



The Michelsen Centre

for Industrial Measurement Science and Technology

**A Centre of Research-based Innovation
Bridging Industry and Science**

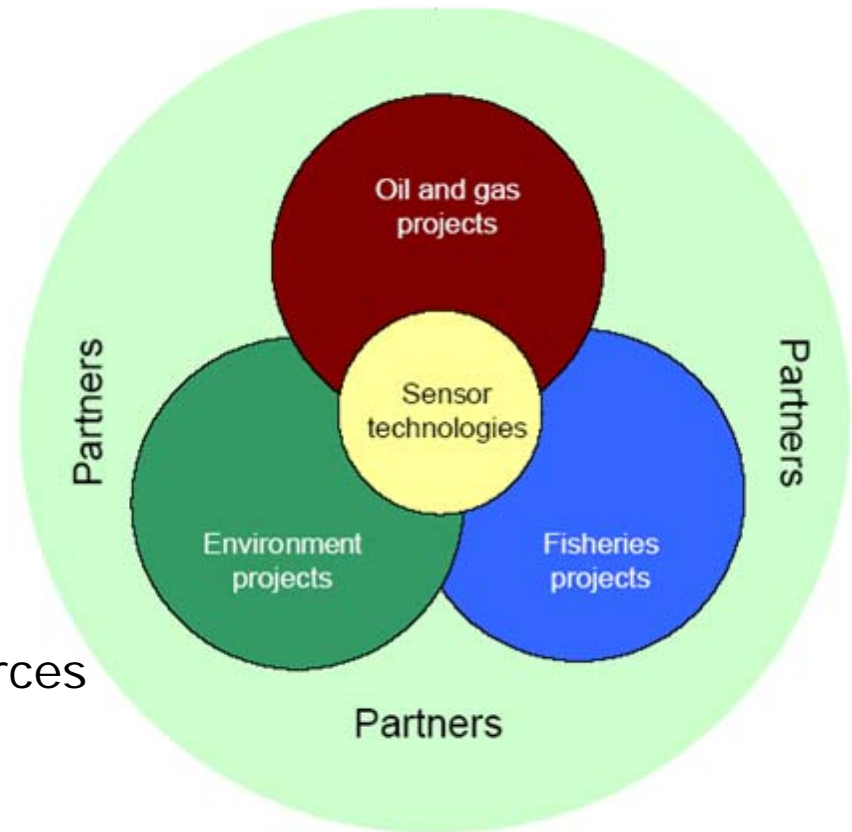
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Outline

- An overview of MIMT - a Centre of Research-based Innovation
 - Vision
 - Partners
 - Technological themes
 - Scientific and technological foundation
- Running innovation projects

Vision

- Interdisciplinary resource centre for:
 - Oil & Gas
 - Fisheries & Aquaculture
 - Environmental monitoring
- Develop new and innovative solutions
- Exploit technological synergies for:
 - Improved commercial performance
 - Improved exploitation of natural resources
 - Improved mutual understanding in environmentally sensitive areas.



A Centre of Research-based Innovation

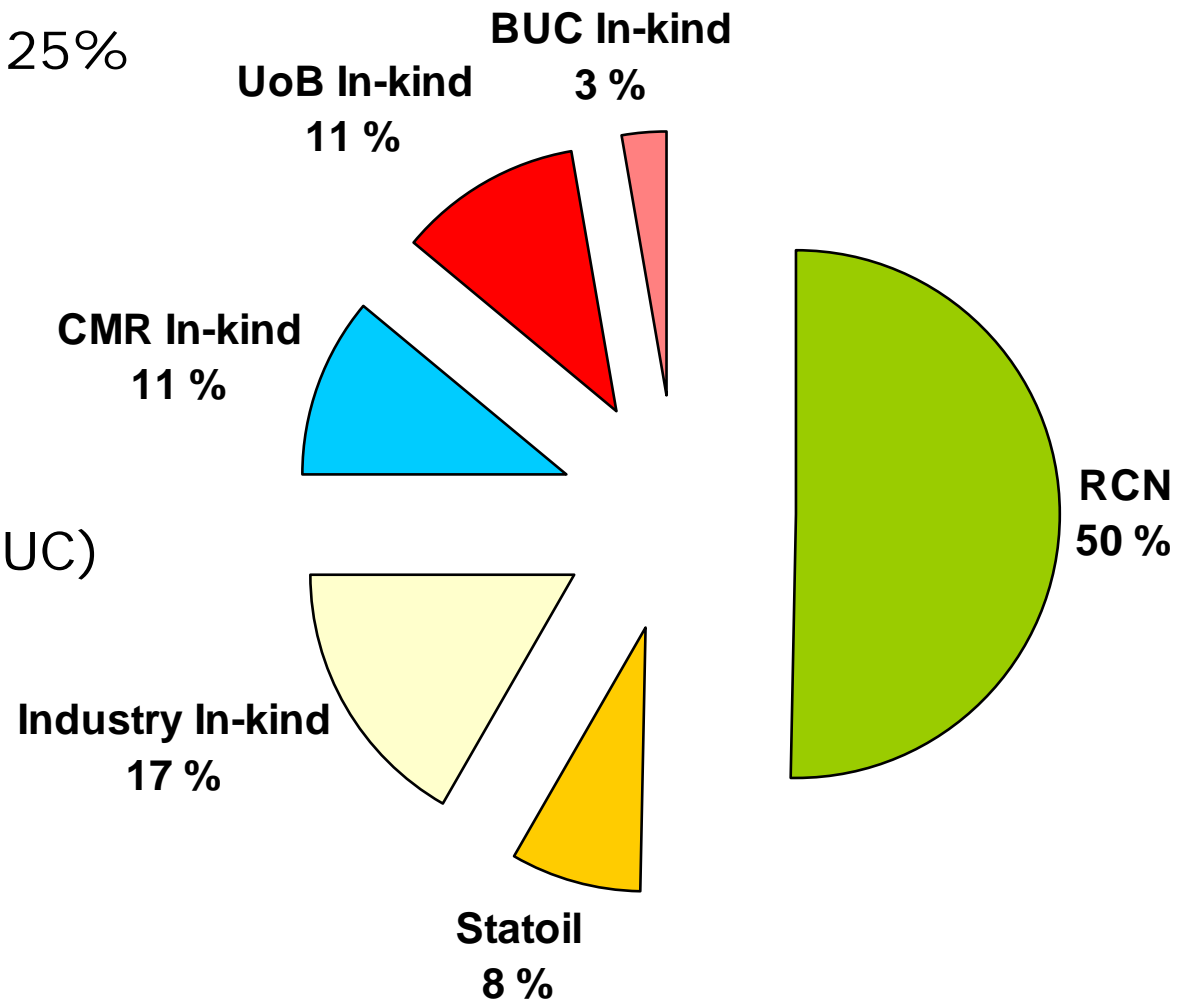
- Status granted by the Research Council of Norway
 - 14 Centres of Research-based Innovation in various disciplines
 - Period 2007-2014
- Close collaboration
 - Research-intensive companies
 - Outstanding research environments
 - Industrial partners active in board, funding, and research
- Bridging research and industry
 - Technological innovations
 - Not product development (due to EU legislation)

Partners of the Michelsen Centre

- Host organisation
 - Christian Michelsen Research AS, industrial R&D
- Research partners:
 - University of Bergen (UoB), R&D and education
 - Institute of Physics and Technology
 - Institute of Geophysics
 - Institute of Biology
 - Institute of Chemistry
 - Bergen University College (BUC), R&D and education
 - Avdeling for ingeniør- og teknologifag
- Industrial partners
 - Oil & Gas
 - CGGVeritas
 - FMC Metering
 - Roxar
 - Seawell
 - Statoil
 - Environmental monitoring
 - Aanderaa Data Instruments (AADI)
 - Fisheries & Aquaculture
 - MMC Tendos

Funding 2010

- MNOK 25
- Industry contributions 25%
 - In-kind
 - Cash
- RCN funding 50%
- In-kind from research partners (CMR, UoB, BUC)

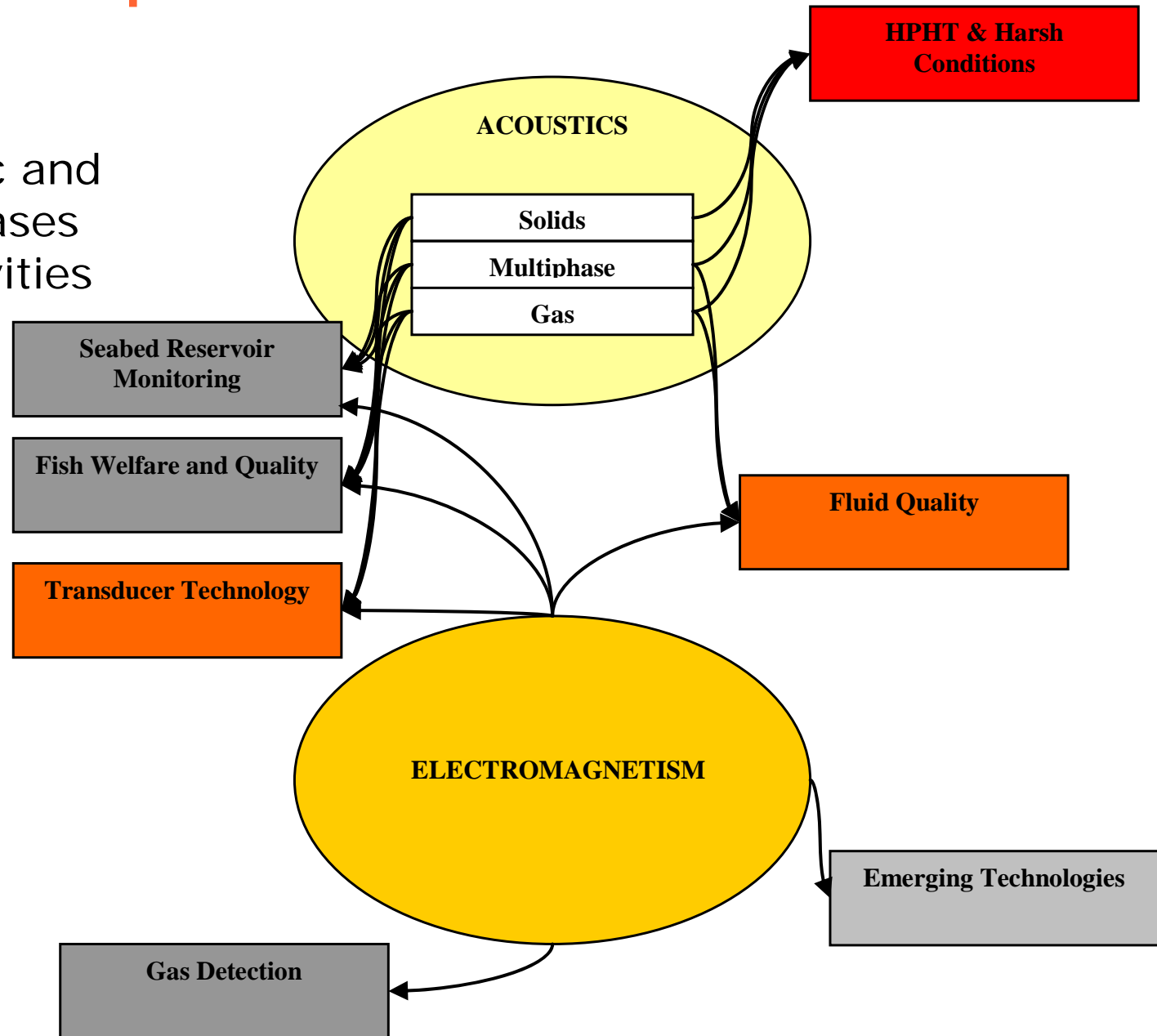


MI MT Technological Themes

Area	Program	Application Areas		
		Oil & Gas	Fish.& Aquacult	Env. Mon.
Flow Measurement	Fluid quality			
	Transducer Technology & Signal processing			
Down-hole	HPHT & Harsh Conditions			
Monitoring	Gas detection			
	Fish welfare and quality			
	Seabed Reservoir Monitoring			
Emerging Techn.	Nanotechnology			
	Optics			

MIMT Partner Cooperation

- Strong scientific and technological bases linking the activities



MIMT Scientific Foundation

- Co-funding of Professorship in Experimental Acoustics
- 6 Professor IIs (University of Bergen), 4 international experts
- Guest lecturers
- Guest researchers
- Scientific publishing 2007-2010
 - 45 publications in peer-reviewed journals and conferences
 - 26 contributions to other technical and scientific meetings

MIMT Scientific Recruitment

- 8 PhDs and postdocs funded by the centre
 - 3 PhDs and 1 postdoc 2008-2012
 - 4 PhD positions 2011-2014
- Additional 10 PhDs / postdocs associated with the centre
- Bergen School of Measurement Science
- 16 MSc theses, 6 BSc projects

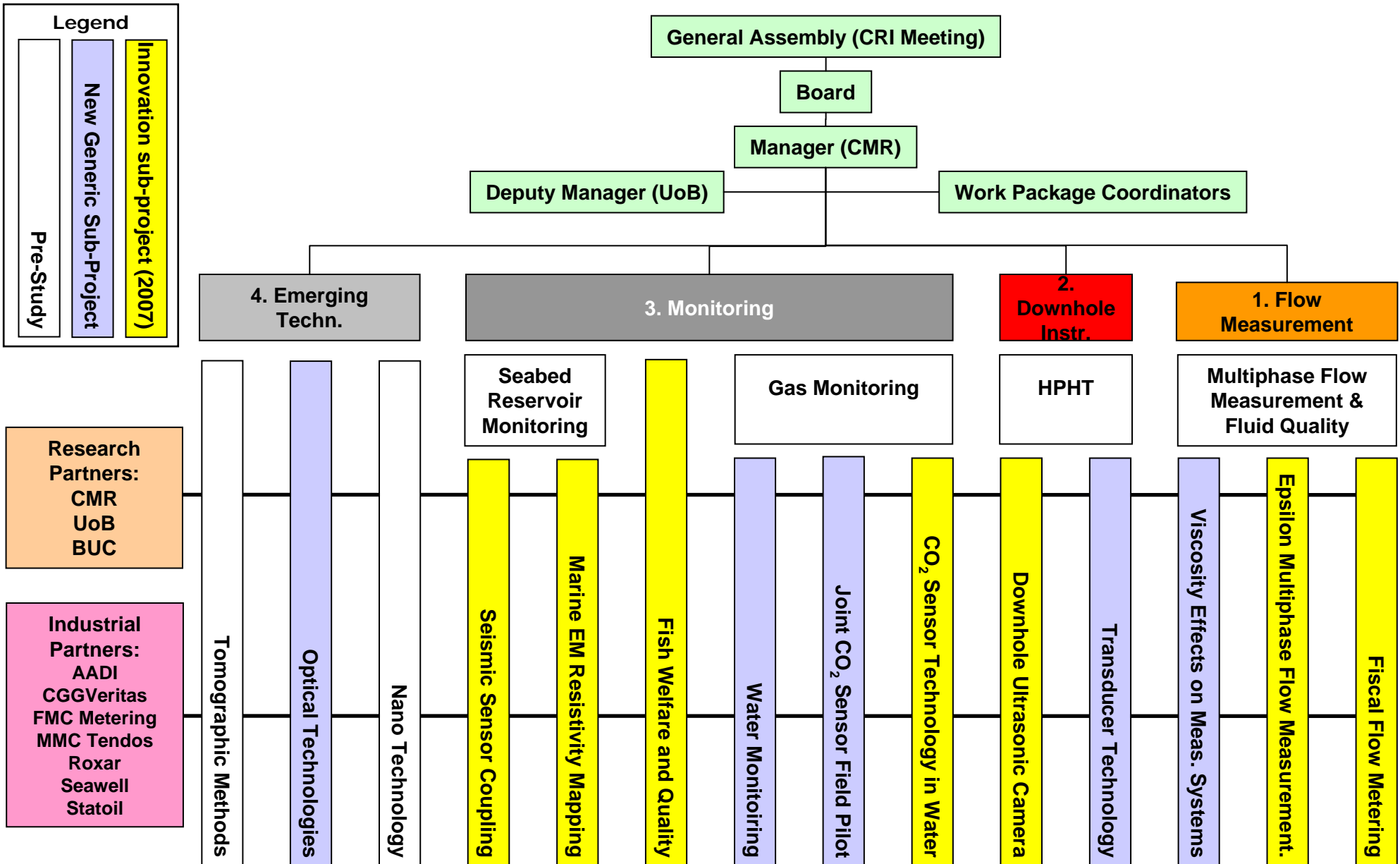
MIMT Visibility

- 16 seminars and workshops 2009-2010
 - Most of them open also for non-partners
- Website www.michelsencentre.no
- Industry courses (1-3 days)
 - Fiscal Metering (based on NFOGM's handbook)
 - Uncertainties (ISO GUM)

MI MT projects

- Oil & Gas
 - Fiscal Flow Metering
 - Epsilon Multiphase Flow Metering
 - Seismic Sensor Coupling
 - Downhole Ultrasonic Camera
 - Marine EM Resistivity Mapping
- Environmental monitoring
 - Sensor Technology for CO₂ in Water
- Fisheries & Aquaculture
- New projects and pre-studys

Project Organisation



Summary - What MIMT Offers

- An innovation network bridging science and industry
 - Research-intensive companies
 - Outstanding research environments
 - Active industry participation in innovation projects
- A forum for creating new innovation activities
 - Forum for identifying technological gaps and challenges
 - Developing and running innovation projects
 - Funding applications 2009 NOK 420 million
 - Seminars and workshops
 - Professional meeting place
- Contact info
 - www.michelsencentre.no
 - erling@cmr.no , +47 992 33 201



OIL AND GAS

Fiscal Flow Metering

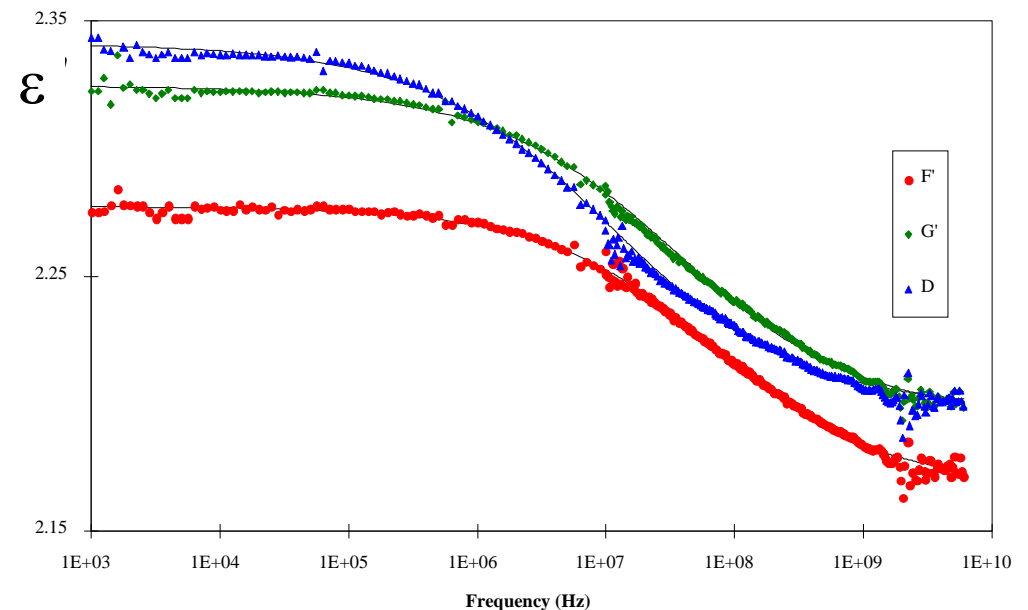
- Fiscal metering
 - Measurement of the amount of oil and gas
 - Export / import
 - Ownership allocation (commingled ownership)
- Objective
 - Maintain Norway's leading position in flow metering technology
 - Impact on international standards
- Acoustic (ultrasound) metering technology development
 1. Natural gas at high pressure and high temperature
 2. Oil & gas at high pressure and high temperature
 3. Acoustic signal / fluid flow / elastic structure interaction
 4. Non-intrusive (non-wetted) subsea ownership allocation metering



Epsilon Multiphase Flow Metering

- Metering of multiphase flow (oil / gas / fluid in same pipe)
 - Mature technology
 - Close to 1000 meters in operation worldwide
- Objective
 - Increase the accuracy and reliability of multiphase flow metering
 - Widen the span of flow parameters (temperature, pressure, actual composition of flow)
- Potential for accuracy improvement
 - Improving the understanding of the basic chemical and physical mechanisms

- Activities
 - Collecting chemical and physical fluid data
 - Establish fluid property models
 - Establish electrical and acoustic parameters of oil types
 - Model relations between various physical parameter values



Electrical permittivity of three North Sea crude oils

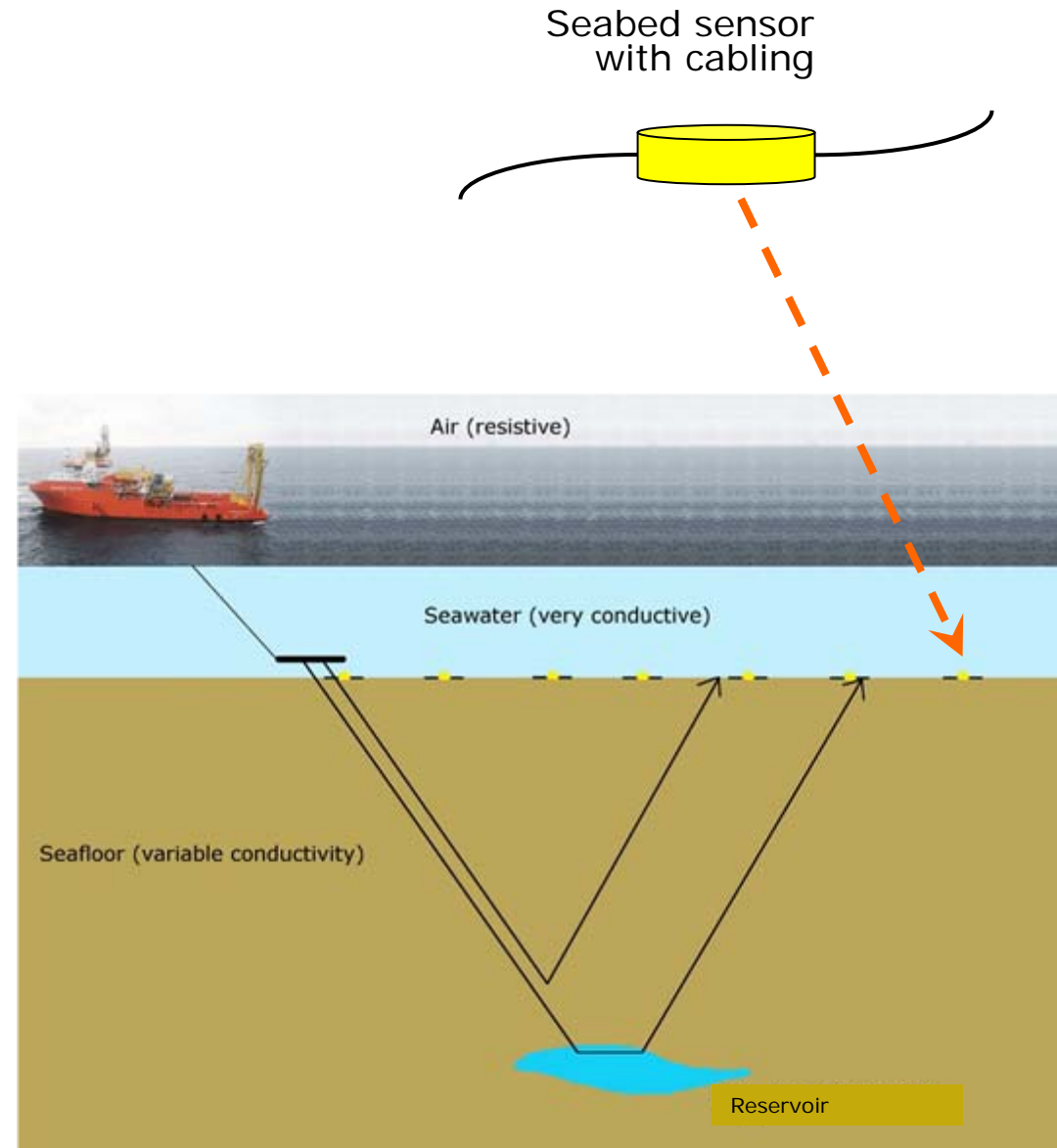
Seismic Sensor Coupling

- Permanent or semi-permanent seismic sensors on the seabed
 - Oil & gas field during production
 - CO₂ storage monitoring
- Missing knowledge in today's technologies
 - The acoustic coupling between the seismic receivers and the seabed
- Goal
 - To evaluate and understand seabed seismic sensor coupling
- Activities:
 - Establishing lab facility for testing of seismic sensor designs with various seabed types
 - Testing of sensor designs and various seabed configurations



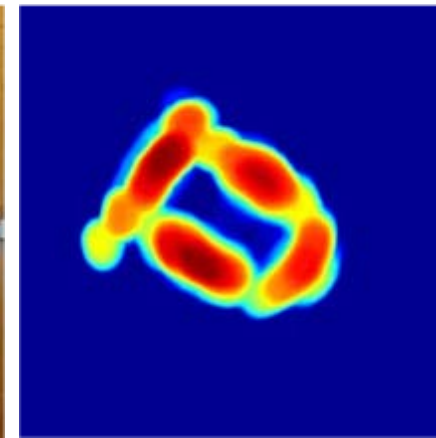
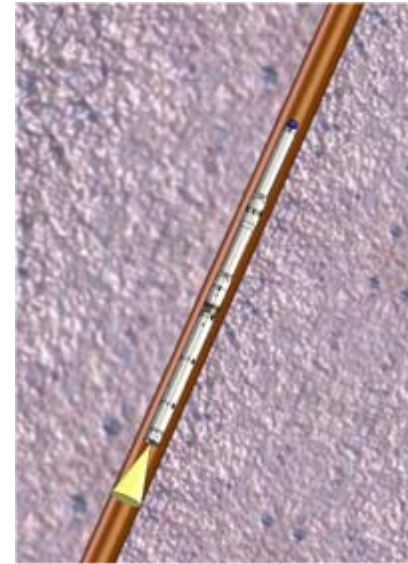
Marine EM Resistivity Mapping

- Objective
 - Improve the mapping of sub seabed geological volumes (reservoirs)
- Electromagnetic sounding method
 - Sub seabed structures create variations in electromagnetic fields
 - Electromagnetic sensors on the seabed
 - Complementary to conventional seismic techniques
- Activities
 - Improve the stability and sensitivity
 - Introduce techniques for compensation of degradation



Downhole Ultrasound Camera

- Objective
 - Reduce time and cost of well maintenance
- Goal
 - Develop ultrasonic technology for downhole imaging to prepare for “fishing operation”
- “Fishing”
 - Technique where obstacles in a well are removed with simple means/operation avoiding full well work-over
 - Camera used to obtain knowledge of the nature of the problem under opaque conditions
- Activities
 - Acoustic simulation and modelling
 - Acoustic characterisation of downhole fluids
 - Building prototype camera
 - Testing of prototype camera

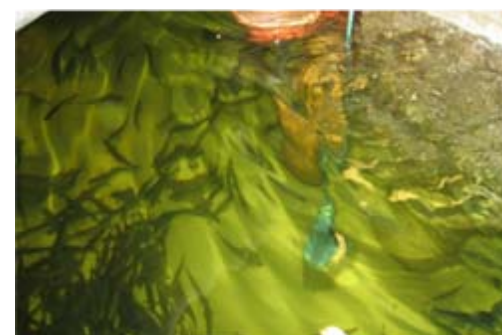


ENVIRONMENTAL
MONITORING



Sensor Technology for CO₂ in Water

- Goal
 - Develop reliable, compact in-situ technology for CO₂ monitoring in the ocean/water
- Application area
 - Environmental monitoring, Fisheries and Oil&gas
- Main activities/achievements
 - Technology evaluations, including lab and field testing
 - Developed first prototype CO₂ sensor
 - Developed calibration setup; Performed calibration, response time testing, drift/repetition testing, compared different sensing foils
 - Pilot testing of prototype CO₂ sensor related to fisheries and environmental monitoring
- Post doc position focusing on high accuracy pH/total alkalinity sensor for carbonate system monitoring



FISHERIES



Fisheries & Aquaculture

- Objective
 - Develop measurement technology for improving fish handling
- Focus on ensuring fish welfare and maximizing product quality through the processes of
 - Catching
 - Loading / unloading
 - Transportation
- Activities:
 - Studies of fish properties to enable measurement technology
 - Welfare and quality in transportation of live fish
 - Measurement and improvement of quality in pelagic fisheries



Photo: Kjell-Tore Sivertsen



OIL AND GAS



FISHERIES



ENVIRONMENTAL MONITORING