

20.12.12

## **Work plan for CREE 2013**

CREE's activities are divided into five work packages as described in the project plan. The leaders of the work packages are listed in parentheses:

WP1: The International Politics of Climate and Energy (Michael Hoel/Ole Jørgen Røgeberg)

WP2: Innovation and Diffusion Policy (Rolf Golombek)

WP3: Regulation and Market (Nils-Henrik von der Fehr)

WP4: Evaluation of Environmental and Energy Policy Measures (Bente Halvorsen)

WP5: The Next Generation of Numerical Models (Brita Bye)

The research will take place by the four research partners - Frisch Centre (Frisch), Department of Economics, University of Oslo (ØI), Research department, Statistics Norway (SSB) and Tilburg Sustainability Center (Tilburg) - our subcontractors – Institute for Energy Technology (IFE), SINTEF Energy (SINTEF) and Natural Resources Law at the Faculty of Law, University of Oslo (Law). In addition to this, several international researchers connected to the center will also contribute.

There will be activities on all work packages in 2013. Below we describe this in more detail.

### **WP1: The International Politics of Climate and Energy**

This work package focuses on the following questions:

- 1) How can international climate treaties be structured to improve participation, ambitions and implementation?
- 2) How is participation in climate treaties influenced by R&D cooperation aimed at reducing abatement costs?
- 3) How does international emission quota trading influence efficiency and equity when the treaty is characterized by weak international cooperation?
- 4) How can carbon leakage be reduced?

- 5) Equity issues. For instance is there a trade-off between intra- and intergenerational equity in climate policies, and how can economic mechanisms such as quota trading be used to handle ethical issues?
- 6) How will the energy market and energy policies vary under different climate-treaty scenarios, and how will energy markets react to carbon taxation?

Research activities in 2012 were in line with expectations, as reflected in the number of published articles. By supplementing the Research Council of Norway's (RCN) funds from other programs with CREE funds (in line with the Research Council's wish that funds from other programs be used as "self-financing" of CREE), research activities on a number of topics have been expanded. For instance, a NORKLIMA project on international climate treaties which ended mid-year 2012 had a total of 14 papers (some finished, some close to submission), a clear increase relative to the ambitions. Also worth noting is that Bård Harstad begun work as a Professor at the University of Oslo in January 2012, working on topics that fall within this work package.

All four research partners in CREE are involved in this work, which will be primarily theoretical, with exception of number 4 above. In addition to these groups a number of international researchers are involved, such as Larry Karp, Johan Eyckmans, Christopher Böhringer and Samuel Fankhauser. Several of these have been financed by running projects financed by the Norwegian Research Council. Some of these (e.g. NORKLIMA) ended this year, while others (e.g., MILJØ2015) will run into 2013.

Alice Ciccone begun her CREE financed PhD at the Department of Economics, University of Oslo, in 2011, of which 50% will be on topics in this WP1. Her work on this work package for 2013 will be on an experiment where the basic idea is to test the effects of responsibility and regret when it comes to decision on behalf of others. This is planned to be in a bargaining context, where we would like to test how climate negotiations may be affected by differences in risk preferences.

One addition to the work package in 2013 is a new Post Doc, Daniel Spiro, employed by CREE in August 2012. One of the subjects he will focus on is energy markets. In order to understand what determines CO<sub>2</sub> emission levels, the development of green energy and how policy may affect these it is essential to understand the mechanisms that shape the world

markets for fossil energy. His research agenda aims analyzing what shapes these markets in the long run. As part of this is he is looking at how politico-economic and behavioral aspects affect the long run supply of oil. About 2/3 of his time will be spent on research related to WP1 in 2013.

As a subcontractor, Natural Resources Law at the Faculty of Law, University of Oslo, is involved in this work package, mainly through Endre Stavang and Christina Voigt. They will mainly supplement the economic analyses through studies on the international climate regime, the importance of law and other policy measures, and will contribute to seminars and workshops organized by CREE.

Further collaboration with the CICEP center is planned in 2013. One of their work packages, led by Steffen Kallbekken, deals with overlapping issues using a different set of theoretical tools (agent-based modeling). A joint workshop is planned for 2013 as a way for the two groups to get better acquainted with each others' research questions, methodological choices and preliminary results, and it is hoped that this might lay the groundwork for further collaboration on specific, shared sub-questions in the future.

The total amount spent on this work package is still high, but is to a large extent due to the substantial amount of time the PhD student and the Post Doc spend on this work package. When it comes to other researchers, the scale of activities on this work package will be reduced next year relative to this year, and we do not plan to work on number 3 in the list above. The reason is that a large part of the activity was co-financed by projects from other Research Council programs (e.g., NORKLIMA, Petrosam) that finished in 2012. There have been no relevant calls for proposals from the Norwegian Research Council this year, but this is expected to change in 2013. Applying for funds to supplement the annual center endowment will therefore be a priority. However, there are still some external funding for this program, such as MILJØ2015 (RCN) and ENTRACTE (EU-funding).

The CREE-specific financing of the different topics is specified below for 2013:

**Table 1: Planned work-months WP1 in 2013**

Topic	Primary institution	2013
-------	---------------------	------

		<b>Total</b>	<b>Of which CREE- financed</b>
Administration	Frisch/ØI (Røgeberg 0.5, Hoel 0.5)	1	1
Structuring international climate agreements to improve participation and compliance (experiment)	Frisch (Røgeberg 0.5) ØI (Brekke 2, Ciccone 6)	8.5	8.5
Abatement-cost reducing R&D and participation in climate treaties	Frisch/ØI (Hoel 0.7) TSC	0.7 0.7	0.7 0.7
Equity and efficiency of quota trading under weak international cooperation	Frisch/ØI (Harstad)	1.2	1.2
Carbon leakage reducing policies – global CGE analyses	SSB Frisch (Carbone)	5.1	2.8
Equity issues	Frisch/ØI	7	0
Energy markets	ØI (Spiro)	8	8

This gives the following distribution of CREE-financing of WP1 (by research institution):

**Table 2: Budget for CREE-financing by research institution on WP1 (in thousand NOK)**

<i>Institution</i>	<i>2013</i>
Frisch	
- Internal researchers (Røgeberg)	141
- Experiments	110
- External researchers (Carbone)	71
- Travel expenses	34
SSB	
- Internal researchers	220
- External researchers (Böhringer)	35
ØI	
- Part time positions Frisch (Hoel, Harstad)	346
- PhD (50%)	408
- Paid research time (Brekke)	184
- Post Doc (67%)	495
TSC	125
Law, UiO	100
<b>Total</b>	<b>2 269</b>

## **WP2: Innovation and Diffusion Policy**

### ***Ongoing activities started before 2013:***

#### *1. R&D in CCS technologies*

Using a numerical model of the European energy market, LIBEMOD, and building on game theory as well as the R&D literature, we examine whether the government should support R&D that will reduce costs of CCS investments or subsidize purchase of CCS technology. We want to study questions like i) should the government support R&D in CCS technologies? If so, what type of instruments should be used? and ii) will the market provide too much or too little R&D relative to the first-best outcome?

As some of the people who were supposed to work on this subproject have spent much more time on WP 5 – developing the numerical model LIBEMOD – than indicated in the 2012 CREE work plan, this subproject has been delayed. A documentation of this subproject is expected to be available in spring 2013. However, while there has been a delay on this subproject, the people who were supposed to work on this, have produced two papers on environmental R&D that were not part of the 2012 CREE work plan.

#### *2. The profitability of environmental R&D*

Environmental policy will typically increase the profitability of providing environmentally friendly technologies to the market. This sub-project analyzes empirically the causal effect of emission permit regulation on innovation of environmental technologies. It uses a unique Norwegian firm level panel dataset of binding emission permits and environmental patenting. Ph.D student Marit Klemetsen at SSB is working on this sub-project. Klemetsen is partly financed by CREE. A documentation of the project is expected in spring 2013.

#### *3. Strategic choices for energy infrastructure innovation*

This sub-project is conducted by the Tilburg Sustainability Centre (TSC) and Statistics Norway. It examines whether the connected markets for transport lead to specific distortions in the innovation market for the development of new clean energy infrastructure/technologies/platforms. A PhD student has been hired at TSC (Inge van den Bijgaard) and will work on this. The work has started and will continue in 2013.

#### *4. Behavioral economics*

Recent studies have demonstrated that individuals may fail to respond to economic incentives in the expected way, and that these failures seem to display regularities that make them likely to appear in the context of consumers' investments in energy-saving equipment. We are writing a survey on this literature to get a better understanding of the state of the art. The survey is expected to be finished early in 2013. After this work is finished, we will get in contact with Department of Psychology (UiO) to see if there is some common ground for joint research.

#### *New activities in 2013*

##### *5. Environmental R&D instruments*

There are several reasons to support environmental R&D: knowledge spillovers making future R&D more efficient, commitment problems with respect to future environmental policy and globally insufficient environmental policies due to lack of international environmental agreements on global pollutants. We will study the optimal use of three technology push policies 1) Patent systems, 2) Innovation prizes and 3) Subsidies to R&D projects under various circumstances: i) Global environmental policies are too weak in the near and intermediate future, and ii) Governments cannot commit to future environmental policy goals. In particular, we are interested in to what degree there are systematic differences between market goods R&D and environmental R&D that suggest that different support programs should be offered.

This study will run for several years. It has also funding from EU's seventh framework program (ENTRACTE).

##### *6. Hyperbolic discounting and underinvestments in energy efficient technology*

Investments in energy efficient technology is characterized by an investment cost in the present, and a future flow of energy savings. Several studies have claimed that even when the net present value of the future energy savings exceed the investment cost, households and firms underinvest in energy efficient technology. Within the field of behavioral economics, one of the proposed explanations for time-inconsistent preferences is hyperbolic discounting; that the present is given more weight than future periods. Underinvestment in energy efficient technology could be a result of such preferences, and if so, one way to overcome such

underinvestments could be to spread the investment cost over the same time periods as the energy savings occur.

We are in the very early planning stage of a randomized field experiment to study this subject. As an alternative to current policies subsidizing technology investments, the field experiment will evaluate a novel policy where an agency grants interest free loans to investors of energy efficient technology that are paid back over a given time period in which energy savings occur. The field experiment will be designed such that it is possible to evaluate 1) the share of participants in each treatment that chooses to invest in a certain technology and 2) a difference-in-difference comparison of energy consumption before and after intervention in treatment and control groups. The experiment requires collaboration with ENOVA as well as a grid owner or power supplier such as Hafslund. We are working on establishing such collaboration.

This study will, if we succeed in implementing it, run for at least two years.

### *7. Spillovers in environmental R&D*

As a following-up study of sub-project 2, PhD student Marit Klemetsen plans to use the same data base to study the causal effects on emissions from environmental technological innovations. From 2013 Klemetsen also is partly financed by the EU project ENTRACTE and she will continue working with analyses of causal effects of environmental policy on the profitability of providing climate and environmental technologies to the market. A possible extension will be to analyze whether there are differences in R&D spillovers between traditional R&D and environmental R&D.

**Table 3: Planned work-months WP2 in 2013**

<b>Topic</b>	<b>Primary institution</b>	<b>Total</b>	<b>Of which CREE-financed</b>
Project administration	Frisch (Golombek)	0.5	0.5
R&D in CCS technologies	Frisch (Golombek) SSB	0.5 0.5	0.5 0.5
Profitability of environmental R&D/ Spillovers in environmental R&D	SSB	10	4
Strategic choices for energy infrastructure	Tilburg SSB	4 1	1.5 0

innovation			
Environmental R&D instruments	Frisch SSB	1.8 1.5	0 0.5
Behavioral economics/Hyperbolic discounting	Frisch (Hauge)	1.5	1.5

**Table 4: Budget for CREE-financing by research institution on WP2 (in thousand NOK)**

<i>Institution</i>	<i>2013</i>
Frisch	
- Internal researchers (Golombek, Hauge)	349
- Travel expenses	34
SSB	
- Researchers	110
- PhD project (4 months)	340
- Master thesis	20
Tilburg	125
Total	978

### **WP3: Regulation and Market**

In this work package, the main 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 CO<sub>2</sub>. The work is planned mainly as theoretical and empirical studies, but numerical models, either already existing or developed in other work packages, will be utilized also. As such, part of the work within this package will be conducted in cooperation with or as part of Working Packages 4 and 5.

The work in 2013 will consist partly of continuation and finishing of on-going projects and partly of starting up of new projects. Below we describe plans for core projects.

#### *Integration of Wind Power in the Northern-European Power Markets*

Wind power, on-shore as well as off-shore, has been identified as a key technology for renewable energy, where the EU has an ambition that Europe should become a global leader and where countries like Denmark, the United Kingdom, Sweden and Germany already invest heavily in wind mills, or have concrete plans to do so. Short-term variation in the availability of wind makes it difficult to integrate wind power on a large scale in conventional energy systems, but with access to sufficient amounts of storable hydropower, the potential for wind is substantially larger. The idea that Scandinavia may become an electric battery - a "blue battery" - for Europe has therefore attracted considerable interest, both academically and politically. In this project, we ask to what extent the existing hydro capacity can accommodate a large-scale expansion of wind power in and around the North Sea, taking account of the possibility of building pumped storage and the cost of constructing large international interconnectors that will provide back up and balancing capacity for the countries both inside and outside of the Nord Pool area.

Work on this project is documented in CREE Working Paper no 6/2012. The project will be continued, building on and extending this work. A paper on pumped-storage hydroelectricity is in preparation, exploring the economics of this solution to the non-storability of intermittent energy in a theoretical framework with thermal generation, pure intermittent energy and general hydropower and with possibilities for trade between countries with different energy mixes.

#### *Green Certificates and Competition in Electricity Markets*

A number of studies have analyzed how green certificates affect the functioning of electricity markets, both with respect to short-term price formation and long-term investment. One result is that green certificates may undermine the efficiency of energy markets by increasing price volatility. In addition, green certificates may provide market participants with the possibility of exploiting market power by imposing so-called "margin squeezes". In this project we study the importance of green certificates for electricity markets, and analyze how potentially negative effects may be counteracted by suitable regulation.

Work on this project is documented in Nils-Henrik M. von der Fehr and Stephanie Ropenus, Green Certificates, Vertical Relations and Market Power. The paper has been submitted for publication to a scientific journal. We plan to extend the analysis, depending on the reaction the paper receives.

### *Effects of reduced nuclear capacity in Europe*

The aim of this project is to study numerically possible impacts of reduced nuclear capacity in Europe. The nuclear crisis at Fukushima, Japan, in 2010 has affected nuclear policy in several countries. For Europe the most important policy change is the announcement of the German government to phase out all nuclear power plants by 2022. Nuclear power in Germany accounted for 23% of national electric consumption before the shutdown of 8 nuclear power plants in March 2011. The shutdown of the remaining plants will have a significant impact on the energy markets in Europe. Will the shortage of supply be met by increased fossil fuels or other renewable energy? How will this affect CO<sub>2</sub> emissions in Europe and from different European countries? How will the trade in energy goods between countries be affected from the shutdown? To study these questions, we will use a large-scale partial equilibrium model for the European energy market (LIBEMOD). The model will be updated when it comes to base year (2010) and when it comes to plans for nuclear (and other energy) investment decisions taken after the Fukushima crisis.

The project has been slightly delayed, awaiting (partial) funding from the EU. Funding has now been secured from ENTR'ACTE, and the project started in the autumn with developing reference scenarios. Analyses of reduced nuclear capacities will start early in 2013.

### *Interaction between Electricity and Quota Markets*

Prices in the European market for CO<sub>2</sub> permits have varied considerably. These price variations have not only created uncertainty for market participants with respect to the profitability of investments to reduce CO<sub>2</sub> emissions, but have an impact on the cost of producing electricity, and hence electricity prices, which again have affected incentives to invest in generation. In this project, we study how price variations on the permit market affect the electricity market, and how the interaction between these markets impact incentives to invest in generation and measures to reduce emissions.

Work on this project is documented in a paper in *Environmental and Resource Economics* (52 (2), pp. 213-233). We are currently working on how to extend this work.

### *Natural Resources and Sovereign Expropriation*

An important question for governments of countries endowed with large natural resources is how to govern these resources, including choice of ownership structure and rights to exploitation. An example is the Norwegian hydro resources, which, since the introduction of the "panic laws" in the early 20th century, have been governed by a regime in which "national" ownership is combined with leasing of exploitation rights to third parties. Questions of ownership and governance are inherently political and policies may change abruptly, following changes in government, changes in the value of the resources or other events. At the same time, the type and quality of governance is crucial for the efficient exploitation of natural resources. In this project we study such issues, including how the regime governing natural resources depend on political and economic factors, as well as how such factors, through their influence on the regime, affect the efficiency of resource exploitation.

During 2012 we have worked on building a suitable theoretical model to study some of the relevant questions. The work has been presented at a number of seminars and workshops and we are currently working on writing up the analysis in a working paper.

Another part of this subproject will be conducted by our new Post Doc, Daniel Spiro. He will work on a paper on nationalizing natural resources (with Ragnar Torvik). They will study how resource owners will behave under the possibility of losing their resource due to nationalization, how this in turn affects the incentives for governments to nationalize the resource and finally how world price for the resource is affected by these.

#### *Information and transparency in electricity markets*

A new project starting up in 2013 is the following. The performance of electricity markets depends crucially on information collected from and made available to market participants. The EU Commission is currently working on new legislation to regulate the amount, type and format of such information. This raises fundamental question about the relationship between transparency, market power and competition, as well as the cost of collecting and publishing information. A fundamental insight from economic theory is that more information is not always better and the challenge is therefore to balance the positive and negative effects by collecting and publishing the right information.

In 2013, we plan to undertake an analysis of these issues, by drawing on existing economic theory and applying it to the specific characteristics of electricity markets.

The following table sums up the resources allocated from CREE to this working package in 2013.

**Table 5: Budget for CREE-financing by research institution on WP3 (in thousand NOK)**

<i>Institution</i>	<i>2013</i>
ØI	
- Part time positions Frisch (von der Fehr, Førsund)	528
- External (Baldursson)	69
- Post doc (Spiro), 33%	247
Frisch	
- Research assistant (2 months)	203
Total	1 047

#### **WP4: Evaluation of Environmental and Energy Policy Measures**

Within the first two to three years, the activity on WP4 will focus on four research topics:

- i) *Rebound and adverse effects of energy policy:* How does increased energy efficiency affect energy consumption? How do various policy measures to reduce household energy use affect energy consumption in other sectors (spill-over effects)?
- ii) *The households' response to soft policy measures:* A description of the historic policy tool use (both soft and hard). Describe the effects of soft policy tools on household energy consumption, and discuss how soft policy tools affect the efficiency of hard policy measures. Will they reinforce each other, or cancel each other out?
- iii) *Environmentally friendly transportation:* How does the policy initiative to increase the number of electric cars in personal transportation affect CO<sub>2</sub> emissions?
- iv) *Indoor temperature and energy consumption in families with children:* How does the choice of indoor temperature vary across households with different heating equipment, and how does this affect household energy consumption?

### ***Research communities and methods***

In the initial phase, the work on WP4 is focused on four research communities: economists from Statistics Norway (SSB), social anthropologists from Centre for Development and the Environment (SUM), and economists from the Frisch Centre/University of Torino and the Department of Economics at the University of Oslo (ØI). The different research communities will apply a variety of methods to analyze the research questions listed above. The economists at SSB apply micro econometric analysis to estimate how policy tools affect household energy demand based on micro data from the Norwegian Survey of Consumer Expenditure. The social anthropologists from SUM apply social practice theory to describe how energy is a part of daily tasks, and how policy measures affect habits and the interrelation between household members, and through this its effects on household energy consumption. The economists at Frisch/Torino/ØI will build a micro simulation model for car purchases based on estimations on vehicle purchase data. Based on this model, simulations will be done to analyze how the goals for a reduction in CO<sub>2</sub> emissions may be achieved within the year 2020.

During the first couple of years, each research community will apply its own methods to research questions i) and ii). The aim is to learn from the traditional research approaches within each field, discuss differences in results and assess the strengths and weaknesses of each approach. We want to learn from each other's disciplines, with the end goal of combining the analytic approaches. The first collaboration is planned between SSB and SUM, and a joint study is planned when the initial economic and anthropological analyses are finished.

### **Research activities in 2012**

The analyses in SSB have gone as planned. Two popular science articles on rebound effects are finished; one of which is published and one accepted for publication (research topic i). We have also written two articles aimed for publication in international journals, on research topics i) and ii) respectively (see also Table 6). Both of these are in its final stages of completion. In 2012, SSB employed a student assistant to give a historic summary of policy tools aimed at household energy consumption. This work is now finished and documented. This information will be used in the analyses planned in 2013.

The anthropological research and analysis by SUM have been delayed due to legal matters that needed to be clarified prior to getting access to the same sample of households as is used in SSBs economic analysis. These legal matters are now solved, and the work of collecting the data will commence in January 2013. A master student (Misha Jemsek) is recruited. He will conduct qualitative interviews and write a thesis on the use of heat pumps in Norway. Studies of the system of provision surrounding heat pumps in Norway are also conducted.

During 2012 there has also been a close collaboration between SSB and SUM on several projects which was not planned for 2012. SUM and SSB participated in planning and organizing a PhD seminar arranged by the MILEN research school, June 5-6 2012: “The effects of environmental policy measures: potentials and challenges”. They have also contributed to the “Forskningsskampanjen”, which is an annual research project for pupils in Norwegian schools arranged by the Norwegian research council and Miljølære, University of Bergen (research question iv). A report on this project will be finished during December 2012 and January 2013. Finally SSB and SUM contributed with input and personnel to the Norwegian research council’s stand during “Forskningstorget”, which was arranged in five Norwegian cities.

The planned analyses at Frisch/University of Torino/ØI are also falling somewhat behind. The reason for the delay is that it has taken longer than anticipated to create the data set, due to problems merging information from different data sources. So far the modeling is almost finished and tested out, and the data are now ready to be analyzed.

### ***Time table, budget and publication plan for 2013***

Table 6 gives the planned analyses on the three different research questions in 2013, by research topics and institution. We plan to write articles for publication in international journals for each research question reported in the table. For some of these articles, a preliminary draft is (almost) finished, whereas for others, a draft will be written in 2013. SSB plan to submit the drafts written in 2012 on research topics i) and ii) for publication in international journals, and write a second article on research topic ii) in 2013, using the information collected in 2012 about the historic policy tool use aimed at changing household energy consumption. Researchers from Frisch/Torino/ØI plan to publish two article in 2013 on the research question iii), and researchers from SUM plan to publish two articles on the research questions i) and ii) within 2013. To increase the availability of the research at an

early stage, all articles aimed for publication in international journals will also be published in working paper series at the respective institutions.

**Table 6: Planned analyses in WP4 for 2013.**

<i>Research questions</i>	<i>Institution</i>
<b>i) Rebound and adverse effects of energy policy.</b> <ul style="list-style-type: none"> <li>- The effect on the mix of household energy consumption of investments in air-to-air heat pumps.</li> <li>- Empirically examine and use social practice theory for analyzing rebound effects in relation to heat pumps among households</li> </ul>	SSB  SUM
<b>ii) Response to soft policy measures</b> <ul style="list-style-type: none"> <li>- How has energy labeling on household appliances affected household electricity consumption?</li> <li>- How do soft policy measures affect the efficiency of an increase in electricity taxation?</li> <li>- How do soft policy measures affect practices and attitudes among households?</li> </ul>	SSB  SSB SUM
<b>iii) Environmentally friendly transportation</b> <ul style="list-style-type: none"> <li>- How may we reduce the emission per km through changes in the car fleet?</li> </ul>	Frisch/Torino/ØI
<b>iv) Indoor temperature and energy consumption</b> <ul style="list-style-type: none"> <li>- Master thesis: How do attitudes affect indoor temperature in families with children?</li> </ul>	SSB

This research is planned financed through a combination of CREE funds and own funding (other RCN projects). The resource use, share financed by CREE and funding requirements by CREE is indicated in Table 7 (by institution and subject). It is assumed that, what is not financed by CREE is financed by the institutions through own funding.

**Table 7: Financing plan by institution for WP 4 in 2013. Months of labor, NOK.**

<i>Institution</i>	<i>Resource use (months)</i>	<i>Share (%) financed by CREE</i>	<i>Funding by CREE (thousand NOK)</i>
<b>SSB</b>	<b>14 months</b>		
- Administration	1 month	100%	110
- i) Analyses	1 month	0%	
- ii) Analyses	12 months	0%	
- iv) Master thesis	6 months	100%	20
Frisch/Torino			
- Professor II	2 months	60%	201

ØI - PhD student (50%)	6 months	100%	408
SUM	9 months, field study, workshop, conferences, travel	60%	750 <sup>1</sup>
Total			1 489

### ***Description of the analyses planned for 2013***

*Statistics Norway:* The new analysis at Statistics Norway will focus on the effects of soft policy measures on household energy consumption, and how soft policy tools may affect the efficiency of hard policy measures (research topic ii). For this analysis, we will apply historical micro data from the Norwegian Survey of Consumer Expenditure, available for the period 1975 to 2009, in combination with the information on historical policy use (collected in 2012). We will also prepare the analyses started in 2012 for submission in international journals. The plan is to write one new article and submit three articles for international publication in 2013. In addition, one of the winners of CREEs master scholarship will write her thesis on how environmental concerns and other attitudes affect energy consumption in families with children through differences in indoor temperature, heating equipment, etc., applying data collected by the pupils in “Forskningskampanjen” (research topic iv).

*SUM's* overall ambition is to apply social practice theory (sociology, ecological and behavioral economics, social anthropology and social psychology) to understand domestic energy consumption and the promotion of energy savings to reduce CO<sub>2</sub> emissions. *SUM* will continue to review the rebound literature and study system of provision surrounding heat pumps. This work will start during the autumn 2012 in collaboration with the master student. The master student will continue to work with his thesis, which will be finalized in the spring 2013. The interviews of 10-15 Norwegian households who use heat pumps will be selected among respondents, who were included in SSB's household survey, will be interviewed during the spring of 2013. The purpose is to obtain material related to research questions i) and ii) and provide input to interdisciplinary discussions with SSB on approaches and findings. The aim is to write two academic papers on each of the two research topics, to be submitted in 2013.

---

<sup>1</sup> *SUM's* budget for 2013 was initially NOK 500 000. In addition, 250 000 has been transferred from to 2012 to 2013 (see explanation above).

*Frisch/Torino/ØI*: In 2013, the work on the two models will continue. In model 1 the demand for new cars are modeled in two stages: First, the buyers choose the segment of cars out of 5 segments, ranging from small cars to SUV. Given the segment, the buyers choose between different types of cars. The data set contains all new cars bought in Norway since January 2004. Many characteristics of the cars are observed, such as weight, cylinder volume, potential CO<sub>2</sub> emissions, fuel consumption per km, type of fuel etc. The price of the car is observed and also the taxes paid by the consumer at the moment of purchase (engangsavgiften). Furthermore, information on the location of the purchased vehicles had been acquired, specifically the county and municipality where each vehicle was bought. The probabilities of demand (segment and type of car) are estimated, and in the estimation it is accounted for that buyers' response to prices may vary across buyers, and therefore geographically across Norway. This variation is not observed and it is assumed to be captured by a stochastic term distributed in the population. In model 2 both demand and car importers pricing and importing decisions are modeled jointly with the modeling of demand. The reason for doing this is that unobserved factors in demand may correlate with price. The joint estimation of demand and pricing of new cars may correct for this possible bias when demand is estimated separately. The models allow for a calculation of how expected CO<sub>2</sub> emissions in the fleet of new cars is affected by a change in taxation, for instance from replacing taxes tied to purchases of cars to taxes related to the use of the car (taxes on fuel costs). In 2013, the aim is to write 2 academic papers which will be submitted to international journals.

#### **WP5: The Next Generation of Numerical Models**

To analyze policies that stimulate innovation and diffusion of new environmentally friendly technologies, integrated economy-energy-environment models are necessary tools. In 2012 we have developed and updated our energy market model (LIBEMOD), and this work will be completed in 2013. Next year the work will concentrate on using these new model versions for different policy analyses. In 2012 we have also established a new family of integrated macroeconomic Computable General Equilibrium (CGE) models, called the SNoW-models (Statistics Norway World models). In 2013 we will continue developing this family of models and use them for relevant policy analyses.

We will continue our work on all the main topics in WP5 as described in the project application from 2011, see Table 8 for detailed plans. Most of the policy analyses based on numerical model simulations that we plan for 2013 are mentioned under WP1, WP2 and WP3. These activities are listed in Table 8 and will not be repeated here. Below we concentrate on projects that are not part of any of the other WPs.

### *National and international integrated models:*

#### Electricity market models

In 2012 we have worked with updating (model base year changed from 2000 to 2009), extensions (including more than 10 new countries) and modeling new energy technologies in our energy market model LIBEMOD. Research assistant Hilde Hallre (Frisch Centre) together with Finn Roar Aune (Statistics Norway), will complete programming and updating the model in the spring 2013. The new model version will be documented in a report. The new version will be used for policy analyses on topics related to other WPs in 2013, see Table 8. We will also continue our project with SINTEF Energy to improve the data and modeling of the power market, and to identify the extent to which output from LIBEMOD and SINTEF's Samkjøringsmodell (Europe version) differ when input data are harmonized as much as possible. We will also use the two models to examine an environmental policy issue. This project will be completed in 2014.

#### CGE-models

We have also established a new family of integrated macroeconomic Computable General Equilibrium (CGE) models, SNoW-models (Statistics Norway World models) for energy and environmental policy analyses. SNoW\_No is our new CGE model for Norway. A pilot version of this model based on a GTAP database structure (a global database detailed on trade, environmental and energy data used for generating models worldwide) is completed in 2012, programmed in GAMS. We have established our Norwegian database for SNoW\_No in close cooperation with the national accounts, energy and the environment statistics, at Statistics Norway. On this project we are cooperating extensively with Christoph Böhringer (University of Oldenburg), part-time funded by CREE. In 2013 we will continue improving the data and the model structure, especially the modeling of process emissions and dynamic investment and consumer behavior, and testing the model. Beyond 2013 we plan to extend the SNoW-family of models with linking the SNoW\_No model to the global model system.

### **Policy analyses**

We will use the new model for Norway SNoW\_No to analyze environmental and economic efficiency effects of policies towards improving energy efficiency. This is part of the EU project ENTRACTE. In this project we will model energy efficiency measures and costs based on information from a state of the art report on these issues written by IFE for CREE in 2012. We will continue our cooperation with IFE on developing cost curves of energy efficiency measures in buildings, and energy efficiency costs in industries in 2013.

In 2013 we will also finalize two studies of policies to spur diffusion of climate technologies that both models technological innovation and diffusion processes within a numerical CGE-framework for Norway. The first is a study of second-best options to reduce emissions, like direct investment support, and the effects in terms of welfare costs and emissions. We use a detailed CGE model for Norway, MSG-TECH, that models different abatement technologies for the industries. The other study is an analysis of policies to spur diffusion of climate technologies in a small open economy, depending on different international carbon policy regimes, within an empirical growth model with endogenous technological change (the ITC-model, Statistics Norway). Both the projects are financed by the Renergi-program (Norwegian research council), see Table 8 for details.

### **Model Forum and Scenarios**

We plan to have our next model forum in April 2013. The topic for the forum is: “The Next Generation of Numerical Models – part 1”. CREE (The Frisch Centre and Statistics Norway) will present the new versions of LIBEMOD and SNoW\_No, exemplified by model analyses. IFE and SINTEF will also contribute with relevant project analyses.

Table 8 describes our plans for the coming years, while Table 9 describes the amount of resources that will be spent on each project in 2013 and how they are financed. Table 10 presents the cost scheme for WP5 in 2013 for that part of the project that is 100% financed by CREE.

**Table 8: Time schedule for projects, WP5, period 2013 – 2014, (other related WPs are given in parentheses).**

<i>Topic</i>	<i>2013</i>	<i>2014</i>	<i>Institution</i>
National and international integrated models			
Updating/expanding LIBEMOD	X		SSB and Frisch
New data year	X		
Including new countries/regions in Europe	X		
Updating technology data	X	X	SSB/Frisch/SINTEF
Improving data/modeling SNoW_No	X	X	SSB
Modeling of process emissions	X		
Dynamic investment and consumer behavior	X	X	
Modeling energy efficiency measures	X	X	
Testing the model	X	X	
Incorporating new parameters from quantification studies (WP4)	X	X	
Linking the SNoW_No to the global SNoW family		X	
Policy analysis:			
National and international climate policies; welfare and carbon leakage effects, SNoW-model (WP1)	X		SSB
Energy efficiency policies in SNoW_No	X	X	SSB
Innovation and diffusion processes and policies for new energy- and climate technologies (MSG-TECH/ITC) (WP2)	X	X	SSB
Use LIBEMOD to analyze effects of phasing out nuclear power in Europe (WP3)	X		SSB/Frisch/SINTEF
Model forum and scenarios			
Meeting point for development of integrated environmental- and economy models with a rich presentation of energy- and environmental technologies	X	X	SSB, Frisch, SINTEF and IFE
Presentation of empirical model analyses of energy- and environmental policies	X	X	

**Table 9: Time schedule and financing, WP5, by institutions, months**

<i>Institution</i>	<i>2013</i>	<i>Financed by CREE</i>
SSB		
Administration	1 month	1 month
SNoW/MSG/ITC	5 months	2 months
LIBEMOD	6 months	3 months
Externals (Böhringer, Liski)	5% positions	100%
Frisch		
LIBEMOD	5 months	5 months
IFE and SINTEF	2 months	2 months
<b>Total, WP5*</b>	20 months	13 months

\*Excl. externals

Own funding consists of other Research council funding (primarily RENERGI) and some governmental funding at SSB. Both Frisch and SSB have other relevant projects financed outside CREE.

**Table 10: Cost plan for CREE funding, WP5, by institution (1000 NOK)**

<i>Institution</i>	<i>2013</i>
SSB	
Administration	110
SNoW/MSG/ITC	210
LIBEMOD	300
Externals (Liski)	69
Externals (Böhringer)	34
Frisch	
LIBEMOD (Hallre, Golombek, Kittelsen)	439
IFE and SINTEF Energy	600
Total	1 762

**Total funding for all 5 work packages**

The following table summarizes the total funding for all 5 working packages in 2013:

**Table 11: Cost plan for CREE funding 2013, by working package (1000 NOK)**

Administration	1 710
Conferences	300
MILEN's research school	100
WP1	2 269
WP2	978
WP3	1 047
WP4	1 489
WP5	1 762
	9 655

**Table 12: Cost plan for 2013 distributed to institutions (1000 NOK)**

Administration	1 710
Conferences	300
MILEN's research school	100
Frisch	1 582
SSB	1 578
ØI (including PhD and Post doc)	2 685
Tilburg	250
Subcontractors	1 450
	9 655

In addition to this, CREE has some external funding on projects that fall into the different work packages as mentioned above. The funding from each program can be split into several work packages, and it is therefore very difficult to allocate the money to the work packages. We have therefore not done that. For 2013 this funding is specified in Table 13:

**Table 13: Own funding (1000 NOK)**

<b>Program</b>	<b>Source</b>	<b>Institution</b>	<b>Amount</b>
PETROSAM: Petroleum industry research	RCN	Frisch	112
MILJØ2015: Equity in climate policy	RCN	Frisch	1 200
IPCC	KLIF	Frisch	150
ENTRACTE	EU	Frisch	977
RENERGI: Diffusion of climate tech.	RCN	SSB	1 100
RENERGI: Household response.	RCN	SSB	1 000
MSG-contract	Ministry of Finance	SSB	400
Own funding	SSB	SSB	700
Own funding	ØI	ØI	1 000
Own funding	TSC	TSC	250
<b>Total</b>			<b>6 889</b>

**Possibilities for additional funding:**

Based on Tables 12 and 13 above, the total CREE budget for 2013 is NOK 16 544 000

According to our project plan

(<http://www.frisch.uio.no/cree/docs/Final%20proposal%20to%20RCN%20-%20CREE.pdf>),

the original financial needs to fund our planned activities was NOK 20 550 000, thus we lack about 4 million NOK. The main reason for this is that RCN did not have any announcements for social science energy and environmental research in 2012. Thus, we will spend a lot of resources on research proposals for additional funding in 2013.

**Other activities:**

CREE will organize a series of meeting, seminars and conferences in 2013. So far, the following dates are decided:

The *model forum meeting* will be on 16 April.

The *user conference* will be on 16 April.

The *research workshop* will be on 16-17 September.