CREE WORK PLAN 2018

User-oriented activities

In 2017, CREE enhanced its efforts to involve and respond to user interests. In 2018, the user-oriented activities will be 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.

Deliverable: Half-day user seminar in April in Oslo. Open invitation, to be distributed in March. Topic of the seminar will be decided jointly with CICEP in January/February.

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. We now organize dialogue seminars on topics of particular interest to our user partners. The topic of the dialogue seminar in November 2017 was the social discount rate. We plan to organize one dialogue seminar in 2018.

Deliverable: Half-day dialogue seminar in November in Oslo. All CREE partners are invited. Topic to be decided in August. Some possible topics are i) how to assess CO2 emission reductions, and ii) alternative approaches to understand investment in environmentally friendly energy.

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 syntheses report can be the output from a CREE dialogue seminar, potentially with contributions also from CREE user partners.

Deliverable: Two reports to synthesize the main research output from two of the four CREE flagships. Drafts ready in fall 2018. These will be distributed to CREE user partners for comments.

CREE news letter

We plan four issues per year of the CREE newsletter. Prior to 2017, we had separate news letters about CREE events, and separate mails on newly released CREE working papers. These have now been merged and extended with information on CREE in the media.

Deliverables: Four newsletters. Planned to be launched in February, June, September and December.

CREE hot line

In 2017, we launched 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. We organized five CREE hot lines in 2017. CREE hot line will continue in 2018.

Deliverables: Number of hot lines and topics depend on demand from CREE user partners.

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.

Deliverable: Joint with Section for environmental statistics in Statistics Norway, CREE will produce indicators for green transition. CREE will organize a user meeting with CREE users, non-research groups within Statistics Norway and other stake holders in fall 2018. Here, results from the study will be presented and discussed. Later, an article summarizing the results we be available at the web site of Statistics Norway.

CREE web pages

The CREE web pages have been updated and significantly extended in 2017 in order to reflect the reorganization of CREE projects into flagships (rather than work packages).

Deliverable: Continuous updating of the web page with respect to CREE events, CREE news and CREE in the media. Updating occasionally of new publications of reports.

CREE research workshop

CREE will continue to organize an annual two-day research workshop with international participation (by invitation only).

Deliverable: CREE research workshop in Oslo in October. Closed seminar with international participation.

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?

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.2 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 provides and middlemen (aggregators)? Does the current regulatory regime support efficient development of distributed electricity and storage?

I.3 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.4 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, CO_2 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 2018

Table I.1 summarizes the planned work on flagship I for 2018, describing main research questions and collaborations between institutions. For more information, consult the 2018 CREE project directory. **(http://www.cree.uio.no/projects/).** Table I.2 provides information on planned working papers/reports as well as planned submissions and expected resubmissions in 2018 by project.

Table I.1 Research questions in ongoing projects planned for 2018. Project number refers to the 2018 CREE project directory. Institution summarizes all collaborating units. Flagship I.

Projects	***Project number***	***Institution***
I.1 Intermittency, flexibility and security of supply		
- Effects of reduced nuclear capacity in Europe	34	Frisch/SSB/NMBU
- Flexibility in electricity markets	39	ØI/Frisch
- Security of supply in a green power market - capacity mechanisms	42	Frisch/IFE/SSB/ØI/UiO law
- Legal challenges and opportunities for Norway under a re-designed electricity market	51	UiO Law
I.2 Transmission and integration		
- Regionalizing Norway in the numerical model LIBEMOD	9	SSB/Frisch
- Cooperation and regulation for building electric interconnectors	52	ØI/Toulouse
I.3 Distributed electricity and storage		
- The European electricity market towards 2050 - the battery revolution	53	Frisch/IFE/SSB
- Security of supply in a green power market - location signals for renewable power	42	Frisch/IFE/SSB/ØI/UiO law
I.4 Regulatory instruments		
- Effects of the EU ETS on manufacturing plants	18	SSB/Skattedir/NMBU
- Avoiding nature-senstive oil extraction	32	U Uppsala
- Natural resources and sovereign expropriation	35	UiO/U Reykjavik/U Uppsala
- The European electricity market towards 2050 - targets and instruments	53	Frisch/SSB
- WINDLAND	54	SSB /IFE/ NMBU/ NINA/ UiO Law/ Vista Analyse
I.5. CCS		
- The role of CCS in reaching a low-carbon society	55	Frisch

Table I.2 Planned working papers/reports and planned submissions/resubmissions in 2018. Flagship I.

Project	No	Working paper/ Report	Submission/ Resubmission
Regionalizing Norway in LIBEMOD	9	X	
Effects of the EU ETS on manufacturing plants	18		X
Avoiding nature-sensitive oil extraction	32		X
Effects of reduced nuclear capacity in Europe	34		X
Natural resources and sovereign expropriation	35		X
Flexibility in electricity markets	39		X
Security of supply in a green power market – The challenges and opportunities of intermittent Power	42	X	
Legal challenges and opportunities for Norway under a re-designed European electricity market	51	X	
The European electricity market towards 2050	53	X	X
WINDLAND: Spatial assessment of environment-economy trade-offs to reduce wind power conflicts	54	X	
The role of CCS in reaching a low-carbon society	55		X
CREE Master theses in environmentally friendly energy	57	X	

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 and frequency regulation 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.4 we aim to cooperate more with Professor Olli Tahvonen at Helsinki

Univeristy. Our intention is to write a research paper discussing the role of Scandinavian forest resources in transport.

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 Tahvonen, Helsinki University, on III.3. All are international experts.

Large research projects

Electrification of transport: Challenges, mechanisms and solutions - ELECTRANS (KPN funded by the Norwegian Research Council under the ENERGIX program, with participation form Statistics Norway, Frisch Centre and Institute of Transport Economics)
The overall objective of ELECTRANS 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 2018

Table II.1 summarizes the planned work on flagship II for 2018, describing main research questions and collaborations between institutions. For more information, consult the 2018 CREE project directory **(http://www.cree.uio.no/projects/).**

Table II.1 Research questions in ongoing and new projects planned for 2018. Project number refers to the 2018 CREE project directory. Institution summarizes all collaborating units. Flagship II.

Projects	***Project number***	***Institution***
II.1 Electrification of private road transport		
- ELECTRANS - The role of compatibility of charging systems	50	SSB
- ELECTRANS - Balancing PHEV and BEV usage with public transport	50	SSB/Leuven/TØI
- Driving towards the low-emission society - Establish a dataset consisting of all cars and car owners in Norway	56	Frisch/TØI
II.2 Integrating transport in the electricity market		
- ELECTRANS - Integrating electric road transport with electricity supply	50	Frisch/SSB/TØI
- ELECTRANS - Using electric vehicles as back-up power	50	SSB
II.3 Over-coming barriers to more sustainable commercial transport		
- The design of a CO2 fund for transport in Norway	57	CREE Master thesis
II.4 Biofuels in road and air transport		
- Cost benefit analysis of a 20% biofuels blending mandate in Norway	57	CREE Master thesis

Table II.2 Planned working papers/reports and planned submissions/resubmissions in 2018. Flagship II.

Project	**No**	**Working paper/ Report**	**Submission/ Resubmission**
Electrification of transport: Challenges, mechanisms and solutions (ELECTRANS)	50	X	X
Driving towards the low-emission society	56	X	
CREE Master theses in environmentally friendly energy	57	X	

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? How does household behavior affect the opportunity to release the technical energy savings potential in existing residential buildings, and how does this affect planned investments in the energy system?

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.
- Multidisciplinary project with SUM, SINTEF Byggforsk, IFE, NVE, Enova and OED related to III.2, III.3 and III.4.

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 project with funding from the Norwegian Research Council that addresses topics under this flagship:

Security of Supply, funded by ENERGIX 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 NVE, Enova and OED at the beginning of 2019, discussing how behavior affect the efficiency of policy tools aimed at increasing the energy efficiency in existing buildings, and how we may build an analyzing tool to incorporate the knowledge gained from different disciplines into the model used to analyze current and future system needs (III.3).

Planned work for 2018

Table III.1 summarizes the planned work on flagship III for 2018, describing main research questions and collaborations between institutions. For more information, consult the 2018 CREE project directory **(http://www.cree.uio.no/projects/).**

Table III.1 Research questions in ongoing and new projects planned for 2018. Project number refers to the 2018 CREE project directory. Institution summarizes all collaborating units. Flagship III.

Project	*Project number*	*Institution*
III.1 Innovation and diffusion of green technologies		
- Strategic technology policy to support renewable energy technologies	24	SSB/NMBU/RFF
- How should CCS technologies be supported?	25	Frisch/SSB/NMBU
- Environmental innovation prizes	26	Frisch/SSB/ØI
- Innovation in clean energy as a commitment device	27	Tilburg
- Triggering environmentally-friendly technology development	29	SSB
III.2 Technical building standards and energy use		
- How do technical building standards (TEK) affect energy consumption in non-residential buildings?	58	SSB/SUM/NVE
III.3 Increased energy efficiency in buildings buildings		
- How do firms react to investment subsidies aimed at increasing energy efficiency in existing commercial buildings?	59	SSB/SUM/Riksrevisjonen
III.4 Utilization of smart technologies		
- Security of supply - designing flexible demand	42	Frisch/SSB/IFE/UiO Law
- Rebound and adverse effects of energy efficiency measures	43	SSB
- Investments and utilization of energy efficient household appliances	48	SSB
- Household energy practices in low energy buildings	49	SUM/SINTEF Byggforsk
III.5 Energy security and option value		
- Willingness to pay for avoiding black outs exceeding 24 hours	60	SSB/SUM/Statnett/NVE

Table III.2 Planned working papers/reports and planned submissions/resubmissions in 2018. Flagship III.

Project	No	Working paper/ Report	Submission/ Resubmission
How should CCS technologies be supported?	25		X
Environmental innovation prizes	26		X
Innovation in clean energy as a commitment device	27	X	
Rebound and adverse effects of energy efficiency measures	43		X
Investments and utilization of energy efficient household appliances	48	X	
Household energy practices in low energy buildings	49		X
Technical building standards and energy use in non- residential buildings	58		X
Energy security and option value in residences	60	X	

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: Bariers 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 and abroad 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 PETROMAKS 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 involvement

Miljødirektoratet, Ministry of Finance, Ministry of Climate and Environment, The science-policy forum in the Smart Paths project.

Planned work for 2018

Table IV.1 summarises the planned work for 2018, describing main research questions and collaborating units. For more information, consult the 2018 CREE project directory **(http://www.cree.uio.no/projects/).**

Table IV.1 Research questions in ongoing and new projects planned for 2018. Project number refers to the 2018 CREE project directory. Institution summarizes all collaborating units. Flagship IV.

Project	*Project number*	*Institution*
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
- Systems for refunding emissions payments	11	SSB/UiO/Gothenburg
- Innovation in clean energy as a commitment device	27	Tilburg
- Smarth Paths – Global technological and economic drivers	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
- Abatement of greenhouse gases in Norway and the EU towards 2030	8	SSB
- 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	62	ØI
- Sustainable transition to sustainability - green R&D clubs	63	UiO/Frisch/SSB
IV.3 Barriers and opportunities to transformation		
- WILL - sluggish behavioral responses	3	SSB
- 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	31	ØI
- Smart Paths - norms and responses to climate policy	61	SSB
- Sustainable transition to sustainability - policy restrictions	63	UiO/Frisch

Table IV.2 Planned working papers/reports and planned submissions/resubmissions in 2018. Flagship IV.

Project	No	Working paper/ Report	Submission/ resubmission
Allocation rules for carbon permits	2	X	X
"WILL" - Governing EU-Norwegian willingness to extract, combust and consume less carbon	3	X	X
Energy efficiency, energy systems and the economy	5		X
Prospects: Global and national transformation from a fossil-fuel-dependent economy	7	X	X
Abatement of greenhouse gas emissions in Norway and the EU towards 2030	8	X	
Systems for refunding emissions payments	11		X
Pareto-improving climate policies	12		X
Climate treaties with reciprocal preferences	13	X	
Obstacles to permit trade	16	X	
Ambiguity aversion	17		X
Investment in green technologies	19		X
The climate system and irreversible catastrophes	21		X
Intergenerational decision-making	23	X	
Technology and time inconsistency	31		X
Should foresters forecast?	36		X
The role of CCS in reaching a low-carbon society	55		X
Smart paths	61	X	
Mitigation under the Paris agreement	62		X
Sustainable transition to sustainability	63	X	

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 10 million NOK. Therefore, the

budget share of the 8 million is below 0.5 – the requirement is a budget share below 0.75.

Deliverables by 31 December 2018

- One user seminar
- One dialogue seminar
- Synthesis reports of two flagships
- Four newsletters
- At least two CREE hot line meetings
- One research workshop
- Around 21 working papers, mainly published as CREE working papers
- Around 26 submissions/resubmissions
- At least 8 published papers in journals or books in 2018.