CenSES

CENTRE FOR ENVIRONMENT-FRIENDLY ENERGY RESEARCH

Annual Report 2011

Centre for Sustainable Energy Studies

Message from the Chair of the Board

The year of 2011 has been a very exciting year for CenSES, as this was the first year of operating as Centre for Environment-friendly Energy Research (FME), and as one of three new centres with focus on social science-related energy research in Norway. Thus, it was a highlight when the Centre was formally opened by the Minister of Petroleum and Energy, Ola Borten Moe, at the opening conference in June 2011. Here Borten Moe revealed his high expectations towards the future public energy debate, and invited academia to be more engaged in this respect. This is also one of CenSES' objectives.

With 8 Norwegian research partners, 21 user partners and 10 collaborating international research partners, CenSES has a good possibility to achieve its research objectives and interdisciplinary ambitions. As this annual report shows, CenSES is already involved in many interesting research projects, and I am looking forward to follow CenSES in its further development. Having conducted 3 PhD workshops, a successful Annual Conference in Oslo with 70 participants from academia and industry, CenSES is also under way of producing important input to energy policy through reports and publications. This I expect to see more of in the years to come, as CenSES produces more and more valuable knowledge that is relevant and important to policy makers and public authorities.

Kari Melby, Chair of the Board, CenSES

Message from the Centre Director

CenSES was established as a research centre in April 2009 as a cooperation between the research partners. In February 2011 we were awarded status as Centre for Environmentally-friendly Energy Research (FME) by the Research Council of Norway, and we secured the cooperation with 21 user partners and 10 international partners. It has been a year focusing on starting up new activities and implementing the centre organization and structure.

One highlight for me has been the recruitment of the master students, researchers, PhD candidates and post docs. Close to 100 researchers has been involved in CenSES research and education activities in 2011. Throughout the year, we have observed among the partners the same spirit that triggered us to establish the research cooperation: A genuine interest in cooperation - between disciplines and between different organizations.

You can read more about the results of the CenSES activities in this annual report.

Asgeir Tomasgard, Centre Director, CenSES

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Photo of Asgeir Tomasgard on this page: Tore Oksholen, Universitetsavisa.
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CenSES in 2011

CenSES will develop fact based knowledge for strategic decisions, relevant both for government and industry. The focus is knowledge for a national energy policy, for national and international climate policy and for strategies of innovation and commercialization.

The CenSES consortium includes research groups from Institute for Energy Technology, Institute for Research in Economics and Business Administration, Norwegian School of Economics and Business Administration, Norwegian University of Science and Technology, SINTEF, Sogn and Fjordane University College, Vestlandsforsking and University of Oslo. CenSES research integrates the following disciplines: energy system and market, industrial ecology, economics, political science, sociology, innovation studies, and science and technology studies.

The main focus in CenSES in 2011 has been to establish the consortium and to start up the research teams in our five Research Areas:

RA1. Policy making and transition strategies
RA2. Energy systems and markets
RA3. Economic analysis
RA4. Innovation, commercialization and public engagement
RA5. Scenario development

For each of these we have produced a 5-year research plan, as well as more detailed yearly work plans. Also we have established a coordinating mechanism across the research areas, in form of user cases. These user cases have a focus on coordinating deliverables in 2012 and 2013, within selected topics of high importance for the user partners. Meetings were held in Trondheim, Oslo, Bergen and Sogndal to define these.

The CenSES consortium has been established with the research partners mentioned above, 21 user partners and the international partners. Our board has been constituted with 5 members from the research partners and 5 from industry. We are in the process of initiating the cooperation with our international research partners. In 2011 cooperation with Tsinghua, University of Maryland, Joint Global Change Research Institute, ETSAP, Lancaster University and DIW Berlin has been particularly strong, with joint research activities, educational training and research visits.

When it comes to dissemination events, the two main activities were the opening conference in June and the annual conference in December. FME CenSES was formally opened by Minister of Petroleum and Energy, Ola Borten Moe in June, and the opening conference had contributions from researchers, public bodies, industry and the research council. CenSES annual conference was held in December in Oslo over two days with 70 participants. In addition, a set of centre activities has been started: a newsletter, a web site, a blog, FME Innovation forum. A joint dialogue forum with Technoport is under planning.

A strong focus in CenSES is recruitment and education. By the end of 2011 CenSES had recruited 25 PhD candidates and 4 post docs. During the year, 28 master students wrote their thesis in the centre and related projects. We established a PhD network for the young researchers. The PhD network also includes 22 PhD candidates in related projects where CenSES researchers participate. An international PhD winter school with 100 participants was arranged on "Managing uncertainty in energy infrastructure investments".

Main Research Objective

CenSES main research objective is to conduct research that supports public and private decision makers in strategic decisions and policies that will promote environment-friendly energy technologies and lead to a sustainable energy system. The research will result in new policy recommendations, tools and models, strategies and scenarios supporting the transition to a sustainable energy system.

Main Research Areas

RA1. Policy making and transition strategies
RA2. Energy systems and markets
RA3. Economic analysis
RA4. Innovaton, commercialization and public engagement
RA5. Scenario development

Scenario development is an arena of integration where policy and framework conditions, technology strategies, investment strategies and impacts are to be coupled in a consistent way.

In addition, selected user cases will be implemented across the research areas.

Objectives

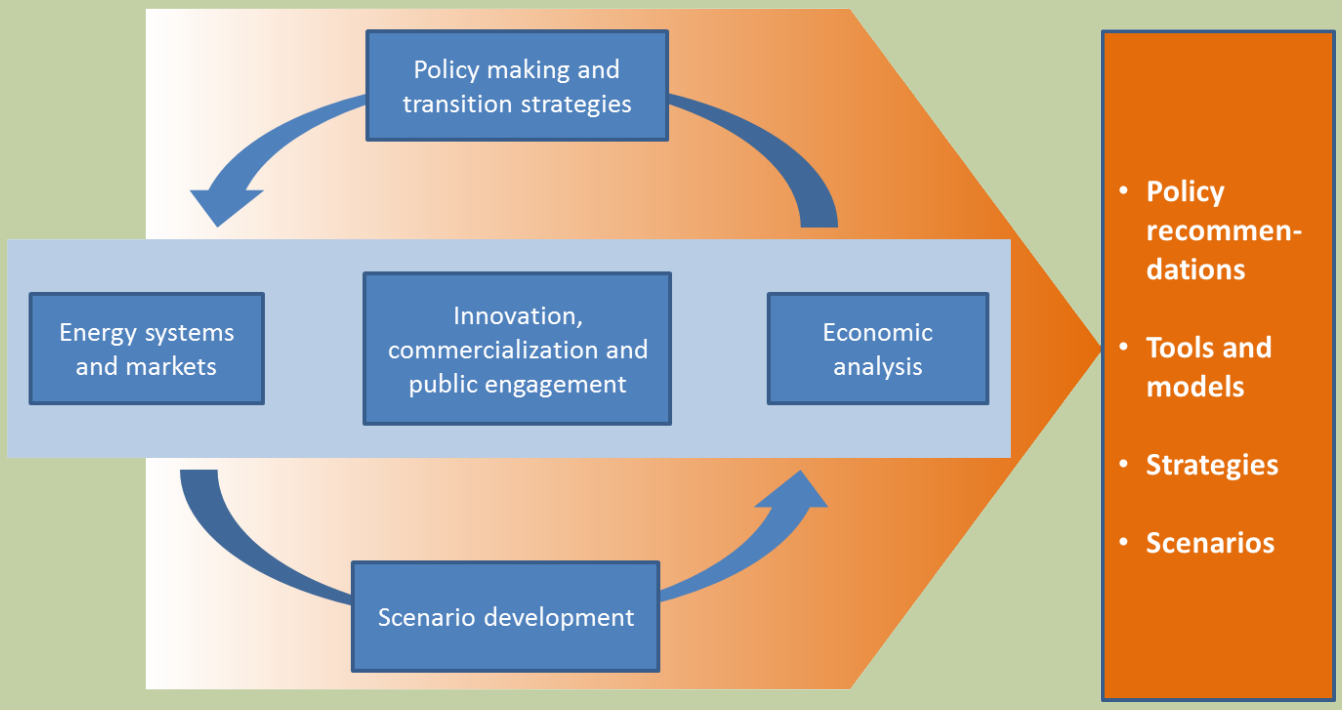
Objectives for education and recruitment

- Develop master courses and a PhD school in social scientific energy studies
- Supervise at least 20-30 master students every year
- Educate 40 PhD candidates and post docs under the FME budget

Relevance objectives

- CenSES will perform a number of scenario studies and user cases in cooperartion with the user partners

CenSES Research Areas



Dissemination objectives

Disseminate results to the public through:
- Yearly conferences
- Workshops and seminars
- Bi-monthly newsletter
- High visibility in the news media

Establish Innovation Forum in cooperation with the technology-oriented FMEs

Establish an Energy Strategy Board together with Technoport

Establish a public website

Establish a blog at forskning.no (Dei fornybare)

Publication objectives

- Publish 120 articles in Journals with peer review
- Present 150 papers on international conferences
- Write 3 scientific books and 40 book chapters in edited books

In addition to strictly academic dissemination through journals and scientific conferences, CenSES have high goals concerning publishing results that will be useful tools for energy policy making and can contribute to creating a better and broader energy discussion in society

CenSES in Numbers 2011

25 PhD candidates with financial support from the centre budget and 22 in related projects are recruited.

4 Post docs with financial support from the centre budget and 2 in related projects are recruited.

28 Master students

11 Journal papers

3 Book chapters

39 Conference presentations/invited lectures

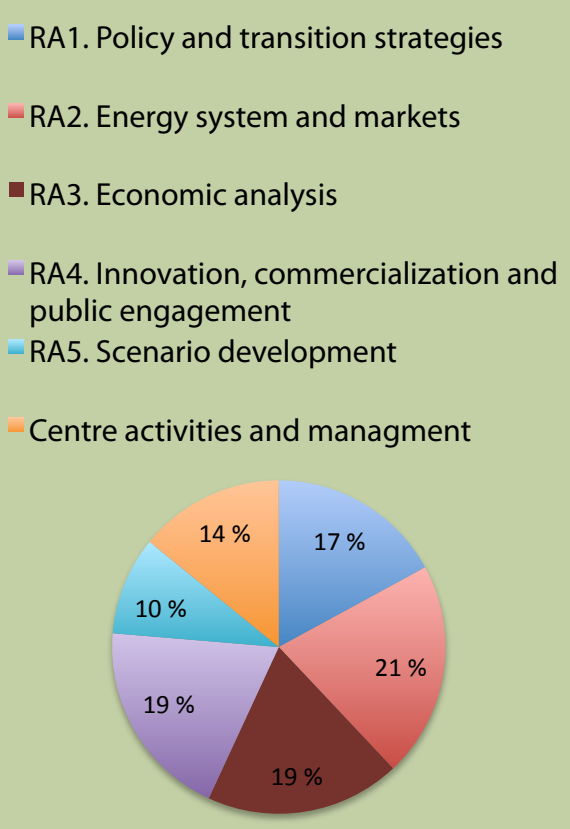
15 Popular science publications and presentations

4 meetings to establish user cases
Established 2 user cases

Started 8 new projects with funding from the Research Council of Norway and EU

Arranged 1 winterschool and 3 PhD workshops
Coarranged 1 scientific conference

NOK 252 mill 2011-2018



Organization

CenSES Management Group

Asgeir Tomasgard
NTNU

Marianne Ryghaug
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Vivian Anette Lagesen
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Kari Aamodt Espegren
IFE

Gunnar Eskeland
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Roger Sørheim
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Bjørn Bakken
SINTEF

Olav Wicken
UiO

Arne Stokka
SINTEF

Erling Holden
HiSF

Carina E Reinholtsen
NTNU

Marianne Kvaal
NTNU

CenSES Board

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Pro-Rector for Research, NTNU

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Head of Strategy and Analysis Unit, Enova

Frode Rømo
Research Director, SINTEF

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Centre Director, UiO

Lasse Torgersen
Senior Energy Market Analyst, Norsk Hydro

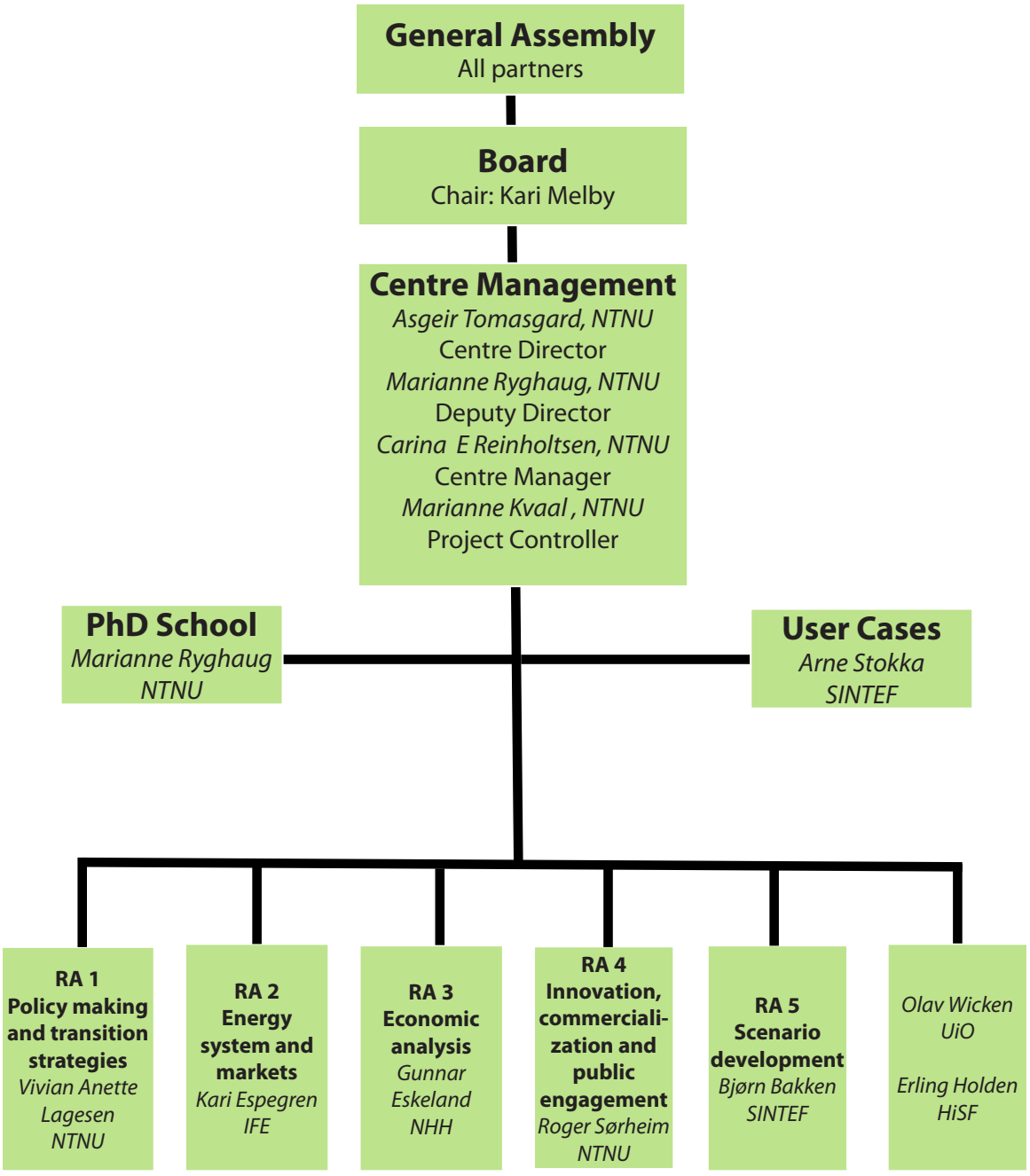
Mette Bjørndal
Vice Rector, NHH

Ole Schanke Eikum
CEO, SFE

Hilde Strøm
Leading Business Developer, Statoil

Trond A Jensen
Adviser, Statnett

Arve Holt
Research Director, IFE


General Assembly
All partners
Board
Chair: Kari Melby
Centre Management
Asgeir Tomasgard, NTNU
Centre Director
Marianne Ryghaug, NTNU
Deputy Director
Carina E Reinholtsen, NTNU
Centre Manager
Marianne Kvaal , NTNU
Project Controller
PhD School
Marianne Ryghaug
NTNU
User Cases
Arne Stokka
SINTEF
RA 1
Policy making and transition strategies
Vivian Anette Lagesen
NTNU
RA 2
Energy system and markets
Kari Espegren
IFE
RA 3
Economic analysis
Gunnar Eskeland
NHH
RA 4
Innovation, commercialization and public engagement
Roger Sørheim
NTNU
RA 5
Scenario development
Bjørn Bakken
SINTEF
Olav Wicken
UiO
Erling Holden
HiSF

Partners

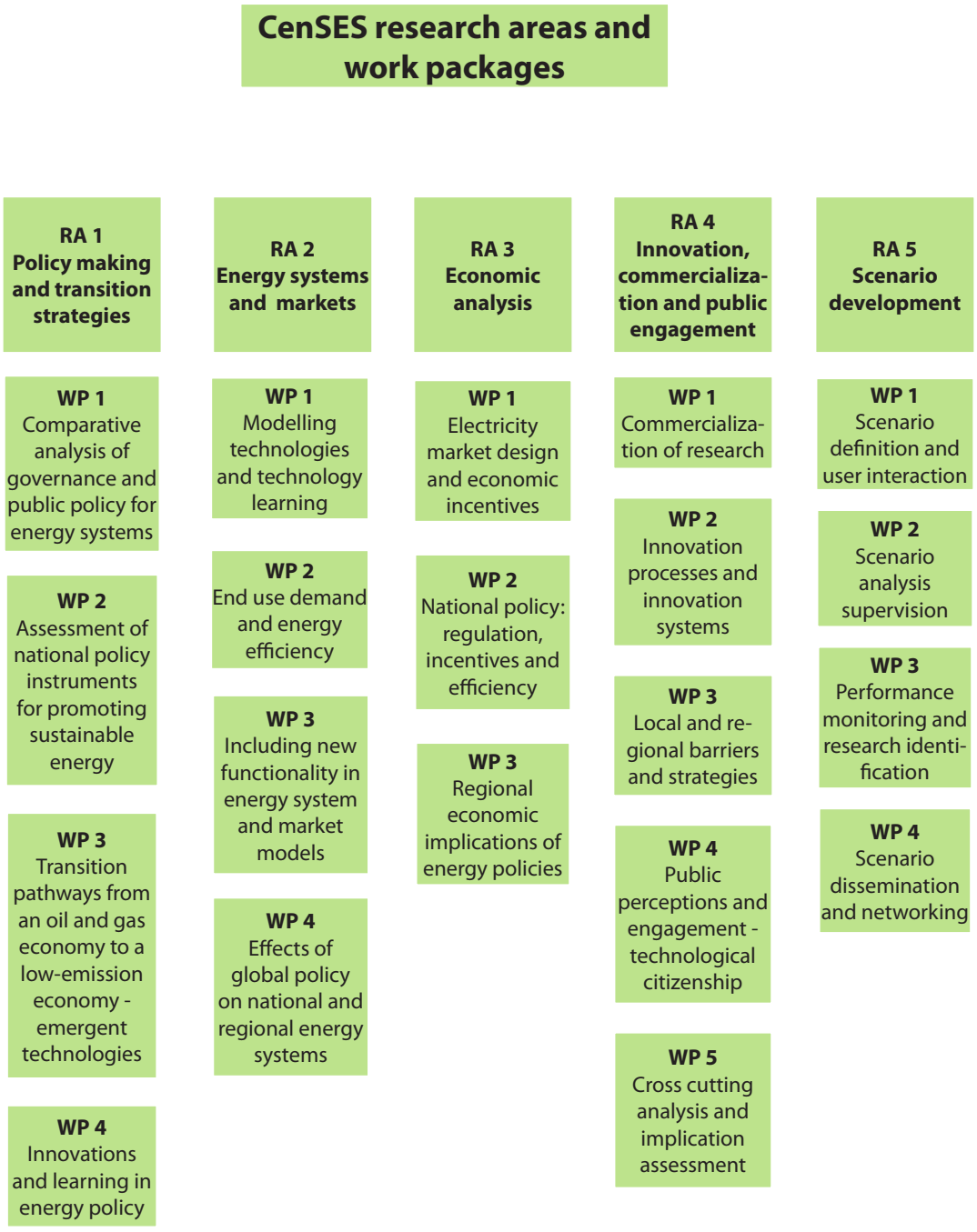
National research partners

User partners

International research partners

Joint Global Change Research Institute

CenSES Research Areas and Work Packages



RA1 Policy Making and Transition Strategies

RA1 consists of four work packages:

- WP1 Comparative analysis of governance and public policy for energy systems

- WP2 Assessment of national policy instruments for promoting sustainable energy

- WP3 Transition pathways from an oil and gas economy to a low-emission economy with a focus on emerging technologies

- WP4 Innovations and learning in energy policy

Senior researchers in the 2011 team

- Sjur Kasa (TIK, UiO)
- Audun Ruud (SINTEF Energy),
- Hans Torvatn (SINTEF T&S)
- Knut Holtan Sørensen (KULT, NTNU)
- Eva Rosenberg (IFE)
- Erling Holden (HiSF)
- Øystein Moen (IØT, NTNU)
- Marianne Ryghaug (KULT, NTNU)
- Vivian Anette Lagesen (KULT, NTNU)

Research in 2011

We have started to re-analyse and systematise the partners' previous work regarding RA1 and to synthesize available results relevant to WP 2 "Assessment of national policy instruments for promoting sustainable energy". A popular scientific report that contains characterization and evalutation of policy instruments will be written during 2012 and available for policy making and strategies.

Some of the important historical observations that has already been outlined as relevant to this report are:

- The development of the politics of energy economization (ENØK) from the mid-seventees and forward. Here, engineering perspectives was superseded and replaced by economic perspectives. The ENØK policy was also characterised by a frequent shift between different policy instru-

Knowledge and strategy for policy innovation

In WP4 two PhD candidates, Robert L. Jomisko and Eirik Swensen, are studying what kind of knowledge input is made use of and what strategies are pursued to develop a capacity for policy innovation in the energy, environment and climate area. These two projects are particularly focused on the relationship between scientific knowledge and policy-making. Their projects are about the learning and use of knowledge in political decision making processes related to climate and renewable energy.

Photo: Marianne Ryghaug

In order to form a picture of these processes they have interviewed several persons in public committees. Official Norwegian Reports are sources of knowledge for decision-making processes. By investigating who participate in these committees, what kind of work is conducted and how this knowledge is used, they can get a better understanding of politics in the making. The investigation of the dynamics in the committees will be supplied by relevant document studies.

Jomisko and Swensen are also conducting a study of knowledge cultures in different ministries. The objective of these studies is to improve the decision making base for the future climate and energy strategies for decision makers within the public and private sector, on both a user and system level.

ments, which was articulated through a series of white papers that came every other year during the 1980s.

- The deregulation of the electricity market

- The shift from ENØK to Enova as the body with repsonsibility of transforming the energy production and use early in the 2000s.

- The deregulation of the energy supply in 1990

- The development of the CCS compromise

- Stricter building regulations

- The climate agreement (klimaforliket) and the priority of R&D on sustainable energy

- Green certificates

- The decision to expand the electricity grid from approx. 2010

- Taxes and fees (CO2) and arrangement for quotas

Some theses

Based on what we know about policy instruments so far, we believe we may formulate some theses:

- Norwegian energy policy has been based on an exaggerated belief on economic/financial instruments, first and foremost taxes and fees.

- Norwegian energy policy has emphasized R&D as an important instrument, but seemingly without formulating clear ideas about what is needed to be able to use the results from this research.

- Norwegian energy policy is dominated by hydro power as a kind of golden standard. This may have been an impediment to focus more on new renewable energy sources.

- There is a policy deficiency with regard to the developement of new renewable energy in Norway. The energy law was supposed to make interventions from politicians unnecessary, and the possibilities for governing the regulation of energy supply disappeared (with Statnett being an exception, but that possibility has only recently been made use of).

- The building industry has to a little degree responded to financial instruments. Here, the change in building codes has been most efficient.

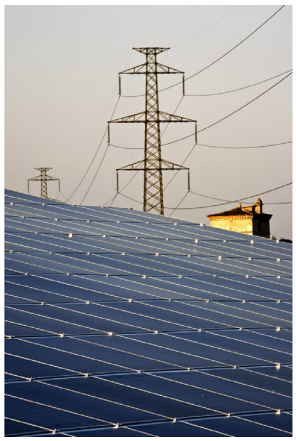
ENØK policy in practice. Photo: Marianne Ryghaug

RA 2 Energy Systems and Markets

RA2 consists of four work packages:

- WP1: Modelling technologies and technology learning
- WP2: End use demand and energy efficiency
- WP3: Including new functionality in energy system and market models
- WP4: Effects of global policy on national and regional energy systems.

Renewable energy and system integration



Research in 2011

There is a common understanding of the importance of reliable data sources, and work has been initiated to find the suitable format of the joint CenSES energy system database.

In the first phase the development of the database focuses on energy production (renewable technologies and CCS), and includes technology data and economic parameters. Availability and access to the database, and how the data can be maintained after CenSES has also been an important part of the discussion.

Zero Emission Buildings

Karen Byskov Lindberg works on a PhD project 50% financed by CenSES and 50% by the FME Zero Emission Buildings (ZEB). She works a quarter of her time with the Norwegian Directorate of Water and Energy.

In order to find how Zero Emisssion Buildings will influence the energy system, it is necessary to establish knowledge on the existing building stock to find the differences from existing buildings to ZEB buildings.

In the first part of the project, load profiles for existing buildings will be studied, mainly non-residential buildings, identifying energy demand patterns for different energy services, i.e. electric appliances and heating. Secondly load profiles for ZEB buildings, both residential and non-residential, will be established for Norwegian conditions.

And lastly the ZEB load profiles is to be analysed using the energy system analysis tool TIMES and the power market model EMPS.

In this project the main challenges are establishing representative ZEB-buildings, and identifying the response on the load profiles due to smart grid and DSM. Through the analysis of the load profiles with the energy system and power market modelling tools, we seek to identify the influence on future investment in transmission capacities (TIMES) and stability of the grid (EMPS) due to more frequent power exchange.

The first RA2 workshop held in 2011 was dedicated to the following topics:

- Integration of technology and market modelling
- Including both politics and innovation/commercialization in the learning curves for technology.
- The challenge of integrating different models and methodologies

Future energy demand is an important input to energy system models, and work related to identification of the need of energy demand projections among CenSES partners has been carried out. We have started to analyze the influence of energy efficiency, and will strengthen our effort to understand the behavioral aspects and barriers related to implementation of energy efficient measures. An additional project to be able to include behavioral aspects in energy system models is needed.

Various energy systems models are used by researchers and PhD candidates. Improvements and new functionality have been implemented in the different models to be able to give a better description of the energy system. The main improvements so far have been related to modelling uncertainty and dynamics in long term investment models that also include operational detail.

Studies of the effects of global policy on national and regional energy systems are related to work carried out in the two RENERGI projects LinkS and NET-model. So far the modelling part of the projects have been carried out, thus results from analysis of effects of different policies will be available from 2012.

In the LinkS project, development and testing of an investment algorithm for electricity infrastructure in Europe continues in collaboration with RA5. Furthermore, the Integrated Assessment Model GCAM is now operative at SINTEF Energy, and will be used for scenario analyses in RA5.

Participation in international networks like ETSAP and EMF 28 has been prioritized. More information can be found in the section on international cooperation.

RA3 Economic Analysis

RA3 has three work pacages:

- WP1 Electricity market design and economic incentives

- WP2 National policy: Regulation, incentives and efficiency

- WP3 Regional economic implications of energy policies

The main objective of this research area is to develop criteria to evaluate policies, including those for a transitionary phase towards a lower-carbon energy sector. Work performed at PhD level includes consequences of more wind energy, policies to promote wind, carbon capture and storage, other aspects of renewable energy, as well as energy efficiency in transport.

A study of wind power in the Nordic market

Johannes Mauritzen is a fourth year PhD candidate at the department of Finance and Management Science at NHH. He will defend his dissertation in May 2012. He is also an affiliated researcher and current guest at the Research Institute for Industrial Economics (IFN) in Stockholm. He holds a masters degree in Economics from the University of Washington in Seattle.

He has researched and written about wind power in the Nordic electricity market. His work is primarily empirical, using data and statistical methodologies. He found that in Denmark more wind power leads to lower price variation. This is likely due to wind power lowering peak prices more than base-load prices. Mauritzen also investigates the interaction of Danish wind power and Norwegian hydro power by way of spot market mechanisms. At times of ample supply in Denmark - in particular when combined heat and power plants are running - up to 40 percent of Danish wind power is exported and stored in Norwegian hydro power magazines. Capacity constraints still limit this interaction however, and wind power is shown to have a much higher effect on Danish prices than on Norwegian prices.

Finally, the project also analyse the decision to scrap wind turbines in Denmark and find a strong role of the opportunity cost caused by the interaction of changes in government policy, technological change, and differences in the wind resources. The result is that turbines located in areas with better wind resources are actually at a higher risk for being scrapped.

Picture: Mauritzen presenting his research at the 2011 CenSES annual conference. Photo: Claude R. Olsen

Research in 2011

RA3 has presented its work both in academic and in broader fora, with a PhD dissertation having been submitted for defence. Some results to highlight are that both renewable support and ETS may be successful in the intermediate term but may be insufficient to support the longer term efforts that transition requires beyond wind and natural gas in Europe.

Current work focuses on the electricity sector, on policy evaluation including political economy, expectations and technological change. A specific focus on Europe, and on a world in which there is only partial commitment to climate change policies is presently emphasized.

The BEEER Conference

A major CenSES event in 2011 was the Bergen Economics of Energy and Environment Research (BEEER) conference, where many CenSES and other researchers presented their research, cosponsored by NHH, SNF, CenSES partner BKK and others.

In the panel discussion that addressed a broader audience than just researchers, the topic discussed was how objectives relate to instrument use in Norway's electricity sector, with Statnett's Auke Lont and BKK's Toril Christensen as industry representatives. Important issues raised by the industry representatives were that new intermittent power will both raise requirements for transmission and systems and imply power availability in a system that is not necessarily growing. This question in part motivated a research proposal, INTREPED , which was successfully funded from RENERGI and will augment CenSES resources in this area.

RA 3 is organizing the BEEER conference also in 2012, with an increasing international representation, topics reflecting broadening work in sectoral directions, towards international treaties, and towards the interaction with other environmental challenges.

RA 4 Innovation, Commercialization and Public Engagement

RA4 has five work packages:

- WP1 Commercialization of research (Lars Øystein Widding, NTNU IØT)
- WP2 Innovation processes and innovation systems (Olav Wicken, UiO TIK)
- WP3 Local and regional barriers and strategies (Erling Holden, HiSF)
- WP4 Public perceptions and engagement – technological citizenship (Knut Holtan Sørensen, NTNU KULT)
- WP5 Cross cutting analysis and implication assessment (Audun Ruud, SINTEF ENERGI)

Research plan

Research on innovation, commercialization and public engagement cover a wide range of topics. First, innovation research is dominated by system perspectives which have led to a number of innovation system models at national, regional, sectorial and technological levels of analysis. In RA 4 we take a somewhat different approach as we focus on how firms get access to and use resources, including financial, physical, human and organizational resources.

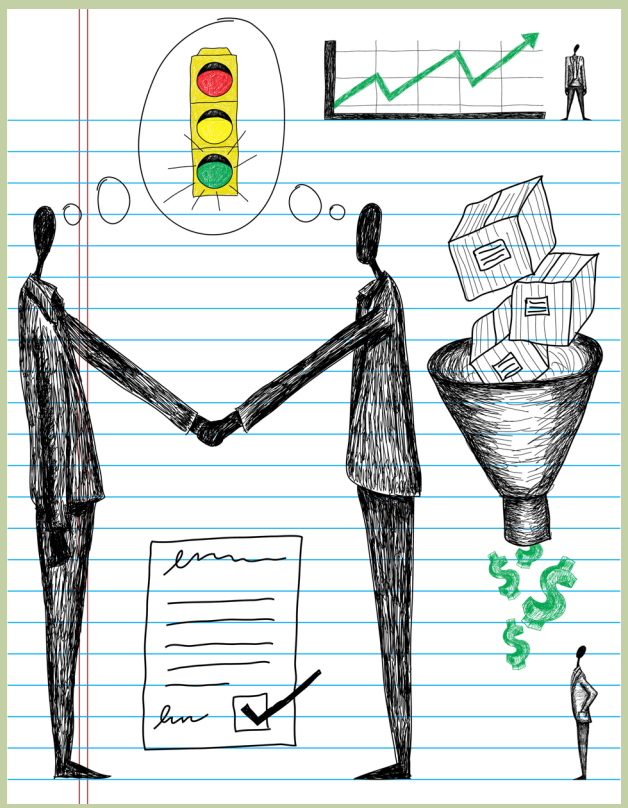
Public policy and regulations may also influence both access to and use of resources and will be given particular emphasis in the analyses of firm and project level strategies and decisions.

Furthermore, the large scale investments needed to develop, innovate and implement new alternative energy technologies require fairly large coalitions of actors meeting a politically moderated demand. This suggests a need to focus on infrastructural innovation, even if existing literature in this field is limited to studies of relatively small-scale experiments.

Public engagement is critical to the outcome of innovation and commercialization. Recent research asks what is needed to achieve robust and mature public evaluations: early involvement, transparency, adequate information, opportunities for deliberation, and acknowledgement of contributions from a diversity of expertise.

Research in 2011

A number of new PhD candidates and post docs have started during 2011. An example of a PhD project that combines several of the perspectives raised above is the project initiated by Vivek Sinha and Vegar Ausrød. They are focusing on decentralized renewable energy production in emerging markets. In particular they examine how different kind of business models can be drivers for the development of renewable energy to rural areas in third world countries



CenSES School of Entrepreneurship

The RA 4 team has also developed the concept "CenSES School of Entrepreneurship". This is a commercialization training program targeted to PhD candidates and young researchers within the field of renewable energy.

Participants in the program will have a unique opportunity to investigate the commercial potential of their research, to learn the basics of developing a business idea, and to meet fellow researchers with an interest in commercializing.

The program will be implemented during the autumn of 2012.

RA 5 Scenario Development

RA5 consists of four work packages:

- WP1 Scenario definition and user interaction
- WP2 Scenario analysis supervision
- WP3 Performance monitoring and research identification
- WP4 Scenario dissemination and networking

Research in 2011

The main objective of the Research Area 5 Energy scenario development is to provide scenario driven knowledge and analyses to policy- and decision makers to aid in the development and evaluation of sustainable energy strategies.

RA5 will be a main area of integrating results from the other research areas, and shall also provide input to the other RAs regarding research questions and needs of improved models. A first review of relevant scenarios is currently under development in WP1. The main purpose of this first review is not to make a comprehensive list of any relevant scenario study, but rather to establish a methodology to structure and compare various scenario studies and their assumptions.

In the LinkS project (RA2) an investment model for electricity infrastructure in Europe is under development and testing. The model has already been successfully used on scenarios up to 2050 from the SUSPLAN project (www.susplan.eu), and is now being used in the Energy Modelling Forum Subgroup 28 to examine infrastructure development under the new PRIMES scenarios from the European Commission's Energy Roadmap 2050.

The integrated assessment model GCAM from the LinkS project is now operative at SINTEF Energy and is currently being modified to enable studies of trade leakage related to Aluminium industry in Europe.

Current work within RA5 is mainly focusing on international energy studies. A first RA5 workhop in April is under planning where both an international top-down and a national/regional bottom-up perspective will be discussed.

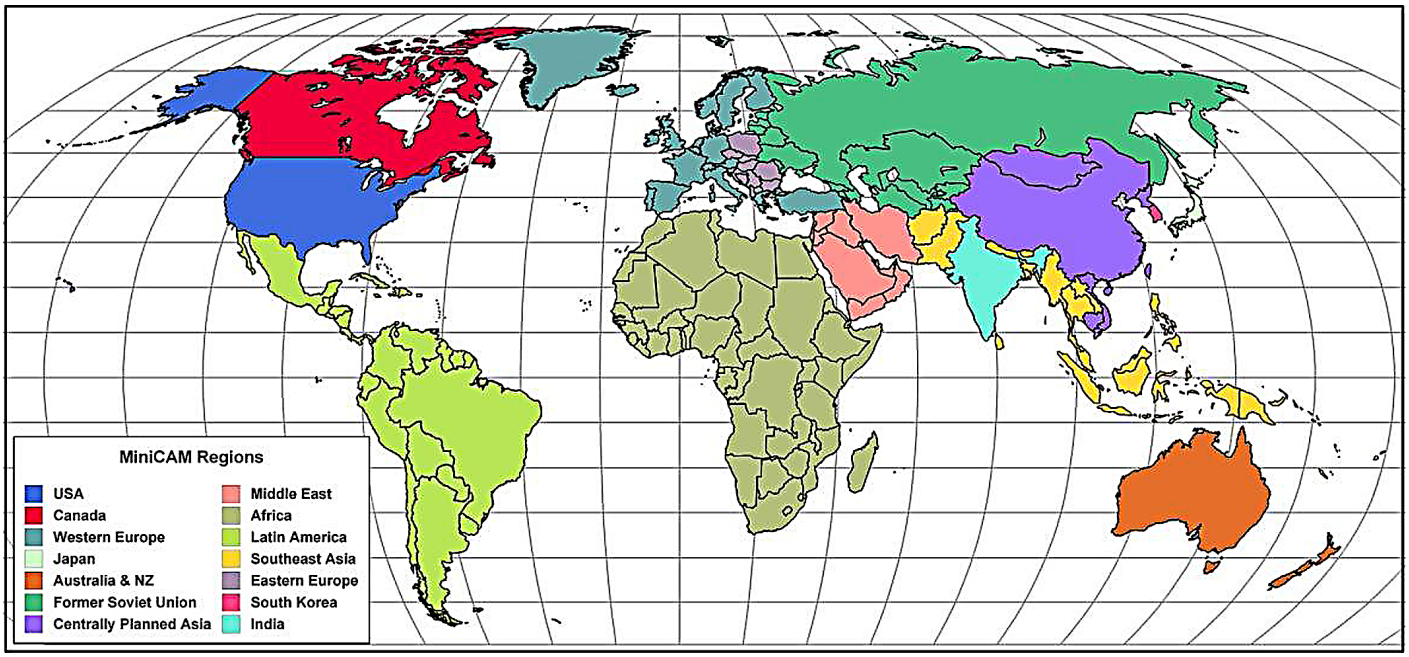


Figure from Joint Global Change Research Insitute showing regions in the GCAM tool.

LinkS - Linking global and regional energy Strategies

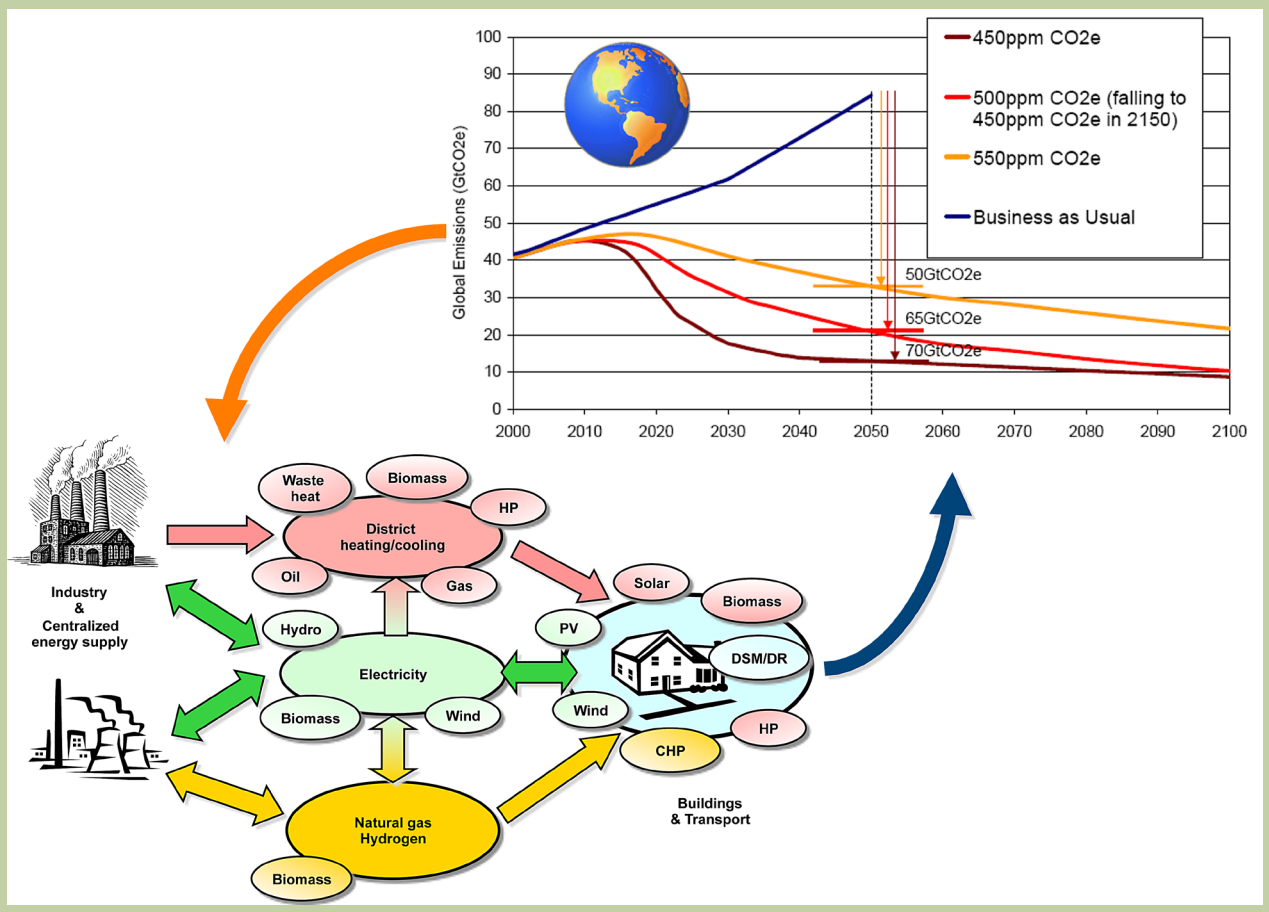


Figure from LinkS showing the links between global and regional models

The project «Linking global and regional energy Strategies (LinkS)» analyses how global strategies can be used as long term guidelines for development of energy supply and technologies in regional energy systems.

Today, regions like the EU have quite ambitious strategies for renewable energy and emission mitigation, while others have no specific strategies yet. If rapidly growing economies like Brazil, Russia, India and China delay their emission reduction efforts, the OECD countries have to do correspondingly more to keep total GHG emissions within necessary limits.

We therefore have to find strategies that are efficient and acceptable in several regions. For exmple, what would be the consequence of implementing a "20-20-20" type of strategy for China? We will also develop a methodology to sort regions and countries to enable recommendation of mitigation strategies depending on the level of economic and industrial development for that specific region.

The partners in LinkS employ several energy system models. Our US partner Joint Global Change Research Institute calculates the long term development of global economy, energy supply, land use and climate with the equilibrium model Global Change Assessment Model (GCAM) in a 100 year perspective for 14 regions of the world (see figure).

Different scenarios are then projected down into different regions by three technology specific models: World Gas Model (WGM) from the University of Maryland is used for global gas and oil markeds, the EMPS model of SINTEF is used for the European power market while MARKAL from Tsinghua University in Beijing is used in regional energy systems in China. A new energy system investment model for the European system is developed by NTNU in cooperation with SINTEF.

In addition, new methodologies are developed to integrate these models, in particular the evaluation of which investments to do where and when to ensure development in the desired direction. Furthermore, the project assesses suitable regulations and policies to implement the recommended strategies in different regions.

International Cooperation

2011 has been a year where we have focused on initiating cooperation with the individual international research partners. Some highligts are described here:

International winter school at Oppdal

In March 100 international researchers met for one week to study managment of uncertainty in energy infrastructure investments. Topics were:

– Modelling uncertainty: focusing on investments, options, energy markets, etc
– Multi-stage stochastic programming
– Stochastic equilibrium and capacity expansion

PhD candidates that chose to hand in an essay received 7.5 ECTS based on 30 hours of lectures over the busy week. The winter school had participants from 40 universities in 25 countries. Lectures on the topics where given by a mix of CenSES researchers and leading international professors.

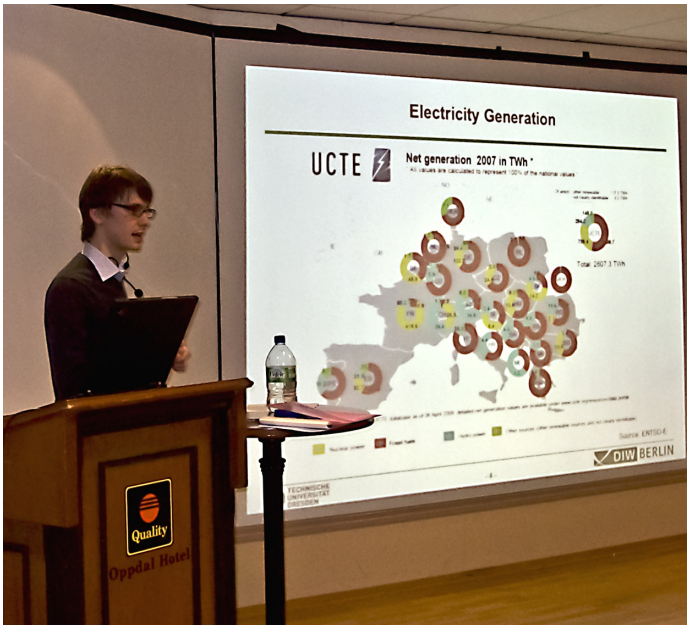
Lecturers were: Suvrajeet Sen (Ohio state Univiersity), Stein W. Wallace (Lancaster University), Maria Theresa Vespucci (Bergamo Univeristy), Stein-Erik Feten (NTNU), Asgeir Tomasgard (NTNU), Ruud Egging (NTNU), Mette Bjørndal (NHH), Antonio Conejo (Universidad de Castilla - La Mancha), Xiang Li (Massachusetts Insititute of Technology), Daniel Kuhn (Imperial College), Friedrich Kunz and Daniell Huppmann (DIW, Berlin) and Afzal Siddiqui (University College London).

The school was organized by CenSES in cooperation with Petromaks and the Research School in Business Economics and Administration (NFB). For more information on the program and material (see www.iot.ntnu.no/winterschool11).

International research cooperation on energy modelling

In the LinkS project under RA 2 we have initialized a cooperation on energy system models for scenario studies. NTNU, SINTEF, University of Maryland, Joint Global Change Research Institute and Tsinghua are the partners. This is a project that started already before CenSES received FME -

Lectures at Oppdal. Photo: Ruud Egging



Friedrich Kunz (DIW) teaching for PhD candidates.
Photo: Ruud Egging

funding, meaning the parties have already co-operated for a few years. In 2011 the whole group met first in Oslo in June and later in Maryland in November. The next meeting will take place in Beijing in 2012. In between there has been researcher exchange. The main purpose of this work is to link the energy system models at global level with regional models to achieve consistency in input data, policies and scenario results. The project tools are used to study effects of policy on energy prices and investments.

As a consequnce of LinkS we also started a cooperation on a multifuel mulitsector equilibrium model for the energy system. This cooperation also includes DIW Berlin and the work was inititated at meetings in Berlin in July and October. The purpose of this cooperation is to ensure data quality and support joint modelling efforts of a global energy system model. From CenSES perspective the main motivation is to develop a model that can be used to study the role of Norway as a supplier of flexibility to the European energy market, both through renewable energy and natural gas.

International energy modelling networks

SINTEF and NTNU has been invited into Energy Modelling Forum Group 28 together with DIW Berlin and a number of European partners. This is an European consortium that will analyse energy scenarios for Europe.

Through the participation in Energy Technology System Analysis Programme (ETSAP) via CenSES partner IFE, we get access to models and data and an international network working with TIMES models. IFE partiticipated in two ETSAP workshops in 2011, one in Paris and one in Stanford. This is a valuable contribution to CenSES work with energy scenarios and sustainable energy system design.

The work in ETSAP and EMF 28 will be closely coordinated with RA2 and RA5 in CenSES.

Cooperation in education

The cooperation on energy system models also includes an educational component. In the long run we want to initiate exchange at PhD and master level with cooperating institutions, and we already started some coooperation with DIW Berlin (through TU Berlin and University of Maryland.)

- Two master students from Trondheim participated in a training week at TU Berlin as part of the co-operation on the energy system equlibrium model in October led by prof. Christian von Hirschausen.

- In December prof. Steven Gabriel from University of Maryland visited Trondheim and gave a 3 days compact course on equilibrium models as part of NTNU´s PhD course in Energy markets.

- A joint paper on modelling combined investment and operations of energy systems was submitted by professors and PhD candidates at University of Maryland and NTNU

International workshop on pricing in electricity markets

This workshop held at at Voss in November attracted researchers from Norway, Netherlands, Belgium, Italy and Spain as well as several of CenSES user partners. Around 25 people met for 3 days to share ideas about the developments of Europes electricity markets. Keynote speakers were Yves Smeers from Université Catholique de Louvain and Antonio Conejo from Universidad de Castilla - La Mancha and
William W. Hogan, Harvard University.

Some of the presentations given were:

- Market design and extended LMP (Hogan)
- Pricing Non-Convexities in an Electricity Pool (Conejo)
- Investment and Capacity Expansion in the Electricity Market (Smeers).

In the program the participants found time for a visit to the power station Evanger kraftverk (1500 meters into the mountain by Evangervatnet). This plant is owned and operated by CenSES user partner BKK. Almost as exiting was the workshop dinner with the local speciality Smalahove.

Prof. Yves Smeers, CORE, at workshop. Photo: A. Tomasgard

Researcher exchange UCL San Diego

In the autumn of 2011 CenSES deputy director Prof. Marianne Ryghaug was invited to be part of the Science Studies research team and to collaborate with Professor Naomi Oreskes at UCL San Diego. The visiting scholar experience involved active research in the area of sustainable energy as well as participation in the activities of the Science Studies Programme.

Prof. Ryghaug was placed at the University of California, San Diego, the Department of History/Science Studies Programme. She participated in a research project on Climate Change Communication which was seen as furthering the understanding of how public consensus and dissent is formed in relation to climate change both in USA and Norway. Dr. Ryghaug gave talks in different workshops and produced publications that was widely discussed in the blogosphere (like realclimate.org).

The visit was seen as part of the strategy of CenSES to further collaboration with Universities in the US and strengthen the international relations to leading climate and energy scientists.

Energy policy in China

Dr. Yu Wang From Tsinghua University in Beijing participated in a Trondheim workshop focusing on the energy situation in Asia. She visited CenSES in November, and gave a lecture on the policy framework used to implement China´s strategy on renewable energy and energy effciency. We hope the cooperation with Tsinghua on energy policy research and energy system models will be further strenghened over the coming years.

Offshore wind in China and Norway

CenSES participates in a Joint Research Centre between Jia Tong University in Shanghai and NTNU. In September the researchers from the two groups met in Trondheim. There the JRC management decided to allocate two PhD positions, one in China and one at NTNU, to a joint project on System Analysis and Sustainable Energy Studies. The title of the project will be "Developing offshore wind industry in and between China and Norway" and will focus on the necessary conditions and policy needed to achive offshore wind development in the two countries and cooperation between them.

Smart grid applications for households

In 2011 we initiated a cooperation with prof. Stein W. Wallace and PhD candidate Pedro Crespo Del Granado. The topic of their research is how energy storage and distributed energy generation in households can help in removing peaks from the energy system. They have performed case studies both on typical households in the UK and on the university campus in Lancaster. Their research is relevant for several of CenSES PhD candidates, and they visited Trondheim and Nord- Trøndelag Energi (NTE) in Steinkjer in August to start cooperation on this topic. Their studies so far indicate that the use of batteries in households can shave off peaks in the demand without increased costs for the households. From the Norwegian side we are interested in what kind of business models would motivate households to be willing to provide flexibility to the system (PhD project of Stig Ottesen) and how this will affect the energy system (PhD project of Karen Byskov Lindberg).

Offshore wind park

Prof. Stein W. W.allace, Lancaster University.
Photo: A. Tomasgard

User Cases

We will over the life time of the centre perform a number of cross-cutting "User Cases". While the research in RA1-RA5 has a time frame of 5-8 years, these cases will be limited to a period of 1-2 years and will be defined dynamically through the life time of the centre.

Of course, cooperation with user partners also happen in the research areas directly, but a user case is a coordinatng mechanism spanning at least two research areas focusing on coordinatng short term deliverables from these within a spesific topic.

The idea is that user cases will stimulate cooperation, between researchers, and between user partners and researchers.

Initially in 2011, five user cases were suggested in CenSES. At the end of 2011, user cases on two topics have been initiated:

- Flexible Norwegian energy as a green service to Europe

- Energy efficiency improvements: Missing in action?

The cases were selected after a process where meetings with CenSES user partners were held in Trondheim, Bergen, Oslo and Sogndal. Most of CenSES user partners participated in these, and the profile of the user cases were shaped by the process. Other user cases will be started in 2012 and 2013 following a similar process.

Flexible Norwegian energy as a green service to Europe

This user case is actually combining topics from the two earlier suggested user cases: Norway as a green battery for Europe: How to share burdens and benefits, and The role of natural gas: Transition fuel or long-term solution?

Kjetil Midthun is the leader of this user case, based on RA2. It is connected to research activities in RA3, and co-operates with FME CEDREN on studies of energy storage and balancing energy.

In this user case we focus on the potential for Norway to act as a green battery for Europe. The definition of a green battery in this context includes energy production from renewable sources as well as natural gas. We include both the export of energy directly as well as balancing services in our study.

A main motivation for this user case is to explore the potential for utilizing:

- The inherent flexibility in the natural gas system
- Pumping of water utilizing low electricity price
- The flexible operation of the Norwegian hydro power system

An example of such facilitation is the possibility to handle situations with very low electricity prices due to overflow of intermittent energy. We will investgate how to balance the highly fluctuating energy production from non-dispatchable energy production in wind parks, both by offering short-term storage of gas in Norway´s pipeline system and by hydro pumping importing electricty from the wind parks.

From the user meeting in Bergen. Photos: Hallvard Lyssand, NHH

Energy efficiency improvements: Missing in action?

Often, techno-economic models indicate that energy efficiency improvements are very profitable, while real world studies indicate low implementation. This user case contrasts behaviorally based studies and historic transition/adoption rates with technology based models in order to inform policy formation.

Prof. Knut Holtan Sørensen is responsible for this user case. It will be developed with research activities in RA1 as a base, inviting researchers from the other RAs to participate.

Dissemination

CenSES opening conference

CenSES was celebrating its FME status by arranging a kikc-off conference in Trondheim in June. The centre was formally opened by the minister of Petroleum and Energy, Ola Borten Moe and Rector Torbjørn Digernes from NTNU. Presentations were given by Fritjof Unander from the Research Council of Norway, Rector Jan Haaland from NHH, Trond Jensen from Statnett, Eli Aamot from Statoil and several of the researchers in the centre.

Ola Borten Moe said in his opening speech that he expects that CenSES will perform independent and fact based studies and provide knowledge relevant for the users of the centre. He encouraged the researchers to be more visible in the public debate when energy and climate related topics are discussed.

Division director Unander from the Research Council emphasized the CenSES teams endurance when it came to applying for FME status in two rounds and the success of the CenSES team in ensuring addtional financing through the RENERGI program.

Annual conference

The yearly CenSES conference was arranged in Oslo over two days in December with 70 participants. Day 1 focused on the potential for renewable energy, challenges and possibilities for investments in infrastructure and energy production and long term energy scenarios. One example was Prof. Edgar Hertwich who promoted a more holistic view on the development of the energy system, recognizing the need for drastic changes, not only marginal improvements. In the work on energy scenarios there is a need to focus more on a sustainable development path. Lasse Torgersen from Norsk Hydro discussed the future possibilities for energy intensive industry in Norway.

On day 2 the focus was on developing user cases in CenSES. The follwoing workshops were arranged:

- Energy efficiency improvements
- Norway as a green battery for Europe
- The role of natural gas: Transition fuel or long-term solution?
- Electricity and transport: Increased burden or joint benefits?
- Energy technology and technology transfer – a commercial opportunity and an instrument in climate policy?

FME Innovation forum

In 2010 CenSES established FME Innovation Forum in cooperation between the FME´s, Innovation Norway and IntPow. The forum's second meeting took place in 2011. The purpose is to establish a joint arena to:

- promote innovation and commercialization
- coordinate innovation activitities in the FMEs
- let parties from industry, academia and government meet to address joint challenges or interests when it comes to innovation in the energy sector.

So far 7 of the 8 existing technology oriented FMEs has participated in the Innovation Forum meetings. The forum is open for all organizations with an interest in the topics described above.

In the last meeting Innovation Norway represented with Bergny Irene Dahl and Marianne Tonnning Kinnari presented the current instruments existing in the market to support energy related innovations for companies.

Prof. Roger Sørheim at NTNU presented ideas about an School of Entrepreneurship for PhD candidates. The plan is that PhD candidates with a technology theme in their PhD work, can participate in a training program focusing on entreprenurship. The program will be split in 3 short blocks.

Tone Ibenholt from the Reseach Council presented views on the objectives for innovation and value creation in the FMEs.

From the opening: Deputy director Marianne Ryghaug, Minister of Petroleum and Energy Ola Borten Moe and Director Asgeir Tomasgard.

From CenSES opening conference at Dragvoll. Photo: NTNU

From the annual CenSES conference in Oslo in December. Photo: Claude R. Olsen

Education

PhD education

The goal of CenSES is to organize a multidisciplinary PhD school to coordinate and strengthen the education of the centre's PhD candidates, but also to attract PhD candidates outside CenSES and from abroad. So far the strategy seem to have been sucessfull. CenSES has been able to recruit many new and highly competent researchers from Norway and abroad . At the end of 2011 CenSES had recruited 25 new PhD students over the Centre budget as well as 4 post docs.

PhD network

From the PhD network meeting in Selbu where Stewart Clark gave a course on English writing and Claude Olsen an introduction on writing chronicles. Photo: Carina Reinholtsen

In addition to the 25 PhD students covered directly over the CenSES FME budget, at the end of 2011 there were 21 candidates writing their PhD thesis in related projects. These projects are either tightly integrated with CenSES research areas or are on related topics with CenSES researchers as senior personnel.

We have established a network for these PhD students and the post docs counting around 50 people. In 2011 they had 3 meetings from June to December, and this is an activity we plan to continue in 2012. The main advantages are that they get a meeting place where they see other research going on in the centre, build their research network and broaden their perspective on energy research.

Master Education

CenSES aim to develop a comprehensive master program in Social Studies of Energy at NTNU. The first step in this direction was taken in 2011, by starting to develop a master specialization in technology management as part of the new master study program in renewable energy at NTNU. The development of master programs in line with the needs of society and the recruitment needs of CenSES will of course be done in conjunction with existing master programs at the involved partner institutions like the Master in Energy, Natural Resources and the Environment at NHH.

We plan that 20-30 master students will write their thesis for CenSES every year. In 2011 we had 28 students writing their master thesis in CenSES and related prosjects.

PhD candidates with financial support from the centre budget

Veronica Araoz
NHH

Vegar Lein Ausrød
NTNU

Øyvind Bjørgum
NTNU

Jørn Toft Bysveen
NTNU

Xiaomei Cheng
NHH

Geoffrey Gilpin
Vestforsk/ UMB

Mads Dahl Gjefsen,
UiO

Ole Inge Gjerald
Vestforsk/ NTNU

Jens Hanson
UiO

Daniel Haugstvedt
NTNU

Robert L. Jomisko
NTNU

Karen Byskov Lindberg
NTNU

Sylvia Lysgård
NTNU

Johannes Mauritzen
NHH

Patrick Narbel
NHH

Morten Nielsen
NTNU

Ha Thi Bich Pham
UiO

Hilde Reinertsen
UiO

Bente Johnsen Rygg
HiSF/NTNU

Vivek Sinha
NTNU

Christian Skar
NTNU

Eirik Swensen
NTNU

William Throndsen
NTNU

Hans Jakob Walnum
Vestforsk/AAU

Tyson Weaver
HiSF/NTNU

Post docs with financial support from the centre budget

Ola Edvin Vie
NTNU

Ekaterina Bjørnåli
NTNU

Parmita Saha
HiSF

Gerardo Perez Valdés
NTNU

Budget and Reported Costs

Partner	2011	2012	2013	2014	2015	2016	2017	2018	2019	All years
NTNU IØT	4 142	7 317	5 503	4 675	4 593	4 017	3 801	3 912	96	**38 056**
NTNU HF	4 718	7 700	7 047	7 281	6 577	6 523	6 644	4 957	142	**51 590**
NTNU Indecol	0	452	1 081	1 382	2 131	2 172	1 331	34	36	**8 619**
NTNU Elkraft	96	319	319	319	223	0	0	0	0	**1 275**
NTNU Samfunnsforskning	0	200	100	100	100	100	100	100	0	**800**
UiO	2 084	3 167	3 051	3 051	3 150	3 150	3 150	2 200	0	**23 003**
HiSF	1 794	2 921	2 221	1 649	575	575	575	575	0	**10 885**
VF	1 163	1 441	795	458	638	638	638	638	0	**6 409**
NHH	2 349	2 877	2 688	2 738	2 788	2 838	2 888	2 938	0	**22 104**
Sintef EF	3 049	4 650	3 631	3 249	3 238	3 227	3 215	3 202	0	**27 461**
Sintef TS	2 040	2 382	2 167	2 302	2 173	2 160	2 148	2 136	0	**17 508**
IFE	2 100	2 006	2 081	2 120	2 120	2 110	2 110	2 140	0	**16 787**
SNF	1 407	1 398	1 399	1 502	1 372	1 361	1 349	1 336	0	**11 124**
Total research partners	**24 943**	**36 829**	**32 083**	**30 825**	**29 677**	**28 871**	**27 950**	**24 168**	**275**	**235 621**
Total user partners	**1 693**	**1 693**	**1 693**	**1 543**	**1 543**	**1 543**	**1 543**	**1 543**	**0**	**12 794**
Abroad	**160**	**540**	**575**	**575**	**575**	**575**	**500**	**500**	**0**	**4 000**
Total	**26 796**	**39 062**	**34 351**	**32 943**	**31 795**	**30 989**	**29 993**	**26 211**	**275**	**252 415**

For the table showing budget and results, the numbers for 2011 are the actual reported costs. The numbers for NTNU HF includes the costs for the centre management and joint centre activities.

Funding plan

Partner	2011		2012		2013		2014		2015		2016		2017		2018		2019		All years		
	financial	inkind	financial	inkind	financial	inkind	financial	inkind	financial	inkind	financial	inkind	financial	inkind	financial	inkind	financial	inkind	financial	inkind	total
NTNU IØT	0	4 015	0	6 075	0	4 340	0	3 512	0	2 697	0	2 441	0	2 544	0	2 654	0	96	0	28 374	**28 374**
NTNU HF	0	3 726	0	4 315	0	4 391	0	4 707	0	3 807	0	3 547	0	3 620	0	2 835	0	142	0	31 091	**31 091**
NTNU Indecol	0	0	0	8	0	26	0	354	0	1 044	0	1 022	0	692	0	34	0	36	0	3 216	**3 216**
NTNU Elkraft	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
NTNU Samfunnsforskning	0	0	0	50	0	25	0	25	0	25	0	25	0	25	0	25	0	0	0	200	**200**
UiO	0	2 000	0	2 000	0	2 000	0	2 000	0	2 000	0	2 000	0	2 000	0	2 000	0	0	0	16 000	**16 000**
HiSF	0	613	0	1 166	0	1 170	0	833	0	375	0	375	0	375	0	375	0	0	0	5 282	**5 282**
VF	0	513	0	791	0	795	0	458	0	0	0	0	0	0	0	0	0	0	0	2 557	**2 557**
NHH	0	1 650	0	1 700	0	1 750	0	1 800	0	1 850	0	1 900	0	1 950	0	2 000	0	0	0	14 600	**14 600**
Sintef EF	0	2 050	0	2 350	0	2 000	0	2 000	0	2 000	0	2 000	0	2 000	0	2 000	0	0	0	16 400	**16 400**
Sintef TS	0	1 200	0	1 200	0	1 200	0	1 200	0	1 200	0	1 200	0	1 200	0	1 200	0	0	0	9 600	**9 600**
IFE	0	700	0	700	0	700	0	700	0	700	0	700	0	700	0	700	0	0	0	5 600	**5 600**
SNF	0	500	0	500	0	500	0	500	0	500	0	500	0	500	0	500	0	0	0	4 000	**4 000**
Total research partners	**0**	**16 968**	**0**	**20 855**	**0**	**18 897**	**0**	**18 089**	**0**	**16 198**	**0**	**15 710**	**0**	**15 606**	**0**	**14 323**	**0**	**275**	**0**	**136 920**	**136 920**
Total user partners	**3 900**	**1 693**	**4 025**	**1 693**	**2 650**	**1 693**	**2 525**	**1 543**	**2 400**	**1 543**	**2 400**	**1 543**	**2 400**	**1 543**	**2 400**	**1 543**	**0**	**0**	22 700	12 794	**35 494**
Research Council	**4 235**	**0**	**12 489**	**0**	**11 110**	**0**	**10 786**	**0**	**11 654**	**0**	**11 337**	**0**	**10 443**	**0**	**7 945**	**0**	**0**	**0**	80 000	0	**80 000**
Total	**8 135**	**18 661**	**16 514**	**22 548**	**13 760**	**20 590**	**13 311**	**19 632**	**14 054**	**17 741**	**13 737**	**17 253**	**12 843**	**17 149**	**10 345**	**15 866**	**0**	**275**	**102 700**	**149 714**	**252 415**

Cost per Research Area

	2011		2012		2013		2014		2015		2016		2017		2018		2019		All years		
	financial	inkind	financial	inkind	financial	inkind	financial	inkind	financial	inkind	financial	inkind	financial	inkind	financial	inkind	financial	inkind	financial	inkind	total
BUDGET RA1	506	4 769	2 128	5 651	1 745	5 641	1 811	4 769	946	3 112	940	3 060	937	3 074	912	3 062	0	0	9 924	33 139	**43 064**
BUDGET RA2	2 699	5 176	3 247	5 804	2 420	3 769	1 974	3 939	1 853	4 585	1 619	4 387	1 617	4 465	1 594	3 639	0	0	17 022	35 762	**52 784**
BUDGET RA3	1 612	2 814	2 763	2 864	2 658	2 914	2 788	2 928	3 979	2 978	3 646	3 028	3 312	3 078	3 297	3 128	0	0	24 056	23 731	**47 787**
BUDGET RA4	1 634	2 982	3 738	5 161	2 598	5 263	2 392	4 660	2 814	2 998	2 811	2 693	2 808	2 747	904	2 805	0	0	19 699	29 309	**49 008**
BUDGET RA5	364	1 120	1 493	1 231	1 888	1 127	1 946	1 417	1 985	2 108	2 038	2 080	1 513	1 735	933	1 135	0	36	12 161	11 989	**24 150**
BUDGET Management	785	1 799	1 392	1 838	1 099	1 877	1 171	1 918	1 216	1 961	1 262	2 005	1 310	2 050	1 359	2 097	0	239	9 593	15 784	**25 376**
BUDGET Center	535	0	1 754	0	1 353	0	1 229	0	1 261	0	1 421	0	1 346	0	1 346	0	0	0	10 245	0	**10 245**
TOTAL	**8 135**	**18 661**	**16 514**	**22 548**	**13 760**	**20 590**	**13 311**	**19 632**	**14 054**	**17 741**	**13 737**	**17 253**	**12 843**	**17 149**	**10 345**	**15 866**	**0**	**275**	**102 700**	**149 714**	**252 415**

For the tables above, the financial numbers for 2011 are the reported numbers. The in-kind information is the planned numbers because the reports are not ready. Numbers for 2012-2019 are plans.

Appendix 1: Personell

Key Researchers

Name	Institution	Main research area
Espegren, Kari	IFE	RA 2
Lind, Arne	IFE	RA 2
Rosenberg, Eva	IFE	RA 2
Seljom, Pernille (25 % IFE)	IFE	RA 2
Eskeland, Gunnar	NHH	RA 3
Bjørndal, Mette	NHH	RA 3
Sandal, Leif	NHH	RA 3
Andersson, Jonas	NHH/SNF	RA 3
Rud, Linda	NHH/SNF	RA 3
Gaasland, Ivar	SNF	RA 3
Godal, Odd	SNF	RA 3
Heum, Per	SNF	RA 3
Wicken, Olav	UiO	RA 1 & 4
Kasa, Sjur	UiO	RA 1 & 4
Aall, Carlo	Vestlandsforsking	RA 1 & 4
Holden, Erling	HiSF	RA 1 & 4
Stokka, Arne	SINTEF TS	RA 3
Midttun, Kjetil	SINTEF TS	RA 3 & 2
Torvatn, Hans	SINTEF TS	RA 1
Bakken, Bjørn	SINTEF Energi	RA 5 & 2
Ruud, Audun	SINTEF Energi	RA 1
Belsnes, Michael	SINTEF Energi	RA 5
Graabak, Ingeborg	SINTEF Energi	RA 5
Huertas-Hernando, Daniel	SINTEF Energi	RA 5 & 2
Tomasgard, Asgeir	NTNU	RA 3 & 2
Ryghaug, Marianne	NTNU	RA 1
Lagesen, Vivian Anette	NTNU	RA 1
Sørensen, Knut	NTNU	RA 1
Westgaard, Sjur	NTNU	RA 2
Fleten, Stein-Erik	NTNU	RA 2
Moen, Øystein	NTNU	RA 4
Widding, Øystein	NTNU	RA 4
Sørheim, Roger	NTNU	RA 4
Hertwich, Edgar	NTNU	RA 5
Strømman, Anders Hammer	NTNU	RA 5
Aasen, Tone Merete Berg	NTNU Samfunnsforskning	RA 4

PhD candidates with financial support from the centre budget

Name	Nationality	Period	Sex M/F	Topic
Araoz, Veronica	Mexican	01.08.08- 01.08.12	F	Essays in Pricing in Deregulated Electricity Markets
Ausrød, Vegar Lein	Norwegian	01.11.10- 31.10.14	M	Commercialization of renewable energy
Bjørgum, Øyvind	Norwegian	01.10.10- 01.12.14	M	The long-term growth and pre-commercial processes of International New Ventures
Bysveen, Jørn Toft	Norwegian	19.08.10- 31.10.11	M	Four essays on risk management of electricity derivatives in the Nordic electricity market
Cheng, Xiaomei	Chinese	15.09.11- 15.09.15	F	Exploring the total-factor carbon efficiency for developing countries
Gilpin, Geoffrey	Canadian	01.09.08- 31.08.12	M	Life-cycle-assessment of 1st through 4th generation biofuels
Gjefsen, Mads Dahl	Norwegian	15.03.10- 15.09.13	M	Framing Public Engagement with New Energy Technologies
Gjerald, Ole Inge	Norwegian	01.09.08- 31.08.12	M	Renewable strategies? Implementing and commercializing new energy technologies
Hanson, Jens	Norwegian	01.01.08- 01.05.12	M	Solar energy technology, industry and policy
Haugstvedt, Daniel	Norwegian	01.06.10- 01.06.14	M	Operational and financial aspects of hydropower production
Jomisko, Robert L.	Norwegian	01.09.10- 01.09.14	M	Policy Development for Renewable Energy
Lindberg, Karen Byskov (50% CenSES, 50% ZEB)	Norwegian	01.09.11- 01.09.15	F	The impact of zero emission buildings (ZEB) on the energy system through smart grid and demand side management (DSM)
Lysgård, Sylvia	Norwegian	15.01.11- 29.03.15	F	Policy Development for Renewable Energy
Mauritzen, Johannes	Norwegian	01.08.08- 01.08.12	M	Windonomics: empirical essays on the economics of wind power in the Nordic electricity market
Narbel, Patrick	Swiss/Finnish	15.08.10- 14.08.14	M	Framework promoting the development of renewable energy in developing countries
Nielsen, Morten	Norwegian	01.08.10- 13.11.11	M	Modelling Long-term Energy Infrastructure Development
Pham, Ha Thi Bich	Vietnamese	01.12.08- 30.04.12	F	Transformations in the cement industry - A natural resource based industry in the context of climate change
Reinertsen, Hilde	Norwegian	01.05.10- 19.12.13	F	Powering global development? A study of efforts to identify results of technology transfers within Norwegian development aid to the energy sector, 1965-2010
Rygg, Bente Johnsen	Norwegian	01.01.09- 01.08.13	F	Renewable Energy as a Community Concern: How Local Communities Face the Challenge of Increasing Use and Production of Renewable Energy
Sinha, Vivek	Indian	01.08.11- 01.08.15	M	Unleashing the potential of renewable energy for decentralized production: an investigation into organization strategies and system requirements
Skar, Christian	Norwegian	16.08.10- 15.08.14	M	Modelling of the European power market for low emission scenarios
Swensen, Eirik	Norwegian	01.09.10- 31.08.14	M	Policy Development for Renewable Energy
Throndsen, William	Norwegian	01.04.11- 01.04.15	M	The development of smart grid technologies in an STS perspective
Walnum, Hans Jakob	Norwegian	01.09.11- 31.08.14	M	An interdiciplinary understanding of rebound effects. A discussion of rebound effects in the transport sector
Weaver, Tyson	American	01.09.11- 31.08.14	M	Norwegian hydropower international development

PhD candidates working on projects in the centre with financial support from other sources

Name	Fund-ing	Nationality	Period	Sex M/F	Topic
Arvesen, Anders		Norwegian	01.08.08-01.08.12	M	Industrial ecology perspective of offshore wind power industry
Dahlen, Kai Erik	PURELEC/ RENERGI	Norwegian	01.10.10-30.09.14	M	Risk management and assessment for energy markets: Extreme value statistics
Gibon, Thomas		French	01.12.11-30.11.15	M	Scenario-based life cycle inventory methods to inform climate mitigation
Godbolt, Åsne Lund	RENERGI	Norwegian	01.08.08-13.01.14	F	Building markets, shaping policy? The role of economics in energy policy and energy use
Gribkovskaia, Victoria		Belarusian		F	Essays on Pricing in Electricity Markets
Guest, Geoffrey				M	
Haugom, Erik	ELCAR-BONRISK/ RENERGI	Norwegian	01.01.09-31.12.12	M	Modelling and forecasting electricity prices and volatilities
Heidenreich, Sara	RENERGI	German	15.09.10-14.09.13	F	Public Engagement with Offshore Wind Energy
Jakobsen, Siri	RCN, For-skning-sløft nord	Norwegian	01.08.10-01.08.14	F	Sustainable innovation in the process industry, innovation, cooperation and technology transfer
Karlstrøm, Henrik	RENERGI	Norwegian	18.08.08-19.11.11	M	Empowering markets? The construction and maintenance of a deregulated market for electricity in Norway.
Klimek, Alexandra	RENERGI	German	01.09.09-08.12	F	Public Engagement in Post Carbon Strategies: Patterns of attitudes and engagement
Kong, Jiehong		Chinese	08.07-09.12	F	Pricing in the energy supply chain
Ottesen, Stig		Norwegian	01.01.11-31.12.14	M	Techno-economic modelling of smart energy systems
Sakshaug, Stein		Norwegian		M	Distributed energy systems
Seljom, Pernille	RENERGI	Norwegian	01.01.11-01.07.14	F	The future Norwegian energy system in a European context
Skjeret, Frode		Norwegian	01.11.09-01.11.12	M	Regulation of electricity markets
Skjølsvold, Tomas Moe	RENERGI	Norwegian	01.08.08-25.03.12	M	Innovation and commercialization in bioenergy
Steen, Markus		Norwegian	01.06.10-30.05.14	M	Green industrial restructuring and the emergence of novel production networks in new renewable energy
Steinmo, Marianne	Helgeland Spare-bank	Norwegian	01.08.10-01.08.14	F	Sustainable innovation in the process industry
Toftaker, Marit	RENERGI	Norwegian	01.01.10-31.03.13	F	EV User Preferences and User Strategies
Veka, Steinar	ELCAR-BONRISK/ RENERGI	Norwegian	15.08.10-15.08.14	M	Preliminary project name: Price formation and risk premium in the Nordic electricity derivatives market
Øverås, Ingrid	RCN-Not in my nature	Norwegian		F	Not In My Nature? The Controversies & Politics of Environmentalism & Public Planning in Localising Wind Farms

Postdoctoral researchers with financial support from the centre budget

Name	Nationality	Period	Sex M/F	Topic
Bjørnåli, Ekaterina	Norwegian	01.11.11- 31.10.14	F	Commercialization processes in entrepreneurial firms: examples from renewable energy
Valdés, Gerardo Alfredo Perez (starts at LinkS project 01.04.12)	Mexican		M	Energy system investment models.
Vie, Ola Edvin	Norwegian	On leave until 01.01.13	M	The need for knowledge integration in renewable energy innovation and commercialization
Saha, Parmita	Bangladeshi	01.09.11- 31.08.14	F	Identifying barriers to development of hydropower project in Norway

Postdoctoral researchers working on projects in the centre with financial support from other sources

Name	Funding	Nationality	Period	Sex M/F	Topic
Molnar, Peter	RENERGI	Slovakian	01.03.11- 21.10.14	M	How investors in small hydro and wind power plants make their investment decisions.
Hansen, Gard Hopsdal	RENERGI	Norwegian	06.09-12.11	M	Renewable strategies? Implementing and commercializing new energy technologies

Master degrees

Name	Sex M/F	Topic
Gravdehaug, Guro	F	Real Options in Small Hydropower Investments: An Empirical Study from Norway (PURELEC)
Remmen, Ragnhild	F	Real Options in Small Hydropower Investments: An Empirical Study from Norway (PURELEC)
Fuglerud, Marius	M	Hydroelectric Real Options. A Structural Estimation Approach (PURELEC) + Bottom-Up Modeling of the Nord Pool System Price (FINERGY)
Vedahl, Knut Erik	M	Hydroelectric Real Options. A Structural Estimation Approach (PURELEC) + Bottom-Up Modeling of the Nord Pool System Price (FINERGY)
Løset , Gaute Dag	M	The future potential of LNG as a bunker fuel: How the new environmental regulations will change the bunker fuel market (pre master thesis).
Tveten, Rolf Erik	M	The future potential of LNG as a bunker fuel: How the new environmental regulations will change the bunker fuel market (pre master thesis).
Heggeseth, Alf Gunnar	M	Growth Patterns among Small Norwegian Exporting Firms (pre master thesis).
Lome, Ola	M	Growth Patterns among Small Norwegian Exporting Firms (pre master thesis).
Sølvskudt, Ida	F	The Birth of a New Industry: A Company level analyze of the Development of the Norwegian Wave and Tidal Energy Industry (pre master thesis).
Sønning, Birthe	F	The Birth of a New Industry: A Company level analyze of the Development of the Norwegian Wave and Tidal Energy Industry (pre master thesis).
Bergaplass , Kristian	M	Energy Supply and Energy Need in Northern Norway: Coordination and Planning Challenges (pre master thesis).
Eriksen, Christian	M	Energy Supply and Energy Need in Northern Norway: Coordination and Planning Challenges (pre master thesis).
Refsland, Birgitte	F	Entry Strategies in International Markets for New, Technology Based Firms (pre master thesis).
Tjosevik, Ragnhild	F	Entry Strategies in International Markets for New, Technology Based Firms (pre master thesis).
Medbø, Vegard	M	Energisystemmodellering (pre master thesis).
Arvesen, Øystein	M	Energisystemmodellering (pre master thesis).
Kullmann, Carl-Erik	M	Energisystemmodellering (pre master thesis).
Haga, Geir Anders	M	Likevektsmodellering i energisektoren (pre master thesis).
Samseth, Eivind	M	Likevektsmodellering i energisektoren (pre master thesis).
Lervik, Victoria	F	Økonomisk potensiale ved Smartgrid (pre master thesis).
Landmark, Victoria Fearnley	F	Økonomisk potensiale ved Smartgrid (pre master thesis).
Vefring, Signy	F	Budstrategi for offshore vindkraft (pre master thesis).
Kleveland, Morten Rørslett	M	An operational framework for evaluating the potential for technology transfer in energy projects
Sønstebø, Knut Peter Larsen	M	An operational framework for evaluating the potential for technology transfer in energy projects
Skutle, Carl Magnus	M	A Mixed Complementarity Model of European Energy Markets
Gundersen, Lars Harald	M	A Mixed Complementarity Model of European Energy Markets
Lundby, Martin	M	Fundamental risk analysis and forecasts of Nord Pool electricity prices using quantile regression
Uppheim, Kristoffer	M	Fundamental risk analysis and forecasts of Nord Pool electricity prices using quantile regression

Appendix 2: Related Projects Including CenSES Research Partners

Modelling and forecasting risk in the electricity market, carbon market and related energy markets (ELCARBONRISK).
RCN/RENERGI. 2010 - 2014.
Project leader: Sjur Westgaard, NTNU. Total budget: NOK 13 770 000

Investment in renewable electricity under climate policy uncertainty (PURELEC).
RCN/RENERGI. 2010 - 2014
Project leader: Stein-Erik Fleten, NTNU. Total budget: NOK 8 450 000

Congestion Management and Block Bids in Deregulated Electricity Market.
RCN/RENERGI. 2009 - 2012
Project leader: Kurt Jörnsten, NHH.

Public acceptance of post carbon strategies
RCN/RENERGI. 2009 - 2014
Project leader: Knut Holtan Sørensen, NTNU. Total budget: NOK 8 891 000

Building markets, shaping policy? The role of economics in energy policy and energy use.
RCN /RENERGI. 2007 - 2013
Project leader: Knut Holtan Sørensen, NTNU. Total budget: NOK 3 368 00

RenewStrat, Implementing and commercializing new energy technologies.
RCN/RENERGI. 2008 - 2012
Project leader: Knut Holtan Sørensen, NTNU. Total budget: NOK 5 048 000

ECar, A strategy for electrification of road transport in Norway.
RCN /RENERGI. 2009 - 2013
Project leader: Tarjei Solvang, SINTEF Energy Research. Total budget: NOK 10 600 000

Environmental Sustainability Benchmarking of Low-Carbon Energy Technologies.
RCN/RENERGI. 2011 - 2013
Project leader: Edgar Hertwich, NTNU.

Optimal power network design and operation.
RCN /RENERGI. 2011 - 2015
Project leader: Morten Hovd, NTNU. In budget for CenSES: NOK 2 700 000

Guidelines for the implementation of "Electric Road Transport" policies in Europe.
ERA-NET and RCN /RENERGI. 2010 - 2012
Project leader: Marianne Ryghaug, NTNU. Total budget: NOK 315 000

Dissemination of Scientific Knowledge as a Policy Instrument in Climate Policy. RCN/NORKLIMA. 2011 - 2014
Project leader: Göran Sundqvist, UiO. Total budget: NOK 6 200 000

Intermittent Renewables, Balancing Power and Electricity Market Design (INTREPED).
RCN/RENERGI. 2012 - 2015
Project leader: Gunnar Eskeland, SNF. Total budget: NOK 6 000 000.

Regional effects of energy policy (RegPol).
RCN /RENERGI. 2012 - 2015
Project leader: Arne Stokka, SINTEF Technology and Society. Total budget: NOK 11 950 000

Financial EngineeringAnalysis of Investment and Operations in Electricity Markets (FINERGY).
RCN /RENERGI. 2007 - 2012
Project leader: Stein-Erik Fleten, NTNU. Total budget: NOK 8 099 061

Renewable energy as transition strategy.
RCN/RENERGI. 2011 - 2014
Project leader: Keith Smith, UiO.

The future Norwegian energy system in a European context
RCN/RENERGI. 2011 - 2014
Project leader: Kari Aamodt Espegren, IFE. Total budget: NOK 7 270 000

Nordic Energy Technology Perspectives
Nordic Energy Research. 2011 - 2012
Project leader: Kari Espegren, IFE. Total budget: DKK 833 000

Professionalism and pragmatism? The management of environmental knowledge and interdisciplinarity in consulting companies.
RCS/Miljø2015. 2008 - 2012
Project leader: Vivian Anette Lagesen, NTNU. Total budget: NOK 5 994 000

Energy Technology System Analysis Programme
RCN/RENERGI. 2012 - 2015
Project leader: Kari Aamodt Espegren, IFE. Total budget: NOK 1 720 000

Integrating households in the smart grid (IHSMAG).
ERA-NET. 2012 - 2014
Project leader NTNU: Marianne Ryghaug, NTNU. Total budget: EUR 1 148 810

NORSTRAT - Nordic electricity road map 2050: Strategic choices towards carbon neutrality
Nordic Energy Research. 2011 - 2015
Project leader: Ingeborg Graabak, SINTEF Energy Research

NORD-STAR - Centre of Excellence for Strategic Adaptation Research.
Nordforsk. 2011 - 2015
Centre director: Michael Goodside, Aarhus University. Total budget: NOK 35 000 000

Appendix 3: Publications

Journal papers

Daamen, Dancker D. L., Terwel, Bart W., Mors, E. t., Torvatn H., et al., 2011, Scrutinizing the impact of CCS communication on opinion quality: Focus group discussions versus Information-Choice Questionnaires: Results from experimental research in six countries. Energy Procedia, 6182-6187, ISSN 1876-6102.

Eskeland, G.S, Mideksa T. K., Rive N.A., 2011, Europe's climate goals and the electricity sector, Energy Policy,doi:10.1016/j.enpol.2011.10.038

Hojem, T. S. M., and Lagesen V. A. , 2011, Doing environmental concerns in consulting engineering. Engineering Studies, Volum 3.(2) s. 123-143

Holden E., Linnerud K., 2011., Troublesome Leisure Travel: The Contradictions of Three Sustainable Transport Policies, Urban Studies, 48(14) 3087–3106.

Holden, E. (accepted, 2013), Ecological Footprint, in Susan J Smith et al (eds) International Encyclopedia of Housing and Home (Oxford: Elsevier)

Holden, E., Linnerud, K. (accepted, 2013), Housing and Sustainable Transport, in Susan J Smith et al (eds) International Encyclopedia of Housing and Home (Oxford: Elsevier)

Holden, E., Linnerud, K. (accepted, 2014), The Unmanageable Leisure-time Travel, in: Hickman, R., Bonilla, D. Givoni, M. and , Banister, D. (eds) International Handbook on Transport and Development (Edward Elgar)

Pietzner, K., Schumann D., Tvedt, S. D., Torvatn H., et al., 2011, Public awareness and perceptions of carbon dioxide capture and storage (CCS): Insights from surveys administered to representative samples in six European countries. Energy Procedia, 6300-6306, ISSN 1876- 6102.

Ryghaug M., Sørensen K. H., Næss R., 2011, Making sense of global warming: Norwegians appropriating knowledge of anthropogenic climate change. Public Understanding of Science, Volum 20 (6),778-795

Ryghaug, M., 2011, Obstacles to sustainable development: The destabilisation of climate change knowledge. Sustainable Development, Volum 19.(3) s. 157-166

Tyson Weaver (2011), Financial appraisal of operational offshore wind energy projects, in review, Renewable & Sustainable Energy Reviews (nov).

Book chapters

Holden, E. (2012): Transport for Suburbia, (Paul Mees, Eartscan), Urban Studies, Vol 49/01

Fodstad M., Midthun K. and Tomasgard, A., Tactical portfolio optimization in the natural gas supply chain, In Giorgio Consigli, Marida Ida Bertocchi, Michael A. H. Dempster (editors) , Stochastic Optimization Methods in Finance and Energy: New Financial products and energy market strategies, New York, Springer, 2011.

Nørstebø V. S., Schütz P., Fodstad M., Hellemo L., Midthun K., Rømo F., Tomasgard A., 2011, Using Operations Research to Plan Natural Gas Production and Transportation on the Norwegian Continental Shelf. Wiley Encyclopedia of Operations Research and Management Science. Oxford, John Wiley & Sons, Inc.

Conference presentations/invited lectures

Bakken B., Kraftsektoren mot 2050, invited lecture, NVE, 10.06.11

Bakken B., European scenarios, Statkraft workshop, NTNU, 20.06.11

Egging R., Case studies with a multi-fuel market equilibrium model, Presented at Fifth Transatlantic Infraday, Washington DC, USA, Nov 2011

Eskeland G. S., Foredrag for Mistrastiftelsen og CEPS, Political Economy of Climate Policy, Stockholm, 21.09.11.

Eskeland G. S., Foredrag for NFR, Kan samfunnsvitere gi oss ny teknologi? UiB, Bergen, 29.09.11

Eskeland G. S., Foredrag for RENERGI styret, Hva hvis klimapolitikk er ledelse?, Bergen. 04.11.11

Eskeland G. S., Klimaforum, Hva hvis klimapolitikk er ledelse?, Litteraturhuset Oslo, 11.10.11

Espegren K. A., Energisystem i endring? Utvikling av langsiktige modeller for energisystemet, Energi Norge FoU årsforum, Oslo, 20.09.11

Fodstad M., Presentation of infrastructure research at NTNU and SINTEF, European Energy modelling forum, Potsdam, Germany, November 2011.

Gjefsen M. D., How do environmental organizations talk about the uncertainties of CCS? Or: From local interventions to general principles. Annual Meeting o f the Society for Social Studies of Science (4S), 02.-05.11.11

Gjerald O.I., From business idea to license approval for Norwegian wind power projects, International Energy Agency (IEA); Social Acceptance of Wind Energy, Trondheim, 15.10.11

Gjerald, O.I, Frå forretningsidé til konsesjonsgodkjenning for norske vindkraftprosjekt, Vestlandsforsking, 14.03.11

Hansen, G. H., JRC project proposals: Analyzing the Chinese turbine industry and the encounter between Chinese and Norwegian actors. Shanghai Jiaotong-NTNU JRC workshop, Trondheim, 20.09.11

Hansen, G. H., Offshore vind – et aktørperspektiv. Offshore Vind Konsensusworkshop, 12.04.11

Hansen, G. H., The adventure in-between – social acceptance of offshore wind in Norway. IEA Task 28: Norwegian expert day, 15.10.11

Hansen, G. H., The adventure in-between – the making of offshore wind in Norway (and China). NTNU Japan Seminar: Renewables and Energy Security in Japan, East-Asia and Norway, 10.11.11

Holden E., Fornybar energi: mer eller mindre bærekraftig utvikling?, Exploring Sustainability, Norsk Geografisk Selskap, Losby gods, 21.01.11

Holden, E., Fornybar energi og mediastrategi, Medieseminar Høgskulen i Sogn og Fjordane, Sogndal, 08.03.11

Lagesen V.A., Consulting engineers as transition actors?, Annual Meeting Society for the Social Studies of Science (4S), Cleveland, 02.11.11 - 05.11.11

Midthun K., Fodstad M., Hellemo L., Werner A., Tomasgard A., Natural gas infrastructure design with a production perspective, INFORMS Annual Meeting, Charlotte, North-Carolina, USA, 15.11.11.

Midthun K., Hellemo L., Werner A., Tomasgard A., Perez-Valdes, G., Ramona Infrastrucutre: A multi horizon stochastic programming investment model, 2nd Trondheim Gas Technology Conference, Trondheim, 03.11.11.

Nielsen M. B., A multi-stage stochastic programming approach to power system expansion planning, OR2011, Zurich, 2011.

Perez-Valdes, G., Parallelized Branch and Fix Coordination on Energy System Investment Problems – Talk at INFORMS Annual Meeting. Charlotte, NC, USA. November 2011.

Reinertsen H., Fuelling global development: Norwegian efforts to translate and transfer petroleum technologies, experiences, and expertise to the developing world. Holdt på konferansen "Conceptualizing the World", UiO, 14.09.11

Ryghaug, M., Hansen, G. H., Skjølsvold, T. M., Sustainable energy innovations: the strategies of Gyro Gearloose. Society for Social Studies of Science Annual Meeting, Cleveland (presentasjon, Marianne) 02.-05.11.11

Schumann D., Reiner D., Pietzner K,. et. al, Similarities and differences of simultaneous influences on risk perceptions of CCS project proposals. The 6th Trondheim CCS Conference (TCCS-6), 2011-06-16.

Seljom P., Energisystemmodellering av Norge, CenSES lansering, Trondheim, 27.06.11

Skar C., A Multi-stage Stochastic Programming Approach to Power System Expansion Planning INFORMS Annual Meeting. Charlotte, NC, USA, November 2011.

Steen, M., Hansen, G. H., Same sea, different ponds. The emergence of offshore wind in the North Sea. Annual meeting of the Association of American Geographers (AAG), Seattle (presentasjon, Markus), 12.-16.04.11

Swensen, E., 2011, Kapittel 1: Informasjon til befolkningen, I: Statusrapport for norsk klimapolitikk 2011, BI, s. 15-20.

Tomasgard A., A Stochastic Complementarity Model for Pipeline Transport Booking and investments, Informs international conference, Charlotte, NC, November 2011.

Tomasgard A., A stochastic mixed integer model for natural gas infrastructure investments, CPAIOR2011Workshop on Mathematical Optimization for Energy Networks in Berlin, Germany, May 2011.

Tomasgard A., Long term expansion of the European power system governed by global emission mitigating strategies - A two-stage stochastic linear programming approach, Workshop on pricing in deregulated energy markets, Voss, Norway, November 2011.

Tomasgard A., Solving Discretely-Constrained Stochastic Mathematical Programs with Equilibrium Constraints – illustrated by a case from the North Sea, guest lecture, Humboldt University, Berlin, May 2011.

Tomasgard A., Tverrfaglig forskning ved Senter for studier av bærekraftig energy- CenSES, Seminar MILEN, Universitetet i Oslo, November 2011.

Torvatn H., Communication Strategies, Knowledge about and Attitude towards Carbon Capture and Storage in six European Countries, Sino-Norwegian Network of Excellence on Applied Research on CO" Capture Techniques and Concepts Joint kick-off and workshop, Hangzhou, China, 08.03.11

Torvatn H., Erfaringer fra BiogassTrøndelag, KRD og KS klimakonferanse "Fra plan til handling i det lokale klimaarbeidet – slik oppnår vi klimamålene", Oslo 21.02.11

Torvatn H., Tvedt S. D., Schumann D., Being told does not change anything. The 6th Trondheim CCS Conference (TCCS-6), 16.06.11.

Vie, O. E., The need for knowledge integration in renewable energy innovation projects, 21th Nordic Academy of Management Conference, Nordic Academy of Management, Stockholm, 22.08.11 - 24.08.11

Popular science

Gilpin G., 2011, If you always do what you always did, you will always get what you have always got, blogg, Dei Fornybare på forskning.no, 26. oktober

Gilpin G., 2011, To bio or not to bio?, blogg, Dei Fornybare på forskning.no, 20. mai

Gjerald O. I., 2011, Korleis vere rådgjevar og debattant i grøne konfliktar? Fornybarforskarens dilemma, blogg, Dei Fornybare på forskning.no, 04. mai

Gjerald O. I., 2011, Miljøorganisasjonane sin plass i energidebatten, blogg, Dei Fornybare på forskning.no, 02. oktober

Holden E., 2011, Er vannkraft fornybar energi? blogg, Dei Fornybare på forskning.no, 1. februar

Holden E., 2011, Fornybar energi og transport – del 1, blogg, Dei Fornybare på forskning.no, 29. april

Holden E., 2011, Fornybar energi og transport – del 2, blogg, Dei Fornybare på forskning.no, 29. august

Holden E., 2011, Kampen om Arealene, blogg, Dei Fornybare på forskning.no, 15. februar

Rygg B. J., 2011, Vindkraftutbygging i kommune-Norge, blogg, Dei Fornybare på forskning.no, 1. mars

Swensen E., 2011, Samfunnsnyttig forskning?, blogg, Vitenskaperne på forskning.no, 16. oktober

Swensen E., 2011, Teknologioptimisme og miljøengasjement, blogg, Vitenskaperne på forskning.no, 12. mai

Weaver T., 2011, Debaters: load your arguments, blogg, Dei Fornybare på forskning.no, 11.november

Weaver T., 2011, Is hydro power the only profitable electricity production in Norway?, blogg, Dei Fornybare på forskning.no, 14.september

Weaver T., 2011, Mobilizing O&G to offshore wind, blogg, Dei Fornybare på forskning.no, 7.juni

Weaver T., 2011, Offshore wind- the new frontier, blogg, Dei Fornybare på forskning.no, 15.mars

CenSES

CENTRE FOR ENVIRONMENT-FRIENDLY ENERGY RESEARCH

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"Knowledge and engagement for sustainable energy transition"

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