

Til medlemmene av Styret for **CREE - Oslo Centre for Research on Environmentally friendly Energy**

Lars Bergman
Cathrine Hagem
Karine Nyborg
Sverre A. C. Kittelsen
Ståle Aakenes
Kenneth Birkeli
Ellen Skaansar
Kjell Steinar Berger
Rolf Korneliussen
Knut Kroepelien

Observatør Forskningsrådet:
Hans Otto Haaland

Fra:
Rolf Golombek

Styremøte i CREE - Oslo Centre for Research on Environmentally friendly Energy

Det innkalles med dette til styremøte

06. november 2017, kl. 13.15-15.00

i Forskningsparken, rom **HAGEN 4**, Gaustadalléen 21, 0349 Oslo.

Sak S-17/12 Godkjenning av innkalling og saksliste

Sak S-17/13 Godkjenning av referat fra forrige møte (ett vedlegg)

Sak S-17/14 Informasjonsaker

CREE arrangementer og aktiviteter høst 2017
Innsendte søknader fra CREE miljøet
Ny runde med FME-S
Bemanningssituasjon

Sak S-17/15 Regnskap og økonomi

- Prognose for 2017

- Budsjett for 2018

(Vedlegg: CREE budsjett 2017-2019)

Forslag til vedtak:

Styret tar orienteringen om økonomien i 2017, inkludert prognosen, til etterretning.

Styret vedtar fremlagte budsjett for 2018.

Sak S-17/16 Rapportering til Norges Forskningsråd

Kort gjennomgang av CREEs arbeidsplan for 2017 og årsrapport for 2016.
Kommentarer og synspunkter fra styret med hensyn til fremtidige justeringer av denne typen dokumenter.
(Vedlegg: Arbeidsplan 2017 og årsrapport 2016.)

Forslag til vedtak:

Administrasjonen bes om å ta hensyn til kommentarene som kom fram under møtet ved utarbeidelse av årsrapporten for 2017 og arbeidsplanen for 2018.

Sak S-17/17 Eventuelt

Datoer for styremøter våren 2018.

Møtereferat – styremøte for CREE S-II.17

Referat fra styremøtet i CREE - Oslo Centre for Research on Environmentally friendly Energy, kl. 13.15-15.00, 22. mai 2017, møterom Terra, Forskningsparken, Gaustadalleen 21, 0349 Oslo

Styrets medlemmer som var til stede

Lars Bergman - Stockholm School of Economics - HHS.
Karine Nyborg – Økonomisk Institutt - ØI
Sverre A. C. Kittelsen - Frischsenteret
Ståle Aakenes - Gassnova
Kenneth Birkeli - Miljødirektoratet
Ellen Skaansar - Norges vassdrags- og energidirektorat - NVE
Kjell Steinar Berger - Statkraft
Rolf Korneliussen - Statnett

Fra administrasjonen

Rolf Golombek - Frischsenteret
Jørg Gjestvang - Frischsenteret

Referenter:

Rolf Golombek og Jørg Gjestvang

Forfall:

Cathrine Hagem - Statistisk Sentralbyrå.

Sak S-17/6 Godkjenning av innkalling og saksliste

Vedtak: Godkjent

Sak S-17/7 Godkjenning av referat fra forrige møte (ett vedlegg)

Vedtak: Godkjent

Sak S-17/8 Informasjonsaker

- Arrangementene våren 2017 har omfattet kick-off seminar, to CREE hot line, brukerkonferanse arrangert sammen med CICEP, samt CREE lunsj. I 2017 vil syv studenter få CREE masterstipend på NOK 20 000. CREE newsletter publiseres hvert kvartal.
- Norges forskningsråd gjennomførte site visit hos CREE i mai.
- Høsten 2017 vil CREE arrangere sin årlige forskerworkshop, samt et dialogseminar med brukerne.

Vedtak

Styret tar informasjonen til etterretning.

Sak S-17/9 CREE årsberetning

Styret var godt fornøyd med årsrapporten. Styret hadde likevel noen forslag til justeringer av teksten som en ber administrasjonen vurdere ifm. fremtidige årsrapporter.

Vedtak:

Beretningen for 2017 ble tatt til etterretning. For fremtiden vil CREEs årsberetning bli behandlet på et styremøte før fristen for innsending til Norges forskningsråd utløper (1 april).

Sak S-17/10 Nye konsortiemedlemmer

Energi Norge og Klima- og miljødepartementet ønsker i bli tatt opp som konsortiemedlemmer i CREE.

Vedtak:

Energi Norge og Klima- og miljødepartementet tas opp som konsortiemedlemmer i CREE.

Sak S-17/11 Eventuelt

Neste styremøtet blir mandag 6 november kl. 13.15-15.00

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Lars Bergman
Stockholm School of Economics
Styreleder

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Karine Nyborg
Økonomisk Institutt

.....
Sverre A. C. Kittelsen
Frischsenteret

.....
Ståle Aakenes
Gassnova

.....
Kenneth Birkeli
Miljødirektoratet

.....
Ellen Skaansar
Norges vassdrags- og energidirektorat

.....
Kjell Steinar Berger
Statkraft

.....
Rolf Korneliussen
Statnett

Langtidsbudsjett CREE

Tall i tusen kroner		2016	2017		2018	2019
	Noter	Regnskap	Budsjett	Prognose	Budsjett	Budsjett
INNTEKTER						
Forskningsrådet	1	4 359	8 094	6 994	9 100	8 000
UiO		448	552	552	500	500
Brukerpartnere		175	350	350	350	350
Overført fra året før		0	0	0	0	0
Inntekter i alt		4 982	8 996	7 896	9 950	8 850
KOSTNADER						
Forskning	2	3 081	4 986	4 095	6 271	5 299
Eksterne II-ere	3	106	504	252	681	545
Forskerutdanning	4	471	433	433	0	0
Masterstipendier		50	120	140	80	80
TSC		125	250	250	250	250
Underleverandører		450	1 200	1 206	1 211	1 217
Administrasjon	5	609	1 194	1 312	1 240	1 238
Møter og konferanser		90	310	208	216	221
Utgifter i alt		4 982	8 996	7 896	9 950	8 850
Overføres til neste år		0	0	0	0	0
KOSTNADSSTED						
		2016	2017		2018	2019
Frisch vertskap	6	749	1 624	1 660	1 537	1 539
Forskning senterleder	7	278	483	584	502	522
Frisch partner	8	1 381	1 881	889	2 892	1 978
SSB partner	9	908	1 881	1 881	2 001	1 978
ØI partner	10	986	1 174	1 174	877	821
TSC partner		125	250	250	250	250
Eksterne II-ere	3	106	504	252	681	545
IFE -underleverandør		150	500	500	500	500
JUS - underleverandør		50	300	306	311	317
SUM - underleverandør		250	400	400	400	400
Sum partnere og underleverandører		4 982	8 996	7 896	9 950	8 850

Noter:

- Den årlige utbetalingen fra NFR varierer fra år til år, men er i gjennomsnitt 8 mill.
- Lønns- og driftskostnader knyttet til forskning utført av fast ansatt ved Frisch, SSB og ØI.
- Eksterne II-ere som ikke har fast ansettelse ved Frisch, SSB, ØI eller Tilburg. Ikke alle stillingene ble besatt i 2017.
- Ph. D studenter og Post Doc.
- Inkluderer 0,25 årsverk pr. år til CREE forskningsleder i henhold til praksis fra 2011.
- Frisch vertskap er utgiftene til den administrative tiden til senterleder, utgifter til sentersekretær, styret, møter, konferanser og annet som er knyttet til driften av CREE.
Grunnet utvikling av websider og manglende føring av CREE leder tillegg, er utgiftene økt noe.
- Grunnet omlegging av regnskapsføringen på Frischsenteret ble ikke alle kostnadene knyttet til CREE leder lagt inn i budsjettet våren 2017. Avviket utgjør ca. 100.000 kroner årlig (inklusive avgifter etc.). Halvparten dekkes gjennom Frisch vertskap.
- Lønns- og driftskostnader for forskermånedssverk utført av fast ansatte ved Frischsenteret.
Frisch partner overfører ca 0,9 mill. fra 2017 til 2018.
- Lønns- og driftskostnader for forskermånedssverk utført av fast ansatte ved SSB.
- Lønns- og driftskostnader for forskermånedssverk utført av fast ansatte ved ØI. Dette inkluderer eventuelle midler til stipendiat. Summen inkluderer kr 135' som er avsatt til fri disposisjon til CREE-miljøet på ØI. Dette beløpet ble innført i 2015.
- Dette er et anslag på antall mnd hvis alle midlene ble brukt på lønn.
- For 2017 er det anslått gjennomsnittlige månedssatsler lik:
SSB/ØI/TILBURG: 135', IFE 254' II ere 140' Frisch: 180',
- Inkluderer forskermånedssverk utført av senterleder.

ANSLAG FORSKNINGSMÅNEDSVERK¹¹

	12	2 016	2017		2 018	2 019
		Regnskap	Budsjett	Prognose	Budsjett	Budsjett
Frisch	13	1	3	4	5	4
SSB		7	14	14	15	14
ØI		4	5	5	6	6
Tilburg		1	2	2	2	2
IFE		1	2	2	2	2
Andre underleverandører		2	5	5	5	5
Post Doc		6	0	0	0	0
Stipendiater		5	5	5	0	0
Eksterne II-ere		1	4	2	5	4
Sum		27	40	39	39	35

CREE WORK PLAN 2017

Introduction and overview

In November 2016, CREE obtained funding for three additional years. Based on the recommendations of an international assessment group from 2015, CREE is making a number of changes to further improve the center's effectiveness in the remaining funding period:

- Restructuring the leadership group: Dr. Rolf Golombek will be the CREE Director in the 2017-19 period. All user partners have been offered to become members of the CREE board.
- Increasing user involvement through seven distinct user-oriented activities ranging from improved communication efforts (newsletter and synthesis reports) to more direct engagement with user interests (CREE hot-line and dialogue seminars on subjects suggested by users)
- Organizing the center research thematically in four Flagships, each focusing on a key issue relating to environmentally friendly energy:
 - **Radical emissions reductions in ETS sectors** (Leaders: Professor Nils-Henrik von der Fehr, University of Oslo, and Dr. Snorre Kverndokk, Frisch Centre)
 - **Environmentally friendly transport** (Leader: Dr. Mads Greaker, Statistics Norway)
 - **Environmental regulations and utilization of smart technologies** (Leader: Dr. Bente Halvorsen, Statistics Norway)
 - **Towards the low-emission society** (Leader: Senior Researcher Taran Fæhn, Statistics Norway).
- Ensure that each flagship effort involves plans and activities to
 - **Deepen user involvement** through concrete activities involving specific Centre users
 - **Make research more multi-disciplinary** by drawing on CREE sub-contractors and participants:
 - Centre for Development and the Environment at the University of Oslo (SUM - anthropology)
 - Faculty of law at the University of Oslo (law)
 - Institute for Energy Technology (IFE - technology)
 - SINTEF Building and Infrastructure (SINTEF Byggforsk – architecture and engineering)
 - **Strengthen international cooperation** by requiring that each flagship effort involves international experts

- **Continue research education activities.** For the period 2011-2016, five doctor dissertations were defended by researchers associated with CREE (three of these were women), and one researcher finished his post doc. For 2017, CREE has one (female) PhD student. Other educational activities will be to offer four CREE Master Scholarship: each student will obtain a CREE supervisor and will be offered office space among the research partners.
- **Gender awareness.** Two of the five flagship leaders are women. The CREE project portfolio covers seven large research projects funded by the Research Council of Norway. Among the seven project leaders, three are women, including one who recently obtained her PhD.

User-oriented activities

CREE is increasing its efforts to involve and respond to user interests. These efforts are organized in seven distinct user-oriented activities:

Annual user seminar

Like previous years, CREE will, jointly with the FME-S center CICEP, organize a half-day policy oriented seminar in the spring. The event is open to all interested parties in addition to the user partners of CREE and CICEP.

CREE dialogue seminar

In recent years, the dialogue seminar has provided users with an arena where they can present views, perspectives and ideas relevant to their own concerns in order to receive comments and engage in discussion with CREE researchers, who can draw on the general research literature as well as their own expertise. In the future, we will also organize dialogue seminars on topics of particular interest to our user partners, communicating and synthesizing up-to-date analysis and research. This may involve questions such as i) which social discount rate should be used in cost-benefit analyses? ii) how should CO₂ emission reductions be assessed? and iii) what policy instruments would be effective in spurring environmentally friendly research, development and diffusion? We plan to organize one or two dialogue seminars each year.

CREE synthesis reports

These reports may be overview articles on policy issues related to environmentally friendly energy, or discussion of methodological topics. In particular, a synthesis report can be the output from a CREE dialogue seminar, potentially with contributions also from CREE user partners.

CREE news letter

We plan four to six issues per year of the CREE newsletter. Previous, we had separate news letters about CREE events, and separate mails on newly released CREE working papers. These will now be merged and extended with information on CREE in the media, and they will appear more frequently.

CREE hot line

We will launch a pilot project – CREE hot line. This refers to informal meetings, organized at short notice when requested by the center user partners, where CREE researchers participate to contribute on topics of interest to the user partner, for example, how to analyze a specific policy question.

Statistics on green industries

CREE will cooperate with Statistics Norway and the Norwegian Ministry of Climate and Environment to produce statistics on production and exports of green products and services.

CREE web pages

The CREE web pages will be updated and extended in order to reflect the reorganization of CREE projects into flagships (rather than work packages). They will also offer more information and facilitate information gathering.

CREE research workshop

CREE will continue to organize an annual two-day research workshop with international participation (by invitation only). Because our user partners are also invited, we will consider to include a policy-oriented session as part of the program.

Flagships

The Centre research activities will be organized within four thematically specified Flagships to strengthen the thematic unity and focus of the CREE center. Each Flagship will also have specific activities and tasks related to making research more cross-disciplinary, more responsive to user needs, and with a stronger international component.

Flagship I: Radical emissions reductions in ETS sectors

The ETS sectors (the sectors covered by the EU Emissions Trading system) are mainly heavy energy-using installations such as power stations, oil and gas platforms, and industrial plants. These cover about 45% of EU's greenhouse gas emissions. Non-EU members like Iceland, Lichtenstein and Norway are also part of the trading system.

ETS puts a limit on total emissions in these sectors, but individual participants can trade permits between themselves. In addition, these sectors also face other regulations, both from the EU and their domestic governments (e.g., carbon taxes), that provide further incentives to reduce emissions.

In this flagship, we consider emissions reductions in the ETS sectors. We concentrate our research on the power market, but we will also study other sectors. We aim to study and understand the driving forces behind the regulations and the choice of regulatory instruments in these sectors. Further, how they impact the Norwegian energy system and energy production, including investments in technologies and transmissions. We also study how regulations can be designed to ensure first-best or second-best investment decisions. Finally, we will study environmental costs of investments in the energy system.

Flagship leaders: Professor Nils-Henrik von der Fehr, University of Oslo, and Dr. Snorre Kverndokk, Frisch Centre.

Flagship themes

I.1 Intermittency, Flexibility and Security of Supply – How can we accommodate rapidly increasing shares of intermittent energy sources (solar, wind) in the power mix? More intermittent electricity will require enhanced flexibility in other parts of the power market to ensure overall balance at all times: Where will this flexibility come from? Will the market provide sufficient incentives for flexibility or are special measures required? Are current regulations conducive to flexibility, or is there a need for reform?

I.2 Transmission and Integration – Intermittent power generation will vary by time and place (e.g., wind, sun, weather), and will frequently be produced in areas that currently have limited transmission capacity. This will require more transmission capacity. Weather stochasticity may be reduced by increasing the capacity of interconnectors (such as the one between the Nordic countries and the rest of Europe). Also, more efficient use

of existing transmission capacity is warranted. How can new transmission resources be mobilized? Are transmission system operators (TSOs) and regulators able and willing to facilitate development of transmission networks, in particular where cooperation across jurisdictions is required? Do current market conditions, in particular transmission tariffs, encourage efficient use of transmission networks, or are reforms required?

I.3 Distributed Electricity and Storage – New technology – including renewable generation, batteries and information and communication technology – is rapidly changing the role, not only of distribution networks, but also of distribution system operators (DSOs). Are there barriers to the rolling out of new technologies? Do (distribution) tariffs and electricity prices encourage the adoption and efficient use of new technologies? What should be the role of DSOs, in particular in relation to other, new market players, such as suppliers of technology, service providers and middlemen (aggregators)? Does the current regulatory regime support efficient development of distributed electricity and storage?

I.4 Regulatory Instruments and Impacts – Reductions of emissions in the ETS sectors may be achieved with different instruments, including emissions quotas and taxes, quality standards, subsidies to green energy sources and an outright ban on the use of certain resources. What is the experience with the various instruments? Are they equally efficient? To what extent should the choice of instrument depend on the underlying characteristics of regulated sectors? What motivates the different regulatory choices that governments make, across countries, sectors and types of emissions? Are there conflicts between stimulating renewable production and the local environment?

I.5 CCS – Carbon capture and storage may be necessary to contain global warming below 1.5 or 2 degrees, as is the current political ambition. Adoption of CCS technology in the power sector, however, has by far been behind predictions. Why has the technology not been implemented, and which policy instruments are available to raise adoption of this technology? What is the economic value of CCS-effort with regard to learning effects, CO₂ reductions and the option of storage? What are the market imperfections in the three markets (capture, transport, storage) and what policies would target these imperfections? Can CCS be economically profitable without government support? What will the consequences for Norwegian industry (including oil and gas) be with and without CCS, given that we aim for the two-degree target?

Multi-disciplinary activities

- Close collaboration with engineers from Institute for Energy Technology (IFE) on I.1 and I.4, as well as the new projects *Security of supply* and *Windland* (see below).
- Close collaboration with lawyers from Faculty of Law (UiO) on I.1 as well on *Security of supply* and *Windland* (see below).
- Close collaboration with natural scientists from Norwegian Institute for Nature Research (NINA) on the project *Windland* (see below).

International collaboration

Professor Fridrik Baldursson, Reykjavik University. Professor Claude Crampes, University of Toulouse. Dr. ing. Markus Blesl, University of Stuttgart. Professor Claudie Boiteau, Director of the Master programme Law and Market Regulation, Université Paris-Dauphine.

Large research projects

CREE has two research projects with funding by the Research Council of Norway that address topics under this flagship:

Security of Supply, funded by ENERGIX and lead by the Frisch center. Scientific partners: Frisch Centre, Statistics Norway, University of Oslo (Department of economics, Faculty of law) and Institute of Energy Technology (IFE). This project started in 2016, and relates to flagship themes I.1 and I.3.

Windland: Spatial assessment of environment-economy trade-offs to reduce wind power conflicts, funded by ENERGIX and led by SSB. Scientific partners: Institute for Energy Technology (IFE); Norwegian University of Life Sciences, NMBU; Norwegian Institute for Nature Research (NINA), Vista Analyse; Faculty of Law, University of Oslo (UiO). This project relates to I.4.

User involvement

- Gassnova will work closely with CREE researchers on I.5.
- NVE, Statkraft, Statnett and OED will be involved in I.1-I.4 through meetings, consultations and seminars.

Planned work for 2017

Table I.1 summarizes the planned work on flagship I for 2017, describing main research questions and collaborations between institutions. Some of the projects will be started in 2017 (“new”), the remaining were launched earlier. For more information, consult the 2017 CREE project directory (http://www.cree.uio.no/docs/Project_directory_2017.pdf).

Table I.1 Research questions in ongoing and new projects planned for 2017. Project number refers to the 2017 CREE project directory. Institution summarizes all collaborating units.

<i>Projects</i>	<i>Project number</i>	<i>Institution</i>
I.1 Intermittency, flexibility and security of supply <ul style="list-style-type: none"> - Effects of reduced nuclear capacity in Europe - Flexibility in electricity markets - Security of supply in a green power market - capacity mechanisms - Legal challenges and opportunities for Norway under a re-designed electricity market 	<p>35</p> <p>40</p> <p>42</p> <p>new - 51</p>	<p>Frisch/SSB/NMBU</p> <p>ØI/Frisch</p> <p>Frisch/IFE/SSB/ØI/UiO law</p> <p>UiO Law</p>
I.2 Transmission and integration <ul style="list-style-type: none"> - Regionalizing Norway in the numerical model LIBEMOD - Integration of, and competition between, regional electricity markets - Cooperation and regulation for building electric interconnectors 	<p>9</p> <p>39</p> <p>new - 52</p>	<p>SSB/Frisch</p> <p>ØI</p> <p>ØI/Toulouse</p>
I.3 Distributed electricity and storage <ul style="list-style-type: none"> - The European electricity market towards 2050 - the battery revolution - Security of supply in a green power market - location signals for renewable power 	<p>new - 53</p> <p>42</p>	<p>Frisch/IFE/SSB</p> <p>Frisch/IFE/SSB/ØI/UiO law</p>
I.4 Regulatory instruments <ul style="list-style-type: none"> - Effects of the EU ETS on manufacturing plants - Systems for refunding emissions payments - Avoiding nature-sensitive oil extraction - Natural resources and sovereign expropriation - The European electricity market towards 2050 - targets and instruments - WINDLAND 	<p>18</p> <p>24</p> <p>33</p> <p>36</p> <p>new - 53</p> <p>new - 54</p>	<p>SSB/Skattedir/NMBU</p> <p>SSB/UiO/Gothenburg</p> <p>U Uppsala</p> <p>UiO/U Reykjavik/U Uppsala</p> <p>Frisch/SSB</p> <p>SSB /IFE/ NMBU/ NINA/ UiO Law/ Vista Analyse</p>
I.5. CCS <ul style="list-style-type: none"> - The role of CCS in reaching a low-carbon society 	<p>new - 55</p>	<p>Frisch</p>

Flagship II: Environmentally friendly transport

Norway has committed to a 40% reduction of greenhouse gas emissions from the non-ETS sectors by 2030. Transport makes up a major share of Norwegian emissions in the non-ETS. Although there will be flexibility available for the non-ETS sector across the EU members, the Norwegian Parliament has announced that they aim for radical domestic emission cuts in transport.

Norwegian transport can be divided into sea, air, rail and road. Road can further be divided into private, light duty and heavy duty vehicles. The sustainability of transport can be improved by i) reducing the total amount of traveling, ii) modal shift, e.g. from road to rail, and iii) by introducing new technologies (e.g., electric vehicles). For policy it is important to obtain the right balance between the measures; taking into account that there may be market imperfections when introducing new technologies.

Flagship leader: Dr. Mads Greaker, Statistics Norway

Flagship themes

II.1 Electrification of private road transport. What is the most efficient way to increase the share of plug-in hybrid electric vehicles (PHEV) and/or battery electric vehicles (BEV) in the Norwegian car fleet? How have the different incentive mechanisms for PHEVs and BEVs like free parking, free charging, and access to bus lanes, worked with respect to increase the PHEV and BEV market shares? What determines the right balance between PHEV/BEV usage and public transport, and how can this mix be achieved? What are the potential costs of incompatibility between charging systems?

II.2 Integrating transport with electricity markets. What kind of problems may arise in electricity supply as the share of the car fleet requiring charging on the road increases towards 50%? How can BEV owners be motivated and incentivized to provide back-up power capacity when their car is not in use? How does the market share of BEVs affect the value of a smart grid?

II.3 Over-coming barriers to more sustainable commercial transport. What types of technological, behavioral and infrastructure barriers exist for low- or zero-emission technology in commercial road transport? How can firms be motivated and incentivized to adopt zero- or low-emission light and heavy duty vehicles? One proposal has been to create a CO₂-fund to finance low emission technology for light and heavy duty vehicles – what are the benefits and drawbacks of such a solution? What is the potential for emission reductions in national sea transport, including the fishing fleet? Is there a future role for hydrogen, and should the government actively support its introduction?

II.4 Biofuels in road and air transport. What is the optimal policy mix of biofuels; should storage of organic carbon receive subsidies, should those who burn organic carbon be taxed, and should biofuels technologies for transport purposes be subsidized? Which of the politically feasible second-best policies come closest to the first best? Is the proposal by the Norwegian Parliament to increase the blending of biofuels in gasoline and diesel to 20 percent by 2020 a good idea? To what extent should Norwegian consumption of biofuels be covered by Norwegian forestry resources?

Multi-disciplinary content

For II.1 and II.2, we already have close cooperation with TØI, and the research will encompass many disciplines, for example, political science and engineering. In II.3 we will engage with technological experts, for example at IFE, in order to understand the technological options for commercial road and sea transport. Our aim is to write a common paper on the design of a CO₂ fund for transport. In II.3 we aim to cooperate with **Norwegian Centre for Sustainable Bio-based Fuels and Energy** at NMBU, which is a new FME. Our intention is to write a common policy paper discussing the target of increasing the blending mandate to 20% by 2020.

International collaboration

We will cooperate with Professor Stef Proost at Leuven University on II.1 and II.2, with Professor Thomas Sterner, University of Gothenburg, on II.3, and with Professor Olli Tavonen, Helsinki University, on III.3. All are international experts.

Large research projects

Electrification of transport: Challenges, mechanisms and solutions - ELECTTRANS (KPN funded by the Norwegian Research Council under the ENERGIX program, with participation from Statistics Norway, Frisch Centre and Institute of Transport Economics)

The overall objective of ELECTTRANS is to provide new knowledge about the challenges and opportunities in electrifying the private car fleet in Norway. The point of departure is that by 2030, at least 50% of the private car fleet will be electric. The project is a part of the research in both II.1 and II.2.

Driving towards the low-emission society (Funded by the Norwegian Research Council under the ENERGIX program, with participation from Frisch Centre and Institute of Transport Economics)

The primary aim of the project is to obtain accurate and reliable knowledge on the effects of existing and potential future policies to support the transition to zero- and low-emission automobiles in Norway. The project is a part of II.1.

User involvement

Statkraft, Ringerikskraft, Meschkraft and Veidirektoratet are already involved in II.1 through ELECTRANS. We will also seek to involve Statnett and NVE. The plan is to engage The Norwegian Environment Agency and the Municipality of Oslo in II.2. For III.3 we will among others engage Statkraft.

Planned work for 2017

Table II.1 summarizes the planned work on flagship II for 2017, describing main research questions and collaborations between institutions. Some of the projects will be started in 2017 (“new”), the remaining were launched earlier. For more information, consult the 2017 CREE project directory (http://www.cree.uio.no/docs/Project_directory_2017.pdf).

Table II.1 Research questions in ongoing and new projects planned for 2017. Project number refers to the 2017 CREE project directory. Institution summarizes all collaborating units.

<i>Projects</i>	<i>Project number</i>	<i>Institution</i>
II.1 Electrification of private road transport <ul style="list-style-type: none"> - ELECTRANS - The role of compatibility of charging systems - ELECTRANS - Balancing PHEV and BEV usage with public transport - Driving towards the low-emission society - Establish a dataset consisting of all cars and car owners in Norway 	 50 50 new - 56	 SSB SSB/Leuven/TØI Frisch/TØI
II.2 Integrating transport in the electricity market <ul style="list-style-type: none"> - ELECTRANS - Integrating electric road transport with electricity supply - ELECTRANS - Using electric vehicles as back-up power 	 50 50	 Frisch/SSB/TØI SSB
II.3 Over-coming barriers to more sustainable commercial transport <ul style="list-style-type: none"> - The design of a CO2 fund for transport in Norway 	new - 57	CREE Master thesis
II.4 Biofuels in road and air transport <ul style="list-style-type: none"> - Cost benefit analysis of a 20% biofuels blending mandate in Norway 	new - 57	CREE Master thesis

Flagship III: Environmental regulations and utilization of smart technologies

Achieving ambitious environmental and climate goals requires broad adoption of environmentally friendly and energy efficient technologies in homes and businesses. This flagship aims to increase our understanding of how policies can motivate and incentivize research, development and diffusion of both low-emissions technologies and technologies aiming at lowering energy consumption. What impact will economic factors, habits and norms have on development and utilization of new technologies? How do firms and consumers use and respond to new technologies? To what extent does adoption of the new technologies actually reduce energy demand? A variety of analytical and empirical approaches that draw on economic theory and other social sciences will be applied.

Flagship leader: Dr. Bente Halvorsen, Statistics Norway

Flagship themes

III.1 Innovation and diffusion of green technologies – Are there reasons to support the development of environmentally friendly technologies at higher levels than the development of other technologies? How can we design efficient support schemes for green R&D specifically? Is an innovation prize an efficient instrument to spur research and development? Are CCS technologies best supported by subsidizing development of technology or by subsidizing acquisition of technology? What are the effects of the Norwegian R&D tax credit program on environmental patenting?

III.2 Technical building standards and energy use - How do technical building standards affect energy consumption? How does the design of the built environment and energy saving devices influence user behavior? What are the greatest barriers for not achieving the full energy savings potential?

III.3 Increased energy efficiency in existing buildings - How do firms react to investment subsidies aimed at increasing energy efficiency in existing commercial buildings?

III.4 Utilization of smart technologies – To what extent will the load curve change due to new, smart technology applications and time-dependent tariffs? How does the utilization of new, smart technologies depend on characteristics like design, placement within the home and habits?

III.5 Energy security and option value – To what extent are households and businesses concerned about energy security when choosing their energy technologies? How are

households and businesses affected by power grid failures? What is the option value of having an alternative energy source for heating or being a prosumer?

Multi-disciplinary activities

- Close collaboration with social anthropologists from Centre for Development and the Environment (SUM), which is a CREE sub-contractor, on topics III.2, III.3, III.4 and III.5.
- Collaboration with architects and engineers from SINTEF Building and Infrastructure (SINTEF Byggforsk) on topic III.4. Planning new, joint projects related to III.1, III.2, III.4 and III.5.

International collaboration

Professors Reyer Gerlagh and Sjak Smulders, Tilburg University and Tilburg Sustainability Centre, on topic III.1.

Large research projects

CREE has one research projects with funding from the Norwegian Research Council that addresses topics under this flagship:

Security of Supply, funded by ENERGI and lead by the Frisch center, is related to III.4. Scientific partners: Frisch Centre, Statistics Norway, University of Oslo (Department of economics, Faculty of law) and Institute of Energy Technology (IFE).

User involvement

Ringerikskraft is involved in III.4. Further, we plan to work closely with Statnett and NVE on two new projects related to topics III.2 and III.5 that addresses topics of particular interest for our user-partners. We also plan to start working on a joint new project with Riksrevisjonen at the end of 2017/beginning of 2018, discussing policy tools aimed at increasing the energy efficiency in existing buildings (III.3).

Planned work for 2017

Table III.1 summarizes the planned work on flagship III for 2017, describing main research questions and collaborations between institutions. Some of the projects will be started in 2017 (“new projects”). For more information, consult the 2017 CREE project directory

(http://www.cree.uio.no/docs/Project_directory_2017.pdf).

Table III.1 Research questions in ongoing and new projects planned for 2017. Project number refers to the 2017 CREE project directory. Institution summarizes all collaborating units.

<i>Project</i>	<i>Project number</i>	<i>Institution</i>
III.1 Innovation and diffusion of green technologies <ul style="list-style-type: none"> - Strategic technology policy to support renewable energy technologies - How should CCS technologies be supported? - Environmental innovation prizes - Innovation in clean energy as a commitment device - Triggering environmentally-friendly technology development 	25	SSB/NMBU/RFF
	26	Frisch/SSB/NMBU
	27	Frisch/SSB/ØI
	28	Tilburg
	30	SSB
III.2 Technical building standards and energy use <ul style="list-style-type: none"> - How do technical building standards (TEK) affect energy consumption in commercial buildings? 	new - 58	SSB/SUM/NVE
III.3 Increased energy efficiency in buildings buildings <ul style="list-style-type: none"> - How do firms react to investment subsidies aimed at increasing energy efficiency in existing commercial buildings? 	new - 59	SSB/SUM/Riksrevisjonen
III.4 Utilization of smart technologies <ul style="list-style-type: none"> - Security of supply - designing flexible demand - Rebound and adverse effects of energy efficiency measures - Investments and utilization of energy efficient household appliances - Household energy practices in low energy buildings 	42	Frisch/SSB/IFE/UiO Law
	43	SSB
	48	SSB
	49	SUM/SINTEF Byggforsk
III.5 Energy security and option value <ul style="list-style-type: none"> - Willingness to pay for avoiding black outs exceeding 24 hours 	new - 60	SSB/SUM/Statnett/NVE

Planned research applications

In 2017 we plan to write one application to the NRC for a major research project in collaboration with anthropologist at SUM and architects and engineers at SINTEF. The main aim of this application is to shed light on the interaction between residents and new smart technologies in passive, low energy and active/plus houses. The project will contain research questions of economic, anthropological, technical and architectural nature, and have several user partners. The planned project relates to III.1, III.2, III.4 and III.5.

Flagship IV: Towards the low-emission society

While the first three flagships focus on specific sectors and technologies, this flagship aims at taking a comprehensive view by focusing on larger entities; nations, regions and the world. Development and diffusion of environmentally friendly technologies are driven by the long-term goal of becoming a low-emission society. The public good-characteristics of the environment and the climate call for coordinated and over-arching policies across sectors and/or nations. There is a need to understand the political, legal, economic, behavioural and technological motivations and obstacles for alternative pathways.

Approaches in this flagship embrace theoretical and numerical models of technological, behavioural and political responses to challenges in the energy-environment-climate nexus. It is also pivotal to learn from experience by using empirical methods and experiments of behavioural responses.

Flagship leader: Senior Researcher Taran Fæhn, Statistics Norway

Flagship themes

IV.1: Greening the economy

- Transition of the economy from fossil-fuel based industries and petroleum dependency to green energy and clean activities
- National, regional and global scenarios of technological, economic and environmental development (e.g. in the wake of Paris)
- The conflict between short-run abatement considerations and long-run transformation
- Time-inconsistency and commitment problems.

IV.2: National and international climate policies and treaties

- Impacts on competitiveness, trade and carbon leakage of low-emission strategies
- Multilateral negotiations, agreements, coalitions/clubs and coordination of policies
- Impacts on global energy markets of demand and supply side policies.

IV.3: Barriers and opportunities to transformation

- The interaction of multiple political goals and policy instruments
- Political and distributional aspects of transformation (lobbyism, inter-generational burden and inequality)
- Ethical, psychological and legal aspects of transformation – the impacts of alternative behavioural responses.

Multi-disciplinary activities:

- Close collaboration with technology experts from IFE on IV.1 and IV.2.
- Collaboration with expert of psychology and behavioural economics on IV.2
- Collaboration with natural scientists on IV.3.

International collaboration:

As seen from the table below, there is substantial international involvement in our projects. We will have particularly close and frequent cooperation with Professor Böhringer, University of Oldenburg (IV.1 and IV.3).

Large research projects

CREE has four research projects with funding from the Norwegian Research Council that address topics under this flagship:

Will: Funded by KLIMAFORSK and led by SSB, is related to IV.3. Scientific partners: CICERO, University of Oldenburg and NMBU.

Prospects: Funded by PETROSAM2 and led by SSB, is related to IV.1. Scientific partners: Frisch, University of Stavanger, University of Oldenburg and Nord Universitet.

Smart Paths: Funded by KLIMAFORSK and led by SSB, is related to IV.2 and IV.3. Scientific partners: IFE, BI, University of Strathclyde and University of Oldenburg. This project has a policy/science forum of experts from policy-making, government and industry.

Sustainable transformation to sustainability: Funded by KLIMAFORSK and led by the Frisch center, is related to IV.2. Scientific partners: Frisch Centre, Statistics Norway, University of Oslo (Department of economics, Department of Political Science).

User involment

Miljødirektoratet, The science-policy forum in the Smart Paths project.

Planned work for 2017

Table IV.1 summarises the planned work for 2017, describing main research questions and collaborating units. Some of the projects will be started in 2017 (“new”). For more information, consult the 2017 CREE project directory

http://www.cree.uio.no/docs/Project_directory_2017.pdf.

Table IV.1 Research questions in ongoing and new projects planned for 2017. Project number refers to the 2017 CREE project directory. Institution summarizes all collaborating units.

<i>Project</i>	<i>Project number</i>	<i>Institution</i>
IV.1 Greening the economy		
- Residential energy efficiency and European carbon policies	4	SSB
- Energy efficiency, energy systems and the economy	5	SSB
- Prospects - impact of climate policy on petroleum extraction	7	SSB
- Innovation in clean energy as a commitment device	28	Tilburg
- Smarth Paths – Global technological and economic drivers	new - 61	SSB
IV.2 National and international climate policies and treaties		
- Allocation rules for carbon permits	2	SSB/NMBU
- WILL - Norwegian climate policies: impacts on competitiveness and carbon leakage	3	SSB/Cicero/Oldenburg /NMBU
- Implications of Paris	10	Frisch
- Pareto improving climate treaties	12	Frisch/JCGRI
- Climate treaties with reciprocal preferences	13	ØI
- Investment in green technologies	19	ØI
- Extraction treaties	20	ØI
- Mitigation under the Paris agreement	new - 62	ØI
- Sustainable transition to sustainability - green R&D clubs	new - 63	UiO/Frisch/SSB
IV.3 Barriers and opportunities to transformation		
- WILL - sluggish behavioral responses	3	SSB
- Decision making in environmental-related dilemmas	14	Frisch/ØI/Oslo Econ
- Obstacles to permit trade	16	Frisch
- Ambiguity aversion	17	ØI
- The climate system and irreversible catastrophes	21	Frisch/Beijer
- Intergenerational decision making	23	Frisch/ØI
- Time-inconsistent discounters	32	ØI
- Smart Paths - norms and responses to climate policy	new - 61	SSB
- Sustainable transition to sustainability - policy restrictions	new - 63	UiO/Frisch

Planned research applications:

In 2017 we plan to write two applications to the RCN: One on green industries (IV.1) and one on multiple policy instruments and impacts on emissions and innovation in green technologies (IV.2).

Flagships versus projects

Several of the projects above will be relevant for more than one flagship. Some examples under flagship I are model development on LIBEMOD, that will be useful in flagship II, and the new projects “The European electricity market towards 2050” and “The battery revolution”; these overlap with projects under flagship IV.

Funding

CREE receives 8 million NOK from the Norwegian Research Council annually. In addition, CREE has six large projects with funding from the Norwegian Research Council and some internal funding; the total amount of these sources exceeds 40 million NOK. Therefore, the budget share of the 8 million is below 1/6 – the requirement is a budget share below 0.75.

Deliverables by 30 November 2017

- One user seminar
- At least one dialogue seminar
- At least one synthesis report
- At least three news letters
- At least two CREE hot line meetings
- Updated CREE web pages
- One research workshop
- At least 10 reports
- At least 8 accepted papers in journals or books.



Oslo Centre for Research on Environmentally friendly Energy

Annual Report 2016



Executive Summary

CREE - Oslo Centre for Research on Environmentally friendly Energy - was established in 2011 as a Social Sciences based energy research centre funded by the Research Council of Norway (FME Samfunn) with an annual grant of NOK 8 million over an eight-years period (2011-19). Because of the delay in deciding whether CREE would receive the last three years of funding, the centre received NOK 4 million from the Research Council of Norway in 2016.

Research and impact

To a large extent, energy and climate policy is focused on how to develop and utilize new technology and more environmentally friendly energy sources. This does not occur by itself, but instead is dependent on institutional and economic frameworks. In this regard, CREE fills the gap compared to the knowledge coming from the other FME centres, as it is based on a broad aspect of economic research including theoretical and empirical analyses, numerical modelling and laboratory experiments. Economic analyses in combination with knowledge other fields are highly relevant for policy makers, regulators and important agents in the energy market.

One example of our research over the last years is to identify efficient measures to reduce CO₂ emissions in a fossil-fuel based economy. The conventional way of implementing policies to reduce CO₂ emissions is through the demand side, that is, introducing measures or instruments to reduce the consumption of fossil fuels. Supply side measures, that is, cutting domestic production of fossil fuels as a climate policy measure is less frequently discussed, let alone pursued. The purpose has been to deduce the cost-effective combination of the two types of policies, given a target for a country's (or coalition's) contribution to global CO₂ abatement. It is explored how the optimal domestic climate policies depend on the emissions from extraction, the costs of downscaling domestic fossil fuel demand and supply, and the market behaviour in the fossil fuel markets. The numerical analysis looks at Norway, which has an ambitious target for domestic demand side measures for 2020, but has so far not considered using supply side measures. The report finds that it is cost-effective for Norway to let most of the contribution to global emission reductions be achieved through supply side measures, see CREE report 4/2016.

http://www.cree.uio.no/publications/CREE_working_papers/pdf_2016/hagem_storosten_carbon_leakage_and_green_paradox_wp04_2016.pdf).

Cooperation and partners

The main focus is on economic research as the research partnership is formed by the Frisch Centre, the Department of Economics (ØI) at the University of Oslo (UoO), the Research department at Statistics Norway (SSB), and the Tilburg Sustainability Center, in the Netherlands. Cooperation with the Centre for Development and Environment (UoO), Faculty of Law (UoO), and Institute for Energy Technology broadens the research perspective. The user perspective is ensured by several partners from industry and government; Gassnova, the Norwegian Environment Agency, the Norwegian Ministry for Petroleum and Energy, the Norwegian Water Resources and Energy Directorate, Statkraft Energy AS, Statnett SF and Statoil ASA.

Research goal

The main aim of the centre is to collect and develop knowledge on the effects of regulatory conditions in the energy market and how these affect technological improvements such as innovation in and diffusion of technology for renewable energy, energy efficiency and carbon capture and storage. The centre provides a basis for better regulatory strategies and for policy instruments designed to reach energy and climate goals established nationally and internationally. CREE will also strive to develop methodological frameworks appropriate for achieving these goals.

Organization of the research

Our portfolio is divided into five working packages that cover international climate and energy policy, innovation and diffusion, markets and regulation, evaluation of policy measures, and development of numerical models. The research packages cover what we consider to be the most important aspects in the economics of energy and climate.

Activities and outreach

2016 has been the fourth year of CREE activities. The activities have concentrated on the research done in the different working packages, in addition to the annual research workshop, CREE seminars and several user activities including the annual user conference, the annual

dialogue seminar and seminar presentations for users. The annual user conference had as its theme "The Paris Agreement: Towards a global green shift ", and there were about 90 participants. The research workshop is mainly for our research partners, international network and sub-contractors, but user partners are also welcome to participate. The workshop is smaller in scale with between 30 and 40 participants. On the other hand, the dialogue seminar is an arrangement where users present what they consider to be the interesting topics in the field and researchers respond to these topics. The different activities organised by CREE cover a large aspect of discussions of topics and analyses on both theoretical and applied character. The meeting places are important for networking and the outreach of our research.

The CREE scientists have held more than 75 conference and seminar presentations in 2016, and they have been mentioned numerous times in the media.

At the end of 2016, we obtained two projects in the ENERGIX programme and two projects in the KLIMAFORSK programme. Hence, from January 2017 we have six large projects with funding from the Research Council of Norway.

Publications

In 2016 we published 23 papers in international peer reviewed journals, 1 book, 5 book chapters, 15 working papers and 18 popular science articles.

Educational activities

In 2016, we continued to reap the fruits of our efforts to fund and encourage PhDs in energy and climate economics; two CREE researchers defended their doctoral thesis, and one CREE researcher finished his four-years period as a post.

Structural changes following the midt-term evaluation

In late fall 2016, the Norwegian Research Council decided to finance the last three years of the eight-years centre period, subject to some requirements. The CREE administration, joint with key CREE researchers, started immediately to reorganize the centre in order to meet these requirements. This effort, which takes place in close cooperation with the CREE users, is expected to be finalized at the end of the first quarter in 2017. Effective July 1 2016, Rolf Golombek replaced Snorre Kverndokk as the CREE Director.

Final remarks

CREE has during its five years of operation contributed to the understanding of energy markets, impacts of regulations on energy use, emissions and innovations, and effective and fair design of climate policies. Our research is important as it is published in very good and good international journals, CREE researchers receive international prizes¹, it has attracted media attention, and it is appreciated by users as our researchers are constantly demanded as advisors for policy makers, as presenters at seminars and discussion partners. To take one example, CREE has collaborated with the Ministry of Finance to develop an equilibrium model for the Norwegian economy (SNOW-No) that can be used for calculations in the next White Paper on Long-term Perspectives for the Norwegian Economy (Perspektivmeldingen). In accordance with the wishes of the Ministry of Finance, the model has been extended, for example by including of all greenhouse gases in the Kyoto Protocol. In addition, the model has been adapted so that the model user can control some parameters that are particularly relevant/interesting for the Ministry of Finance.

¹ In January 2017, the Sören Wibe prize was awarded jointly to Michael Hoel, Bjart Holtsmark, and Katinka Holtsmark for a joint paper published in Journal of Forest Economics.



1 CREE

There is increasing evidence that the global climate is changing, and that this change is mainly due to human activities. As has been stressed by the latest IPCC assessment report published in 2014, climate change can have a substantial impact on the economy, ecosystems and human welfare, and may have catastrophic impacts for parts of the world. Thus, there is a need to reduce greenhouse gas emissions as well as to adapt to inevitable changes. In 2015 the international community was successful in reaching a treaty (the Paris agreement) where nearly all countries in the world agreed to reduce their greenhouse gas emissions. A lot of details have still to be worked out, but technology improvements are widely held to be essential if we are to achieve the required emission cuts.

However, there are several challenges: the research and development effort, as well as diffusion and utilization of new, environmentally friendly energy sources, require appropriate incentives. Another important challenge is the future design and improvements of climate and energy treaties, such as the Paris agreement, that will help achieving a better social outcome. In this respect effective policy instruments and fair outcomes are important. The aim of CREE,

Oslo Centre for Research on Environmentally friendly Energy, is to provide a solid base for policy making on these topics. CREE will also contribute to the collection and establishment of knowledge on how different regulations affect both the energy market and technological development. The centre studies policy instruments designed to reach the goals established in national and international energy and climate policy, while also examining how international treaties could be designed to achieve broader participation and deeper abatement.

The research of the centre is primarily grounded in economics, as reflected by the main research partners: Department of Economics at the University of Oslo, the Research Department at Statistics Norway, the Frisch Centre and the Tilburg Sustainability Centre. In addition, in 2016 the centre has drawn on other perspectives through cooperation with researchers from other disciplines within the social sciences, law and technology.

The centre has the following vision, which is stated in our Strategic Plan:

- We want to be a leading international research centre within energy, environmental, resource and climate economics
- We will generate knowledge that can contribute to a cost-effective and sustainable exploitation of Norwegian and international energy resources by industry and governments, as well as an effective and fair climate and energy policy, both nationally and internationally
- We will contribute to recruitment and training at the master, doctoral and post doctoral levels in energy and environmental economics at the University of Oslo. Recruiting women to research will have a particular focus.

This report summarizes the activities and the achievements of the centre in 2016.

2 Research plan and strategy

CREE organized its research into the following five work packages in 2016:

Work Package I: Regional and national energy and climate policies

(Research Director: Brita Bye, Statistics Norway)

WP I concentrates on analyses of regional and national energy and climate policies. Analyses of regional and national energy and climate policies are in nature more close to reality than global studies, and often analysed empirically. Examples of topics analysed in this work package are policies that deal with carbon leakage when the carbon policy is unilateral or multi-lateral but not global, as border carbon adjustments (tariffs etc.), supply vs. demand side regulations of fossil fuels, or free allocation of quotas in a tradeable emission quota system as, e.g., the EU-ETS. Interactions between policy instruments as energy efficiency measures, carbon pricing and other regulations are other topics.

The methods range from simple models used to illustrate some theoretical results, to detailed multi-sector and multi-region partial and economy-wide models that analyse specific policies.

Work Package II: Global climate policies and negotiations

(Research Directors: Michael Hoel, Department of Economics, University of Oslo, and Mads Greaker, Statistics Norway)

WP II concentrates on analyses of global climate policies and negotiations. By the end of 2015 the UN climate negotiations ended with a treaty in Paris. The treaty is exceptional because nearly all countries in the world committed to reduce their GHG emissions. Although a success, the Paris treaty raises many challenges: First and foremost, the current emission reduction pledges are not large enough to reach the 2⁰ C target. Thus, a crucial question which CREE aims to study is how to get countries to step up their emission reduction pledges. Second, the emission reduction pledges are not legally binding, and there is no sanction mechanism built into the treaty aimed at countries not fulfilling their pledges.

Third, everyone agrees that technological development is crucial for combatting climate change, but how the clean R&D step up is going to happen is not formalized in the treaty.

While the research in this work package builds on economic theory and game theory, it is multidisciplinary as several of the projects are based on behavioral economics and theories of equity.

Work Package III: Innovation and Diffusion policy

(Research Director: Rolf Golombek, Frisch Centre)

Transition to a low-carbon society will require radical environmentally-friendly technology innovations. Work package III contains theoretical and empirical studies on how to promote innovation in environmentally-friendly technologies on how to ensure that these technologies are widely used by firms and consumers. The methods used in this work package cover applied economic theory, large-scale simulation models and econometrics/statistics.

A key reason for the government to support private R&D is that the innovator will in general not be able to appropriate the full social benefit of the innovation. This observation provides a rationalization for the government to support private research and development. One unconventional R&D instrument is an innovation prize, that is, the actor receives an amount of money from the regulator/government if he succeeds in developing a new technology that meets some pre-specified technical conditions. We have shown that the regulator can design an innovation prize that provides the correct social incentives to undertake R&D.

We have examined different types of R&D support for CCS (carbon capture and storage), and asked whether this should take the form of support to development of CCS technologies or purchase of CCS technologies. Our conclusion is that we should support the development of the CCS technology.

Another major activity has been to study empirically how environmental regulations may trigger more environmentally friendly R&D, measured by the number of patents. Here, we draw on a rich Norwegian panel data set that includes information about the type and number of patent applications, technology standards, non-tradable emission quotas, and a large number of control variables. We identify strong and significant effects on innovations from the implicit regulatory costs of direct environmental regulations.

Work Package IV: Regulation and Market

(Research Director: Nils-Henrik M. von der Fehr, Department of Economics, University of Oslo)

In this work package, the main research question is how regulation of energy markets affects the development of green energy, and how measures to promote green energy impact the functioning of energy markets. It is of particular interest to study the implication of regulation across national borders, especially with respect to infrastructure, since an international regulatory framework is crucial for the exploitation of Norwegian energy and environmental resources, both in traditional areas and in new areas like capture and storage of CO₂. The work is mainly theoretical and empirical studies, but numerical models, either already existing or developed in other work packages, are also utilized.

Work Package V: Evaluation of Environmental and Energy Policy Measures

(Research Director: Bente Halvorsen, Statistics Norway)

Work Package V contains empirical studies evaluating the impact of environmental and energy policy measures. In 2016, the work was in close collaboration with social anthropologists from Centre for Development and the Environment (SUM), which is one of our sub-contractors.

An important topic in understanding how to cut GHG emissions is the use of smart technologies, like heat pumps. We find large rebound effects when households install this technology; our results suggest that average electricity consumption is roughly unchanged. This is due to reduced use of firewood and fuel oils, but also to an increase in heated area and higher indoor temperature. There are large variations in indoor temperature throughout the day between households, which depends on installed heating equipment. Further, households with heat pumps and common central heating system keep a higher indoor temperature. Using anthropological methods, we analyse how households respond to electricity meters showing energy consumption by various activities. We find that households seem to appreciate information about costs.

Needless to say, the research in all work packages benefit from contact with subcontractors and user partners. For the vision and strategy of the total CREE activity, see the new CREE strategy plan, which was finalized in 2016:

<http://www.cree.uio.no/about/pdf/cree-strategic-plan-2015-2019.pdf> .

For a complete listing of all projects, see the CREE project directory (<http://www.cree.uio.no/projects/>).

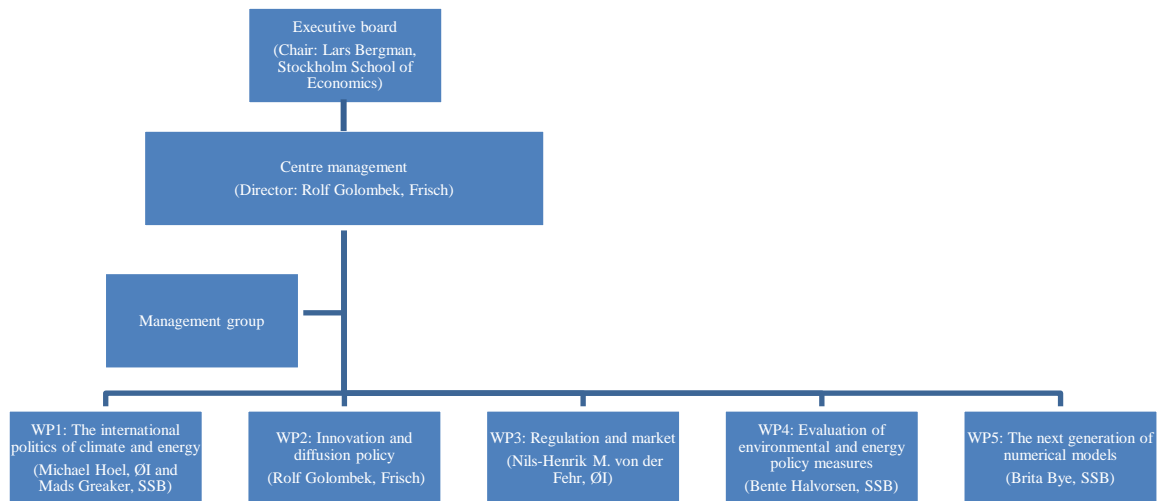
3 Centre organization

In 2016, Snorre Kverndokk served as the CREE Director until July 1, when Rolf Golombek continued as the CREE Director. The organization of the centre in 2016 was as shown in the figure below.

The chair of the executive board (Lars Bergman, Stockholm School of Economics) does not represent any of the research partners, user partners or sub-contractors, and is therefore independent of the partners in CREE.

The board also consisted of one member from each of the three Norwegian research partners and one member from each of the user partners. At the end of 2016, the board members were Sverre A. C. Kittelsen (Frisch Centre), Cathrine Hagem (Statistics Norway), Karine Nyborg (University of Oslo), Kenneth Birkeli (The Norwegian Environment Agency), Kjell Berger (Statkraft), Jan Bråten (Statnett), Ellen Skaansar (Norwegian Water Resources and Energy Directorate) and Ståle Aakenes (Gassnova). The Norwegian Ministry of Petroleum and Energy does not want to be on the board. The board had four meetings in 2016, see http://www.cree.uio.no/about/board/board_meetings/.

The administration of CREE is located at the Frisch Centre. Dr. Rolf Golombek is the Director (Dr. Snorre Kverndokk was the Director until July 2016), and Jørg Gjestvang is the Project Coordinator. The administration has regular meetings with the management group, that is, the work package leaders, to discuss matters of importance for the centre.



The partners of CREE are divided into research partners and user partners. The research partners are:

Ragnar Frisch Centre for Economic Research (Frisch Centre), Oslo (host institution)

Research department, Statistics Norway, Oslo

Department of economics, University of Oslo

Tilburg Sustainability Center, Netherlands.

CREE has six user partners:

Gassnova SF

Norwegian Environment Agency

Norwegian Ministry for Petroleum and Energy

Norwegian Water Resources and Energy Directorate

Statkraft Energy AS

Statnett SF.

Statoil withdrew as a user partner from 15 March 2016.

The user partners of the centre contribute with funding and with members on the board, but also to the research with detailed knowledge about markets, technologies and policy.

In late fall 2016, the Norwegian Research Council decided to finance the last three years of the eight-years centre period, subject to some requirements suggested by the international

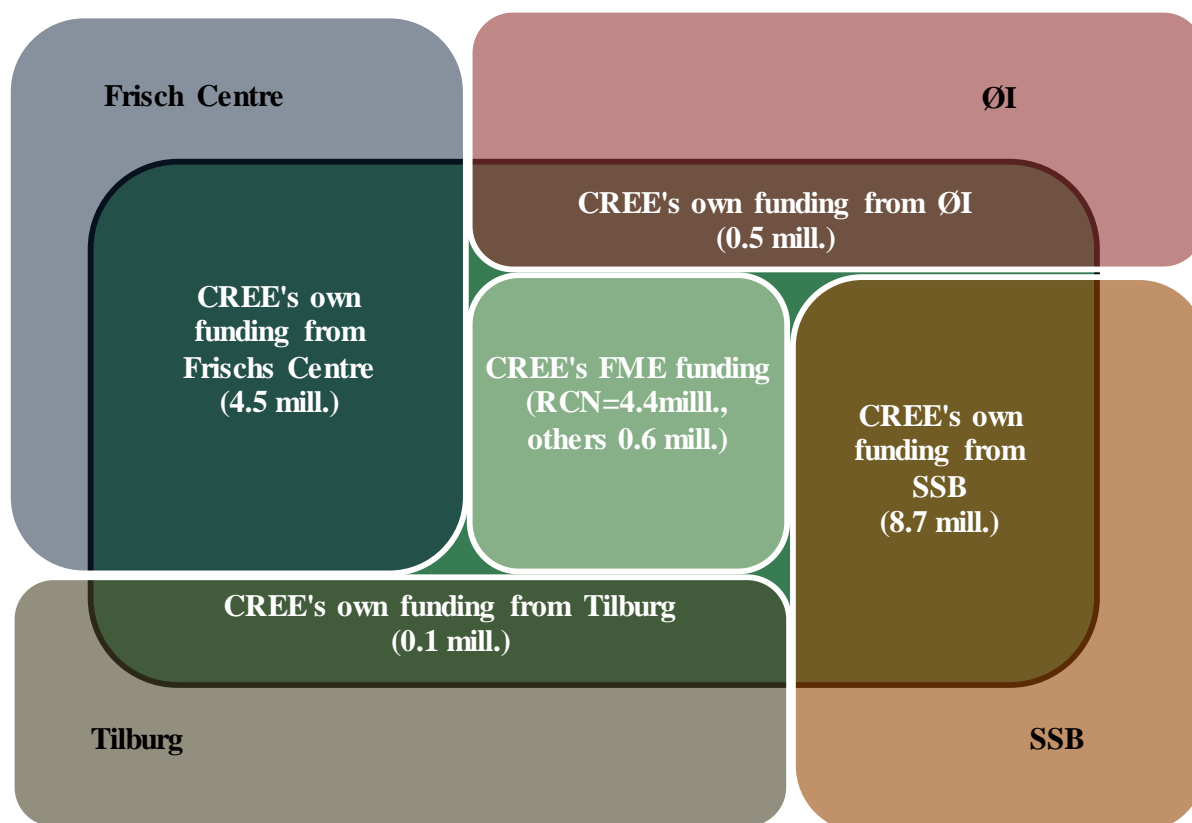
evaluation committee that assessed CREE in 2015. These requirements include i) stronger user involvement, ii) enhanced additionality of the centre, iii) more interdisciplinary activities, iv) implementation of a centre strategy for international cooperation, and v) structural changes of the CREE administration and its board. In November, the CREE administration, joint with key CREE researchers, started to reorganize the centre in order to meet the requirements. This effort, which takes place in close cooperation with the CREE users, is expected to be finalized at the end of the first quarter in 2017.

4 Funding

The funding of CREE in 2016 comes from various sources. The centre has normally an annual contribution from the Research Council of Norway (RCN) of NOK 8 million, user partner funding of NOK 350,000, and funding from the University of Oslo (UoO) of NOK 500,000. Because of the delay in deciding whether CREE would receive the last three years of funding, the centre received NOK 4 million from RCN and 175,000 from user partners. In addition, the centre has secured its own funding through other programs under RCN. The figure below gives an overview of the total funding in 2016. Note that in the figure, the funding from RCN is NOK 4.4 million, which is more than the annual grant. The reason is that 0.4 million was transferred from 2015. For more detailed information, see Appendix A2, which also shows the distribution of costs by CREE research partners and other units affiliated to the centre. Note that costs cover activities directly funded by RCN as well as activities financed by own funding, for example, funding through other RCN programs.

CREE funding in 2016

Total CREE centre funding incl. own funding. (18.8 mill.)



Own funding = professional work that is beneficial to the CREE centre, but is not part of CREE's direct funding from The Research Council of Norway. Own funding should be at least 25% of the total budget of CREE.

FUNDINGS

The Research Council of Norway	4.4
Others	0.6
<i>Public funding (UoO)</i>	0.4
<i>Privat funding (User partners)</i>	0.2
Own funding	13.8
<i>Frisch</i>	4.5
<i>SSB</i>	8.7
<i>ØI</i>	0.5
<i>Tilburg</i>	0.1
Sum total funding	18.8

5 Professional activities and results

The professional activities in 2016 have been concentrated on the research in the work packages, the research workshop, CREE seminars, and several user activities including the user conference and the dialogue seminar.

The CREE workshop took place in Oslo (at Statistics Norway) on 24-25 October. 30 people attended the workshop, mainly researchers from the research partners and sub-contractors in CREE, but also from our international network. Presentations covered research from the work packages, and on subjects related to the work packages. The program is available at <http://www.cree.uio.no/outreach/events/6th-research-workshop.html>.

There were 9 CREE seminars 2016, including 5 seminars given by international visitors. The seminars were given at Statistics Norway, Frisch Centre and University of Oslo. For a list of all seminars, see <http://www.cree.uio.no/outreach/events/?view=allprevious>.

The user conference was held in April and was co-organized with CICEP, another centre for social science research on environmentally friendly energy (FME-S). The conference was in Norwegian and the topic was “The Paris Agreement: Towards a global green shift?” This was successful, and about 90 people attended the conference. For more information about the conference, see

http://www.cree.uio.no/outreach/events/brukerkseminar_cree_cicep_160428.html.

CREE also organized a half-day dialogue seminar with the user partners, where the user partners chose the subjects for dialogue; see

http://www.cree.uio.no/outreach/events/user-meetings/dialogseminar_161208.html.

In 2016, 23 papers were published in international peer reviewed journals (see the Publications table below and Appendix A3). We have also published one book², five book chapters and produced 15 CREE working papers. Further, we have published 18 popular science articles and 8 other publications. The CREE scientists have held 76 conference and seminar presentations. They have also been mentioned at least 20 times in the media. When

² Førsund, F. (2015): *Hydropower Economics*. Second Edition. New York; Springer Science & Business Media.

comparing with output from previous years, the fact that CREE received NOK 4 million – as compared to NOK 8 million in previous years – should be taken into account.

Publications 2011-2016

	2011	2012	2013	2014	2015	2016
Journal articles:	8	16	21	28	19	23
Books and article in books:		2	7	6	2	6
Working Papers:	9	21	30	20	24	15
Popular scientific articles:	4	10	12	7	7	18
Other publications:		5	3	2	18	8
Conference and seminar presentations:		100	100	74	108	76
CREE in the media:	9	41	31	23	26	20

For more information about the publications, see <http://www.cree.uio.no/publications>



5.1 Snapshots of some research projects in 2016

The effects of the EU Emissions Trading System on greenhouse gas emissions

The study "The impacts of the EU ETS on Norwegian plants' emissions, value added and productivity" examines the impacts of the EU Emissions Trading System (EU ETS) on the environmental and economic performance of Norwegian plants. The EU ETS is regarded as the cornerstone climate policy both in the EU and in Norway, but there has been considerable debate regarding its effects due to low quota prices and substantial allocation of free allowances to the manufacturing industry. Both quota prices and allocation rules have changed significantly between the three phases of the ETS (respectively 2005-7, 2008-12, and 2013-20).

Access to detailed data at the plant level for the years 2001-13 allowed us to investigate potential effects of the ETS on several important aspects of plant behaviour, using statistical methods. The results indicate a weak tendency of emissions reductions among Norwegian plants in the second phase of the ETS, but the result is not statistically significant. In the other two phases, no effects on emissions were found. We find no significant effects on emission intensity (emissions per unit of production) in any of the ETS phases.

The study also finds positive effects on wealth creation and productivity for the regulated plants in phase 2 of the ETS, but not in the other two phases. The positive effects may be due to the large amount of free allowances, relatively high carbon prices, and that plants may have passed on the additional marginal costs to consumers. The results of this study indicate that

most Norwegian firms can tolerate somewhat smaller amount of free allowances without operating at a loss.

Klemetsen, M.E., K.E. Rosendahl and A.L. Jakobsen (2016): The impacts of the EU ETS on Norwegian plants' environmental and economic performance. *Discussion papers No. 833*, Statistics Norway, *NMBU Working Paper 3/2016*, *CREE Working Paper 03/2016*.

Climate policies in a fossil fuel producing country – demand versus supply side policies

The conventional way of implementing policies to reduce CO₂ emissions is through the demand side, that is, introducing measures or instruments to reduce the consumption of fossil fuels. Supply side measures, that is, cutting domestic production of fossil fuels as a climate policy measure is less frequently discussed, let alone pursued. In the present situation where countries or a group of countries act unilaterally, demand side versus supply side policies matters.

The purpose of this paper is to deduce the cost-effective combination of the two types of policies, given a target for a country's (or coalition's) contribution to global CO₂ abatement. We explore how the optimal domestic climate policies depend on the emissions from extraction, the costs of downscaling domestic fossil fuel demand and supply, and the market behaviour in the fossil fuel markets. These aspects are crucial for the global abatement effects of demand- and supply-side policies. Our numerical analysis looks at Norway, which has an ambitious target for domestic demand side measures for 2020, but has so far not considered using supply side measures.

Even though leakages are likely to be larger with supply side measures than demand side measures, the main conclusion of this analysis is that it is cost-effective for Norway to let most of the contribution to global emission reductions be achieved through supply side measures. In our benchmark scenario, two thirds of a given global reduction should be realised through supply side measures, that is, by reducing oil extraction. The most targeted instrument for supply side policies is a tax per barrel of domestic oil extraction. The paper discusses the practical challenges with implementing supply side measures and points to

alternatives like more restrictive practise when it comes to opening new areas for oil exploration.

Innovation prizes

The government influences demand for new abatement technologies through its environmental policy. If the government uses innovation prizes to provide the socially correct incentives for a monopoly innovator to invest in R&D, the innovation prize for environmental R&D will therefore in general differ from the innovation prize for market goods R&D. We show that if the slope of the demand curve/marginal benefit of abatement curve is sufficiently large relative to the slope of the marginal cost curve, then the innovation prize for environmental R&D should be greater than the innovation prize for market goods R&D. We also demonstrate that if the government can use a tax rebate to promote diffusion of the innovation, the innovation prize for environmental R&D should always be greater than the innovation prize for market goods R&D.

Golombek, R., M. Greaker and M. Hoel (2015): Innovation prizes for environmental R&D. *CREE working paper*, 19/2015.

Energy technology and energy economics:

Analysis of energy policy in two different model traditions

Models are useful and widely employed tools for studying energy and climate policy in the disciplines of both technology and economics. We use one-country models from each tradition to elucidate similarities and distinctions between the two traditions. Our policy example is the introduction of a cap on the household sector's purchase of energy. The two models generate fairly different results, particularly with respect to the electricity market. In the economic CGE model SNOW, almost all the reduction takes place as less household electricity demand, through increasing energy efficiency and limiting demand for energy-based housing services. The latter option is excluded as a response in the technology-rich energy system model TIMES-Norway, since energy services are exogenously given. As in the economic model, induced energy efficiency measures reduce energy demand. Nevertheless,

household demand for electricity remains virtually unchanged. One important explanation is the rich modelling of alternate energy production technologies in homes. A cap on marketed energy leads to increased investment in heat pumps and substitution of ambient energy. Electricity demand is kept up as it is required for operating heat pumps. Household demand for other kinds of energy, particularly firewood, drops instead. The analyses reveal that even if a large knowledge exchange has resulted in the two model traditions approaching each other, significant differences remain. There is a need to consider the effects of energy policy from several disciplinary perspectives before taking important policy decisions.

Bye, B., K. Espegren, T. Fæhn, E. Rosenberg and O. Rosnes: Energiteknologi og energiøkonomi: Analyser av energipolitikk i to ulike modelltradisjoner. *Samfunnsøkonomen*, nr. 6, 2016.



5.2 Snapshots of some collaboration with user partners

Ministry of Finance

CREE has collaborated with the Ministry of Finance to develop an equilibrium model for the Norwegian economy (SNOW-No) that can be used for calculations in the next White Paper on Long-term Perspectives for the Norwegian Economy (Perspektivmeldingen). In accordance with the wishes of the Ministry of Finance the model extensions include updating the dataset, expansion of the number of sectors, more detailed breakdown of taxes, as well as the inclusion of all greenhouse gases in the Kyoto Protocol. The model has been adapted so that the model user can control some parameters that are particularly relevant/interesting for the Ministry of Finance. Further adaptations makes it possible for the Ministry of Finance to

simulate various configurations of climate policy (eg., a cap on emissions, carbon taxes and allowances). In addition, the model has become more user-friendly. Several courses and workshops on how to use the model has been arranged for the Ministry of Finance.

Norwegian Environment Agency I

CREE has developed and updated a model for the study of energy and climate policy. The model combines the macro perspective of numerical equilibrium approaches with the technology knowledge of energy models. In this project CREE has collaborated with The Norwegian Environment Agency on data processing and with IFE (Institute for Energy Technology) on modelling. In the autumn of 2016, CREE shared their experiences with this type of collaboration with researchers and bureaucrats in Scotland.

Norwegian Environment Agency II

In the spring of 2016, the Norwegian Environment Agency worked on a report that would calculate the cost of electrifying private car transport in Norway. Because achieving emission reductions in transportation is a lengthy process, it is important to know how comprehensive the policies implemented now should be.

The Norwegian Environment Agency invited CREE to discuss how fast costs would decrease, and to what extent the fall in costs will depend on market developments in Norway. The CREE research in the work package on innovation and diffusion of clean technologies was vital to the CREE contribution.

Ministry of Finance, Ministry of Petroleum and Energy

CREE has assisted the Ministry of Finance and the Ministry of Petroleum and Energy in conducting cost-benefit analyses of three CCS projects: Norcem's cement plant at Porsgrunn, Yara fertilizer plant in Porsgrunn, and the Klemetsrud waste management plant in Oslo. Our contributions were related to i) assessing whether it was likely that the projects would spur technological innovations that would benefit future CCS facilities, and ii) determine the value of the technological gains. Our activity during the work package on innovation and diffusion of clean technologies provided a scientific basis for assessing these two issues. As far as we know, this is the first time technological gains have been valued in a cost-benefit analysis.

Ministry of Climate and Environment, Ministry of Finance

A project has been completed on the Norwegian costs for achieving the 2030 targets on greenhouse gas emissions, in close communication with experts from the Ministry of Climate and Environment and the Ministry of Finance. Several discussion meetings and a presentation of the final report have been completed. A section of the 2017 National Budget is devoted to this report.

5.3 Interdisciplinary contact and cooperation

Technology research is essential for developing our numerical models. IFE has been an important partner and subcontractor to CREE from the beginning. Their work on modelling various energy technologies in the detailed energy optimization model TIMES-Norway can provide valuable input in economic models. Especially IFE has supplied estimates of energy efficiency technologies and potentials in the building sector, and we have published a joint article in the journal *Samfunnsøkonomen* where we compare the engineering approach and the economist approach of modelling energy efficiency and relevant measures. Cooperation with IFE has so far also resulted in research projects from the research programme ENERGIX (RCN).

Beyond the collaboration with technologists, we have initiated and started a series of multidisciplinary collaborative projects with researchers from the fields of anthropology, psychology and law. Social anthropologists at SUM (UoO) are heavily involved in the work package "Evaluation of Environmental and Energy Policy Measures". A joint project with the Department of Psychology (UoO) is based on the common methodology of behavioural experiments (in lab). The project provides a good foundation for studying attitudes to risk relevant to the design of climate policies. Further, researchers at the Faculty of Law (UoO) are participating in one of our ENERGIX projects.



6 International cooperation

All the research partners in CREE have a large international network, which is shown through extensive co-authorship with researchers from other countries (see <http://www.cree.uio.no/publications/>). When it comes to articles in peer reviewed international journals, about half of the 23 papers that were published in 2016 had foreign authors or co-authors. This illustrates that CREE works internationally, both through co-authorship and through impacts in the international research community.

CREE researchers also participate actively at international conferences and seminars (e.g., IAEE and EAERE), in international groups (e.g., IPCC), networks (e.g., CESifo), and lecture at foreign universities and institutions.

CREE has an international research partner - Tilburg Sustainability Center - and three foreign researchers had a part-time position paid by CREE in 2016:

- Fridrik Baldursson, Reykjavik University
- Christoph Böhringer, Oldenburg University
- Jared Carbone, University of Calgary.

In addition to the foreign researchers who are employed part time by CREE, several foreign researchers have contracts on CREE projects that are externally funded, i.e., not paid by the direct funding of CREE.

CREE organizes an annual research workshop where we invite researchers from our network. At the workshop in 2016 (24-25 October), the following non-Norwegian researchers attended (see

http://www.cree.uio.no/outreach/events/research_workshops/6th-research-workshop.html):

- Reyer Gerlagh (University of Tilburg)
- Mario Blazquez de Paz (Research Institute of Industrial Economics, Sweden)
- Christoph Böhringer (Univ. Of Oldenburg)
- Itziar Lazkano (University of Wisconsin-Milwaukee)
- Fridrik Baldursson (Reykjavik University).

Several foreign researchers held CREE seminars in 2016. Below is a list of these seminars:

Stef Proost, Economics at KULeuven: Benefits to the Majority From Universal Service, 15. Nov. 2016

Karen Pittel, CES Ifo: Policy Options for the Decarbonization of the EU Power Sector, 10. Mai 2016

Geoffrey Heal, Columbia University: Feeling the Heat: Temperature, Physiology & the Wealth of Nations, 25. Apr. 2016

Brooks Kaiser, University of Southern Denmark: Technical and Institutional Change: transitions in Resource-Based Inuit Communities, 12. Apr. 2016

Reyer Gerlagh, Tilburg University: Committed to a decarbonizing world, 2. Mars 2016

7 Recruitment

In 2016, two of our scientists defended their thesis and our Post Doc Daniel Spiro finished his four years of work:

- Bjart Johannes Holtmark (Statistics Norway) defended his thesis "Seven essays on policies and international cooperation to abate emissions of greenhouse gases" for the dr. philos degree on 15 January
- Marit Elisabeth Klemetsen (Statistics Norway) defended her thesis "Impacts of policies on emissions and environmental innovation in Norway " for the PhD-degree on 6 June.

CREE gives a master scholarship of NOK 20.000 to up to three master students annually. These are offered an office at one of the Norwegian research partners, supervision by one or two of the CREE researchers, access to all CREE arrangements, and the possibility to publish

their thesis in the CREE Working Paper series. For 2016 scholarships were given to Marie Brun Landmark and Shan Jiang. Their theses are published in the CREE working paper series.

8 Cooperation with other FME centres

CREE has a close collaboration with CICEP, one of the other social science-related energy research centers (FME Samfunn) funded by the Research Council of Norway. CICEP has many overlapping projects with CREE as both centres have a large interest in international climate negotiation and agreements. Every spring CREE and CICEP organize a joint user conference for our research partners and other interested institutions. We also organize research workshops together, write joint research proposals and have some joint research projects.

In addition, we have common interests with CenSES, the third FME Samfunn, in numerical modelling of energy markets and new energy technologies, and we have organized workshops and Model Forums together. In 2016 we were both involved in the project “Implications of Paris”, a project initiated by Joint Global Change Research Institute (JGCRI), University of Maryland, that will study several implications of the Paris agreement. The project is organized as a series of workshops; the first one was in the spring 2016.

9 Communication and dissemination

The main users of CREE are, in addition to the research community, industry, Government and the general public. The communications to users are mainly through the following channels:

- Dissemination of research and media activity through our webpage (www.cree.uio.no)
- Hold an annual user conference (April). This is organized together with CICEP
- Organize user activities such as meetings and seminars
- Publish in Norwegian-language journals such as *Samfunnsøkonomen* and *Økonomiske analyser*
- We contribute to hearings in the Parliament and public debates.

CREE has invested heavily in communication, for instance through an internal reward system for communicating through the media. We have dedicated a website for news on CREE research, see <http://www.cree.uio.no/outreach/>, and had 20 reports in the media in 2016. Researchers from CREE have been involved in debates in the media over the past year on subjects such as climate treaties, electric vehicles, bio fuels, and energy efficiency.

When it comes to user-oriented communication measures, we usually give about 75-100 presentations each year. This includes meetings with all user partners, seminars, workshops and conferences. In addition to the two regular user arrangements in the spring and the fall, we organize seminars for users that are interested in certain topics.



CREE - Oslo Centre for Research on Environmentally friendly Energy

Name: CREE

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Phone: 22 95 88 10

E-mail: [cree-admin at frisch.uio.no](mailto:cree-admin@frisch.uio.no)

Web: www.cree.uio.no/

Appendix:

A1 Personnel

Key Researchers

Name	Institution	Main research area
Golombek, Rolf	Frisch Centre	Environmental Economics, Energy Economics, Applied Game Theory
Hauge, Karen	Frisch Centre	Environmental Economics
Kittelsen, Sverre	Frisch Centre	Production theory, Efficiency measurement, Regulation, Health Economics, Energy Economics
Kverndokk, Snorre	Frisch Centre	Environmental and Resource Economics, Health Economics
Nævdal, Eric	Frisch Centre	Resource Economics, Economic management of ecological systems, dynamic optimization, modeling of the risk of disasters, animal behavior
Røgeberg, Ole	Frisch Centre	Welfare analysis, endogenous preferences, rational addiction theory, consumer theory
Strøm, Steinar	Frisch Centre	Microeconomics
Asheim, Geir	Department of Economics, University of Oslo	Game theory, intergenerational justice, green national accounting
Brekke, Kjell Arne	Department of Economics, University of Oslo	Behavioral Economics, Experimental Economics, Resource and Environmental Economics, Real options and stochastic analysis
Framstad, Nils Christian	Department of Economics, University of Oslo	Stochastic optimization
Førsund, Finn	Department of Economics, University of Oslo	Resources, energy, environment, production theory, productivity
Harstad, Bård	Department of Economics, University of Oslo	Political Economics, Public Economics, Contract Theory, Environmental Economics
Hoel, Michael	Department of Economics, University of Oslo	Energy and climate economics, environmental economics, resource economics
Lund, Diderik	Department of Economics, University of Oslo	Resources, energy and environment, economics
Nyborg, Karine	Department of Economics, University of Oslo	Environmental economics, economic analysis of social and moral norms, behavioral economics.
Piacquadio, Paolo Giovanni	Department of Economics, University of Oslo	Microeconomic Theory, Welfare Economics, Game Theory, Public Economics, and Environmental Economics
Strand, Jon	Department of Economics, University of Oslo	Natural resources economics, Environmental economics, Climate policy, Public, transportation and energy economics, Water economics, Cost-benefit analysis
Vislie, Jon	Department of Economics, University of Oslo	Microeconomics, environmental economics, incentives, public economics
Von der Fehr, Nils	Department of Economics, University of Oslo	Microeconomics, Industrial Economics, Regulation, Competition Policy.
Aune, Finn Roar	Research Department, Statistics Norway	Energy and environmental economics
Bye, Brita	Research Department, Statistics Norway	Macroeconomic
Fæhn, Taran	Research Department, Statistics Norway	Macroeconomic
Greaker, Mads	Research Department, Statistics Norway	Energy and environmental economics
Grimsrud, Kristine M.	Research Department, Statistics Norway	Energy and environmental economics
Hagem, Cathrine	Research Department, Statistics Norway	Energy and environmental economics
Halvorsen, Bente	Research Department, Statistics Norway	Energy and environmental economics
Holtmark, Bjart	Research Department, Statistics Norway	Energy and environmental economics
Isaksen, Elisabeth Thuestad	Research Department, Statistics Norway	Energy and environmental economics
Larsen, Bodil Merethe	Research Department, Statistics Norway	Energy and environmental economics
Rosnes, Orvika	Research Department, Statistics Norway	Energy and environmental economics
Storrøsten, Halvor B.	Research Department, Statistics Norway	Energy and environmental economics
de Zeeuw, Aart	Tilburg Sustainability Center	Sustainability, Dynamic game theory, Environmental economics, Environmental policy, Mathematical economics
Gerlagh, Reyer	Tilburg Sustainability Center	Climate Change, Economics, Energy economics, Environmental economics
Smulders, Sjak	Tilburg Sustainability Center	Energy and environmental economics
van der Heijden, Eline	Tilburg Sustainability Center	Energy and environmental economics

Associated Researchers

Baldursson, Fridrik	Reykjavik University	Financial Economics, Industrial Economics, Environmental and Resource Economics
van den Bijgaart, Inge M.	Planbureau voor Leefomgeving (Netherlands Environmental)	Effect of Fiscal Regulations of CO2 Emissions of New Cars
Böhringer, Christoph	University of Oldenburg	Energy Economics
Carbone, Jared	University of Calgary	Environmental and Resource Economics
Eyckmans, Johan	Hogeschool-Universiteit Brussel	Economics of climate change, emissions trading, applications of game theory to the formation of international environmental agreements, cost benefit analysis, general equilibrium and integrated assessment modeling, evaluation of environmental policies, economics of waste management, industrial organization and normative economic theory
Gravir, Anders	Ringerikskraft	Energy markets
Green, Richard	Imperial College London	Energy markets
Jensen, Svenn	Norewegian University of Life Sciences	Environmental Economics
Liski, Matti	Aalto University School of Economics	Energy and environmental economics
Rosendahl, Knut Einar	Research Department, Statistics Norway	Energy and environmental economics
Spiro, Daniel	Oslo and Akershus University College of Applied Sciences.	Energy and environmental economics
Tahvonen, Olli	University of Helsinki	Economics of forestry, Age-structured population models and economic optimization, Economics of natural resource utilization and conservation, Environmental economics, Economic-ecological optimization models, Economic growth, environment and natural resources, Economics of climate change, Economics of non-renewable resources

Post Doc students with financial support from the Centre budget

Name	Funding	Nationality	Period	Sex M/F	Topic
Spiro, Daniel	CREE	Swedish	2012-2016	M	Energy and environmental economics

Post Doc students working on projects in the centre with financial support from other sources

Name	Funding	Nationality	Period	Sex M/F	Topic
Holtmark, Katinka Kristine	Department of Economics, University of Oslo	Norwegian	2015-2019	F	Microeconomics, political economy, environmental economics

PhD students with financial support from the Centre budget

Name	Funding	Nationality	Period	Sex M/F	Topic
Ciccone, Alice	CREE	Italian	2011-2015	F	Economic of the climate change with econometric applications
Klemetsen, Marit	CREE	Norwegian	2011-2015	F	Innovation in energy- and environmental technology industries: Identifying knowledge externalities and effects of policies
Michielsen, Thomas	CREE	Dutch	2010-2014	M	Innovation in energy marked

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

Name	Funding	Nationality	Period	Sex M/F	Topic
Midttømme, Kristoffer	Department of Economics, University of Oslo	Norwegian	2011-2014	M	Technology diffusion
Dalen, Hanne Marit	Research Department, Statistics Norway	Norwegian	2009-2017	F	The use of multiple instruments in energy and environmental policy.
Mideksa, Torben	Department of Economics, University of Oslo	Swedish	2012-2016	M	Primary Concentration: Contract Theory Secondary Concentrations: Environmental Economics and Political Economics
Holtmark, Katinka Kristin	Department of Economics, University of Oslo	Norwegian	2012-2016	F	Development Economics, Natural Resource Economics, Microeconomics
van den Bijgaart, Inge M.	Planbureau voor Leefomgeving (Netherlands Environment)	Dutch	Nov. 2013- Aug. 2016	F	Effect of Fiscal Regulations of CO2 Emissions of New Cars

Master thesis CREE Name	Institution granting degree	Adviser	Year	Sex	Title of thesis
Abrahamsen, Kamila Lund		Spiro, Daniel	2014	F	Elektrisitetspriser: En empirisk og teoretisk analyse av tilbud og etterspørsel
Andersson, Runa Haave		Nyborg, Karine og Holtsmark, Bjart	2013	F	"STABILITY OF INTERNATIONAL CLIMATE TREATIES THE IMPORTANCE OF HETEROGENEITY"
Andenes, Liv Jorunn		Wilhite, Harold Langford	2014	F	Bicycle Commuting in Oslo - Practices, Constraints and new Directions for Policy
Beisland, Christina Stene	CREE	Greaker, Mads	2013	F	From Targets and Timetables to Technology Investments
Birkelund, Henriette	CREE	Halvorsen, Bente	2013	F	Oppvarming og innnetemperaturer i norske barnefamilier - En analyse av husholdningenes valg av innnetemperatur
Boroumand, Yasaman		Rosendahl, Knut Einar		F	Price Elasticity of Non-OPEC Supply
Gavenas, Ekaterina		Rosendahl, Knut Einar		F	On the way to a Cleaner Future: A Study of CO2 Emissions on Norwegian Continental Shelf
Hjort, Ingrid C.	CREE	Greaker, Mads	2015	F	Innovation Prizes for Environmental R&D in Presence of Lobbyism
Jakobsen, Anja Lund		Rosendahl, Knut Einar		F	Does the Polluter Pay in the EU ETS, or does the EU ETS Pay the Polluter?
Jiang, Shan	CREE	Kverndokk, Snorre	2016	F	Pareto improving Climate Policies for the Main CO2 Emitting Countries/Regions
Landmark, Marie Brun	CREE	Harstad, Bård	2016	F	Environmental effects of international electricity trade
Matungwa, Bernard		Wilhite, Harold Langford	2014	M	An Analysis of PV Solar Electrification on Rural Livelihood Transformation: A Case of Kisiju-Pwani in Mkuranga District, Tanzania
Nesje, Frikk	CREE	Ekstern	2013	M	Distrust, but verify?: Theoretical insights into auditing carbon sequestration in tropical forests
Nesvik, Linn Camilla		von der Fehr, Nils-Henrik M.	2012	F	Geografiske kostnads- og prisforskjeller i det norske kraftmarkedet : En tidsserieanalyse av de norske kraftprisene fra 2006 til 2011
Reinlie, Kristine Borgeraas		Brekke, Kjell Arne	2014	F	Er elsertifikatene grønne? En analyse av samspillet mellom det svensk-norske elsertifikatmarkedet og det europeiske kvotemarkedet
Røed, Tiril Salhus		Hoel, Michael	2014	F	Klimagassutslipp og subsidiering av fornybar Energi: En numerisk analyse av klimagevinst ved innføring av grønne sertifikater
Salvesen, Ingerid		Wilhite, Harold Langford	2014	F	Practicing the preaching?: A study of the Transition Movement in Norway and its effort to change energy-related practices
Sletten, Thea Marcelia		Hoel, Michael	2012	F	A Framework for Studying the Environmental Impact of Biofuel Policies
Syrstad, Ragnhild Sjoner	CREE	Golombek, Rolf and Müller, Andreas	2016	F	Climate and Energy Security Policies in the EU: Conflict or Cohesion?
Valseth, Asmund Sunde	CREE	Harstad, Bård	2014	M	Competing Climate Policies
Verlo, Kjell Rune	CREE	von der Fehr, Nils-Henrik M.	2015	M	Kommersielle nettinvesteringer - Løsningen på behovet for økte investeringer i overføringsnettet?
Weidle, Maiken Katrine	CREE	Greaker, Mads and Nyborg, Karine	2014	F	Is low carbon taxation optimal climate policy for a developing country? A numerical simulation of technology adoption
Weyer, Ingrid Semb	CREE	Greaker, Mads	2015	F	Directed technical change in clean and dirty technologies: Is it possible to redirect R&D in a multiregion world?
Vik, Martin Andreas		von der Fehr, Nils-Henrik M.	2012	M	Node- eller soneprising i kraftmarkeder: Hvilket markedsdesign løser best markedsrett ved flaskehals?

A2 Statement of Accounts

(All figures in 1000 NOK)

Funding

	Amount
The Research Council	4 359
Research Partners (own funding)	
Frisch Centre (Host Institution)	4 521
Statistics Norway	8 684
Department of Economics, UoO	500
Tilburgs Sustainability Center	125
User partners	
Statkraft Energy AS	50
Statnett	125
Public partners	
University of Oslo	448
<hr/>	
Total	18 812

Costs

Research Partners	
Frisch Centre (Host Institution)	6 811
Statistics Norway	9 632
Department of Economics, UoO	1 079
Tilburgs Sustainability Center	250
Centre for Development and the Environment, UoO	250
The Faculty of Law - Natural Resources Law, UoO	50
Institute for Energy Technology (IFE)	740
<hr/>	
Total	18 812

A3 Publication

Journal papers (<http://www.cree.uio.no/publications/>)

Aaheim, A. and T. Mideksa (2016): [Requirements to Metrics of Greenhouse Gas Emissions, Given a Cap on Temperature](#). *Ecological Economics*. Vol 131, s 460- 467.

Asheim, G. B. and F.. Nesje (2016): Destructive intergenerational altruism, *Journal of the Association of Environmental and Resource Economics*, Vol 3, no. 4 Page 957-984. [PDF]

Battaglini, M. and B. Harstad (2016): [Participation and Duration of Environmental Agreements](#), *Journal of Political Economy*, Volume 124, No 1 Page 160-204.

Bye, B, and M. E. Klemetsen (2016): [The Impacts of Alternative Policy Instruments on Environmental Performance: A Firm Level Study of Temporary and Persistent Effects](#), , *Environmental and Resource Economics*, Volume 65, Issue 263 Page 1-25.

Böhringer, C., J.C. Carbone and T. F. Rutherford (2016): [Embodied Carbon Tariffs](#), , *Scandinavian Journal of Economics*.Forthcoming.

Böhringer, C., J. C. Carbone and T. F. Rutherford (2016): [The Strategic Value of Carbon Tariffs](#), , *American Economic Journal: Economic Policy*, Vol 8 Issue1, Page 1–25.

Eyckmans, J., S. Fankhauser and S. Kverndokk (2016): [Development Aid and Climate Finance](#), *Environmental and Resource Economics*, Volume 63, Issue 2, pp 429-450

Fæhn, T., C. Hagem, L. Lindholt, S. Mæland, and K.-E. Rosendahl (2016): [Climate policies in a fossil fuel producing country, Demand versus supply side policies](#)., *Energy Journal* Vol 38, Issue 1, pp 77-102.

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CREE in the news

- Bil er største forurensere - unntatt olje

I intervju med Stavanger Aftenblad sier CREE-forskeren Taran Fæhn (SSB) at regjeringens bilpakke vil ikke gi lavere CO2-utslipp.

Stavanger Aftenblad 30 nov. 2016

- MARKEDETS MAKT OVER MILJØET -

Vil kutt i norsk oljeproduksjon redde klimaet fra kollaps?

I en artikkel om konsekvenser for CO2 utslipp av reduksjon av norsk oljeproduksjon uttrykker CREE-forskeren Catrine Hagem(SSB) at under dagens system vil norske kutt i oljeproduksjonen gi globale utslippsreduksjoner.

[Klassekampen 17 nov. 2016](#)

- Norske klimamål - hvilke mål?

CREE-forskeren Taran Fæhn(SSB) drøfter i DN noe av utfordringene med uklare innenlandske klimamål.

[DN 24 okt. 2016](#)

- Snart vil du kunne bruke elbilen til å lage deg morgenkaffen

Sammen med andre forfattere skriver CREE-forskeren Anders Gravir Imenes (Ringerikskraft) i to artikler i Dagbladet om hvordan Elbilen går på tilnærmet fornybar strøm og kan bli framtidens energilager.

[Dagbladet 12 okt. 2016](#)

- Elbilen er ingen klimaversting

[Dagbladet 20 okt. 2016](#)

- Å snu onde sirkler

CREE-forskeren Karine Nyborg(UiO) skriver i DN om hvordan klima-adferd kan endres gjennom sosiale normer.

[DN 7 okt. 2016](#)

- Skitne norske felt

CREE forskeren Knut Einar Rosendahl (NMBU) uttrykte seg om CO2-utslipp fra norsk olje- og gassutslipp i Brennpunkt programmet Oljelobbyisten.

[NRK Brennpunkt 4 okt. 2016](#)

Se også artikkel i Morgenbladet om CO2-utslipp fra Norske felt

[Morgenbladet 7. okt. 2016](#)

- Trenger vi Hydrogenbilen?

CREE-forskeren Mads Greaker(SSB) uttrykker i NRK:Forbrukerinspektøren skepsis til det å satse på både Elbil- og Hydrogenbil teknologien.

[NRK:Forbrukerinspektøren 5 okt. 2016](#)

- Regnskogsparadokset

CREE forskeren Bård Harstad (UiO) skriver i en kronikk i DN om hvorfor det kan være så vanskelig å få rike land til å betale for å bevare regnskogen.

[DN 18 sep. 2016](#)

- Frykten for karbonlekkasje

CREE forskerne Marit Elisabeth Klemetsen (SSB), Knut Einar Rosendahl (NMBU), Halvor Briseid Storrøsten (SSB) omaler noe av konsekvensene med Paris avtalen i forbindelse med karbonlekkasje problematikken.

[DN 4 mai 2016](#)

- Energieffektivisering gir ikke resultater

Intervju med CREE forsker Cathrine Hagen (SSB) om rapport om effekter av energieffektiviseringstiltak i «Energieffektivisering gir ikke resultater»

Klassekampen 21 apr. 2016

- En klimapolitikk med bare vinnere

I forbindelse med prosjektet [Intergenerational and intragenerational equity of climate policy](#) er CREE forskeren Snorre Kverndokk (Frisch) intervjuet av Forskningsrådet.

[Forskningsrådet 10 mars 2016](#)

- Feil og upresist om grønn skattekommisjon

Medlemmer av grønn skattekommisjon, Lars-Erik Borge professor (NTNU), Brita Bye forsker (CREE,SSB), Michael Hoel professor (CREE,UiO) og Knut Einar Rosendahl professor (NMBU, CREE), korrigerer feil i Marius Holm sitt innlegg i [Aftenposten 4 mars](#).

[Aftenposten 14 mars 2016](#)

- Biodrivstoff kan forsterke klimaproblemet

CREE forsker Bjart Holtmarks (SSB) og hans [doktoravhandling](#) er ofte trukket frem i media i forbindelse med bruk av biodrivstoff.

[Diverse oppslag 2016](#)

- Feilslått politikk

CREE forsker Cathrine Hagem (SSB) referert til i leserinnlegg om grønne sertifikater og vindkraft.

[Glåmdalen 03 Mars 2016](#)

- Han flytter klimapolitikken ned i bakken

Økonomiprofessor Bård Harstad (UiO/CREE) er omtalt i forbindelse med at han har fått 15 mill. kroner fra EU for å analysere hvorvidt vi burde flytte klimapolitikken fra de høye luftlagene og ned i kullgruvene. CREE forsker Taran Fæhn (SSB) er intervjuet om temaet.

[Aftenposten 21 Feb. 2016](#)

- Kvoter ga ikke utslippskutt

Omtale av CREE-studie om EUs kvotesystem ved bl.a. CREE forskerne Marit Klemetsen (SSB) og Knut Einar Rosendahl (NMBU/SSB)

[DN 08. Feb. 2016](#)

[DN 09. Feb 2016 Leder](#)

- Miljøøkonom Bård Harstad får 15 mill. fra EU

CREE forskeren Bård Harstad (Prof. UiO) får sitt andre superstipend fra EU. I Norge er det bare Nobelprisvinner Moser som har klart det samme.

[UiO 25. Jan 2016](#)

[Aftenposten 23. Jan. 2016](#)

- Teknologi alene redder ikke klimaet - vi må bite i det sure skatteplet

CREE forsker Eric Nævdal (Frisch) forklarer hvorfor teknologiutvikling ikke kan løse miljøproblemene alene.

[Aftenposten jan/feb 2016](#)