Synthesis report of Flagship III:

Green innovations and utilization of smart technologies

1. Overview

Achieving ambitious environmental and climate goals requires broad adoption of environmentally friendly and energy efficient technologies in homes and businesses. This Flagship aims to increase our understanding of how policies can motivate research, development and diffusion of both low-emission technologies and technologies aiming at lowering energy consumption. What impact will economic factors, habits and norms have on development and utilization of new technologies? How do firms and consumers use and respond to new technologies? To what extent does adoption of the new technologies reduce energy demand?

Bente Halvorsen

The Flagship is led by senior researcher, Dr. Bente Halvorsen, and include a broad collaboration across research partners, user partners and contractors. The work on this Flagship has involved researchers from all CREE's four research partners, both national and international, as well as user partners and sub-contractors from multiple disciplines. The research spans from traditional economic analysis to multi- and coauthored interdisciplinary analyses. The Flagship constitutes of 13 independent projects applying a variety of analytical and empirical approaches. Four of these projects were conducted in close collaboration with user partners, five included researches who were not economists, contributing to interdisciplinary analysis within CREE, and two projects involved international research partners. The work on these projects has resulted in several publications (see Appendix). As of November 2019, a total of 65 publications have been produced, of which 20 has been published in international journals and four as contributions to international books. The collaboration with user partners has taken many forms and resulted in various meetings and presentations, collaborations on constructing novel data sets, as well as research proposals and project collaborations. The sections 3.1, 3.3 and 3.4 give closer descriptions of three of these collaborations; one with a user partner, one international collaboration and one interdisciplinary collaboration with a sub-contractor. The Flagship has also financed 7 Master students, and three of our PhD candidates has written publications on topics related to Flagship III.

We are also proud to report that the 2017 Erik Kempe Award for "the best paper in the field of environmental and resource economics, published in the previous two years in a refereed journal by an author affiliated to a European research institution" was given to the two CREE researchers, Mads Greaker and Kristoffer Midttømme, for an article published in Journal of Public Economics on topics related to Flagship III (see section 3.2 for more information).

2. Research questions and main results

The research on this Flagship has focused on two major themes: Innovation and diffusion of green technologies, and how green technologies affect energy use. Research and Development (R&D) in a firm creates new knowledge, which also benefits other firms, and thus entails a positive externality in society. A main reason to support private R&D is that the innovator will in general not be able to appropriate the full social benefit of the innovation. In economics, this is usually referred to as the appropriability problem, and it provides a rationalization for the government to support private R&D. This research examines how policies should be designed to overcome the appropriability problem. An important aspect of the research is to see the design of Research, Development and Diffusion (R&D&D) instruments in relation to other environmental policies. A key research topic is therefore the optimal design of the R&D&D policy instruments.

Development of new and more environmentally friendly technologies is a premise for achieving a green transition, but no guarantee. To ensure the desired development, the technology needs to be widely spread and used in the desired way. As most economic decisions are left to consumers and producers, the diffusion and use of an environmentally friendly technology depends on how it meets the wants and needs of the public, given their preferences, costs considerations, income/profits and what alternative technologies are available. An important research topic is thus how these new technologies are speed and used in society, and how this affects the use of different energy sources.

2.1 Main results: Innovation and diffusion of green technologies

Like other types of R&D, environmentally-friendly R&D is also characterized by market failures and obstacles. In many regions, renewable energy targets are a primary decarbonization policy. Another instrument that might trigger more use of renewable energy is simply a subsidy on use of renewable energy and/or on production of renewable energy capital. Fischer et. al (2018) demonstrate that under imperfect competition upstream, subsidies may improve welfare both globally and nationally. From a national point of view, Fischer et. al finds that upstream subsidies (support to producers) are preferred over downstream subsidies (support to users) of renewable energy. We have also conducted a study on how patents work together with R&D subsidies and climate policy (Gerlagh et. al, 2014). If the emission price is set according to the marginal damage of the emissions, the optimal level of R&D subsidies and patent lifetime change over time: In the early stages of clean energy development, innovators find it more difficult to capture the social value of their innovations. Thus, for a given finite patent lifetime optimal clean energy R&D subsidies are initially high, but then fall over time. Alternatively, if research subsidies are kept constant, the optimal patent lifetime should initially be long and fall over time.

Whereas research subsidies are standard policy instruments, innovation prizes have not been much discussed in the literature. With an innovation prize, the actor receives an amount of money from the regulator/government if he/she succeeds in developing a new technology that meets some pre-specified technical conditions. The innovator invests in R&D to develop a new technology, being aware that an innovation prize will be received if he is successful. Golombek et al. (2015) show that the regulator can design an innovation prize that solves the appropriability problem. Further, conditions under which an innovation prize for environmental R&D should be greater than an innovation prize aimed to lower cost of production for standard market goods are identified, and how these conditions depend on i) heterogeneity among users of the technology, and ii) the environmental policy instrument of the regulator. The article also shows how an innovation prize can be combined with a diffusion subsidy to reach the social efficient outcome of R&D&D.

Design of instruments to promote more CCS is another key research topic. This technology has been seen by the IEA and the EU as having the potential to bridge the gap between the current carbon-based society and a future low-carbon society. Using CCS electricity technologies, either with coal or natural gas as the fuel, may reduce emissions by as much as 90 percent relative to standard fossil-fuel based technologies. One main disadvantage of CCS is high costs. These may, however, be lower through continued R&D. An important question is then whether CCS should be prompted through subsidizing the producers of CCS technology (upstream subsidy) or through subsidizing the use of CCS technology (downstream subsidy). Golombek et. al (2016) have shown that for the EU it is optimal to offer an upstream subsidy to the EU producers, but no downstream subsidy. By offering an upstream subsidy to the EU producers, production is shifted from the non-EU producers to the EU producers, thereby shifting profits to the EU producers and at the same time gaining consumers because total production increases.

Econometric analysis on the efficiency of Norwegian policy instruments to promote R&D in firms are also conducted on this Flagship. Klemetsen et. al (2018) study empirically how environmental regulations may trigger more environmentally friendly R&D, measured by number of patents. The results indicate that indirect regulations will only have potential persistent effects if environmental taxes are increasing over time. Thus, technology standards and non-tradable emission permits may be a useful complement to market-based instruments in spurring innovation in environmentally friendly technologies (see also section 3.1). Klemetsen (2015) examines the impact of R&D tax credits and direct R&D subsidies on Norwegian firms' patenting. For environmental patenting, the study found no significant effects of tax credits, whereas the effects of direct subsidies are large and significant.

Some argue that environmental R&D should take precedence over market goods R&D in subsidy programs. Unless there is reason to believe there is a systematic difference in the magnitude of these market failures between the two cases, these market failures should not lead to any systematic difference in the incentives for environmental R&D and for market goods R&D. Greaker and Hoel (2011) discuss a potential difference between the market goods case and the environmental technology case, namely the way in which demand for the new innovation is determined. They show that the assumption that incentives for environmental R&D are lower than incentives for market goods R&D is not generally true. This holds independent of the type of environmental policy instrument being used. Greaker et. al (2017) illustrate another situation where the governments should prioritize clean R&D. Dealing with major environmental problems requires a R&D shift towards clean technology. In the case where most researchers are working with developing clean technology, both productivity spillovers and the risks of future replacement increase. Consequently, the gap between the private and social values of an innovation is greatest for clean technologies as compared to other technology developments.

To sum up, the research finds that both innovation prizes, technology standards and non-tradable emission permits may be important policy instruments to trigger more environmentally-friendly R&D as an alternative to, or in combination with, more traditional subsidies and taxes. The research also finds a clear preference to up-stream (producer) subsidies as compared to down-stream (user) subsidies to enhance the environmentally friendly R&D activities in the economy.

2.2 Main results: Green technologies and energy use

The installation and utilization of environmentally friendly technology in households and firms is necessary for accomplishing the green transition. Thus, the other main field of research in this Flagship is how new technology is used in households and firms, and how this affects energy consumption. One of the major topics of this research has been rebound and adverse effects of energy efficiency measures on energy consumption. These effects occur because increased efficiency decreases the cost of using energy to produce goods and services. In our research, the rebound effects have been exemplified by the effect on household energy consumption of having invested in a heat pump. We have conducted both economic and anthropological analyses on this topic (Halvorsen et. al 2016, Winther and Wilhite 2015, Halvorsen and Larsen 2013, Bøeng et. al 2013). We find large rebound effects of heat pump ownership, and on average, electricity consumption is unchanged after installing a pump. This is partly due to reduced use of alternative fuels like firewood and fuel oils, but also a result of an increase in the heated area and higher average indoor temperature in the residence. These findings seem to be robust with respect to analytical approach, as we find the same effects both in economic and anthropological analyses. Similar results are found in a study analyzing factors effecting residential indoor temperature, where we find that the indoor temperature varies with the heating equipment (Halvorsen and Dalen 2013). Households with a common central heating system is the group with the highest indoor temperature, followed by households with a heat pump. On the other end of the spectrum, households that use a lot of firewood for heating have the lowest average temperature in the living room on cold winter mornings.

Another important topic of this research has been behavioral responses to soft policy tools (i.e. to increase awareness) to reduce energy consumption. Using anthropological methods, Westskog et. al (2015) have analyzed how households relate to electricity meters showing energy consumption by various activities. They find that households are concerned with the information provided, and especially seems to appreciate information about costs. Winther and Belle (2017) use qualitative data from Norway and the United Kingdom to analyze how the new technology of in-home display monitors may affect social practices and relations. A key question is whether the display triggers a new practice of monitoring electricity consumption. Among both groups, many participants gave detailed accounts of how they monitored the displays. The regular consulting of displays suggest that monitoring electricity became a new routine for many of the participating households. This conclusion was strengthened by the observation that the Norwegian flat-owners continued to use less electricity than their neighbors up to one year following the installation of the new meter display.

A new technology may only affect energy consumption if it fulfills the wants and needs of its user. The ability of the technology to reduce energy use thus depends on the publics preferences. We find that households concerned about costs tend to invest in heat pumps more than others, whereas environmental concerns are paramount in explaining purchase of wood pellets stoves (Lillemo et. al 2013). We also find that the main reason very few households chose to purchase a pellets stove, despite the investment subsidy, is that alternative heating equipment are viewed as better or more desirable (Lillemo et. al 2011). A study comparing the distribution of electricity on different end-uses for the years 1990, 2001 and 2006 find that electricity for basic use, such as washing, cooling of food and heating of water, does not vary much over the period (Dalen and Larsen 2015). Total energy consumption for heating purposes is also quite stable over the period. However, electricity for heating may vary considerably across years, depending on relative energy prices and temperature.

With respect to how policies affect technology choices in firms, Storrøsten (2012) finds that tradable emissions permit and an emissions tax affect the technology choice differently under uncertainty. A tax encourages the most flexible abatement technology if and only if stochastic costs and the equilibrium permit price have sufficiently strong positive covariance, compared with the variance in consumer demand for the good produced. Moreover, the regulator may not, in general, be able to design tradable emissions permits and an emissions tax such that the two regimes are equivalent when technology choice, uncertainty and the product market are considered. Finally, the firms' technology choices are socially optimal under tradable emissions permits, but not under an emission tax.

To sum up, the research conducted illustrates that policy measures may help facilitate a green transition with respect to energy use, but that the policy measures must be carefully designed to reduce behavioral barriers and avoid undesired side effects, such as rebound effects. Our research indicates that subsidizing the purchase of a particular equipment is no guarantee for its diffusion if the potential buyers perceive alternative technologies as superior or more desirable. This was the case for pellet stoves, where the Norwegian public preferred to buy heat pumps instead in spite of a subsidy on pellet stove purchases. Given that a household or a firm has chosen to install more energy efficient equipment, we find (in some cases) very strong rebound effects, as the new technology may change how they choose to use energy after the equipment is installed. Some of these changes may be desired (e.g. increased energy efficiency) whereas others are more discussable (e.g. increased share of electricity for heating). We also find that increased information about personal electricity use in the form of more advanced meter displays affects how the households use electricity in their homes.

3. Highlighted publications

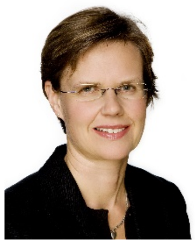
The discussion above gives a broad overview of the research that has been conducted on topics related to Flagship III since CREE was established in 2011. Now, we will look closer at four of the publications, illustrating different aspects of our research. The first is the research of a PhD students who, in close collaboration with one of our user partners, has developed a novel panel data set which contains important information about how governmental regulations affect R&D activities in firms. The second example is an award-winning article, also coauthored by one of our PhD student. The third article is an example of how new networks built within CREE resulted in international collaborations. Finally, we describe an interdisciplinary article which is a result of the collaboration that was established between CREE and the MILEN center at the University of Oslo.

3.1 Direct regulations and environmentally friendly innovations

Marit Klemetsen is one of the three PhD candidates working on topics related to Flagship III. She used a novel data set containing information about direct environmental regulations at a firm level as well as information on the type and number of patent applications. She had a close collaboration with the Norwegian Environment Agency, which is one of CREE's user partners, when collecting information about the environmental regulations to construct the regulatory part of her data set. Based on this collaboration, she (co)authored four articles forming her PhD thesis "Impacts of policies on emissions and environmental innovation in Norway", which she defended 6. June 2016.

Marit Klemetsen

One of the articles looks at how direct regulations affect environmentally friendly innovations.[1] It provides new evidence on the role of direct (command-and-control) regulations in relation to innovations in environmental technologies. While pricing is generally considered the first-best policy instrument, direct regulations, such as technology standards and non-tradable emission quotas, are common when a regulator faces multiple emission types and targets, heterogeneous recipients, or uncertainty about marginal damages. Using this rich Norwegian panel dataset that includes information about the type and number of patent applications, direct environmental regulations and many control variables, the article analyze the effects of direct regulations on environmental patenting. Inspection violation status was used as a measure of regulatory stringency, while controlling for risk class. Violation status captures the probability that a firm might be sanctioned for violating its emission permit. Controlling for risk class captures firm heterogeneity related to dirtiness and inspection frequency. The analysis empirically identifies strong and significant effects on innovations resulting from the implicit regulatory costs of direct regulations.

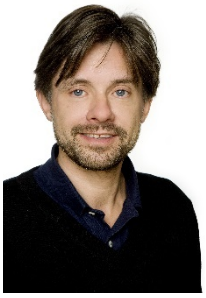


Brita Bye

[1] *Klemetsen M. E., B. Bye and A. Raknerud (2018): «Can Direct Regulations Spur Innovations in Environmental Technologies? A Study on Firm-Level Patenting", Scandinavian Journal of Economics 120(2), 1-34.*

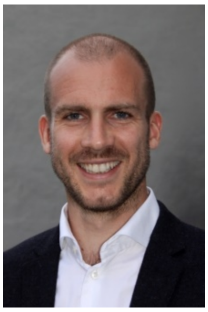
3.2 Optimal taxation of network externalities

The 2017 Erik Kempe Award was given to the two CREE researchers Mads Greaker and Kristoffer Midttømme for their article "Optimal Environmental Policy with Network Effects: Will Pigouvian Taxation Lead to Excess Inertia?" published in Journal of Public Economics.[2] This article is a part of Midttømmes PhD dissertation, which he defended 25. September 2015.



Mads Greaker

The article studies the diffusion of a clean substitute to a dirty durable in a dynamic model. Consumer utility of both durables increases in their respective market shares due to network effects. First, the optimal dirty good tax is characterized. The tax should achieve a long run optimal division of the market between the two goods. Along the transition path to this steady state the optimal tax depends on the current and future market shares of the clean durable. Thus, even if the marginal environmental damage from an additional dirty durable is constant, the optimal tax should not be constant. Second, the article studies whether excess inertia can occur if the emission tax is not optimally set. The authors find that a constant tax that only accounts for the environmental damage caused by the dirty good may lead to excess inertia. Excess inertia could happen even if the clean technology is proprietary, and the technology owner has incentives to sponsor the initial market diffusion of the technology.



Kristoffer Midttømme

The Nomination Committee gives the following motivation for the award: "Mads Greaker and Kristoffer Midttømme receive the Erik Kempe Award for a novel and insightful contribution to the literature on environmental tax policy, which focuses on economies with network goods. They characterize the optimal tax on an externality-generating good in this environment. They also show, by means of numerical simulations that are calibrated to the adoption of electric vehicles in Norway, that network effects may temporarily motivate much higher taxes than suggested by standard Pigouvian formulas, and that suboptimal tax policies neglecting these network effects may hinder the diffusion of clean substitutes for the dirty technology. As such, Greaker and Midttømme have contributed to the academic literature by examining optimal taxation of externality-generating goods in a novel and arguably important setting, and by addressing a timely policy problem of clear practical relevance."

3.3 Using technology subsidies to avoid leakage

Several projects have a close collaboration between Norwegian and international researchers; both with our research partner at the Tilburg Sustainability Center as well as with other international researchers. One of these researchers is Carolyn Fischer at Resources for the Future. In a study recently published in Journal of Environmental Economics and Management, Fischer coauthored an article with CREE researchers Mads Greaker and Knut Einar Rosendahl discussing using technology subsidies to avoid carbon leakages.[3]

Carolyn Fischer

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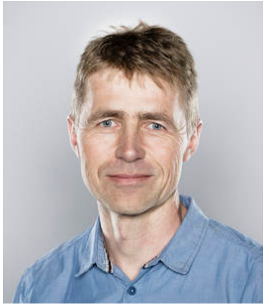
[2] *Greaker, M. and K. Midttømme (2016): "Optimal Environmental Policy with Network Effects: Will Pigouvian Taxation Lead to Excess Inertia?", Journal of Public Economics 143, 27-38.*

[3] *Fischer, C., M. Greaker and K.E. Rosendahl (2017): "Robust technology policy against emission leakage: The case of upstream subsidies", Journal of Environmental Economics and Management 84, 44-61.*

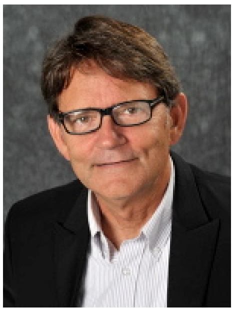
Asymmetric regulation of a global pollutant between countries can alter the competitiveness of industries and lead to emissions leakage, which hampers countries' welfare. In order to limit leakage, governments consider supporting domestic trade-exposed firms by subsidizing their investments in abatement technology. The suppliers of such technologies tend to be less than perfectly competitive, particularly when both emissions regulations and advanced technologies are new. In this context of twin market failures, this article considers the relative effects and desirability of subsidies for abatement technology. It finds a more robust recommendation for upstream subsidies than for downstream subsidies. Downstream subsidies tend to increase global abatement technology prices, reduce pollution abatement abroad and increase emission leakage. On the contrary, upstream subsidies reduce abatement technology prices, and hence also emissions leakage.



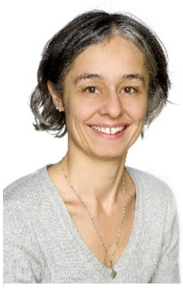
Knut Einar Rosendahl

3.4 Green technology investments and household energy practices

Throughout the entire period, CREE researchers have had a close interdisciplinary collaboration with anthropologists at Centre for Development and Environment (SUM) at the University of Oslo. SUM has been one of the main Norwegian sub-contractors for CREE from the start in 2011 until now. The main research topic analyzed in this collaboration is household behavior related to energy consumption. The collaboration has resulted in several multi- and interdisciplinary publications. Here, we present one of these papers, analyzing changes in energy practices resulting from the use of heat pumps in Norwegian households, and how this introduction of green technology affects household energy consumption.[4]

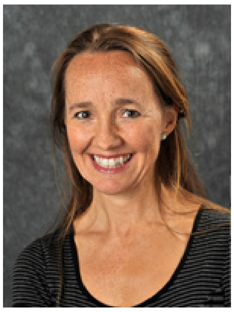


Harold Wilhite



Bodil Larsen

In this article, an interdisciplinary team of economists and anthropologists, study the case of Norwegian households' use of heat pumps. The heat pump is a technology that has the potential to reduce electricity consumption by up to 25% compared to conventional electric heating, but, as demonstrated in this study, when taken into use it results in little or no change in electricity consumption. To explain this large rebound effect, we use a quantitative economic analysis combined with qualitative interviews attuned towards examining the effect of heat pumps on people's everyday practices. We find that, on average, households with and without a heat pump use approximately the same amount of electricity. The main sources of rebound identified were higher indoor temperature and heated living space, less firewood and fuel oil use and less use of night set-backs and reduced temperature while away from the home. This implies that welfare and the energy efficiency of residential space heating have increased and that total residential energy consumption is reduced because of increased use of heat pumps in Norwegian homes.



Tanja Winther

[4] *Halvorsen, B., B. Larsen, H.L. Wilhite, T. Winther (2016): Revisiting household energy rebound: Perspectives from a multidisciplinary study, Indoor and Built Environment 27(7), 1114-1123.*

Appendix: Tables

Table A1: Publications under Flagship III by 1. November 2018.

Author	Title	Publication	Year
1. Scientific Journals			
Fischer, C., M. Greaker and K.E. Rosendahl	Strategic Environmental Technology Policy as a Supplement to Green Certificates	Resource and Energy Economics 51, pp 84-98	2018
Klemetsen M. E., B. Bye and A. Raknerud	Can Direct Regulations Spur Innovations in Environmental Technologies? A Study on Firm-Level Patenting	Scandinavian Journal of Economics, pp 1-34	2018
Fischer, C., M. Greaker and K.E. Rosendahl	Robust technology policy against emission leakage: The case of upstream subsidies	Journal of Environmental Economics and Management 84, pp 44-61	2017
Greaker,M., T. R. Heggedal and K. E. Rosendahl	Environmental Policy and the Direction of Technical Change	Scandinavian Journal of Economics	2017
Green R., I. Staffell	“Prosumage” and the British Electricity Market	Economics of Energy & Environmental Policy 6(1)	2017
Winther, T. and S. Bell	(In press): Domesticating In Home Displays in selected British and Norwegian households.	Journal of Science and Technology Studies 31(2)	2017
Fæhn, T. and E. T. Isaksen	Diffusion of climate technologies in the presence of commitment problems.	Energy Journal 37(2), pp 155-180	2016
Greaker, M. and K. Midttømme	Network effects and environmental externalities: Do clean technologies suffer from excess inertia?	Journal of Public Economics 143, pp 27-38	2016
Halvorsen, B., B. Larsen, H.L. Wilhite and T. Winther	Revisiting household energy rebound: Perspectives from a multidisciplinary study.	Indoor and Built Environment 25(7), pp 1114-1123.	2016
Dalen H.M. and B.M. Larsen	Residential End-use Electricity Demand: Development over Time.	Energy Journal 36(4), 165-182	2015
Westskog, H., T. Winther and H. Sæle	The effects of In-Home Displays - Revisiting the Context.	Sustainability 7(5), pp 5431-5451	2015
Winther, T. and H. Wilhite	An analysis of the household energy rebound effect from a practice perspective: spatial and temporal dimensions.	Energy Efficiency 8(3), pp 595-607	2015
Eggert, H. and M. Greaker	Promoting Second Generation Biofuels: Does the First Generation Pave the Road?	Energies 7, pp 1-16	2014
Gerlagh, R. S. Kverndokk, K.E. Rosendahl	The optimal time path of clean energy R&D policy when patents have finite lifetime.	Journal of Environmental Economics and Management 67(1), January 2014, pp 2–19	2014
Strbac, G., M. Pollitt, C.V. Konstantinidis, I. Konstantelos, R. Moreno, D.M. Newbery and R.J. Green	Electricity transmission arrangements in Great Britain: Time for change?	Energy Policy, Vol 73, pp 298-311	2014
Greaker, M.	Strategic Environmental Policy.	Encyclopaedia of Energy, Natural Resource and	2013

Author	Title	Publication	Year
		Environmental Economics 3, pp 313-320	
Halvorsen, B.	Estimating consumption and changes in stock of storable goods applying micro expenditure data.	Environmental Economics 4(2), pp 42 - 53.	2013
Halvorsen, B. and B.M. Larsen	How serious is the aggregation problem? An empirical illustration.	Applied Economics, 45(26), pp 3786-3794	2013
Lillemo, S.C. and B. Halvorsen	The impact of lifestyle and attitudes on residential firewood demand in Norway.	Biomass and Energy 57, pp 13–21.	2013
Lillemo, S.C., F. Alfnes, B. Halvorsen and M. Wik.	Households' Heating Investments: The effect of motives and attitudes on choice of equipment.	Biomass and Energy 57, pp 4–12	2013
2. Popular Science Journals			
Bye, B., C. Hagem, B. Halvorsen and B.M. Larsen	Evaluering av virkemidler for å fremme energieffektivisering. En oversikt over økonomisk litteratur	Rapporter 2016/16, Statistisk sentralbyrå.	2016
Bøeng, A.-C., B. Halvorsen and B.M. Larsen	Fører effektiviseringstiltak til uønskede adferdsendringer?	RØST no. 1/2013	2013
Halvorsen, B.	Vi fryser for å spare energi.	Økonomiske analyser, 2/2013	2013
Halvorsen, B. and B.M. Larsen	Hvem eier varmepumpe og hva gjør det med strømforbruket?	Økonomiske analyser, 2/2013	2013
Fæhn, T.	Utvikling av klimateknologier - hvordan kan Norge bidra?	Økonomiske analyser 6/2012, Statistisk sentralbyrå	2012
Bøeng, A.C., B. Halvorsen and B.M. Larsen	Vil subsidiering av energieffektivt utstyr løse miljøproblemene?	Økonomiske Analyser 5/2011, Statistisk sentralbyrå.	2011
3. Other publications			
Dengler S., R. Gerlagh, S. Trautman, G. van der Kuilen	Climate Policy Commitment Devices	FEEM WP 49.2017	2017
Fischer, C., M. Greaker and K.E. Rosendahl	Are Renewable Energy Subsidies in Need of Reform?	J. Strand (eds.): The Economics and Political Economy of Energy Subsidies, CESifo Seminar Series, Cambridge, MA: The MIT Press.	2016
Klemetsen, M.	Policy incentives for firm behaviour. 4 articles on environmental innovation and emissions.	Doctoral thesis, University of Oslo.	2016
Rosendahl, K.E.	Miljøgevinster av å subsidiere fornybar energiteknologi.	P. Hagen and G.Holst Volden (eds.): Investeringsprosjekter og miljøkonsekvenser. En antologi med bidrag fra 16 forskere, Concept rapport nr 48, NTNU, Trondheim: Ex ante akademisk forlag, pp. 147-159.	2016
Wilhite, H.	The Political Economy of Low Carbon Transformation: Breaking the Habits of Capitalism.	London: Routledge.	2016

Author	Title	Publication	Year
Bye, B., C. Hagem, B. Halvorsen and B.M. Larsen	Effekter av virkemidler for å fremme energieffektivisering.	Oppdragsrapport for OED I forbindelse med deres arbeid med Energimeldingen.	2015
Golombek, R., M. Greaker and S. Kverndokk	Virkemidler som kan fremme utvikling og bruk av miljøteknologi, (Policy measures that can promote the developmenent and use of green technology)	Attachment 3 to the report by the Green Tax Commission (NOU 2015:15), Ministry of Finance, Norway	2015
Klemetsen, M. E.	The effects of innovation policies on firm level patenting	Discussion paper no 830, Statistics Norway	2015
Hoel, M. and A. de Zeeuw	Technology Agreements with Heterogeneous Countries.	in Todd L. Cherry, Jon Hovi and David McEvoy (editors): Toward a New Climate Agreement: Conflict, Resolution and Governance. Routledge.	2014
Winther, T., H. Wilhite and K. Standal	Strømbruk i husholdninger: Effekter av display.	CICERO	2014
Halvorsen, B. and H. M. Dalen	"Ta hjemmetempen": rapport fra Forskningskampanjen 2012.	Rapporter 13/2013, Statistisk sentralbyrå.	2013
Rosenberg, E.	Energieffektivisering i bygninger – norske potensialstudier.	Institutt for energiteknikk, rapport IF/KR/F-2012/079	2013
Halvorsen, B.	Utviklingen i strømforbruket, prisfølsomheten og strømmarkedet.	SSB Publikasjoner - rapporter	2012
Wessman, S., B. Halvorsen and B.M. Larsen	Statlige og kommunale tilskuddsordninger for elektrisitetssparing i husholdninger.	Dokumentasjon 1970-2012. Notater 67/2012, Statistisk sentralbyrå.	2012
Wessman, S., B. Halvorsen and B.M. Larsen	Særavgifter relatert til husholdningenes energiforbruk, Dokumentasjon 1970-2012.	Notater 66/2012, Statistisk sentralbyrå.	2012
Wessman, S., B. Halvorsen and B.M. Larsen	Statlige og kommunale tilskuddsordninger for elektrisitetssparing i husholdninger - Dokumentasjon 1970-2012.	Notater 67/2012, Statistisk sentralbyrå.	2012
4. CREE Working Papers			
Khan, A.Z.	Why Say No to Solar Energy? - An Exploration of Residential Reluctance towards Solar Energy	CREE WP 04/2018	2018
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Author	Title	Publication	Year
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