



# Annual Report 2014

Centre for Sustainable Energy Studies

# Message from the Chair of the Board

As the chair of the board of CenSES and Pro-Rector for research at NTNU, I am pleased to say that CenSES is a central part of NTNU's commitment within energy related research.

The cooperation with research partners and user partners in the center is a good example of the coordinated effort needed to define transition strategies for a more sustainable energy system.

This kind of cooperation is fundamental in order to further develop NTNU's strategic energy program over the next 10 years.

CenSES has in its first years contributed with a high number of publications coming out of the research as well as dissemination to policy makers, companies and the public in general.

It is our hope at NTNU that the further research in CenSES will contribute to the research-based knowledge needed to understand and shape the energy and climate policy of the future.



Kari Melby  
Chair of the Board, CenSES

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# Report from the Centre Director

In 2013, CenSES' third year as a Centre for Environmentally friendly Energy Research (FME), we had a focus on delivering relevant research results to our partners. One of the important mechanisms we have established is the concept of User Cases, research with a duration of 1-2 years, directly aimed at answering important questions for our user partners. These cases are typically performed in a cross-disciplinary way in close cooperation between user partners and researchers.

The focus areas of the user cases have been Norway's role in a European energy system with more renewables, Energy policy measures and Energy demand in Norway towards 2050. The case looking at Norway's role in Europe delivered a draft report in 2013 and will be finished in spring 2014, incorporating input we received after consultation with the user partners. The two other user cases will deliver the first draft reports in spring 2014, having spent much of 2013 in dialogue with users. You can read more on CenSES' three first user cases in the annual report.

The LinkS project that has been part of CenSES research areas *Energy Systems and markets* and *Scenario Development* has finished, and an extensive final report as well as an executive summary are available. The project analysed the links between global climate policy and regional energy systems. The EMPIRE model developed in LinkS has already been used to perform policy studies for the Zero Emission Platform (ZEP) in their energy markets working group. It is a good example illustrating that CenSES results also makes it possible for our researchers to participate in European initiatives. We want to see more of that in future years.

In 2013 our PhD candidates continued their work. At the end of the year we had 26 PhD candidates supported by the centre, while one candidate successfully completed his PhD in 2013. The next round of PhD candidates will be hired in early 2015 as the current

ones graduate. Together with our partners we will define the exciting research tasks for the next group of candidates during 2014.

In 2013 five new research projects received funding with CenSES partners. Another 21 PhD candidates are working in these and other related projects and are part of the CenSES PhD network.

In addition around 70 master students wrote their thesis related to the centre, at NTNU, NHH and UiO. It is encouraging that an increasing number of students are interested in writing their thesis on energy policy or studying energy systems and markets.

Our five Research Areas (RA) had a productive year, with 25 journal papers, nearly 80 conference presentations, 35 presentations for our partners, as well as press coverage in broadcast, print and digital media.

At the CenSES annual conference arranged in Oslo in December, we saw for the first time that the majority of presentations were from our PhD students. The conference was an inspiring mix of results from CenSES young researchers and senior researchers' perspectives on the topics.

In 2013 the Ung Energi initiative developed further through the website [www.ungenergi.no](http://www.ungenergi.no). All the material on the website is written and collected by the Ung Energi project group consisting of youths. The objective is to increase the knowledge and awareness of environmentally friendly energy technologies; to highlight related challenges and opportunities for society among youths in general; and to increase recruitment to the field. After 2013 we consider the pilot phase as over, and Ung Energi continues as a project with support from CenSES and several partners from industry and government.

The PhD and master education as well as dissemination activities in Ung Energi also creates a lot of new energy in the future!



Asgeir Tomasgard  
Centre Director, CenSES

# About CenSES

Centre for Sustainable Energy Studies (CenSES) was established in 2011 as a national Centre for Environment-friendly Energy Research (FME) by the Norwegian Research Council. The objective of the FME initiative is the establishment of time-limited research centres which conduct concentrated, focused and long-term research of high international calibre in order to solve specific challenges in the field.

FME 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.

CenSES research integrates the following disciplines: energy systems and markets, industrial ecology, economics, political science, sociology, innovation studies and science and technology studies.

The CenSES consortium includes research groups from Institute for Energy Technology (IFE), Institute for Research in Economics and Business Administration (SNF), Norwegian School of Economics (NHH), Norwegian University of Science and Technology (NTNU), SINTEF, Sogn og Fjordane University College, Vestlandforskning and University of Oslo (UiO).

## Research partners



UiO • Universitetet i Oslo





# 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.

## Key objectives

### Objectives for education and recruitment

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

### Relevance objectives

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

### Dissemination objectives

- Disseminate results to the public through:
  - Yearly conferences
  - Workshops and seminars
  - Quarterly 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 [www.censes.no](http://www.censes.no)
- Establish a blog "Dei bærekraftige" at [forskning.no](http://forskning.no)

### Publication objectives

- Present 150 papers on international conferences
- Publish 120 articles in academic journals with peer review
- 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 2014

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## Events

- 3 Conferences arranged
  - 12 Workshop arranged
- 

## Publications

- 40 Articles published in academic journals
- 12 Articles published in anthologies
- 18 Reports



## Presentations



- 66 Conference presentations
- 60 Presentations for project target groups

# Research



- 9 New research projects
  - 24 PhD students funded by CenSES
  - 25 PhD students in additional projects
  - 10 Post docs funded by CenSES
  - 11 Post docs with external funding
  - 2 PhD Dissertations
- 

# Partners



- 19 User partners
- 8 National research partners
- 10 International research partners



# Leadership

## CenSES Management Group



**Asgeir  
Tomasgard**  
NTNU



**Marianne  
Ryghaug**  
NTNU



**Knut H.  
Sørensen**  
NTNU



**Kari Aamodt  
Espegren**  
IFE



**Gunnar  
Eskeland**  
NHH



**Roger  
Sørheim**  
NTNU



**Erling  
Holden**  
HiSF



**Carlo Aall**  
Vestlands-  
forskning



**Ingeborg  
Graabak**  
SINTEF



**Olav Wicken**  
UiO



**Kjetil  
Midthun**  
SINTEF



**Marit  
Martinsen**  
NTNU



**Kristin  
Klockervold**  
NTNU



**Tove  
Svenning**  
NTNU

## CenSES Board



**Kari Melby**  
Pro-Rector  
for Research,  
NTNU



**Andreas Enge**  
Head of  
Strategy and  
Analysis Unit,  
Enova



**Frode Rømo**  
Research  
Director,  
SINTEF



**Fulvio  
Castellacci**  
Centre  
Director, UiO



**Lasse  
Torgersen**  
Senior  
Energy Market  
Analyst, Norsk  
Hydro



**Mette  
Bjørndal**  
Professor,  
NHH



**Ola Lingaas**  
Vice President,  
SFE



**Hilde Strøm**  
Leading  
Business  
Developer,  
Statoil



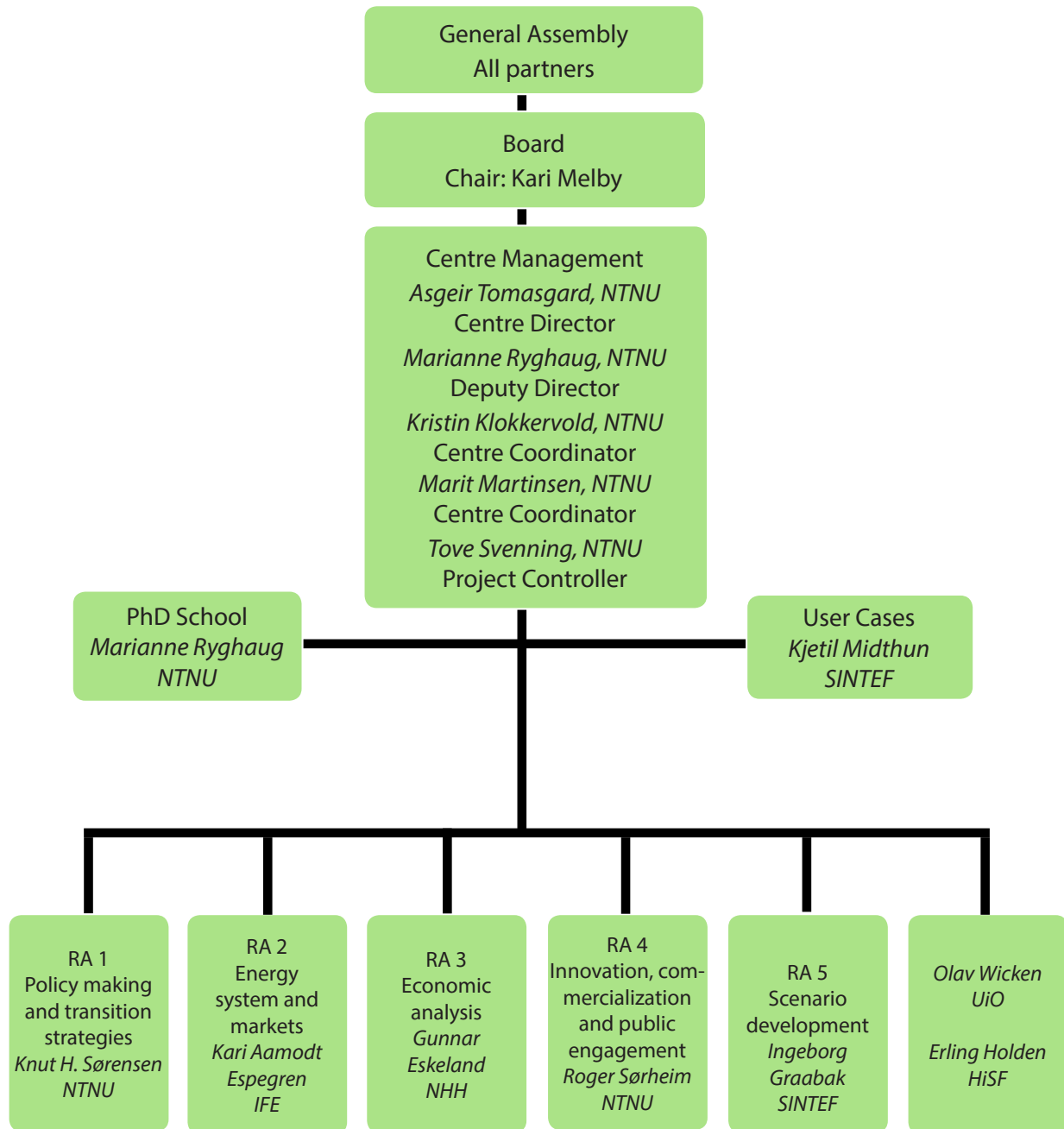
**Trond A  
Jensen**  
Adviser,  
Statnett

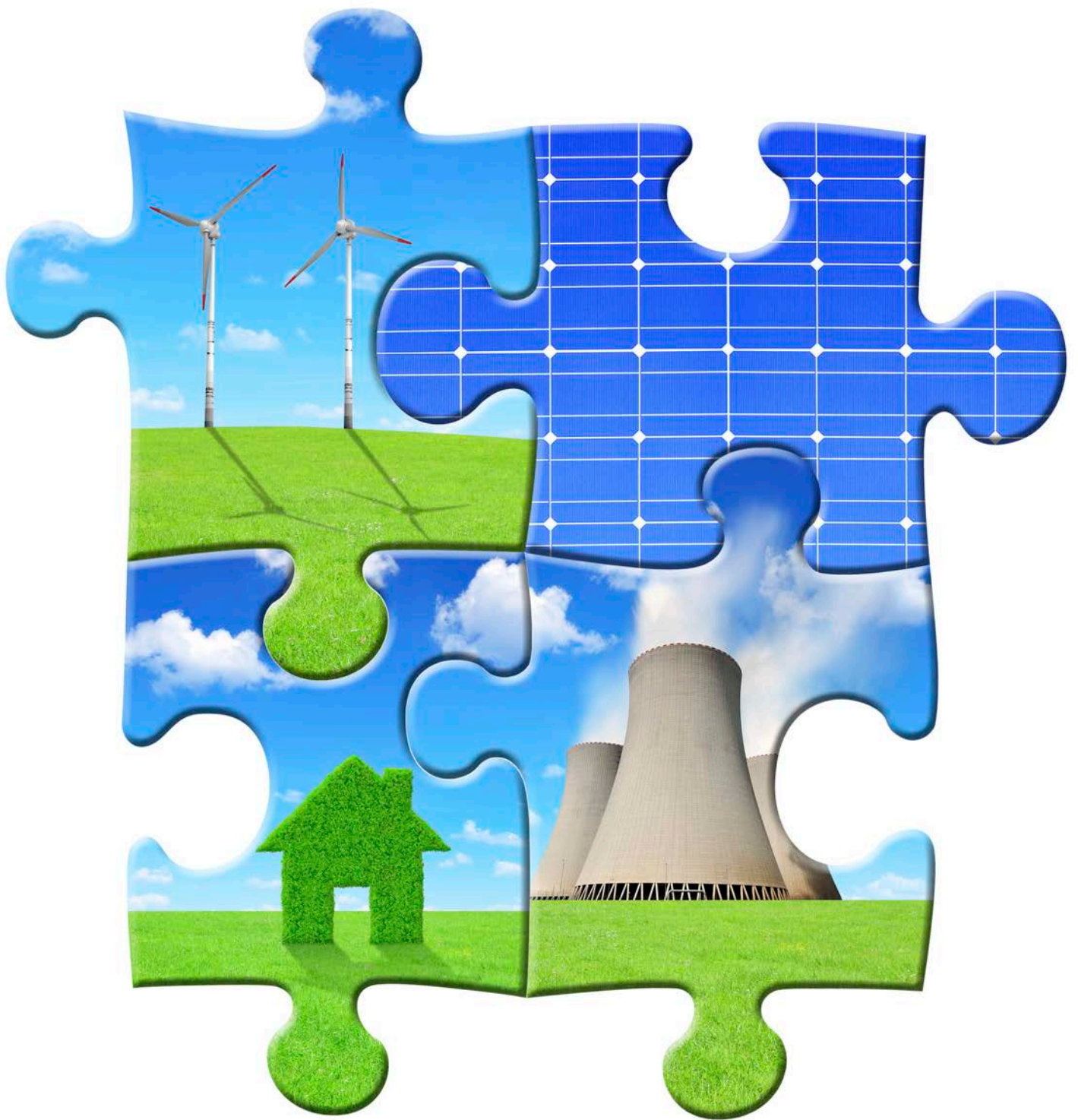


**Arve Holt**  
Research  
Director, IFE



# Organisational chart





# Partners

## National research partners



## User partners



## International research partners



# Main Research Areas

CenSES is divided in five major research areas, which includes policy recommendations, tools and models, strategies and scenarios. Each research area consist of several specific work packages.

Research Area 1: Policy making and transition strategies

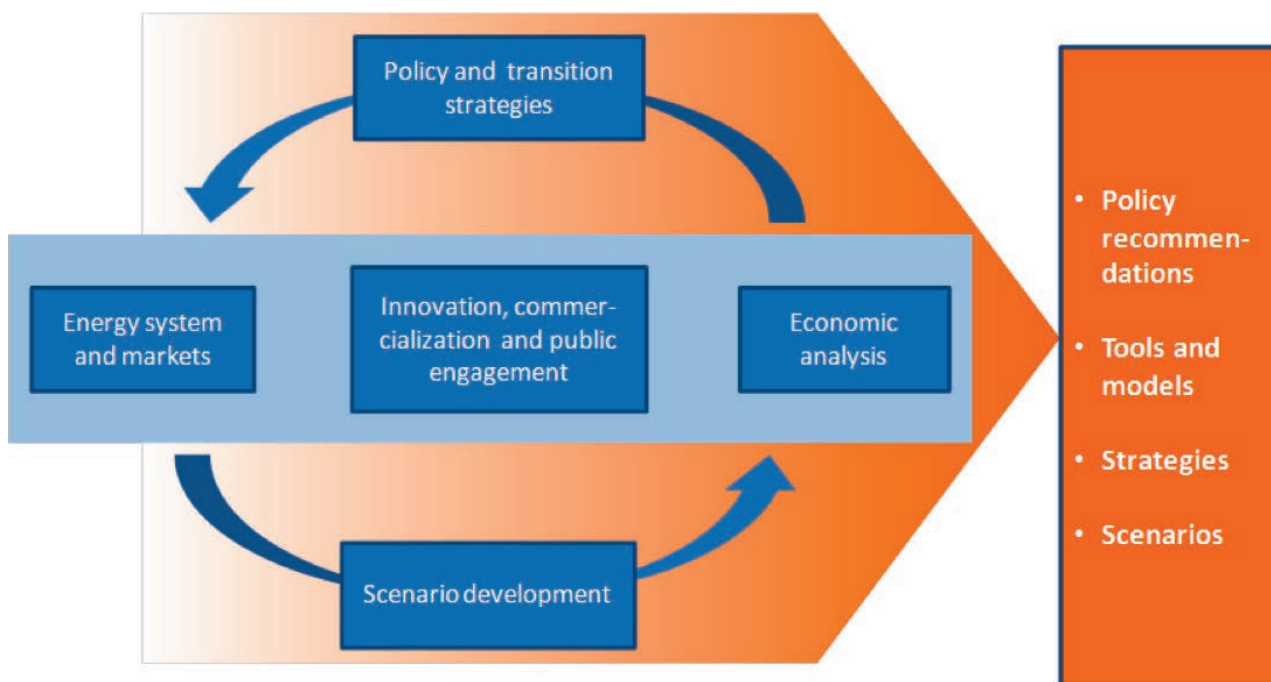
Research Area 2: Energy systems and markets

Research Area 3: Economic analysis

Research Area 4: Innovation, commercialization and public engagement

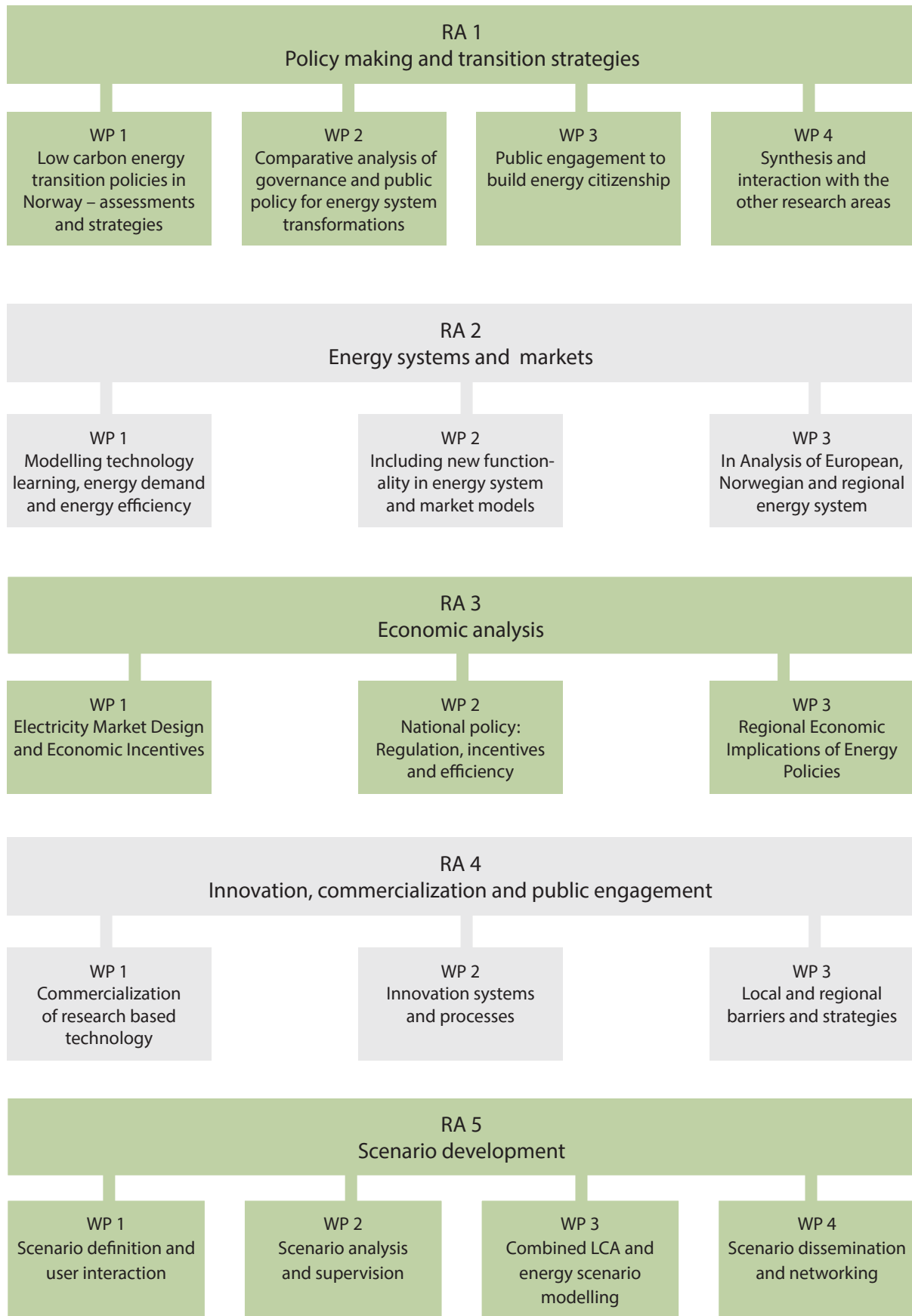
Research Area 5: Scenario development

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 are implemented across the research areas.





# Research Areas and Work Packages



# RA 1 Policy Making and Transition Strategies

## RA1 consists of four work packages:

- WP 1 Low carbon energy transition policies in Norway – assessments and strategies
- WP 2 Comparative analysis of governance and public policy for energy system transformations.
- WP 3 Public engagement to build energy citizenship
- WP 4 Synthesis and interaction with the other research areas.

The work packages were revised and reconfigured during 2014, based on achievements and experiences. Furthermore, WP 3 was moved from RA4 to RA1.

## Research in 2014

The efforts in 2014 have above all been directed at the conclusion of PhD projects. Three candidates successfully defended their theses:

- Sara Heidenreich: “Blowing in the wind: The socialization of offshore wind technology”.
- Åsne Lund Godbolt: “Market, money and morals. The ambiguous shaping of energy consumption in Norwegian households”.
- Alexandra Klimek: “Engineering and Politics: Embedding Carbon Capture, Transport and Storage (CCS) in Norway”.

In 2014, a study of the role of economics in energy policy and energy use was concluded. This study has been under-

taken by a team consisting of Margrethe Aune, Åsne Lund Godbolt, Henrik Karlstrøm and Knut H. Sørensen. The study has analysed the content of economic arguments related to energy policy, energy markets and consumption of electricity as well as their effects. In addition, we have examined how Norwegian households relate to their consumption of energy, the liberalised market for electricity and renewable energy. This includes the relationship between economic and other arguments. The project has resulted in two dissertations (Godbolt and Karlstrøm), a few published papers and several papers in the pipeline for publication.

Transition strategies have been studied on several arenas and with respect to a diversity of technologies. Some examples may be mentioned: Marit Toftaker, Helen Gansmo and Marianne Ryghaug have looked at Norwegian policies in support of electrical vehicles. Tomas Moe Skjølsvold has studied the performative role of future visions with regard to smart grid development. Heidrun Åm has analysed how solar energy scientists may be seen as transition actors, while Bente Johnsen Rygg has investigated how Norwegian local government engage with local development of environmentally friendly energy. Knut H. Sørensen has looked at strategies used to “mainstream” technologies previously considered alternative, like wind energy and electric cars. Eirik Swensen has analysed ambiguities related to the efforts of developing technology for carbon capture and storage. ■



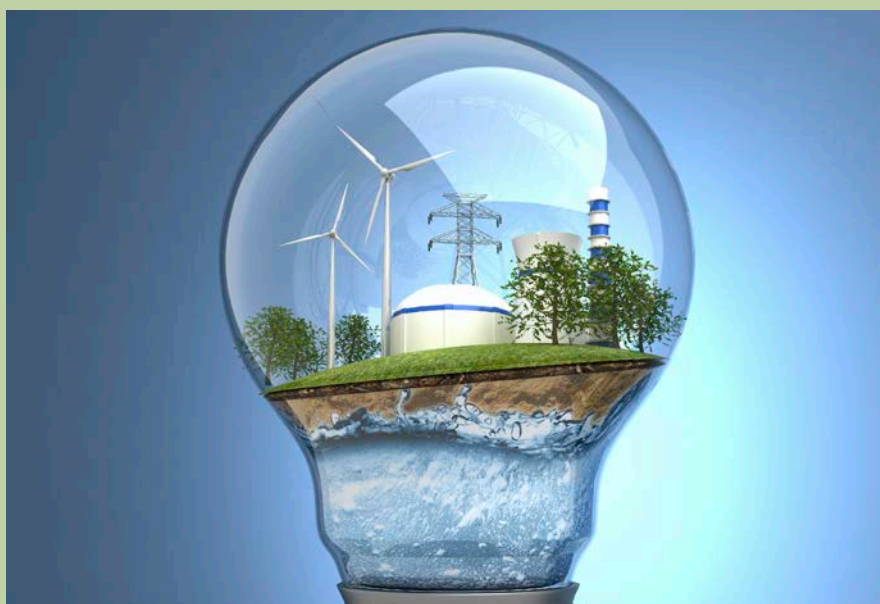
## The previous future of smart grid technology

Marianne Ryghaug, William Throndsen and Tomas Skjølvold has been working on the IHSMAG project (Intergrating Households in the Smart Grid) this year. Skjølvold has as a part of this project written an article about the previous future of smart grid technology.

The study has analysed a ten-year long technology debate, which dealt with the so-called advanced electricity meters in Norway (1998–2008). This debate circled around one central question: should the implementation of this technology be forced through regulations or should the market decide on pace and character of implementation? In 2008 it was decided that it was best to regulate the implementation. Throughout these 10 years, the debate was largely concerned with how the future would look with or without regulation.

Images of futures may be performative in the sense that when “the future” is presented, this influences present action and navigation. With this in mind, the study has analysed future visions and expectations as they were formulated in the smart grid technology debate. It has traced the role of these futures in the policy debate and their effects on the policy outcome. Two modes of the performativity of imaginations of the future have been identified: (1) translative and (2) transformative images of futures. Translative images of futures are often mobilized as spokespersons for desired technology or policy trajectories. Here, they work as (a) stage setting devices: sparking debate, enrolling new actors in the debate and generating interest. Further, they work as (b) regulative tools: establishing the need for political decisions, either to realize the content of future visions, or to avoid the contents of alternative futures. Transformative images of futures do more subtle and gradual work, shifting the practical, symbolic and cognitive meaning of “what” the technology in question might become in the future.

In the Norwegian debate, one crucial question was whether a future with advanced meters could be justified in societal economic terms. For years, it was impossible to justify large scale implementation with economic models. However, as the technology matured, and increasingly complex technological futures were imagined, Norwegian citizens were ascribed increasing levels of economic rationality. While future practice change could not be quantified, the “non-quantifiable” ideas about the relationship between input (information) and (changed) electricity consumption became rhetorically very powerful. ■



# RA 2 Energy Systems and Markets

## Work related to the Work Packages in RA2

The activities of RA2 are in a wide spectre related to energy systems and markets. The research is ranging from analysis of details in the energy system or in the electricity market to analysis of global energy systems. Research groups from CenSES have been actively involved in the analysis performed by the European Energy Modeling Forum (EMF) and in IEAs Energy Technology Systems Analysis Program (ETSAP).

In WP1 on Modelling technology learning in energy systems we made an effort to establish a common Censes Energy Database (CED); however it has been decided that this work has to be extended into a national technology database in cooperation with both CenSES and CREE partners. Establishment and operation of national energy database will require national funding.

The research in WP2 on Energy demand and energy efficiency has been related to making a new energy projection towards 2050. A detailed study has been performed to be able to develop a baseline projection and alternative scenarios for future energy demand in Norway. The work with the Position Paper "Norway's role as a flexibility provider in a renewable Europe" has been presented at Technoport Talk in Trondheim, and at a «Klimafrokost» arranged by Norsk

Klimastiftelse in Oslo. The work with the Position Paper "CenSES-Energy demand towards 2050" has been presented at the RERC2014 conference in Oslo, and at the ETSAP workshop in Beijing.

The relation between energy economists and the development of energy policy, and the impact of socio-economics on energy policy and energy demand has been studied thoroughly.

In WP3 Including new functionality in energy system and market models a variety of energy system and market models have been used by researchers and PhD-students. The research has been focused on improvement of the models. Two new energy system models have been developed; EMPIRE and MultiMOD. EMPIRE is a long-term investment model for energy systems where the impact of short-term variability on long-term investments in energy production is included. The MultiMOD is an equilibrium model that includes a large number of alternative fuels.

In WP4 Effects of global policy on regional energy systems the main research has been in related to the LinkS-project. In 2014 a study for the Zero Emission Platform (ZEP) was carried out focusing on renewable energy technologies and storage to achieve emission reduction. ■

## Development of a bidding Model for a Multi-reservoir Hydropower system

The European power system is expected to become more integrated and include a larger share of intermittent renewable production. This development is driven by EU environmental targets and ambitions. In Norway, new cables to Europe, tighter market coupling and increased contributions from intermittent production is expected to give increased price volatility, larger volumes and higher prices in balancing markets. This will increase the importance and profit potential of a consistent view on trade in all short-term markets. The producers' ability to optimally bid their resources in a broad and complex range of markets is a premise for the efficient utilization of Norwegian hydropower resources and the ability to provide balancing flexibility to the system.

Hydropower producers need to schedule when to release water from reservoirs and participate in wholesale electricity markets where the day-ahead production is physically

traded. A mixed-integer linear stochastic model for bid optimization and short-term production allocation has been developed and tested through a simulation procedure implemented for a complex real-life river system. The new stochastic bid model sees uncertainty in both spot market prices and inflow to the reservoirs. The same simulation procedure has also been implemented for a practice-based deterministic heuristic method similar to what is currently used for bid determination in the industry, and the results are compared.

The stochastic approach gives improvements in terms of higher obtained average price and higher total value than the deterministic alternative. This approach also performs well in terms of startup costs. In the presence of river flow travel delay, the practice-based method is even more outperformed by the stochastic model.





Styggevatnet, (Photo Vegard Martinsen)



Master students Ellen K. Åsgaard and Gørild Andersen presented at the BEEER conference in Bergen in May 2014.

A new research project based on this work will be carried out by researchers in CEDREN and CenSES. The project aims at learning how hydropower producers should bid in day-ahead markets that are integrated in a sequence of balancing markets. This will be achieved by studying optimal behaviour in short-term markets by the use of research models. The next step will be to extend the detailed hydropower scheduling models currently used by the industry with balancing markets based on the knowledge gained from the research models. Providing a consistent description of market and inflow uncertainty is a premise for both these steps. ■

# RA 3 Economic Analysis

## RA3 works in three work packages:

- WP 1 Electricity market design and economic incentives
- WP 2 National policy: Regulation, incentives and efficiency
- WP 3 Regional economic implications of energy policies

WP 1 is in predominance through workload and output due to cofinancing of objectives with the research project Intermittent Renewables, balancing Power and Electricity market Design (INTREPED), while WP 2 and WP 3 also benefit from other financing, inter alia with Nordstar, and with the Renergi project Regpol, and a UN and a World Bank activity.

We emphasize in this report current work on transport. Transport results is important in work package 2, since domestic transport under nonglobal cooperation is an emitting sector not subject to much carbon leakage. Transport also plays an important role in WP 3, with the regional dimension being important not only in the transport system but also in other environmental challenges, such as air quality.

## Climate policy, transport and the environment

Transport is a major share of world energy use (25 to 30 percent), and domestically almost all of this is road transport. In developed economies, personal mobility dominates: most of it by car in the daily commute. Transnational transport is about five percent of global greenhouse gas emissions,

about half of which is cargo by ship, the other half is passengers by aviation.

In European countries, a major experiment is started, with Norway in the lead, using the structure of new car taxes to 'decarbonize' the future vehicle fleet. Eskeland and Yan have acquired a detailed data set on new vehicles sold in Norway, to study this process.

Figure 1 below, is an example of the descriptive analysis. First, as the tax system shifts to strengthen the penalty on CO<sub>2</sub> gram per vehicle kilometer penalty, the distribution of vehicles sold shifts to the left. Secondly, electric vehicles show up in significant numbers, due not only to the new vehicle tax formula (feebates, in the international literature jargon), but also to other privileges such as bus-lanes, free tolls and ferries, as well as internationally a carbonfobic technology trend, driven by policies and policy expectations.

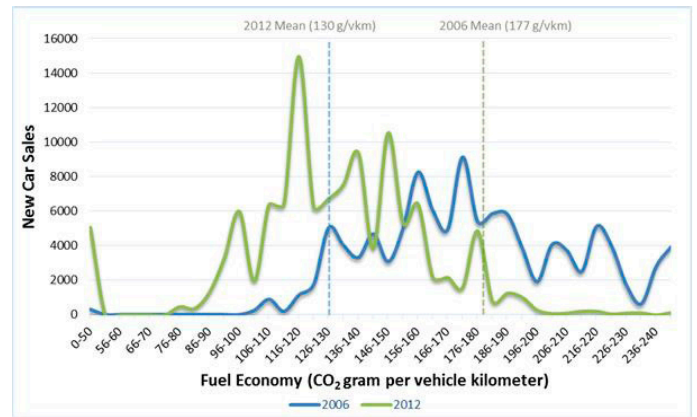


Figure 1

## Sun and Lemons:

### Getting over information asymmetries in the California solar power market

Building power plants has traditionally been the domain of large utilities and electricity companies who built centralized generation plants often fired by coal or gas. However with the dramatic fall in costs of distributed energy technologies like solar and wind power, consumers and businesses are increasingly able to generate their own electricity. But problems arise when consumers and small businesses, who lack significant technological know-how and financial resources need to make investment decisions involving advanced technological components.

In the research project "Sun and Lemons: Getting over information asymmetries in the California solar market," post doc Johannes Mauritzen investigates the problem of consumers being unable to judge the quality of solar panels. In particular, he analyze the adoption of panels from new Chinese manufacturers, which tended to be significantly cheaper, but where the quality of the panels was highly uncertain.

Consumers who are unwilling to invest in panels from unknown Chinese manufacturers could have become a barrier to entry, leading to higher prices and a slower adoption of solar panel systems.

In his study, he uses a dataset of more than 100,000 solar panel installations in California between 2007 and 2014 and a hierarchical regression model. Mauritzen finds that contractors who install solar panels were able to increase market share and likely bring down overall costs by simultaneously using cheaper Chinese panels while also adopting a leasing business model. Instead of consumers purchasing the solar panel systems directly, the contractor owns the system while the consumer agrees to a long-term contract to pay for the electricity generated by the panels.

While individual consumers do not have the engineering and financial resources to judge the quality of panels, a large



Figure 2 shows a stylized representation of welfare cost estimates. It is not as if car buyers are viewed as being interested in CO<sub>2</sub> intensity in itself, but rather that CO<sub>2</sub> intensity makes it easier for car-makers to provide qualities users want: horse-powers, size, etc. When raising the CO<sub>2</sub> related feebate by 50 percent, government revenue rises by D minus B, and the welfare cost of the ten percent decarbonization is E. The study draws in part on work done earlier in cooperation with TOI.

The study aims to recover how this transformation of the

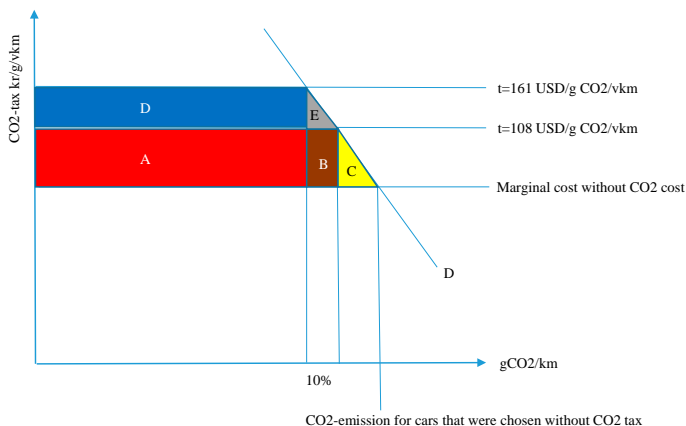


Figure 2

vehicle fleet is accomplished: to what extent are consumers sacrificing qualities they cherish; to what extent are makers pushed to provide these qualities by other means than through CO<sub>2</sub>?

The study accompanies broader studies along two lines.

In one, covering all transport, it is highlighted that each 'vehicle mile' – whether aviation, by ship, etc – can be decarbonized in ways such as these, but that other responses must be allowed to accompany them. Some common features are that decarbonization economies accompany:

- scale economies in 'vehicle size': bus carbon-leaner than car
- capacity utilization: full car leaner than empty bus
- speed: slow movements leaner than fast
- hybridization: under variable loads, combined engine configurations leaner than singular.

In another, urban development and mobility is examined, pushing the question of public transport's relation to city size and density. This study challenges conventional wisdom on charging for emissions and congestion, showing that such charges may have to be tailored not to block agglomeration benefits, especially in poor cities. The part of conventional wisdom that is retained is dense development along high-capacity transportation corridors. ■

contractor can take steps such as getting panels professionally inspected and visiting panel factories. In this way, contractors can aggregate and control the risk of poor panel quality, allowing for the large-scale use of Chinese-produced panels. In turn, costs were reduced and adoption of panel systems was increased.

These results have implications for understanding the rapidly emerging solar power industry and in turn informing regulations and public policy. For example, California's subsidy scheme for solar panels provided grants to investors of solar power systems, but did not specify that the owner of the solar panels also needed to be the home owner. This flexibility allowed for the innovation of a leasing business model to take hold. ■



Post doc  
Johannes Mauritzen

# RA 4 Innovation, Commercialization and Public Engagement

## Work related to the Work Packages in RA 4

In RA 4 we will develop knowledge within three main areas:

1) What factors influence the commercialization of research? How can commercialization processes from research institutions be stimulated? How can research result in spin-off and technology transfer? How does one identify commercial potential, and enable paths towards actual commercialization?

2) If there is a tension between knowledge creation and spillover, how does this influence policy in a small open economy in Europe? The roles innovation systems in a globalized world.

3) How do local and regional barriers in private and public sector hinder transition strategies and what strategies that are needed to overcome such barriers?

The research plan for RA 4 was revised during 2014. In WP 1 will the focus be somewhat stronger on the development of spin-off firms from research organizations. We will develop further the interesting paths related to dynamic business models in developed and less developed countries. We will also continue the mapping of innovation activities in the technical FMEs. In WP 2 was the initial focus on analyzing attempts to build innovation systems to support the development and introduction of technologies to transform renewable energy sources (wind, solar, bio, wave) into energy/

electricity. Many of these emerging technologies are initially challenged both by their intrinsic newness and the competition with existing technologies, which called our attention to the analysis of the specific conditions that make, or hamper, emerging technologies from becoming more cost-effective. In the coming period we will therefore focus more on international aspects of innovation systems building to embed new technologies in economy and society. This will involve both cross-national (bi-lateral/multi-lateral) and international (particularly EU) analysis.

In WP 3 will the focus be on how meeting the EU's and Norway's ambitious renewable energy targets will have significant local consequences. Policy makers must make decisions that balance the consequences for the economy, the society, and the environment. Most of the activity in WP 3 will be related to the RELEASE project (Renewable Energy Projects: Local Impacts and Sustainability). The project is financed by RCN and a number of user partners.

RA4 will dedicate resources in order to participate in the scenario work outlined in RA 5. This will be done in close relation with key researchers in RA 2 and RA 1. Furthermore, the RA 4 team will take lead in the development of the position paper "Nurturing new technologies". Finally, we will in RA 4 continue to support student startups focusing on renewable energy solutions. This could be related to both technology development and business model innovations. ■



### Renewable Energy Research Conference (RERC) 2014

Post doc Ekaterina Bjørnåli attended the RERC2014 conference that was organized at the University of Oslo in June 2014.

More than 160 researchers from prominent international and Norwegian research institutes put forward their latest discoveries and analysis within the field of renewable energy.

Bjørnåli presented her paper about the factors affecting the growth of clean-tech start-ups under the theme "Innovation and Public engagement". She was showing that current studies have focused on such external factors as policies and regulations while the firm-specific and individual factors have been neglected. She argued for the need to investigate the role of individuals and firm-level factors in the development of clean-tech start-ups.

The paper has been published in Energy Procedia. ■





## Morpho Solar AS – from baking injera in Ethiopia to the world market

Morpho Solar AS is a start-up from the NTNU School of Entrepreneurship that works with marketing of the solar grill Solgrillen and developing a heat battery for solar grills. Along the way to where Morpho is today, there was much learning and many turning points.

The journey started with us who today form Morpho's core team, three fourth-year students at the NTNU School of Entrepreneurship, got in touch with a PhD student at NTNU's Institute for Energy and Process Technology (EPT) via NTNU TTO. The PhD student showed us a prototype of a "Solar Stove" (or "Solovn" in Norwegian). This was a system complete with solar collector, heat transfer to a cooking plate, and heat storage. Such technologies had been developed at EPT since 2007. The team wanted to work with something which gave environmental gains and could lead to positive effects in developing countries. Therefore, we chose to work further with this idea.

At the beginning, "Team Solovn" as the team at the NTNU School of Entrepreneurship was called, consisted of five students. Early on, we received support from Spark NTNU to travel to Ethiopia for market research and feasibility studies. We focused on Ethiopia since deforestation, scarcity of accessible fire wood, and grave health damages from indoor smoke represent serious problems in the region. Moreover, the idea's proprietor is Ethiopian such that we had a good starting point with respect to contact network and basic understanding of the local business environment. Consequently, the solar stove idea aimed at baking the common bread "Injera" – which resembles the Norwegian svele or lefse.

While Ethiopia was considered a starting point for sales of solar stoves to institutions such as bakeries and schools, we regarded India as quite interesting because of the large number of companies working with thermal solar energy. Hence, the team wanted to travel to India to meet these companies and create contacts for potential collaboration. For this, we received support from CenSES. This helped us also much in gaining insight into how this industry functions and we could clarify strengths and weaknesses of our technology.

We established valuable contacts in both Ethiopia and India, but it was in the USA in the summer of 2014 when our work with Solovn became Morpho Solar. During the summer term, the team met – through the School of Entrepreneurship at Boston University – the founders of One Earth Designs at a conference for solar cookers. One Earth Designs are a startup that already has been on the market with a solar grill since 2013.



*The Morpho solar team in action, Dag Håkon Haneberg, Guri Grytli Seim and Even Haug Larsen*

This grill is acknowledged as a quality product which can show the work that thermal solar energy is a good solution for some energy challenges. However, One Earth Designs had not managed to find a way to store solar energy. But we did! Furthermore, NTNU's research in this field was already known to be well advanced in the world.

After meeting One Earth Designs, the relations between the two start-ups have become closer and closer. Since autumn 2014, Morpho Solar has been the distributor in Scandinavia – and now in the whole of Europe – for Solgrillen, and Morpho Solar use NTNU technology as a starting point to develop a heat storage for the solar grill such that the two products form a complete solution for the user. Today, it looks like that the Morpho team will be able to work full-time with salary in their own start-up from this summer on. This is a fast progress for a start-up company and we are proud to succeed in a priority business area which is incredibly important for our common future – clean energy. Solgrillen will be available in Jernia shops in Norway shortly after Easter, and the heat storage is on the way. In addition, we have some large international partners waiting.

To be supported by CenSES meant and means very much for Morpho Solar, and we hope to be able to continue this collaboration also in the future. ■

# RA 5 Scenario Development

The main objective of RA 5 is to provide scenario driven knowledge and analyses to policy- and decision makers to aid in the development and evaluation of sustainable energy strategies. RA 5 has in 2014 focused on analysing scenarios in projects related to CenSES:

- Energy Modelling Forum (EMF) subgroup 28: Development of electricity infrastructure under scenarios for the EU's Energy Roadmap 2050
- NORSTRAT (Nordic Energy Research): Four scenarios for carbon free Nordic power system in 2050
- E-Highway2050 (RTE/ENTOS-E): Five scenarios for development of European electricity highways to 2050.

A process with development of a set of common CenSES scenarios is started. Development of the CenSES scenarios will be a main activity in 2015, and the work will be based on the experiences from the scenario work in RA 5 projects up to now, e.g. the LinkS and the NORSTRAT project.

Several of the CenSES partners (IFE, NTNU IØT, SINTEF T&S, SINTEF Energy Research) applied for a common KPN scenario project in 2014: "Norwegian Energy Road Map 2050". Unfortunately the proposal was rejected by the end of the year.

The RA 5 team has been involved in a number of activities, workshops and dissemination in 2014. The most relevant ones are:

- Bjørn Bakken was interviewed by Aftenposten and Gemini about the Links project (see below).
- NORSTRAT was presented: for Energy Norway on a half-day seminar in April; on a seminar arranged by Sør-Trøndelag Fylkeskommune in May; on the ECOS2014 conference in Helsinki in June; on a policy workshop arranged by European Energy Research Alliance in Brussel in June and on the CenSES annual conference in December.

NORSTRAT arranged a workshop with about 15 persons from Nordic power industries in Helsinki in October.

The LinkS project was formally finalized in 2013, but some of the work continued in 2014. The Links manager, Bjørn Bakken, was interviewed by Gemini and Aftenposten. His key message was based on the results from the "Global 20-20-20" scenario in LinkS. In this scenario the EU 20-20-20 policies is extended in time and space and an increasing number of the world's regions gradually adopt the EU policies. The main conclusion from the analysis is that bottom-up, regionally independent policy measures could yield significant climate

## A Nordic power system without emission of GHG

NORSTRAT (2011-2015) is a project in the "Sustainable Energy System 2015" program financed by Nordic Energy Research. One of the objectives is to show how a fully integrated Nordic power system can become carbon neutral and what is profitable in terms of expansion of transmission grids in such a future.

A scenario methodology is used to analyse the power system in 2050 by the EMPS model and an investment algorithm is used for evaluation of profitability of expansion of transmission links. The investment algorithm run in a loop with the EMPS model, and price differences between nodes in the EMPS model are compared with annualized costs for expansion of transmission grid capacities.

The drivers "Volume of new RES" and "Integration with the Continental European system" are used to establish four main

scenarios (see figure 1): Carbon Neutral, Purely RES, European Battery and European Hub. All fossil production in the Nordic countries is assumed phased out and the demand is increased to 444 TWh/year (approximately 390 TWh/y in 2012) in all the scenarios.

In Carbon Neutral and in European Battery ca 140 TWh/y of new RES production is integrated into the Nordic system, in Purely RES and in European Hub as much as 240 TWh/y. In Carbon Neutral and in Purely RES the transmission capacities between the Nordic region and Continental Europe are kept at 2012-level.

In European Battery and in European Hub they are increased according to profitability criteria. In Purely RES all nuclear production is assumed to be decommissioned as well. Distribution of new renewable production is mainly based on existing projects in 2012.



change mitigation results as an alternative to a single global carbon market. Each region can in principle design and introduce their own policies independently of each other. Provided these regional policies are sufficiently strong and correctly timed, a set of independent regional policies seems to give

almost as large emissions reductions as a global carbon market but at a somewhat higher socio-economic cost (10-15 per cent higher). This may therefore be a feasible approach in the absence of a single global agreement and should be considered for future global climate negotiations. ■



Sysendammen (Photo Vegard Martinsen)

The results indicate that the fossil production can be phased out with modest impacts on the transmission grid (the Carbon Neutral scenario). About 57 GW internal transmission capacities in the Nordic region and 5 GW capacities between the Nordic region and Continental Europe are used as starting point for the analyses (2012 level). The profitable increases are internally in the Nordic region (GW): Carbon Neutral: 5, Purely RES: 18.1, European Battery: 10.8 and European Hub: 18.9. The profitable increases between the Nordic region and Continental Europe are (GW): European Battery: 12.2, European Hub: 19.2. Regional and distribution grids are not included in the analyses. ■

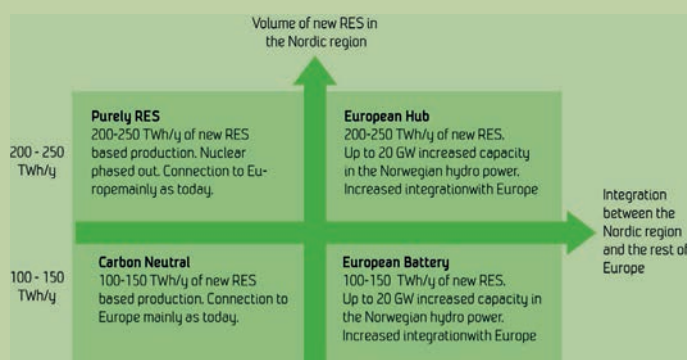


Figure 1. The NORSTRAT scenarios

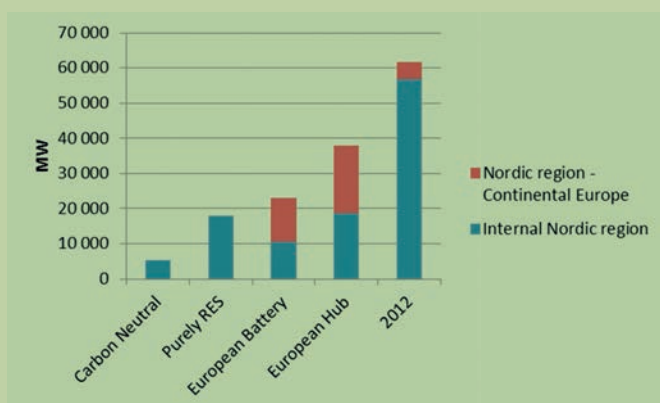


Figure 2. Profitable investments in transmission grids

# User Cases and Position papers

The user cases in CenSES bring together researchers across the defined Research Areas to address specific research topics. The topics are decided upon in cooperation with the user partners in CenSES, and all user partners can suggest new user cases. The end result of the user cases will be a Position Paper that will be made publicly available and launched at open workshops.

There are currently three ongoing user cases in CenSES:

- Flexible Norwegian energy as a green service to Europe
- Energy demand projections in Norway towards 2050 Energy policy instruments.

Additionally, three new user cases were decided upon in 2014:

- Decarbonization of the transport sector by large scale electrification
- The common Swedish - Norwegian elcertificate market
- Nurturing new technologies.

These user cases will be started during 2015.

## Flexible Norwegian energy as a green service to Europe

Renewable power sources play a greater role in the European energy mix, increasing the need for a stable but flexible source to counter the unpredictable nature of wind and solar power. We investigate Norway's capabilities to provide such flexible services and, in this way, to act as a green battery for Europe. Our study includes both direct export of energy and balancing services. The user case is done in cooperation with FME CEDREN.

Contact person: Kjetil Midthun (SINTEF T&S)

## Energy demand projections in Norway towards 2050

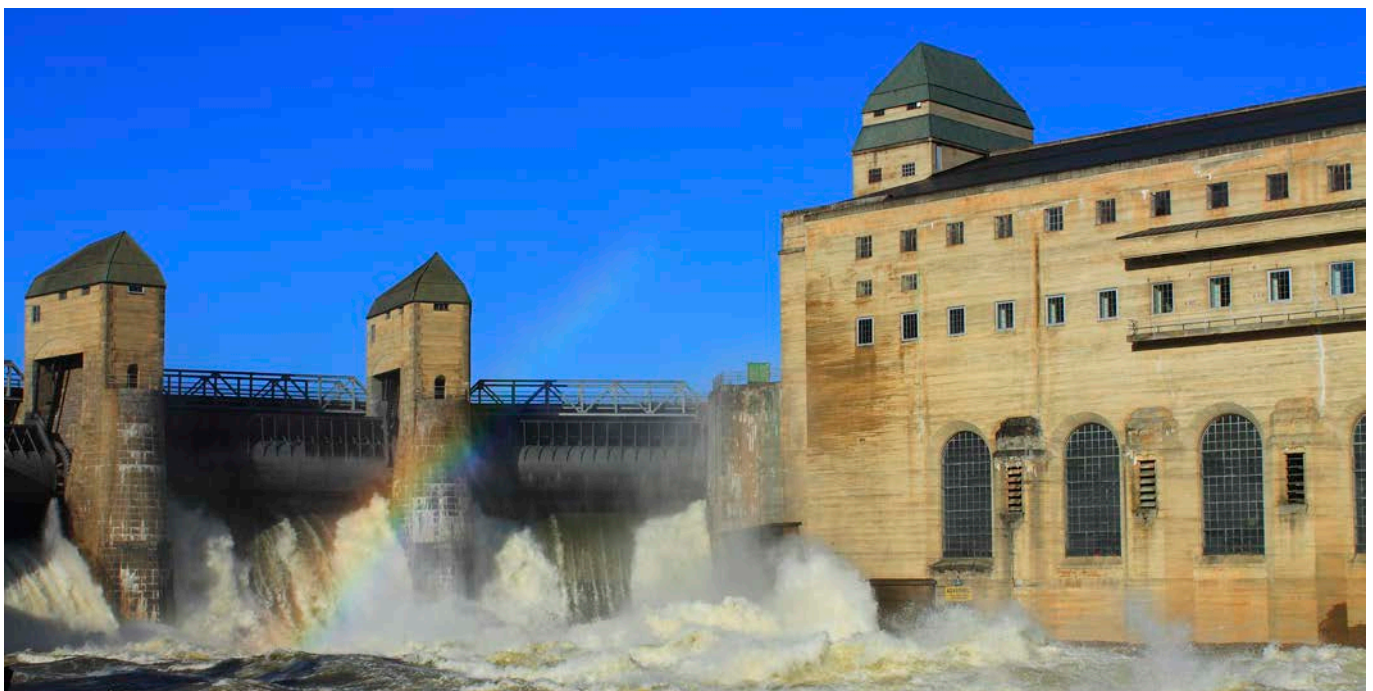
The user case investigates Norwegian energy demand towards 2050. We develop demand projections and analyse various energy carriers and services. We examine both stationary and mobile energy demand, including electricity for oil and natural gas production. The case describes a reference scenario for energy demand development as well as several scenarios building on alternative assumptions or developments such as population growth, industrial development or political instruments.

Contact person: Kari Espegren (IFE)

## Energy policy instruments

What do we know about energy policy instruments? They are basically designed to address and achieve energy policy goals. Energy policy objectives and priorities on their hand are shaped by how resource policy and industrial policy are balanced with climate policy considerations. Evidence indicates that politicians must decide on a clearer energy policy. This position paper wants to contribute to this by addressing three main issues; 1) Which energy policy instruments are available? 2) Which instruments actually work? And 3) What instruments can be advantageously developed and used?

Contact person: Jøran Solli (NTNU) ■







Dam Presteinvatn (Photo Vegard Martinsen)

## New User cases and Position papers

Based on meetings and discussions with the user- and research partners in 2014, we have decided upon three new user cases that will be started in 2015: “Decarbonization of the transport sector by large scale electrification”, “The common Swedish - Norwegian elcertificate market” and “Nurturing new technologies”. The final content of the user cases will be discussed together with the user partners at workshops during 2015, but an initial description is provided below for each user case.

### Decarbonization of the transport sector by large scale electrification

This user case will consider aspects of a large scale electrification of the transport sector. This includes power transmission, distribution networks, the need for instantaneous power and power balance. Public perception and attitudes towards electrification of transportation services will also be discussed. Additionally, gaining an understanding of various rebound effects by following the transport behaviour of different groups will be included. This incorporates questions such as: How does transport behaviour change a) for those not buying an e-car, b) those having acquired an e-car recently and going through a transition phase, and c) those who have been using an e-car for some time? In addition, life-cycle analysis in general and recycling of batteries is planned as a part of the user case.

Contact person: Ingeborg Graabak (SINTEF Energy)

### The common Swedish - Norwegian elcertificate market

The user case will summarize our research on the properties of green certificates. This will include a discussion of the background and motivation for the introduction of green certificates, analyses and discussions of the expected and planned development of power production and transmission capacity due to the certificates as well as a comparison between the two countries included in the green certificates: Norway and Sweden.

Contact person: Kari Espegren (IFE)

### “Nurturing new technologies”

In the work with the user case we will discuss the efficiency and properties of different incentive schemes for promoting renewable energy. Which incentive schemes and regulatory frameworks will stimulate long-term technology development and the introduction of new technologies in the market? The work will cover a broad range of technologies and incentive schemes such as green certificates, feed-in tariffs and CAPEX-support for CCS installations. Moreover, we will discuss selection mechanisms for incentive schemes – why are certain mechanisms chosen in certain settings and what is the motivation behind these mechanisms?

Contact person: Markus Steen (SINTEF T&S) ■



# International Cooperation

## Driving the Energy Transition Together: Research & Innovation for the Energy Union



Marianne Ryghaug,  
key note speaker at  
SET-Plan

On “Energy Citizenship” Professor Marianne Ryghaug, Deputy Director of CenSES attended the SET-Plan conference Rome, as a key note speaker 9-11 December, 2014.

The 2014 SET- Plan Conference fell at a crucial time, when momentum is gathering towards the development of the SET Plan Integrated Roadmap and an Action Plan promoting stronger collaboration between Member States and with the EU in areas such as energy efficiency, competitive low-carbon supply of energy, and system optimization including smart cities and communities.

Gathering 500 energy stakeholders from across Europe, the SET Plan conference facilitated debate around the EU’s key energy policy targets for 2030: sustainability, competitiveness and security of supply and the importance of research and innovation in achieving them.

After an overall political introduction about the Integrated Roadmap, Session 2 provided an overview of the needs and expectations for the European energy system of key European stakeholders: Industry, Research, Civil Society and Private Investors.

Ryghaug presented The Citizens Perspective. In her speech she covered the needs of civil society towards a low carbon energy system for Europe; the main expectations of the area with respect to the development of a low carbon energy system and the specific research and/or innovation challenges the community is facing to contribute to a competitive, sustainable and secure energy system. The presentation focused on the role of citizens and contribution of social sciences and humanities in the development of a low carbon energy system for Europe, important factors that may trigger the engagement of citizens towards new low carbon energy technologies; and the main elements for an active participation of citizens in the energy system and related policy making.

Ryghaug argued that policy makers expect and need people to become more active participants in energy systems in order to reach ambitious climate goals: “While citizens in the past has been understood as passive, we now see a potential for a conceptual shift where we will have to think differently about how to engage users and communities towards new low carbon energy technologies”. Knowledge about energy citizenship Ryghaug claimed to be vital for the success of the SET plan. ■

## BEEER Conference



NHH hosted the 5th annual Bergen Economics of Energy and Environment Research (BEEER) conference in May 2014. The event was a great success, bringing together the research community on the economics of energy and environment with participants from all over Norway and Europe.

CenSES Post doc Johannes Mauritzen presented the effect of oil prices on field production. In his recent work with Jonas Andersson, he found that the main impact of oil prices on field production occurs in the planning stage for the field.

The BEEER conference also included presentations from Norwegian master students for the best master thesis. CenSES master students Gørild Slettjord Andersen and Ellen Krohn Aasgård from NTNU won the award for their thesis on bidding in the day-ahead electricity market. This annual award, from Norwegian Association of Energy Economics (NAEE), encourages master students around Norway to strive for robust and relevant master research.

A new BEEER conference is scheduled to take place in May 2015. ■

## Smart Grids and the Social Science

The electricity system is undergoing a digital transformation. This brings with it some technical challenges, but this is also a societal challenge. In April CenSES and ZEB co-hosted a workshop on smart grids and the social sciences, to critically engage smart grids from a social scientific perspective. The workshop attracted scholars from 13 countries who discussed how we could make sense of, engage with and participate in the smart grid development as social scientists. Much of the work presented will be published in a special issue of the journal Energy research and social science. ■

For more see: <http://smartergrids.wordpress.com>



## Household Preferences for reducing greenhouse gas Emission in four European High Income Countries (HOPE)



Western Norway Research Institute (Vestlandsforskning) is the Norwegian partner in a three-year and four-country comparative European project that are going to investigate the extent the European households are willing to change their consumption patterns in order to contribute in halving societies greenhouse gas emissions (GHG), and further more to analyse the changes in current climate policies needed to enhance such changes. The project is financed by the Joint Program Initiative mechanism and is part of the call "Societal transformation in the face of climate change".

The HOPE project will generate new knowledge in three areas (1) the drivers behind current household emission, (2) households' choices to achieve imposed GHG reduction targets; (3) economic costs & benefits as well as health co-benefits of each choice.

The study comprises three stages: (1) A household interview survey including the assessment of the current household footprint of direct and indirect GHG

emissions. (2) An on-site simulation, in which household will be guided through a GHG reduction simulation of 60 GHG saving options. For each behavioral change, the resulting savings (GHG reduction), costs and health co-benefits will be shown. (3) A semi-structured qualitative follow-up interview addressing household views on potential barriers and motivation for the measures chosen in stage 2.

Engaging with policy-makers from the start we will develop possible innovations in current climate policy regimes at EU, national and local levels of governance to support households in their consumption choices.

The research consortium consists of five partners: Institute of Public Health (IPH), Heidelberg (lead partner), TEC-Conseil (a French research & consultancy company), Centre International de Recherche sur l'Environnement et le Développement (CIRED), Western Norway Research Institute and Umeå University, Division of Epidemiology & Global Health. ■

	Germany	France	Norway	Sweden
Name of town	Mannheim	Communauté du Pays d` Aix	Bergen	Umeå
Population	290,000; immigr+	350,000	250,000	120,000, growth+
Emission targets	-40% (2020)	non	-50% (2030)	-50% (2025)
Economy	Manufacturing	Touristic, service	Touristic, service	Services, manuf.
Climate	Average	Warm	Cold, heavy rain	Cold temperate

Table 1 - Sample Locations: populations of comparable mid-size towns involved in the HOPE project

### Nordic researchers, IEA and Nordic Energy Research cooperates on the second edition of Nordic Energy Technology Perspectives

A new Nordic Energy Technology Perspectives project started autumn 2014. The project aims to develop Nordic research competencies and provide in-depth analysis on how the Nordic countries can meet the challenges identified in the first publication. Analysis of issues critical in realising a decarbonised Nordic energy system will be carried out, with a specific focus on urban analysis and energy system integration. We will address the urban level by looking at how to achieve a sustainable transport system and a smarter utilisation of energy in cities. In addition, we will study the wider international level by analysing how the Nordic energy system can interplay with Europe, with a focus on electricity integration.

The project aims to:

- Develop Nordic research competencies and cooperation
- Provide research-based analysis to inform Nordic decision-makers
- Share knowledge to inform decisions on decarbonisation outside the Nordic region

The second edition of the publication Nordic Energy Technology Perspectives will be launched in the middle of 2016.

The partners:

Norway: IFE, Sweden: IWL and Profu, Denmark: DTU Risø and EA Energianalyse, Finland: VTT and Iceland: University of Iceland. ■

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### Singapore-China Energy Forum 2014



Singapore-China Energy Forum 2014: Opportunities and Challenges in China's Energy and Carbon Markets. Third from the left: Ruud Egging.

On 2 and 3 October 2014, the Energy Studies Institute at the National University of Singapore organized the Singapore-China Energy Forum 2014. The Chinese government has stated ambitions to reduce Greenhouse Gas emissions. Coal consumption must be reduced and natural gas is one

option to do so. Associate professor at NTNU Ruud Egging, one of only few European participants, was invited to discuss the "Role of China in the World Gas Market". In recent years, China has started importing large volumes of natural gas. Projections by the International Energy Agency show further increasing Chinese imports, with great impact on global natural gas trade. Quantitative scenarios with the Global Gas Model, joint work by NTNU, DIW Berlin, and SINTEF Research Manager Kjetil Midthun, illustrated Chinese domestic infrastructure developments, increased liquefied natural gas imports and pipeline supplies from Central Asia and Russia.

During a half-day workshop at the end of the forum various research collaboration opportunities were discussed. There is a clear demand for Western expertise and experience in projects varying from energy market reform and carbon market design, to flexible strategic and infrastructure planning and interconnection of Chinese energy markets and transportation networks with neighboring countries. ■



## Research exchange to Freiburg

Photo: Karen Byskov Lindberg



Systems (ISE) was founded here in 1981, which is recognized as one of the best research institutes on solar energy worldwide. The main focus in the beginning was solar thermal energy (ST), but advanced quickly to photo voltaics (PV) and further to multi-junction concentrated PV (CPV), the latter holding the world record of 46 % efficiency. Today, ISE has about 1300 employees, and has a wide specter of technology development of PV and ST modules, storage technologies, energy efficient solar buildings, and smart control of energy use of both buildings and electric vehicles, together with on-site PV generation.

The widely spread PV technology and the subsequent concept of Zero Energy Buildings is well known in Germany.

Freiburg is a city situated in the south-west corner of Germany, close to the border of France and Switzerland. To the east, the mountains of Swartzwald (the black forest) ascends with skiing possibilities in winter, and hiking and mountain biking in summer. Freiburg lies in the heart of a wine district with many local wineries. In this part of the Rhine valley, the Gutedel grape – brought here by the Romans – is the local pride.

Freiburg is the sunniest city in Germany, so maybe it was no coincidence that the Fraunhofer Institute for Solar Energy

Because of the experience on prosumers and smart grid technologies, this has been a focus area for research longer than in most other countries. The smart grid department at ISE covers a wide aspect of technologies and solutions for smart homes and smart communication technologies, which was very inspiring in my work on Zero Emission Buildings. Working together with this team challenged my own views and ideas, and I gained significant knowledge, which resulted in a very productive year with several common papers. ■

PhD candidate Karen Byskov Lindberg

## Research exchange to TU Berlin

With support from CenSES, I was able to have a research exchange stay at TU Berlin from early September to early December 2014. More precisely, I was located at the Centre for Entrepreneurship under Professor Jan Kratzer. This is an international environment with high activity levels within research, education and practice-oriented programs. Their focus is of course within the entrepreneurship domain, but they have also ongoing activities targeted towards cleantech and renewable energy both within research and programs. For instance, they are German hosts of Climate-KIC, which is a large EU educational project, for students and PhDs, that aim to develop innovative products that counteract the adverse effects of climate change and supports student innovators and entrepreneurs within the field of cleantech.

During my visit, I mainly focused on developing and writing my own research papers in peaceful surroundings. I also enjoyed fruitful discussions with fellow PhDs and other

academic staff with a different perspective than myself. Another bonus is that through attending academic presentations and events in German, my limited German language skills were challenged and further developed. Overall, TU Berlin provides good facilities and opportunities for research, and a fun social environment. And of course, Berlin is a wonderful city!

I would like to thank CenSES for supporting my exchange, and especially Roger Sørheim and Øystein Widding for support and encouragement before and during my stay. ■



PhD candidate  
Øyvind Bjørgum

# Dissemination

## Grønn Agenda

On February 25, 2014, the Ministry of Climate and Environment invited to a debate at NTNU. CenSES director Asgeir Tomasgard participated in the panel together with minister of Climate and Environment Tine Sundtoft. The Grønn Agenda (Green Agenda) meeting was the third one in Sundtoft's tour around the country in order to get input to the initiative for green development and environmental technology.

"We face a very large challenge. We must transform production and consumption such that we achieve about 80 percent lower greenhouse gas emissions and much better resource efficiency. This means large investments each single year for 30 to 50 years. Hence, the demand for technologies which can help to tackle this challenge", Sundtoft said.

Sundtoft is keen to see climate and environmental challenges as something which creates new opportunities for society. Sundtoft made more specific what green development is about: development of environmentally friendly input factors in a number of industries, for everything from

renewable energy to maritime transport, construction and processing industries and utilization of natural resources such as seaweed and kelp for production of food and energy. All panel participants agreed that focusing on environmental technology needs governmental support.

"For many investments in environmental technology, the risk is too high as long as pollution is cheap. Often, this is immature technology which shall be rolled out in immature markets. In such cases, the government should purposely subsidize investments at an early stage", Asgeir Tomasgard stated.

Tomasgard also had specific suggestions to overcome this. "In order to increase commercialization of research, direct measures such as earmarked supplementary scholarships for interested PhD candidates are conceivable. This way, they can learn more about entrepreneurship already during their training period".

For more information about the panel discussion, see [www.censes.no](http://www.censes.no). ■



The Ministry of Climate and Environment, Tine Sundtoft invited to debate at NTNU.



## China's Offshore Wind Industry 2014



Korsnes at CenSES annual conference

PhD student Marius Korsnes published an industry report titled "China's Offshore Wind Industry 2014: An overview of current status and development" in August 2014.

The report gives an overview of China's emerging offshore wind industry, including detailed descriptions of the policy environment, the industry development and the major barriers connected with developing the industry. The report is based on data collected during a one-year field stay in Shanghai in 2013 and 2014. The data included 43 interviews with industry, government and research communities, a two-month research stay at a European certification company entering offshore wind in China, as well as several workshops and conferences on onshore and offshore wind.

The report finds that the major barrier to offshore wind development in China was the high cost of developing offshore wind projects. In order for projects to obtain an acceptable rate of return, the government needs to set policy incentives that encourage large SOEs to invest in offshore wind farms. The industry supply chain appeared to be able to support a long-term market of sufficient scale.

One area of concern for the industry as a total was the lack of mechanisms that ensure the quality and long-term performance of offshore wind technologies.

Nevertheless, the data, and the

fact that China's offshore wind industry developed slower than expected, indicated that quality-issues were taken seriously, for instance in terms of selecting appropriate sites. ■



## Climate Council

CenSES director Asgeir Tomasgard is one of 25 permanent members of the climate council recently established by the minister of Climate and Environment Tine Sundtoft. "The climate council will be among several future arenas to ensure a good dialogue on climate policy and the necessary transformation to a low-emission society", says minister of Climate and Environment Tine Sundtoft.

The climate council's mission will be to provide advice and suggestions to how the climate settlement (Klimaforliket) can be strengthened and Norway can be put on track for a low-emission society in 2050. All advice and suggestions will be public.

"We have long wished for a climate arena gathering business and industry, politicians, environmental organisations, and researchers", Asgeir Tomasgard says.

For CenSES, working with the fact base for future's sustainable energy system, it is a pleasure and useful to be invited to this arena. We thank for the invitation and look forward to the time ahead. ■



The Ministry of Climate and Environments first meeting with her Climate Council. (Photo Department of Climate and Environment)

# Dissemination

## Energy storage in future energy systems

At the end of October, CEDREN and CenSES in collaboration with the Research Council and European Energy Research Alliance arranged a joint seminar on energy storage. Topics discussed were various storage technologies and requirements of future energy systems. Over 30 representatives from the energy industry attended to discuss status and prospects for these technologies.

CEDREN and CenSES both work with energy system analyses, albeit from slightly different angles. Through their work with scenario modeling and consequence studies, they also saw the need for increased focus on energy storage. The seminar topic was chosen based on suggestions from user partners, and the aim was to provide an overview over opportunities and challenges with respect to the part energy storages will play in future energy systems.

CenSES director Asgeir Tomasgard presented examples for challenges Europe faces under various energy and climate political scenarios, emphasizing the need for flexibility caused by increased renewable energy production.

CEDREN director Atle Harby followed up with an overview over technologies for mechanical storage.

“The different storage technologies flywheel, pressurized air, flexible hydropower, and storage pumping play different roles as they provide energy storage on different time scales. Today, adjustable hydropower and storage pumping represent the only large-scale storage technology which is competitive and will play a central role many decades ahead”.

Norway is fortunate since we also have a large amount of natural gas at our disposal which, similar to hydropower, is a great source of flexibility. Kjetil Midthun from CenSES / SINTEF presented viewpoints on this, with particular emphasis on the energy stored in gas export infrastructure.

Other topics also discussed on the seminar were CCS and fossil energy sources, Norwegian hydropower, usage of hydrogen and a number of storage technologies, from large-scale battery technology to geothermic energy storage. ■



Energy storage in future energy systems seminar



UngEnergi at Trondheim Maker Faire

### UngEnergi

In 2013 UngEnergi successfully created a stable platform for the website [ungenergi.no](http://ungenergi.no). The project group consisting of youths between 16-22, had partly achieved reaching the goal to create a website around sustainable energy for high-school students. A broad spectre of information about renewable energy was now easily accessible for the target group. Backed by CenSES and various other contributors, the project was headed with full speed into 2014.

With a goal to keep developing the website in 2014, the project group started creating material that could be more directed towards the teachers. This is a method the group decided would be the best way to reach out to the largest possible crowd. Getting the website to be accepted into schools had previously been a challenge.

The main innovation UngEnergi introduced to the website in 2014, was a section specifically made for teachers. Material that could be used directly into class was published, and instantly received positive feedback, both from students and teachers. This material consists mainly around fully developed project “packages” that teachers can use in tutoring. These packages containing i.e. “how-to” videos, finished power-point presentations and tasks around the package theme. Examples of such themes vary from an easy-to-build wind turbine, to a sun-powered charger for a mobile phone.

Another important step marketing the website, was the presence of the project group at various seminars and gatherings, both for teachers and various crowds. Showing up at for example “Trondheim Maker Faire”, “Forsknings-torget” and “Opplæringsdagen”. This proved to be a great way to improve visitor numbers, and leap in the use of the website was detected.

At the end of 2014, the project group reached a collective goal towards 2015, where an agreement to keep developing “packages” was the most important priority. Also the challenge of keeping the website up-to-date around current news, is to be prioritized. ■

For more information, visit [www.ungenergi.no](http://www.ungenergi.no)



### Tweet tweet

At the end of 2014 CenSES had 238 followers, and we were following 576, all key national and international stakeholders such as industry decision makers, politicians, scientists and researchers.

We use twitter to present our research and to communicate with people that are sharing the same passion about sustainable energy. In 2014 one of our tweets reached more than 15, 000 people!

**Follow us on twitter!**  
**@FMECenSES**



## CenSES annual conference

Around 70 participants attended the CenSES annual conference December 4-5 2014. The participants were a mix of CenSES user partners, researchers and PhD students. There were 22 presentations covering topics such as UN climate policy, energy use in households, energy demand in Norway, new technology and commercialization, energy markets, climate policy and scenariostudies.

A majority of the presentations at the conference were CenSES PhD students or PhD students from related projects presenting their research results. PhD candidate Ingeborgrud talked about pure electric driving pleasure, PhD candidate Walmun was presenting "godstransportprosjektet" and phd candidate Skar was presenting energy storage in future energy systems.

The research area leaders presented research result from their areas, such as Gunnar Eskeland with his presentation

about Urban sustainable development: what it means to build cities for the future, and Kari Espegren presenting energy demand projects in Norway towards 2050.

Edgar Hertwich gave the participants an insight to UNs climate report with the theme "Black or green? We choose our energy future now."

Even Haug Larsen, a masterstudent from NTNU presented the history behind Morpho Solar, a CenSES supported project about the future way to cook.

The conference invited to diversity in the presentations, and it created many discussions that may be relevant in the future.

Presentations can be found at [www.censes.no](http://www.censes.no) ■



Ruud, Tomasgard, Weaver and Steen are discussing the research presented.



Black or green? by Edgar Hertwich.



Around 70 participant attended the annual conference at Scandic Eddekkoppen, Oslo.

# Education

## Master students

In 2014 approximately 50 master students wrote their thesis on environmentally friendly energy systems and markets in CenSES. Key researchers, post docs and phd students from the center supervised the master students.

## PhD students

There were 24 PhD students funded by CenSES in 2014. Two of these students finished their thesis during the year, Patrick Narbel, NHH and Daniel Haugstvedt, NTNU. Further to this, an additional 27 PhD students were employed in related projects with funding from other sources. These students were invited to participate in events organized by CenSES, and some of them presented their work at the annual conference in December. Three of these students finished their thesis during the year, Aleksandra Klimek, NTNU, Sara Heidenreich, NTNU and Åsne Lund Godbolt, NTNU.

## Examples of PhD courses given in 2014

- Stochastic programming with applications in energy, finance and insurance (Georg Pflug and Asgeir Tomasgard)
- Complementarity Models and Equilibrium with Discrete Decisions (Steven Gabriel)
- Implementing and integrating renewables in the energy system-focusing on consumer behavior and energy storage, NorRen Summer School (Ann Mari Svensson) ■



## Master thesis: Collaborating in Research Centres – How knowledge intensive firms benefit from collaborating in research centres.

This master thesis by Emil Johan Oliver and Hans Christian Toftesund aims to answer how knowledge intensive firms benefit from collaborating in research centres, which is based on their desire to study Norwegian Centres for Environmentally Friendly Energy Research (CEER) where several research institutions and firms are involved.

Their conclusion is that large firms with funds for R&D have the research partners develop firm-specific competence which is later applied in binary research projects. Smaller firms with lower R&D capacity conduct research that advanced their technological development within the research centre. Supporting industry partners primarily benefit by gaining insight into the state-of-the-art as well as customer insight. Thus, all industry partners benefit from different kinds of knowledge creation.

## Master thesis: Commercialization of Norwegian Wind Energy Technologies

This master thesis by Abhijit Banik aims to contribute to research on renewable technology commercialization, by addressing how Norwegian companies can successfully commercialize new wind energy technologies. A multiple case study investigating six different Norwegian B2B wind technology providers through several in-depth interviews is used as a basis for the analysis and discussion in this paper.

The research shows that wind technology providers should create a whole product to overcome the chasm between early innovators and mass-market customers. Decision-makers should be aware of external factors such as competitors, the government and the fact that the wind industry is dynamic and immature. ■





## Developing multidisciplinary research collaboration journeys

In 2014, members of CenSES Markus Steen, Jens Hanson, Håkon Normann, Tyson Weaver and Gard Hopsdal Hansen conducted a week-long intensive workshop. The preliminary goal was to explore if combining data and theoretical perspectives could create a stronger research contribution.

Using several years of data collected from the oil and gas, process, hydropower and other renewable energy industries, the intent of the project is to draw upon various theoretical knowledge bases in economic geography, innovation studies, industrial development and strategic management to explain how old established industries embark on new paths within emerging renewable energy sectors. To date the process has resulted in a newspaper commentary in SYSLA. Their main aim is to publish two articles based on joint work: one on industrial dynamics and one on policy. Both articles are at draft stage and will be presented at conferences (NESS2015, IST2015) and submitted for publishing in 2015.

Through several follow up workshops, the researchers have identified a set of key factors for creating multidisciplinary work through CenSES, namely:

- Participation at CenSES gatherings: get to know and be known (who is doing what, and how it might be relevant for your work, finding common ground)
- Chances for success in establishing a working relationship increase with stronger social ties
- Identify areas of theoretical overlap that allow openings from several theoretical pillars
- Willingness to open up and share data
- Be patient and open investing time in exploring common ideas from diverging theoretical perspectives
- Leverage each other's competence in their respective fields, don't try to read yourself up to date on each other's theoretical pillars
- Operating virtually demands active virtual participation
- To achieve quality, accept that multidisciplinary research takes time.

By actively participating in the multidisciplinary project work, the researchers recognize it has provided a foundation for developing new ideas for future projects both within and outside the working group. ■

## 2014 Dissertation: Patrick Narbel, NHH

Patrick André Narbel defended his PhD thesis in June 2014 for his PhD degree at NHH. His thesis “Essays in Renewable Energy Economics” deals with several key issues related to the spread of new renewable energy technologies (e.g. wind and solar) globally.

Energy is a key component of our lives. All goods and services surrounding us require energy, either to be useful or during its production.

In our early history, humans learned to use wood and solar energy (heating) as well as wind (transport) to cover their energy needs. The invention of the steam engine changed the way we lived, progressively reducing our use of renewable energy as we shifted to and expanded our use of fossil energies. These energy sources have contributed to making the society what it is today. However, concerns about resource scarcity and climate change have fostered a renewed interest for non-hydro based forms of renewable energy, especially wind and solar energy. This is because it is these sources of energy which can contribute to solving both of these grand challenges.

The scarcity issue leaves little room for doubt that renewable energy represents the future of energy. The threat of climate change is likely to increase the speed of a transition towards a sustainable energy supply. However, shifting to cleaner energy is no easy feat and it requires addressing many concerns relating to the economics and engineering of renewable energy.

Identifying where we stand today in our understanding of renewable energy and of the barriers lying ahead is the major quest pursued in this thesis. More specifically, the emphasis is put on the economic apprehensions surrounding the transition to a more sustainable energy mix.

In that domain one finds many questions of interest that to a large extent have gone unanswered. For example, where do we stand with our ability to economically harness renewable energy sources? Why would countries invest in these comparatively expensive sources of energy?

Which countries are doing this and how can the deployment of intermittent sources of energy be facilitated in an efficient manner? These questions cover some of the concerns I have attempted to address during my PhD studies. The thesis explore these issues and Patrick find that rich countries dependent on coal imports are those with the highest share of intermittent power. This relates to the double target of reducing dependency on foreign countries and abate greenhouse gas emissions.

Despite their economics rapidly improving, wind and solar power largely remain dependent on subsidies for their deployment. However, the biggest barrier remains their intermittency. This intermittency creates a cost for the system (need for back-up) which is not integrated in current policy instruments. Alternative policy instruments could be better design to force investors to integrate market needs in the investment decision, such that the most valuable projects for the power system would be built first. ■



***“Energy is a key component of our lives. All goods and services surrounding us require energy, either to be useful or during its production”.***

*Patrick Narbel, PhD Thesis*

## 2014 dissertation: Sara Heidenreich, NTNU

Sara Heidenreich defended her PhD thesis in October 2014 at the Department of Interdisciplinary Studies of Culture. Her thesis "Blowing in the wind: The socialization of offshore wind technology" deals with the socialization of the emerging offshore wind technology in Norway. In particular, it focuses on two potential agents of socialization, news media and scientists.

The development of renewable energy technologies is a widely acknowledged strategy to address climate change. However, for a successful implementation of technology, socialization, i.e. embedding the technology into society, is crucial.

The first paper, *Dingpolitik at Sea: Offshore wind energy in the news media discourse*, focuses on news media as socialization agents. Siting renewable energy offshore is often considered a solution to implementation problems onshore, as it is "out of sight, out of mind". By analyzing the Norwegian news media discourse on offshore wind energy, this paper investigates whether moving wind turbines at sea really prevents controversy. It finds that although media coverage is largely positive, still, offshore wind energy is contested mainly within economic, environmental and moral frameworks. Further, values and concerns rather than facts are contested in the media debate, while the technology, in its physical form, is blackboxed.

The second paper, *Sublime technology and object of fear: Offshore wind scientists assessing publics*, and the third paper, *Outreaching, outsourcing, and disembedding: How offshore wind scientists consider their engagement with the public*, address offshore wind scientists as socialization agents. They study the scientists' imaginings of the public(s) and their socialization strategies.

The findings indicate that the scientists construct ambivalent narratives about the public(s). The continued presence of narratives of a negative public in the context of a technology that is supposed to be "out of sight, out of mind," could be understood as an act of othering the public. Moreover, most scientists did not embrace their role as agents of socialization. Rather, the strategies of outsourcing the socialization to other actors and of disembedded technology development, i.e. declaring socialization unnecessary, are common.



The thesis highlights the important role of the media both as agent of and arena for socialization. Furthermore, considering the hesitance among scientists to act as agents of socialization, it suggests that other actors may be more suitable agents of socialization. It also points to the significance of the "out of sight, out of mind" motive which is used to construct socialization as irrelevant and disembedded technology development. Hence, the new trend to produce renewable energy at sea may present new challenges for its socialization. ■



## Education

### PhD candidates with financial support from the centre budget



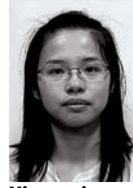
**Vegar Lein  
Ausrød**  
NTNU



**Øyvind  
Bjørgum**  
NTNU



**Lisa Marie  
Assmann**  
NHH



**Xiaomei  
Cheng**  
NHH



**Linda  
Ellingsen**  
NTNU



**Mads Dahl  
Gjefsen**  
UiO



**Ole Inge  
Gjerald**  
Vestforsk/NTNU



**Zhonghua Su**  
NTNU



**Tyson  
Weaver**  
HiSF/NTNU



**Daniel  
Haugstvedt**  
NTNU (2014)



**Robert L.  
Jomisko**  
NTNU



**Karen Byskov  
Lindberg**  
NTNU



**Patrick  
Narbel**  
NHH (2014)



**Håkon  
Normann**  
UiO



**Ha Thi Bich  
Pham**  
UiO



**Sylvia  
Lysgård**  
NTNU



**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



**Thomas  
Gibon**  
NTNU



**Hilde  
Nykamp**  
TIK



**Jens Hanson**  
UiO (2013)



**Veronica  
Araoz**  
NHH (2012)



**Johannes  
Mauritzen**  
NHH (2012)



**Trine  
Unander**  
NTNU

### Post docs with financial support from the centre budget



**Ola Edvin Vie**  
NTNU



**Ekaterina  
Bjørnåli**  
NTNU



**Parmita Saha**  
HiSF



**Gerardo  
Perez Valdés**  
NTNU



**Erik Haugom**  
NTNU



**Adela Pages**  
NTNU



**Johannes  
Mauritzen**  
NHH



**Jens Hanson**  
UiO



**Anders  
Arvesen**  
NTNU



**Stefan  
Pauliuk**  
NTNU





## Budget and reported costs

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	4 142	7 049	8 197	6 490	7 312	4 663	4 634	4 516	514	47 517												47 517
NTNU HF	4 661	6 420	6 842	6 726	7 857	9 038	8 911	7 160	156	57 771												57 771
NTNU Indecon	0	616	1 496	2 161	1 435	1 086	34	36	7 969													7 969
NTNU Elkraft	96	247	239	321	349	78	0	0	1 329													1 329
NTNU Samfunnsforskning	0	0	76	12	267	100	100	0	655													655
UIO	1 074	4 140	4 127	3 655	2 346	2 889	2 890	2 891	342	24 354												24 354
HISF	1 794	2 896	1 852	2 194	8 859	9 024	8 618	591	0	35 827												35 827
VF	1 042	1 127	797	1 195	510	510	510	0	6 200													6 200
NHH	2 349	3 089	2 688	2 738	2 788	2 888	2 888	2 938	0	22 316												22 316
SintefEF	3 178	4 856	3 510	3 207	3 431	3 221	3 209	3 196	0	17 808												17 808
SintefTS	1 804	2 433	2 381	2 234	2 347	2 089	2 076	2 067	0	17 431												17 431
IFE	2 100	2 047	2 032	2 110	2 137	2 110	2 110	2 140	0	16 786												16 786
SNF	1 407	1 398	1 289	1 551	1 375	1 368	1 355	0	11 124													11 124
<b>Total research partners</b>	<b>23 648</b>	<b>36 317</b>	<b>35 525</b>	<b>34 594</b>	<b>41 013</b>	<b>39 045</b>	<b>38 399</b>	<b>27 498</b>	<b>1 048</b>	<b>217 087</b>												217 087
<b>Total user partners</b>	<b>947</b>	<b>1 127</b>	<b>1 006</b>	<b>1 276</b>	<b>1 343</b>	<b>1 343</b>	<b>1 343</b>	<b>552</b>	<b>0</b>	<b>9 728</b>												9 728
Abroad	160	173	556	192	425	552	552	552	0	3 161												3 161
<b>Total</b>	<b>24 755</b>	<b>37 617</b>	<b>37 087</b>	<b>36 062</b>	<b>42 781</b>	<b>40 940</b>	<b>40 294</b>	<b>29 393</b>	<b>1 048</b>	<b>289 977</b>												289 977

For the tables showing budget and results, the numbers for 2011-2014 are the actual reported costs. The numbers for NTNU HF includes the costs for the centre management and joint 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	6 236	0	6 391	0	5 315	0	5 842	0	3 140	0	3 289	0	3 511	0	95	0	37 836	37 836	
NTNU HF	0	3 670	0	3 951	0	4 246	0	4 751	0	3 799	0	5 009	0	5 479	0	4 058	0	156	0	35 119	35 119	
NTNU Indecon	0	616	0	616	0	616	0	674	0	422	0	93	0	75	0	34	0	36	0	2 566	2 566	
NTNU Elkraft	0	0	0	0	0	22	0	32	0	0	0	0	0	0	0	0	0	0	0	54	54	
NTNU Samfunnsforskning	0	0	0	0	0	18	0	12	0	25	0	25	0	25	0	25	0	0	0	130	130	
UIO	0	990	0	3 414	0	2 776	0	2 542	0	1 417	0	1 989	0	1 990	0	1 991	0	242	0	17 351	17 351	
HISF	0	613	0	1 166	0	866	0	952	0	6 536	0	7 804	0	7 363	0	375	0	0	0	25 675	25 675	
VF	0	392	0	477	0	797	0	684	0	0	0	0	0	0	0	0	0	0	0	2 350	2 350	
NHH	0	1 650	0	1 912	0	1 750	0	1 800	0	1 850	0	1 900	0	1 950	0	2 000	0	0	0	14 812	14 812	
SintefEF	0	2 179	0	2 362	0	2 039	0	2 166	0	2 000	0	2 000	0	2 000	0	2 000	0	0	0	16 746	16 746	
SintefTS	0	964	0	1 265	0	1 277	0	1 219	0	1 200	0	1 200	0	1 200	0	1 200	0	0	0	9 525	9 525	
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	
<b>Total research partners</b>	<b>0</b>	<b>15 673</b>	<b>0</b>	<b>22 599</b>	<b>0</b>	<b>21 998</b>	<b>0</b>	<b>21 348</b>	<b>0</b>	<b>24 292</b>	<b>0</b>	<b>24 360</b>	<b>0</b>	<b>24 571</b>	<b>0</b>	<b>16 395</b>	<b>0</b>	<b>529</b>	<b>0</b>	<b>171 764</b>	<b>171 764</b>	
<b>Total user partners</b>	<b>3 900</b>	<b>947</b>	<b>4 025</b>	<b>4 025</b>	<b>4 025</b>	<b>4 025</b>	<b>4 025</b>	<b>4 025</b>	<b>4 025</b>	<b>4 025</b>	<b>4 025</b>	<b>4 025</b>	<b>4 025</b>	<b>4 025</b>	<b>4 025</b>	<b>4 025</b>	<b>4 025</b>	<b>4 025</b>	<b>4 025</b>	<b>4 025</b>	<b>4 025</b>	<b>4 025</b>
Research Council	4 235	0	9 866	0	12 273	0	10 237	0	11 548	0	11 287	0	11 030	0	9 005	0	519	0	0	80 000	80 000	
<b>Total</b>	<b>8 135</b>	<b>16 619</b>	<b>13 891</b>	<b>23 726</b>	<b>14 590</b>	<b>23 004</b>	<b>13 438</b>	<b>22 624</b>	<b>16 640</b>	<b>25 635</b>	<b>15 237</b>	<b>25 703</b>	<b>14 380</b>	<b>25 914</b>	<b>11 655</b>	<b>17 738</b>	<b>519</b>	<b>529</b>	<b>108 485</b>	<b>181 492</b>	<b>289 977</b>	

## 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	3 870	1 412	4 953	597	4 740	558	5 151	2 049	2 703	1 735	4 373	1 721	4 822	1 369	3 343	0	0	9 946	33 954	43 900
BUDGET RA2	2 699	5 036	3 465	5 286	3 137	5 205	2 333	4 009	2 034	3 398	1 977	2 881	1 899	2 925	1 879	2 934	419	0	19 842	31 675	51 517
BUDGET RA3	1 612	2 586	2 282	2 851	2 093	2 651	2 731	2 778	2 434	2 934	2 411	2 984	2 393	3 034	2 379	3 084	0	0	18 336	22 901	41 237
BUDGET RA4	1 634	2 314	3 327	6 466	3 345	6 800	3 952	6 086	4 665	12 196	3 467	11 819	3 355	11 570	1 971	4 743	100	242	25 815	62 236	88 051
BUDGET RA5	364	1 050	1 052	1 888	2 093	1 622	2 050	2 091	2 456	2 357	2 021	1 559	1 968	1 435	1 016	1 463	0	36	13 021	13 021	26 521
BUDGET Management	785	1 764	1 542	2 256	1 046	1 928	1 312	1 861	1 177	2 047	1 300	2 087	1 348	2 128	1 396	2 171	0	251	9 906	16 493	26 400
BUDGET Center	535	0	811	26	1 772	58	652	498	2 332	0	2 326	0	1 695	0	1 646	0	0	0	11 769	582	12 351
<b>TOTAL</b>	<b>8 135</b>	<b>16 619</b>	<b>13 891</b>	<b>23 726</b>	<b>14 083</b>	<b>23 004</b>	<b>13 588</b>	<b>22 474</b>	<b>17 147</b>	<b>25 635</b>	<b>15 237</b>	<b>25 703</b>	<b>14 380</b>	<b>25 914</b>	<b>11 655</b>	<b>17 738</b>	<b>519</b>	<b>529</b>	<b>108 485</b>	<b>181 492</b>	<b>289 977</b>



# 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
Eskeland, Gunnar	NHH	RA 3
Bjørndal, Endre	NHH	RA 3
Bjørndal, Mette	NHH	RA 3
Sandal, Leif	NHH	RA 3
Andersson, Jonas	NHH	RA 3
Gaasland, Ivar	SNF	RA 3
Wicken, Olav	UiO	RA 1 & 4
Smith, Keith	UiO	RA 1 & 4
Aall, Carlo	Vestlandsforskning	RA 1 & 4
Simonsen, Morten	Vestlandsforskning	RA 1 & 4
Hille, John	Vestlandsforskning	RA 1 & 4
Holden, Erling	HiSF	RA 1 & 4
Stokka, Arne	SINTEF TS	RA 2
Midthun, Kjetil	SINTEF TS	RA 2 & 3
Torvatn, Hans	SINTEF TS	RA 1
Steen, Markus	SINTEF TS	RA 4
Nilsen, Sverre Konrad	SINTEF TS	RA 5
Graabak, Ingeborg	SINTEF Energi	RA 5
Bakken, Bjørn	SINTEF Energi	RA 5
Warland, Leif	SINTEF Energi	RA 5
Dalen, Kari	SINTEF Energi	RA 5
Knutzen, Jørgen	SINTEF Energi	RA 5
Ruud, Audun	SINTEF Energi	RA 1 & 5
Haug, Jens	SINTEF Energi	RA 5
Tomasgard, Asgeir	NTNU	RA 2 & 3
Ryghaug, Marianne	NTNU	RA 1 & 4
Lagesen, Vivian A.	NTNU	RA 1 & 4
Sørensen, Knut H.	NTNU	RA 1 & 4
Næss, Robert	NTNU	RA 1 & 4
Hansen, Gard Hopsal	NTNU	RA 4
Solli, Jøran	NTNU	RA 1
Vie, Ola Edvin	NTNU	RA 2 & 4
Fleten, Stein-Erik	NTNU	RA 2
Westgaard, Sjur	NTNU	RA 2
Widding, Øystein	NTNU	RA 4
Moen, Øystein	NTNU	RA 2
Sørheim, Roger	NTNU	RA 4
Hertwich, Edgar	NTNU	RA 5
Egging, Ruud	NTNU	RA 3 & 5
Østerlie, Thomas	NTNU Samfunnsforskning	RA 4



## Postdoc researchers with financial support from CenSES

Name	Nationality	Funding	Period	Sex	Topic
Arvesen, Anders	Norwegian	CenSES	01.02.2013-31.01.2015	M	Transition to a Sustainable Energy Infrastructure
Bjørnåli, Ekaterina	Norwegian	CenSES	01.11.2011-25.08.2016	F	Commercialization processes in the entrepreneurial firms: examples from renewable energy
Haugom, Erik	Norwegian	CenSES	01.10.2013-30.09.2017	M	Modelling and forecasting energy prices and volatilities
Hanson, Jens	Norwegian	CenSES	01.10.2013-10.01.2015	M	
Pages, Adela	Spanish	CenSES	01.08.2012-30.09.2014	F	Energy system and market modelling
Pauliuk, Stefan	German	CenSES	10.04.2013-01.08.2015	M	Critical materials and a common modelling framework for Industrial Ecology
Saha, Parmita	Bangladesh	CenSES	01.09.2011-31.08.2014	F	Identifying barriers to development of hydropower project in Norway
Valdes, Gerardo	Mexico	CenSES	01.04.2012-31.03.2014	M	Energy system investment models
Vie, Ola Edvin	Norwegian	CenSES	01.01.2013-31.12.2014	M	The need for knowledge integration in renewable energy innovation and commercialization
Mauritzen, Johannes	Norwegian	CenSES	01.01.2013-31.12.2015	M	Statistical Modelling in Energy Markets

## Postdoc researchers working on CenSES projects with financial support from other sources

Name	Funding	Nationality	Period	M/F	Topic
Andersen, Allan Dahl	Norwegian	RENERGI/ RenTrans	2012-2014	M	The role of infrastructure and policy making for transition processes, focusing on Norwegian renewable energy sector
Fyhn, Håkon	Norwegian	NORSTAR	01.08.2012-31.07.2014	M	Energy efficiency through refurbishment, the role of intermediary actors
Garcia, Diego	Spanish	IFE	01.05.2014-01.05.2015	M	Life Cycle Assessment
Karlstrøm, Henrik	Norwegian	RCN	21.03.2012-01.06.2015	M	Public acceptance of renewable technologies
Molnar, Peter	Slovakia	RENERGI	01.03.2011-21.10.2014	M	How investors in small hydro and wind power plants make their investment decisions
Munoz, Lucia Liste		NFR	01.08.2014-01.08.2016	F	Environmental knowledge management in Norwegian local governments.
Pichler, Alois	Austria	RENERGI	01.01.2011-31.12.2014	M	Optimal power network design and operations
Skjøsvold, Tomas Moe	Norwegian	IHSMAG/ERA-NET	27.08.2012-26.08.2015	M	Social scientific perspectives on smart grid development
Åm, Heidrun	Austria	RCN	01.01.2011-23.11.2015	F	Social, political and ethical issues concerning the development of solar cells

## PhD candidates with financial support from CenSES

Name	Nationality	Period	M/F	Topic
Araoz, Veronica (Defended 30.05.12)	Mexican	14.08.2009- 14.08.2012	F	Essays in Pricing in Deregulated Electricity Markets
Assmann, Lisa Marie	German	15.08.2012- 14.08.2016	F	Essays in Shipping Economics
Ausrød, Vegar Lein	Norwegian	01.11.2010- 15.05.2015	M	Commercialization of renewable energy
Bjørgum, Øyvind	Norwegian	01.10.2010- 15.07.2015	M	The long-term growth and pre-commercial processes of international new Ventures
Cheng, Xiaomei	Chinese	15.09.2011- 14.09.2015	F	Returns to scale of Norwegian electricity distribution companies
Ellingsen, Linda	Norwegian	15.09.2013- 14.09.2016	F	Environmental impact of electrifying the transport sector
Gibon, Thomas	France	01.12.2011- 01.12.2015	M	Scenario-based life cycle inventory methods to inform climate mitigation
Gjefsen, Mads Dahl	Norwegian	15.03.2010- 10.12.2014	M	Framing public engagement with new technologies
Gjerald, Ole Inge	Norwegian	01.09.2008- 31.12.2015	M	Renewable strategies? Implementing and commercializing new energy technologies
Hanson, Jens (Defended 04.10.13)	Norwegian	01.01.2008- 29.06.2012	M	Solar energy technology, industry and policy
Haugstvedt, Daniel (Defended 17.01.14)	Norwegian	01.06.2010- 17.01.2014	M	Operational and financial aspects of hydropower production
Jomisko, Robert	Norwegian	01.09.2010- 15.03.2014	M	Policy Development for Renewable energy
Lindberg, Karen Byskov	Norwegian	01.09.2011- 01.03.2016	F	The impact of zero emissions buildings (ZEB) on the energy system through smart grid and demand side management (DSM)
Lysgård, Sylvia	Norwegian	01.09.2011- 28.02.2016	F	Hva dreier det seg om? Næringsliv, politikk og praksiser i to norske (miljø)saker
Mauritzen, Johannes (Defended 14.05.12)	Norwegian	01.08.2008- 01.05.2012	M	Windonomics: empirical essays on the economics of wind power in the Nordic electricity market
Narbel, Patrick (Defended 14.08.14)	Switzerland/ Finland	15.08.2010- 14.08.2014	M	Framework promoting the development of renewable energy in developing countries
Normann, Håkon	Norwegian	19.03.2012- 30.08.2015	M	Explaining the innovation policy towards renewable energy technologies in Norway by analysing the functional patterns across different technological innovation systems
Nykamp, Hilde	Norwegian	01.02.2012- 01.07.2015	F	Sustainable buildings-innovations in the construction industry
Pham, Ha Thi Bich (Defended 09.06.12)	Vietnamese	01.12.2008- 09.06.2012	F	Transformations in the cement industry- A natural resource based industry in the context of climate change
Reinertsen, Hilde	Norwegian	01.05.2010- 01.06.2015	F	Powering global development? A study off efforts to identify results of technology transfers within Norwegian development aid to the energy sector, 1965-2010
Rygg, Bente Johansen	Norwegian	01.02.2011- 12.12.2014	F	Renewable energy as a community concern: How local communities face the challenge of increasing use and production of renewable energy
Sinha, Vivek	India	01.08.2011- 14.08.2015	M	Unleashing the potential of renewable energy for decentralized production: an investigation into organization strategies and system requirements
Skar, Christian	Norwegian	16.08.2010- 01.05.2015	M	Modelling of the European power market for low emission scenarios
Zhonghua, Su	Chinese	01.03.2013- 29.02.2016	F	A multi-stage multi-horizon stochastic equilibrium model of global multi-fuel energy markets
Swensen, Eirik	Norwegian	01.09.2010- 19.12.2014	M	Policy Development for renewable energy
Throndsen, William	Norwegian	01.04.2011- 30.09.2015	M	The development of smart grid technologies in an STS perspective
Unander, Trine	Norwegian	08.01.2013- 03.05.2018	F	Innovation and learning energy policy: The role of the environmental groups in rethinking Norwegian energy policy
Walnum, Hans Jakob	Norwegian	01.09.2011- 01.04.2015	M	An interdisciplinary understanding of rebound effects. A discussion of rebound effects in the transport sector
Weaver, Tyson	American	01.09.2011- 30.11.2015	M	Norwegian hydropower international development

## PhD candidates working on CenSES projects with financial support from other sources

Name	Funding	Nationality	Period	M/F	Topic
Arvesen, Anders (Defended 01.01.13)	Indecol	Norwegian	01.08.08- 31.07.12	M	Industrial ecology perspective of offshore wind power industry
Babri, Sahar	NHH	Iranian	01.08.2012- 01.08.2015	F	Essays on regionaleconomics
Bouman, Evert	ESBLET	Dutch	01.06.2012- 30.05.2014	M	Prospective environmental impacts and material requirements of climate change mitigating technologies and measures
Dahlen, Kai Erik	NFR Purelec Renergi	Norwegian	01.10.2010- 14.09.2015	M	Risk management and assessment for energy markets: extreme value statistics
Gilpin, Geoffrey	UMB	Canada	01.02.2011- 31.12.2015	M	Life cycle analysis of 1st through 4th generation biofuels
Godbolt, Åsne Lund (De- fended 13.06.14)	NFR	Norwegian	01.08.2008- 13.06.2014	F	Building markets, shaping policy? The role of economics in energy policy and energy use
Gribkovskaia, Victoria	NHH	Belarusian	01.08.2007- 01.06.2015	F	Essays on pricing in electricity markets
Guajardo, Mario (Defended 14.08.13)	NHH		14.08.2009- 14.08.2013	M	Joint decision making and cost sharing: Theory and applications in natural resource supply chains
Hagfors, Lars Ivar	NFR, Riskyres	Norwegian	01.10.2013- 30.09.2017	M	Real options: Case studies and empirical evidence from the electricity industry
Haugom, Erik (Defended 24.10.12)	NFR - Renergi	Norwegian	01.01.2009- 24.10.2012	M	Modeling and forecasting electricity prices and volatilities
Heidenreich, Sara (Defended 24.10.14)	NFR, RENERGI	German	15.09.2010- 24.10.2014	F	Blowing in the wind: The socialization of offshore wind technology
Helgesen, Per Ivar	Renergi	Norwegian	01.06.2012- 31.05.2016	M	Regional effects of energy policy
Cai, Hong	NHH	Chinese	14.08.2012- 14.08.2016	F	Nodal Pricing in a Coupled European Power Market with More Wind Power
Ingeborgrud, Lina	NFR	Norwegian	01.08.2014- 31.07.2017	F	Exploring "Cities of the future" and local transportation systems through environmental knowledge management
Jakobsen, Siri	NFR	Norwegian	01.08.2010- 01.07.2015	F	Sustainable innovation in the process industry, innovation, cooperation and technology transfer
Johansen, Ulf	NFR	Norwegian	21.03.2012- 15.11.2014	M	Winners and losers in regional economic development.
Karlstrøm, Henrik (Defended 20.03.12)	NFR	Norwegian	18.08.2008- 20.03.2012	M	Empowering markets? The construction and maintenance of a deregulated market for electricity in Norway
Klimek, Alexandra (Defended 09.12.14)	NFR,Renergi	German	01.09.2009- 09.12.2014	F	Public engagement in post carbon strategies: patterns of attitudes and engagement
Jiehong Kong (Defended 25.08.12)	NHH		14.08.2008- 25.08.2012	M	Integration and coordination of supply chain: Case studies in forestry and petroleum industries
Korsnes, Marius	NTNU	Norwegian	21.05.2012- 20.05.2015	M	Developing offshore wind industry in and between Norway and China
Lauvås, Thomas	RFF-Nord/ Helgeland Sparebank	Norwegian	19.03.2013- 18.09.2017	M	Technology entrepreneurship and university-industry technology transfer
Ottesten, Stig	NCE Halden	Norwegian	01.01.2011- 30.06.2016	M	Techno-economic modelling of smart energy systems
Seljom, Pernille	NFR , Renergi	Norwegian	01.01.2011- 01.09.2015	F	The future Norwegian energy system in a European context
Shiyu Yan	NHH	Chinese	01.09.2013- 01.09.2017	M	Using CO2 differentiated vehicle tax to improve new vehicle fuel economy: evidence from Norway
Skjeret, Frode	NECCI	Norwegian	01.11.2012- 01.03.2015	M	Regulation of electricity markets
Skjølsvold, Tomas Moe (Defended 24.08.12)	NFR-Renergi	Norwegian	11.08.2008- 24.08.2012	M	Innovation and commercialization in bioenergy
Steen, Markus	RSO/SVT	Norwegian	01.06.2010- 30.05.2015	M	Green industrial restructuring and the emergence of novel production networks in new renewable energy
Steinmo, Marianne	HBS	Norwegian	01.08.2010- 31.03.2015	F	Sustainable innovation in the process industry



Name	Funding	Nationality	Period	M/F	Topic
Søraa, Roger	NFR/KLIMA-FORSK	Norwegian	01.01.2014-01.01.2017	M	Crafting Climate Transitions from Below
Toftaker, Marit	NFR,Renergi	Norwegian	01.01.2010-01.12.2015	F	EV user preferences and user strategies
Tunc, Durmaz	NHH	Turkish	01.08.2009-01.09.2015	M	Essays in energy, environment and technology
Veka, Steinar	NFR;Elcarbon risk/Renergi	Norwegian	01.08.2012-31.07.2015	M	Preliminary project name: Price formation and risk premium in the Nordic electricity derivatives market
Xiaozi Liu	NHH		14.08.2010-14.08.2012	F	Essays on economic optimization: bridging fisheries economics and fisheries biology.
Øverås, Ingrid	NTNU/KULT	Norwegian		F	

## Master degrees

Name	M/F	Institution	Topic
Aakre, Elin	F	UiO	TIS of Norwegian wood-based biofuel – an analysis of drivers and barriers 2005-2015
Aamot, Frida Arnesen & Ytterbø, Marianne	F	NTNU	National strategic investments in electricity transmission capacity in Europe.
Arnfinnsen, Martin	M	NTNU	Passiv versus aktiv – samproduksjoner og innramminger av fremtidens bygg
Aune, Pål	M	NTNU	Kinas energimiks og dens avhengighet av kull
Banik, Abhijit	M	NTNU	Commercialization of Norwegian wind Energy Technologies
Berntsen, Stine Anette & Vatn, Hege Grønning	F	NTNU	Business Models for Extracting the Value of Flexibility in Electricity Systems.
Birkelund, Henrik & Opdal, Martin	M	NTNU	The effects of Implied Volatility on Forecasts of Realized Volatility in the Nordic Power Forward Market
Braun, Sebastian Matthias	M	NTNU	Business Models in Smart Grids.
Chiesura, Lorenzo	M	NHH	The relation between Venture Capital and Private Equity investments in Renewable Energy Sources.
Correia, J.C & Tennfjord, M.N.	F	NTNU	Critical Components of business models for renewable energy based rural electrification. NTNU School of Entrepreneurship,
Deal Elliot	M	NHH	Cars Bounce Back from Tax Changes: The Rebound Effect from Recent Changes to the Norwegian Motor Vehicle Registration Tax
Dolnacianu, Andreea Luminita & Omar, Ikram	M	NHH	Mind the gap: analyzing the impact of offshore wind power on conventional power in the UK.
Eliassen, Markus & Steine, Sturla	M	NTNU	A new quantile Regression Model to forecast one day ahead Value at Risk
Erspamer, Kai & Moore, Finolo	M	NHH	Improved Wind Measurement and Wind Farm Project Development - Determining the Financial Value of Enhanced, High-Resolution Wind Resource Potential Data in the Investment Process.
Frøysnes, Ane Storhaug	F	NTNU	Bare en jævla boks til fem milliarder? En analyse av visjonsarbeidet knyttet til Avanserte måle- og styringssystemer (AMS)
Gøransson, Markus	M	NTNU	Sentrale styringssystemer i husholdninger - Produsenter og sluttbrukeres syn på hva styringssystemer "gjør", bør gjøre, og vil gjøre i fremtiden
Haw, Rochelle	F	NHH	Facility Location and Production-Distribution in Rooftop Hydroponics: Food Production Solutions for Greener Urban Areas
Heggheim, Hanne & Mogensen, Ingvild	F	NTNU	Wind Power Investment under Uncertainty and Simultaneous Electricity and Green Certificate Equilibrium
Hole, K.	M	NTNU School of Entrepreneurship	Framework for Experimental Learning: Replicable Business Models in Rural Electrification.
Ingebretsen, Erik & Johansen, Tor Haakon Gimsdal	M	NHH	The profitability of pumped hydro storage in Norway.

Klevsand, Anna	F	NTNU	Raketten som aldri tok av. Debatten om den avlyste norske energimeldingen
Kristensen, Aurora	F	NTNU	Klimaendringenes konsekvenser for Norsk Arktis og Norges forvaltningsstrategier for å håndtere dette
Kristoffer Ingebritsen & Jonas Kaldahl	M	NTNU	Sequential investment in gas fired power plants
Johnsen, Asbjørn	M	NTNU	Etablering av hurtigladeinfrastruktur for elbiler i Norge
Monsen, Fredrik	M	NTNU	Ungdom og IKT i dvalemodus. En studie av ungdom, IKT og energipolitiske aktører i et klimaperspektiv
Ni, Yuanming		NHH	Global Potential for Carbon Storage Based on Forest Ecosystems
Oliver, Emil Johan & Toftesund, Hans Christian	M	NTNU	Collaborating in research centres
Olson Lisa	F	NHH	Biofuels from algae
Peeva, Zhelyiana	F	NHH	Energy Efficiency in Buildings in Bulgaria: A case study of schools
Pettersen, Anna	F	NHH	Inventory Management in the Aftermarket: An empirical study of Rolls-Royce Energy
Petterson, Tor Brørs	M	NTNU	El-sykelbrukere
Roalsø, Helene, Jacobsen, Tina Slåttedal & Størksen, Benedicte Hjelle	F	NTNU	Multinational Corporations Investing in the Marine Energy Industry The process of MNC's investing in the wave and tidal energy industries.
Rogne, Jonas Pauck & Wangen, Thor Morten	M	NHH	A real option approach to Hydro's investment at Karmøy.
Rundlang, Erik & Tjeransen, Carl Fredrik	M	NTNU	Effektiviteten I det europeiske kraftmarkedet: Et tiltak for å inkludere fleksibilitet fra termisk kraftproduksjon.
Ruiz, Hector Campos	M	NHH	Analysis of Petroleum Tax Regimes for Private Investments in the Mexico. Ongoing.
Sefakor, Abgesi	M	NHH	The 21st Century Environmental Kuznets Curve (EKC): An analysis of OECD and Non-OECD Countries.
Simonsen, Rikke Mohn	F	UiO	Standardization and Sustainable energy transition
Skorstad, Lise	F	NTNU	Miljøsertifisering i bedrifter
Solbu, Gisle	M	NTNU	God klimapolitikk eller dyr fornybar moro? Fortellinger om norsk-svenske elsertifikater og vindmøller på Fosen/Snillfjord
Tsagkaropoulos, Nikolaos	M	NHH	Bicycle Sharing Systems, Are they here to stay?
Tveter, Henrik Thorgesen	M	NHH	Large scale transition from conventional to electric vehicles and the consequences for the security of electricity supply – a demand side analysis of electricity consumption.
Velázquez, Stephanie Maritza Villegas	F	NHH	The road from diesel to natural gas. The impact of changing fuel sources in road transportation: the case of Kuehne + Nagel
Vesterås, Thea	F	UiO (TIK)	Rørbru som innovativ fjordkryssingsløsning: Den krevende veien fra idé til realitet.

# Appendix 2: Related Projects Including CenSES Research Partners

Public acceptance of post carbon strategies  
RCN/RENERGI 2009-2014  
Project leader: Knut Holtan Sørensen  
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  
Total budget: NOK 3 368 00

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

Crafting Climate Advisors-Developing Arenas for the  
Education of Craftsmen in the Face of Climate Transitions  
KLIMAFORSK 2013  
Project leader: Jøran Solli  
Total budget: NOK 187 000

useTsmartly-Environmental peer-to-peer education for youths with  
focus on smart use of Information and Communication Technologies.  
IEE 2013-2016  
Project leaders: Knut H. Sørensen and Robert Næss  
Total budget: NOK 2 300 000

Bringing environmental knowledge into action:  
Environmental knowledge management in Norwegian  
local governments (BREV).  
Miljø2015 program 2014-2017  
Project leader: Vivian Anette Lagesen  
Total budget NOK 5 000 000

Dissemination of scientific knowledge as a policy instrument  
in climate policy.  
RCN/NORKLIMA 2011-2014  
Project leader: Gøran Sundquist  
Total budget: NOK 6 200 000

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

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

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

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

Hvordan vil en dreining av fornybarstøtten i EU i retning av mer  
markedstyrte instrumenter påvirke grønne investorer? (RISKY-RES)  
NFR, ENOVA, NVE, Statnett and Energi Norge 2013-2016  
Project leader: Stein-Erik Fleten  
Total budget: NOK 7 000 000

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

Greenhouse gas emission goal for cars;  
feasibility and policy instruments  
SD 2012-2013  
Project leader: Gunnar Eskeland  
Total budget: NOK 500 000

Regional effects of energy policy (RegPol)  
RCN/RENERGI 2012-2016  
Project leader: Arne Stokka  
Total budget: NOK 11 950 000

Renewable energy as transition strategy  
RCN/RENERGI 2011-2014  
Project leader: Keith Smith  
Total budget: NOK 7 800 000

Teknologibasert entreprenørskap og innovasjon som driver  
industriell utvikling i Nord-Norge (Norway)  
NFR og Helgeland Sparebank 2013-2016  
Project leader: Roger Sørheim  
Total budget: NOK 5 500 000

Influence of bioethanol fuels treatment for operational performance,  
ecological properties and GHG emissions of spark ignition engine  
EEA 2013-2015  
Project leader: Otto Andersen

Renewable Energy Projects: Local Impacts and Sustainability (RELEASE)  
NFR 2014-2017  
Project leader: Erling Holden  
Total budget: NOK 25 000 000

Environmental Sustainability benchmarking of low-carbon  
energy technologies  
RCN/RENERGI 2011-2015  
Project leader: Edgar Hertwich  
Total budget: NOK 2 954 000

NORSTRAT- Nordic electricity road map 2050:  
Strategic choices towards carbon neutrality  
Nordic Energy Research 2011-2015  
Project leader: Ingeborg Graabak  
Total budget: NOK 14 384 156

NORDSTRAT - Centre of excellence for Strategic adaption research  
Nordforsk 2011-2015  
Centre Director: Michael Goodside  
Total budget: 35 000 000

Day-Ahead Bidding with Multiple Short-Term Markets.  
ENERGIX/NFR 2014  
Project leader: Marte Fodstad

Integration of Power Transmission Grids - Prospects and Challenges at Na-  
tional and European Levels in advancing the energy transition.  
ENERGIX/NFR 2014 -  
Project leader: Allan Dahl Andersen

Preliminary project support for network building and research application.  
Innovasjon Norge Sogn og Fjordane 2014-2015  
Project leader: Carlo Aall



# Appendix 3: Publications

## Journal papers

1. Aall, C. (2014). Fornybareventyr eller forbruksmareritt? Om nødvendigheten av et lavenergismått. *Plan 3-4*: 67-73.
2. Arvesen, A., Nes, R.N., Huertas-Hernando, D., Hertwich, E.G. (2014). Life cycle assessment of an offshore grid interconnecting wind farms and customers across the North Sea. *The International Journal of Life Cycle Assessment* 19(4): 826-837.
3. Berger, G., Rubik, F., Feindt, P., Holden, E. (2014). Sustainable Mobility – Challenges for a Complex Transition. *Journal of Environmental Policy and Planning* 16(3): 303-320.
4. Bjørgum, Ø., Sørheim, R. (2014). The funding of new technology firms in a pre-commercial industry – the role of smart capital. *Technology Analysis & Strategic Management*
5. Bjørnåli, E., Ellingsen, A. (2014). Factors Affecting the Development of Clean-Tech Start-Ups: A Literature Review. *Energy Procedia* 58: 43-50.
6. Calvin, K., Edmonds, J., Bakken, B.H., Wise, M., Kim, S., Luckow, P., Patel, P., Graabak, I. (2014). EU 20-20-20 energy policy as a model for global climate mitigation. *Climate Policy*
7. Gilpin, G., Hansen, O.J., Czerwinski, J. (2014). Biodiesels and advanced exhaust aftertreatments combined effect on global warming and air pollution in EU road-freight transport. *Journal of Cleaner Production* 78: 84-93.
8. Hojem, Thea Sofie Melhuus; Sørensen, Knut Holtan; Lagesen, Vivian Anette. Designing a 'green' building: expanding ambitions through social learning. *Building Research & Information* 2014 ;Volum 42.(5) s. 591-601 NTNU
9. Holden, E. (2014). Moving Towards Low Carbon Mobility. *Journal of Environmental Policy and Planning* 16 (4): 577-581. NTNU HISF
10. Holden, E., Linnerud, K., Banister, D. (2014). Sustainable development: Our Common Future revisited. *Global Environmental Change* 26(1): 130-139.
11. Huppmann, D., Egging, R. (2014). Market power, fuel substitution and infrastructure – A large-scale equilibrium model of global energy markets. *Energy* 75: 483-500.
12. Karlstrøm, H., Ryghaug, M. (2014). Public attitudes towards renewable energy technologies in Norway. The role of party preferences. *Energy Policy* 67: 656-663.
13. Kaut, M., Midthun, K.T., Werner, A., Tomasgard, A., Hellemo, L., Fodstad, M. (2014). Multi-horizon stochastic programming. *Computational Management Science* 11(1-2): 179-193.
14. Mauritzen, J. (2014). On livestock and emissions, California, technology and jobs, algorithms. *The Economist* 410: 8869
15. Mauritzen, J. (2014). Scrapping a wind turbine: Policy changes, scrapping incentives and why wind turbines in good locations get scrapped first. *Energy Journal* 35(2): 157-181.
16. Modaresi, R., Pauliuk, S., Løvik, A.N., Müller, D.B. (2014). Global Carbon Benefits of Material Substitution in Passenger Cars until 2050 and the Impact on the Steel and Aluminum Industries. *Environmental Science and Technology* 48: 10776-10784.
17. Narbel, P. (2014). Estimating the cost of future global energy supply. *Renewable and Sustainable Energy Reviews* 34: 91-97.
18. Narbel, P. (2014) Rethinking how to support intermittent renewables. *Energy* 77: 414-421.
19. Paraschiv, F., Fleten, S.-E., Schürle, M. (2014). A spot-forward model for electricity prices with regime shifts. *Energy Economics* 47: 142-153.
20. Pauliuk, S., Müller, D.B. (2014). The Role of In-Use Stocks in the Social Metabolism and in Climate Change Mitigation. *Global Environmental Change* 24: 132-142. NTNU
21. Ryghaug, M., Toftaker, M. (2014). A transformative practice? Meaning, competence, and material aspects of driving electric cars in Norway. *Nature and Culture* 9(2): 146-163. NTNU
22. Salom, J., Marszal, A.J., Widén, J., Candanedo, J., Lindberg, K.B. (2014). Analysis of load match and grid interaction indicators in net zero energy buildings with simulated and monitored data. *Applied Energy* 136: 119-131.
23. Salom, J., Widén, J., Candanedo, J., Lindberg, K.B. (2014). Analysis of grid interaction indicators in net zero-energy buildings with sub-hourly collected data. *Advances in Building Energy Research*
24. Skjølvold, T.M. (2014). Back to the futures: Retrospecting the prospects of smart grid technology. *Futures. The Journal of Policy, Planning and Futures Studies* 63: 26-36. NTNU
25. Steen, M., Hansen, G.H. (2014). Same Sea, Different Ponds: Cross-Sectorial Knowledge Spillovers in the North Sea. *European Planning Studies* 22(10): 2030-2049.
26. Tøsse, S.E. (2014). Concern and confidence. Architects making sense of climate adaptation. *Environment and Planning, B: Planning and Design* 41(1): 24-38.
27. Vie, O.E., Stensli, M., Lauvås, T. (2014). Increasing companies absorptive capacity through participation in collaborative research centres. *Energy Procedia* 58: 36-42.
28. Weaver, T.J., Moen, Ø., Landstad, K.S., Standeren, M.I. (2014). Investigating the international expansion of high growth power providers in emerging markets: motives, management and entry modes. *Journal for International Business and Entrepreneurship Development* 7(4): 289-308.
29. Walnum, H.J., Aall, C., Løkke, S. (2014). Can Rebound Effects Explain Why Sustainable Mobility has not been Achieved? *Sustainability* 6(12): 9510-9537.
30. Bjørnåli, E.S., Ellingsen, A. (2014). Factors Affecting the Development of Clean-tech Start-Ups: A Literature Review. *Energy Procedia* 58(43-50).
31. Eskeland, G. (2014). Moving Towards Low Carbon Mobility. *Economics of Energy & Environmental Policy* 3(1)121-127.
32. Walnum, H.J., Aall, C., Løkke, S. (2014). Can Rebound Effects Explain Why Sustainable Mobility has not been Achieved? *Sustainability* 6(12): 9510-9537.
33. Normann, H.A. (2014). The role of politics in sustainable transitions: The rise and decline of offshore wind in Norway. *Environmental Innovation and Societal Transition* doi: 10.1016/j.eist.2014.11.002
34. Korsnes, M. (2014). Fragmentation, Centralisation and Policy Learning: An Example from China's Wind Industry. *China aktuell - Journal of Current Chinese Affairs* 3: 175-205.
35. Swensen, E. (2014). Karbonfangst og -lagring (CCS) - den umulige posisjonen. *Nytt Norsk Tidsskrift* 31(4): 431-440.
36. Ydersbond, I., Korsnes, M. (2014). Wind power in China and in the EU: a comparative analysis of key drivers. *Energy Procedia* 58: 95-102.
37. Fodstad, M., Midthun, K.T., Tomasgard, A. (2014). Adding flexibility in a natural gas transportation network using interruptible transportation services. *European Journal of Operational Research*

## Dissertations

1. Narbel, P. (2014). Framework promoting the development of renewable energy in developing countries. PhD Dissertation, NHH
2. Haugstvedt, D. (2014). Operational and financial aspects of hydropower production. PhD dissertation, NTNU

## Monography

1. Andersen, O. (2014). Unintended Consequences of renewable energy-problems to be solved. Springer. ISBN 978-1-4471-5532-4: 94 pages.
2. Narbel, P. A., Hansen, J.P., Lien, J.R. (2014). Energy Technologies and Economics. Springer ISBN 978-3-319-08225-7

## Articles published in anthologies

1. Holden, E., Linnerud, K. (2014). The Unmanageable Leisure-time Travel. In Hickman, R., Bonilla, D. Givoni, M. and, Banister, D. (Eds.) International Handbook on Transport and Development. Cheltenham, Edward Elgar.
2. Hertwich, E.G., Gibon, T., Bouman, E., Arvesen, A., Suh, S., Heath, G., Bergesen, J., Ramirez, A., Vega, M., Shi, L. (2014). Integrated life-cycle assessment of electricity-supply scenarios confirms global environmental benefit of low-carbon technologies. Proceedings of the National Academy of Science of the United States of America 2014: pp NTNU
3. Lindberg, K. B., Ånestad, A., Doorman, G.L., Fischer, D., Wittwer, C., Sartori, I. (2014). Optimal investments in Zero Carbon Buildings. In Proceedings 1st International Conference on Zero Carbon Buildings Today and in the Future. Birmingham, ISBN 978-1-904839-77-4: 145-153.
4. Skar, C., Doorman, G.L., Tomasgard, A. (2014). Large-scale power system planning using enhanced Benders decomposition. In 18th Power system Computations Conference, PSCC 2014. IEEE conference proceedings 2014 ISBN 978-83-935801-2-5. NTNU
5. Skar, C., Doorman, G.L., Tomasgard, A. (2014). The future European power system under a climate policy regime. In ENERGYCON 2014. IEEE International Energy Conference. IEEE conference proceedings 2014 ISBN 978-1-4799-2449-3: 318-325. NTNU
6. Bjørndal, E., Bjørndal, M.H., Cai, H. (2014). Nodal pricing in a coupled electricity market. Proceedings European Energy Markets (EEM 14) Conference. DOI: 10.1109/EEM.2014.6861222: 1-6.
7. Brovold, S., Skar, C., Fosso, O.B. (2014). Implementing Hydropower Scheduling in a European Expansion Planning Model. In Nærland, T.U. (Ed.) Renewable Energy Research Conference, RERC 2014. Elsevier: 117-122.

## Conference presentations/invited lectures

1. Arvesen, A. (2014). Assessing the life-cycle effects of energy transitions. Accounting for life-cycle emissions in analysis of future energy systems; 13 November 2014.
2. Bjørgum, Ø. (2014). Commercialization of the marine energy industry. TU Berlin - NTNU workshop; 24-25 April. NTNU
3. Espegren, K.A., Rosenberg, E., Lind, A. (2014). Modeling of future energy demand. Renewable Energy Research Conference (RERC 2014), Oslo, 16-18 June 2014. IFE

4. Gansmo, H.J., Ryghaug, M., Toftaker, M. (2014). Initiatives towards Electric Road Transport in five European countries: Lessons learnt and future opportunities. Behave energy conference; 3-4 September 2014. NTNU
5. Heidenreich, S. (2014). Outreaching, outsourcing, and disembedding: How offshore wind scientists consider their engagement with the public. Social construction of technology coming of age: new challenges and opportunities ahead; 3-5 June 2014.
6. Heidenreich, S. (2014). Public Engagement with wind energy at KULT/NTNU. EERA Wind Sub-Programme: Economic and social aspects of wind integration, Kick-off meeting; 13 November 2014. NTNU
7. Heidenreich, S., Klimek, A., Sørensen, Knut, K.H., Åm, H. (2014). Making post carbon publics: Technoscientists' constructions of and engagement with the public. 4S Annual Meeting; 20-24 August 2014. NTNU
8. Karlstrøm, H., Sørensen, K.H. (2014). Publics making sense of energy efficiency: economy or comfort?. Annual Meeting of the Society for the Social Study of Science; 20-23 August 2014. NTNU
9. Knudsen, J.K., Dalen, K. (2014). The Need for Political-Institutional Transitions in a European Context: The case of hydropower and water resources management. Renewable Energy Research Conference; 16-17 June 2014. ENERGISINT
10. Lindkvist, C.M., Skjølvold, T.M. (2014). 'Why on earth would we involve the user?' On user imaginaries in a smart micro grid demonstration project. Smart Grids and the Social Sciences; 10-11 April 2014. NTNU
11. Mauritzen, J. (2014). The Effect of Oil Prices on Offshore Production: Evidence from the Norwegian Continental Shelf. FIBE; 3-5 January 2014. NHH
12. Mauritzen, J. (2014). The Effect of Oil Prices on Offshore Production: Evidence from the Norwegian Continental Shelf. IAEE International Conference, New York; 15-18 June 2014. NHH
13. Mauritzen, J. (2014). The Great Fall: Global vs. Local Economies of Scale in the California Solar Power Market. IAEE Asia Conference, Beijing; 19-21 September 2014. NHH
14. Pauliuk, S., Majeau-Bettez, G., Müller, D.B., Hertwich, E.G. (2014). Towards a Unified Accounting and Modelling Framework for Industrial Ecology. ISIE Asia-Pacific Conference; 17-19 November 2014. NTNU
15. Pauliuk, S., Milford, R., Allwood, J., Müller, D.B., Hertwich, E.G. (2014). Managing Global Material Stocks Under Emissions Constraints – A Case Study for Steel. ISDR conference, Trondheim, 18-20 June 2014. NTNU
16. Pauliuk, S., Wood, R., Müller, D.B., Hertwich, E.G. (2014). Launching the spaceman economy - How much service can we get out of a globally constrained economy?. Biannual conference of the International Society for Ecological Economics; 13-15 August 2014. NTNU
17. Sinha, V., Ausrød, V.L., Widding, L.Ø. (2014). The Role of the Entrepreneur's Business Model in Shaping Nascent Markets: Husk Power Systems and the Decentralized Renewable Energy Market in India. Australian Centre for Entrepreneurship Research Exchange Conference (ACERE); 2014-02-04 - 2014-02-07 NTNU
18. Tomasgard, A. (2014). Analysing natural gas transport capacity markets using stochastic programming and complementarity. 4th PhD Winter school on stochastic programming; 23-28 March 2014. NTNU
19. Lind, A. (2014). Step-wise modelling of energy efficiency measures vs. elastic end-use demand. Energy Systems 2014 Conference, London, United Kingdom.
20. Rosenberg, E., Seljom, P. (2014). Update and improvement of wind power in ETSAP-TIAM, ETSAP-TIAM Workshop UCL London, 2 April 2014
21. Espegren, K.A. (2014). Example of modelling of renewable policy, using TIMES-Norway, EERA-E3 workshop, Brussels, Belgium, April 2014.

22. Espegren, K.A. (2014). Electricity trade/balancing seen from Norway, IEA Workshop, Paris, France, 9-10 October 2014.
23. Espegren, K.A. (2014). Input from Norway to Nordic analysis, IEA Workshop, Paris, France, 9-10 October 2014.
24. Seljom, P., Tomasgard, A. (2014). Stochastic modelling of short-term uncertainty in TIMES - A case study of wind power in Denmark, Energy Modeling in Denmark WS, Copenhagen, 17 November 2014.
25. Chronopoulos, Michael. (2014). IAEs international conference, Rome, October 2014.
26. Eskeland, G. (2014). Klimaøkonomikonferanse; Beyond IPCC – Future paths for Climate Research, Göteborg, 17 October 2014.
27. Eskeland, G. (2014). Lederskap i klimapolitikken. Forskerkonferansen. Bergen, 4-6- January 2014.
28. Eskeland, G. (2014). What if Climate Policy is about Leadership. Beyond IPCC-Future paths for Climate Research Conference. Gothenburg, 17 October, 2014.
29. Eskeland, G. (2014). Title. Transnovakonferansen, Trondheim, 12 March 2014.
30. Eskeland, G. (2014). Blessed or less by nature's gifts: The Resource Curse Avoided. ABCDE Conference, Washington, 2-3 June 2014.
31. Eskeland, G. (2014). Leadership in Climate Policy. Conference- International Association of Energy Economics International Conference- IAAE. New York, 15-19 June 2014.
32. Aall, C. (2014). Rebound Effect I: Energy, efficiency, and Growth. Fourth international Conference on Degrowth for Ecological Sustainability and Social Equity. Leipzig, 2-5 September 2014.
33. Tomasgard, A. (2014). Stochastic programming with decision dependent probabilities, Uncertainty Fest, Seminar at IMPA, October 2014. Rio, 15 October 2014.
34. Bjørndal, E. (2014). Adjusting for Quality in the Benchmarking of Electricity Network Companies. Conference on benchmarking methods for the incentive regulation of the energy sector - evaluating and improving the German approach. Bonn, 2014.
35. Bjørndal E., Bjørndal M.H. (2014). StoNED versus Two-stage DEA for Regulation of Electricity Networks, North American Productivity Workshop. Ottawa. 2014
36. Bjørndal M.H. (2014). Incentive regulation, benchmarking and the regulated rate of return. GDF Suez Chair Inauguration workshop, Université catholique de Louvain CORE, 3 June 2014.
37. Ryghaug, M. (2014). The citizen's perspective. ZET Plan conference, Roma, 10-11 December 2014.
38. Skjeret, F. (2014). Minimising risks when introducing wind power. Intermittent renewables, balancing powers and electricity market design. Norway, 25-27 August, 2014.
39. Andersson, J., Bjørndal, E., Bjørndal, M.H., Rud, L. (2014). Wind Power, Congestion Management and the Variability of Power Prices. IFORS 2014 - 20th Conference of the International Federation of Operational Research Societies. Barcelona, 13-17 June 2014.
40. Bjørndal, E. (2014). Adjusting for Quality in the Benchmarking of Electricity Network Companies. Seminar on benchmarking methods for the incentive regulation of the energy sector - evaluating and improving the German approach. Bundesnetzagentur, 27 May 2014.
41. Bjørndal, E., Bjørndal, M.H., Midtun, K.T., Tomasgard, A. (2014). Congestion Management by Dispatch or Re-Dispatch: Flexibility Costs and Stochastic Effects. Conference - IFORS 2014 - 20th Conference of the International Federation of Operational Research Societies. Barcelona, 13-18 July 2014.
42. Bjørndal E., Bjørndal, M.H. (2014). StoNED versus Two-stage DEA for Regulation of Electricity Networks. Conference - INFORMS Annual Meeting. San Francisco, 9-12 November 2014.
43. Tomasgard, A., Bjørndal, E., Bjørndal, M.H., Midtun, K.T. (2014). Congestion Management by Dispatch or Re-Dispatch: Flexibility Costs and Stochastic Effects. Workshop- Intermittent Renewables, Balancing Power and Electricity Market Design. 25-27 August 2014.
44. Cai, H., Bjørndal, E., Bjørndal, M.H. (2014). Nodal Pricing Applied to Feed-in RES in a Hybrid Pricing Context. Conference- INFORMS Annual Meeting. San Francisco, 9-12 November 2014.
45. Cheng, X., Bjørndal, E., Bjørndal, M.H. (2014). Malmquist Productivity Index Analysis Based on StoNED: Case of Norwegian Electricity Distribution Company. INFORMS Annual Meeting. San Francisco, 9-12 November 2014.
46. Chronopoulos, M., Eskeland, G. (2014). The Value of Better Wind Information in Investment Decisions. Workshop - Science Meets Industry. Bergen, 9 September 2014.
47. Durmaz, T. (2014). Energy Storage and Renewable Energy. Conference- The 37th IAAE International Conference, Special PhD Session. New York, 15-18 June 2014.
48. Durmaz, T. (2014). R&D, Growth and Climate Change. Researchers meeting, Norwegian Association of Economists. Oslo, 5-6 January 2014.
49. Normann, H.A. (2014). Offshore wind and carbon capture and storage in Norway. IST 2014, Utrecht, 27-29 August 2014.
50. Ingeborgrud, L., Ryghaug, M. (2014). What can we learn from the socialization of electric cars in Norway? SCOT Conference. Trondheim, 2-4 June 2014.
51. Karlstrøm, H. (2014). The converging logics of climate change and migration politics. Workshop Climate Change, Migration and Neoliberalism. Lund, 11-12 September 2014.
52. Korsnes, M. (2014). Creating paths for China's offshore wind industry: Supply chain logics and a mentality change from swiftness to thriftiness. Seminar- ETH PhD-Academy on Sustainability and Technology, Appenzell, 8-13 June 2014.
53. Korsnes, M. (2014). Offshoring Offshore Wind: A Norwegian (ad)venture in China. Society for Social Studies of Science (4S) / ESOCITE. Buenos Aires, 20-23 August 2014.
54. Korsnes, M. (2014). Perceptions and visions of China's emerging offshore wind industry. Workshop- Social construction of technology coming of age: new challenges and opportunities ahead. Trondheim, 3-5 June 2014.
55. Korsnes, M. 2014. The creation of China's offshore wind industry: Catching up in design but not in time? 5th International Sustainability Transitions (IST) Conference. Utrecht, 27-29 August 2014.
56. Korsnes, M. (2014). The Rapid Growth of China's Wind Industry – An Institutional Analysis. Shanghai Social Studies Colloquium (SSSC). Shanghai, 24 February 2014.
57. Korsnes, M. (2014). Visions and perceptions of China's emerging offshore wind industry. 20th Annual International Sustainable Development Research Conference: Resilience - The New Research Frontier, Trondheim, 18-20 June 2014.
58. Næss, R. (2014). Grønne omstillinger og paradokser. Konferanse - Omstilling til en grønn økonomi - hva må til for å nå dit? Trondheim, 26 November 2014.
59. Solli, J., Næaa, R. (2014). Brukbar klimakunnskap? BREV-workshop. Trondheim, 19 November 2014.



60. Sørensen, K.H. (2014). Introduction to "Making post carbon publics". 45 annual meeting. 20-23 August 2014.
61. Trondsen, W. (2014). Material participation in the smart grid - Exploring different modes of articulation. Workshop- Integrating the Household in the Smart Grid meeting. Tecnalia, 23-24 October 2014.
62. Trondsen, W., Ryghaug, M. (2014). Material participation in the smart grid: Exploring different modes of articulation. Workshop- Smart grids and the social sciences. Trondheim 10-11 April 2014.
63. Toftaker, M. (2014). Will future car users drive electric? 4th postgrad STS conference. Lancaster 4-10 January 2014.
64. Åm, H. (2014). From a multi-level perspective to a multi-actorial politics of translation: A reflection on transition studies based on the case of solar technology R&D in Norway. 9th International Conference in Interpretive Policy Analysis. Wageningen, 3-5 July 2014.
65. Åm, H., Lagesen, V.A. (2014). How publics make publics: 'Othring' as an energy transitions logic. Conference 45/ESOCITE. Buenos Aires, 20-23 August 2014.
66. Gjefsen, M.D. (2014). Geiger Memorial Lecture- Public support for climate change action: Lessons from Norway. 28 April 2014. UiO
67. Tomasgard, A. (2014). Guest lecture- Optimization models for energy planning, lecture at UFSC - Universidade Federal de Santa Catarina, June 2014
68. Tomasgard, A. (2014). Guest lecture- Energy research at NTNU, lecture at UFSC - Universidade Federal de Santa Catarina, June 2014
69. Tomasgard, A. (2014). Guest lecture- Analysing natural gas transport capacity markets using stochastic programming and complementarity, 4th PhD Winter school on stochastic programming, Bad Hofgastein, March 2014
70. Egging, R. (2014). Invited speaker- Role of China in the world gas market. China Energy Forum, Singapore, 2-3 October 2014
71. Tomasgard, A. (2014). Modelling global climate and energy policy using stochastic programming. invited tutorial at VOCAL conference, Veszprem, Hungary, 14 December 2014
72. Ryghaug, M. (2014). The citizens perspective. Invited speaker at the SET-Plan 2014 conference, Rome, 10 December 2014
73. Eskeland, G. (2014). Title. FIBE conference, Trondheim, January 2014.

## Dissemination and presentations for partners

1. Bjørnåli, E.S., Ellingsen, A. (2014). Factors Affecting the Development of Clean-tech Start-Ups: A Literature Review. Renewable Energy Research Conference- RERC 16-18 June 2014.
2. Heidenreich, S., Næss, R., Fyhn, H., Snøraa, R.A. (2014). KULT-Prosjektene "Crafting Climate Change" og "UseItSmartly" hadde en stand på Yrkes-NM/Opplæringsdagen. Yrkes-NM/Opplæringsdagen. 28-30 October 2013. NTNU
3. Heidenreich, S., Næss, R., Liste, M.L., Ingeborgrud, L. (2014). Miljøkommunikasjon? Den sosio-tekniske løsningen. Sammen med ungdommer fra UngEnergi hadde vi en stand på forskningstorget med ulike aktiviteter for barn og voksne om fornybar energi (med fokus på solenergi) og om IKT og energi. Forskningstorget; 19-20 September 2014 NTNU
4. Holden, E. (2014). Kampen om arealene. NITO-Naturviterne, debatt om fornybar energi; 2 December 2014 HISF
5. Hole, K., Sinha, V., Widding, L.Ø. (2014). Framework for Experimental Learning: Replicable Business Models in Rural Electrification. International Council for Small Business (ICSB). 11-14 June 2014. NTNU
6. Mauritzen, J. (2014). Now or Later? Trading wind power closer to real-time and how poorly designed subsidies lead to higher balancing costs. Workshop on Intermittent Renewables and Market Design - Hardanger; 25-27 August 2014. NHH
7. Skjølvold, T.M. (2014). Communicating on bioenergy R&D: how to deal with media, controversy and public perception?. CenBio Days, 26 March 2014. NTNU
8. Skjølvold, T.M. (2014). Et samfunnsvitenskapelig blikk på fornybar energi og innovasjon. Gradsdagen i fornybar energi. 19 June 2014. NTNU
9. Skjølvold, T.M. (2014). Husholdningene og Smartgrids: et bruker- og samfunnsfokus på ny energiteknologi. Fremtidens elektriske energisystem; 17-20 March 2014. NTNU
10. Skjølvold, T.M., Ryghaug, M. (2014). From 'rolling out' to enrolling. Norwegian smartgrid strategies. Integrating Households in the Smartgrid meeting; 23-24 October 2014. NTNU
11. Sørensen, K.H. (2014). Mellom naturvern og bærekraftig utvikling. Utfordringer ved utvikling og utbygging av fornybar energi på vei mot lavutslippssamfunnet. Seminar, 06 May 2014. NTNU
12. Sørensen, K.H., Klimek, A., Heidenreich, S. (2014). Forskeres oppfatninger om og forhold til allmennheten. Møte i DKNVS26 May 2014. NTNU
13. Tomasgard, A. (2014). Adding Flexibility in a Natural Gas Transportation Network Using Interruptible Transportation Services, IFORS. 20th Conference of the International Federation of Operational Research Societies; 13-18 July 2014. NTNU
14. Tomasgard, A. (2014). Energieffektivisering i helsebygg - hvordan utnytte fleksibilitet i energisystemet i en bygning?. FSTL's høstmøte, 03 November 2014. NTNU
15. Tomasgard, A. (2014). Energy research at NTNU. Gjesteforelesning, 06 October 2014. NTNU
16. Tomasgard, A. (2014). Optimization models for energy planning. Gjesteforelesning; 03 October 2014. NTNU
17. Tomasgard, A. (2014). Stochastic programming with decision dependent probabilities. EURO mini conference on stochastic programming; 24-26 October 2014. NTNU
18. Vie, O.E., Stensli, M., Lauvås, T.A. (2014). Aiming at knowledge integration between industry and research through collaboration in research centres. OLKC (Organization Learning, Knowledge & Capabilities) 2014; 23-24 April 2014 NTNU
19. Vie, O.E., Stensli, M., Lauvås, T. (2014). Increasing companies absorptive capacity through participation in collaborative research centres. RERC 2014; 16-18 June 2014. UIN NTNU
20. Weaver, Tyson; Steen, Markus. (2014). Intertemporal and cross sectorial dynamics of energy system transitions. oikos Young Scholars Energy Academy 2014; 2014-04-07 - 2014-04-10 HISF NTNU
21. Weaver, T., Steen, M. (2014). Strategy antecedents of energy system transitions. ETH PhD Academy on Sustainability and Technology; 08 June - 13 August 2014. HISF NTNU
22. Lind, A. (2014). Hvordan virker ulike tiltak inn på Oslos fremtidige energisystem. Workshop i regi av OREC: Energiomdanning og fordeling. Kjeller, Norge. August 2014.
23. Espegren, K.A., Rosenberg, E., Lind, A. (2014). Modeling of future energy demand. Renewable Energy Research Conference -RERC, Oslo, 16-18 June 2014.
24. Espegren, K.A. (2014). Scenarier for lavutslippssamfunn 2050, Workshop om framtidens transport, Miljødirektoratet, Oslo, Norge, 19 August 2014.

25. Lind, A. (2014). Analyser av sertifikatmarkedet med norsk-svensk TIMES-modell. Seminar i regi av Energi Norge: Modelling av elsertifikatmarkedet. Oslo, Norge, 19 Oktober 2014.
26. Tomasgard, A. (2014). Energieffektivisering i helsebygg - hvordan utnytte fleksibilitet i energisystemet i en bygning?, FSTL 's høstmøte (forum for sykehusens tekniske ledelse), Trondheim 03 November 2014.
27. Tomasgard, A. (2014). Stochastic programming with decision dependent probabilities, EURO mini conference on stochastic programming, Paris, 24-26 October 2014.
28. Tomasgard, A. (2014). Adding Flexibility in a Natural Gas Transportation Network Using Interruptible Transportation Services, IFORS, 20th Conference of the International Federation of Operational Research Societies. Barcelona, July 2014.
29. Espegren, K.A. (2014). Framtidig energibruk i Norge prosjektet snart gjennomført – hva er videre planer i denne arbeidsgruppen? Brukermøte, Statkraft, 9 September 2014.
30. Tomasgard, A. (2014). Multimod energisystem, modell for Europa, Brukermøte, Startkraft, 9 September 2014.
31. Bjørndal E., Bjørndal M.H. (2014). Challenged or Inefficient? - Compensating for Environmental Cost Drivers in the Regulation of Electricity Networks. INFORMS Annual Meeting. San Francisco. 2014
32. Andersson, J., Bjørndal, E., Bjørndal, M.H., Rud, L. (2014). Wind Power, Congestion Management and the Variability of Power Prices. Workshop, Intermittent Renewables, Balancing Power and Electricity Market Design. Hardingasete, 25-27 August 2014.
33. Bjørndal, E., Bjørndal, M.H. (2014). Challenged or Inefficient? - Compensating for Environmental Cost Drivers in the Regulation of Electricity Networks. Conference: INFORMS Annual Meeting. San Francisco, 9-12 November 2014.
34. Bjørndal, E., Bjørndal, M.H., Midtun, K.T., Tomasgard, A. (2014). Congestion Management by Dispatch or Re-Dispatch: Flexibility Costs and Stochastic Effects. Workshop- Intermittent Renewables, Balancing Power and Electricity Market Design. Hardingasete, 25-27 August 2014.
35. Bjørndal E., Bjørndal, M.H. (2014). Evaluering av StoNED-metoden for benchmarking og regulering av norske nettselskaper. Workshop- Næringspolitisk verksted. Energi Norge, 17 September 2014.
36. Cai, H., Panos, E., Bjørndal, M., HBjørndal, E. (2014). Nodal Pricing in a Coupled European Power Market with More Wind Power. Workshop- Intermittent Renewables, Balancing Power and Electricity Market Design, Hardingasete, 25-27 August 2014.
37. Chronopoulos, M., Eskeland, G. (2014). The Value of Better Wind Information in Investment Decisions. Intermittent Renewables, Balancing Power and Electricity Market Design. Workshop- Intermittent Renewables, Balancing Power and Electricity Market Design. Hardingasete 25-27 August, 2014.
38. Chronopoulos, M., Eskeland, G. (2014). The Value of Better Wind Information in Investment Decisions. Conference- Bergen Economics of Energy and Environment Research Conference (BEEER). Bergen, 12-13 May 2014.
39. Normann, H.A. (2014). Offshore wind and carbon capture and storage in Norway. The Renewable Energy Research Conference (RERC), Oslo, 16-18 June 2014.
40. Smeers, Y., Martin, S., Bjørndal, M.H. (2014). Reservation of Transmission Capacity. Workshop - Intermittent Renewables, Balancing Power and Electricity Market Design. Hardingasete, 25-27 August 2014.
41. Ydersbond, I. Korsnes, M. (2014). Wind power in China and in the EU: a comparative analysis of key drivers. Renewable Energy Research Conference (RERC). Oslo 16-18 June 2014.
42. Hertwich, E (2014). Svart eller grønt? Vi velger vår energiframtid nå-FNs siste klimareport, CenSES annual conference, Oslo, 4-5 December 2014.
43. Thronsdn, W. (2014). Smarte målere som materialisert politikk. Hvordan forvalte brukernes politiske engasjement i utrullingsfasen? CenSES annual conference, Oslo, 4-5 December 2014.
44. Skjølvold, T. M. (2014). Fra utrulling til innrulling. Implementering av AMS og smartgrid i Norge, CenSES Annual Conference, Oslo, 4-5 December 2014.
45. Ingeborgrud, L. (2014). Ren elektrisk kjøregleder! Brukererfaringer med elbil i Trondheimsområdet, CenSES annual conference, Oslo, 4-5 December 2014
46. Eskeland, G. (2014). Urban sustainable development: what it means to build cities for the future, CenSES annual conference, Oslo, 4-5 December 2014.
47. Espegren, K.A. (2014). Energibruksutvikling i Norge til 2050, CenSES annual conference, Oslo, 4-5 December 2014.
48. Sørensen, K.H. (2014). Fra uskyldig til bekymret forbruk: endringer i norske husholdningers syn på elektrisitet, CenSES annual conference, Oslo, 4-5 December 2014.
49. Bjørgum, Ø. (2014). Forretningsutvikling i den pre-kommersielle bølge- og tidevannsindustrien, CenSES annual conference, Oslo, 4-5 December 2014.
50. Heidenreich, S. (2014). Sosialisering av teknologi for vindkraft til havs, CenSES annual conference, Oslo, 4-5 December 2014.
51. Korsnes, M. (2014). Globalising standards: A narrative analysis of offshore wind standardisation in China, CenSES annual conference, Oslo, 4-5 December 2014.
52. Haug, E. (2014). Morpho Solar-framtidens måte å lage mat på-historien om en CenSES-støttet oppstart, CenSES annual conference, Oslo, 4-5 December 2014
53. Ottesen, S. (2014). Optimal budgivning for fleksible forbrukere i elektrisitetmarkedet, CenSES annual conference, Oslo, 4-5 December 2014.
54. Mauritzen, J. (2014). Sun and Lemons: Getting over information asymmetries in the California Solar market, CenSES annual conference, Oslo, 4-5 December 2014.
55. Lind, A. (2014). Analyser av elsertifikatmarkedet, CenSES annual conference, Oslo, 4-5 December 2014.
56. Egging, R. (2014). Practical insights from a global multi-energy market and infrastructure model, CenSES annual conference, Oslo, 4-5 December 2014.
57. Walnum, H.J. (2014). Godstransportprosjektet, CenSES annual conference, Oslo, 4-5 December 2014.
58. Arvesen, A. (2014). Integrert livsløpsanalyse av framtidige energisystemer, CenSES annual conference, Oslo, 4-5 December 2014.
59. Narbel, P. (2014). Mangler norsk klimapolitikk veiledning? CenSES annual conference, Oslo, 4-5 December 2014.
60. Graabak, I. (2014). Scenario analysis of a Nordic power production without GHG emissions, CenSES annual conference, Oslo, 4-5 December 2014.
61. Skar, C. (2014). Energilagring og investeringer i det fremtidige energisystem, CenSES annual conference, Oslo, 4-5 December 2014.
62. Knudsen, J.K., Dalen, K. (2014). The Need for Political-Institutional Transitions in a European Context: The case of hydropower and water resources management. Renewable Energy Research Conference; 16-17 June 2014

## Reports and notes

1. Bakken, B.H., Dalen, K., Graabak, I. (2014). Linking global and regional energy Strategies (LinkS) Executive Summary. Trondheim: SINTEF Energi 2014, ISBN 978-82-594-3576-7: 18 paes. SINTEF Energi. Rapport TR A7373. ENERGISINT
2. Bakken, B.H., Dalen, K., Graabak, I., Knudsen, J.K., Ruud, A., Warland, L., Wolfgang, O., Doorman, G.L., Skar, C., Tomasgard, A., Valdes, Gerardo, A.P. (2014). Linking Global and Regional Energy Strategies (LinkS). Trondheim: SINTEF Energi AS 2014, ISBN 978-82-594-3570-5: 170 pages. SINTEF Energi. Rapport TR A7352. ENERGISINT NTNU
3. Graabak, I., Warland, L. (2014). A carbon neutral power system in the Nordic region in 2050 D3.1 in the NORSTRAT project. SINTEF Energi AS 2014, ISBN 9788259435736: 95 pages. SINTEF Energi. Rapport TR A7365, ENERGISINT
4. Korsnes, M. (2014). China's Offshore Wind Industry. Science Meets Industry - Offshore Wind. NTNU
5. Mauritzen, J. (2014). Sun and Lemons: Getting over Information Asymmetries in the California Solar Market. Norges Handelshøyskole. Institutt for Foretaksoekonomi. Discussion Paper 2014 NHH
6. Mauritzen, J. (2014). The Effect of Oil Prices on Offshore Production: Evidence from the Norwegian Continental Shelf. Norges Handelshøyskole. Institutt for Foretaksoekonomi. Discussion Paper 2014 NHH
7. Mauritzen, J., Tangerås, T. (2014). Real-time Versus Day-ahead Market Power in a Hydro-based Electricity Market. Norges Handelshøyskole. Institutt for Foretaksoekonomi. Discussion Paper 2014 NHH
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## Contact persons for the research partners

### Norwegian University of Science and Technology (NTNU)

Department of Industrial Economics and Technology  
Management (IØT)

Roger Sørheim

Email: roger.sorheim@iot.ntnu.no

Department of Interdisciplinary Studies of Culture (KULT)

Knut H. Sørensen

Email: knut.sorensen@ntnu.no

Department of Energy and Process Engineering

Edgar Hertwich

Email: edgar.hertwich@ntnu.no

### NTNU Samfunnsforskning AS

Thomas Østerlie

Email: thomas.osterlie@samfunn.ntnu.no

### SINTEF Energy Research

Ingeborg Graabak

Email: Ingeborg.graabak@sintef.no

### SINTEF Technology and Society

Kjetil Midthun

Email: Kjetil.Midthun@sintef.no

### Institute for Energy Technology (IFE)

Kari Aamodt Espegren

Email: kari.espegren@ife.no

### Norwegian School of Economics (NHH)

Gunnar Eskeland

Email: gunnar.eskeland@nhh.no

### Institute for Research in Economics and Business Administration (SNF)

Ivar Gaasland

ivar.gaasland@snf.no

### University of Oslo, Centre for Technology, Innovation and Culture (TIK)

Olav Wicken

Email: olav.wicken@tik.uio.no

### Sogn og Fjordane University College

Erling Holden

Email: erling.holden@hisf.no

### Vestlandsforskning

Carlo Aall

Email: caa@vestforsk.no

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Centre for Sustainable Energy Studies

CenSES - Centre for Sustainable Energy Studies  
Faculty of Humanities  
NTNU  
NO-7491 Trondheim  
Norway

censes@ntnu.no  
www.censes.no

### Contact persons for the centre management:

Asgeir Tomasgard, Director  
asgeir.tomasgard@iot.ntnu.no

Marianne Ryghaug, Deputy Director  
marianne.ryghaug@ntnu.no

Kristin Klokkervold, Centre Coordinator  
kristin.klokkervold@ntnu.no

Marit Martinsen, Centre Coordinator  
marit.martinsen@ntnu.no