements in 2013. Three seminars were arranged in Trondheim, two in Oslo and one on Svalbard. The seminar 30th January in Oslo was attended by H.M. King Harald V. The topic of the seminar was "Food form the Ocean – Norway's Opportunities". Regular meetings open to the public were held in Bergen (7), Oslo (6), Stavanger (6), Grimstad (1), and Trondheim (7), Some of the themes from these meetings are rendered in this review.

The annual meeting for NTVA's Industrial Council was in Oslo 7th March.

Lerchendal gård

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FOREWORD

Eivind Hiis-Hauge
President

As president of NTVA, my predecessor Roy H. Gabrielsen took important initiatives to strengthen the role of NTVA. One example is the fruitful collaboration with The Norwegian Academy of Science and Letters (DNVA). Another is the initiation of a process to formulate a national energy strategy as a basis for NTVA's work in this crucial field.

It is an honor for me to take office as president of NTVA. The academy started almost 60 years ago as a local group in Trondheim, with close ties to NTH, the Norwegian Technical University. Today, NTVA has nationwide activity in five Norwegian cities and this has certainly strengthened our visibility.

In 2013, the work on a national energy strategy was completed, and the result can be found on our home page. We are grateful to all the contributing experts. In particular, we thank Sverre Aam for taking on the responsibility for completing the process after Roy H. Gabrielsen was no longer able to coordinate this work.

On October 4th, the general secretary and the president of NTVA were granted an audience with His Majesty the King, the high protector of NTVA. His Majesty showed a keen interest in the work of NTVA, and he also participated in the symposium organized in January 2013 in collaboration with DNVA.

It is a special pleasure for me to congratulate Knut Åm as new honorary member of NTVA and Hans Christen Rønnevik as recipient of the NTVA special award. They have both amply deserved those rewards as detailed later in this review.

NTVA is a national institution with strong international ties. We are a member of CAETS, a global council of engineering academies, and of Euro-CASE, a corresponding European council. NTVA was represented in the 2013 convocation of CAETS in Budapest, focusing on the challenging theme of engineering education in a rapidly changing world. We were also represented in last year's Euro-CASE meeting in Lisboa, where innovation was the theme. For several years, Euro-CASE has worked systematically to become recognized by the EU Commission as a valuable discussion partner on science and technology, and this work is now bearing fruit. NTVA is actively involved in the formulation of two Euro-CASE platforms, one on innovation and one on energy.

NTVA is committed to strengthening fact-based public debates on central issues related to education, research, science and technology. In our tabloid times when loud, simplistic haggling has a tendency to dominate, insistence on slow, thoughtful and informed argumentation is more important than ever. NTVA sees this as one of our basic challenges.

HONORARY MEMBERSHIP IN NTVA AWARDED TO

KNUT ÅM

The award of honorary membership is based on Åm's significance in the development of Norwegian petroleum industry, for his many years of work in NTVA's council and as leader for NTVA's industrial council.

Knut Åm was born in 1944, in Årdal in Sogn. He received his education at the department for geology of rocks, in technical geology at NTH in 1967, Laudabilis with setting. He commenced his professional career as a geophysicist at the Geological Survey of Norway, NGU, from 1969–74. This was followed by a period of five years at the Oil Directorate in Stavanger before he became Statoil's first director for research and development in 1979. In 1982, Knut Åm was employed by Phillips Petroleum Company Norway, and sent to the head office in Bartlesville, Oklahoma. This was the start of a career that lasted until 1999. Since 1983, Knut Åm has taken on – often as the first Norwegian – various roles of leadership in the company both in Norway and in the USA. From 1992 until 1996, he was the Chief Executive Officer in Norway, and he returned to Bartlesville, Oklahoma, for his three last years as Senior Vice President and Head of Worldwide Exploration and Production. Knut Åm was a member of Statoil's board from 1999 to 2007.

Knut Åm (right) recieves NTVA Honorary Memember Diploma from President Eivind Hiis Hauge

As a leader, Knut Åm has combined professional insight with national and industrial political considerations in an outstanding manner. Examples of areas in which Knut Åm has contributed are:

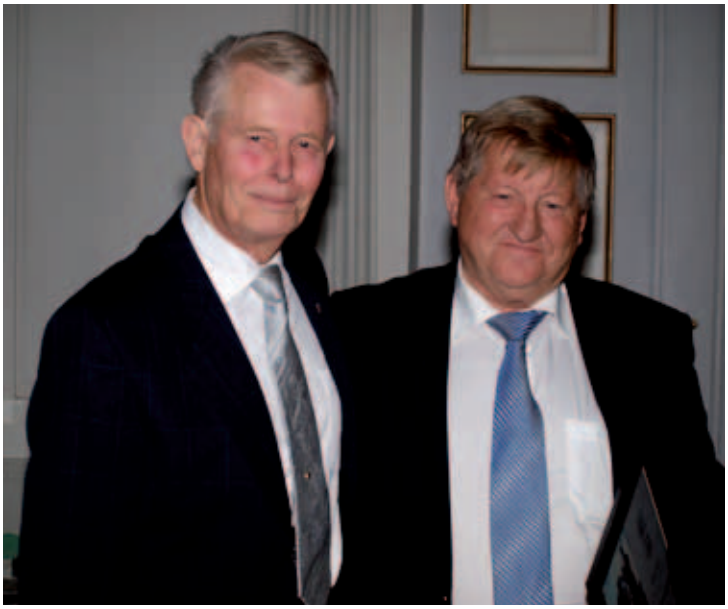
- *Interpretation of the aeromagnetic measurements from NGU that led to early publications that showed large sediment pools in Skagerak, in the Norwegian Sea, and in the Barents Sea*
- *Committee work concerning the need for safety and contingency research that led to a Proposition to the Storting (Norwegian Parliament) and to a major research program financed by the Norwegian government and by industry*
- *Development of the Research section at Statoil and the establishment of several major R&D projects*
- *Work on the water injection project, the major jacking project and extension of Ekofisk (Ekofisk II) – all gigantic technological projects that resulted in an extended life and considerable increase of the reserves*
- *Report from the Utvinningsutvalget (Committee on extraction) 2010 (the "Åm committee") that has contributed toward putting technology and increased extraction on the agenda – both for the authorities and for industry.*
- *Presentation of research through work as editor and contributor to various periodicals and as author of both scientific and popular science articles*
- *Through his work as one of the top leaders of a major international oil company, Åm has been an excellent ambassador for Norway.*

NTVA'S SPECIAL AWARD TO

HANS CHRISTEN RØNNEVIK

The recipient of NTVA's special Special Award for 2013 is Hans Christen Rønnevik. According to the statutes, the Special Award is to be bestowed upon persons who have demonstrated excellent work in developing new technology for the good of Norwegian society and for the development of industry.

Hans Christen Rønnevik, was born on June 26, 1945, in Haugesund. He received his cand. real. (MSc) degree with a major in geology from the University of Bergen in 1971. He started his professional career as a petroleum geologist in the Department of Industry in 1972-73. This was followed by a period, from 1973 to 1983, in various positions in the Norwegian Petroleum Directorate where he worked with the mapping and evaluation of the potential of petroleum on the Norwegian continental shelf. From 1983 to 1984 he was senior geologist in Norske Shell, and vice president of exploration at Saga Petroleum until 1999. He was vice president in Det Norske (Det Norske Oljeselskap) from 2000 to 2004. He is now manager of exploration for Lundin Norway.



Hans Christen Rønnevik (right) receives NTVA Special Award 2013from Knut Åm, Chairman for Award Committee

Hans Christen Rønnevik has been awarded the prize for his role in the development of a new model of exploration that, among other things, led to the discovery of the Johan Sverdrup field in the Norwegian Sea. This is a result of Rønnevik's groundbreaking work with major innovation in the exploration for oil and gas. His work has given new life to a mature area in the Norwegian Sea, and resulted in the discovery of the Avaldsnes and Aldous fields, which together comprise the Johan Sverdrup field with a predicted production capacity of between 1.2 and 2.6 billion barrels. This makes the field one of the largest on the Norwegian continental shelf. It is especially significant that the field lies in the area that was awarded the first license on the Norwegian continental shelf in 1965, and which has previously been explored and returned by Esso, Elf and Statoil.

As exploration manager and geologist at Lundin Norway AS, Hans Christen Rønnevik has rightfully received much of the honor for the ideas that have led to this success. He and his colleagues have been innovative in combining their knowledge of geology, using new methods to reinterpret and analyze old sets of data, collecting new data and carrying out new interpretations and analyses in order to achieve a more complete picture of the subsurface. Altogether, this has produced a valuable breakthrough. Rønnevik and Lundin have had the focus and the guts where no one else dared to invest. Their discoveries show that good geological work combined with insightful creativity can give new life to old areas with so-called "limited remaining potential".

NTVA **TECHNOLOGY FORUM 2013**

TECHNOLOGY FOR IMPROVING USE OF RESOURCES IN THE HEALTH SECTOR

In most of the OECD countries, the costs of health and care services are increasing faster than the national income. Two factors that contribute significantly to this situation are the growing numbers of elderly who need help, and the increasing numbers of cancer cases. To a certain degree, these factors are interrelated. The treatment of cancer is a long and therefore costly process.

One of the most certain predictions for the Norwegian economy is that this strong increase in the use of resources in the sector will continue in the years to come. The number of elderly will greatly increase in the coming decades, and most of the elderly will be wanting more and better services. In the communities that are most affected by this aging trend, one out of every three residents will be older than 67 years of age by 2030. Care for the aged is labor-intensive, and the potential for economizing on resources in this area is probably less than in other sectors of the economy. In Norway, one out of five of those who are in active employment are working in the health and care sector. In 20 years, as many as one out of three may be employed in such work.

Today, 250 billion Norwegian crowns, or 10% of Norway's GNP, goes to the health sector annually. Approximately 85% of this is financed by public funding and the sector is thus the largest public expenditure. Approximately 7 billion crowns, or barely 3%, are used annually in R&D in this sector. A small portion of this is aimed toward health and care for the elderly, and little of it gives any commercial return or industrial development. Other high cost countries invest significantly more than Norway does in industrial development in order to explore the potential that lies in this increasing need.

Considering today's situation in the health sector, along with the clear trends for the future, NTVA wants to look more closely at the role technology can play in making better use of resources. Here, too, the knowledge triangle is applicable – research, innovation and education. We want to put our emphasis on the cooperation between institutions that provide treatment and the interdisciplinary environments at our universities. Special methods of treatment and technical solutions will be presented and discussed. Treatment in the health sector is about people and technology. Technology should not only solve medical problems, but its use must also be acceptable for both the patient and the person treating.





A NATIONAL ENERGY STRATEGY 2013–2017

On the basis of a review of the global energy situation, and Norway's special status within it, NTVA is of the opinion that the unique opportunities inherent in Norway's natural energy resources must be further developed. This will involve the following:

- Adequate investment must be made in research activities in fields in which Norway has a distinct advantage, and which have the potential to produce economic and environmental benefits.
- Considerable emphasis must be directed towards the coordination of energy-related research, and the energy system in its totality must be made the focus of research activities.
- Investment must be made in basic research with the aim of providing Norway with a head start in terms of know-how and innovation.

It is NTVA's view that there is a need for the following:

- A restructuring of the global energy system with a focus on more sustainable and climate-neutral energy sources, technologies and systems
- Massive implementation of energy efficiency measures in all aspects of society, including the development of new transport and urban development projects ("smart cities")
- An increase in the sustainable exploitation of conventional and unconventional fossil energy sources at all levels within the value chain and, in particular, new methods for improved and enhanced oil recovery (IOR/EOR), more efficient combustion engines, and carbon management
- The achievement of Norwegian industry's competitiveness within a future low-carbon society.

In addition to its efforts in the field of basic research, Norway must invest in the following fields in particular:

- Hydropower, offshore wind power, and other fields of renewable energy production in which Norwegian industry has the ability to succeed as a globally competitive major or subsidiary supplier
- Energy efficiency combined with "smart" energy systems adapted to the Norwegian climate and installed in new and existing buildings
- Cable technology for large-scale power supply transfer
- The capture, transport, storage and exploitation of CO_2 which can lay the foundation for long-term wealth generation based on Norway's petroleum resources
- Energy-intensive materials manufacturing industries in which Norway has strong traditions
- The safe and environmentally-friendly recovery of Norway's petroleum resources
- System analyses which provide a comprehensive understanding of the technical, market-related, environmental and socio-economic aspects of the energy system.

FOOD FROM THE OCEAN – NORWAY'S OPPORTUNITIES

This was the title of a symposium jointly organized by the Norwegian Academy of Science and Letters (DNVA), the Norwegian Academy of Technological Sciences (NTVA) and the Research Council of Norway (RCN). The symposium was held in the House of DNVA in Oslo 30 January 2013. His Majesty King Harald attended the symposium.

Photo: Eirik Lislerud, DNVA

H.M. King Harald V

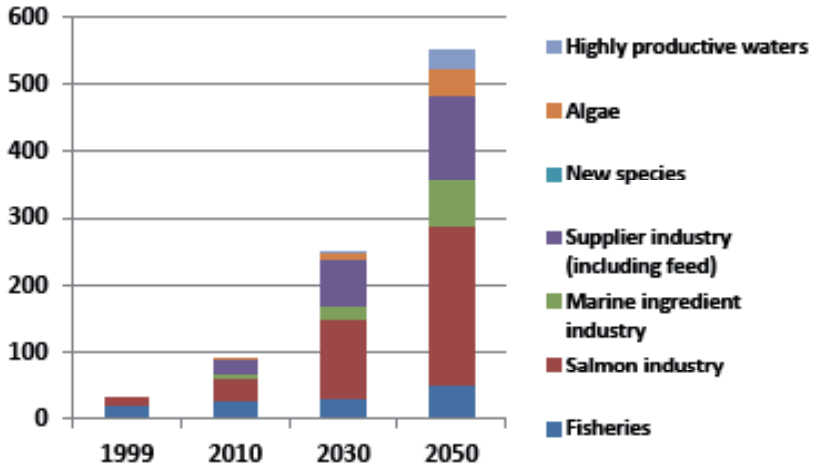
Norway has jurisdiction over sea areas that total more than 5 times its land areas. Throughout our history, the utilisation of the coastal areas has always been of great importance for the survival and income of the people of Norway. Norway has only three industrial sectors with the potential to become so-called "global knowledge hubs". The first of these is the offshore-based oil and gas industry. The second is the maritime sector. The third is the seafood sector, which now also incorporates aquaculture and other biomarine industries in addition to the traditional fishing industry.

In 2012, The Royal Norwegian Society of Sciences and Letters (DKNVS) and NTVA published a new report called *"Verdiskaping basert på produktive hav i 2050"* ("Value created from productive oceans in 2050"). This report estimates the total values created from productive oceans in 2050 to be NOK 550 billion, which is more than six times the value today. Our ability to extract future potential resources will depend to a great extent on several external factors. The marine sector must be given the necessary support within the future development of Norwegian industry. In Norwegian waters, priority must be given to food production in areas where the natural conditions are suitable for increased production. This will require management regimes based upon scientific knowledge, where optimal use of an area for food production is prioritised.

The figure below presents the estimates of value generation potential in the different fields within the marine sector. The estimates have been made on the basis of how development is expected to progress within the fields in question.

Photo: Eirik Lislerud, DNVA

Minister of Education and Research Kristin Halvorsen



ON MAY 14TH 2013, NTVA IN COOPERATION WITH THE NORWEGIAN SCIENTIFIC ACADEMY OF POLAR RESEARCH (NVP), ORGANIZED THE FOLLOWING EVENT:

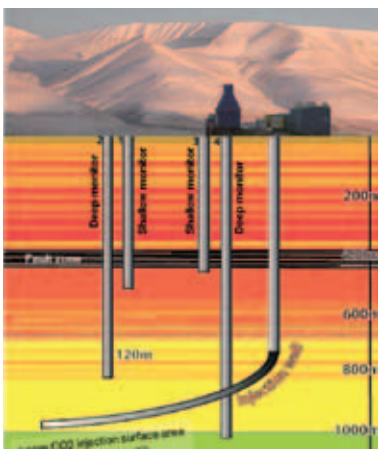
SAFE STORAGE OF CO_2 BELOW LONGYEARBYEN

In October 2006, the University Centre in Svalbard (UNIS) took the initiative to use the natural advantages of Svalbard to turn Longyearbyen into a green showcase, demonstrating the full carbon capture and storage (CCS) value chain. During the years that followed, the Longyearbyen CO_2 lab personnel drilled seven wells to evaluate the feasibility of CO_2 storage. Extensive scientific activities have been carried out including geological analysis of drill cores, seismic data acquisition and evaluation, and water injection and pressure testing of the reservoir. From a wealth of data, reservoir simulations have been performed.

At the seminar, Gunnar Sand (former Director, now advisor at UNIS), Snorre Olaussen (professor at UNIS) and Alvar Braathen (former professor, now adjunct professor at UNIS) presented a first estimation of the storage capacity of the naturally fractured aquifers making up the reservoir. They confirmed the reservoir storage capability at 670–970 m depth, giving a first indication of the reservoir size. They also confirmed that the rocks above the reservoir have a good sealing capacity, ensuring that the potential for leakage is very low.

Research and education have been important parts of the Longyearbyen CO_2 Lab program. In addition to testing and researching the subsurface structures, UNIS has developed field based university courses on Master and PhD levels in cooperation with university and industry partners. So far, 22 Master and PhD students have been using data from Longyearbyen projects as part of their degree work. Future plans for the Longyearbyen CO_2 Lab include carbon capture at the local coal-fuelled power plant, enabling Longyearbyen to demonstrate the entire CCS value chain from the coal in the nearby mines through carbon capture to storage in the sub-surface structures. There is also an ambition to establish a research and monitoring program that follows the migration of CO_2 through the sub-surface structures over time, demonstrating safe storage.

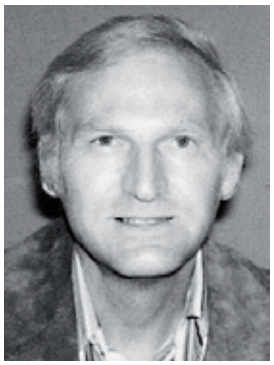
Industrial and funding partners in the Longyearbyen CO_2 Lab program are ConocoPhillips, Statoil, Store Norske, Lundin, Statkraft, BakerHughes, Leonhard Nilsen and Gassnova. The research partner list includes UiO, UiB, NTNU, SINTEF, IFE, Norsar, NGU and NGI. The program has been supported by the CLIMIT-program and UNIS is a partner in the SUCCESS center for CO_2 storage (FME).



50 YEARS OF PHYSICAL ELECTRONICS AT NTH/NTNU

– RESEARCH AS THE FOUNDATION FOR EDUCATION AND INNOVATION

Andreas Tonning



Tore Wessel-Berg

In September, 1963, Andreas Tonning was appointed Professor of the Department of Electrotechnology at NTH (Norwegian Institute of Technology), known today as NTNU (Norwegian University of Science and Technology. In 1965, Tore Wessel-Berg joined the department as professor. Together, they developed the field of physical electronics at NTH. Their activities expanded rapidly with the establishment of continuing studies (Lic. Techn./Dr.Eng.), an increase in the scientific staff, and a considerable number of commissioned activities. The study program was strongly coupled to ongoing research, and soon became popular among the students. From the start, it was important that research was to be verified through use. This was important in order to get financial support, and it also became important in later launching of new industrial enterprises.

Today, the field of physical electronics is part of the larger Department of Electronics and Telecommunications. The topics of projects and master theses often originate as suggestions from the industry and other external environments. The topics for doctoral studies are always connected to research in the department, and this strong coupling has therefore been significant for many candidates at both master and doctoral levels.

In 2011, NTVA's technology forum addressed the topic of innovation and the role of the universities. The forum gave its recommendation to strengthen the relationship between the university and industry also when it comes to strategic research in the institution. The 50-year anniversary of physical electronics provided a good opportunity to address this issue which is so important for the future industrial activity in electronics in Norway. The anniversary was highlighted by a symposium for specially invited participants in Trondheim, on September 5. By bringing together people who are established in education, research and industry, this symposium was a positive contribution to the future development of the subject at NTNU.

NTVA IN **BERGEN**

In 2013, NTVA organized seven events in Bergen. At the meeting on 19 February Professor Nikolai Østgaard, University of Bergen, gave a presentation on the topic:

TERRESTRIAL GAMMA FLASHES, THE MOST ENERGETIC PHOTON PHENOMENON IN OUR ATMOSPHERE

Only 20 years after the discovery of Cosmic Gamma-ray Bursts from the universe, another completely unknown phenomenon involving gamma rays was discovered serendipitously by the Burst and Transient Source Experiment (BATSE) at the Compton Gamma Ray Observatory (CGRO). Short-lived (~1 ms) and very energetic (>1 MeV), photon emissions were found to originate from the Earth's atmosphere. The BATSE instrument had the ability to determine directionality and was designed to detect cosmic gamma-ray bursts with a typical duration of a few seconds. However, occasionally, it measured very short-lived gamma-ray flashes coming from the Earth. They were measured too often to be ignored; in 1994, after careful validation, Jerry Fishman and colleagues reported the discovery of a new phenomenon in our atmosphere: Terrestrial Gamma-ray Flashes (TGFs). Limited by the energy range of the BATSE instrument, they could only report that there were photons with energies above 1 MeV in the TGFs. Later it has been found that photons with energies up to 40 MeV are produced in a TGF. These flashes are therefore the most energetic natural photon phenomenon that exists on Earth. As recently observed, bursts of antimatter are also produced during a TGF.

We know that TGFs are related to electrical discharges in thunderstorm systems and that electrons accelerated to relativistic energies are involved in producing high-energy bremsstrahlung photons. *However, it is not known 1) how frequent TGFs are, 2) the altitude range in which they are produced, 3) the spatial extent of their source region, 4) the angular distribution of the photons at the production altitude or 5) what kind of thunderstorms and lightning they are related to.* The newly established Centre of Excellence, Birkeland Centre for Space Centre (BCSS), led by professor Nikolai Østgaard, will attack these questions by combining unprecedented measurements of TGFs with modelling of electron acceleration in thunderstorm electric fields, X- and gamma-ray production and propagation, lightning initiation and development. BCSS is building X- and gamma-ray detectors especially designed for TGF observations to be placed on the International Space Station, on balloons and on aircraft. Electric discharge experiments are also performed in the laboratory. The study of TGFs is one of the 4 main questions BCSS will focus on. The first 5 years, the study of TGFs is also supported by an ERC Advanced Grant that Professor Nikolai Østgaard was awarded last year.

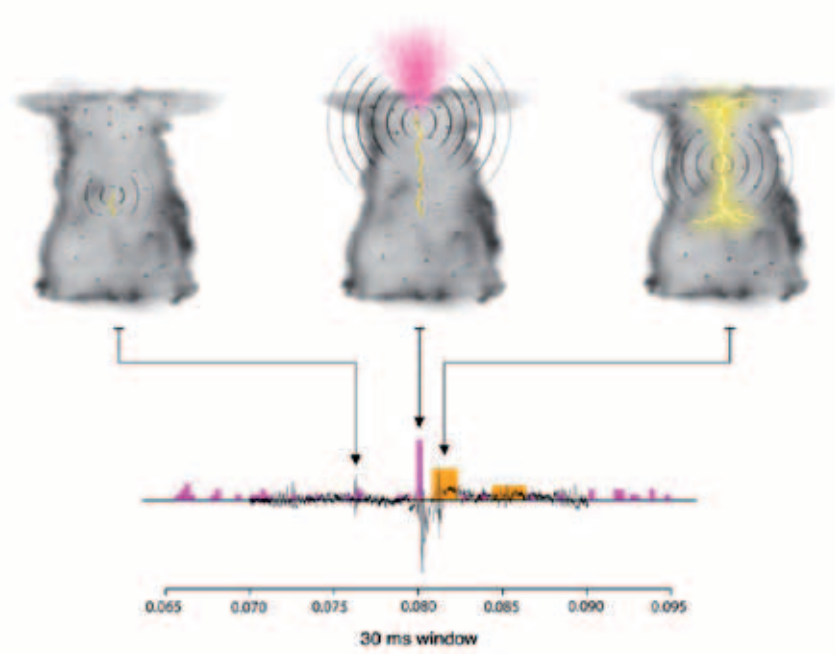


Figure 1: Animated presentation of BCSS last paper on TGF research (Østgaard et al, 2013). By combining gamma-ray observations (purple), optical lightning data (yellow) from space and ground measurements of radio signals (black) from the electric discharge, we established the sequence of events in the lightning discharge as follows: A conducting leader starts propagating from the negative to the positive charge region. Just before the leader shortcuts the two charge regions and produce the bright visible lightning stroke, the electric field between the negative leader tip and the positive charge region is so large that electrons are accelerated to relativistic energies and produce gammas. (Animation is developed by BCSS, and can also be found on: http://www.youtube.com/watch?v=nBI4tWGPs5c)

NTVA IN **OSLO**

In 2013, NTVA organized nine events in Oslo. At the meeting on 22th January Leif-Inge Jakobsen, Product Manager ,VISMA, and Therese Staal Brekke, Project Manager, Norsk Form gave a presentation on the topic:

TECHNOLOGY FOR SENIORS – ENGAGING IN A GLOBAL CHALLENGE

Over the next 30 years, the number of seniors over 67 years will double in Norway. The number of people in need of care will increase dramatically compared to the number of people paying taxes and the number of nurses and care workers. This challenge is global and most apparent in developing countries. Visma engages heavily in innovation for technology that will enable elderly to live safely at home for as long as possible, thus freeing capacity for healthcare workers.

ASSISTIVE TECHNOLOGY IN ELDERLY CARE

Visma is a leading supplier of software solutions to the elderly care sector in Norway. We believe new innovation in assistive technology will make an important contribution to the care of the elderly in institutions and at home. Mobile solutions, remote health monitoring, electronic sensors and equipment such as fall detectors, door monitors, bed alerts, pressure mats and smoke and heat alarms can improve elderly people's safety, security and ability to cope at home.

Care at home is often preferable for patients and is usually less expensive for care providers than institutional alternatives. These solutions assist the elderly in their day-to-day lives, and, what is perhaps more important, help individuals maintain an independent lifestyle in their own homes. New technology will also enable care workers to perform their work more efficiently.

The use of assistive technology is an important component in solving the challenges ahead. Visma can install sensors at home for the elderly that monitor and prevent potential accidents. When an incidence occurs, for example a fall, sensors will send out alarms. Such alarms can be received by health care personnel's mobile devices so that the personnel can respond with necessary actions. All such alarms will automatically be registrered in the official health journal (EPJ). Health care personnel will visit the home of the elderly, secure necessary actions and report what actions have been taken.

Visma already has a strong position in technology for elderly care. Together with forward thinking Municipalities and various partners, we are now developing and implementing technology for elderly care.

Leif-Inge Jakobsen
Product Manager

NTVA IN **STAVANGER**

In 2013, NTVA organized six meetings in Stavanger. At the meeting on 14 March, Tor Berge Gjersvik, Senior R&D Manager, FMC Kongsberg Subsea, gave a presentation on the topic:

THE FUTURE IS ON THE FLOOR OF THE SEA

The oil industry started the development of subsea technologies and capabilities on an industrial scale from the late 70s and onwards to offset the depth limitations with fixed platforms. As it takes time to develop, qualify and implement new technologies, it was not until the late 80s and through the 90s that subsea developments really took off. And during the last 10 years, the industry has also moved process equipment like oil/gas and oil/water separators subsea. This requires subsea pumping to energize the oil for flow to topside facilities or to the shore. Next year (2015) the first large subsea gas compressor station will be installed by Statoil subsea at Åsgard in the Norwegian Sea.

The industry is now looking at a future with even deeper waters, longer distances, and colder weather as well as poor infrastructure in remote areas like the Arctic. Initiatives like Statoil's "Subsea Factory"™ and FMC Technologies "All Subsea" will require R&D and qualification of new technologies for long distance pipeline transport of oil and gas, power supply from shore, electric control systems, new materials, and remotely operated subsea intervention systems. As the subsea tie-back range capability is extended beyond the current limit of about 200 km, the need for offshore surface facilities like FPSOs and fixed platforms will be reduced. And the fewer the offshore surface facilities, the fewer the number of people who are required offshore. As a consequence, risks to personnel and the offshore environmental footprint will be significantly reduced.

All the main subsea technology providers are engaged in R&D and technology development in Norway. One of these, Aker Solutions, is truly a Norwegian company while another, FMC Technologies, has its roots in subsea and a major part of its activities at Kongsberg. SIEMENS of Germany also has a proud and distinguished history in Norway, and has placed its R&D center for subsea in Trondheim.

With the challenges facing the subsea industry in the years ahead, the innovative environments these companies have created and maintain in Norway will certainly provide significant contributions to the oil industry in Norway and hopefully continue to play a dominant role subsea throughout the world.

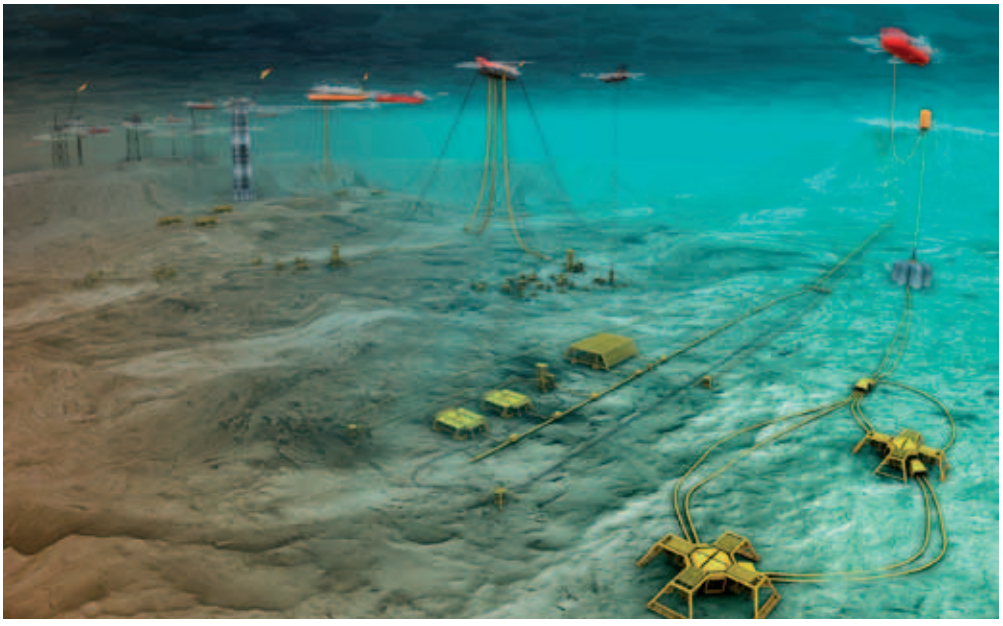


Illustration by FMC Technologies Evolution of Subsea Technology

NTVA IN **TRONDHEIM**

In 2013, NTVA organized ten events in Trondheim. At the meeting 22 January, Professor Kari Melby, Norwegian University of Science and Technology, NTNU, and Professor Gunnar Öquist, Umeå University, Sweden, gave presentations on the topic:

FOSTERING BREAKTHROUGH RESEARCH: A COMPARATIVE STUDY

Gunnar Öquist, Professor Emeritus, Department of Plant Physiology, Umeå Plant Science Centre, Umeå University
Compiled publication data reveal that Sweden exceeds the world average for the 10% most highly cited publications by 15%, while the corresponding figures for Denmark, the Netherlands and Switzerland are between 35 and 40% (1). Furthermore, the category of young researchers performing at the "top 10%" publication level is lower in Sweden than in the more successful reference countries. To explain these differences, the Royal Swedish Academy of Sciences took a comparative 20-year historic perspective, examining in particular policy decisions taken at government level and developments related to universities and funding systems (2).

The analyses showed that the universities are the weak link in the Swedish research system. In the comparison, we identified a series of key factors of fundamental importance to foster research excellence at a high international level. These factors are:

- Strong academic leadership at all levels with focus on establishing creative research environments of scientists with complementary skills.
- Internationally competitive recruitment high on the leadership's agenda.
- Emphasis on mobility and good career opportunities for young researchers.
- Access to competitive, external funding systems with clear missions and long-term perspectives.
- A balance between bottom-up support of independent research by individuals and research environments with novel ideas, and more top-down determined strategic research endeavours filtered through rigorous scientific quality assessments.
- University floor funding/external funding should not be lower than 3/2.

Universities and external funders have different and complementary roles in fostering academic excellence for breakthrough research. Universities should take prime responsibility for competitive recruitment and long-term core funding prioritising scientific quality, while on top of this responsibility, external funders such as research councils should support projects and major national initiatives on a competitive basis.

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Kari Melby

Gunnar Öquist

ANNUAL MEETING
INDUSTRIAL COUNCIL

– A summary of the speech led for NTVA's Industrial Council in Oslo on Mach 7

By Professor Torger Reve, BI Norwegian Business School, Oslo, Norway

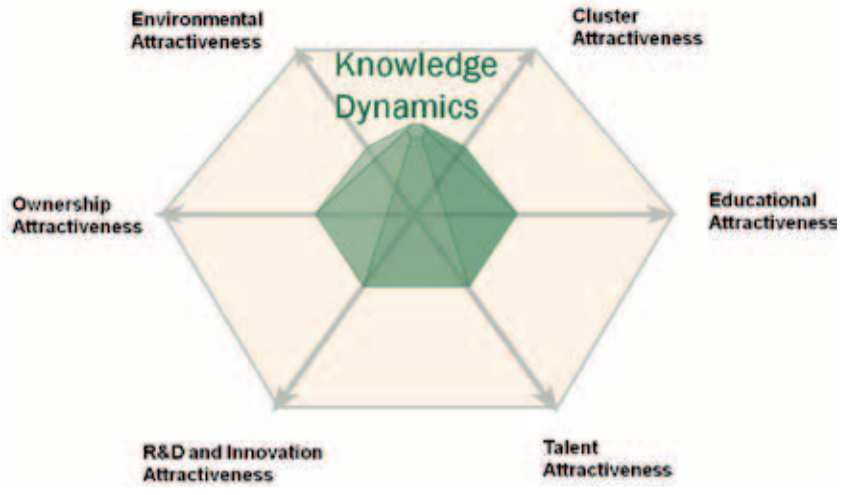
THE KNOWLEDGE COMMONS

In a famous article in Science (1969), Garrett Hardin introduced the concept of the Tragedy of the Commons, referring to our physical environment. The debate on climate and carbon energy illustrates the point in a dramatic way.

In my recent book "A Knowledge-based Norway" (2012), the concept of the Knowledge Commons is adapted. The mechanisms are quite similar to what we observe for natural environments. The industrial value creation of any nation depends not only on the resource endowment, but on the knowledge commons that companies can draw their knowledge resources from. We can think of the knowledge commons as the combination of human skills, competences and values, educational resources, research and development, technology, industrial and market knowhow that industries utilize. It is a combination of tacit and formal competences, but more and more, advanced societies rely on advanced research based knowledge. Who takes responsibility for cultivating the knowledge commons and making it grow into excellence? Government can only do part of the job, focusing on education and basic research.

Industries and industrial clusters have to invest in the more specialized knowledge commons, providing continuous education and taking research into technology, products and services. As individuals we have the responsibility to take our abilities to their full potential. See what happens in emerging economies like China, and compare PISA scores for Shanghai and Norway.

As a small and specialized economy, Norway can only have Global Knowledge Hubs in a few industries. Our research shows that the three strongest Norwegian industries from a global knowledge perspective are in the offshore, maritime and seafood sectors. We refer to these industries as Ocean Industries. This is where Norway has taken industrial leads globally: in maritime and marine technology, in petroleum and renewable energy, and in knowledge and financial services supporting the ocean industries. This is where the industrial potential of the future is for Norway, given that these industries continuously transform and globalize and take new paths. Norway has to invest more in the knowledge commons that are the base for our wealth and welfare. Our future depends on the quality of our human resources, not on how much oil and gas remain to be produced.



Emerald Model

NTVA Review 2013

NORWEGIAN ACADEMY OF TECHNOLOGICAL SCIENCES

NTVA'S INDUSTRIAL COUNCIL

NTVA has an Industrial Council made up of representatives from the industry, public institutions and research institutes. The council assists NTVA in realizing its objectives and strengthening its links to industry by promoting research, education and innovation to the benefit of Norwegian society. The council's executive committee had the following members in 2013:

Suzanne Lacasse, Former Managing Director, Norwegian Geotechnical Institute (NGI), Chairman
Eivind Hiis Hauge, President NTVA, Professor NTNU
Karl Almås, Managing Director, SINTEF Fisheries and Aquaculture
Marianne Harg, Former President, Tekna - The Norwegian Society of Graduate Technical and Scientific Professionals
Ole Gunnar Selvaag, Senior owner and a board member in Selvaag Gruppen A/S.
Lars Holden, Managing Director, Norwegian Computing Center
Hein Johnson, Secretary General, NTVA

Council members:
AS Norske Shell
Christian Michelsen Research AS
Det Norske Veritas AS
EWOS AS
Forsvarets forskningsinstitutt
Fred. Olsen & Co
GE Oil&Gas Norway AS
GE Vingmed Ultrasound AS
Innovasajon Norge
Institutt for energiteknikk
International Research Institute of Stavanger (IRIS)
Kongsberg Norspace AS
Leiv Eiriksson Nyfotek AS
Lundin Norway AS
MARINTEK
Microsoft Development Center Norway AS
NEXANS Norway AS
Norconsult AS
Norges geologiske undersøkelse
Norges Geotekniske Institutt
Norsk Hydro ASA
Norsk Institutt for luftforskning – NILU
Norsk olje og gass
Norsk Regnesentral
Norsk Romsenter
Norut
Rainpower Norge AS
Rolls Royce Marine AS
Schlumberger Information Technology Services
Selvaag Gruppen AS
Simula Research Laboratory
SINTEF
Statnett
Statoil ASA
Syslab International AS
Tekna
Telenor Norge AS
Ulstein Group AS
Umoe AS

New Council member in 2013:
EWOS AS
Lundin Norway AS
Norsk institutt for luftforskning
Norsk olje og gass
Rainpower Norge AS
Statnett
Telenor Norge AS
Ulstein Group ASA

ANNUAL MEETING IN 2013:

The annual meeting for the Industrial Council was arranged in Oslo, 7 March. On this occasion, Torger Reve, Professor, BI – Norwegian Business School and Alf Bjørseth, Scatec, gave speeches on Norwegian industry policy. See page 15.

Suzanne Lacasse took over after Knut Åm as Chair of NTVA's Industrial Council in March 2013. She has been a Member of the NTVA since 1996. She is also an elected member of the Norwegian Academy of Sciences and Letters, the Royal Norwegian Society of Sciences and Technology, the US National Academy of Engineers, the Canadian Academy of Sciences and the French Academy of Sciences (Technology Section). Dr. Lacasse is presently Technical Director at the Norwegian Geotechnical Institute (NGI)

Photo: NGI

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