

# 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 CO<sub>2</sub> 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, CO<sub>2</sub> 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](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>
<b>I.1 Intermittency, flexibility and security of supply</b> <ul style="list-style-type: none"> <li>- Effects of reduced nuclear capacity in Europe</li> <li>- Flexibility in electricity markets</li> <li>- Security of supply in a green power market - capacity mechanisms</li> <li>- Legal challenges and opportunities for Norway under a re-designed electricity market</li> </ul>	<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>
<b>I.2 Transmission and integration</b> <ul style="list-style-type: none"> <li>- Regionalizing Norway in the numerical model LIBEMOD</li> <li>- Integration of, and competition between, regional electricity markets</li> <li>- Cooperation and regulation for building electric interconnectors</li> </ul>	<p>9</p> <p>39</p> <p>new - 52</p>	<p>SSB/Frisch</p> <p>ØI</p> <p>ØI/Toulouse</p>
<b>I.3 Distributed electricity and storage</b> <ul style="list-style-type: none"> <li>- The European electricity market towards 2050 - the battery revolution</li> <li>- Security of supply in a green power market - location signals for renewable power</li> </ul>	<p>new - 53</p> <p>42</p>	<p>Frisch/IFE/SSB</p> <p>Frisch/IFE/SSB/ØI/UiO law</p>
<b>I.4 Regulatory instruments</b> <ul style="list-style-type: none"> <li>- Effects of the EU ETS on manufacturing plants</li> <li>- Systems for refunding emissions payments</li> <li>- Avoiding nature-sensitive oil extraction</li> <li>- Natural resources and sovereign expropriation</li> <li>- The European electricity market towards 2050 - targets and instruments</li> <li>- WINDLAND</li> </ul>	<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>
<b>I.5. CCS</b> <ul style="list-style-type: none"> <li>- The role of CCS in reaching a low-carbon society</li> </ul>	<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 CO<sub>2</sub>-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 CO<sub>2</sub> 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 - ELECTRANS (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 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 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](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>
<b>II.1 Electrification of private road transport</b> <ul style="list-style-type: none"> <li>- ELECTRANS - The role of compatibility of charging systems</li> <li>- ELECTRANS - Balancing PHEV and BEV usage with public transport</li> <li>- Driving towards the low-emission society - Establish a dataset consisting of all cars and car owners in Norway</li> </ul>	 50 50 new - 56	 SSB SSB/Leuven/TØI Frisch/TØI
<b>II.2 Integrating transport in the electricity market</b> <ul style="list-style-type: none"> <li>- ELECTRANS - Integrating electric road transport with electricity supply</li> <li>- ELECTRANS - Using electric vehicles as back-up power</li> </ul>	 50 50	 Frisch/SSB/TØI SSB
<b>II.3 Over-coming barriers to more sustainable commercial transport</b> <ul style="list-style-type: none"> <li>- The design of a CO2 fund for transport in Norway</li> </ul>	 new - 57	 CREE Master thesis
<b>II.4 Biofuels in road and air transport</b> <ul style="list-style-type: none"> <li>- Cost benefit analysis of a 20% biofuels blending mandate in Norway</li> </ul>	 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 ENERGIIX 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](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>
<b>III.1 Innovation and diffusion of green technologies</b> <ul style="list-style-type: none"> <li>- Strategic technology policy to support renewable energy technologies</li> <li>- How should CCS technologies be supported?</li> <li>- Environmental innovation prizes</li> <li>- Innovation in clean energy as a commitment device</li> <li>- Triggering environmentally-friendly technology development</li> </ul>	25 26 27 28 30	SSB/NMBU/RFF Frisch/SSB/NMBU Frisch/SSB/ØI Tilburg SSB
<b>III.2 Technical building standards and energy use</b> <ul style="list-style-type: none"> <li>- How do technical building standards (TEK) affect energy consumption in commercial buildings?</li> </ul>	new - 58	SSB/SUM/NVE
<b>III.3 Increased energy efficiency in buildings buildings</b> <ul style="list-style-type: none"> <li>- How do firms react to investment subsidies aimed at increasing energy efficiency in existing commercial buildings?</li> </ul>	new - 59	SSB/SUM/Riksrevisjonen
<b>III.4 Utilization of smart technologies</b> <ul style="list-style-type: none"> <li>- Security of supply - designing flexible demand</li> <li>- Rebound and adverse effects of energy efficiency measures</li> <li>- Investments and utilization of energy efficient household appliances</li> <li>- Household energy practices in low energy buildings</li> </ul>	42 43 48 49	Frisch/SSB/IFE/UiO Law SSB SSB SUM/SINTEF Byggforsk
<b>III.5 Energy security and option value</b> <ul style="list-style-type: none"> <li>- Willingness to pay for avoiding black outs exceeding 24 hours</li> </ul>	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](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>
<b>IV.1 Greening the economy</b>		
- 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
<b>IV.2 National and international climate policies and treaties</b>		
- 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
<b>IV.3 Barriers and opportunities to transformation</b>		
- 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.