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Preface

NIFU has conducted a follow up study on social science research on environmentally friendly energy, on commission from the Research Council of Norway. The study builds on and updates a 2010 NIFU STEP report on the same subject.

The project report is written by the following NIFU researchers: Antje Klitkou (section 3.1), Pål Børing (section 3.2) and Espen Solberg (section 4.1). Inge Ramberg has been the project leader and author of the remaining parts of the report.

We are grateful to the RCN special advisors Tone Ibenholt and Hans Otto Haaland for their cooperation during the project.

Oslo, November 2016

Sveinung Skule
Director

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Summary

Research based knowledge and solutions have always been important for the development and exploitation of energy resources. Traditionally, energy-related R&D has had a clear bias towards science and technology. There is, however, growing awareness that social sciences also are important to understand and tackle the societal challenges related to energy issues.

Background

This report is commissioned by the Research Council of Norway (RCN) and analyses the status and development of Norwegian social science research on environmentally friendly energy. A similar but more limited study was conducted by NIFU in 2010, covering the period from 1999-2008. This study is partly based on the 2010-report and provides thereby a possibility to follow some trends over a time span of 15 years. A main purpose of the report is to analyse the *current status and the development within this field of study since 2008.* The present study addresses the following three main research questions:

I. How have increased financial incentives for social science research on environmentally friendly energy affected the scientific production and quality of this research in Norway in the 2008 – 2015 period?

II. How do Norwegian and foreign researchers in this field of research cooperate through mutual publications and research projects, such as Horizon 2020?

III. What are the total volume and main areas of research funding for social science research on environmentally friendly energy?

Scope and methodology

The study focuses on renewable energy and other environmentally friendly energy sources, which means that R&D related to nuclear, petroleum and other fossil energy sources are not part of the study. For the purpose of this report, the term “energy” is therefore mainly referring to environmentally friendly energy.

A major methodological challenge lies in the fact that energy research and, in particular, social science research on energy are not distinct research disciplines with official statistical categories. The study is therefore to a large extent an explorative analysis, where multiple approaches and data combinations are used in order to identify the volume and development of this form of research in Norway.

We identify and analyse the relevant research and institutions applying quantitative bibliometric approaches as well as novel use of Norwegian R&D statistics, E-corda data on EU-project funding and register data of relevant RCN project funding.

The scientific publication and quality of social science research on energy in Norway

In chapter 2 we analyse the volume and patterns of Norwegian scientific publication within this field of research. We find a marked growth in the number of articles published, from less than 50 articles in the 1999-2008 period to over 200 articles over the last period covering 2009-2014. This expansion seems to concur with the general increase in Norwegian investments in the field of renewable and environment friendly energy following, the so-called Climate Agreement in 2008.

Furthermore, the citation indicators show a positive development, close to the expected citation rate of all articles published in the identical journal volumes during the last time period. The citation analysis also returned well over twenty articles that are highly cited, within the relevant time frame. Highly cited articles indicate that a considerable number of peers find the published research of interest.

It is thus natural to assume that the increased publishing and citation of peer reviewed articles in this field are signs of increased scientific quality and a development towards a more “mature” field of research. However, these quantitative indicators have limited value for qualitative assessment of scientific quality of the research field in general. For instance, bibliometric data say little about the *content* of each article. Furthermore, our analysis reveals that a large part of R&D in this area is performed by applied research institutes, whose research outputs often appear in other forms than through scientific publications.

In terms of R&D profile, the article publication and citation patterns indicate a particular stronghold for social science research within renewable energy, energy use and energy systems subfields. Also, studies on carbon capture and storage (CCS) are frequently published as well as cited in the articles published with at least one Norwegian author in the relevant period. On the other hand, social science research on hydrogen and hydropower themes are less frequently published and cited in scientific journals.

Researcher cooperation through mutual publications and research projects

In addition to the publication and citation analysis, chapter 3 reports on co-publication of articles as well as cooperative EU-research projects. We find that the level of co-publishing of scientific articles is quite high, as 63 per cent out of the 259 units had more than one address. The authors represented over 200 unique organisations, and more than 150 of them were foreign institutions. This strong degree of co-publication is also a general feature of Norwegian academic research. In the field of social science on environmentally friendly energy, researchers from the USA, Germany, UK, Netherlands, Denmark and Sweden stand out as the most important for the international partners.

The study also includes a Social Network Analysis (SNA), which reveals that scientific collaboration has evolved rapidly over the last fifteen years. From a very fragmented and more or less national scenery, the Norwegian research organisations active in the field have developed both national and international linkages. However, we find that direct collaboration between the main Norwegian universities is less prominent, which is also in line with the general pattern of Norwegian co-publication. At the same time a number of the most central research institutes collaborate with different Norwegian universities. The SNA also shows that involvement of business actors or other types of non-academic actors is much less prominent in social sciences on energy research.

Thirdly, the analysis of the Norwegian participation in the EU framework programmes FP7 and Horizon 2020 find a total project portfolio of 42 projects that can be classified as social science research on environmentally friendly energy. More than half of the relevant H2020 projects are found within the programme denoted “ENERGY: Secure, clean and efficient energy”. In addition, we find a large share of projects with Norwegian participation in this area within the programme denoted ENV: Climate

action, environment, resource efficiency and raw materials. A total of 9 projects had Norwegian coordinator, mainly from research institutes and companies.

The geographic profile of Norwegian partnerships in this area shows an orientation towards partners from Spain, United Kingdom, France, Italy, Germany, the Netherlands and Belgium. We also find a relatively large number of Norwegian private companies (15 different mainly small and medium-sized companies) among the 42 selected projects. This finding points to the more development oriented nature of this project portfolio.

Volume of research funding for social science research on energy

In chapter 4 we estimate *the total volume and* describe *the main areas and institutions of research funding* for social science research on energy. On an aggregate level, we find that approximately 25 per cent of total R&D spending in Norway is related to energy issues (on a broad range of thematic priorities, including social science). Not surprisingly, petroleum related R&D stands out as the most important form of energy in this context, especially in industry, but also to a large extent in the research institute sector. R&D related to renewable energy is mostly conducted in the research institute sector.

If we focus on *R&D related to environmentally friendly energy*, we find that social science constitutes 7 per cent of the energy-related R&D in the institute sector and 14 per cent in the higher education sector. In terms performing units, we find around 25 institutes and departments in the higher education sector which are assumed to perform social science on energy. An equal number of research institutes also appear to have such R&D activity, although the total volume and number of research institutes in this area may be underestimated due to lacking reports of social science activity.

On an aggregate institutional level, we see that NTNU, the University of Oslo and NMBU are the three major performers of social science research on energy. NTNU has shown the highest growth in such R&D for the period 2009-2013 and also seems to have the strongest energy profile in their social science portfolio. Moreover, our analysis indicates that social science on energy most frequently appears in higher education research units with activity in economics research. Political science is also quite important here, followed by humanities and sociology.

In terms of funding from the Research council of Norway, we estimate the volume of the 2009-2015 RCN social science research portfolio on energy to be 242.7 million NOK and find that the annual allowances within the two major RCN programmes in the area have varied from 27.5 million to 49.1 million NOK in the seven-year period. The annual allowances have decreased since the RENERGI program ended in 2012.

In section 3.2 we map the additional funding volume for the relevant projects with Norwegian participants in EU FP 7 and Horizon 2020. We estimate the Norwegian participant proportion of the contribution from the European Commission to be almost 200 million NOK for the 2009-2015 period.

Compared to the estimated 100 million NOK of total financial resources for the field in 2013 alone, and the 242.7 million NOK in the RCN RENERGI and ENERGIX 2009-2015 portfolio, we conclude that national sources and RCN funding in particular are most important for the development of social science research on energy – along with the institutional funding of higher education sector institutions (general university funds). General institutional funds are however less concentrated and dedicated and therefore less able to provide stable funding for research in a cross-disciplinary and “emerging” field such as this. Dedicated funding to the field is primarily channelled through the RCN’s allocations within the RENERGI and ENERGIX programs as well as the FME Samfunn centre allowances for the 2011-2019 period.

Main Norwegian institutions in social science research on energy

We have studied the Norwegian institutions taking part in this subfield of research applying both bibliometric and project portfolio register data and find the following in sections 2.3, 3.1 and 3.3:

Firstly, NTNU appears to be the single Norwegian institution with the highest number of published articles (87) in our sample. But the institutional landscape appears to be rather varied, as a total of 63 different Norwegian research organisations contributed to the scientific publication within the field. NMBU, UiO, CICERO, SSB, NHH and UiB were the most active institutions after NTNU, accounting for 233 of the total 358 Norwegian addresses registered in the last period. NMBU (Norwegian University of Life Sciences) has increased its publication and risen to the second most active research institution in this field. Apart from the universities, we also find a number of important independent research institutes represented. Besides the already mentioned CICERO, we find institutes such as The Ragnar Frisch Centre for Economic Research and The Fridtjof Nansen Institute among the top ten publishing institutions. NHH - Norwegian school of economics and Vestlandsforskning (Western Norway Research Institute) are among the "new" institutions on this list.

Secondly, the main actors in the large collaborative research network in the 2012-2014 period were NTNU, NMBU, Statistics Norway, University of Oslo, CICERO, NHH, NINA and Ragnar Frisch Centre – all belonging to one of the FME centres (on social science and/or on technology). NMBU seems to have gained a particularly central position in the last period compared with its initial role in a small 3-node network in the 1998-2008 period. In general, the last 3-year period was characterised by a further increase of the publication activity and also a higher share of co-publishing compared to the first two periods.

Furthermore, a number of the Norwegian research institutes seem to function as bridges for the national collaboration networks, such as Cicero, Statistics Norway, Ragnar Frisch Centre and NINA. Other research institutes such as Fridtjof Nansen Institute and NIFU appear to be more oriented towards international partners. These institutions' affiliation with the large network goes through their international partners. The most central international research partner in the main network was the Swedish Lund University.

It is, however, well known that institutional concentration and cooperation patterns measured by co-publication have a bias towards academic research and higher education institutions. Data from Norwegian participation in the EU-framework programmes show a slightly different picture, with a stronger role played by research institutes and companies, although several of the major Norwegian universities are active also in this project portfolio.

Main findings

Although the study builds on a mix of different data and methodologies, some elements appear as general findings and conclusions throughout the study.

- Firstly, our analysis indicates a clear expansion of the research activities within social science on environmentally friendly energy in Norway. Along with this expansion we also observe a higher degree of cooperation and a more mature network of collaborating institutions.
- Economics seems to be the sub-discipline of social science which is most frequently associated with energy research. This appears both from the bibliometric analysis and from the study based on R&D-statistics.
- NTNU stands out as the most important Norwegian institution in this field of research, followed by NMBU. A number of research institutes also play a central role, both individually and as important "bridges" in the national networks of collaboration.

1 Introduction

1.1 Background

1.1.1 Growing awareness of human and societal aspects of energy

Energy research has traditionally been related to the natural sciences and technological research and development. Although this is still the case for energy research in general, there is now growing awareness that challenges and possibilities related to energy issues also require research based knowledge from other disciplines, including social sciences.

In a recent article, Sovacool (2014) analyses the content and disciplinary profile of 4444 articles in three central journals of energy research over a time span of nearly fifteen years (1999-2013). He finds that humanities as well as social sciences are clearly underrepresented in the scholarly literature on energy, and concludes that there is

> *a potential for the field of energy studies to expand methodologically, to utilize more research interviews, field research, focus groups, and other human centred methods of data collection and topically, to cover developing countries and issues of energy poverty, psychology and consumer behaviour, anthropology and the social significance of energy use, the social construction of technological systems, the forms and practices of communication that enhance the acceptance of energy information, (…) (Sovacool, 2014)*[1]

Similar statements about the importance of including human and societal aspects of energy issues have also been raised in a number of broad policy processes and agreements, for instance in the OECD Green Growth Strategy from 2011 (OECD, 2011) and in the most recent Lund Declaration from 2015. These concerns regarding the role of social sciences in energy research have also been raised in connection with Norwegian policy processes. One concrete manifestation and follow up of these concerns was the establishment in 2011 of three social science oriented centres for environmentally friendly energy research. This measure was initiated as an extension of the existing scheme for technologically oriented centres (so-called FMEs). According to the international panel for the mid-way evaluation of the social science FMEs, this construction is rather unique in an international context.

[1] The new journal Energy Research & Social Science (ERSS), founded in March 2014 and indexed in Web of Science as of 2016, has published 20 volumes as of October 2016. “ERSS covers a range of topics revolving around the intersection of energy technologies, fuels, and resources on one side; and social processes and influences—including communities of energy users, people affected by energy production, social institutions, customs, traditions, behaviors, and policies—on the other. Put another way, ERSS investigates the social system surrounding energy technology and hardware” according to Sovacool (2014).

A brief R&D policy backdrop

In Norway, most of the energy-related research as well as the environmental research institutes, were organized within the former *Norges teknisk-naturvitenskapelige forskningsråd* (NTNF) until the mid-1980s. In 1985, oil & gas became a central priority in Norwegian research policy while sustainable energy and environment did not receive the same attention. After the 1987 report Our Common Future of the Brundtland Commission, the environmental perspectives were acknowledged and occupational health, safety and environment (HSE) issues as well as environmental technology was included as one of the nine main research priorities for the 1990-ties.

The 1999 White paper on research (St.meld. nr. 39 (1998-99) *Forskning ved et tidsskille,* established four main thematic priorities including *research on energy and environment*. In this way energy and the natural environment represented an integrated effort instead of two separate fields. Once more it was the international momentum, now the Kyoto-protocol, which gave the main legitimation for the thematic priority. Also, building upon the Research Council of Norway (RCN) singular council structure erected in 1993, the two former separate priorities could be included in the new divisional organisational structure from 2003 under the Division for Energy, Resources and the Environment.

The 2008 Climate agreement (political agreement on the White Paper on Norwegian Climate Policy), as well as the 2009 Norwegian White paper on research, *Klima for forskning*, gave the incentive for a major investment in research on climate and renewable energy. Even though technology still was the main focus of interest, the new policy measures were built on a globally oriented and systemic understanding of the energy and environmental issues, thereby a stronger need to integrate social perspectives. The inclusion of social science in the RCN RENERGI and (subsequently) ENERGIX research programmes as well as the three social science research centres on renewable energy in 2011, are all manifest expressions of this social science perspective in the RCN energy research portfolio.

The Norwegian social science research programmes on energy was introduced in the early 1990-ties SAMMEN (Samfunn, miljø og energy), feeding into the RCN social science research programme, SAMRAM, addressing framework conditions for Norwegian energy- and environmental politics, during the 1996-2000 period[2]. Another RCN social science research programme, SAMSTEMT, followed before the RENERGI-program (2004-2013).

The current long term plan on education and research (Meld.St.7 (2014-2015)) underlines the social science research perspective within research on climate, environment and clean energy: the policies must be “integrated across [ ] disciplines such as natural and social science, technology and the humanities in order to understand and handle the effects of these changes”.

1.2 Mandate

Following the national research policy priorities, research funding for research on sustainable energy and environment has received increased financial resources during the 2008-2015 period through various targeted RCN programmes as well as through more general increases in institutional funding and other mechanisms.

On this background, the RCN issued a call for a study on Norwegian social science research on energy in order to analyse *the current status and development research within this field of study since 2008*. In addition, the RCN asked for an overview of *the volume and major financial sources* for social science research on energy and the major research institutions within this field of study. An excerpt of the RCN mandate for the study is found in annex 1.

[2] Aarne Ø. Røvik (red.): Energi og miljø ved et tidsskille –samfunnsfaglige perspektiver fra forskningsprogrammet SAMRAM. Norges forskningsråd 2001.

1.3 Research questions and delimitations

More specifically, the main research questions given in the mandate are the following (our translation):

I. How have increased financial incentives for social science research on environmentally friendly energy affected the scientific production and quality of this research in Norway in the 2008 – 2015 period?

    a. Which *subfields of research and research environments* have developed during this period?

II. How do Norwegian and foreign researchers in this field of research cooperate through mutual publications and research projects, such as Horizon 2020?

    a. Which *subfields of this research are of particular interest to Norway* – and should consequently be supported by Norwegian public funding?

    b. Which *research areas are more generic or international in nature* – and should be regarded in connection with internationally oriented research

III. What are the total volume and main areas of research funding for social science research on environmentally friendly energy?

    a. Which are *the main research funding institutions* for Norwegian social science research on energy?

    b. Which are *the main research institutions* in Norwegian social science research on energy?

The first research question above (I) is based on the overall rationale for the study; whether or not the research investments pay off in the development of the research fields in question. In this study, research quality is indirectly addressed through the publication of research articles in the international peer reviewed journals. Other forms of peer review of research are not within the scope of this study. We do however apply the journal peer review information in the quantitatively oriented bibliometric study in several respects.

We study international cooperation in the second (II) set of research questions – which come part and parcel with research quality issue when it comes to international research publication. The subfields of research of particular interest are deduced from the published papers with at least one Norwegian author address. In addition, the actual funding sources also indicate Norwegian vs. international (European) preferences within this field of study.

The third set of research questions (III) above, addresses the funding and volume of Norwegian research in this field more in detail – paying special attention to the research institutions and groups.

The main challenge of this study, is the multidimensional character of the research field both in relation to research disciplines and institutional borders. Firstly, we find that the major part of the research within this field is truly multidisciplinary. The common denominator is social science research on environmentally friendly energy (that have been published in international journals), with particular reference to *new environmentally friendly energy; e.g. renewable energy production, energy systems, energy use, hydrogen as well as carbon capture and storage (CCS)*. In the 2010 NIFU study, the bibliometric analysis identified ten different subfields of research including the ones mentioned above. The multi-dimensionality is also expressed through the researchers – they are increasingly representing a number of institutions through project and publication cooperation with colleagues outside their home institution. We address this complexity, by applying a number of data sources and methodological approaches.

1.3.1 Defining energy research

A first challenge defining the research field is due to the fact that energy research in general is a broad, multidisciplinary and cross-sectoral research area. Firstly, energy research is performed in both industry, higher education institutions, research institutes and public sector institutions. Furthermore, energy R&D represents a number of disciplines and research areas. A mapping performed by the OECD demonstrates the multi-disciplinary nature of patents within so-called “green technology”:

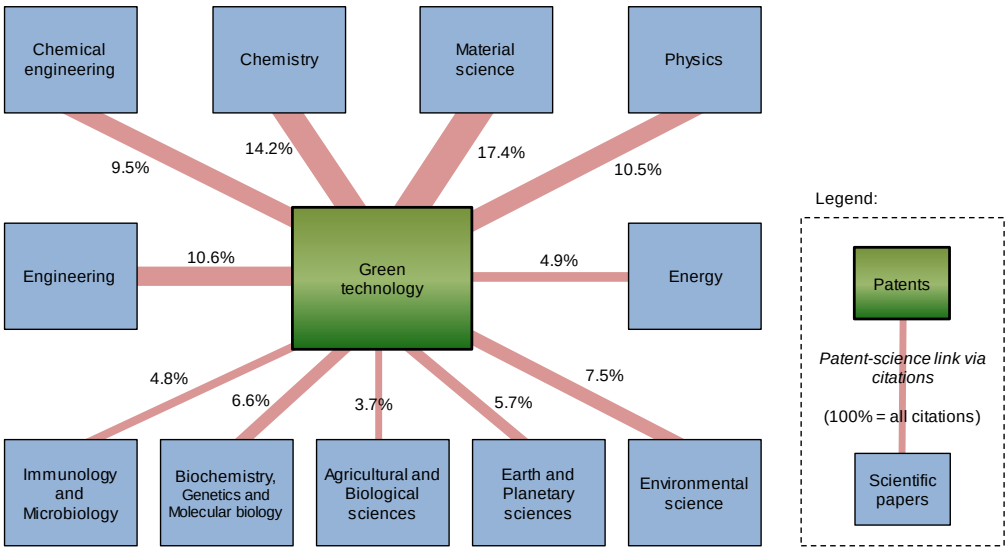

Figure 1 The innovation-science link in green technologies, 2000-2007.

Source: OECD, based on Scopus/Elsevier, OECD patent database and EPO

In the figure above, green technology is defined as patents within the following fields: *renewable energy, fuel cells and energy storage, alternative-fuelled vehicles, energy efficiency* and *“clean” coal*. Based on this definition, green technology seems to rely on a broad range of research disciplines, ranging from engineering and physics to molecular biology and planetary sciences (OECD, 2011).

At the same time, it is worth noting that social science is not included as relevant literature in patent documents within the area of green technology. This absence of social science in patent citations is a general phenomenon, which again demonstrates the limitations of using patent data for capturing research and innovation based on social science.

Using bibliometric data exclusively is one way of overcoming this problem, although social science is often not fully covered there either (see chapter 2). Another way of capturing social science in energy is by exploiting additional elements and questions in R&D statistics.

1.4 Data and methodology

In this study, we identify and analyse the relevant research subfields applying several quantitative bibliometric approaches. We also apply analysis of several register data sources including Norwegian R&D statistics, E-corda data on EU-project funding and register data of relevant RCN project funding. The bibliometric approach is not well suited to analyse the resources and volume of research involved. Here we apply Norwegian R&D-statistics at the institutional level in the Higher education and institute sector. Details on bibliometric and register data approaches are given in chapters 2-4 in this report.

1.5 Report structure

The next chapter (2) includes the *bibliometric study of Scientific quality of the social science research on energy.* Here we report on the specific subfields of research and research institutions have been established in the 2008 – 2015 period.

In chapter 3 we analyse Norwegian researchers and their international cooperation on new environmentally friendly energy- based on both Norwegian researcher's co-publications and their EU project cooperation.

Chapter 4 gives an overview *of financial sources* of Norwegian social science research on new environmentally friendly energy.

2 Social science research on energy – a bibliometric approach

This chapter presents the findings from a *bibliometric study of social science research on environmental friendly energy.* Here, we report on the specific subfields of research and on the research environments that have been established in the 2008-2015 period. We address the first research questions in the mandate, namely:

- How have the increased financial incentives (research funding) for social science research on energy *affected the scientific quality of this research in Norway* in the 2008 – 2015 period?
- Which *subfields of research and research environments* have developed during this period?

This part of the study will indicate whether or not the increased Norwegian investments in the field since 2008 has contributed to an increase in the quality and volume of the social science research within this multidisciplinary field. The data analysis will give an overview over the subfields of research and research environments that have developed.

2.1 Bibliometric methods and data

The bibliometric study maps *social science research articles on environmentally friendly energy* that were published in international journals in the 2009-2014 period applying a *stepwise approach*. The approach is summarized in Table 2. The study combines keyword, journal, and article searches on all Norwegian addresses. This 3 step approach builds on the 2010 NIFU study (in step 1) to ensure comparative results. An identical set of energy subjects defined by keywords was applied including: bio-energy, geothermal energy, hydrogen, hydropower, solar photovoltaic, wind, CCS, renewable energy in general, energy use and energy system, among others.

The index of scientific publishing in the Thomson Reuters ISI Web of Science (WoS) is the starting point for our bibliometric analysis. This study is based on the Social Science Citation Index (SSCI) and articles published from 2009 to 2014. The two types of documents included are articles and reviews. The social science fields are defined on the basis of a selection of journals within the SSCI[3], while the energy-related subjects are identified by keywords.

[3] During our searches we discovered that WoS had redefined several journals included in the SSCI after 2008, including the journal *Energy Policy*. Supplementary journal searches were therefore conducted, resulting in a substantial rise in number of identified WoS-indexed journal articles for this study.

2.1.1 Identification of social science fields and energy-related subjects (Step 1)

The following overview shows which English keywords were applied to identify social science studies on environmentally friendly energy and CCS. For the purpose of comparison, the keywords are identical to the selected keywords for the NIFU STEP 2010 study. Extensive searches were conducted in Web of Science.

The selection of keywords aimed at avoiding a too narrow technology focus, as well as avoiding too general searches. The keywords selected describe the relevant technology systems in a more general way than engineers would apply them in their research literature, but engineers should still be able to recognize their subjects from these keywords. Irrelevant keywords had to be excluded and overlaps between keywords had to be taken into account. The extensive data searches in Step 1 were conducted in Web of Science applying the selected keywords in the table below[4]

Table 1 Selected keywords for the bibliometric approach

Energy use
- energy use
- energy usage
- energy consumption
- energy efficiency
- energy-saving technology
- clean technologies

Energy system
- energy system
- energy infrastructure
- energy network
- strategic niche

Hydrogen
- hydrogen production
- hydrogen generation
- hydrogen storage
- hydrogen transport
- hydrogen distribution
- hydrogen use
- hydrogen fuel
- hydrogen economy

Renewable energy production
- renewable energy/power production/generation
- sustainable energy/power production/generation
- green energy/power production/generation
- environmental energy/power production/generation
- ecological energy/power production/generation

Bio-energy
- bio-energy
- bio-fuel
- biomass waste energy
- biomass feedstock energy
- biomass to liquid
- bio-methanol
- bio-ethanol
- bio-gasoline
- biodiesel

Geothermal energy
- geothermal electricity
- geothermal plant
- hot dry rock
- enhanced geothermal system
- geothermal heat pump
- ground source heat pump

Solar photovoltaic
- photovoltaic energy
- PV energy
- solar cells
- solar panels
- PV-module
- photovoltaic system

Solar thermal power
- solar thermal power
- solar thermal energy

[4] Searches in step 1 revealed all together 223 hits in the 2009-2014 period, including at least one Norwegian address After manually reviewing the references for the titles and abstract of the scientific articles we found that (a number of 42) of these titles did not meet the inclusion criteria of our study, and were consequently excluded from our data base. After this revision, our data set consisted of 167 items, of which 38 proved to be duplicate article references, with hits from different keyword searches, and therefore indicating particular relevance to our study. Leaving out the duplicate references, our data set consisted of 129 unique article references for the 2009-2014 period.

• concentrating solar power
• solar thermal power plant

Hydropower
• hydropower
• hydro power
• hydro energy
• hydropower generation
• hydro power turbine
• small hydro power
• small hydro energy

Wind energy
• wind energy
• wind power
• wind turbine
• wind mill
• wind onshore
• wind offshore
• wind technology
• Wind farm

CCS
• carbon capture and storage
• carbon dioxide capture and storage
• carbon sequestration
• carbon capture
• carbon storage

Also, truncated keyword searches combining ccs*; energy*; hydrogen*; renewable*; bio*; geotherm*; solar*; photovolt*; hydro*; wind* *with*; car*; transport*; vehicles* were included in Step 1.

Supplementary journal searches (Step 2)

Quality checks revealed that several journals that ISI had indexed as social science journals applied in the 2010 study, have been re-categorized by WoS into the science and technology group. Consequently, we conducted supplementary searches on selected journals and Norwegian addresses – to ensure that all WoS-indexed social science journals on energy issues from the 1999-2008 period also were included throughout the 2009-2014 period[5]. In total, the original and the supplementary journal searches resulted in *a net sample of 214 (unique) article references* to articles and review articles after excluding duplicate article references when merging the two subsamples.

Supplementary searches for FME-samfunn centre articles (Step 3)

A last supplementary approach was conducted to ensure that all relevant WoS-indexed articles from the three recently established FME-samfunn centres were included in our sample.

Additional searches were also conducted in WoS for FME-samfunn centre publications. These centres[6] are:

- Centre for Sustainable Energy Studies (CenSES)
- Strategic Challenges in International Climate and Energy Policy (CICEP)
- Oslo Centre for Research on Environmentally friendly Energy (CREE)

Article items on the FME-samfunn publication lists in the 2011-2014 were identified and metadata downloaded from the supplementary searches in the Web of Science. In this search procedure we found identified 135 hits. Reviewing the article meta data we further narrowed down this sample to 45 articles, excluding duplicate article references, articles with no registered Norwegian address, articles published after 2014, articles types other than articles and review articles (e.g. editorial articles) and articles addressing themes not meeting the thematic inclusion criteria's of the bibliometric study on social science research on *environmentally friendly* energy[7].

[5] These supplementary searches gave another 167 hits which also were manually reviewed to avoid irrelevant items and duplicate articles in our sample. In total 85 (of these 167 items) were added to the original 129 article references (stemming from thematic searches).
[6] In 2011 The research Council of Norway established three Centres for Environment-friendly Energy Research (FME) within the social sciences for a period of up to 8 years.
[7] The major part of the FME centre article references in the 2011-2014 period addressed other and broader thematic issues than identified by the primary keyword search approach described above. 85 article references were excluded after reviewing the title, keyword and abstract information for each reference. Often they had a broader focus than

Our total net sample includes 259 unique article for this bibliometric study[8]. Our sample includes articles published both in journals within science and technology field as well as social science indexed journals (after the expansions made by the supplementary journal searches as well as the FME-samfunn centre searches. For the 130 articles included in step 2 and step 3 we have also applied the thematic categorization reviewing WoS title and abstract information for these articles.

Table 2 The three steps of the bibliometric sampling approach

Steps	Number of hits	After reviewing the data	Total
1	223	129	*129*
2	167	85	*214*
3	135	45	*259*

The keyword searches in step 1 together with step 2 supplementary journal searches are needed to make comparisons with the 1999-2008 period (searches conducted for the 2010 report). In general, we find a marked growth in the number of articles published, from less than 50 in the first period, compared to over 200 (259 articles when we include step 3) for the 2009-2014 period. Step 3 sampling addressed the FME Samfunn scientific publications not identified through steps 1 and 2. As these centres did not exist before 2011, the inclusion of their publications constitutes a deviation from the methodology applied in the previous study from 2010. On the other hand, these centres represent new research groups. We therefore find it natural to consider the increased publication activity from these centres as signs of a real expansion of the field.

2.1.2 Bibliometric study description

In the remaining part of this chapter as well as in chapter 3.1 we will analyse the article publications on environmentally friendly energy that have been published in international journals by thematic fields, journals and research institutions/groups addressing:

- Publication volume and research field profile
- Citations of articles – expected rate of citations
- International co-publication

We apply quantitative indicators to describe the publication volume over time, mainly the number of WoS-indexed articles with at least one Norwegian address. These articles are categorised in the different thematic fields and applied later on in the analyses.

The analysis of citations in turn, applies the number of citations registered for the single article in our sample. Here we compare the number of citations for the articles to the mean expected citation rate of the corresponding journals for the time period in question.

We also study *the national and international co-publication* (in chapter.3.1) for the articles in question, applying information on country and institutional address in order to identify the cooperation patterns in the national and international co-publications. These results give us a proxy for the national and international cooperation involved in this field. Also, we apply Social Network Analysis (SNA) to identify co-publication patterns and mapping the development of cooperation patterns within the Norwegian research field during the 1999-2014 period.

sustainable energy, mainly highlighting climate policy related issues. The FME-samfunn articles references identified in Web of Science, were published in 69 different journals.13 of these journals published more than two articles each. Energy policy, Energy economics and Environmental & resource economics were the three most frequent journals with five to eight FME-samfunn article references and addresses each in the period.

[8] The 45 article references identified from the supplementary FME-samfunn searches were added to our previous 214 unique articles references after excluding 21 duplicates from supplementary searches.

2.2 Overall description of the bibliometric publication data

Overall, the 259 WoS-indexed articles in the 6-year period (2009-2014) period indicate a considerable increase in articles compared to the 47 articles published in the same field of research during the previous 10-year period (1999-2008), identified by NIFU in 2010[9]. In the 2010-report a rise in the annual number of articles with Norwegian addresses could be highlighted: from less than six annual articles until 2005 to 8 to 10 annual articles in 2007-2008. This growth has continued in the 2009-2014 period to more than 50 WoS-indexed articles in 2014, depicted in our Figure 2 below. After 2011, also articles identified in step 3 and connected to the FME samfunn centres, are included, contributing to the growth since then.

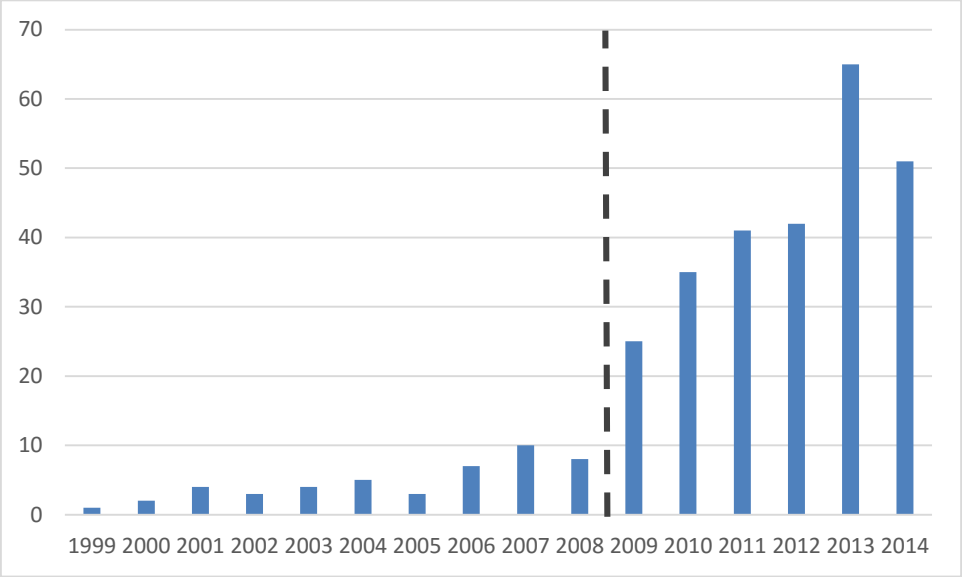

Figure 2 Number of articles with Norwegian addresses in the 1999-2008 period (47 papers) and in the 2009-2014 period (259 papers).

Source: NIFU. Thomson Reuters Web of Science.
Note: The dotted line indicates the border between the two samples and time periods. Please refer to the NIFU 2010-report for documentation on the 1999-2008 searches. These searches were not replicated in the present study. Special attention is needed to ensure that all journals are included in the full 1999-2014 period if replicated.

We also find a rather strong concentration in terms of which journals most articles are published in. 70 per cent of all articles were published in 20 journals which included at least three of the selected articles (N=259) during the period in question. Most prominent of these journals was the Energy Policy which carried 75 or close to 29 percent of all articles published. Energy Economics and Ecological Economics are the two journals following in the table below. In general, we find that “Economics” in the title of six journals of the twenty, indicating a stronghold for this social science discipline in the field.

[9] The types of documents included in the 2016 data set are articles and reviews only. The 2010 data set also included a few other publication types (editorials, comments etc.) giving a slight increase in the number of included bibliometric references.

Table 3 Journals with a minimum of three articles on social science research on energy published in the 2009-2014 period, including a Norwegian address. N=179.

Journal	SN	Number of articles
ENERGY POLICY	0301-4215	75
ENERGY ECONOMICS	0140-9883	14
ECOLOGICAL ECONOMICS	0921-8009	12
GLOBAL ENVIRONMENTAL CHANGE-HUMAN AND POLICY DIMENSIONS	0959-3780	10
ENERGY JOURNAL	0195-6574	7
EUROPEAN PLANNING STUDIES	0965-4313	6
ENVIRONMENTAL & RESOURCE ECONOMICS	0924-6460	6
ECONOMIC SYSTEMS RESEARCH	0953-5314	5
TRANSPORTATION RESEARCH PART D-TRANSPORT AND ENVIRONMENT	1361-9209	5
JOURNAL OF FOREST ECONOMICS	1104-6899	5
ENVIRONMENTAL SCIENCE & TECHNOLOGY	0013-936X	4
RESOURCE AND ENERGY ECONOMICS	0928-7655	4
SCANDINAVIAN JOURNAL OF ECONOMICS	0347-0520	4
CLIMATE POLICY	1469-3062	4
GLOBAL ENVIRONMENTAL POLITICS	1526-3800	3
INTERNATIONAL JOURNAL OF CONSUMER STUDIES	1470-6423	3
ENERGY	0360-5442	3
RENEWABLE & SUSTAINABLE ENERGY REVIEWS	1364-0321	3
EUROPEAN JOURNAL OF OPERATIONAL RESEARCH	0377-2217	3
TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE	0040-1625	3

Source: NIFU. Thomson Reuters Web of Science.

Among the journal titles in Table 3 we also recognise ten of the most important journal titles identified by the 2010 NIFU report from a total 303 different international journals that published a total of 2,459 articles in the 1999-2008 period from all countries. Likewise, of the 47 articles with Norwegian addresses included in that period, most of them (30) were published in Energy Policy and Energy Economics which still are the two most frequent in Table 3 for the 2009-2014 period.

All 259 articles with a Norwegian address from our current article sample were published in 86 international peer reviewed journals are both listed in the *appendix (annex 2 and annex 3)*. This indicates a broad dispersion both in the number and types of journals involved.

2.3 Norwegian social science publication on energy-related subject areas

Following this overall description of the bibliometric publication data, we will now proceed to analyse the publication volume and research field profile in order to address the following research question:

- *Which subfields of research and which research institutions have been established in this period?*

Starting with the institutions, we find Norwegian researchers representing a total of 63 different Norwegian research organisations. Among these, NTNU, NMBU, UiO, CICERO, SSB, NHH and UiB stands out as the most active institutions, accounting for 233 of the total 358 Norwegian addresses reregistered. NTNU is the single Norwegian institution with the highest number of institutional references (87) in our sample.

In the preceding 1999-2008 period, the following Norwegian research institutions published most articles in this research field were: UiB, UiO. NTNU, CICERO and Statistics Norway[10]. In the 2009-2014 period, we find that NMBU has increased its publication and risen to the second most active research institution in this field.

Apart from the universities we also find important independent research institutes represented in the list. In addition to the already mentioned CICERO, The Ragnar Frisch Centre for Economic Research, The Fridtjof Nansen Institute appear on the top ten list in Table 4. NHH - Norwegian school of economics and Vestlandsforskning (Western Norway Research Institute) are among the "new" institutions on this list.

Table 4 Norwegian institutions represented with five or more appearances in the address field

Research institution	Number of articles with institutional reference
Norwegian University of Science and Technology (NTNU)	87
Norwegian University of Life sciences (NMBU)	32
University of Oslo (UiO)	32
CICERO Center for International Climate and Environmental Research	30
Statistics Norway (SSB)	25
Norwegian School of Economics and Business Administration (NHH)	14
University of Bergen (UiB)	13
Ragnar Frisch Centre for Economic Research	9
Western Norway Research Institute (Vestlandsforskning)	8
Fridtjof Nansen Institute	7
SINTEF Energy Research	6
University of Stavanger (UiS)	6
BI Norwegian Business School	5
Institute for Energy Technology (IFE)	5
Nordic Institute for Studies in Innovation, Research and Education (NIFU)	5

Source: NIFU. Thomson Reuters Web of Science.

We now turn to the question of *which subfields of research* we can find in the 2009-2014 period. The figure below indicates the most prominent subjects in the article sample stemming from the keyword and supplementary journal as well as FME samfunn article searches which we have assigned a sub-field based on information in WoS-article title and abstract.

Among our 259 articles, we find the highest share for Renewable energy (27 per cent including transport), Energy use (22 per cent including transport) and Energy system (18 per cent including transport). We also find a high share of articles in the Carbon capture and storage subfield (11 per cent). For the other subfields such as Bioenergy we find lower shares of the articles.

Energy use was also the most prominent subfield of social science energy research internationally during the *1999-2008* period. The second most prominent was Bioenergy (fuels) which is not as

[10] Please refer to NIFU (2011) pp 97-100.

prevalent in the more recent 2009-2014 sample of articles. During this period, we find *transport* in several of the social science research on energy subfields. In total, about 8 per cent of all articles, of which almost a half are found connected to the Energy use subfield.

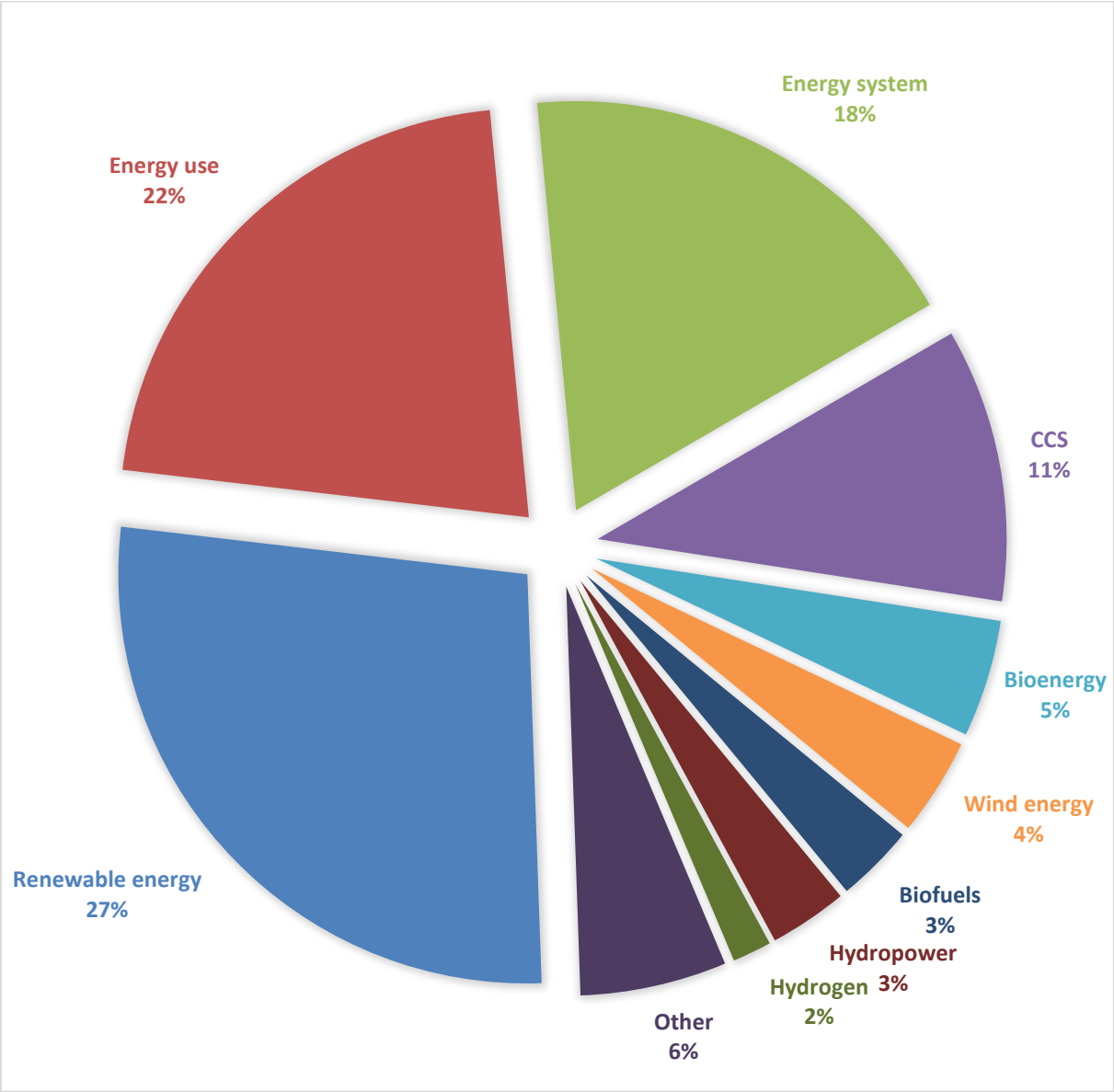

Figure 3 Social science publishing on energy subjects in the 2009-2014 period. N=259

Source: NIFU. Thomson Reuters Web of Science.

Figure 4 depicts the development of article publications within the research subfields over time in Norway. In the 2009-2014 period we find the strongest growth for articles in the subfields of Energy system and Renewable energy. Also for Energy use we find more than five published articles a year. There is also an increase in the number of articles on Carbon capture and storage (CCS). Most other subfields have a rather low number of published articles each year. Bioenergy, Hydrogen and Hydropower are among these subfields. Annex 4 in the appendix lists the number of articles within each subfield of research, including a breakdown for the 20 transport-related articles within these categories.

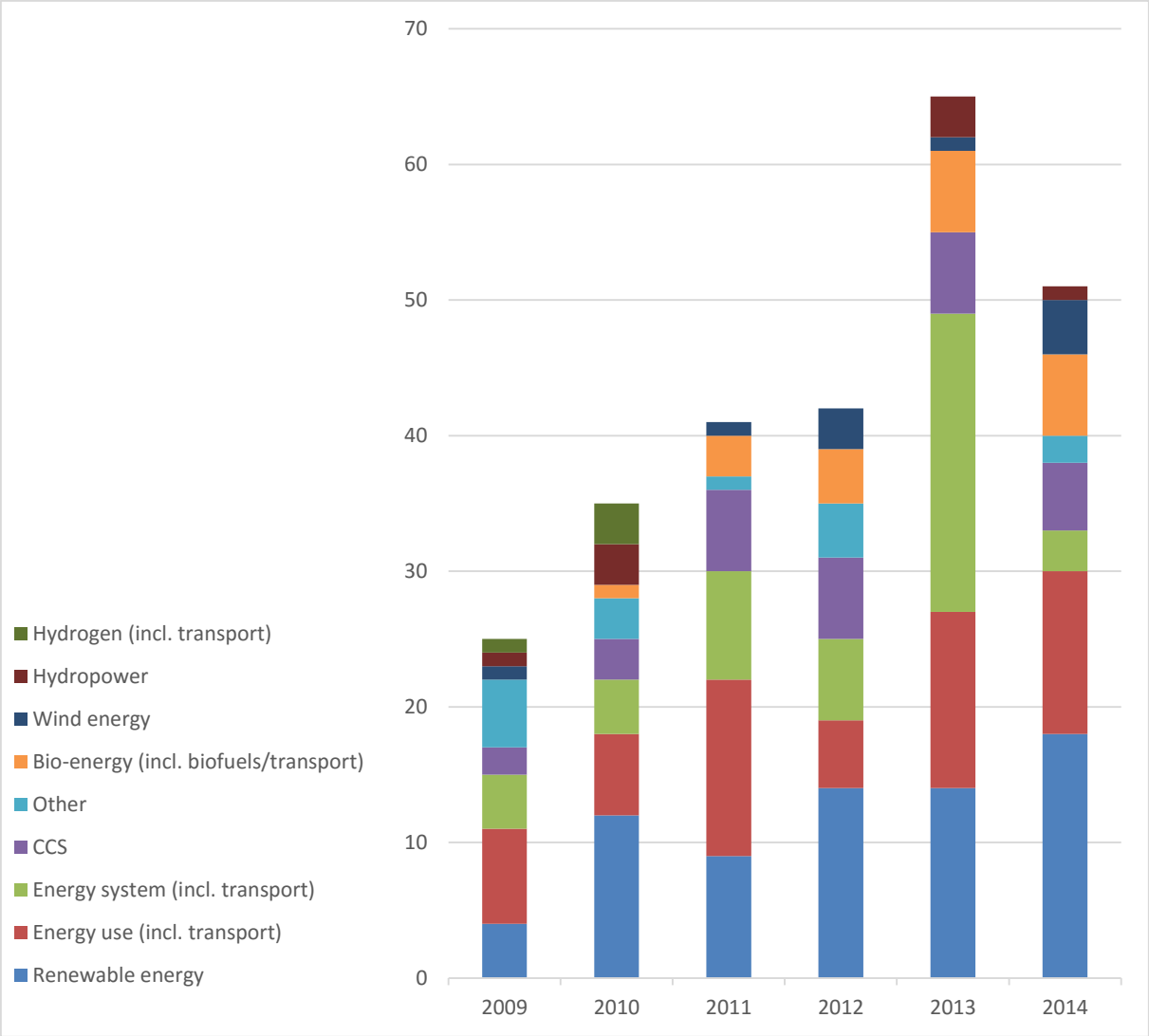

Figure 4 Number of articles published within subfields in the 2009-2014 period. N=259

Source: NIFU. Thomson Reuters Web of Science.

The observed increase in the number of scientific articles after 2012 concurs with the rise in the publications from the SME samfunn centres and other research institutions, including NMBU. The annual variations of the scientific articles within a particular subfield may be due to the fluctuant variations, since many subfields have very few articles and are therefore sensitive to the publication pattern of few actors.

2.4 Citations of articles with Norwegian addresses

Citations are frequently used as an indicator of scientific impact, and thus as a partial measure of quality. It is, however, important to be aware that there are various limitations and weaknesses of citations as an indicator, and citation analysis cannot in any case replace an evaluation conducted by peers (cf. Aksnes, 2005). There are for instance large differences in the average citation frequency between different disciplines. Furthermore, articles may receive a large number of citations for other reasons than scientific quality, for instance when they present an overview of other research or when they present a frequently used methodology.

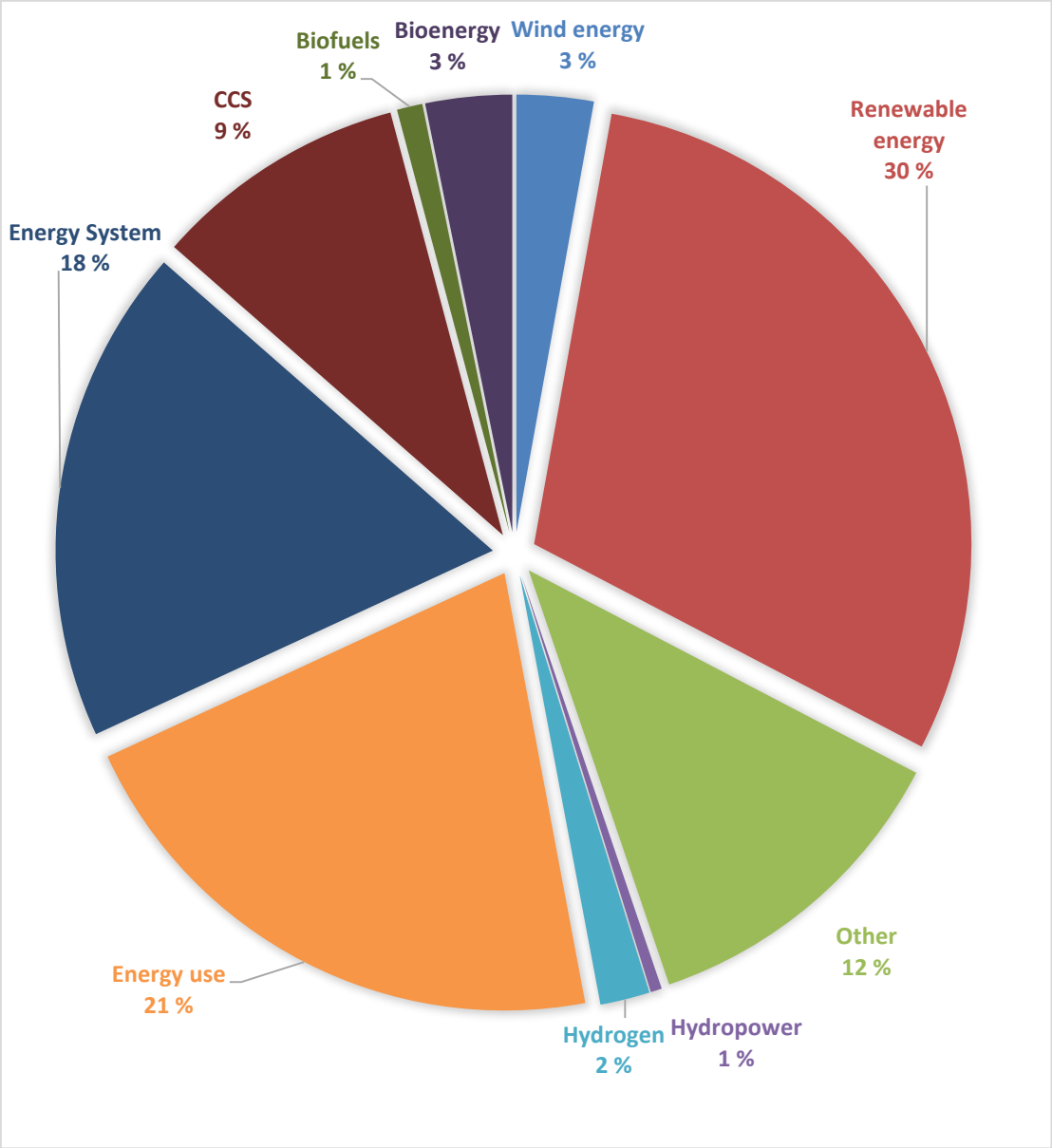

Figure 5 Citation of the published articles within subfields in the 2009-2014 period. Percentage N=1690

Source: NIFU. Thomson Reuters ISI Web of Science / Journal Performance Indicator

Figure 5 indicates the share of the total number of citations for each subfield in the 2009-2014 period. We find that the three most cited subfields are the renewable energy, energy use and the energy system categories (which also have the highest number of published articles as depicted in Figure 3).

By May 2015 we find that 210 of the articles in our sample was cited at least once in another WoS-indexed article. In total, the 259 articles in our sample received 1690 citations, which gives an average of 6.5 citations per article. This is higher than the 5.4 citation rate in the 1999-2008 sample, and close to the expected citation rate of articles in the same publication[11], which was 6.8 citations in the recent period.

It is difficult to find a good comparative basis for the listed citation rate. On the one hand, the average citation rates mentioned above seem low compared to total citation rates for Norwegian research,

[11] The average number of citations received by a paper published in the same journal, in the same year (indexed year), and of the same document type (article, note, review, editorial, etc.)

which are well above world average. On the other hand, the social science research on energy is a fairly young and also a most transdisciplinary field of research. Its first dedicated scientific journal, *Energy Research & Social Science* (ERSS), was founded in March 2014 according to Sovacool (2014) op.cit. The established journals publishing energy research, are usually more disciplinary oriented (leaning towards technology or economics), rather than thematically broader oriented social science aspects within energy research. There is also reason to believe that small countries with generally low citation rates are less represented in this field, which means that the world average is a higher benchmark here than in comparisons of national total citation rates[12].

As expected, we also find that the citation of the articles is skewed. 20 of our 259 articles have received more than 20 citations each, and the most cited article (published in 2009) has received a total of 85 citations in WoS (2015)[13]. Also, as can be expected, we find that the average number of citations each year of publication, drops (from 19.9 in 2009 to 0.8 citations in 2014). 51 of the articles were not cited so far, was mainly published in the two last years (2013 or 2014) of the citation window.

2.5 Concluding remarks

This chapter has presented the bibliometric study of social science research on energy in Norway focussing the subfields of research and on which research institutions have been established in the 2008-2015 period.

We have seen that there has been a marked growth in the number of articles published since 2008, concurring with the increase in Norwegian investments in the field. The citation indicators also show a positive development close to the expected citation rate. However, these quantitative indicators have limited value and validity for evaluating the scientific quality of research, where peer reviewing may provide a more relevant approach. Such an exercise is out of reach for this study.

We may however conclude that it is likely that the increased peer reviewed publishing in international journals (indexed in Web of science) – is one indication for increased quality as well as the scale of the social science research within this multidisciplinary field.

[12] Comparing expected citation rates of a disciplinary oriented Norwegian social science or energy research in general, can consequently be misleading. During our analysis we have also assessed the WoS-indexed category Green & sustainable science & technology as a comparative reference for our Norwegian social science oriented subfield, but found it to be of low relevance for this purpose (including 9 of the total 259 articles in our sample).
[13] Minx, JC; Wiedmann, T; Wood, R; Peters, GP et. al (2009): Input-output analysis and carbon footprinting: an overview of applications in economic systems research. *Economic systems research*. Vol. 21. Issue: 3 pp: 187-216.

3 Norwegian researchers and their international cooperation

This chapter highlights international co-publishing of Norwegian researchers within social science research on Energy – as well as researcher cooperation in this field of study through mutual research projects, such as the EU framework program FP7 and Horizon 2020. Applying bibliometric as well as register data on EU project cooperation, we address the following research question:

- How do the Norwegian and international researchers in this field of research cooperate through mutual publications and research projects, such as Horizon 2020?

3.1 Co-publishing as a proxy for collaboration

Co-publishing of Norwegian researchers includes both collaboration between Norwegian colleagues and international peers. Two approaches are frequently used for analysing co-publishing: Firstly through the analysis of *co-publishing authors* and secondly through the analysis of *co-publishing organisations that the authors are affiliated* to. For the purpose of this report we have chosen the second option partly in order to provide insight in the collaboration patterns on an institutional level. Consequently, co-publishing within the same organisation is by this approach not captured.

3.1.1 Basic statistics on co-publishing

For the 259 papers in our 2009-2014 sample, we identified 216 unique organisations, including 153 foreign organisations. In the table below we depict the most frequent international organisations and show that there is little concentration. The most important organisation represented in the article sample was Lund University with six of the 153 foreign article addresses in the sample. Among the 18 foreign organisations which are most frequently involved in co-publishing with Norwegian institutions, we find that one third are Scandinavian, while also UK, US and German research institutions play central roles.

Table 5 Number of papers co-published with foreign organisations (most frequent appearance)

Organisation name and country	Number of papers
Lund Univ, Sweden	6
Univ Copenhagen, Denmark	4
Univ Leeds, UK	4
Univ Sydney, Australia	4
World Bank, USA	4
Appalachian State Univ, USA	3
Carl von Ossietzky Univ Oldenburg, Germany	3
Millennium Inst, USA	3
Stockholm Univ, Sweden	3
Tech Univ Denmark, Denmark	3
Univ E Anglia, UK	3
Univ Gothenburg, Sweden	3
Univ Oxford, UK	3
Univ Utrecht, Netherlands	3
Aalborg Univ, Denmark	3

Source: NIFU. Thomson Reuters Web of Science.

In general, the country addresses registered for the article sample reveal that researchers from the USA, Germany, UK; Netherlands, Denmark and Sweden are most important for international co-publishing.

Figure 6 shows that there is a trend towards more co-publishing. During the whole 2009-2014 period, 63 per cent of all papers listed more than one co-publishing organisation. As shown by figure 6, this share has increased from below 50 per cent in 2009 to above 70 per cent in 2014. The share of co-publishing seems more varied in the period prior to 2009, but these shares are based on rather few observations (hence the dotted line for this period).

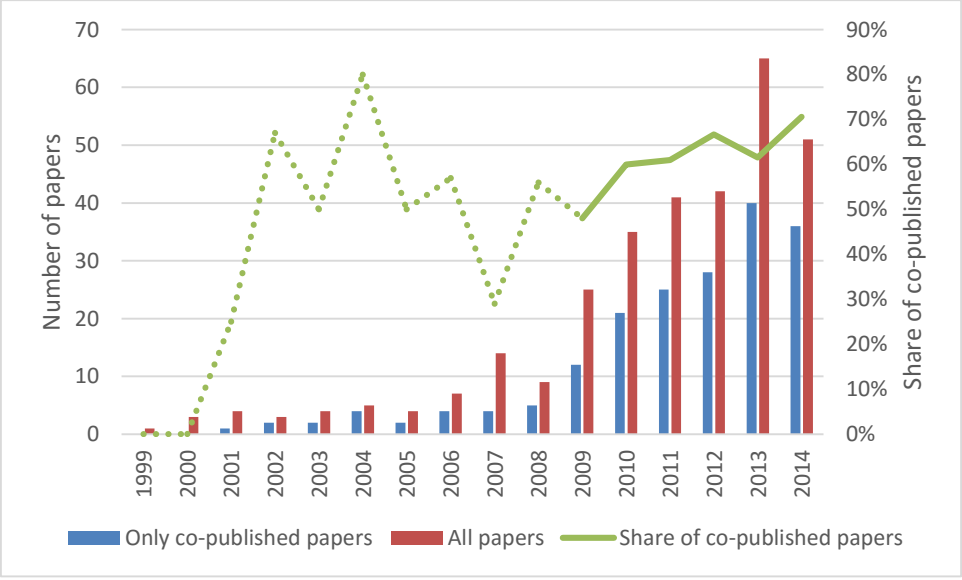

Figure 6 Number of all papers, of all co-published papers and share of co-published papers (papers listed more than 1 organisation). 1999-2014.

Source: NIFU. Thomson Reuters Web of Science.

During the 2009-2014 period, 37 per cent of the papers were published by researchers affiliated to just one organisation. Another third of the papers (36 per cent) had two organisations listed and 15 per cent of the papers listed three organisations. Figure 7 below shows the development of the distribution of the number of organisations listed for all 259 papers. We find a few articles with more than five different collaborating organisations. The following section presents a social network analysis of the co-publications.

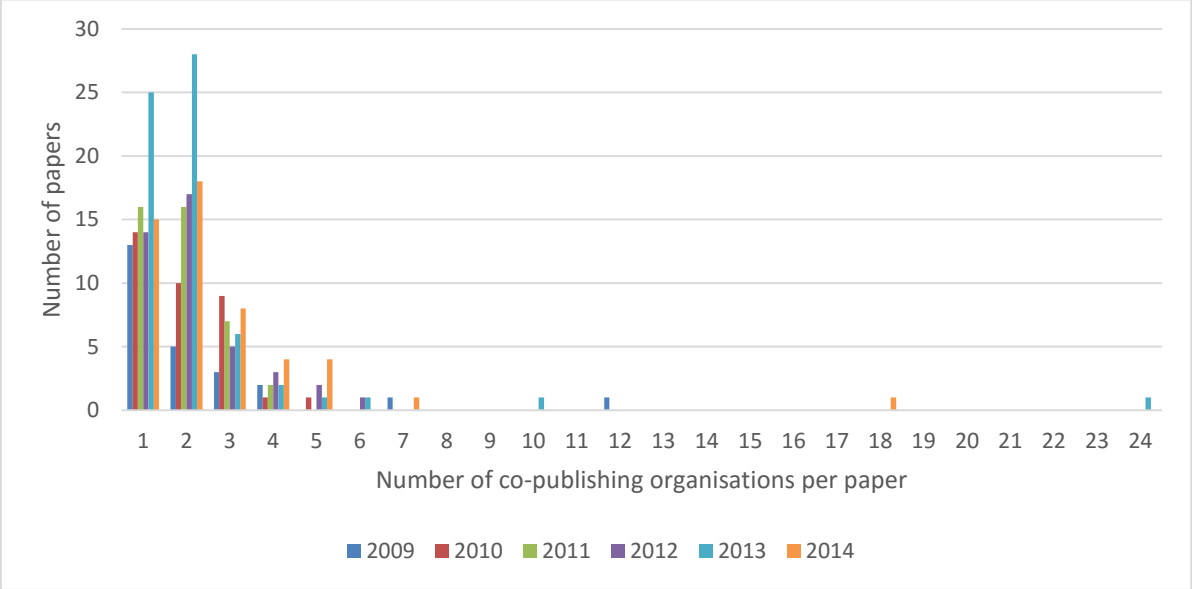

Figure 7 Distribution of the number of co-publishing organisations per paper. 2009-2014.

Source: NIFU. Thomson Reuters Web of Science.

3.1.2 Social Network Analysis of co-published articles

The following analysis uses co-published papers as a proxy for collaboration. As written earlier, 259 WoS indexed papers published in the 2009-2014 period are included. 63% of these (162 papers) had more than one address and they are used for the Social Network Analysis. All together they represent authors from 216 unique organisations.

Social network analysis (SNA) techniques were applied to measure the centrality of different organisations in the networks, such as degree centrality. Degree centrality is defined as *the number of links that a node has*.[14] The links are established through the co-publications. The indicators are calculated with the help of UCINET 6 developed by Borgatti, Everett, and Freeman.[15]

In the 2009-2011 period 58 papers were published (124 organisation names) and between 2012-2014: the number almost doubled to 104 papers (162 organisation names). In order to analyse the 2009-2014 development more closely, we divided the articles into two 3-year periods: 2009-2011 and 2012-2014. Because we had an hypothesis that both publishing and co-publishing increased with the start of the FME centres, we analysed the preceding 10-years period 1999-2008 and added this to the report.

In the following we summarise the main picture for three different periods. In order to demonstrate the main changes in the structure of networks we present below three simplified network graphs. The complete SNA graphs are given in the appendix (annex 5- annex 9). The network graphs were based

[14] Borgatti, S.P. Centrality and network flow. Soc. Netw. **2005**, 27, 55–71.
[15] Borgatti, S.P.; Everett, M.G.; Freeman, L.C. Ucinet for Windows: Software for Social Network Analysis; Analytic Technologies: Lexington, KY, USA, 2002.

on degree centrality measures and created with NetDraw developed by Borgatti.[16] There we give the main overview including also the smaller sub-networks, and then we zoom in on the main network for the two latter periods. Table 6 about the changes of degree centrality for the main organisations in the different periods give more accurate information.

Figure 8 summarises the development of the co-publishing networks over time and illustrates the development from a very early and fragmented stage in the first two periods to a stage where almost all actors are somehow connected to each other and where higher education institutions are most central. This graphic presentation is simplified as it does not provide the names of different actors in the network. The complete information is given in the appendix (annex 5- annex 9) where the organisations are named. In all figures the foreign organisations are also all marked with blue, while Norwegian higher education institutions are coloured with yellow, Norwegian research institutes with orange and Norwegian companies with green.

[16] Borgatti, S.P. NetDraw: Graph Visualization Software; Analytic Technologies: Lexington, KY, USA, 2002.

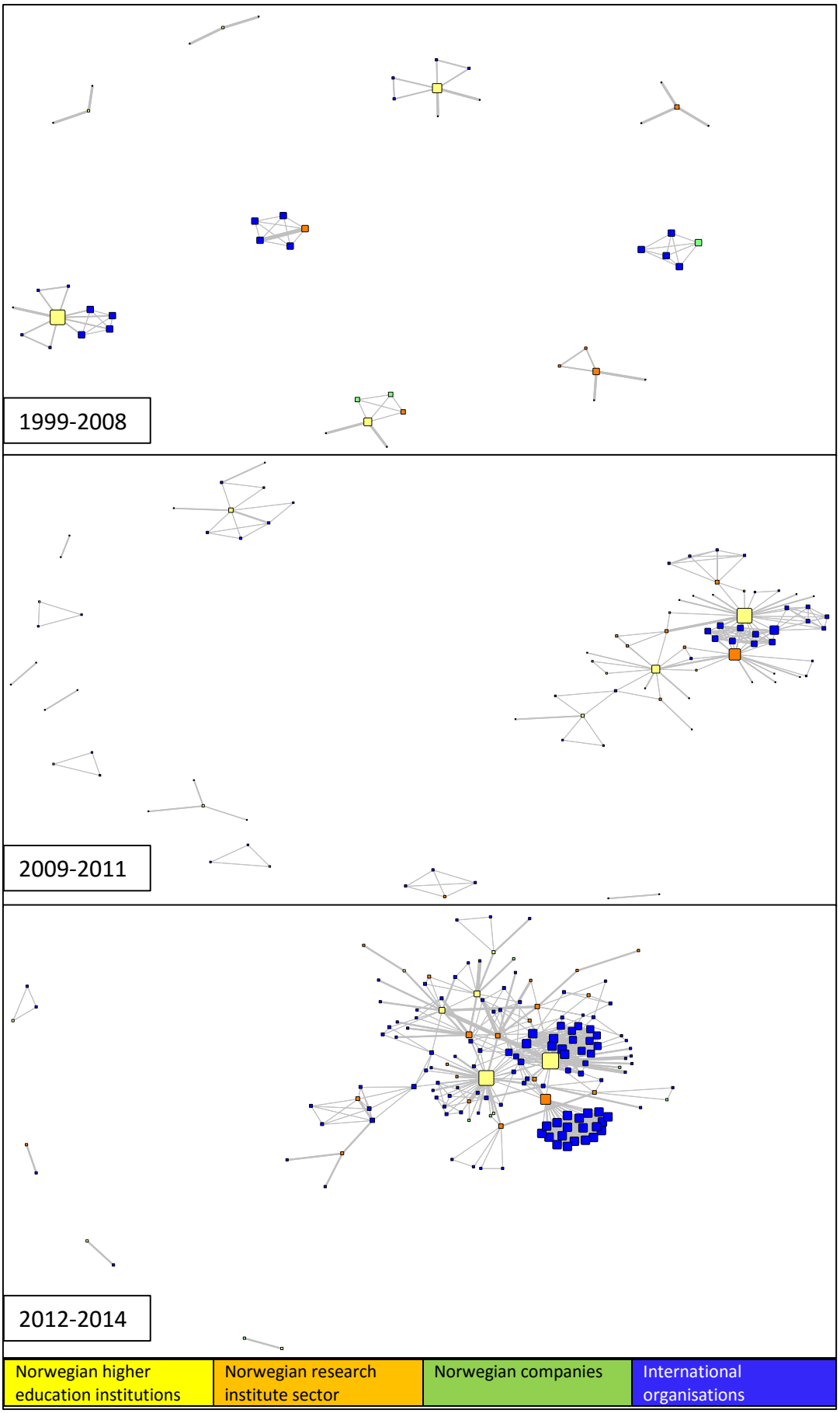

Figure 8 Simplified Social Network Analysis of the main co-publishing network.1999-2008, 2009-2011, 2012-2014, based on degree centrality

Period 1999-2008

This long period was characterised by low publication activity (54 papers in ten years), and also a lower share of co-publishing (24 papers, share of 44%) compared to the latter periods. The social network analysis reveals strong fragmentation: there exist nine small networks, which are not connected to each other. The smallest networks consist of three nodes and the largest of ten nodes. The main Norwegian higher education institutions active in the field established each their own small collaboration network mostly with foreign partners, but did not collaborate with each other: NTNU, NMBU, BI and University of Bergen. University of Oslo collaborated only with national partners. In addition, there existed networks around several of the Norwegian research institutes: Statistics Norway collaborating mainly with other national research institutes, CICERO, and NIFU STEP, which both collaborated mainly with foreign research partners. There were only very few companies involved in the co-publishing networks: Statkraft and Statnett co-published with University of Oslo, and Det Norske Veritas established its own network with several foreign partner organisations.

Period 2009-2011

This 3-years period was characterised by an increased publication activity (101 papers in three years), and also a higher share of co-publishing (58 papers, share of 57%) compared to the first period. The social network analysis reveals two trends: a formation of one large main network and a fragmentation into ten smaller networks, which were not connected to each other. The smallest networks consisted of two nodes. Several of the main Norwegian higher education institutions active in the field, such as NTNU, University of Oslo, and NMBU started collaboration in a larger national and international setting, involving more national research institutes and foreign partners. However, the universities did not co-publish that much with each other. University of Oslo established a strong partnership with Cicero. New actors entered the field, such as University of Stavanger, Agder University, IFE, Sintef, SIFO, Western Norway Research, TØI, NUPI, Norwegian Meteorological Institute, Molde Research and several university colleges. There were some more, but still very few companies involved in the co-publishing networks: Statoil and Petoro collaborated with Stavanger University, Xgria with NMBU, Hokh with University of Oslo and Agder University, and Gexcon collaborated with international partners. Central international research partners in the main network were the University of Copenhagen, Lund University and the World Bank.

Period 2012-2014

The last 3-years period was characterised by a further increase of the publication activity (158 papers in three years), and also a higher share of co-publishing (104 papers, share of 66%) compared to the first two periods. The social network analysis reveals two trends: an expansion of the large main network including more nodes and linkages (Table 6) and inclusion of most of the former separated smaller networks. Only four small networks with two or three nodes each remained disconnected to the large network. Main actors in the large network were NTNU, NMBU, Statistics Norway, University of Oslo, CICERO, NHH, NINA and Ragnar Frisch Centre – all belonging to one of the FME centres.[17] Especially the more central position of NMBU should be highlighted here (from a small 3-nodes network in the first period, to the 7th position in the second period, and finally at the second position – compare Table 6).

[17] The article addresses included with few exception no information about the FME centre the respective organisation was affiliated to. Such information is included under Acknowledgements and is not standardised.

Table 6 Change of centrality of the thirty main actors from 2009-2011 to 2012-2014, based on degree centrality.

2009-2011				2012-2014			
Place	Organisation and country	Degree	Share	Place	Organisation and country	Degree	Share
1	NTNU, Norway	5,726	0,116	1	NTNU, Norway	8,860	0,093
2	CICERO, Norway	3,833	0,077	2	NMBU, Norway	7,432	0,078
3	Univ Oslo, Norway	3,333	0,067	3	SSB, Norway	5,750	0,060
4	Univ Bergen, Norway	1,917	0,039	4	Univ Oslo, Norway	4,833	0,051
5	IFE, Norway	1,583	0,032	5	CICERO, Norway	3,533	0,037
6	Univ Stavanger, Norway	1,333	0,027	6	NHH, Norway	3,333	0,035
7	NMBU, Norway	1,167	0,024	7	Ragnar Frisch Ctr Econ Res, Norway	2,500	0,026
8	Millennium Inst., USA	1,083	0,022	8	SINTEF Energy, Norway	1,833	0,019
9	Western Norway Res. Inst., Norway	1,033	0,021	9	Western Norway Res Inst, Norway	1,700	0,018
10	Univ Copenhagen, Denmark	0,833	0,017	10	MARINTEK, Norway	1,667	0,017
11	Lund Univ., Denmark	0,700	0,014	11	Fridtjof Nansen Inst, Norway	1,500	0,016
12	World Bank, USA	0,667	0,013	12	Lund Univ, Sweden	1,400	0,015
13	SSB, Norway	0,667	0,013	13	Univ Bergen, Norway	1,333	0,014
14	Univ Sidnet, Australia	0,583	0,012	14	Univ Gothenburg, Sweden	1,250	0,013
15	BI, Norway	0,500	0,010	15	Tech Univ Denmark, Denmark	1,083	0,011
16	Carleton Univ., Canada	0,500	0,010	16	Ostfold Res, Norway	1,033	0,011
17	Cornell Univ., USA	0,500	0,010	17	Appalachian State Univ., USA	1,000	0,010
18	Financial Supervisor Author, Norway	0,500	0,010	18	Univ Tromso, Norway	1,000	0,010
19	Harvard Harvard Univ, USA	0,500	0,010	19	Res Inst Ind Econ IFN, Sweden	1,000	0,010
20	Wave Energy Ctr, Portugal	0,500	0,010	20	Norwegian Water Resources & Energy Directorate, Norway	1,000	0,010
21	Helsinki Univ, Finland	0,500	0,010	21	Oregon State Univ, USA	1,000	0,010
22	Roskilde Univ Ctr, Denmark	0,500	0,010	22	NIFU, Norway	0,900	0,009
23	Norwegian Compet Author, Norway	0,500	0,010	23	CREE, Norway	0,833	0,009
24	Argonne Natl Lab, USA	0,500	0,010	24	World Bank, USA	0,833	0,009
25	Xrgia AS, Norway	0,500	0,010	25	TØI, Norway	0,750	0,008
26	Purdue Univ, USA	0,500	0,010	26	Aalborg Univ, Denmark	0,700	0,007
27	Tohoku Univ, Japan	0,500	0,010	27	Carl von Ossietzky Univ Oldenburg, Germany	0,667	0,007
28	Aalborg Univ, Denmark	0,500	0,010	28	Univ Oxford, UK	0,639	0,007
29	Univ Ibadan, Nigeria	0,500	0,010	29	Columbia Univ, USA	0,633	0,007
30	Vestfold Univ Coll, Norway	0,500	0,010	30	Univ E Anglia, UK	0,589	0,006

Note: The columns Degree give the degree centrality measure and the columns Share give the respective share of the organisation of the total number of nodes in the network.

Source: NIFU. Thomson Reuters Web of Science.

Some of the Norwegian research institutes functioned as important bridges for the national collaboration network, such as CICERO, Statistics Norway, Ragnar Frisch Centre and NINA, while other research institutes collaborated only with international partners, such as Fridtjof Nansen Institute and NIFU and they are part of the large network through their international partners. There were still just a few firms included in the co-publishing network, most prominent Hafslund. The most central international research partners in the main network was Lund University.

Summary

The Social Network Analysis reveals that scientific collaboration has evolved rapidly over the last fifteen years. From a very fragmented and more or less national scenery the Norwegian research organisations active in the field have developed both national and international linkages. The main explanation for this rapid change is networking through FME centres. This development will be strengthened further with the results from FME centres focussing on social science issues. Direct collaboration between the main Norwegian universities is less prominent, while a number of the most central research institutes collaborate with different Norwegian universities. The SNA shows also that involvement of business actors or other types of non-academic actors is much less prominent in social sciences on energy research. This remains an untapped resource for the Norwegian researchers.

3.2 Participation in EU project cooperation

Here we provide an overview of the position of social science research in environmentally friendly energy research within the EU's 7th Framework Programme (FP7) and Horizon 2020 (H2020). These

research funding programmes have been chosen as a focus for this study as we expected Norwegian research actors to be active within these contexts.

Below we address to what extent do the EU research programmes support energy research projects based on social science research approaches or disciplines, also describing the total volume and main areas of research funding for social science research on energy (issues) within the FP7 and H2020.

3.2.1 Data sources and methods

We use data from the European Commission's data warehouse E-Corda. The data contain projects funded by the European Union under FP7, and under H2020. The FP7 data cover the period from 2007 to 2013, while the H2020 data cover (so far) the period from 2014 to 2015.

Both the FP7 data and the H2020 data contain information about participants in signed grant agreements. Grant information is provided for each project, including acronym, project start, project end, title, abstract, programmes (different thematic project activity areas), and costs. For each participant within a project we have information about (among other things) its role (project participant or coordinator), name of institution, country of institution, and costs of institution. Note that the unit in the data of participants is an institution, not a person. In each project there is at least one participating institution. In total there are 135,922 participants in the 25,363 projects in the FP7 data, and 35,359 participants in the 8,598 projects in the H2020 data.[18]

Searches for country of institution and keywords

Our search strategy is based on the assumption that the social science research on energy is conducted in various types of programs, not specifically those within a dedicated social science programme. Consequently, we first identify all Norwegian institutions connected to funded FP7- and H2020 projects. Secondly, we perform keyword searches within this sample of projects thematically to energy, and make sure to include projects in the FP7-programme denoted "Energy" as well as the H2020 programme "Energy: secure, clean and efficient energy programme. Finally, we search for social science related research within this sample of funded projects.

In the electronic searches and manual assessment of project descriptions targeting the project title and abstract information, we apply a broad search strategy, including relevant EU-projects with one or more Norwegian addresses. This is also the case for the available database information on «action types». Funded FP7- and H2020-projects are all included in our sample regardless of the type of research and innovation actions. We have chosen this approach since we don't have access to action type information in the FP7-data, nor any qualitative information on the actual research content of the funded EU projects apart from the title and abstract.

Information about country of institution is used to identify whether there are Norwegian institutions within a project. Based on the FP7 data we find that Norwegian institutions participate (either as a participant or coordinator or both) in 1,498 projects of the 25,363 projects, while there are no Norwegian participating institutions in the remaining 23,865 projects. If we use the H2020 data we find that Norwegian institutions participate (as a participant and/or coordinator) in 383 projects of the 8,598 projects, while there are no Norwegian participating institutions in the remaining 8,215 projects.

In the FP7 data, 76 projects are included in the programme denoted "energy" (among the 1,498 projects where Norwegian institutions are involved). In the H2020 data we find that 33 projects are included in the programme denoted "energy: secure, clean and efficient energy" (among the 383 projects where Norwegian institutions are involved).

Social science research projects on energy may also be included in other programmes than those denoted "energy". We have therefore searched with keywords in all the abstracts among the 1,498

[18] The FP7 data are updated per 11.11.2015, and the H2020 data are updated per 26.02.2016.

projects where Norwegian institutions are involved in the FP7 data, and among the 383 projects where Norwegian institutions are involved in the H2020 data. The keywords are “energy”, “Energy”, and “ENERGY”.[19] Note that each of the keywords may not necessarily be a separate word in an abstract, but may be part of a regular expression.

Based on the FP7 data, we find that at least one of the keywords are included in 217 projects abstracts where Norwegian institutions are involved, but where the projects are not included in the programme denoted “energy”.[20] We continue to examine the abstract for all these 217 projects and 76 projects (i.e. a total of 293 projects), in order to decide whether the project can be classified as a social science research project or not.

In the H2020 data we find that at least one of the keywords are included in 42 projects’ abstracts where Norwegian institutions are involved, but where the projects are not included in the programme denoted “energy”. We continue to examine all these 42 projects and 33 projects (i.e. a total of 75 projects), where we go into the abstract for each project in order to decide whether the project can be classified as a social science research project or not.

Based on the total of 293 projects in the FP7 data and the total of 75 projects in the H2020 data, we have searched with new keywords in the abstracts. These keywords are “society”, “social”, “economy” and “economic”. In order not to restrict the searches, we have required that each abstract includes the keywords “soci” and/or “econom”. The keywords may be part of a regular expression, independent of whether the keywords are written with uppercase or lowercase letters.

Assessment of project abstract information

The strategy of conducting these new keyword searches gives us 157 potential projects in the FP7 data and 30 potential projects in the H2020 data that can be classified as social science research projects with Norwegian institutional addresses. Based on the formulations in each abstract among the 157 potential projects in the FP7 data, we find that 27 projects can be classified as social science research projects, 29 projects are societal relevant but we doubt somewhat whether they can be classified as social science research projects, while the remaining 101 projects cannot be classified as social science research projects at all. Among the 27 projects, each abstract includes the keyword “energy”, while this is not satisfied for 4 projects of the 29 projects.

When we examine each abstract among the 30 potential projects in the H2020 data, we find that 15 projects can be classified as social science research projects, 9 projects are societal relevant but we doubt somewhat whether they can be classified as social science research projects, 1 project (which involves investigating the impact of the Innovation Union) is not relevant, while the remaining 5 projects cannot be classified as social science research projects. Among the 15 projects, each abstract includes the keyword “energy”, while this is not the case for 2 projects of the 9 projects.

The total sample of projects that can be classified as social science research projects with Norwegian institutional addresses therefore consists of 27 projects from the FP7 data and 15 projects from the H2020 data. Table 7 below shows the 27 projects from the FP7 data by programme, and Table 8 shows the 15 projects from the H2020 data by programme.[21]

[19] The statistical software package Stata is used in the data analysis, and this package distinguish between uppercase and lowercase letters.
[20] The same applies to 48 projects among the 76 projects that are included in the programme denoted “energy”, but not for the remaining 28 projects, in the H2020 data.
[21] Among the 15 projects from the H2020 we find that 1 project is within the category “SME instrument phase 1”, 1 project is within the category “Standard EF”, 2 projects are within the category “Innovation action”, 4 projects are within the category “Coordination and support action”, 5 projects are within the category “Research and Innovation action”, and 2 projects are within the category “ERA-NET Cofund”. Based on this information, it is possible to discuss whether all these 15 projects can be classified as research projects, but we include them all in the analysis in this section.

Table 7 The 27 projects from the FP7 data that can be classified as social science research projects with Norwegian institutional addresses, by programme (costs in € million)

Programme	Number of projects	Total costs		EC costs contribution	
		Sum	Average	Sum	Average
ENERGY: Energy	6	40.011	6.669	26.566	4.428
ICT: Information and Communication Technologies	5	24.734	4.947	18.091	3.618
SME: Research for the benefit of SMEs	2	2.532	1.266	1.936	0.968
KBBE: Food, Agriculture, and Biotechnology	3	24.575	8.192	18.491	6.164
ENV: Environment (including Climate Change)	5	30.658	6.132	23.487	4.697
SP1-JTI: Joint Technology Initiatives (Annex IV-SP1)	2	87.366	43.683	14.590	7.295
SSH: Socio-economic sciences and Humanities	1	10.159	10.159	7.945	7.945
PEOPLE: Marie-Curie Actions	1	3.580	3.580	3.580	3.580
INFRA: Research Infrastructures	1	26.572	26.572	19.000	19.000
SiS: Science in Society	1	4.590	4.590	3.961	3.961
Total	27	254.775	9.436	137.647	5.098

Table 8 The 15 projects from the H2020 data that can be classified as social science research projects with Norwegian institutional addresses, by programme (costs in € million)

Programme	Number of projects	Total costs		EC costs contribution	
		Sum	Average	Sum	Average
ENERGY: Secure, clean and efficient energy	8	111.397	13.925	49.070	6.134
SECURITY: Secure societies – Protecting freedom and security of Europe and its citizens	2	10.680	5.340	9.846	4.923
MSCA: Marie Sklodowska-Curie actions	1	0.196	0.196	0.196	0.196
INFRA: Research infrastructures	1	8.884	8.884	8.494	8.494
ADVMANU: Advanced manufacturing and processing	1	5.494	5.494	5.494	5.494
ICT: Information and Communication Technologies	1	4.984	4.984	4.984	4.984
ENV: Climate action, environment, resource efficiency and raw materials	1	7.458	7.458	7.458	7.458
Total	15	149.094	9.940	85.543	5.703

From Tables 7 and 8 we see that more than half of the H2020 projects are within energy programmes, while this is only the case for about one of four of the FP7 projects.

In the Appendix we give detailed information about the 27 projects from the FP7 data and the 15 projects from the H2020 data that can be classified as social science research projects. Below we describe the total volume and main areas of research funding for social science research on energy (issues) within the FP7 and H2020. We also give a presentation of which other countries than Norway that are included in these projects, and which Norwegian institutions that are included in these projects.

3.2.2 Average total costs and average EC cost distribution of projects

We have also examined the total costs and EC costs contribution for each of the 27 FP7 projects and the 15 H2020 projects (see the Appendix). We find that the average total costs among the 27 FP7 projects are € 9.436 million, while the average EC costs contribution of total costs are € 5.098 million. These average costs are higher than the corresponding average costs for the 374 projects in total within the programme denoted "energy": the average total costs are € 8.406 million and the average EC costs contribution is € 4.895 million. A major project within the programme denoted "SP1-JTI: Joint Technology Initiatives (Annex IV-SP1)" has € 67.539 million in total costs and € 11.279 million in EC costs contribution. If we exclude this project from the calculations as an outlier, we find that the average total costs are € 7.201 million and the average EC costs contribution is € 4.860 million among the remaining 26 projects.

Among the 15 H2020 projects we find that the average total costs are € 9.940 million, while the average EC costs contribution is € 5.703 million. These average costs are much higher than the corresponding average costs for the 472 projects in total within the programme denoted "ENERGY: Secure, clean and efficient energy": the average total costs are € 3.876 million and the average EC costs contribution is € 2.848 million. The main reason is that three of the projects within the energy programme have between € 26 and 44 million in total costs and between € 9 and 20 million in EC costs contribution. If we exclude these three project from the calculations, we find that the average total costs are € 4.103 million and the average EC costs contribution is € 3.987 million among the remaining 12 projects. Among the remaining 469 projects within the energy programme we find that the average total costs are € 3.688 million and the average EC costs contribution is € 2.786 million.

3.2.3 Countries and the Norwegian institutions involved in the projects

Figure 9 shows which other countries than Norway that are included in the 27 FP7 projects and the 15 H2020 projects. Note that there may be at least two institutions involved in one of these projects that are from the same country, but in the figure we have only counted each country in each project once. If, for example, there are three German institutions in a project, we have only counted Germany once in the project. We see from Figure 10 that Norwegian institutions corporate most with institutions from Spain (ES), United Kingdom (UK), France (FR), Italy (IT), Germany (DE), the Netherlands (NL) and Belgium (BE) in social science research projects. The figure shows that most countries are only included once or twice in the 27 FP7 projects and the 15 H2020 projects.

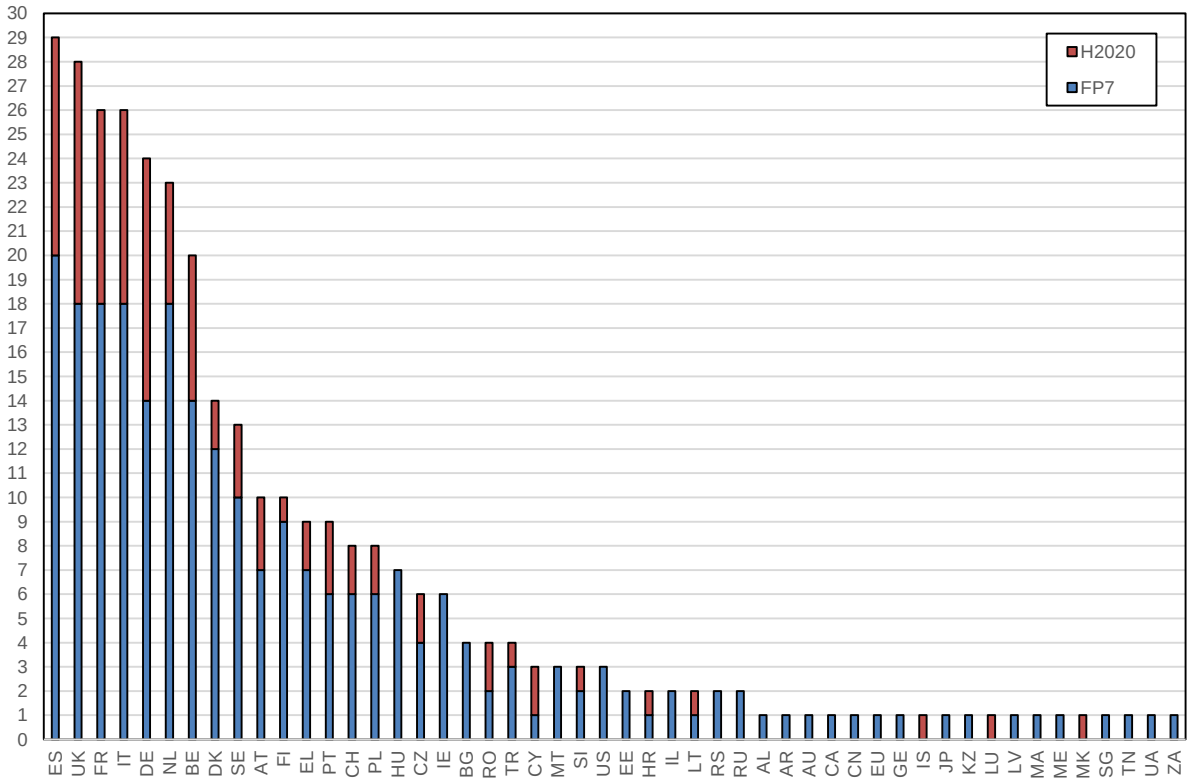

Figure 9 Countries other than Norway included in the 27 FP7 projects and the 15 H2020 projects.

Note: In the figure we have only counted each country in each project once.

In Figure 10 we give a detailed presentation of which Norwegian institutions that are included in the 27 FP7 projects and the 15 H2020 projects. We see from the figure that we find both private enterprises and public institutions (including research institutions and universities) among these institutions. Most of the Norwegian institutions are only included in one project. The institutions that are included in most projects are: Stiftelsen SINTEF are included in 9 different projects, SINTEF Energy AS are included in 5 different projects, NTNU Norges teknisk-naturvitenskapelige universitet (Norwegian University of Science and Technology) are included in 4 different projects, and Universitetet i Bergen (University of Bergen) are included in 3 different projects.

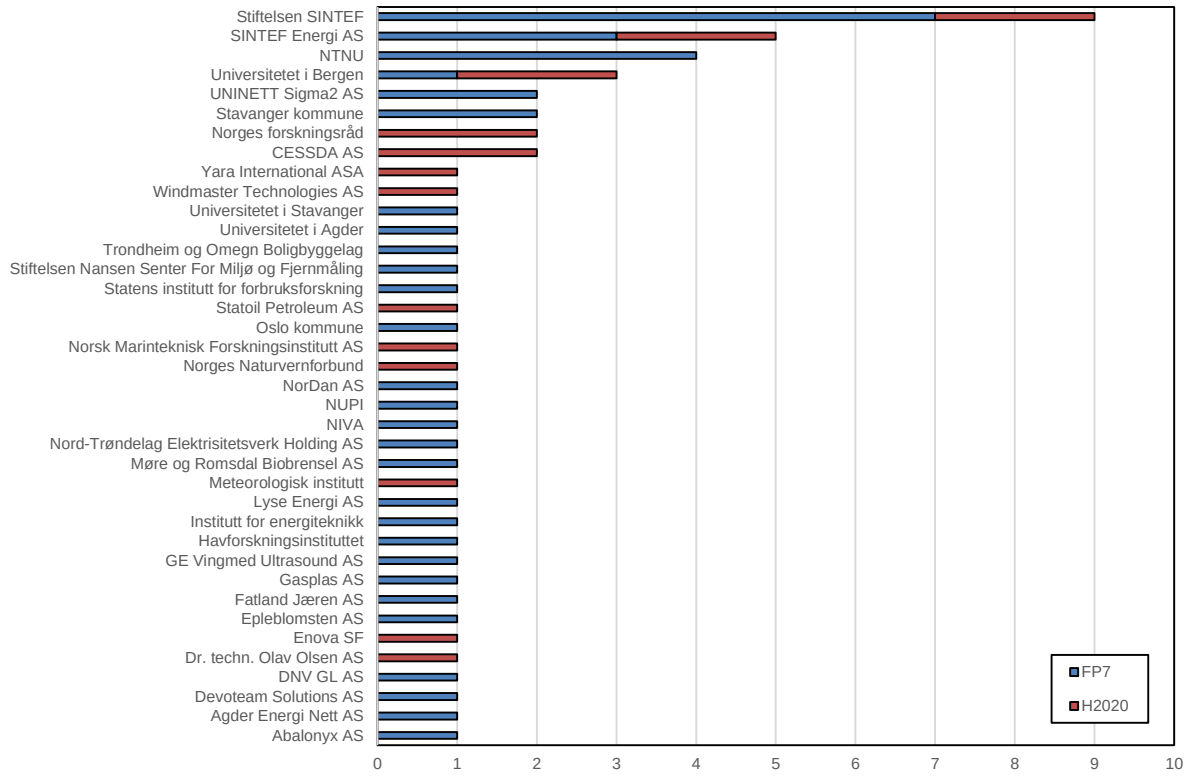

Figure 10 The Norwegian institutions that are included in the 27 FP7 projects and the 15 H2020 projects.

3.3 Summary and main findings

In this chapter we have addressed international co-publishing of Norwegian researchers within social science research on energy – as well as researcher cooperation in this field of study through mutual research projects, such as the EU framework program FP7 and Horizon 2020.

Applying bibliometric as well as register data on EU project cooperation, we have been trying to answer the following research question: *How do the Norwegian and international researchers in this field of research cooperate through mutual/common publications and research projects, such as Horizon 2020?*

We have seen that the level of international co-publishing of scientific articles is quite high: 162 peer reviewed papers (63 per cent) out of a total of 259 units identified in the 2009-2015 period, had more than one address and was used in our Social Network Analysis (SNA). All together they represent authors from 216 unique organisations, including 153 foreign and 63 Norwegian institutions. Also, the country addresses registered for the article sample reveal that researchers from the USA, Germany, UK; Netherlands, Denmark and Sweden are most important for international co-publishing.

Furthermore, the SNA reveals that scientific collaboration has evolved rapidly over the last fifteen years. From a very fragmented and more or less national scenery the Norwegian research organisations active in the field have developed both national and international linkages. However, we find that direct collaboration between the main Norwegian universities is less prominent, while a number of the most central research institutes collaborate with different Norwegian universities. The SNA also shows that involvement of business actors or other types of non-academic actors is much less prominent in social sciences on energy research.

Main actors in the large network identified in the 2012-2015 period were NTNU, NMBU, Statistics Norway, University of Oslo, Cicero, NHH, NINA and Ragnar Frisch Centre – all belonging to one of the

FME centres. Especially NMBU holds the more central position in the last starting out as a small 3-nodes network in the 1998-2008 period.

This chapter have also analysed *how the Norwegian and international researchers in this field of research cooperate through mutual/common research projects within the EU framework programmes FP7 and Horizon 2020.* The main findings here include that

- The total sample of projects that can be classified as social science research projects consists of 27 projects from the FP7 data and 15 projects from the H2020 data.
- More than half of the relevant H2020 projects are found within the programme denoted "ENERGY: Secure, clean and efficient energy". In addition, we find a large project of interest within the programme denoted ENV: Climate action, environment, resource efficiency and raw materials.
- 3 of the FP7 projects and 6 of the selected H2020 projects, had Norwegian coordinator. They represented SINTEF, SINTEF Energy, University of Bergen, Yara International ASA and Windmaster technologies.
- The average total costs among the 27 FP7 projects are € 9.436 million, while the average EC costs contribution of total costs are € 5.098 million.
- Among the 15 H2020 projects we find that the average total costs are € 9.940 million, while the average EC costs contribution is € 5.703 million.
- Also small scale H2020 project (MSCA Marie Sklodowska-Curie scholarship with one participant (Norwegian) only and total cost/ EC cost contribution of € 0.196 million is found in the project portfolio. Another, Norwegian H2020 project has a EC cost contribution of € 0.050 million.
- We find both private enterprises and public institutions from Norway (including research institutions and universities) among these institutions. Most of the Norwegian institutions are only included in one project. The most frequently found institutions are: Stiftelsen SINTEF (included in 9 different projects), SINTEF Energy (included in 5 different projects), NTNU Norwegian University of Science and Technology (included in 4 different projects), and University of Bergen (included in 3 different projects).
- A total of 9 projects had Norwegian coordinator, mainly from research institutes and companies. They represented mainly SIFO, SINTEF, SINTEF Energy, University of Bergen, Yara International ASA as well as Windmaster technologies.
- Norwegian institutions corporate most with institutions from Spain (ES), United Kingdom (UK), France (FR), Italy (IT), Germany (DE), the Netherlands (NL) and Belgium (BE) in the EU PF7 and H2020 social science research projects on energy.

In general, we find that the EU research programmes support quite a few research social science research projects on energy with Norwegian participation, nine of them with Norwegian coordinator and the remaining 36 with a coordinator from another European country. Also, we find that Norwegian private companies (15 different mainly small and medium-sized companies) among the 42 selected projects). This finding points to the more development oriented nature of this project portfolio.

4 R&D expenditure for Norwegian social science research on energy

This chapter addresses the volume and main areas of research funding for social science research on energy – applying both R&D statistics as well as well as register data for the Research Council of Norway. Here, we also identify the main research organisation in the field of study based on reported R&D expenditures devoted to energy research in the field.

4.1 Mapping social science in energy through R&D statistics

This section describes an attempt to map the distribution and amount of social science on energy in the Norwegian R&D system. As energy-related R&D is not captured through conventional categories in R&D-statistics, this exercise must be considered an explorative mapping with several reservations, in particular regarding the total amounts of energy-related social science. Nevertheless, the Norwegian R&D statistics allows for a novel approach to identify central actors in this area, both in the higher education sector and among research institutes.

4.1.1 Energy as a thematic category in Norwegian R&D statistics

Since 2007, the Norwegian collection of R&D statistics have included additional questions aimed at capturing R&D activities related to specific policy priorities. One of these priorities is the broad category of R&D related to “global challenges”, which was introduced in the statistical survey from 2009. This broad category includes the following 8 sub-categories:

1. **Renewable energy**
2. **Other environmental energy**
3. **Petroleum research**
4. **Carbon capture and storage (CCS)**
5. **Other energy research**
6. Other climate research and climate technology
7. Other environmental research
8. Development research

In practice, R&D performers are asked to indicate the amount of their R&D expenditures which is devoted to global challenges and specify this share on the eight sub-topics listed above. The sum of these eight topics should be 100%, which means that the sub-categories are mutually exclusive.

From the list above, topic 1-5 (in bold) seem directly relevant for energy research, while topic 6-8 are more indirectly related to energy research. Figure 11 below shows the total amounts of Norwegian R&D expenditure that was assigned to these first five energy related sub-categories in 2014/13.

In total, R&D related to energy amounts to 10,4 bill. NOK, which accounts for nearly 20 per cent of total R&D spending in Norway. The aggregate data reveals a clear emphasis on petroleum research. The total amount of R&D devoted to this area alone is higher than the sum of the four other energy-related topics.

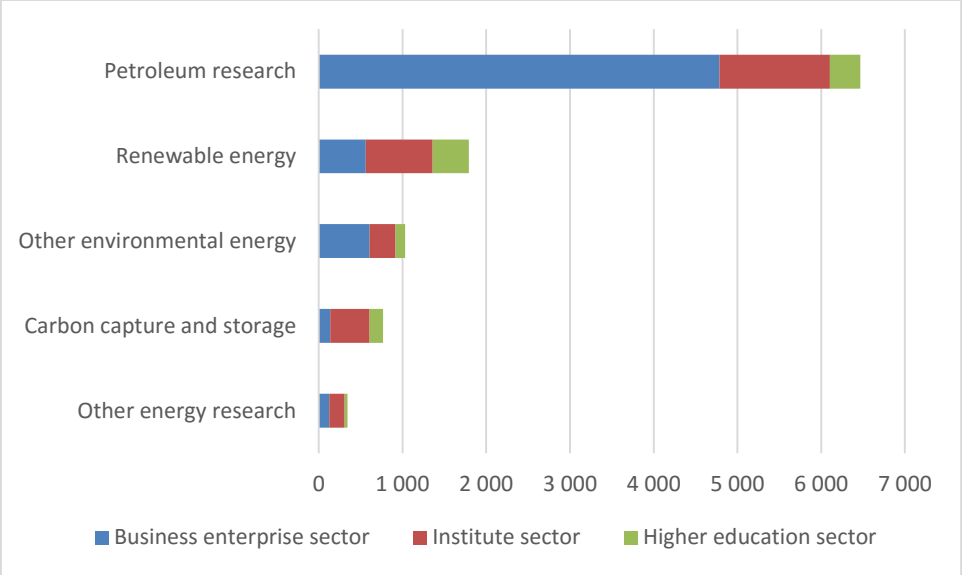

Figure 11 Energy-related R&D expenditure in Norway by type of energy and sector. Mill. NOK 2014/2013(1).

Note: 1) Data for higher education institutions are from 2013.
Source: NIFU/R&D statistics

Figure 11 also shows the repartition of various forms of energy R&D by performing sectors. We see that petroleum related R&D is by far the most important area of energy research in the industry sector, which is not surprising given the strong position of the oil and gas sector in the Norwegian economy. Research institutes stand for the largest share of R&D within renewable energy, although petroleum research is in total slightly more important also for the research institutes.

The relatively equal balance between petroleum research and renewable energy within the institute sector may indicate that this sector can play a central role in the transition from fossil to renewable energy sources. For higher education institutions, renewable energy research seems slightly more important than petroleum research, but both areas account for significantly lower amounts of R&D expenditure than in the institute and business enterprise sectors.

4.1.2 The social science aspect in energy-related R&D

While the overview above gives a general picture of energy R&D in Norway, the question remains how much of this R&D can be classified as social science? In order to identify this aspect, we combine data on energy-related R&D in general with data on the disciplinary profile of research performing entities in the institute sector and in the higher education sector. The business enterprise sector is excluded from this exercise, since there are no data which can indicate the share of social science in the R&D portfolio of companies. In line with the focus on environmentally friendly energy in this report, we also exclude petroleum R&D from this part of the analysis.

More specifically, we identify research institutes and departments within higher education institutions that fulfil the following criteria:

a) reports some amounts of R&D related to one or more of the energy-related R&D-topics
   - ✓ Renewable energy
   - ✓ Other environmental energy
   - ✓ Carbon capture and storage (CCS)
   - ✓ Other energy research

b) reports that social sciences constitute a substantial/major share of the disciplinary profile of the unit in question.

Thus defined, we are able to identify 27 departments and research units at Norwegian higher education institutions and 30 research institutes which all to some degree appear to be involved in social science research on energy according to their R&D reports in 2013/2014. The figure below shows the total amounts of R&D on energy R&D and the total estimated share of social science derived from these 57 institutions.

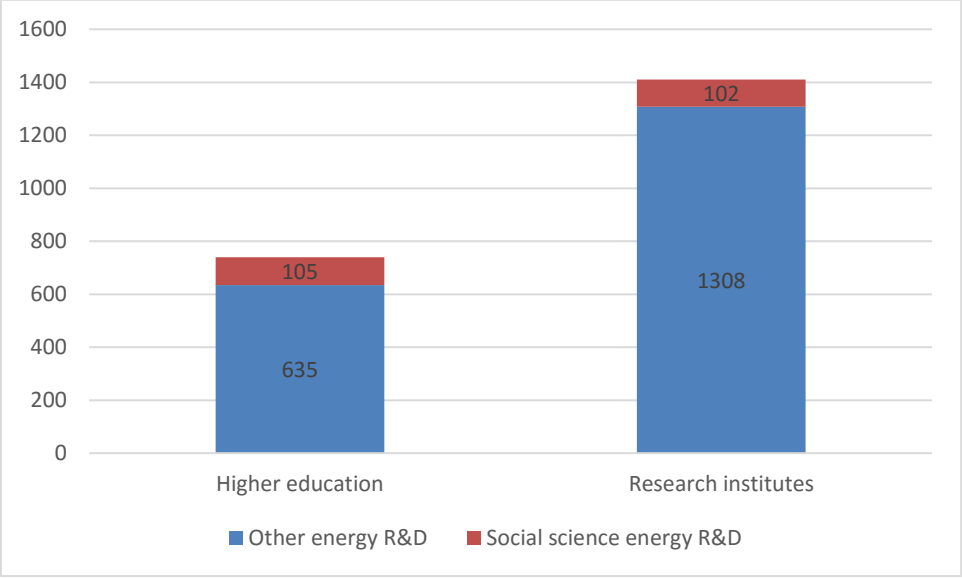

Figure 12 Energy-related R&D in Norway by sector and share of social science. Mill. NOK 2014/2013.

Note: Energy R&D includes here R&D within the following areas: i) renewable energy, ii) other environmental energy, iii) carbon capture and storage (CCS) and iv) other energy research. Petroleum R&D is not included.

Source: NIFU/R&D Statistics

These estimates indicate that just above 100 million NOK is spent on social science on energy in each of the two sectors, which amounts to about 14 per cent of total energy R&D in the higher education sector and around 7 per cent in the institute sector. The relatively low share of social science in the institute sector is probably mostly due to the fact that technical industrial research institutes are major players in this sector in Norway. Many of these institutes are heavily involved in energy-related R&D but report little or no R&D activities within social science. There is, however, reason to assume that several of these institutes also perform some degree of social science, which again means that the amounts for social science on energy for research institutes must be considered as rather conservative estimates.

4.1.3 Social science on energy by performing unit

The table below shows all units in the institute sector that both reported energy R&D and a substantial share of social science. The table also includes some large institutes with high shares of energy-related R&D but no reported activity in social science. As mentioned above, there is reason to expect that these institutes also perform some social science on energy, which is also confirmed in the bibliometric study presented in chapter 2.

Table 9 Norwegian research institutes which reported environmentally friendly energy-related R&D activities and a substantial/assumed share of social science. Percentage of total R&D in 2014.

Institutes with a substantial share of social science activity	Environmentally friendly energy as share of total R&D
ØSTFOLDFORSKNING	47 %
NORUT - SAMFUNNSVITENSKAPELIG DEL	26 %
SENTER FOR KLIMAFORSKNING – CICERO	20 %
STATENS INSTITUTT FOR FORBRUKSFORSKNING	16 %
FORSKNINGSSTIFTELSEN FAFO	14 %
NORSK INSTITUTT FOR LANDBRUKSØKONOMISK FORSKNING (NIBIO from 2015)	13 %
STATISTISK SENTRALBYRÅ	10 %
SNF - SAMFUNNS- OG NÆRINGSLIVSFORSKNING	7 %
VESTLANDSFORSKING	6 %
NORUT ALTA	5 %
STIFTELSEN FRISCHSENTERET FOR SAMFUNNSØKONOMISK FORSKNING	5 %
TRØNDELAG FORSKNING OG UTVIKLING	5 %
ØSTLANDSFORSKNING AS	5 %
IRIS - SAMFUNNS- OG NÆRINGSUTVIKLING	3 %
NORSK UTENRIKSPOLITISK INSTITUTT	3 %
FRIDTJOF NANSENS INSTITUTT	3 %
TRANSPORTØKONOMISK INSTITUTT	3 %
MØREFORSKING	2 %
NORDLANDSFORSKNING	2 %
NORDISK INSTITUTT FOR STUDIER AV INNOVASJON, FORSKNING OG UTDANNING	2 %
INSTITUTT FOR FREDSFORSKNING	1 %
UNI ROKKANSENTERET	1 %
Institutes with low or assumed share of social science activity	**Environmentally friendly energy as share of total R&D**
SINTEF ENERGI AS	67 %
INSTITUTT FOR ENERGITEKNIKK	48 %
STIFTELSEN SINTEF	17 %
UNI MILJØ	16 %
NORSK INSTITUTT FOR VANNFORSKNING	16 %
SINTEF PETROLEUM AS	14 %
IRIS - INTERNATIONAL RESEARCH INSTITUTE OF STAVANGER	13 %
NORSK INSTITUTT FOR NATURFORSKNING	13 %

Note: 1) Environmentally friendly Energy R&D includes here R&D within the following areas: i) renewable energy, ii) other environmental energy, iii) carbon capture and storage (CCS) and iv) other energy research. Petroleum R&D is not included. 2) For reasons of confidentiality, data on amounts of R&D for individual units are not published. Source: NIFU/R&D Statistics

The list of research institutes shows that social science on energy is performed in a wide range of institutes, including i) social science institutes, ii) environmental institutes, iii) regional institutes and iv) technical industrial research institutes. As one might expect, the share of energy R&D is relatively low for most social science institutes, while the technical industrial research institutes have high shares of energy R&D and low or no shares of social science.

It is important to note that these data are not retrieved from a special survey on environmentally friendly energy, but extracted from the ordinary R&D-survey, where the questions regarding energy related R&D appear together with large set of other questions. By experience, the information reported by respondents in ordinary and encompassing R&D surveys may be less accurate and complete compared with special surveys, where respondents are asked to specifically assess one topic or research field. This is also the case for the data on higher education below.

If we turn to the Higher education sector, the data on energy R&D and degree of social science can be broken down on the level institutes and departments. As mentioned above, the 2013[22] data identifies 25 units which reported energy-related R&D activities and a substantial share of social science.

Table 10 Norwegian Higher education institutes which reported environmentally friendly energy-related R&D and a substantial share of social science. Share of unit's total R&D in 2013.

Institute/department	Institution	Environmentally friendly energy as share of total R&D
Institutt for tverrfaglige kulturstudier	NTNU	51 %
Senter for teknologi, innovasjon og kultur (TIK-senteret)	UNIVERSITETET I OSLO	35 %
Institutt for internasjonale miljø- og utviklingsstudier, Noragric	NMBU	26 %
Institutt for industriell økonomi og teknologiledelse	NTNU	25 %
Senter for utvikling og miljø	UNIVERSITETET I OSLO	20 %
Avdeling for samfunnsfag	HØGSKOLEN I SOGN OG FJORDANE	20 %
Institutt for landskapsplanlegging	NMBU	18 %
Handelshøyskolen ved UMB	NMBU	18 %
Handelshøyskolen i Trondheim	HØGSKOLEN I SØR-TRØNDELAG	15 %
Institutt for medie-, kultur- og samfunnsfag	UNIVERSITETET I STAVANGER	12 %
Økonomisk institutt	UNIVERSITETET I OSLO	12 %
Institutt for foretaksøkonomi	NORGES HANDELSHØGSKOLE	11 %
Institutt for regnskap, revisjon og jus	HANDELSHØYSKOLEN BI	11 %
Seksjon for økonomi	HØGSKOLEN I GJØVIK	10 %
Institutt for økonomi- og samfunnsfag	HØGSKOLEN I HARSTAD	10 %
Institutt for økonomi	UNIVERSITETET I BERGEN	10 %
Handelshøgskolen i Tromsø	UNIVERSITETET I TROMSØ	10 %
Nordisk institutt for sjørett	UNIVERSITETET I OSLO	10 %
Avdeling for økonomi og organisasjonsvitenskap	HØGSKOLEN I LILLEHAMMER	9 %
Institutt for Diakoni og Ledelse	DIAKONHJEMMET HØGSKOLE	4 %
Institutt for samfunnsøkonomi	NORGES HANDELSHØGSKOLE	4 %
Sosiologisk institutt	UNIVERSITETET I BERGEN	3 %
Institutt for innovasjon og økonomisk organisering	HANDELSHØYSKOLEN BI	2 %
Institutt for økonomisk-administrative fag	HØGSKOLEN I BERGEN	2 %
Institutt for sosiologi og statsvitenskap	NTNU	2 %
Det juridiske fakultet	UNIVERSITETET I BERGEN	2 %
Avdeling for Økonomi, Informatikk og Samfunnsfag	HØGSKOLEN I MOLDE	1 %

Note: 1) Energy R&D includes here R&D within the following areas: i) renewable energy, ii) other environmental energy, iii) carbon capture and storage (CCS) and iv) other energy research. Petroleum R&D is not included. 2) For reasons of confidentiality, data on amounts of R&D for individual units are not published. Source: NIFU/R&D Statistics

[22] In Norway, full R&D surveys are performed every second/odd year for the Higher Education sector and every year for the institute sector and business enterprise sector. Data for research institutes are therefore more recent.

This overview reveals a pattern where the share of energy R&D in social science academic departments varies from above 50 per cent to a few percentages. Furthermore, the list includes a variety of academic profiles, although we see a clear dominance of economic institutes and departments. The names of departments show that 15 of 27 institutes are economic or economically oriented institutes. This profile will be further examined below. On the institutional level we also see a dominance of the largest universities and economically oriented university colleges and specialized colleges.

As amounts of R&D may be published on an aggregate institutional level, the table below shows the amounts of social science on energy by higher education institutions and types of institution for the period 2009-2013.

Table 11 Estimated expenditure in social science on environmentally friendly energy R&D by main institution in higher education sector. Mill NOK 2009-2013

Institution	2009	2011	2013
UNIVERSITETET I BERGEN	1	8	4
UNIVERSITETET I OSLO	15	24	23
UNIVERSITETET I TROMSØ	1	2	3
NORGES TEKNISK-NATURVITENSKAPELIGE UNIVERSITET	18	25	32
UNIVERSITETET FOR MILJØ OG BIOVITENSKAP	18	18	22
UNIVERSITETET I STAVANGER	2	6	2
UNIVERSITETET I AGDER	-	9	-
NORGES HANDELSHØGSKOLE	4	7	5
HANDELSHØYSKOLEN BI	0	1	6
Øvrige vitenskapelige høgskoler m.fl	1	-	0
Statlige høgskoler	8	3	8
Sum	69	103	105

Note: 1) Energy R&D includes here R&D within the following areas: i) renewable energy, ii) other environmental energy, iii) carbon capture and storage (CCS) and iv) other energy research. Petroleum R&D is not included. 2) For reasons of confidentiality, data on amounts of R&D for individual units are not published.

Source: NIFU/R&D-statistics

As the table shows, the Norwegian University of Science and Technology (NTNU) performs almost one third of the higher education sector's total R&D expenditure on social science on energy and is thereby the largest player. This is also in line with the findings from the bibliometric study described in chapter 2 and 3. On the other hand, these data do not reflect the strong increase in publication activity from NMBU which appeared from the bibliometric analysis. According to the R&D expenditure data, NTNU also appears to have the strongest growth in this field of research. Although the accuracy of these data are rather uncertain, the data indicate that NTNU's position was less dominant in the previous surveys conducted in 2009 and 2011, when the R&D efforts devoted to social science on energy was more equal to the level at the University of Oslo and the University of Life Sciences (NMBU).

Of course, some of the annual changes in the table above may be due to organizational changes or uneven reporting of R&D in this field. Nevertheless, it is natural to assume that the strong increase in NTNU's engagement in social science on energy is partly due to the fact that NTNU has been particularly successful in the national competition in various center-schemes and other new funding mechanisms introduced during the recent years. For instance, NTNU and the Trondheim based institute SINTEF are together hosting 11 of 19 Centers of renewable energy (FME) and 19 of a total of 38 Centers of research based innovation (SFI). Many of these centers are oriented towards energy research, and although science and engineering prevail in terms of disciplinary profile, it is likely that

these new funding opportunities also have contributed to an increase in energy-related R&D at social science units. The same may be the case for the University of Oslo and the University of Life Sciences although to a lesser degree than at NTNU.

The latter assumption is strengthened when looking at the shares of energy research at social science institutes in the higher education sector. Again, NTNU appears with the highest share of energy research measured in proportion of the total R&D expenditure within social science research units. For NTNU, this share also seems to have increased substantially compared with the R&D-surveys for 2007-2011.

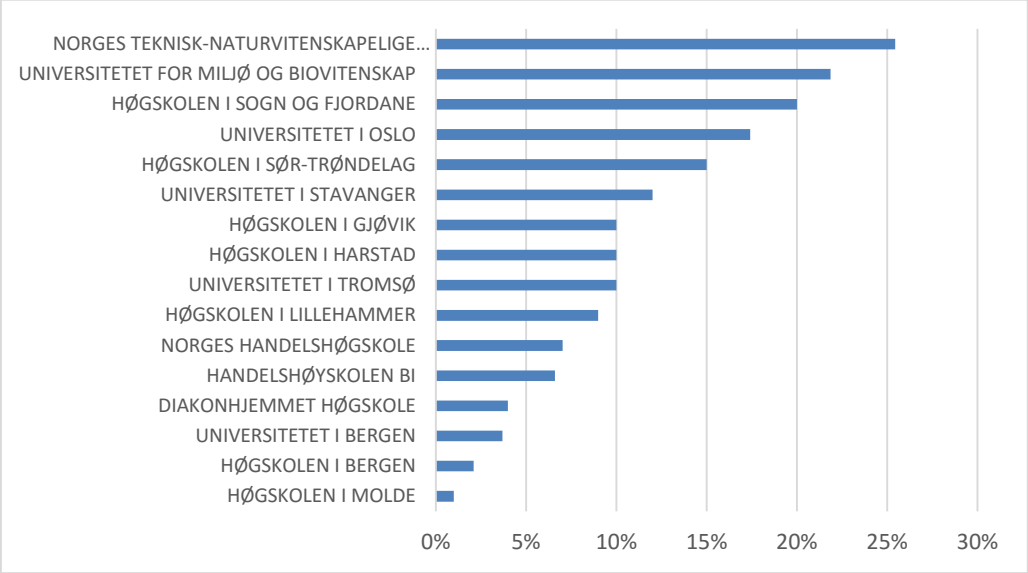

Figure 13 Social science energy research as a share of total R&D expenditure in social science. Mill. NOK by research units in 2013.

Source: NIFU/R&D statistics

4.1.4 Disciplinary profile of social science on energy

Another important question is the disciplinary nature and composition of research units which perform social science on energy in the higher education sector. By combining the data on energy research with the reported disciplinary mix of each unit, we are able to identify the sub-fields of social science which are most frequently linked to social science on energy. Figure 14 below shows the composition in sub-fields of the 103 higher education research units that had reported social science in energy in the years 2007-2013 (of which several units appear in all four years). The bars represent the number of units that reported research activity within each social science sub-field, while the percentages indicate the unit's average share of energy R&D in each particular field.

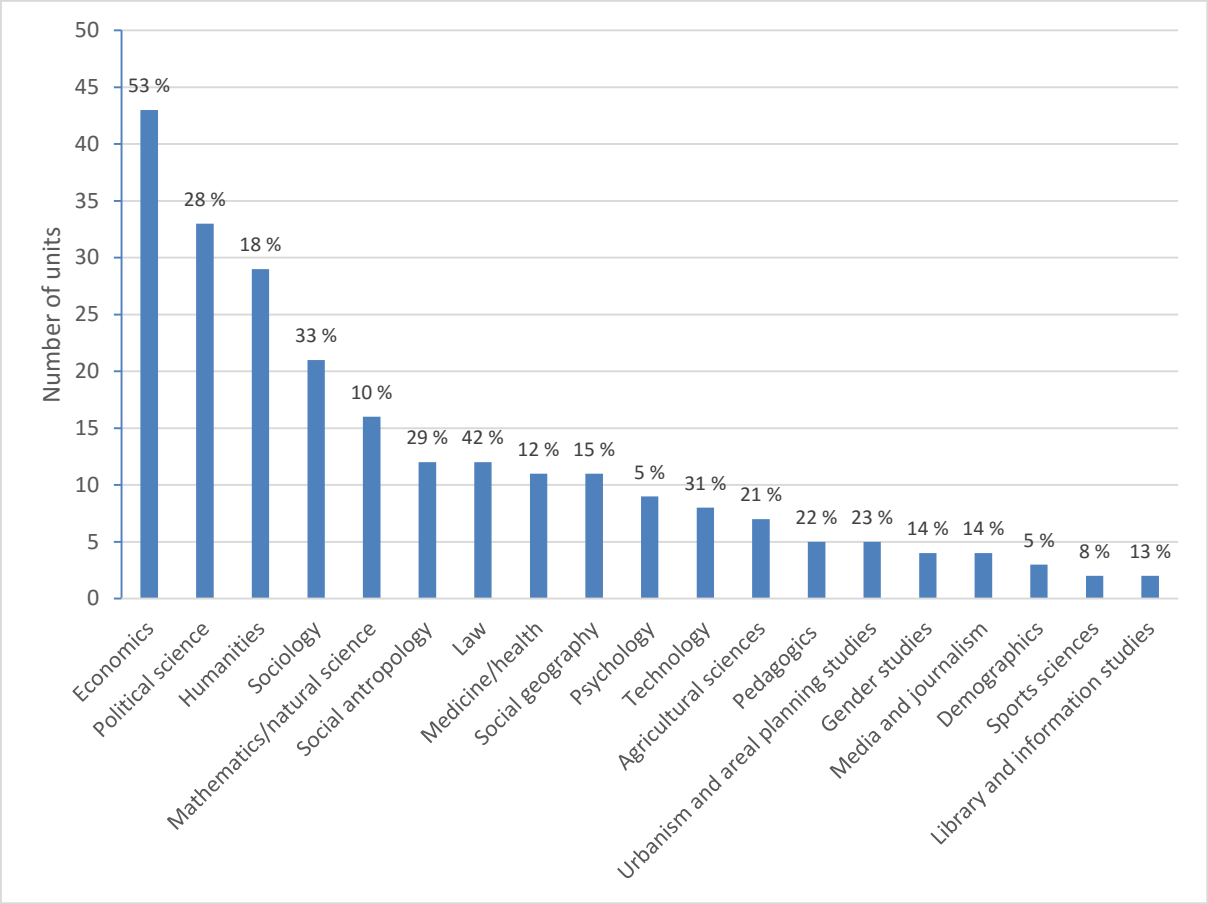

Figure 14 Social science energy research units in higher education sector by sub-fields. 2013.

Source: NIFU/R&D-statistics.

This overview clearly indicates that social science in energy most frequently appears in higher education research units with activity in economics research. As the figure shows, economics is part of the academic profile in 43 units, which means that almost half of all units performing social science on energy have some degree of economics research. Furthermore, the average share of economics in these units is 53 per cent, indicating that a large share of social science in energy has a basis in economics.

Political science is also quite important here, followed by humanities and sociology. It is also worth noting that we find few social science research units with energy-related research that also perform technological research. This finding may indicate that social science on energy represents a distinct research area at universities and university colleges, with few direct links to technology and natural science – at least not in terms of cross-disciplinary research units.

4.1.5 Summary and main findings

Based on a set of additional thematic questions in the Norwegian R&D survey we find that approximately 20 per cent of total R&D spending in Norway is related to energy issues. Not surprisingly, petroleum related R&D stands out as the most important form of energy in this context, especially in industry, but also to a large extent in the research institute sector. R&D related to renewable energy is mostly conducted in the research institute sector.

If we focus on R&D in energy areas outside petroleum R&D, we find that social science constitutes 7 per cent of the energy-related R&D in the institute sector and 14 per cent in the higher education

sector. The share of social science on energy in research institutes is probably underestimated due to lacking reporting of social science in technical industrial research institutes.

In terms performing units, we find 27 institutes and departments in the higher education sector which are assumed to perform social science on energy. In addition, 30 research institutes appear to have such R&D activity, although the number of research institutes may be underestimated due to lacking reports of social science activity.

On an aggregate institutional level, we see that NTNU, the University of Oslo and NMBU are the three major performers of social science on energy. NTNU has shown the highest growth in such R&D for the period 2009-2013 and also seems to have the strongest energy profile in their social science portfolio.

Finally, this overview clearly indicates that social science on energy most frequently appears in higher education research units with activity in economics research. Political science is also quite important here, followed by humanities and sociology. It is also worth noting that we find few social science research units with energy-related research that also perform technological research. This finding may indicate that social science on energy represents a distinct research area at universities and university colleges, with few direct links to technology and natural science – at least not in terms of cross-disciplinary research units.

4.2 Social science research on energy funded by the Research Council of Norway

The Research Council of Norway (RCN) is a major funding source for social science research in Norway, apart from the institutional funding of higher education sector institutions (general university funds). In 2015, total RCN-allocations devoted to social science amounts to more than 1,2 bill NOK, which is 16 per cent of total RCN-funding. Energy is also an important topic in a number of RCN-programmes and instruments. For instance, energy-related R&D (excluding oil and gas) constitutes the largest topic in RCN's portfolio of industry oriented support.

In this part of the study, we seek to identify the share of social science in some of the major RCN programmes related to energy. More specifically, we analyse program portfolio data for the following two major RCN programs in the 2004-2015 period; Clean Energy for the Future, RENERGI, and its successor, the large-scale programme for energy research, ENERGIX. The latter provides funding for research on renewable energy, efficient use of energy, energy systems and energy policy [23]. In addition to this, the three FME-samfunn centres of energy have received annual funding since 2011, in total this amounts to115,4 million NOK in 2011-2015 period [24].

NIFU received portfolio data for the social science research projects in two major RCN programs. The RCN selected the relevant projects. We find that the two research programs RENERGI and ENERGIX have financed a total of 53 projects with a major element of social science research on energy in the 2004-2015 period totalling 242 mill. NOK[25]. 16 of the RENERGI projects allowances mainly included project support and partly personal scholarships. Institute sector institutions stand out as the most frequent project leader, accounting for 10 RENERGI projects in the actual period.

Research institutes also prevail in the portfolio of the 37 ENERGIX projects which have been funded from 2009 and onwards. Under this program, institutes are the project owner in 20 projects, while

[23] http://www.forskningsradet.no/prognett-energix/Home_page/1253980140022
[24] The centres are: Centre for Sustainable Energy Studies (CenSES), Strategic Challenges in International Climate and Energy Policy (CICEP) and Oslo Centre for Research on Environmentally friendly Energy (CREE).
[25] However, parts of this amount may also include transdisciplinary research with technical component.

higher education institutions (NTNU and NMBU) are project leaders for 13 projects. The remaining ENERGIX projects are supporting research projects in industry and business.

Table 12 RCN projects on social science research on energy 2004-2015 by project start and R&D sector. N=53.

R&D sector	2004	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Institute sector	-	2	3	3	5	3	3	4	1	1	5
Business sector	-	1	-	-	-	2	-	-	-	1	1
University sector	1	-	3	2	2	2	2	-	1	-	3
Total	1	3	6	5	8	8	5	4	2	2	9

Source: NIFU/RCN project database.

Table 13 Social science research project portfolio financed by the RCN in the 2008-2015 period. Mill. NOK.

RCN program and R&D sector	Thematic area	
	Social Science	Technology*
ENERGIX -	**171,2**	**34,7**
Institute sector	114,5	24,7
Business sector	1,9	8,2
University sector	54,9	1,8
RENERGI -	**28,3**	**7,7**
Institute sector	26,0	2,7
Business sector	-	-
University sector	2,3	1,0
Other	-	4,0

Source: NIFU/RCN project database categories.

* Note: Thirteen of the projects supported in the social science portfolio have been marked technology as well as Energy systems or Energy policy, economy and society.

The project titles of projects marked “technology” (thematic area), indicate a clear economic profile for most of these projects. The multidisciplinary project making categorization of thematic area complex and can be categorised under multiple thematic areas. A number of social science disciplines are represented in the project portfolio, where economics and political science are most frequently referred to. Annex 12 in the Appendix gives an extensive overview of the project portfolio.

4.2.1 Institutions supported by the RCN social science portfolio on energy

As we mentioned above it is mostly institutions from the institute sector (30 projects) and the university sector (16 projects) that have received RCN-funding in this subfield of research in the 2004-2015 period. All institutions and their projects are listed in Annex 12.

CICERO Center for International Climate and Environmental Research along with SINTEF and Statistics Norway (research department) have all conducted six projects each (CICERO also hosts a FME Samfunn research centre). Other central institutes are Fridtjof Nansen Institute, Ragnar Frisch Centre for Economic Research and Institute for Energy Technology (IFE). These six institute sector institutions conducted 27 of the 30 RCN-financed projects in the subfield all together

Additionally, the 16 RCN projects in the university sector was conducted by the following three universities; NTNU, University of Oslo and the Norwegian University of Life Sciences (NMBU). Four faculties and three university departments were the projects owners of 12 projects at NTNU. That makes NTNU the central university institution in the portfolio.

Finally, the innovation oriented part of the portfolio included four businesses and three other entities as project owners for one of the projects each. Energy Norway (a non-profit industry organisation) and the municipal agency for climate in the City of Oslo. Norwegian institutions financed by the RCN Social Science Research projects on energy 2008-2015.

4.2.2 RENERGI and ENERGIX social science energy project funding

The RCN social science project portfolio on energy has increased in number of projects indicated in table 12 above, from the first project starting in 2004 to 15 projects with start-up in 2015. The table below indicates the volume of research funding for each year in the 2009-2015 period.

Table 14 Annual funding for social science research on energy in RENERGI and ENERGIX programs. Mill. NOK

	2009	2010	2011	2012	2013	2014	2015	Total
ENERGIX - Stort program energi	**12,7**	**25,5**	**33,2**	**47,7**	**35,0**	**24,3**	**27,5**	**205,9**
Bærekraft og ressurseffektivitet	-	-	0,6	0,9	1,0	0,4	5,2	8,1
Markedsdesign for produksjon, omsetting og forsyning	0,3	4,1	3,8	7,1	6,1	4,8	6,0	32,2
Offentlig politikk og virkemidler	6,4	12,3	12,3	14,7	14,3	9,9	4,0	73,9
Systemer Balansetjenester	-	1,8	1,8	1,8	1,2	0,6	2,6	9,8
Systemer Smartnett	-	-	1,4	4,0	2,4	1,9	0,7	10,5
Teknologianalyser, innovasjon og diffusjon	6,1	7,4	13,2	19,1	10,0	6,6	9,1	71,5
RENERGI - Fremtidens rene energisystemer	**15,9**	**14,8**	**4,5**	**1,4**	**-**	**-**	**-**	**36,8**
Markedsdesign for produksjon, omsetting og forsyning	2,4	1,9	0,3	0,7	-	-	-	5,3
Offentlig politikk og virkemidler	10,8	9,9	3,8	0,5	-	-	-	25,1
Teknologianalyser, innovasjon og diffusjon	2,7	3,0	0,4	0,2	-	-	-	6,3
Grand Total	**28,7**	**40,4**	**37,7**	**49,1**	**35,0**	**24,3**	**27,5**	**242,7**

Source: NIFU/RCN project database.

The table indicates that annual allowances within the two RCN programs have varied from 24,3 million to 49,1 million NOK in the seven-year period and have decreased since the RENERGI program ended in 2012 due to the build-up of the ENERGIX social science program portfolio, culminating also in 2012.

Public policy is the single most prominent social science thematic field in both programs, receiving close to 100 million NOK (41 percent) of the total 242 million NOK allowances. The two other major thematic field are named Technology analysis, innovation and diffusion (totalling 77,8 million NOK) and Market design for production, sale and innovation (totalling 37,5 million NOK).

In addition to this 53 project portfolio, the FME Samfunn research centre funding of 3 projects, totals 115,4 million NOK in 2011-2015 period.

4.3 Summary and conclusion

This chapter has given an overview *of financial sources* of Norwegian social science research on new environmentally friendly energy focussing both on the total R&D expenditure registered as well as the expenditure for the relevant RCN project portfolio.

4.3.1 Total volume of the Norwegian research in the field

Based on national R&D statistics we estimated that just above 100 mill NOK was spent on social science on energy in 2013 only, which amounts to about 14 per cent of total energy R&D in the higher education sector and around 7 per cent in the institute sector that year[26]. This estimate reflects that social science research is most likely underreported for the institute sector probably due to the fact that technical industrial research institutes are major players in this sector in Norway. There is reason to assume that several of these institutes also perform some degree of social science, which again means that the amounts for social science on energy for research institutes must considered as rather conservative estimates.

4.3.2 Volume of RCN funded research

Based on allowances for the selected 2009-2015 RCN project portfolio, we have estimated the total volume of R&D to be 242.7 million NOK[27]. Table 14 above indicates that annual allowances within the two RCN programs have varied from 27, 5 million to 49,1 million NOK in the seven-year period and have decreased since the RENERGI program ended in 2012 due to the build-up of the ENERGIX social science program portfolio, cumulating also in 2012.

4.3.3 Main financial source for the research field

In section 3.2 we mapped the additional funding volume for the relevant projects with Norwegian participants in EU FP 7 and Horizon 2020. However, up till 86 participants from 16 different countries taking part in the project consortia[28]. The total EC cost contribution for the selected projects including the Norwegian participants is NOK 1011 million NOK (€ 137.647 million) for the 27 FP7 projects and 684 million NOK (€ 85.543 million) for the 15 H2020 projects in the 2009-2015 period[29]. For the 42 EU-project portfolio all together, the EC cost contribution amounts to 1785 million NOK (€ 223.19 million) *for the European participants in total*.

The Norwegian participants proportion of the EC-contribution for both FP7 and H2020, amounts to nearly 200 million NOK (€24.742 million)[30]. Compared to the estimated 200 million NOK of *total Norwegian R&D expenditures for the field in 2013 alone* (c.f. figure 12, section 4.1), and the 242.7 million NOK in the RCN 2009-2015 RENERGI and ENERGIX portfolio (table 14 above), we conclude that the national sources and the RCN funding in particular are most important for the development the social science research on energy – along with the institutional funding of higher education sector institutions (general university funds). These funds cannot however give the concentrated and dedicated and funding over several years for researcher the field such as the RCN funding provide both within the RENERGI and ENERGIX programs as well as the FME Samfunn centre allowances for the 2011-2019 period.

[26] The estimate is based on the NIFU biannual survey of R&D expenditure and energy related thematic priorities. More details are given in section 4.1 above.
[27] Details available in section 4.2 above.
[28] The average total costs among the 27 FP7 projects are € 9.436 million, while the average EC costs contribution of total costs are € 5.098 million. Among the 15 H2020 projects we find that the average total costs are € 9.940 million, while the average EC costs contribution is € 5.703 million. Please refer to table 8 and table 9 in Section 3.2.
[29] Please refer to table 8 and table 9 in Section 3.2.
[30] The Norwegian participants have the coordinator role in 9 projects out of the 42 selected EU-projects (and two of these projects have only Norwegian participants and a € 0.246 mill EC contribution). Exchange rate €1=8 NOK.

References

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Appendix

Annex 1 Excerpt of the RCN mandate for the study

 Vitenskapelig kvalitet i den samfunnsvitenskapelige energiforskningen: Studien skal gi et bilde på om satsingen de siste årene har bidratt til å heve kvaliteten på og omfanget av den samfunnsvitenskapelige energiforskningen. Dette skal måles gjennom en bibliometrisk analyse av forskningsområdet. Gjennom en analyse av dataene skal det utarbeides en oversikt over hvilke områder og fagmiljøer som er blitt bygget opp de siste årene.

 Internasjonalt samarbeid: Studien skal videre inneholde en kartlegging av samarbeidet mellom norske og internasjonale miljøer blant annet målt gjennom sampublisering og felles forskningsprosjekter, f.eks. Horisont 2020. På bakgrunn av kartleggingen skal det gis en vurdering av:
o Hvilke forskningsfelt er spesifikke for Norge og må derfor ivaretas spesielt av oss?
o Hvilke områder kan sies å være mer generiske/internasjonale og derfor må sees i sammenheng med internasjonal forskning?

 Oversikt over økonomi og temaer: Studien skal gi en oversikt over volum (totalt og fordelt på de viktigste temaene) og finansieringskilder for samfunnsvitenskapelig energiforskning (…)

Annex 2 WoS-indexed journals with Norwegian social science research publication on energy in the 2009-2014 period (N=86)

Source (journal)	SN	Number of articles
ENERGY POLICY	0301-4215	75
ENERGY ECONOMICS	0140-9883	14
ECOLOGICAL ECONOMICS	0921-8009	12
GLOBAL ENVIRONMENTAL CHANGE-HUMAN AND POLICY DIMENSIONS	0959-3780	10
ENERGY JOURNAL	0195-6574	7
EUROPEAN PLANNING STUDIES	0965-4313	6
ENVIRONMENTAL & RESOURCE ECONOMICS	0924-6460	6
ECONOMIC SYSTEMS RESEARCH	0953-5314	5
TRANSPORTATION RESEARCH PART D-TRANSPORT AND ENVIRONMENT	1361-9209	5
JOURNAL OF FOREST ECONOMICS	1104-6899	5
ENVIRONMENTAL SCIENCE & TECHNOLOGY	0013-936X	4
RESOURCE AND ENERGY ECONOMICS	0928-7655	4
SCANDINAVIAN JOURNAL OF ECONOMICS	0347-0520	4
CLIMATE POLICY	1469-3062	4
GLOBAL ENVIRONMENTAL POLITICS	1526-3800	3
INTERNATIONAL JOURNAL OF CONSUMER STUDIES	1470-6423	3
ENERGY	0360-5442	3
RENEWABLE & SUSTAINABLE ENERGY REVIEWS	1364-0321	3
EUROPEAN JOURNAL OF OPERATIONAL RESEARCH	0377-2217	3
TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE	0040-1625	3
JOURNAL OF REGULATORY ECONOMICS	0922-680X	2
JOURNAL OF SUSTAINABLE TOURISM	0966-9582	2
GEOFORUM	0016-7185	2
ENVIRONMENTAL POLITICS	0964-4016	2
JOURNAL OF ENVIRONMENTAL ECONOMICS AND MANAGEMENT	0095-0696	2
ENVIRONMENTAL SCIENCE & POLICY	1462-9011	2
AMERICAN JOURNAL OF AGRICULTURAL ECONOMICS	0002-9092	2
ECONOMICS OF ENERGY & ENVIRONMENTAL POLICY	2160-5882	2
CLIMATIC CHANGE	0165-0009	2
BIOMASS & BIOENERGY	0961-9534	2
SUSTAINABILITY	2071-1050	2
SUSTAINABLE DEVELOPMENT	0968-0802	2
APPLIED ENERGY	0306-2619	2
NORSK GEOGRAFISK TIDSSKRIFT-NORWEGIAN JOURNAL OF GEOGRAPHY	0029-1951	2
ENVIRONMENTAL VALUES	0963-2719	1
ENVIRONMENTAL COMMUNICATION-A JOURNAL OF NATURE AND CULTURE	1752-4032	1
FUTURES	0016-3287	1
ENGINEERING STUDIES	1937-8629	1
ENERGY FOR SUSTAINABLE DEVELOPMENT	0973-0826	1

ENERGIES	1996-1073	1
ECONOMIC THEORY	0938-2259	1
ECONOMIC MODELLING	0264-9993	1
ECONOMIC AND LABOUR RELATIONS REVIEW	1035-3046	1
ECOLOGICAL MODELLING	0304-3800	1
DAEDALUS	0011-5266	1
CONSERVATION AND MANAGEMENT OF ARCHAEOLOGICAL SITES	1350-5033	1
BUSINESS STRATEGY AND THE ENVIRONMENT	0964-4733	1
BUILDING RESEARCH AND INFORMATION	0961-3218	1
BIORESOURCE TECHNOLOGY	0960-8524	1
B E JOURNAL OF ECONOMIC ANALYSIS & POLICY	1935-1682	1
ELECTRONIC COMMERCE RESEARCH AND APPLICATIONS	1567-4223	1
RESEARCH POLICY	0048-7333	1
LAND ECONOMICS	0023-7639	1
LEISURE STUDIES	0261-4367	1
MARINE POLICY	0308-597X	1
MATHEMATICAL SOCIAL SCIENCES	0165-4896	1
NATURE + CULTURE	1558-6073	1
OPEN HOUSE INTERNATIONAL	0168-2601	1
INTERNATIONAL ECONOMIC REVIEW	0020-6598	1
RENEWABLE ENERGY	0960-1481	1
JOURNAL OF THE ACADEMY OF MARKETING SCIENCE	0092-0703	1
REVIEW OF AFRICAN POLITICAL ECONOMY	0305-6244	1
REVIEW OF POLICY RESEARCH	1541-132X	1
SCANDINAVIAN POLITICAL STUDIES	0080-6757	1
SOCIAL CHOICE AND WELFARE	0176-1714	1
SOCIETY & NATURAL RESOURCES	0894-1920	1
URBAN STUDIES	0042-0980	1
OSTEUROPA	0030-6428	1
JOURNAL OF CLEANER PRODUCTION	0959-6526	1
GLOBAL POLICY	1758-5880	1
IEEE TRANSACTIONS ON POWER SYSTEMS	0885-8950	1
INTERNATIONAL ENVIRONMENTAL AGREEMENTS-POLITICS LAW AND ECONOMICS	1567-9764	1
WORLD DEVELOPMENT	0305-750X	1
INTERNATIONAL JOURNAL OF HYDROGEN ENERGY	0360-3199	1
INTERNATIONAL JOURNAL OF LIFE CYCLE ASSESSMENT	0948-3349	1
JOURNAL OF WORLD ENERGY LAW & BUSINESS	1754-9957	1
INTERNATIONAL JOURNAL OF TOURISM RESEARCH	1099-2340	1
JOURNAL OF TRANSPORT GEOGRAPHY	0966-6923	1
JOURNAL OF ENVIRONMENT & DEVELOPMENT	1070-4965	1
JOURNAL OF ENVIRONMENTAL PSYCHOLOGY	0272-4944	1
JOURNAL OF HAZARDOUS MATERIALS	0304-3894	1
JOURNAL OF HUMAN RIGHTS	1475-4835	1
JOURNAL OF INDUSTRIAL ECOLOGY	1088-1980	1

JOURNAL OF POLICY MODELING	0161-8938	1
GLOBAL CHANGE BIOLOGY BIOENERGY	1757-1693	1
INTERNATIONAL JOURNAL OF TECHNOLOGY MANAGEMENT	0267-5730	1

Annex 3 List of scientific articles with Norwegian addresses identified in the 2009-2014 period by first author (N=259)

Authors	Publication year	Title	Source
Aall, Carlo	2011	Energy use and leisure consumption in Norway: an analysis and reduction strategy	JOURNAL OF SUSTAINABLE TOURISM
Aall, Carlo; Klepp, Ingun Grimstad; Engeset, Agnes Brudvik; Skuland, Silje Elisabeth; Stoa, Eli	2011	Leisure and sustainable development in Norway: part of the solution and the problem	LEISURE STUDIES
Aasen, M.; Westskog, H.; Wilhite, H.; Lindberg, M.	2010	The EU electricity disclosure from the business perspective-A study from Norway	ENERGY POLICY
Aasgard, Ellen K.; Andersen, Gorild S.; Fleten, Stein-Erik; Haugstvedt, Daniel	2014	Evaluating a Stochastic-Programming-Based Bidding Model for a Multireservoir System	IEEE TRANSACTIONS ON POWER SYSTEMS
Adaramola, M. S.; Oyewola, O. M.	2011	On wind speed pattern and energy potential in Nigeria	ENERGY POLICY
Amundsen, Eirik S.; Andersen, Per; Jensen, Frank	2011	Testing for cross-subsidisation in the combined heat and power generation sector: A comparison of three tests	ENERGY ECONOMICS
Amundsen, Eirik S.; Bergman, Lars	2012	Green Certificates and Market Power on the Nordic Power Market	ENERGY JOURNAL
Amundsen, Eirik S.; Nese, Gjermund	2009	Integration of tradable green certificate markets: What can be expected?	JOURNAL OF POLICY MODELING
Andersen, Allan Dahl; Andersen, Per Dannemand	2014	Innovation system foresight	TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE
Andersen, Otto; Gossling, Stefan; Simonsen, Morten; Walnum, Hans Jakob; Peeters, Paul; Neiberger, Cordula	2010	CO2 emissions from the transport of China's exported goods	ENERGY POLICY
Andersen, Trude Berg; Nilsen, Odd Bjarte; Tveteras, Ragnar	2011	How is demand for natural gas determined across European industrial sectors?	ENERGY POLICY
Andrew, Robbie; Peters, Glen P.; Lennox, James	2009	APPROXIMATION AND REGIONAL AGGREGATION IN MULTI-REGIONAL INPUT-OUTPUT ANALYSIS FOR NATIONAL CARBON FOOTPRINT ACCOUNTING	ECONOMIC SYSTEMS RESEARCH
Arvesen, Anders; Bright, Ryan M.; Hertwich, Edgar G.	2011	Considering only first-order effects? How simplifications lead to unrealistic technology optimism in climate change mitigation	ENERGY POLICY
Arvesen, Anders; Christine, Birkeland; Hertwich, Edgar G.	2013	The Importance of Ships and Spare Parts in LCAs of Offshore Wind Power	ENVIRONMENTAL SCIENCE & TECHNOLOGY
Arvesen, Anders; Hertwich, Edgar G.	2012	Assessing the life cycle environmental impacts of wind power: A review of present knowledge and research needs	RENEWABLE & SUSTAINABLE ENERGY REVIEWS

Arvesen, Anders; Nes, Rasmus Nikolai; Huertas-Hernando, Daniel; Hertwich, Edgar G.	2014	Life cycle assessment of an offshore grid interconnecting wind farms and customers across the North Sea	INTERNATIONAL JOURNAL OF LIFE CYCLE ASSESSMENT
Asheim, Geir B.; Mitra, Tapan	2010	Sustainability and discounted utilitarianism in models of economic growth	MATHEMATICAL SOCIAL SCIENCES
Asheim, Geir B.; Mitra, Tapan; Tungodden, Bertil	2012	Sustainable recursive social welfare functions	ECONOMIC THEORY
Asheim, Geir B.; Zuber, Stephane	2013	A complete and strongly anonymous leximin relation on infinite streams	SOCIAL CHOICE AND WELFARE
Aune, Finn Roar; Dalen, Hanne Marit; Hagem, Cathrine	2012	Implementing the EU renewable target through green certificate markets	ENERGY ECONOMICS
Baldursson, Fridrik M.; von der Fehr, Nils-Henrik M.	2012	Price Volatility and Risk Exposure: On the Interaction of Quota and Product Markets	ENVIRONMENTAL & RESOURCE ECONOMICS
Bang, Guri	2010	Energy security and climate change concerns: Triggers for energy policy change in the United States?	ENERGY POLICY
Barrett, John; Peters, Glen; Wiedmann, Thomas; Scott, Kate; Lenzen, Manfred; Roelich, Katy; Le Quere, Corinne	2013	Consumption-based GHG emission accounting: a UK case study	CLIMATE POLICY
Bassi, Andrea M.; Powers, Robert; Schoenberg, William	2010	An integrated approach to energy prospects for North America and the rest of the world	ENERGY ECONOMICS
Bassi, Andrea M.; Shilling, John D.	2010	Informing the US Energy Policy Debate with Threshold 21	TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE
Bassi, Andrea M.; Yudken, Joel S.; Ruth, Matthias	2009	Climate policy impacts on the competitiveness of energy-intensive manufacturing sectors	ENERGY POLICY
Bauer, Joanna; Altinkemer, Kemal; Haugland, Dag	2010	Center-oriented algorithms for the minimum energy broad and multicast problem in wireless ad hoc networks	ELECTRONIC COMMERCE RESEARCH AND APPLICATIONS
Belyi, Andrei; Overland, Indra; Vishnyakova, Anna	2011	Challenges to Russia's post-Rao UES energy paradigm: a window of opportunity for sustainable market development	JOURNAL OF WORLD ENERGY LAW & BUSINESS
Benth, Fred Espen; Benth, Jurate Saltyte	2009	Dynamic pricing of wind futures	ENERGY ECONOMICS
Bergersen, Ove; Boen, Anne S.; Sorheim, Roald	2009	Strategies to reduce short-chain organic acids and synchronously establish high-rate composting in acidic household waste	BIORESOURCE TECHNOLOGY
Berker, Thomas; Gansmo, Helen Josok	2010	Paradoxes of Design: Energy and Water Consumption and the Aestheticization of Norwegian Bathrooms 1990-2008	SUSTAINABLE DEVELOPMENT
Bjertnaes, Geir H.	2011	Avoiding adverse employment effects from electricity taxation in Norway: What does it cost?	ENERGY POLICY

Bjornstad, Even	2012	Diffusion of renewable heating technologies in households. Experiences from the Norwegian Household Subsidy Programme	ENERGY POLICY
Blindheim, Bernt	2013	Implementation of wind power in the Norwegian market; the reason why some of the best wind resources in Europe were not utilised by 2010	ENERGY POLICY
Boamah, Festus	2014	How and why chiefs formalise land use in recent times: the politics of land dispossession through biofuels investments in Ghana	REVIEW OF AFRICAN POLITICAL ECONOMY
Boamah, Festus	2014	Imageries of the contested concepts "land grabbing" and "land transactions": Implications for biofuels investments in Ghana	GEOFORUM
Boasson, Elin Lerum; Wettestad, Jorgen	2014	Policy invention and entrepreneurship: Bankrolling the burying of carbon in the EU	GLOBAL ENVIRONMENTAL CHANGE-HUMAN AND POLICY DIMENSIONS
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Boehringer, Christoph; Rosendahl, Knut Einar; Schneider, Jan	2014	Unilateral Climate Policy: Can OPEC Resolve the Leakage Problem?	ENERGY JOURNAL
Boomsma, Trine Krogh; Meade, Nigel; Fleten, Stein-Erik	2012	Renewable energy investments under different support schemes: A real options approach	EUROPEAN JOURNAL OF OPERATIONAL RESEARCH
Bright, Ryan M.; Stromman, Anders H.	2010	Incentivizing wood-based Fischer-Tropsch diesel through financial policy instruments: An economic assessment for Norway	ENERGY POLICY
Burgess, Neil D.; Mwakalila, Shadrack; Munishi, Pantaleo; Pfeifer, Marion; Willcock, Simon; Shirima, Deo; Hamidu, Seki; Bulenga, George B.; Rubens, Jason; Machano, Haji; Marchant, Rob	2013	REDD herrings or REDD menace: Response to Beymer-Farris and Bassett	GLOBAL ENVIRONMENTAL CHANGE-HUMAN AND POLICY DIMENSIONS
Bye, Brita; Jacobsen, Karl	2011	Restricted carbon emissions and directed R&D support; an applied general equilibrium analysis	ENERGY ECONOMICS
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Calvin, Katherine; Edmonds, Jae; Bakken, Bjorn; Wise, Marshall; Kim, Sonny; Luckow, Patrick; Patel, Pralit; Graabak, Ingeborg	2014	EU 20-20-20 energy policy as a model for global climate mitigation	CLIMATE POLICY
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Cavicchi, Bianca; Bryden, John M.; Vittuari, Matteo	2014	A comparison of bioenergy policies and institutional frameworks in the rural areas of Emilia Romagna and Norway	ENERGY POLICY
Cherry, Todd L.; Garcia, Jorge H.; Kallbekken, Steffen; Torvanger, Asbjewn	2014	The development and deployment of low-carbon energy technologies: The role of economic interests and cultural worldviews on public support	ENERGY POLICY
Cherry, Todd L.; Kallbekken, Steffen; Kroll, Stephan	2012	The acceptability of efficiency-enhancing environmental taxes, subsidies and regulation: An experimental investigation	ENVIRONMENTAL SCIENCE & POLICY
Christiansen, Marielle; Fagerholt, Kjetil; Nygreen, Bjorn; Ronen, David	2013	Ship routing and scheduling in the new millennium	EUROPEAN JOURNAL OF OPERATIONAL RESEARCH
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Coenen, Lars; Benneworth, Paul; Truffer, Bernhard	2012	Toward a spatial perspective on sustainability transitions	RESEARCH POLICY
Dietz, Thomas; Stern, Paul C.; Weber, Elke U.	2013	Reducing Carbon-Based Energy Consumption through Changes in Household Behavior	DAEDALUS
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Durham, Brian; Van de Noort, Robert; Martens, Vibeke Vandrup; Vorenhout, Michel	2012	Organic Loss in Drained Wetland Monuments: Managing the Carbon Footprint	CONSERVATION AND MANAGEMENT OF ARCHAEOLOGICAL SITES
Eggert, Hakan; Greaker, Mads	2012	Trade Policies for Biofuels	JOURNAL OF ENVIRONMENT & DEVELOPMENT
Eggert, Hakan; Greaker, Mads	2014	Promoting Second Generation Biofuels: Does the First Generation Pave the Road?	ENERGIES
Egging, Ruud	2013	Drivers, trends, and uncertainty in long-term price projections for energy management in public buildings	ENERGY POLICY
Ektvedt, Tone Marie	2011	Firewood consumption amongst poor inhabitants in a semiarid tropical forest: A case study from Piura, northern Peru	NORSK GEOGRAFISK TIDSSKRIFT-NORWEGIAN

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Ericson, Torgeir	2009	Direct load control of residential water heaters	ENERGY POLICY
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Ferkingstad, Egil; Loland, Anders; Wilhelmsen, Mathilde	2011	Causal modeling and inference for electricity markets	ENERGY ECONOMICS
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Framstad, N. C.	2011	A remark on R.S. Pindyck: "Irreversibilities and the timing of environmental policy"	RESOURCE AND ENERGY ECONOMICS
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Gilpin, Geoffrey; Hanssen, Ole Jorgen; Czerwinski, Jan	2014	Biodiesel's and advanced exhaust aftertreatment's combined effect on global warming and air pollution in EU road-freight transport	JOURNAL OF CLEANER PRODUCTION
Girod, Bastien; van Vuuren, Detlef Peter; Hertwich, Edgar G.	2014	Climate policy through changing consumption choices: Options and obstacles for reducing greenhouse gas emissions	GLOBAL ENVIRONMENTAL CHANGE-HUMAN AND POLICY DIMENSIONS
Glomsrod, Solveig; Wei, Taoyuan; Liu, Gang; Aune, Jens B.	2011	How well do tree plantations comply with the twin targets of the Clean Development Mechanism? The case of tree plantations in Tanzania	ECOLOGICAL ECONOMICS
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Golombek, Rolf; Greaker, Mads; Kittelsen, Sverre A.	2011	Carbon Capture and Storage Technologies in the European Power Market	ENERGY JOURNAL

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Gossling, Stefan	2009	Carbon neutral destinations: a conceptual analysis	JOURNAL OF SUSTAINABLE TOURISM
Gossling, Stefan	2013	National emissions from tourism: An overlooked policy challenge?	ENERGY POLICY
Greaker, Mads; Hagem, Cathrine	2014	Strategic Investment in Climate Friendly Technologies: The Impact of Global Emissions Trading	ENVIRONMENTAL & RESOURCE ECONOMICS
Greaker, Mads; Heggedal, Tom-Reiel	2010	Lock-In and the Transition to Hydrogen Cars: Should Governments Intervene?	B E JOURNAL OF ECONOMIC ANALYSIS & POLICY
Grimsby, Lars Kare	2011	Securing energy equity	ENERGY POLICY
Gulbrandsen, Lars H.; Stenqvist, Christian	2013	The limited effect of EU emissions trading on corporate climate strategies: Comparison of a Swedish and a Norwegian pulp and paper company	ENERGY POLICY
Gullberg, Anne Therese	2013	Pressure or Information? Lobbying for Binding Renewable Energy Targets in the European Union	REVIEW OF POLICY RESEARCH
Gullberg, Anne Therese	2013	The political feasibility of Norway as the 'green battery' of Europe	ENERGY POLICY
Gullberg, Anne Therese; Ohlhorst, Doerte; Schreurs, Miranda	2014	Towards a low carbon energy future - Renewable energy cooperation between Germany and Norway	RENEWABLE ENERGY
Gullberg, Anne Therese; Skodvin, Tora	2011	Cost Effectiveness and Target Group Influence in Norwegian Climate Policy	SCANDINAVIAN POLITICAL STUDIES
Halvorsen, Bente	2009	Conflicting Interests in Environmental Policy-making?	ENVIRONMENTAL & RESOURCE ECONOMICS
Halvorsen, Bente; Larsen, Bodil M.; Nesbakken, Runa	2010	Is There a Win-Win Situation in Household Energy Policy?	ENVIRONMENTAL & RESOURCE ECONOMICS
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Hansen, Petter Vegard	2009	Inflow Uncertainty in Hydropower Markets	SCANDINAVIAN JOURNAL OF ECONOMICS
Hanss, Daniel; Bohm, Gisela	2012	Sustainability seen from the perspective of consumers	INTERNATIONAL JOURNAL OF CONSUMER STUDIES
Hanss, Daniel; Bohm, Gisela	2013	Promoting purchases of sustainable groceries: An intervention study	JOURNAL OF ENVIRONMENTAL PSYCHOLOGY

Harsem, Oistein; Claes, Dag Harald	2013	The interdependence of European-Russian energy relations	ENERGY POLICY
Haugen, Hans Morten	2012	International Obligations and the Right to Food: Clarifying the Potentials and Limitations in Applying a Human Rights Approach When Facing Biofuels Expansion	JOURNAL OF HUMAN RIGHTS
Heggelund, Gorild M.; Buan, Inga Fritzen	2009	China in the Asia-Pacific Partnership: consequences for UN climate change mitigation efforts?	INTERNATIONAL ENVIRONMENTAL AGREEMENTS-POLITICS LAW AND ECONOMICS
Hertwich, Edgar G.	2011	THE LIFE CYCLE ENVIRONMENTAL IMPACTS OF CONSUMPTION	ECONOMIC SYSTEMS RESEARCH
Hoel, Michael	2011	The Supply Side of CO2 with Country Heterogeneity	SCANDINAVIAN JOURNAL OF ECONOMICS
Hoel, Michael; Holtsmark, Bjart; Holtsmark, Katinka	2014	Faustmann and the climate	JOURNAL OF FOREST ECONOMICS
Hoel, Michael; Jensen, Svenn	2012	Cutting costs of catching carbon-Intertemporal effects under imperfect climate policy	RESOURCE AND ENERGY ECONOMICS
Hojem, Thea S. M.; Sorensen, Knut H.; Lagesen, Vivian A.	2014	Designing a 'green' building: expanding ambitions through social learning	BUILDING RESEARCH AND INFORMATION
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Holden, Erling; Linnerud, Kristin	2011	Troublesome Leisure Travel: The Contradictions of Three Sustainable Transport Policies	URBAN STUDIES
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Holden, Steinar	2013	Avoiding the resource curse the case Norway	ENERGY POLICY
Holtsmark, Bjart	2012	Harvesting in boreal forests and the biofuel carbon debt	CLIMATIC CHANGE
Holtsmark, Bjart	2013	The outcome is in the assumptions: analyzing the effects on atmospheric CO2 levels of increased use of bioenergy from forest biomass	GLOBAL CHANGE BIOLOGY BIOENERGY
Holtsmark, Bjart	2013	Boreal forest management and its effect on atmospheric CO2	ECOLOGICAL MODELLING
Holtsmark, Bjart; Hoel, Michael; Holtsmark, Katinka	2013	Optimal harvest age considering multiple carbon pools - A comment	JOURNAL OF FOREST ECONOMICS
Holtsmark, Bjart; Skonhoft, Anders	2014	The Norwegian support and subsidy policy of electric cars. Should it be adopted by other countries?	ENVIRONMENTAL SCIENCE & POLICY

Huppmann, Daniel; Egging, Ruud	2014	Market power, fuel substitution and infrastructure - A large-scale equilibrium model of global energy markets	ENERGY
Huseby, Robert	2010	Person-Affecting Moral Theory, Non-Identity and Future People	ENVIRONMENTAL VALUES
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Jax, Kurt; Barton, David N.; Chan, Kai M. A.; de Groot, Rudolf; Doyle, Ulrike; Eser, Uta; Goerg, Christoph; Gomez-Baggethun, Erik; Griewald, Yuliana; Haber, Wolfgang; Haines-Young, Roy; Heink, Ulrich; Jahn, Thomas; Joosten, Hans; Kerschbaumer, Lilin; Korn, Horst; Luck, Gary W.; Matzdorf, Bettina; Muraca, Barbara; Nesshoever, Carsten; Norton, Bryan; Ott, Konrad; Potschin, Marion; Rauschmayer, Felix; von Haaren, Christina; Wichmann, Sabine	2013	Ecosystem services and ethics	ECOLOGICAL ECONOMICS
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Klockner, Christian Andreas; Nayum, Alim; Mehmetoglu, Mehmet	2013	Positive and negative spillover effects from electric car purchase to car use	TRANSPORTATION RESEARCH PART D-TRANSPORT AND ENVIRONMENT
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Moiseyev, Alexander; Solberg, Birger; Kallio, A. Maarit I.	2013	Wood biomass use for energy in Europe under different assumptions of coal, gas and CO2 emission prices and market conditions	JOURNAL OF FOREST ECONOMICS
Moiseyev, Alexander; Solberg, Birger; Kallio, A. Maarit I.; Lindner, Marcus	2011	An economic analysis of the potential contribution of forest biomass to the EU RES target and its implications for the EU forest industries	JOURNAL OF FOREST ECONOMICS
Morken, John; Sapci, Zehra; Stromme, Jon Eivind T.	2013	Modeling of biodiesel production in algae cultivation with anaerobic digestion (ACAD)	ENERGY POLICY
Moura, Maria Cecilia P.; Castelo Branco, David A.; Peters, Glen P.; Szklo, Alexandre Salem; Schaeffer, Roberto	2013	How the choice of multi-gas equivalency metrics affects mitigation options: The case of CO2 capture in a Brazilian coal-fired power plant	ENERGY POLICY
Movilla, Santiago; Miguel, Luis J.; Felipe Blazquez, L.	2013	A system dynamics approach for the photovoltaic energy market in Spain	ENERGY POLICY
Mueller, Liana; Berker, Thomas	2013	Passive House at the crossroads: The past and the present of a voluntary standard that managed to bridge the energy efficiency gap	ENERGY POLICY
Naess, Petter	2014	Urban Form, Sustainability and Health: The Case of Greater Oslo	EUROPEAN PLANNING STUDIES
Naess, Petter; Naess, Teresa; Strand, Arvid	2011	Oslo's Farewell to Urban Sprawl	EUROPEAN PLANNING STUDIES

Narbel, Patrick A.	2013	What is really behind the adoption of new renewable electricity generating technologies?	ENERGY FOR SUSTAINABLE DEVELOPMENT
Narbel, Patrick A.	2014	Rethinking how to support intermittent renewables	ENERGY
Narbel, Patrick Andre; Hansen, Jan Petter	2014	Estimating the cost of future global energy supply	RENEWABLE & SUSTAINABLE ENERGY REVIEWS
Newton, Peter; Nichols, Elizabeth S.; Endo, Whaldener; Peres, Carlos A.	2012	Consequences of actor level livelihood heterogeneity for additionality in a tropical forest payment for environmental services programme with an undifferentiated reward structure	GLOBAL ENVIRONMENTAL CHANGE-HUMAN AND POLICY DIMENSIONS
Njos, Rune; Jakobsen, Stig-Erik; Fosse, Jens Kristian; Engelsen, Christine	2014	Challenges to Bridging Discrepant Knowledge Bases: A Case Study of the Norwegian Centre for Offshore Wind Energy	EUROPEAN PLANNING STUDIES
Norlund, Ellen Karoline; Gribkovskaia, Irina	2013	Reducing emissions through speed optimization in supply vessel operations	TRANSPORTATION RESEARCH PART D-TRANSPORT AND ENVIRONMENT
Olson, Erik L.	2013	It's not easy being green: the effects of attribute tradeoffs on green product preference and choice	JOURNAL OF THE ACADEMY OF MARKETING SCIENCE
Osmundsen, Petter; Emhjellen, Magne	2010	CCS from the gas-fired power station at Karsto? A commercial analysis	ENERGY POLICY
Overland, Indra	2013	Gas, Price, and Russia's Modernization Pricing Policy and Energy Efficiency in Russia	OSTEUROPA
Owen, Anne; Steen-Olsen, Kjartan; Barrett, John; Wiedmann, Thomas; Lenzen, Manfred	2014	A STRUCTURAL DECOMPOSITION APPROACH TO COMPARING MRIO DATABASES	ECONOMIC SYSTEMS RESEARCH
Pauliuk, Stefan; Muller, Daniel B.	2014	The role of in-use stocks in the social metabolism and in climate change mitigation	GLOBAL ENVIRONMENTAL CHANGE-HUMAN AND POLICY DIMENSIONS
Pettersen, Ida Nilstad; Boks, Casper; Tukker, Arnold	2013	Framing the role of design in transformation of consumption practices: beyond the designer-product-user triad	INTERNATIONAL JOURNAL OF TECHNOLOGY MANAGEMENT
Pierru, Axel; Roussanaly, Simon; Sabathier, Jerome	2013	Capital structure in LNG infrastructures and gas pipelines projects: Empirical evidences and methodological issues	ENERGY POLICY
Raadal, Hanne Lerche; Dotzauer, Erik; Hanssen, Ole Jorgen; Kildal, Hans Petter	2012	The interaction between Electricity Disclosure and Tradable Green Certificates	ENERGY POLICY
Randers, Jorgen	2012	Greenhouse gas emissions per unit of value added ("GEVA") - A corporate guide to voluntary climate action	ENERGY POLICY

Riddington, Geoff; McArthur, David; Harrison, Tony; Gibson, Hervey	2010	Assessing the Economic Impact of Wind Farms on Tourism in Scotland: GIS, Surveys and Policy Outcomes	INTERNATIONAL JOURNAL OF TOURISM RESEARCH
Risholt, Birgit; Berker, Thomas	2013	Success for energy efficient renovation of dwellings-Learning from private homeowners	ENERGY POLICY
Rodseth, Kenneth Lovold	2013	Capturing the least costly way of reducing pollution: A shadow price approach	ECOLOGICAL ECONOMICS
Rodseth, Kenneth Lovold; Romstad, Eirik	2014	Environmental Regulations, Producer Responses, and Secondary Benefits: Carbon Dioxide Reductions Under the Acid Rain Program	ENVIRONMENTAL & RESOURCE ECONOMICS
Roinioti, Argiro; Koroneos, Christopher; Wangensteen, Ivar	2012	Modeling the Greek energy system: Scenarios of clean energy use and their implications	ENERGY POLICY
Rosenberg, Eva; Fidje, Audun; Espegren, Kari Aamodt; Stiller, Christoph; Svensson, Ann Mari; Moller-Holst, Steffen	2010	Market penetration analysis of hydrogen vehicles in Norwegian passenger transport towards 2050	INTERNATIONAL JOURNAL OF HYDROGEN ENERGY
Rosendahl, Knut Einar; Strand, Jon	2011	Carbon Leakage from the Clean Development Mechanism	ENERGY JOURNAL
Rosendal, G. Kristin; Andresen, Steinar	2011	Institutional design for improved forest governance through REDD: Lessons from the global environment facility	ECOLOGICAL ECONOMICS
Rosnes, Orvika	2014	Subsidies for renewable energy in inflexible power markets	JOURNAL OF REGULATORY ECONOMICS
Rostvik, Harald N.	2013	MASS HOUSING AND SUSTAINABILITY	OPEN HOUSE INTERNATIONAL
Rygg, Bente Johnsen	2012	Wind power-An assault on local landscapes or an opportunity for modernization?	ENERGY POLICY
Ryghaug, Marianne; Sorensen, Knut H.	2009	How energy efficiency fails in the building industry	ENERGY POLICY
Ryghaug, Marianne; Toftaker, Marit	2014	A Transformative Practice? Meaning, Competence, and Material Aspects of Driving Electric Cars in Norway	NATURE + CULTURE
Saelen, Hakon; Kallbekken, Steffen	2011	A choice experiment on fuel taxation and earmarking in Norway	ECOLOGICAL ECONOMICS
Salom, Jaume; Marszal, Anna Joanna; Widen, Joakim; Candanedo, Jose; Lindberg, Karen Byskov	2014	Analysis of load match and grid interaction indicators in net zero energy buildings with simulated and monitored data	APPLIED ENERGY
Sanda, Gaute Egeland; Olsen, Eirik Tandberg; Fleten, Stein-Erik	2013	Selective hedging in hydro-based electricity companies	ENERGY ECONOMICS
Sandsmark, Maria	2009	A regional energy paradox-the case of Central Norway	ENERGY POLICY
Sandsmark, Maria; Tennbakk, Berit	2010	Ex post monitoring of market power in hydro dominated electricity markets	ENERGY POLICY
Sartori, Igor; Wachenfeldt, Bjorn	2009	Energy demand in the Norwegian building stock: Scenarios on potential reduction	ENERGY POLICY

Jensen; Hestnes, Anne Grete			
Schaafsma, M.; Morse-Jones, S.; Posen, P.; Swetnam, R. D.; Balmford, A.; Bateman, I. J.; Burgess, N. D.; Chamshama, S. A. O.; Fisher, B.; Freeman, T.; Geofrey, V.; Green, R. E.; Hepelwa, A. S.; Hernandez-Sirvent, A.; Hess, S.; Kajembe, G. C.; Kayharara, G.; Kilonzo, M.; Kulindwa, K.; Lund, J. F.; Madoffe, S. S.; Mbwambo, L.; Meilby, H.; Ngaga, Y. M.; Theilade, I.; Treue, T.; van Beukering, P.; Vyamana, V. G.; Turner, R. K.	2014	The importance of local forest benefits: Economic valuation of Non-Timber Forest Products in the Eastern Arc Mountains in Tanzania	GLOBAL ENVIRONMENTAL CHANGE-HUMAN AND POLICY DIMENSIONS
Schoyen, Halvor; Brathen, Svein	2011	The Northern Sea Route versus the Suez Canal: cases from bulk shipping	JOURNAL OF TRANSPORT GEOGRAPHY
Seljom, Pernille; Rosenberg, Eva; Fidje, Audun; Haugen, Jan Erik; Meir, Michaela; Rekstad, John; Jarlset, Thore	2011	Modelling the effects of climate change on the energy system-A case study of Norway	ENERGY POLICY
Siddiqui, Afzal; Fleten, Stein-Erik	2010	How to proceed with competing alternative energy technologies: A real options analysis	ENERGY ECONOMICS
Singh, Bhawna; Stromman, Anders H.	2013	Environmental assessment of electrification of road transport in Norway: Scenarios and impacts	TRANSPORTATION RESEARCH PART D-TRANSPORT AND ENVIRONMENT
Singh, Bhawna; Stromman, Anders H.; Hertwich, Edgar G.	2012	Scenarios for the environmental impact of fossil fuel power: Co-benefits and trade-offs of carbon capture and storage	ENERGY
Singh, Bhawna; Stromman, Anders H.; Hertwich, Edgar G.	2012	Environmental Damage Assessment of Carbon Capture and Storage Application of End-Point Indicators	JOURNAL OF INDUSTRIAL ECOLOGY
Sjolie, Hanne K.; Latta, Greg S.; Solberg, Birger	2013	Potential impact of albedo incorporation in boreal forest sector climate change policy effectiveness	CLIMATE POLICY
Sjolie, Hanne K.; Latta, Greg S.; Solberg, Birger	2013	Dual discounting in climate change mitigation in the forest sector	JOURNAL OF FOREST ECONOMICS

Skjaerseth, Jon Birger; Wettestad, Jorgen	2010	Fixing the EU Emissions Trading System? Understanding the Post-2012 Changes	GLOBAL ENVIRONMENTAL POLITICS
Skjolsvold, Tomas Moe	2012	Curb Your Enthusiasm: On Media Communication of Bioenergy and the Role of the News Media in Technology Diffusion	ENVIRONMENTAL COMMUNICATION-A JOURNAL OF NATURE AND CULTURE
Skjolsvold, Tomas Moe	2013	What We Disagree about When We Disagree about Sustainability	SOCIETY & NATURAL RESOURCES
Skjolsvold, Tomas Moe	2014	Back to the futures: Retrospecting the prospects of smart grid technology	FUTURES
Skodvin, Tora	2010	Pivotal politics in US energy and climate legislation	ENERGY POLICY
Solli, Joran	2010	Where the eagles dare? Enacting resistance to wind farms through hybrid collectives	ENVIRONMENTAL POLITICS
Solli, Joran	2013	Navigating standards - constituting engineering practices - how do engineers in consulting environments deal with standards?	ENGINEERING STUDIES
Sopha, Bertha Maya; Klockner, Christian A.; Hertwich, Edgar G.	2011	Exploring policy options for a transition to sustainable heating system diffusion using an agent-based simulation	ENERGY POLICY
Sopha, Bertha Maya; Klockner, Christian A.; Skjevrak, Geir; Hertwich, Edgar G.	2010	Norwegian households' perception of wood pellet stove compared to air-to-air heat pump and electric heating	ENERGY POLICY
Sparrevik, Magnus; Lindhjem, Henrik; Andria, Verania; Fet, Annik Magerholm; Cornelissen, Gerard	2014	Environmental and Socioeconomic Impacts of Utilizing Waste for Biochar in Rural Areas in Indonesia-A Systems Perspective	ENVIRONMENTAL SCIENCE & TECHNOLOGY
Spash, Clive L.; Lo, Alex Y.	2012	Australia's Carbon Tax: A Sheep in Wolf's Clothing?	ECONOMIC AND LABOUR RELATIONS REVIEW
Steen, Markus; Hansen, Gard Hopsdal	2014	Same Sea, Different Ponds: Cross-Sectorial Knowledge Spillovers in the North Sea	EUROPEAN PLANNING STUDIES
Steen, Markus; Karlsen, Asbjorn	2014	Path creation in a single-industry town: The case of Verdal and Windcluster Mid-Norway	NORSK GEOGRAFISK TIDSSKRIFT-NORWEGIAN JOURNAL OF GEOGRAPHY
Steinshamn, Stein Ivar	2011	A Conceptional Analysis of Dynamics and Production in Bioeconomic Models	AMERICAN JOURNAL OF AGRICULTURAL ECONOMICS
Strand, Jon; Rosendahl, Knut Einar	2012	Global emissions effects of CDM projects with relative baselines	RESOURCE AND ENERGY ECONOMICS
Strandbakken, Pal	2009	Sociology fools the technician? Product durability and social constraints to eco-efficiency for refrigerators and freezers	INTERNATIONAL JOURNAL OF CONSUMER STUDIES

Timilsina, Govinda R.; van Kooten, G. Cornelis; Narbel, Patrick A.	2013	Global wind power development: Economics and policies	ENERGY POLICY
Tjernshaugen, Andreas	2011	The growth of political support for CO2 capture and storage in Norway	ENVIRONMENTAL POLITICS
Tjernshaugen, Andreas	2012	Technological Power as a Strategic Dilemma: CO2 Capture and Storage in the International Oil and Gas Industry	GLOBAL ENVIRONMENTAL POLITICS
Torvanger, Asbjorn; Meadowcroft, James	2011	The political economy of technology support: Making decisions about carbon capture and storage and low carbon energy technologies	GLOBAL ENVIRONMENTAL CHANGE-HUMAN AND POLICY DIMENSIONS
Torvanger, Asbjorn; Shrivastava, Manish Kumar; Pandey, Nimisha; Tornblad, Silje H.	2013	A two-track CDM: improved incentives for sustainable development and offset production	CLIMATE POLICY
Tromborg, Erik; Havskjold, Monica; Lislebo, Ole; Rorstad, Per Kristian	2011	Projecting demand and supply of forest biomass for heating in Norway	ENERGY POLICY
Tukker, Arnold; Poliakov, Evgueni; Heijungs, Reinout; Hawkins, Troy; Neuwahl, Frederik; Rueda-Cantuche, Jose M.; Giljum, Stefan; Moll, Stephan; Oosterhaven, Jan; Bouwmeester, Maaike	2009	Towards a global multi-regional environmentally extended input-output database	ECOLOGICAL ECONOMICS
Tveten, Asa Grytli; Bolkesjo, Torjus Folsland; Martinsen, Thomas; Hvarnes, Havard	2013	Solar feed-in tariffs and the merit order effect: A study of the German electricity market	ENERGY POLICY
Underdal, Arild	2010	Complexity and challenges of long-term environmental governance	GLOBAL ENVIRONMENTAL CHANGE-HUMAN AND POLICY DIMENSIONS
van Alphen, Klaas; van Ruijven, Jochem; Kasa, Sjur; Hekkert, Marko; Turkenburg, Wim	2009	The performance of the Norwegian carbon dioxide, capture and storage innovation system	ENERGY POLICY
Vatn, Arild	2009	An institutional analysis of methods for environmental appraisal	ECOLOGICAL ECONOMICS
Vennemo, Haakon; He, Jianwu; Li, Shantong	2014	Macroeconomic Impacts of Carbon Capture and Storage in China	ENVIRONMENTAL & RESOURCE ECONOMICS
von der Fehr, Nils-Henrik M.	2013	Transparency in Electricity Markets	ECONOMICS OF ENERGY &

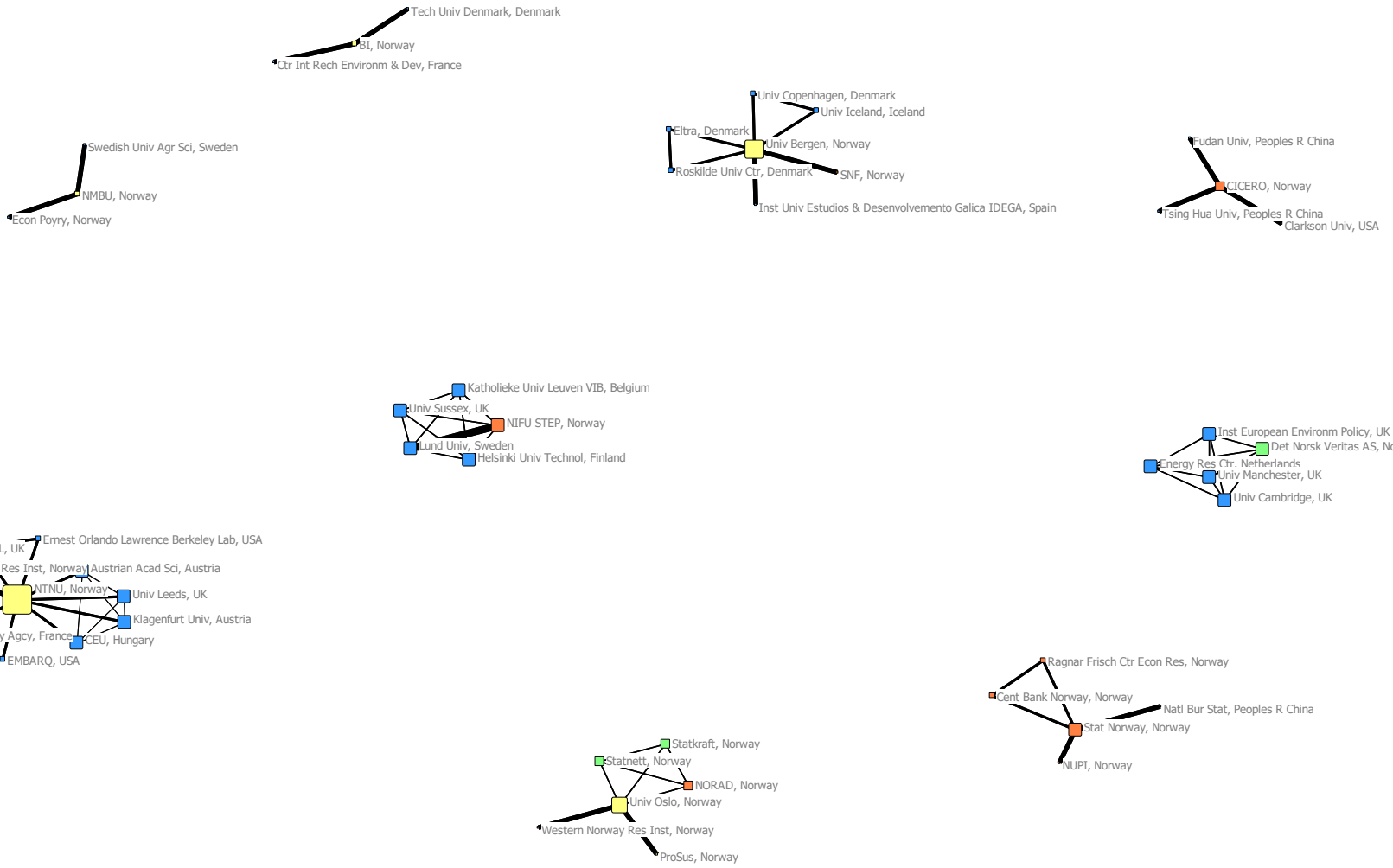
			ENVIRONMENTAL POLICY
Walnum, Hans Jakob; Aall, Carlo; Lokke, Soren	2014	Can Rebound Effects Explain Why Sustainable Mobility Has Not Been Achieved?	SUSTAINABILITY
Ward, Patrick; Shively, Gerald	2012	Vulnerability, Income Growth and Climate Change	WORLD DEVELOPMENT
Weaver, Tyson	2012	Financial appraisal of operational offshore wind energy projects	RENEWABLE & SUSTAINABLE ENERGY REVIEWS
Wei, Taoyuan	2010	A general equilibrium view of global rebound effects	ENERGY ECONOMICS
Wei, Taoyuan	2011	What STIRPAT tells about effects of population and affluence on the environment?	ECOLOGICAL ECONOMICS
Weinzettel, Jan; Steen-Olsen, Kjartan; Hertwich, Edgar G.; Borucke, Michael; Galli, Alessandro	2014	Ecological footprint of nations: Comparison of process analysis, and standard and hybrid multiregional input-output analysis	ECOLOGICAL ECONOMICS
Wettestad, Jorgen; Eikeland, Per Ove; Nilsson, Mans	2012	EU Climate and Energy Policy: A Hesitant Supranational Turn?	GLOBAL ENVIRONMENTAL POLITICS
Wiig, Arne; Kolstad, Ivar	2012	If diversification is good, why don't countries diversify more? The political economy of diversification in resource-rich countries	ENERGY POLICY
Wood, Richard	2009	Structural decomposition analysis of Australia's greenhouse gas emissions	ENERGY POLICY
Wright, Christopher	2011	Export Credit Agencies and Global Energy: Promoting National Exports in a Changing World	GLOBAL POLICY
Yamakawa, Asuka; Peters, Glen P.	2011	STRUCTURAL DECOMPOSITION ANALYSIS OF GREENHOUSE GAS EMISSIONS IN NORWAY 1990-2002	ECONOMIC SYSTEMS RESEARCH
Zhang, Daisheng; Aunan, Kristin; Seip, Hans Martin; Larssen, Steinar; Liu, Jianhui; Zhang, Dingsheng	2010	The assessment of health damage caused by air pollution and its implication for policy making in Taiyuan, Shanxi, China	ENERGY POLICY
Zhang, Daisheng; Aunan, Kristin; Seip, Hans Martin; Vennemo, Haakon	2011	The energy intensity target in China's 11th Five-Year Plan period-Local implementation and achievements in Shanxi Province	ENERGY POLICY
Zhu, Liang; Schade, Gunnar Wolfgang; Nielsen, Claus Jorgen	2013	Real-Time Monitoring of Emissions from Monoethanolamine-Based Industrial Scale Carbon Capture Facilities	ENVIRONMENTAL SCIENCE & TECHNOLOGY

Annex 4 Subfield themes for the WoS-indexed articles in 2009-2014 sample. N=259

	2009	2010	2011	2012	2013	2014	Total
Renewable energy	4	12	8	14	13	18	69
Energy use	7	5	11	5	10	9	47
Energy system	4	4	8	5	20	1	42
CCS	2	3	6	6	6	5	28
Bio-energy		1	2	1	4	3	11
Wind energy	1		1	3	1	4	10
Energy use_transport		1	2		3	3	9
Hydropower	1	3			3	1	8
Biofuels			1	3		3	7
Energy system_transport				1	2	2	5
Hydrogen	1	1					2
Hydrogen_transport		2					2
Renewable energy_transport			1		1		2
Bio-energy_transport					2		2
Other	5	3	1	4		2	15

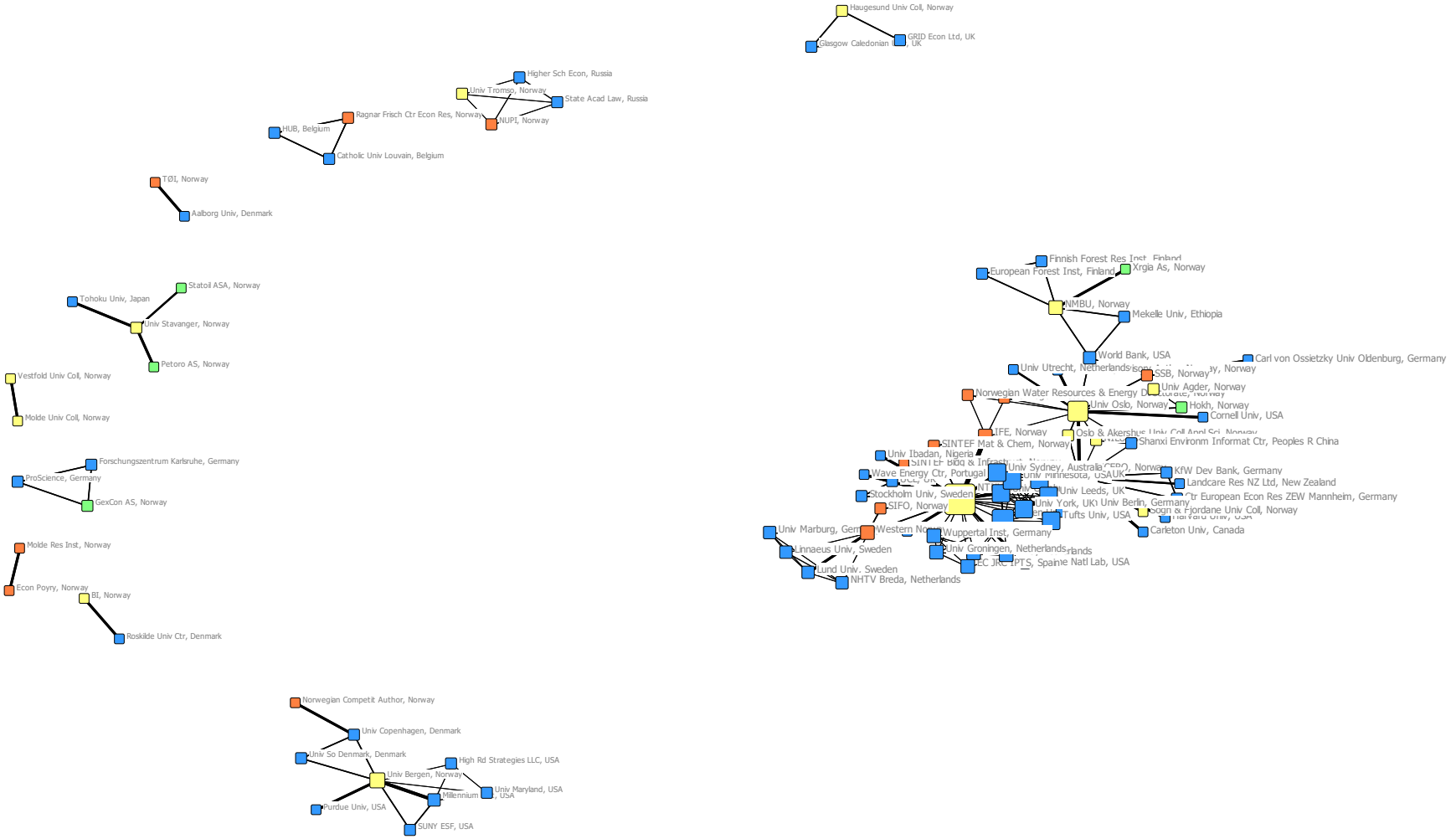
Source:NIFU

Annex 5 SNA 1999-2008 (24 papers)

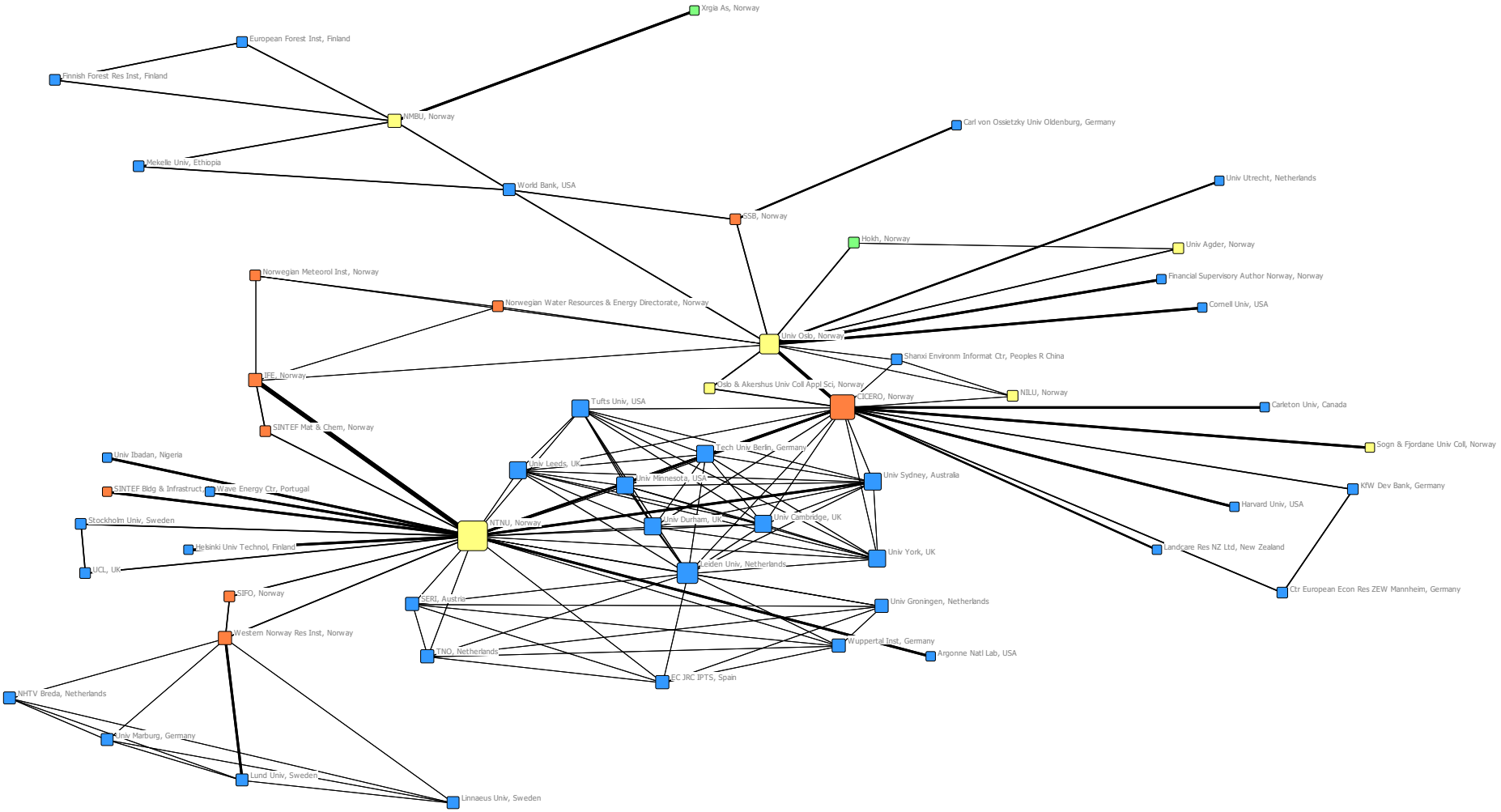


Colour codes: Yellow: Universities, Orange: Research institutes, Green: Firms, Blue: Foreign partners

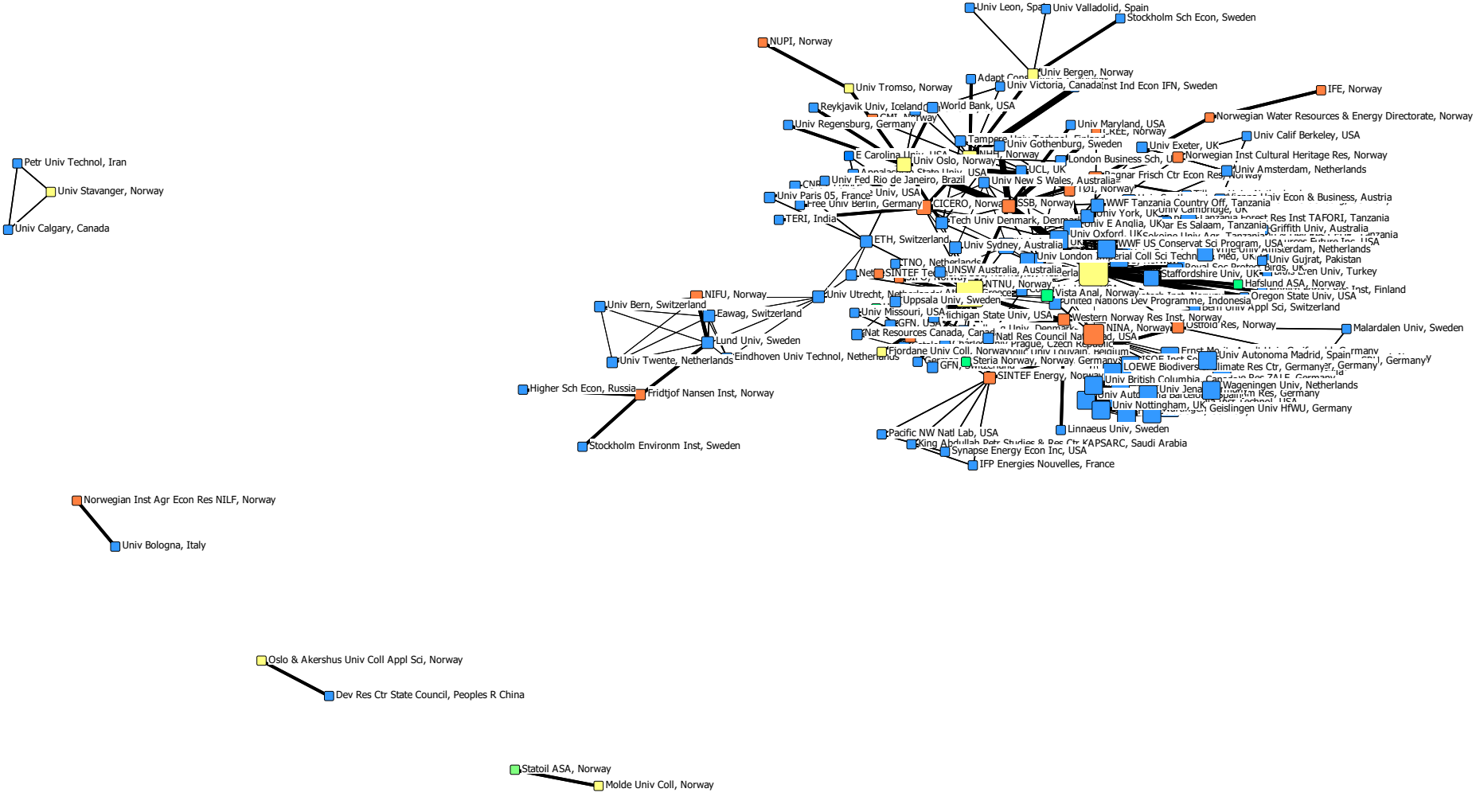
Annex 6 SNA 2009-2011 (58 papers)



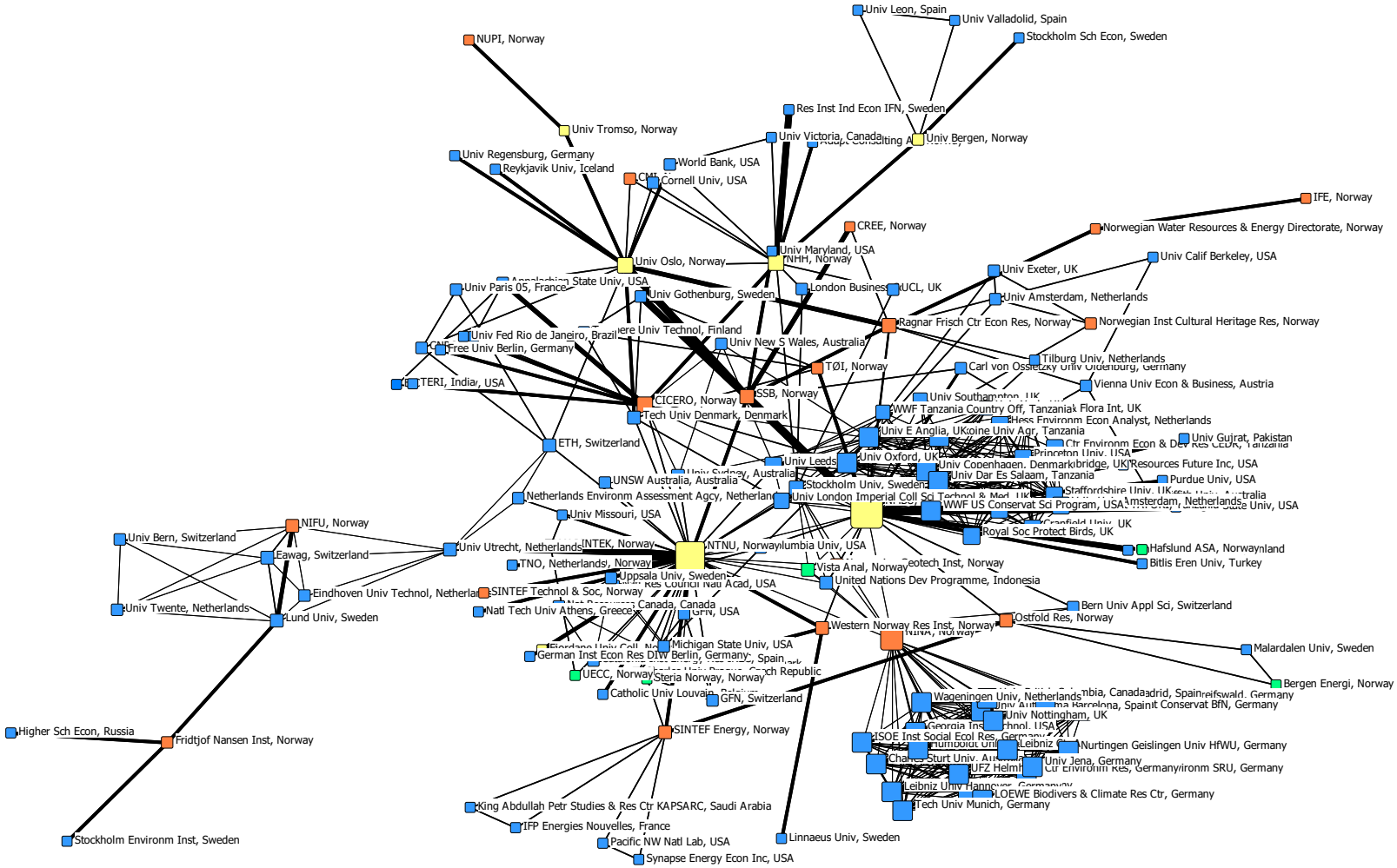
Annex 7 SNA 2009-2011 of main network



Annex 8 SNA 2012-2014 (104 papers)



Annex 9 SNA 2012-2014 of main network



Annex 10 The 27 FP 7 projects that can be classified as social science research projects with Norwegian institutional addresses

1. Title: 'Fluid Foods Pasteurizer and Homogenizer based on Centrifugal Hydrocavitation Reactor'. Total costs: € 1.183 million. EC contribution: € 0.895 million. Number of participants: 8. Programme: 'SME: Research for the benefit of SMEs'. Coordinator: IT. Countries included: IE, IT, MT, NO. 1 Norwegian participant: Epleblomsten AS.

2. Title: 'Tidal Energy Converter Cost Reduction via Power Take Off Optimisation'. Total costs: € 1.349 million. EC contribution: € 1.041 million. Number of participants: 7. Programme: 'SME: Research for the benefit of SMEs'. Coordinator: UK. Countries included: NL, NO, PT, SE, UK. 1 Norwegian participant: SINTEF Energi AS (SINTEF Energy Research).

3. Title: 'Risk of Energy Availability: Common Corridors for Europe Supply Security'. Total costs: € 4.085 million. EC contribution: € 3.022 million. Number of participants: 16. Programme: 'ENERGY: Energy'. Coordinator: IT. Countries included: AT, DE, EL, ES, FI, FR, IT, KZ, NO, RU. 1 Norwegian participant: Institutt for energiteknikk (Institute for Energy Technology), Kjeller.

4. Title: 'Barriers for energy changes among end consumers and households'. Total costs: € 2.002 million. EC contribution: € 1.457 million. Number of participants: 8. Programme: 'ENERGY: Energy'. Coordinator: NO. Countries included: CH, FR, HU, NL, NO, UK. 1 Norwegian participant: SIFO Statens institutt for forbruksforskning (National Institute for Consumer Research).

5. Title: 'Sustainable Refurbishment of Building Facades And External Walls'. Total costs: € 3.420 million. EC contribution: € 2.652 million. Number of participants: 11. Programme: 'ENV: Environment (including Climate Change)'. Coordinator: FI. Countries included: EE, ES, FI, NO, UK. 2 Norwegian participants: Trondheim og Omegn Boligbyggelag, Stiftelsen SINTEF.

6. Title: 'Initial Training Network for Wave Energy Research Professionals'. Total costs: € 3.580 million. EC contribution: € 3.580 million. Number of participants: 13. Programme: 'PEOPLE: Marie-Curie Actions'. Coordinator: PT. Countries included: DK, ES, FR, IE, NL, NO, PT, UK. 1 Norwegian participant: NTNU Norges teknisk-naturvitenskapelige universitet (Norwegian University of Science and Technology).

7. Title: 'Self learning Energy Efficient builDings and open Spaces'. Total costs: € 4.082 million. EC contribution: € 2.899 million. Number of participants: 9. Programme: 'ICT: Information and Communication Technologies'. Coordinator: ES. Countries included: DE, ES, NO, UK. 1 Norwegian participant: Universitetet i Stavanger (University of Stavanger).

8. Title: 'Development of regional and Pan-European guidelines for more efficient integration of renewable energy into future infrastructures'. Total costs: € 4.570 million. EC contribution: € 3.323 million. Number of participants: 16. Programme: 'ENERGY: Energy'. Coordinator: NO. Countries included: AT, BG, CZ, DE, ES, IT, NL, NO, PL, RO, RS, UK. 1 Norwegian participant: SINTEF Energi AS (SINTEF Energy Research).

9. Title: 'Synthetic biology – Engaging with New and Emerging Science and Technology in Responsible Governance of the Science and Society Relationship'. Total costs: € 4.590 million. EC contribution: € 3.961 million. Number of participants: 28. Programme: 'SiS: Science in Society'. Coordinator: DE. Countries included: AT, BE, CA, CH, DE, DK, FI, FR, IT, NL, NO, SE, SI, UK, US. 1 Norwegian participant: Universitetet i Bergen (University of Bergen).

10. Title: 'Innovative plasma based transformation of food waste into high value graphitic carbon and renewable hydrogen'. Total costs: € 4.841 million. EC contribution: € 3.785 million. Number of participants: 8. Programme: 'ENV: Environment (including Climate Change)'. Coordinator: UK. Countries included: DE, FR, HU, NO, UK. 2 Norwegian participants: Gasplas AS, Abalonyx AS.

11. Title: ‘ICT-based Intelligent management of Integrated RES for the smart grid optimal operation’. Total costs: € 5.223 million. EC contribution: € 3.656 million. Number of participants: 8. Programme: ‘ICT: Information and Communication Technologies’. Coordinator: ES. Countries included: EE, ES, IT, NO. 2 Norwegian participants: Stiftelsen SINTEF, Nord-Trøndelag Elektrisitetsverk Holding AS.

12. Title: ‘Scalable Energy Management Infrastructure for Aggregation of Households’. Total costs: € 5.378 million. EC contribution: € 3.764 million. Number of participants: 12. Programme: ‘ICT: Information and Communication Technologies’. Coordinator: DK. Countries included: CH, DE, DK, NO. 3 Norwegian participants: Devoteam Solutions AS, Universitetet i Agder (University of Agder), Agder Energi Nett AS.

13. Title: ‘Equitable Testing and Evaluation of Marine Energy Extraction Devices in terms of Performance, Cost and Environmental Impact’. Total costs: € 5.482 million. EC contribution: € 3.990 million. Number of participants: 23. Programme: ‘ENERGY: Energy’. Coordinator: UK. Countries included: BE, DK, ES, FR, IE, IT, NL, NO, PT, SE, UK. 1 Norwegian participant: DNV GL AS.

14. Title: ‘Food Refrigeration Innovations for Safety, consumer Benefit, Environmental impact and Energy optimization along cold chain in Europe’. Total costs: € 8.166 million. EC contribution: € 5.992 million. Number of participants: 26. Programme: ‘KBBE: Food, Agriculture, and Biotechnology’. Coordinator: FR. Countries included: BE, CZ, EL, ES, FR, HU, IT, NL, NO, TR, UK. 2 Norwegian participants: Fatland Jæren AS, SINTEF Energi AS (SINTEF Energy Research).

15. Title: ‘Demonstration of a cost effective medium size Chemical Looping Combustion through packed beds using solid hydrocarbons as fuel for power production with CO2 capture’. Total costs: € 8.194 million. EC contribution: € 5.305 million. Number of participants: 11. Programme: ‘ENERGY: Energy’. Coordinator: NO. Countries included: BE, ES, FR, IT, NL, NO, PL. 1 Norwegian participant: Stiftelsen SINTEF.

16. Title: ‘Global Re-ordering: Evolution through European Networks’. Total costs: € 10.159 million. EC contribution: € 7.945 million. Number of participants: 16. Programme: ‘SSH: Socio-economic sciences and Humanities’. Coordinator: UK. Countries included: AR, AU, BE, CN, DK, ES, HU, IT, JP, NL, NO, SG, UK, US, ZA. 1 Norwegian participant: NUPI Norsk Utenrikspolitisk Institutt (Norwegian Institute of international affairs).

17. Title: ‘Towards COast to COast NETworks of marine protected areas (from the shore to the high and deep sea), coupled with sea-based wind energy potential’. Total costs: € 11.323 million. EC contribution: € 9.000 million. Number of participants: 39. Programme: ‘KBBE: Food, Agriculture, and Biotechnology’. Coordinator: IT. Countries included: AL, BE, BG, DE, DK, EL, ES, FR, GE, HR, IL, IT, MA, ME, MT, NO, RO, RU, TN, TR, UA, UK. 1 Norwegian participant: Stiftelsen Nansen Senter For Miljø og Fjernmåling.

18. Title: ‘nearly Zero energy Neighborhoods’. Total costs: € 15.678 million. EC contribution: € 9.470 million. Number of participants: 12. Programme: ‘ENERGY: Energy’. Coordinator: ES. Countries included: ES, FR, NO, PL, SE. 3 Norwegian participants: NTNU Norges teknisk-naturvitenskapelige universitet (Norwegian University of Science and Technology), Stiftelsen SINTEF, Oslo kommune.

19. Title: ‘Smart Power Management in Home and Health’. Total costs: € 19.827 million. EC contribution: € 3.311 million. Number of participants: 18. Programme: ‘SP1-JTI: Joint Technology Initiatives (Annex IV-SP1) ’. Coordinator: DE. Countries included: BE, DE, ES, FR, IE, IT, NL, NO, SE. 2 Norwegian participants: Stiftelsen SINTEF, GE Vingmed Ultrasound AS.

20. Title: ‘Arrowhead’. Total costs: € 67.539 million. EC contribution: € 11.279 million. Number of participants: 82. Programme: ‘SP1-JTI: Joint Technology Initiatives (Annex IV-SP1)’. Coordinator: SE. Countries included: AT, BE, CZ, DK, ES, FI, FR, HU, IT, LV, NL, NO, PT, SE, UK. 3 Norwegian participants: Lyse Energi AS, Stiftelsen SINTEF, NorDan AS.

21. Title: ‘Monitoring and Evaluation of Spatially Managed Areas (MESMA)’. Total costs: € 8.641 million. EC contribution: € 6.569 million. Number of participants: 21. Programme: ‘ENV: Environment (including Climate Change)’. Coordinator: NL. Countries included: BE, BG, DE, DK, EL, ES, IE, IT, MT, NL, NO, PL, UK. 2 Norwegian participants: Norsk institutt for vannforskning (NIVA), Havforskningsinstituttet (Institute of Marine Research).

22. Title: ‘Development and application of standardized methodology for the PROspective SUstaInability assessment of TEchnologies’. Total costs: € 6.330 million. EC contribution: € 4.782 million. Number of participants: 25. Programme: ‘ENV: Environment (including Climate Change)’. Coordinator: NL. Countries included: AT, BE, CH, DE, DK, EL, ES, FI, FR, HU, NL, NO, PT, SE, US. 1 Norwegian participant: NTNU Norges teknisk-naturvitenskapelige universitet (Norwegian University of Science and Technology).

23. Title: ‘Advanced Model Development and Validation for Improved Analysis of Costs and Impacts of Mitigation Policies’. Total costs: € 7.426 million. EC contribution: € 5.699 million. Number of participants: 14. Programme: ‘ENV: Environment (including Climate Change)’. Coordinator: DE. Countries included: AT, DE, EL, EU, FR, IT, NL, NO, UK. 1 Norwegian participant: NTNU Norges teknisk-naturvitenskapelige universitet (Norwegian University of Science and Technology).

24. Title: ‘Logistics for Energy Crops’ Biomass’. Total costs: € 5.086 million. EC contribution: € 3.499 million. Number of participants: 23. Programme: ‘KBBE: Food, Agriculture, and Biotechnology’. Coordinator: FR. Countries included: BE, DK, ES, FI, FR, IT, NL, NO, PL, UK. 2 Norwegian participants: Møre og Romsdal Biobrensel AS, Stiftelsen SINTEF.

25. Title: ‘PRACE – Third Implementation Phase Project’. Total costs: € 26.572 million. EC contribution: € 19.000 million. Number of participants: 29. Programme: ‘INFRA: Research Infrastructures’. Coordinator: DE. Countries included: AT, BE, BG, CH, CY, CZ, DE, DK, EL, ES, FI, FR, HU, IE, IL, IT, NL, NO, PL, PT, RS, SE, SI, TR, UK. 2 Norwegian participants: UNINETT Sigma2 AS, UNINETT Sigma2 AS.

26. Title: ‘Enlightenment and Innovation, Ensured through Pre Commercial Procurement in Cities’. Total costs: € 5.400 million. EC contribution: € 3.992 million. Number of participants: 16. Programme: ‘ICT: Information and Communication Technologies’. Coordinator: NL. Countries included: BE, DE, ES, FI, FR, IT, NL, NO, SE. 1 Norwegian participant: Stavanger kommune.

27. Title: ‘Accelerate SSL Innovation for Europe’. Total costs: € 4.650 million. EC contribution: € 3.780 million. Number of participants: 25. Programme: ‘ICT: Information and Communication Technologies’. Coordinator: NL. Countries included: BE, CH, DE, DK, ES, FI, FR, IT, LT, NL, NO, SE, UK. 1 Norwegian participant: Stavanger kommune.

Annex 11 The 15 H2020 projects that can be classified as social science research projects with Norwegian institutional addresses

1. Title: ‘Qualification of innovative floating substructures for 10MW wind turbines and water depths greater than 50m’. Total costs: € 7.275 million. EC contribution: € 7.275 million. Number of participants: 12. Programme: ‘ENERGY: Secure, clean and efficient energy’. Coordinator: NO. Countries included: DE, DK, ES, FR, IT, NO, UK. 2 Norwegian participants: Dr. techn. Olav Olsen AS, Norsk Marinteknisk Forskningsinstitutt AS.

2. Title: ‘ERA-NET Smart Cities and Communities’. Total costs: € 29.872 million. EC contribution: € 9.138 million. Number of participants: 18. Programme: ‘ENERGY: Secure, clean and efficient energy’. Coordinator: AT. Countries included: AT, BE, CH, CY, ES, FI, NL, NO, PT, RO, SE, TR. 1 Norwegian participant: Norges forskningsråd (Research Council of Norway).

3. Title: ‘Enabling consumer action towards top energy-efficient products’. Total costs: € 1.934 million. EC contribution: € 1.794 million. Number of participants: 17. Programme: ‘ENERGY: Secure, clean and efficient energy’. Coordinator: FR. Countries included: AT, BE, CH, CZ, DE, ES, FR, IT, LT, LU, NO, PL, PT, RO, SE, UK. 1 Norwegian participant: Norges Naturvernforbund.

4. Title: ‘Wide-Impact cyber SEcurity Risk framework’. Total costs: € 3.396 million. EC contribution: € 2.563 million. Number of participants: 7. Programme: ‘SECURITY: Secure societies – Protecting freedom and security of Europe and its citizens’. Coordinator: ES. Countries included: ES, FR, IT, NO, SI, UK. 1 Norwegian participant: Stiftelsen SINTEF.

5. Title: ‘A panEuropean framework for strengthening Critical Infrastructure resilience to climate change’. Total costs: € 7.284 million. EC contribution: € 7.284 million. Number of participants: 20. Programme: ‘SECURITY: Secure societies – Protecting freedom and security of Europe and its citizens’. Coordinator: EL. Countries included: CY, DE, EL, FR, HR, IT, NO, PL, UK. 1 Norwegian participant: Meteorologisk institutt (Norwegian Meteorological Institute).

6. Title: ‘Synergies for Europe’s Research Infrastructures in the Social Sciences’. Total costs: € 8.884 million. EC contribution: € 8.494 million. Number of participants: 6. Programme: ‘INFRA: Research infrastructures’. Coordinator: UK. Countries included: DE, NL, NO, UK. 1 Norwegian participant: CESSDA AS.

7. Title: ‘Repower Democracy: How grassroots energy initiatives are changing the face of democracy in Europe’. Total costs: € 0.196 million. EC contribution: € 0.196 million. Number of participants: 1. Programme: ‘MSCA: Marie Sklodowska-Curie actions’. Coordinator: NO. Countries included: NO. 1 Norwegian participant: Universitetet i Bergen (University of Bergen).

8. Title: ‘Developing a Pilot Case aimed at establishing a European infrastructure project for CO2 transport’. Total costs: € 0.788 million. EC contribution: € 0.788 million. Number of participants: 7. Programme: ‘ENERGY: Secure, clean and efficient energy’. Coordinator: NO. Countries included: DE, NL, NO, UK. 1 Norwegian participant: SINTEF Energi AS (SINTEF Energy Research).

9. Title: ‘Process Intensification through Adaptable Catalytic Reactors made by 3D Printing’. Total costs: € 5.494 million. EC contribution: € 5.494 million. Number of participants: 13. Programme: ‘ADVMANU: Advanced manufacturing and processing’. Coordinator: NO. Countries included: CZ, DE, ES, FR, NO, PT, UK. 2 Norwegian participants: Yara International ASA, Stiftelsen SINTEF.

10. Title: ‘Moving Towards Adaptive Governance in Complexity: Informing Nexus Security’. Total costs: € 7.458 million. EC contribution: € 7.458 million. Number of participants: 9. Programme: ‘ENV: Climate action, environment, resource efficiency and raw materials’. Coordinator: ES. Countries included: BE, DE, ES, IT, NL, NO, UK. 1 Norwegian participant: Universitetet i Bergen (University of Bergen).

11. Title: ‘Deployment of Deep Enhanced Geothermal Systems for Sustainable Energy Business’. Total costs: € 44.057 million. EC contribution: € 20.000 million. Number of participants: 10. Programme: ‘ENERGY: Secure, clean and efficient energy’. Coordinator: IS. Countries included: DE, FR, IS, IT, NO. 1 Norwegian participant: Statoil Petroleum AS.

12. Title: ‘DemoWind 2 ERA-NET Cofund action - delivering cost reduction in offshore wind’. Total costs: € 25.933 million. EC contribution: € 8.558 million. Number of participants: 8. Programme: ‘ENERGY: Secure, clean and efficient energy’. Coordinator: UK. Countries included: BE, DK, ES, NL, NO, UK. 2 Norwegian participants: Norges forskningsråd (Research Council of Norway), Enova SF.

13. Title: ‘Expertise hub for a market uptake of energy-efficient supermarkets by awareness raising, knowledge transfer and pre-preparation of an EU Ecolabel’. Total costs: € 1.468 million. EC contribution: € 1.468 million. Number of participants: 9. Programme: ‘ENERGY: Secure, clean and efficient energy’. Coordinator: NO. Countries included: BE, DE, ES, FR, IT, MK, NO, SE. 1 Norwegian participant: SINTEF Energi AS (SINTEF Energy Research).

14. Title: ‘Wind and Turbulence Radar for Offshore wind energy’. Total costs: € 0.071 million. EC contribution: € 0.050 million. Number of participants: 1. Programme: ‘ENERGY: Secure, clean and efficient energy’. Coordinator: NO. Countries included: NO. 1 Norwegian participant: Windmaster Technologies AS.

15. Title: ‘Integrating Big Data, Software and Communities for Addressing Europe’s Societal Challenges’. Total costs: € 4.984 million. EC contribution: € 4.984 million. Number of participants: 12. Programme: ‘ICT: Information and Communication Technologies’. Coordinator: DE. Countries included: AT, BE, DE, EL, ES, FR, IT, NO, UK. 1 Norwegian participant: CESSDA AS.

Annex 12 Country abbreviations

Abbreviation	Country
AL	Albania
AR	Argentina
AT	Austria
AU	Australia
BE	Belgium
BG	Bulgaria
CA	Canada
CH	Switzerland
CN	China
CY	Cyprus
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
EL	Greece
ES	Spain
FI	Finland
FR	France
GE	Georgia
HR	Croatia
HU	Hungary
IE	Ireland
IL	Israel
IS	Iceland
IT	Italy
JP	Japan
LT	Lithuania
LU	Luxembourg
LV	Latvia
MA	Morocco
ME	Montenegro
MK	Former Yugoslav Republic of Macedonia (FYROM)
MT	Malta
NL	Netherlands
NO	Norway
PL	Poland
PT	Portugal
RO	Romania
RS	Serbia
RU	Russia
SE	Sweden
SG	Singapore
SI	Slovenia
TN	Tunisia
TR	Turkey
UA	Ukraine
UK	United Kingdom
US	United States
ZA	South Africa

Annex 13 RCN project portfolio. Social science studies of energy 2004-2015. N=53

Project #	Project title	First year	Last year	Organisation	Subfield of study
158973	Not in my nature? The controversies and politics of environmentalism and public planning in localising wind farms	2004	2013	NTNU Det humanistiske fakultet	Offentlig politikk og virkemidler
173110	Potential for energy savings in Norwegian households: Effects of energy policies on consumption	2006	2010	Statistisk sentralbyrå	Offentlig politikk og virkemidler
173112	Investment in clean energy technologies under uncertainty	2006	2012	Stiftelsen Frischsenteret for samfunnsøkonomisk forskning	Teknologianalyser, innovasjon og diffusjon
174210	Discount rates for energy investments	2006	2012	Pöyry Management Consulting (Norway) AS	Markedsdesign for produksjon, omsetting og forsyning
178199	Building markets, shaping policy? The role of economics in energy policy and energy use	2007	2014	Institutt for tverrfaglige kulturstudier	Offentlig politikk og virkemidler
178374	Financial Engineering Analysis of Investment and Operations in Electricity Markets	2007	2012	Institutt for industriell økonomi og teknologiledelse	Markedsdesign for produksjon, omsetting og forsyning
178392	Emission trading in Europe: The importance of allocation rules	2007	2011	Statistisk sentralbyrå	Offentlig politikk og virkemidler
180062	Climate change Altering the Nordic Energy System	2007	2011	Fridtjof Nansens institutt (FNI)	Offentlig politikk og virkemidler
180064	The effects of Climate Change on the Norwegian Energy System towards 2050	2007	2010	Institutt for energiteknikk	Teknologianalyser, innovasjon og diffusjon
180073	Influence of climate change on growth and carbon sequestration potential of bioenergy crops	2007	2011	Norges miljø- og biovitenskapelige universitet (NMBU)	Teknologianalyser, innovasjon og diffusjon
185315	Impacts of Climate change and Energy Policies on the electricity Sector	2008	2011	Samfunns- og næringslivsforskning AS	Offentlig politikk og virkemidler

185343	Multiple instruments and the design and implementation of effective energy and climate policy	2008	2011	Statistisk sentralbyrå	Offentlig politikk og virkemidler
185371	Second Generation Biofuel - Technology Development and Impacts on Biomass markets	2008	2012	Norges miljø- og biovitenskapelige universitet (NMBU)	Teknologianalyser, innovasjon og diffusjon
185384	Subsidizing R&D and installment of carbon abatement in open economies	2008	2011	Statistisk sentralbyrå	Teknologianalyser, innovasjon og diffusjon
185397	Renewable strategies? Implementing and commercialising new energy technologies	2008	2013	NTNU Det humanistiske fakultet	Teknologianalyser, innovasjon og diffusjon
190769	Do customer information programs influence energy consumption?	2009	2012	CICERO Senter for klimaforskning	Offentlig politikk og virkemidler
190780	Electricity Demand Knowledge	2009	2013	SINTEF Energi AS	Markedsdesign for produksjon, omsetting og forsyning
190913	Linking global and regional energy Strategies	2009	2013	SINTEF Energi AS	Teknologianalyser, innovasjon og diffusjon
190977	Public Acceptance of Post Carbon Strategies	2009	2016	NTNU Det humanistiske fakultet	Teknologianalyser, innovasjon og diffusjon
190979	Reforming The EU Emissions Trading System: Causes and Consequences	2009	2012	Fridtjof Nansens institutt (FNI)	Offentlig politikk og virkemidler
190982	Towards carbon neutral settlements. Processes, concept development and implementation	2009	2013	NTNU Fakultetet for arkitektur og billedkunst	Offentlig politikk og virkemidler
192891	Samfunnsøkonomiske kostnader ved at sluttbrukere opplever avbrudd, spenningsforstyrrelser og rasjonering	2009	2012	Energi Norge	Markedsdesign for produksjon, omsetting og forsyning
195191	Transport and Environment - Measures and POlicies	2009	2015	Transportøkonomisk institutt Stiftelsen Norsk senter for samferdselsforskning	Offentlig politikk og virkemidler

199880	Towards a low carbon energy future: Norway's policy opportunities and constraints in an international comparative perspective.	2010	2014	CICERO Senter for klimaforskning	Offentlig politikk og virkemidler
199883	The EU Energy and Climate Package: Causes, Content and Consequences	2010	2014	Fridtjof Nansen stiftelsen på Polhøgda	Offentlig politikk og virkemidler
199904	Modelling and forecasting risk in electricity, carbon and related energy markets (Oil, Gas, Coal)	2010	2014	NTNU Fakultet for samfunnsvitenskap	Markedsdesign for produksjon, omsetting og forsyning
199908	Investment in renewable electricity under climate policy uncertainty	2010	2014	NTNU Fakultet for samfunnsvitenskap	Markedsdesign for produksjon, omsetting og forsyning
199911	Diffusion of climate technologies	2010	2013	Statistisk sentralbyrå	Teknologianalyser, innovasjon og diffusjon
200599	IPCC-SRREN Special Report on Renewable Energy Sources and Climate Change Mitigation	2010	2011	Klima og forurensningsetaten - Oslo	Teknologianalyser, innovasjon og diffusjon
200601	Socio-Economic Drivers in Implementing Bioenergy Projects? Norwegian participation in IEA Bioenergy Task 29 2010-2012	2010	2013	Energigården - Senter for bioenergi AS	Teknologianalyser, innovasjon og diffusjon
200609	Verdien av fleksibel vannkraft i et marked med kortsiktig prisvariasjon	2010	2014	Energi Norge AS	Systemer Balansetjenester
206998	Environmental Sustainability Benchmarking of Low-Carbon Energy Technologies	2011	2014	NTNU Fakultet for ingeniørvitenskap og teknikk	Bærekraft og ressurseffektivitet
207022	Household response to multiple environmental policy instruments	2011	2013	Statistisk sentralbyrå	Offentlig politikk og virkemidler

207052	Renewable energy as transition strategy	2011	2015	Senter for teknologi, innovasjon og kultur (TIK-senteret)	Teknologianalyser, innovasjon og diffusjon
207067	The future Norwegian energy system in a European context	2011	2016	Institutt for energiteknikk	Teknologianalyser, innovasjon og diffusjon
207774	Sustainable Grid Development	2011	2016	SINTEF energi AS	Systemer Smartnett
215947	Participation in IEA's Energy Systems Technology Analysing Programme (ETSAP)	2012	2016	Institutt for energiteknikk	Teknologianalyser, innovasjon og diffusjon
216473	Energy savings - from regulation to realization	2012	2015	CICERO Senter for klimaforskning	Offentlig politikk og virkemidler
216483	Intermittent Renewables, Balancing Services, and Electricity Market Design	2012	2016	Samfunns- og næringslivsforskning AS	Markedsdesign for produksjon, omsetting og forsyning
216513	Regional effects of energy policy	2012	2016	SINTEF Teknologi og samfunn avd Trondheim	Teknologianalyser, innovasjon og diffusjon
228803	Europeanisation of energy-technological innovation systems: drivers, consequences and strategic challenges for Norway	2014	2017	Fridtjof Nansen stiftelsen på Polhøgda	Teknologianalyser, innovasjon og diffusjon
228810	Uncertainties in the European Energy Market: Modeling approaches and policy issues	2013	2016	Stiftelsen Frischsenteret for samfunnsøkonomisk forskning	Markedsdesign for produksjon, omsetting og forsyning
228811	Investment under uncertainty: EU renewable energy and climate policies beyond 2020	2013	2016	NTNU Fakultet for samfunnsvitenskap	Offentlig politikk og virkemidler
235471	A NEW ANALYTIC APPROACH FOR THE GREEN CERTIFICATE MARKET	2014	2015	Optimering AS	Offentlig politikk og virkemidler
243626	Security of supply in a green power market - The challenges and opportunities of intermittent power	2015	2018	Stiftelsen Frischsenteret for samfunnsøkonomisk forskning	Markedsdesign for produksjon, omsetting og forsyning

243756	Revising the National Renewables Policy Mix: The role of state aid and other key EU policies (REMIX)	2015	2018	CICERO Senter for klimaforskning	Offentlig politikk og virkemidler
243947	Power from the People? Driving forces and hindrances.	2015	2018	CICERO Senter for klimaforskning	Teknologianalyser, innovasjon og diffusjon
243964	Day-Ahead Bidding with Multiple Short-Term Markets	2015	2019	SINTEF Energi AS	Systemer Balansetjenester
243994	Integration of Power Transmission Grids - Prospects and Challenges at National and European Levels in advancing the energy transition	2015	2019	Senter for teknologi, innovasjon og kultur (TIK-senteret)	Teknologianalyser, innovasjon og diffusjon
244050	Sustainable governance of river basins with Hydropower production	2015	2018	SINTEF ENERGI AS	Bærekraft og ressurseffektivitet
244074	Comparative climate impact assessment of the forest based bio-economies of Norway, Sweden and Finland	2015	2018	Institutt for energi- og prosessteknikk	Bærekraft og ressurseffektivitet
244109	Towards sustainable renewable energy production: Developing a Life Cycle Impact Assessment framework for biodiversity impacts	2015	2019	Institutt for energi- og prosessteknikk	Bærekraft og ressurseffektivitet
245448	A New Model For Power Markets Under Uncertainty	2015	2017	Optimering AS	Markedsdesign for produksjon, omsetting og forsyning

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