ENOVA

Annual report 2016

Contents

Journey towards the low emission society

In 2015, a new international climate agreement was adopted in Paris. In November 2016, faster than most had expected, the agreement entered into force. This is a signal that the world is united in the fight against climate change, and that the journey towards a low emission society has started in earnest.

Norway and the climate battle

The road to the low emission society is long and winding, and will require a considerable adjustment within all sectors in Norwegian society. Enova has been appointed as a central instrument for this adjustment. We go to work every day to promote the sustainable changes required to build tomorrow's green Norway. We approach this meaningful task with the utmost humility and enthusiasm.

Although Norway accounts for a small share of total greenhouse gas emissions, we can still play a significant role in the global climate work. Norway has unique and valuable expertise within several areas for developing energy and climate technology that can benefit the entire world. Exporting this technology can also generate substantial values for the Norwegian welfare society.

Positive development

For the past five years we have followed up on our 2012 agreement with the Ministry of Petroleum and Energy (MPE). Since 2012, we have contributed to realizing projects with anticipated energy results exceeding 9 TWh, more than 2 TWh higher than the goals for the agreement. We have also awarded considerably more funds to development of new energy and climate technology than the minimum requirement for the agreement term. The funding awarded in 2014 to Hydro's pilot plant for the future's aluminium production still stands as Enova's largest ever funding commitment, and is an example of how predictable policy instruments and long-term collaboration can contribute to important projects for Norway and the low emission society.

Starting from 2015, Enova has also been tasked with improving the efficiency of energy consumption and reducing greenhouse gas emissions from the transportation sector, and the technology projects in this area have also excelled. Zero emission technology is being tested for the first time at several locations in Norway, both onshore and offshore.

The business community plays a vital role in the construction of the low emission society. Without their help, it will be difficult to achieve the green transition. Through our daily contact with companies from all over Norway, and especially through the projects we are able to create together, we have experienced a business community that is increasingly seeing the commercial opportunities of the green transition. The figures also wholeheartedly agree: In 2016, we were pleased to invest a total of NOK 2.3 billion in energy and climate projects in business and industry, the public sector and households. The results come from long-term and close interaction with players in the market. However, Enova's results are not important on their own. What is important is the long-term effect these projects will have on the transition to a low emission society.

Full speed ahead in the transportation sector

The transportation sector in Norway has generally been based on fossil energy sources, and is perhaps also the sector where Norway needs to make the biggest changes. Transportation is therefore a prioritized area for Enova, both in the development of relevant policy instruments as well as in the market work. We saw strong growth in interest here in 2016, particularly from maritime industry.

> *"We are now continuing the good dialogue with the market about new projects that can contribute to a sustainable change towards the low emission society"*

Enova works to stimulate electrification of the transportation sector on several fronts. In 2016, we launched a dedicated infrastructure program vis-à-vis county authorities and municipalities, which we can see has already contributed to the launch of multiple low and zero emission ferries along the coast and more electric buses on the roads. The interest in developing facilities for shore power for ships is also growing rapidly, which we have experienced through our announcements where we have so far contributed support for 33 shore power projects. The charging industry is also in the process of developing a nationwide network of quick chargers for electric cars.

Sun is shining in the industry

There are many positive developments within industry, where the most exciting development from 2016 perhaps comes from the solar industry. We are now seeing the signs of a revitalization of a sector which almost came to a complete halt in 2008 due to the financial crisis and price drop in China. In 2016, we contributed funding for three technology projects with Elkem Solar and NorSun which will make solar cell production more energy efficient. It is gratifying to see that Norwegian industry will be involved as the world continues developing renewable energy production. Otherwise in industry, we are seeing energy and climate projects within most segments, and this spread is important. Although a few locomotives will and must be at the forefront, we are dependent on improvements and innovation within many fronts taking place in parallel. The oil and gas industry also entered the field in 2016. Our experience is that most operators are now intensifying the work on energy management and are setting ambitious goals.

From individual buildings to unified areas

In the construction sector we have intensified the work on promoting more innovative energy solutions. Some innovation projects are stranded at the idea stage because of significant uncertainty. This uncertainty causes decision makers to choose familiar solutions instead. In 2016, we therefore prioritized contributing to more concept assessments that can provide an improved basis for making decisions and thus hopefully more innovation. Among the topics we emphasized are area solutions that, to a greater extent, examine how neighbouring buildings can achieve joint solutions that exploit resources in the best possible manner, in optimal interaction with the existing energy system. The market has also responded positively to this.

Sustainable change

In parallel with the work on realizing the good projects, we spent the year looking at how we can ensure predictable policy instruments and framework so that we can continue to be a relevant partner for the market going forward. Excellent long-term work led to EFTA's Supervisory Body ESA approving Enova's support for development of new energy and climate technology for the period 2017–2022 at the end of the year, while we also signed a new four-year agreement with the Ministry of Petroleum and Energy. We are very pleased to have this in place. Clear and predictable framework conditions are a precondition for continued good cooperation with market players in the years to come.

Climate change is the biggest challenge of our time. For Enova, it is more important than ever to focus our efforts on innovative solutions that contribute to reduced greenhouse gas emissions while at the same time generating value creation. We were therefore especially pleased to start the year, as well as the new agreement term, by introducing three new technology programs that provide a broader spectrum of policy instruments adapted to the demand in the market.

There are many miles still to go to solve the world's energy and climate challenges, and time is running out. We are now continuing the good dialogue with the market about new projects that can contribute to a **sustainable change** towards the low emission society.

Nils Kristian Nakstad
CEO

PART II
INTRODUCTION TO THE ORGANIZATION AND KEY FIGURES

Social mission

Enova SF is a state enterprise, owned by the Ministry of Petroleum and Energy (MPE), and located in Trondheim.

Enova will contribute to Norway reducing greenhouse gas emissions and transitioning to climate-friendly energy consumption and sustainable energy production. We therefore invest heavily in future-oriented energy and climate measures so that more people will start using the good solutions and promote new technology that can transform Norway into a low emission society. We do this within many areas and with many stakeholders, including private businesses, public players and households. The work is based on expertise within energy, climate and technology.

Enova's foremost instrument is investment support for projects, whether they are large industrial projects or smaller measures in households. We manage Norway's funds so they yield the greatest possible benefit for society. By covering some of the extra costs that the market takes on by selecting more energy and climate-friendly solutions, we can promote energy and climate projects that would otherwise not have been realized. The support boosts profitability in the projects and reduces the risk for the project owner, and also strengthens the position of the energy and climate projects when investment decisions are made.

Our other important tool is an advisory service. In small projects, we provide advice through a telephone service, and through information and guidance on our website. In large projects, Enova works closely with applicants over time to improve the project with regard to technical solutions and implementation, as well as making the projects more financially robust. Through this dialogue, projects benefit from our advisers' expertise and the experience Enova has gained through managing a portfolio of several thousand projects.

The Ministry of Petroleum and Energy (MPE) is Enova's owner and principal. The MPE's primary task on behalf of the State is to facilitate a comprehensive and value creating energy policy based on efficient and environmentally friendly exploitation of natural resources. The MPE issues Enova's assignment letter and receives our reporting.

The four-year agreement between the State (through the MPE) and Enova defines and sets the framework for Enova's social mission. The agreement will ensure that the resources from the Energy Fund are managed in accordance with the goals and preconditions at the foundation of the Energy Fund.

Enova's social mission is to create permanent changes in supply and demand for efficient and renewable energy and climate solutions, strengthen security of supply and reduce greenhouse gas emissions.

The social mission must be viewed in a long-term perspective. The Government published its Energy Report in 2016, which, through a comprehensive energy policy, will contribute to security of supply, industrial and commercial development, as well as more efficient and climate-friendly energy consumption. The further development of the energy system is an important part of the transition to a low emission society, and the Energy Report defines the primary direction of this work. New energy and climate technology plays a significant role in the transition.

A new agreement has been made for the period 2017–2020. This reflects the Government's priorities in the energy and climate policy. Enova will have a key role as a policy instrument to realize Norway's objectives.

Enova's vision is *Sustainable change*

Our values:

Market-oriented

Bold

Always learning

Thorough

Ethical guidelines

Our ethical guidelines and fundamental values are Enova's rules of conduct for behaving ethically and in a socially responsible manner in all our activities.

- We have goals, values and ethical guidelines that describe the founding philosophy and actions which should characterize our organization.
- We exercise corporate governance principles where we emphasize openness, transparency, responsibility, equality and long-term perspectives.
- We set high integrity requirements, which for example entail that we do not tolerate any form of corruption, and that we promote free competition.
- We must be open, honest and good listeners in communication and contact with the outside world.
- We do not discriminate based on gender, religion, nationality, ethnicity, societal group or political opinion.
- We must be attentive to changes in what the community in general perceives as good business practices, and evaluate and change our own practice when it is necessary.

Management

Nils Kristian Nakstad

CEO

Nils Kristian Nakstad has been the CEO of Enova since 2008. He is a chartered engineer from the Norwegian University of Science and Technology (NTNU) and has extensive experience from research and industry, including from Sintef, Hydro, ReVolt Technology and participation in the seed capital and venture environment. Nakstad was a member of the Energy Committee that delivered the "Energy Report – value creation, security of supply and the environment" in 2012. He holds multiple board positions, e.g. as a board member in NTNU and deputy chair of the Norwegian Ski Federation's cross-country committee.

Øyvind Leistad

Development Manager

Leistad has been the Development Manager since 2013. He has an educational background in resource economics, financing and investment from the Agricultural University of Norway. Leistad was hired by Enova as a senior adviser in 2005. From 2007-2012, he was the Director of the Energy Production Department in Enova. Leistad has experience from the Ministry of Petroleum and Energy, where he worked with administration of various policy instruments related to stationary energy supply and renewable energy, and energy efficiency in particular. He is a member of the programme board for ENERGIX in the Research Council of Norway.

Gunn Jorun Widding

Director of Enterprise Management

Widding has been the Director of Enterprise Management since 2013. She is a chartered economist from the Bodø Graduate School of Business (HHB). She also has a number of courses from the university colleges in Sør-Trøndelag, Bodø and Lillehammer. Widding has previous experience from management positions in the travel industry, project management and several executive positions in EVRY.

Stein Inge Liasjø

Director of Strategy and Communications

Liasjø was hired by Enova as the Director of Strategy and Communications in 2016. He has an educational background in economics, financial management and media studies from the Norwegian University of Science and Technology in Trondheim and the University of Oslo. Liasjø came to Enova from Aker Solutions, where he held various management positions within communications and finance from 2004. From 2010 to 2014, he worked in China as country manager for Aker Solutions. Liasjø has board experience from multiple companies.

Audhild Kvam

Marketing Director

Kvam has been the Marketing Director since 2013. She has an MBA in business administration from Pacific Lutheran University in the US. Kvam was hired by Enova as the Director of the Energy Efficiency Department in August 2010. She has experience as the VP Strategy and Marketing in Powel ASA, and worked as an information director in Trondheim Energi and managing director of Trondheim Energiverk Kraftsalg AS. She is a board member of Energi 21.

Organization

Enova's most important criterion for success in order to achieve our objectives is the employees' expertise and ability and willingness to cooperate, both internally and with the various market players we work with.

We want to support every person's strengths and determination to do their best. A crucial element of this is to give employees tasks that challenge them to push themselves to develop their expertise. We believe that a good working environment is an important factor for the opportunity to develop oneself through good relationships with colleagues, both professionally and socially, and across departments. The measure of how well we succeed with this effort is that we appear credible, competent and professional in the market.

Through the employee survey, we can confirm that our employees largely identify with Enova's objectives and values. This allows us to actively shape our culture. We have employees with a high level of involvement that want to contribute to our development. This enables us to serve our market well and strengthens the further development of a good working environment.

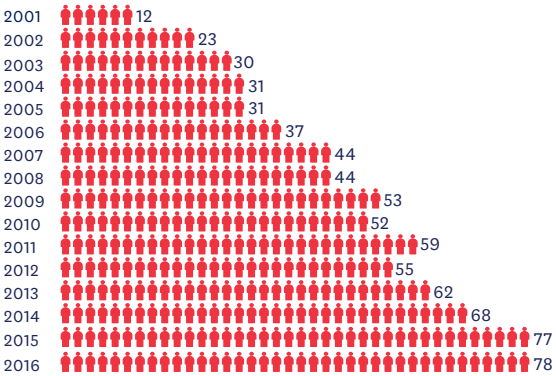
Enova exercises value-based management. This means that we attempt to integrate our values in all parts of the workday, related to decisions, behaviour, priorities and participation. Working in Enova shall be perceived as meaningful regardless of one's position and tasks. The employees' motivation is developed through active implementation of the values through concrete action during their workday. We revised our values in 2016, and all employees were involved in this work. The new values establish the guidelines for how we want to conduct ourselves internally and externally.

2016 was a year characterized by Enova's considerable work on preparing the new agreement term 2017–2020. Several development projects were implemented to lay a good foundation for further development and the ability to accomplish the goals in the new agreement.

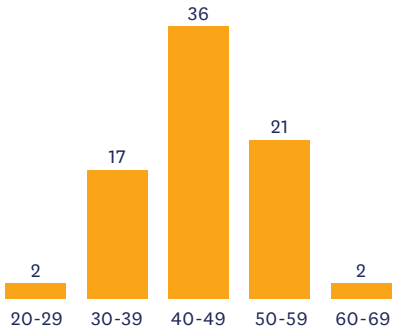
Enova has 78 permanent employees, divided among 40 women and 38 men. The average age is about 45 years. Our employees' educational background and work experience ranges within a number of disciplines, with an emphasis on technical backgrounds and finance. Enova sees the value of gender equality and diversity in the workplace, and believes this strengthens our ability to think broadly and embrace different perspectives. We have organized the business in four departments, with special tasks and responsibilities:

- The **Development Department** develops programmes and follows up supported projects.
- The **Enterprise Management Department** safeguards our support functions within finance, IT and HR.
- The **Strategy and Communications Department** works on the long-term strategy for delivering on the assignment, the overarching framework conditions for the business and communication with our stakeholders.
- The **Marketing Department** markets Enova's services and contributes to realizing projects in all sectors in dialogue with the players in the markets.

Development in number of employees



Age composition



Key figures

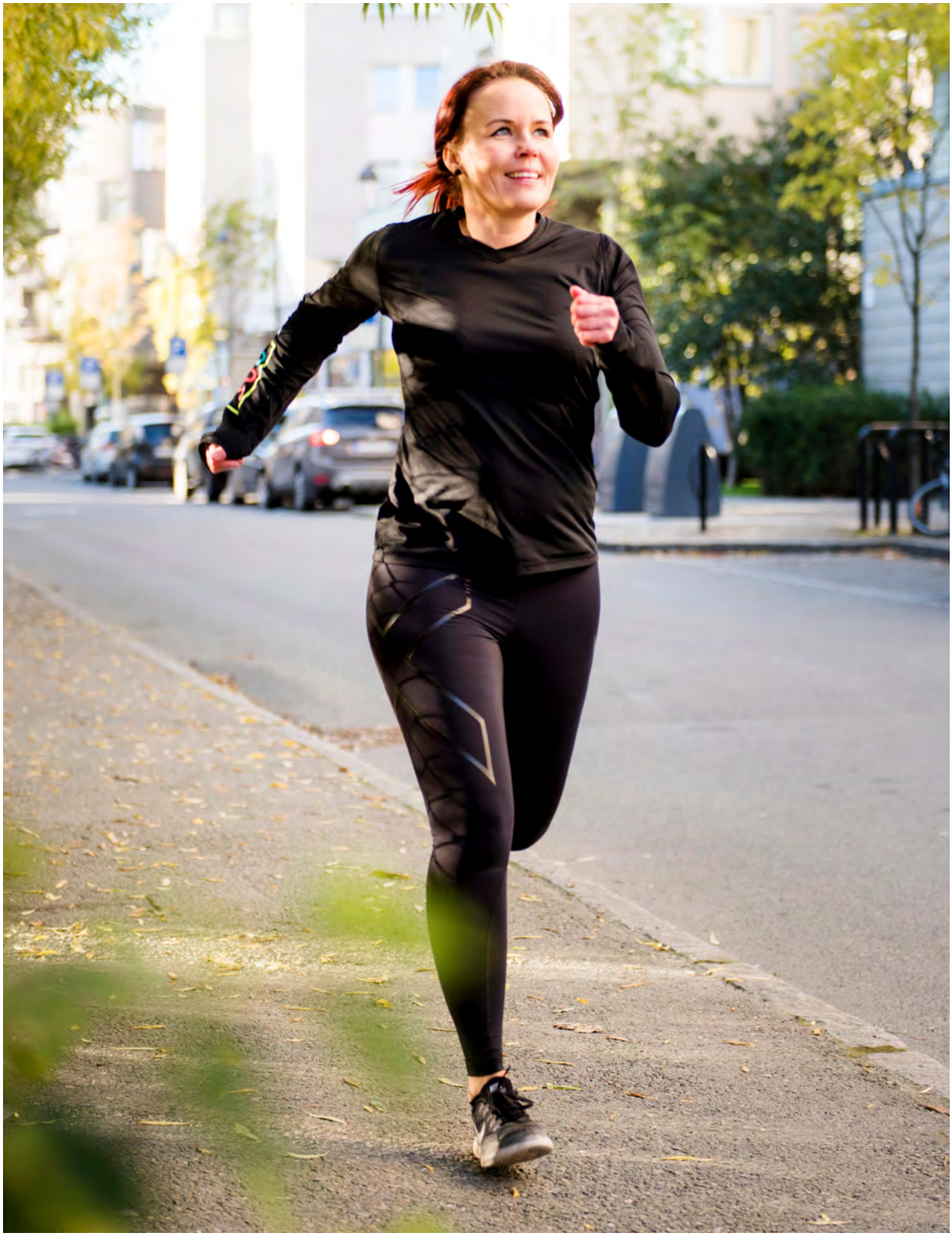
Key figures for the Energy Fund

Key figures	2016	Description
New commitments (NOK MILLION)	2 570	The key figure shows how much Enova has allocated from the Energy Fund to support projects, contractual activities and administrative fees in 2016
Disbursed from the Energy Fund (NOK MILLION)	2 151	The key figure shows how much has been disbursed to projects, contractual activities and administrative fees in 2016. Disbursements were made during the year to projects adopted during the period 2007–2016
Added to the Energy Fund (NOK MILLION)	2 290	The key figure shows how much was added to the Energy Fund in 2016 through return from the Fund for climate, renewable energy and energy restructuring, parafiscal charge on the grid tariff and interest
Contractual energy result (GWh)	3 821	Contractual energy result for projects adopted in 2016
Number of projects	1 008	Number of projects allocated support from the Energy Fund in 2016, except measures funded through the Enova Subsidy
Number of disbursements from the Enova Subsidy	6 468	This key figure shows the number of payments made from the Enova Subsidy in 2016

Key figures for Enova SF

Key figures for Enova SF were prepared based on the standard for central government agencies. Because Enova SF is a state-owned enterprise which follows other accounting standards and has a different financial model, the key figures will not be directly comparable with corresponding key figures for central government agencies.

Key figures	2016	Description
Full-time equivalents	79,8	In 2016, Enova had 79.8 full-time equivalents. Full-time equivalents includes all permanent, temporary employees, summer students and hired capacity from staffing agencies. Full-time equivalents are reduced where employees have reduced hours, have resigned during the course of the year, are on unpaid leave, family leave or have been on long-term sick leave. Hiring of personnel (re-invoicing costs) also reduces the number of full-time equivalents.
Administration contribution (NOK million)	120,8	The MPE stipulates a framework for administration remuneration for Enova SF. In 2016, the framework for administration of the Energy Fund was set to NOK 151 000 000 including value added tax (NOK 120 800 000 excl. VAT). The framework is entirely financed with contributions from the Energy Fund.
Total allocation (NOK million)	129,9	Total allocation for Enova in 2016 was NOK 129 919 699. Total allocation consists of operating income of NOK 120 802 339, as well as retained other equity of NOK 9 117 360.
Payroll costs per full-time equivalent (NOK)	818 474	Payroll costs per full-time equivalent consist of direct wage costs of NOK 64 187 890 and costs for temporary hiring of NOK 1 126 330, divided among the number of completed full-time equivalents.
Percentage of wages in administration contribution	53 %	Payroll costs amounted to 53 per cent of Enova's administration contribution in 2016.
Percentage of consultants in administration contribution	6 %	Purchase of consultancy services amounted to 6 per cent of Enova's administration contribution in 2016.
Utilization rate	96 %	The utilization rate is calculated as total operating expenses in a percentage of the administration contribution.



DEL III
ACTIVITIES AND RESULTS FROM THE YEAR

Part III A | Reporting – the Energy Fund 2012-2016

Enova's main objective

The objective is described as follows in the agreement between the Ministry of Petroleum and Energy (MPE) and Enova for the period 2012–2016: *The objective of Enova and the Energy Fund is to promote environmentally friendly restructuring of energy end-use and energy production, as well as development of energy and climate technology. The enterprise will strengthen security of supply and reduce greenhouse gas emissions.*

The objective is elaborated in seven main objectives:

- Development and introduction of new energy and climate technologies in the market.
- More efficient and flexible use of energy.
- Increased use of other energy carriers than electricity, natural gas and fuel oil for heating.
- Increased use of new energy resources, also through energy recovery and bioenergy.
- More well-functioning markets for energy-efficient, environmentally and climate-friendly solutions.
- Increased awareness in society of the possibilities of utilizing energy-efficient, environmentally and climate-friendly solutions.
- Reduced greenhouse gas emissions in the transportation sector.

The four first main objectives cover the areas where quantifiable energy results are natural. The main objectives overlap to some extent and cannot be added up to a total sum. The energy result from management of the Energy Fund for the period 2012 to the end of 2016 must constitute at least 7 TWh. The primary goal of investments in new energy and climate technology is that it will contribute to reducing greenhouse gas emissions and support the development of restructuring energy end-use and energy production in the long term by developing and utilizing technologies and new solutions. The main objective relating to reduced greenhouse gas emissions in the transportation sector is new from 2015. Results from transport (climate results) are credited during the agreement term as contributions towards achieving the result goal of 7 TWh.

Main objective 1:

Development and introduction of new energy and climate technologies in the market.

This main objective is a direct result of the Climate Agreement in the Storting in 2012. Development of new energy and climate technology is very important in order to solve the global climate challenges. However, these new technologies must reach the market in order to have the desired impact.
With its capital base and proximity to the market, Enova can contribute to bringing technology initiatives from the pilot phase and over to market introduction. This is a critical phase for the projects, where they will demonstrate to the market that the technology functions under normal conditions. This is also a capital-intensive phase. Making it through the critical introduction phase is no guarantee for success in the market. Some technologies succeed and gain a foothold which can be built upon. However, for many technologies, the first encounter with the market will reveal a need to test new approaches and concepts, which may entail having to take one or more steps backwards in the innovation chain. Some technologies are also weighed and found wanting in the competition with other solutions. When Enova awards support to technology projects, this is with the expectation that some of them will be successful, but not all. Enova cannot pick out the winners in advance. Our role is allowing the technologies to be tested in the market, and then the market can determine the winners.

Enova supported technology development within the industry, non-residential buildings, renewable power, renewable heating and transport markets in 2016. A total of 80 technology projects were granted support. Overall, this amounted to NOK 515 million.

Main objective 2:

More efficient and flexible use of energy.

More efficient and flexible use of energy is key in order to strengthen the security of supply in the short and long term. This contributes to reducing peak loads and increases the ability to swap energy source based on price and availability.

Improved energy efficiency projects within buildings and industry help us achieve this main objective. The choices made with regard to building structure and production processes will determine energy end-use for many years to come. If we do not take advantage of the opportunities available in choosing energy-efficient solutions, we will be bound to unnecessarily high energy consumption for many years in the future. In the same way, many of the choices we make today influence how flexible and robust the energy system will be in the next decades.

Projects within Enova's support programmes for energy efficiency are fulfilling this main objective. In 2016, Enova supported energy efficiency projects with an energy result of 3 053 GWh. This corresponds to the total electricity consumption of all households in Sør-Trøndelag. Facilitation for use of other energy carriers than electricity, for example through installation of water-borne heating and increased use of district heating, also contributes to increased flexibility in energy systems. This is discussed further under main objective 3.

Main objective 3:

Increased use of other energy carriers than electricity, natural gas and fuel oil for heating.

Renewable water-borne heating contributes to increased

utilization of energy carriers other than electricity and fossil fuels for heating. Less use of fossil energy carriers results in a direct climate gain in the form of reduced greenhouse gas emissions. Use of more energy carriers also provides increased energy flexibility and more options for efficient utilization of renewable energy resources. Furthermore, increased use of energy carriers such as bioenergy and district heating for heating will reduce pressure on the power balance during dry and cold years.

Enova's programmes for district heating and heating plants are particularly aimed at this main objective. In 2016, Enova supported projects with renewable heating corresponding to 514 GWh, of which about 40 per cent was related to conversion. This corresponds to the electricity consumption of all households in Drammen.

Main objective 4:

Increased use of new energy resources, including through energy recovery and bioenergy.

Norway holds a unique position globally with regard to the high percentage of hydropower, and the electricity certificate system will further increase access to renewable power in Norway. We also have considerable potential for increased energy production from energy resources that are not covered under this system. Bioenergy and heat recovery from industry are examples of such resources. Conversion to such renewable energy resources yields direct climate results.

Enova has programmes within industry, heating, non-residential buildings and residential buildings that support this main objective. In 2016, Enova supported projects that, overall, provide 767 GWh in increased utilization of renewable energy sources and carriers. This energy volume corresponds to the electricity consumption of all households in Sogn og Fjordane County.

Main objective 5:

More well-functioning markets for energy-efficient, environmentally and climate-friendly solutions.

Enova will work to make efficient and environmentally friendly energy options the preferred solutions in the market. By supporting innovators and early users, we create a market development where the good solutions become more competitive as a result of increased demand and reduced unit costs. Enova has several instruments that contribute to markets developing future-oriented energy, environmentally and climate-friendly solutions. Through the subsidy programmes, we increase demand for such solutions in the professional market. Furthermore, we help develop the supply side by testing and making products available to the market. Through energy measures in residences, we are stimulating demand in private households and are also familiarizing consumers with the good solutions already in the market.

Main objective 6:

Increased awareness in society of the possibilities of utilizing energy-efficient, environmentally and climate-friendly solutions.

Information and knowledge impact our attitudes and our behaviour. Enova therefore pursues systematic and targeted communication measures to increase use of efficient and environmentally friendly energy solutions, through both marketing and media. We highlight possibilities and give advice to households and the professional market to increase awareness regarding environmentally friendly energy solutions and to trigger measures.

Much of this learning takes place through implementation of projects. Enova offers professional advisory services through application processing and client gatherings. In 2016, nearly 6 500 private individuals received subsidies after implementing energy measures. Enova targets children and young people through energy and climate learning tools that are used in school. Enova's nationwide information and advisory service reaches a diverse audience through telephone, email and Facebook as well as Enova's own website.

Main objective 7:

Reduced greenhouse gas emissions in the transportation sector.

Enova's work within environmentally friendly transport will contribute to reduced greenhouse gas emissions through more environmentally friendly use of energy, more energy-efficient forms of transport and a reduced scope of transportation. Enova has grouped the transportation sector into three parts: land-based passenger transport, land-based freight transport and maritime transport. Enova has established subsidy programmes within all transport groups. Among other things, Enova supports development of charging infrastructure and onshore power, biofuel production and development of new transport-related energy and climate technology. The transport projects that received funding commitments in 2016 will yield a total of 176 ktonnes of CO_2 equivalents in annual reduced greenhouse gas emissions.

Goal achievement related to the social mission

Enova finds that goal achievement related to the social mission is good. Enova has contributed to permanent changes to supply and demand for efficient and renewable energy and climate solutions. Examples of this are that heat pumps have become common property, the market is building passive houses without state funding and the electrification of both onshore and offshore transport is fully under way. Enova has strengthened security of supply by contracting more than 23 TWh in environmentally friendly restructuring of energy end-use and energy production since its establishment in 2001 – an energy result that amounts to more than 10 per cent of annual energy consumption in Norway.

This report provides an account regarding the use of resources from the Energy Fund and the results and activities that have been implemented in 2016.

Objectives and results of the Energy Fund

In 2016, Enova signed project contracts with a total energy result of 3.8 TWh, distributed between 3 606 GWh for ordinary energy projects and 215 GWh for projects within new energy and climate technology. Never before has Enova contracted a higher energy result over the course of a year. In total, Enova allocated NOK 2.6 billion, of which NOK 1.8 billion went to ordinary energy projects and NOK 0.5 billion went to projects within new energy and climate technology. Compared to 2015, the energy result has doubled while the financial support was reduced by about 10 per cent. One important reason for this is that Enova supported several energy efficiency projects within the petroleum sector in 2016 that yielded high energy results per NOK in support.

The activity level in 2016 was high. Approximately 1 000 projects received funding commitments. In addition, about 6 500 measures were awarded subsidies through the Enova Subsidy. This scheme gives homeowners the right to partial reimbursement of their expenses when investing in energy-smart solutions in their residence.From 2015, Enova has been responsible for transportation in addition to stationary energy consumption, and about 700 GWh was contracted in this market in 2016. This means that almost 20 per cent of Enova's overall energy results in 2016 came from transportation, as 124 projects received funding commitments during the year.

Two-thirds of the energy result in 2016 came from the industry. More than 2.5 TWh was contracted in 307 industry projects within mainland industry and the oil and gas activities. The ten largest industrial projects alone account for about half of Enova's energy result in 2016. Seven of these projects are energy management projects in onshore facilities and on fields in the petroleum sector. The energy result for non-residential buildings is about 10 per cent lower than in 2015, with a contractual result of 323 GWh. At the same time, the number of projects increased by about 10 per cent, and the interest level from market players remains stable. About 8 per cent of Enova's overall energy results in 2016 came from non-residential buildings.

Within renewable heating, Enova signed contracts with projects with a total energy result of 162 GWh. Both the energy result and number of projects are lower than in 2015. Low power prices result in lower profitability in the district heating market, which can affect willingness to invest. Moreover, the district heating plants in the largest cities are largely already developed, and the applications we receive now are mainly related to expansion and compaction of existing plants.

Within the residential sector, Enova achieved an energy result of 46 GWh in 2016. This market is characterized by many small projects. Our most important effort is the Enova Subsidy, where Enova has granted subsidies to 70 per cent more energy measures in 2016 than in 2015.

Projects within non-industrial plants and facilities contributed 26 GWh in 2016. This is a decline from 2015. The scope is the same as previous years within aquaculture and facility lighting. Fourteen projects within this category received funding commitments in 2016.

Within renewable power, Enova provided funding commitments to three projects in 2016 related to introduction of new technology, with an energy result totaling 6 GWh.

Figure 3.1

Objectives and results of the Energy Fund

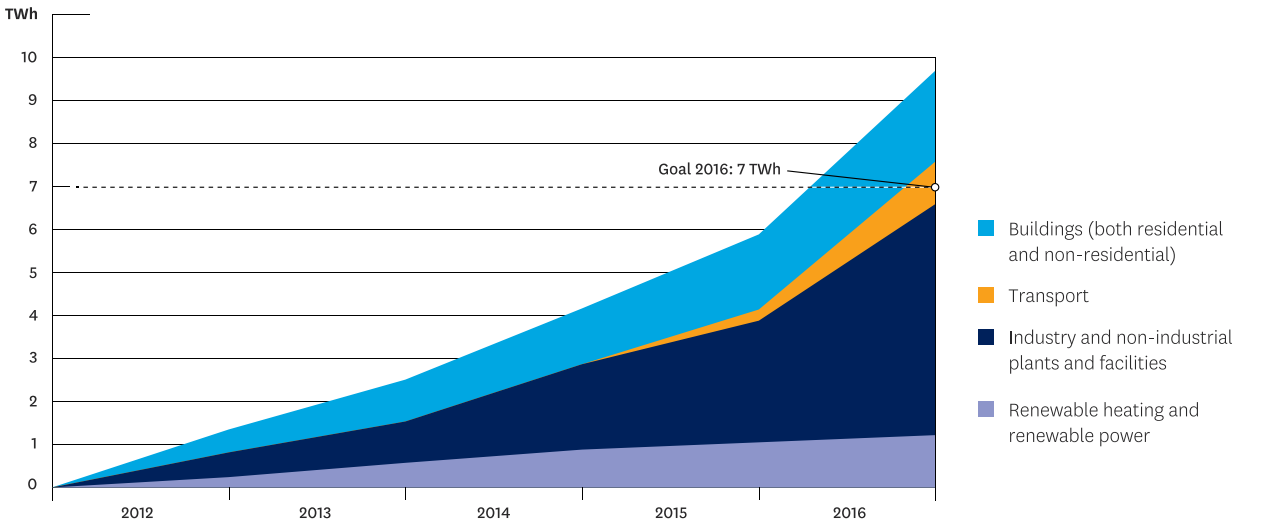


Figure 3.1: *The figure shows accumulated energy results distributed by market in the agreement term 2012–2016. The figures are corrected for cancelled and final reported projects.*

2016 has been characterized by a continued downturn in economic activity in Norway. At the start of the year, the price of oil was less than USD 30 per barrel, after having dropped from levels well above USD 100 per barrel in 2014. Decline in demand and employment in the petroleum industry are considered the most important reasons for the downturn over the last few years. Oil prices rose over the course of 2016, and the decline in petroleum investments waned. The growth in GDP on the Norwegian mainland is slated to be 0.7 per cent as the annual average for 2016, which is substantially lower than the trend growth in the economy, which is estimated at about 2 per cent. NHO's (Confederation of Norwegian Enterprise's) member companies believe that the market situation and prospects have improved throughout the year. And activity in the Norwegian economy has rallied somewhat over the course of 2016[1].

During economic downturns, companies often have an increased focus on cost reductions and greater interest in implementing efficiency projects. Enova's subsidy schemes can thus be highly effective during economic downturns. At the same time, energy prices, seen in a five-year perspective, have been relatively low in 2016, although they have increased throughout the year. This results in weak incentives for completing energy efficiency improvements. Enova's result target for the agreement term of 2012–2016 was made under assumptions that are valid to a varying degree.

At the end of 2016, Enova has signed contracts for 9.7 TWh during the agreement term 2012-2016, corrected for cancellations and final reported projects. The overall result target for the agreement term was 7 TWh. We must take into account a certain level of cancellations after 2016 as well, which will lower the energy result for the agreement term. Enova finds that the distribution of projects between markets in 2016 is satisfactory and the contractual result for 2016 and agreement term 2012–2016 viewed as a whole, is higher than expected.

Table 3.1
The Energy Fund's energy results and allocations 2012–2016

	2012		2013		2014		2015		2016		Totalt	
Market	**GWh**	**MNOK**	**GWh**	**MNOK**	**GWh**	**MNOK**	**GWh**	**MNOK**	**GWh**	**MNOK**	**GWh**	**MNOK**
Renewable heating	239	225	327	387	307	338	166	223	162	203	1 201	1 376
Renewable power	3	5	6	13	0,5	1	3	19	6	13	18	51
Industry	554	487	374	269	996	2 107	780	1 256	2 563	647	5 267	4 766
Transport	-	-	-	-	-	-	260	280	695	823	955	1 103
Non-industrial plants and facilities	21	12	13	35	30	31	64	82	26	26	155	185
Non-residential buildings	506	546	414	619	305	404	354	487	323	476	1 903	2 532
Residential buildings	28	82	26	111	19	53	95	160	46	120	215	525
International projects	-	3	-	7	-	2	-	4	-	3	-	19
Advisory services and communications	-	57	-	66	-	55	-	56	-	67	-	301
External analyses and development measures	-	33	-	28	-	33	-	24	-	40	-	158
Administration	-	98	-	110	-	129	-	148	-	151	-	635
Total	**1 350**	**1 547**	**1 161**	**1 642**	**1 658**	**3 152**	**1 723**	**2 741**	**3 821**	**2 570**	**9 714**	**11 652**
Of which:												
Ordinary energy projects	**1 343**	**1 288**	**1 106**	**1 273**	**1 517**	**1 199**	**1 345**	**1 178**	**3 606**	**1 793**	**8 918**	**6 732**
New energy and climate technology projects	**7**	**44**	**55**	**149**	**141**	**1 727**	**378**	**1 327**	**215**	**515**	**796**	**3 761**

Table 3.1: *The table shows aggregated energy results and resources allocated from the Energy Fund in the period 2012– 2016, corrected for cancelled and final reported projects as of 2016. Projects within the programmes for new energy and climate technology are distributed by the respective markets. The Support for biogas and biofuel programme was reported under the Transport market from 2015 (previously reported under the Renewable heating market).*

1 *Sources: Statistics Norway Financial analyses 5/2016, NHO Financial overview 4/2016, Thompson Reuters Datastream.*

Management of the Energy Fund's resources

Each year, the Energy Fund is supplemented with new funds that will be used to fulfil the mission in the agreement between the MPE and Enova, and the annual Assignment Letter from the MPE. The income in the Energy Fund comes from the return on deposits in the Fund for climate, renewable energy and energy restructuring, and from the parafiscal charge on the grid tariff (small additional charge on electricity bills). Overall, this income amounted to just over NOK 2.2 billion in 2016.

Enova can allocate transferred funds from previous years, returned funds from cancelled projects, as well as the interest income from the funds in the Energy Fund. These additions constituted just over NOK 1.7 billion in 2016. Enova thus had an overall framework of NOK 3.9 billion in 2016. A decision was made by the Storting in connection with the Climate Agreement in 2012 to strengthen the Fund for climate, renewable energy and energy restructuring with NOK 25 billion up to and including 2016, creating a total volume of NOK 50 billion. The efforts have been strengthened since 2012, and the Government decided to further reinforce the efforts in the 2016 national budget through a capital increase of another NOK 14.25 billion. The fund balance is thus NOK 67.75 billion. The majority of the returns from the Fund for climate, renewable energy and energy restructuring are added to the Energy Fund.

When Enova decides to award support for projects, the amounts are earmarked in the Energy Fund as commitments. The relevant amount is then disbursed in arrears based on actual project costs. The earmarked amount in the Energy Fund is released for other projects if projects are cancelled.

Enova's ability to transfer unused funds from one year to the next is one of the Energy Fund's strengths. This provides a flexibility that is particularly important for major, capital-intensive individual projects. These are projects that Enova normally has a close dialogue with for a long time prior to an application, but where it is often difficult to predict with any certainty when the projects are ready for a support decision. Major energy and climate projects often have a long project development time. The possibility of transferring funds gives the players assurance that the time of application and decision will not impact the outcome of the case processing. As an additional flexibility, Enova was able to award funding commitments in 2016 for up to NOK 400 million on top of the available funds in the Energy Fund, in accordance with a funding commitment authorization from the MPE.

The overall financing of Enova provides predictability for both market players and Enova, and thus gives Enova the possibility to support large, individual projects, including full-scale production lines in industry. Enova has awarded funding commitments totalling NOK 2.3 billion in support for projects in 2016. These projects will trigger about NOK 4.5 billion in the market, which will create total investments of about NOK 6.8 billion.

Figure 3.2
Management of the Energy Fund's resources

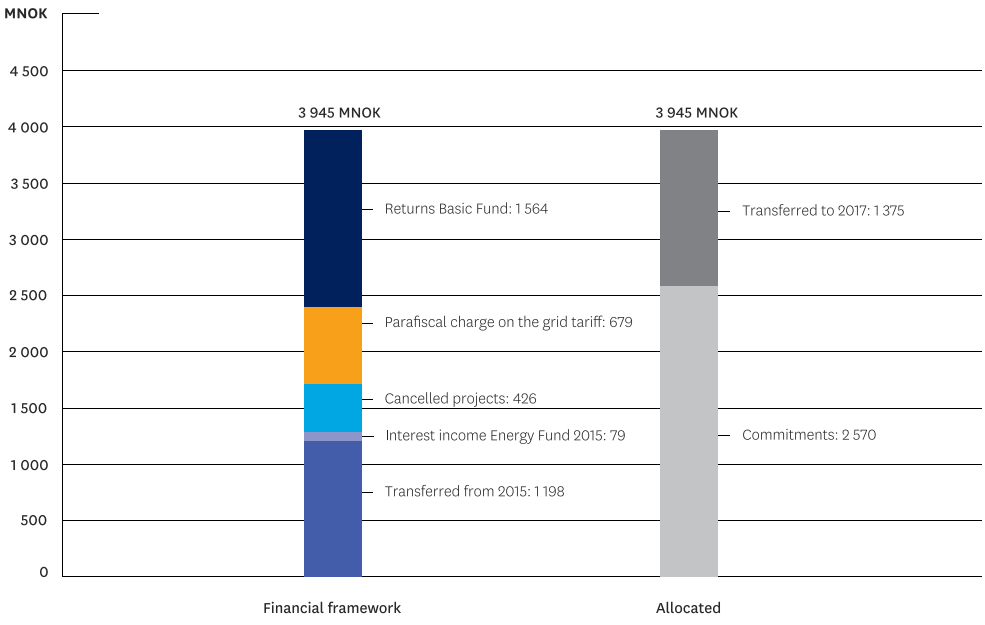


Figure 3.2: *The figure shows a comparison of the Energy Fund's various sources of income and allocations thereof. Projects that are approved and cancelled in 2016 are not included in cancelled projects or commitments.*

Climate reporting

So far, Enova has mainly supported energy projects, but these projects also have climate results; either because the project entails reduction in fossil fuel consumption, or because the resources released and the technologies developed can replace fossil emissions in other areas. Enova supports technology projects that could, over time, be key in achieving the climate goals in Norway, but also globally through spread of the technologies. This section presents greenhouse gas accounts for projects supported by Enova in the period 2012–2016.

The climate accounts take a basis in the pledged energy result (kWh) figures for each project and emission factors for the various energy carriers. The results are reported in CO_2 equivalents, which indicate the combined effect of CO_2 and other types of greenhouse gases[2]. Enova supports measures within improving energy efficiency, restructuring from electricity and fossil energy sources to renewable energy sources and production/distribution of energy from renewable energy sources. Information about which energy sources are replaced is used in the greenhouse gas accounts for restructuring projects. For projects involving development of new production and distribution capacity, we make an assumption regarding which energy sources would be used if the project was not carried out. The assumption regarding alternative energy sources is partly based on price assumptions for electricity and fuel oil[3]. As an assumption regarding replaced energy is used, there is uncertainty associated with calculation of the climate result in these projects. For 2016, these projects correspond to 20 per cent of the total energy result.

Some of the projects, particularly within the new technology programmes, can contribute to greenhouse gas reductions as a result of processes that are independent of the pledged kWh. One example is reduction of process emissions, which is reported in Appendix A Projects within new energy and climate technology 2012–2016.

Method and assumptions

The method, scope and assumptions used as a basis for the climate accounts are essential for the calculations and the result achieved. There is a difference if the calculation takes into account a lifecycle perspective where emissions in all project phases are included (construction, operations, disposal), or if the calculation only includes emissions related to the operations phase. Our calculations only take into account changes in greenhouse gas emissions related to the operations phase in the projects. This provides us with an easy way to assess projects, and is quite similar to the national climate accounts.

National or regional/global perspectives

Another example of method selection and how this will impact the climate accounts is whether the climate calculations are made based on a national or a regional/global perspective (see Figure 3.3). For example, reduced electricity consumption is expected to have a minor climate reward if Norway is used as the system limit, as Norwegian power production is mostly renewable. In 2015, 98 per cent of power production in Norway was renewable (96 per cent hydropower and 2 per cent wind power)[4]. In an expanded perspective, such as the Nordic region or Europe, export of renewable power produced in Norway could have a climate reward if it replaces fossil-based sources in other countries.

Figure 3.3
System limits for the greenhouse gas accounts

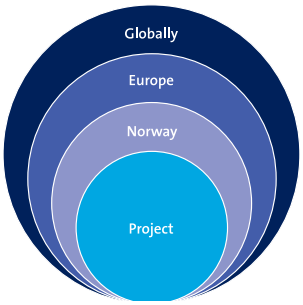


Figure 3.3: *The figure shows how the climate effect of the projects will depend on the system limit chosen in the greenhouse gas accounts.*

2 *Enova uses Global Warming Potential with a 100-year perspective to aggregate various greenhouse gases.*

3 *Enova's price assumption for electricity is based on sale of 3-year forward contracts at NordPool (sliding average last six months). As an addition to the actual electricity price, we calculate a price for the electricity certificates for the electricity certificate period 2015–2035. Enova's price assumption for light fuel oil is based on sale of two-year future contracts for Heating Oil at New York Mercantile Exchange (NYMEX, sliding average last six months), plus government taxes and fees.*

4 *https://www.nve.no/elmarkedstilsynet-marked-og-monopol/varedeklarasjon/varedeklarasjon-2015/*

Energy versus climate results

The projects supported by Enova contribute to achieving the objective of increased security of supply and/or reduced greenhouse gas emissions. For some projects, contributions toward one objective may have a negative impact on the other objective. One example is projects that involve conversion from electricity to a heating plant with fossil fuels in the energy mix to cover peak loads. Enova only supports the renewable share of the project, but overall, the project can contribute to increased domestic greenhouse gas emissions.

Climate result from more efficient fossil fuel consumption

Table 3.2 shows the estimated reduction of greenhouse gas emissions as a result of measures that contribute to direct reductions in consumption of fossil fuels such as coal, oil and natural gas, distributed by market. The calculations were based on improving efficiency of fossil sources and conversion from fossil to renewable energy. The emission coefficients for the various energy carriers in calculations for the 2012–2016 period came from the Norwegian Environment Agency or in some instances from the Ecoinvent database[5].

Table 3.2

Climate result from reduction of fossil fuels for projects approved in 2012–2016

	2016	2012-2016
Market	**ktonnes CO_2 eqv.**	**ktonnes CO_2 eqv.**
Renewable heating	10	122
Renewable power	0	0
Industry	411	596
Transport	176	232
Non-industrial plants and facilities	5	12
Non-residential buildings	15	68
Residential buildings	3	12
Total	**619**	**1 042**

Tabell 3.2: *The table shows climate results, measured in CO_2 equivalents, achieved in each market for measures that relate to improved energy efficiency in fossil energy sources or conversion from fossil to renewable energy.*

Enova estimates that the project portfolio from 2016 will contribute to reducing greenhouse gas emissions by about 600 kilotonnes of CO_2 equivalents, while the result so far in the agreement term is more than 1 000 kilotonnes of CO_2 equivalents.

The industry and transport markets achieve the highest climate results in connection with reduced fossil fuel consumption in 2016. Non-residential buildings and renewable heating are next. The climate results are correlated with the energy results from the various markets. The transport projects also achieve relatively high climate results compared to the other projects.

Projects from facilities subject to quotas in the EU's quota system

According to the Norwegian Environment Agency, 140 Norwegian enterprises in offshore oil and gas, industry and aviation in the EU/EEA area are subject to the EU's quota system[6]. About half of Norwegian greenhouse gas emissions come from facilities that are part of the quota system. Table 3.3 shows that Enova has supported 75 projects in facilities subject to quotas in 2016. These projects contributed to reducing greenhouse gas emissions by just below 400 kilotonnes of CO_2 equivalents.

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5 *http://www.ecoinvent.org/*
6 *http://www.norskeutslipp.no/no/Komponenter/Klimakvoter/Kvoteutslipp/?ComponentType=kvoteutslipp&ComponentPageID=1103&SectorID=90*

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7 *http://www.eea.europa.eu/data-and-maps/figures/co2-electricity-g-per-kwh/co2-per-electricity-kwh-fig-1_2010_qa.xls*
8 *http://www.iea.org/media/workshops/2011/cea/topper.pdf*

Table 3.3

Number of projects in 2016 where Enova supported measures in facilities subject to quotas[1]

Subject to quotas (EU-ETS)	Market	Number of projects	Contractual energy result	Climate result from reduced consumption of fossil fuels
		No.	GWh	ktonnes CO_2 eqv.
Subject to quotas		**75**	**2 098**	**394**
	Renewable heating	13	115	9
	Renewable power	1	0	0
	Industry[2]	59	1 967	383
	Transport	1	11	1
	Non-industrial plants and facilities	1	4	0
Not subject to quotas		**933**	**1 677**	**222**
Total		**1 008**	**3 775**	**616**

Table 3.3: *The table shows the number of projects in 2016 where Enova supported measures in facilities subject to quotas in accordance with the EU Emission Trading System (EU-ETS), as well as energy and climate result achieved through reduced fossil fuel consumption.*
1 *http://www.norskeutslipp.no/no/Komponenter/Klimakvoter/Kvoteutslipp/?ComponentType=kvoteutslipp*
2 *6 of the 59 projects within industry are pilot projects with no direct energy result.*

Climate results from more efficient electricity consumption or conversion from electricity to renewable sources

Enova supports projects that help improve the efficiency of electricity consumption, or conversion from electricity to renewable energy sources. As Norwegian power production is mostly renewable, these projects result in minor or no reduced greenhouse gas emissions in the actual project, and make minor contributions towards reduced greenhouse gas emissions in Norway. Whether the projects contribute to the climate result in other areas will depend on what system limit is used as a basis. Conservation of electricity in Norway could have a climate reward if it replaces power based on fossil sources.

We have calculated the climate result of more efficient electricity consumption for the four different electricity mix scenarios; Norwegian power consumption mix, Nordic power production mix, European power production mix and coal power (EU average). The emission intensities for the power mixes were obtained from the European Environment Agency (EEA)[7], and the emission intensity for coal power came from the IEA8[8].

As expected, Enova's climate results are highly contingent on the assumptions related to the alternative power supply used as comparison. The climate results from reduced electricity consumption and conversion from electricity to renewable sources ranges from 62 to 1 738 kilotonnes of CO_2 equivalents for the period 2012–2016, depending on whether a Norwegian power consumption mix or European power production mix is used as a basis.

Table 3.4

Climate results from measures that reduce electricity consumption

	Norwegian power consumption mix[1]		Nordic power production mix[2]		European power production mix[3]		Coal power (EU average)[4]	
	2016	2012-2016	2016	2012-2016	2016	2012-2016	2016	2012-2016
Market	ktonnes CO_2 eqv.	ktonnes CO_2 eqv.	ktonnes CO_2 eqv.	ktonnes CO_2 eqv.	ktonnes CO_2 eqv.	ktonnes CO_2 eqv.	ktonnes CO_2 eqv.	ktonnes CO_2 eqv.
Renewable heating	1	10	9	59	41	280	92	623
Renewable power	0	0	1	1	2	6	5	14
Industry	5	25	32	149	155	711	344	1 581
Transport	0	1	2	4	8	20	18	45
Non-industrial plants and facilities	0	2	0	9	2	42	5	95
Non-residential buildings	3	21	21	127	99	606	220	1 348
Residential buildings	0	3	2	15	11	72	24	161
Total	**11**	**62**	**67**	**364**	**318**	**1 738**	**708**	**3 867**

Table 3.4: *The table shows climate results from reduced electricity consumption or conversion from electricity to renewable energy sources for projects approved in 2012–2016 based on different electricity mix scenarios. The results are shown by market.*

1 *14 g CO_2-eqv./kWh (source: European Environment Agency)* **2** *83 g CO_2-eqv./kWh (source: European Environment Agency)*
3 *396 g CO_2-eqv./kWh (source: European Environment Agency)* **4** *881 g CO_2-eqv./kWh (source: European Environment Agency)*

New energy and climate technology

Special emphasis was placed on new technology, particularly energy and climate technology in industry, in the agreement between the MPE and Enova for the period 2012–2016. The goal of the technology projects is to harvest experience that will contribute to expertise development, innovation and spread of the technology both nationally and internationally. Together with the market, Enova contributes to reducing greenhouse gas emissions and supporting broad-based energy restructuring development.

The agreement with the MPE stipulates that at least 10 per cent of the annual available funds in the Energy Fund must be earmarked for technology projects within the agreement term. Enova offers support for technology projects in every market. NOK 500 million in support was granted to 80 projects in 2016. This support constitutes about 20 per cent of the allocated funds in 2016.

A higher number of technology projects received support in 2016 compared to 2015, and we have supported projects within most markets. The largest projects within new technology came from industry, and this market received the most support and contributed the highest energy result. Non-residential buildings contributed the highest number of projects.

Table 3.5
Support for new energy and climate technology 2012–2016

	2016			2012-2016		
	No. of projects supported	Contractual energy result	Contractual support	No. of projects supported	Contractual energy result	Contractual support
Market	No.	GWh	NOK million	No.	GWh	NOK million
Renewable heating	**2**	**7**	**14**	**6**	**10**	**31**
Support for introduction of new technology	2	7	14	6	10	31
Renewable power	**3**	**6**	**13**	**13**	**18**	**51**
Støtte til introduksjon av ny teknologi	3	6	13	13	18	51
Industry	**12**	**126**	**200**	**37**	**500**	**2 849**
Support for introduction of new technology	3	0,5	5	9	3	22
Support for new energy and climate technology	7	125	189	21	497	2 795
Pre-project support for new energy and climate technology	2	-	6	7	-	33
Transport	**15**	**50**	**134**	**23**	**144**	**302**
Support for introduction of new technology	2	1	23	6	9	41
Support for new energy and climate technology	13	49	111	17	135	260
Non-industrial plants and facilities	**-**	**-**	**-**	**3**	**8**	**45**
Support for introduction of new technology	-	-	-	3	8	45
Non-residential buildings	**48**	**26**	**153**	**88**	**61**	**422**
Support for introduction of new technology	1	0,2	5	5	3	31
Support for new technology in the buildings of the future	7	1	14	20	5	72
Support for energy-efficient new buildings	12	24	113	35	53	298
Support for concept assessment for innovative energy solutions in buildings and areas	28	-	21	28	-	21
Residential buildings	**-**	**-**	**-**	**9**	**54**	**60**
Support for energy-efficient new buildings (private)	-	-	-	2	0,03	0,2
Communication solutions from advanced metering infrastructure (AMI)	-	-	-	7	54	60
Total New technology	**80**	**215**	**515**	**179**	**796**	**3 761**

Table 3.5: *The table shows energy results and allocations within new energy and climate technology in 2016 and in 2012–2016 distributed by market.*

Looking at the agreement term overall, it shows the same picture.

The technology projects often have relatively modest energy results compared with the support they receive. Untested and immature technology will usually be significantly more expensive than standard solutions. The support need will therefore also be higher than for projects based on well-tested technology. However, these projects are expected to result in long-term ripple effects and positive effects for the climate and value creation. For 2016, a total support level of NOK 515 million provided a direct energy result of 215 GWh, which is a higher energy result per support krone compared with earlier years for technology projects.

Many project owners say that it is challenging to obtain risk capital. Enova finds that the response to the programmes offered has been good, and that the market is willing to be innovative and develop technology.

Table 3.6

10 largest projects within new energy and climate technology (2016), measured by awarded support

Project	Company	Market	Programme	Contractual energy result (GWh)	Contractual support (Million NOK)
Modification and installation of 21 furnaces with associated pre and finishing treatment in plant 3 and 4 at Herøya	Elkem Solar AS	Industry	Support for new energy and climate technology in industry	39	**72**
Energy efficiency improvement through hybrid technology in new explorer cruise ships	Hurtigruten AS	Transport	Support for new energy and climate technology in transport	18	**45**
Pilot for Heat Recovery and Power Production	Hydro Aluminium AS	Industry	Support for new energy and climate technology in industry	2	**44**
New children's hospital, step 2	Helse Bergen HF	Non-residential buildings	Support for energy-efficient new buildings	9	**39**
Industrialization of sawing with 40µm diamond wire	Norsun AS	Industry	Support for new energy and climate technology in industry	10	**29**
Heimdal Upper Secondary School w/ multipurpose hall	Sør Trøndelag county authority	Non-residential buildings	Support for energy-efficiency new buildings	3	**21**
H2-Bergen	Uno-X Hydrogen AS	Transport	Support for new energy and climate technology in transport	0,05	**20**
Testing of hydrogen technology for pure heavy transport evaluation of cost and emission potential	Asko Midt-Norge AS	Transport	Support for introduction of new technology	1	**20**
Energy-efficient and climate friendly recycling of nutrients from krill stickwater	Aker Biomarine Antarctic AS	Industry	Support for new energy and climate technology in industry	39	**19**
Tysnes care cluster	Tysnes municipality	Non-residential buildings	Support for energy-efficient new buildings	2	**14**

Table 3.6: *The table shows the ten largest projects within new energy and climate technology 2016, measured by awarded support.*

Table 3.7
A selection of the largest projects within new energy and climate technology 2016

Project owner	Project description	Support awarded (NOK)	Project's energy result (kWh/year)	Climate result (kg CO_2 eqv./year)
Renewable heating				
Statkraft Varme AS	Transition from semi-dry to dry flue gas cleaning combined with increased energy utilisation at Statkraft's heating plant at Heimdal in Sør-Trøndelag	8 707 686	6 000 000 heating from bio, oil and electricityl	279 600 Reduced use of propane and heating from bio, LPG and electricity
Agder Energi Varme AS	Investment in new boiler for biofuel adapted for wood powder with a low melting point at existing heating plant in Arendal	5 280 330	600 000 Production of district heating	128 864 Reduced use of diesel
Renewable power				
Statoil ASA	Testing and validation of condition monitoring system Kongsberg EmPower (K-EmPower) at Statoil's floating offshore wind turbine HYWIND Demo, with the goal of reducing the number of unforeseen downtimes	1 766 400	248 000 Production of electricity	0
Smøla Vind 2 AS	Testing and validation of condition monitoring system Kongsberg EmPower for Smøla Vindpark, with the goal of reducing the number of unforeseen downtimes	4 201 930	1 773 000 Production of electricity	0
Statkraft Energi AS	Testing of polyurethane foam as filler around pipe rack for Lille Måsevann pumping station connected to Adamselv power plant in Lebesby in Finnmark. Stabilization of bend using polyurethane foam instead of concrete	7 300 000	4 450 000 Production of electricity	0
Transport				
Hurtigruten AS	Construction of two specially designed hybrid explorer cruise ships for polar waters	45 102 723	17 933 671 Reduction of diesel	4 776 095 Reduced use of diesel
Asko Midt-Norge AS	Installation of solar cell facility and hydrogen production facility, as well as investment in four hydrogen-operated delivery trucks at Tiller in Trondheim	19 620 000	944 000 Reduction of diesel, and conversion from diesel	251 406 Reduced use of diesel, and conversion from diesel
Uno-X Hydrogen AS	Construction of two hydrogen filling stations in Bergen, and an electrolyser to supply the stations, with the objective of removing the barriers for using hydrogen vehicles in Norway	19 824 000	47 000 Reduction of diesel	12 517 Reduced use of diesel
Brakar AS	Procurement of six battery electric buses for routes in Drammen, and two pantograph chargers at the final stop and "plug in" charging station at depot	9 560 000	2 706 000 Reduction of diesel, and conversion from diesel	720 662 Reduced use of diesel, and conversion from diesel
Industry				
Elkem Solar AS	Modification of factory production lines at Herøya in Porsgrunn for solar cell production with substantial energy conserving effects	72 000 000	39 000 000 Reduction of electricity	0
Hydro Aluminium AS	Validation of technology for electricity production from waste heat at Hydro Aluminium's pilot plant on Karmøy	44 000 000	1 600 000 Production of electricity	0
Norsun AS	Construction of pilot plant for industrialization of sawing process using a 40µm core wire thickness for wafer production at NorSun's plant in Årdal	28 761 075	10 100 000 Reduction of electricity	0
Aker Biomarine Antarctic AS	Development and installation of technology for energy-efficient recycling of solids in stickwater from krill catching in the area around the Antarctic	19 380 000	39 390 000 Reduction of diesel	10 490 345 Reduced use of diesel
Non-residential buildings				
Helse Bergen HF	Children's hospital at passive house level, 90% transparent solar cells integrated in glass façade, wells for combined heating and cooling production	39 000 000	8 925 977 Production of electricity, heating and cooling, and reduction of electricity	0
Sør Trøndelag county authority	New Heimdal Upper Secondary School with multipurpose hall in Trondheim will fulfil NS3701 minimum requirements for passive houses and be emission-neutral during the operating phase throughout the year using innovative energy solutions	21 479 000	3 111 214 Production of electricity and heating, and reduction of electricity	21 088
Login Vagle AS	Warehouse in Sandnes in Rogaland with energy demand at passive house level and innovative energy system	12 920 000	3 864 784 Production of electricity and heating, and reduction of electricity	0

Table 3.7: *The table shows a selection of the largest projects within new energy and climate technology supported in 2016. The approved support amount and pledged energy result have been corrected according to the final reported result.*

Project status	Innovation
Engineering	· Advanced heat exchanger for cooling of flue gas from 200 degrees Celsius to 140 degrees Celsius without using water injection · Dry flue gas cleaning contributes to improved cleaning and energy efficiency · Reduced calcium consumption, filter dust, water consumption and no need to replace nozzles and bilges related to letting water into the reactor
Under development	· Production of heating when incinerating wood sheets consisting of finely distributed wood powder polluted with inorganic materials such as sand and concrete · Makes it possible to extract energy from materials that otherwise cannot be utilized in a good manner · Production is changed over a short period, which is expedient in energy systems with power that cannot be regulated such as solar and wind power
Under development	· Management system with integration of measured values at high level of detail and with many functionalities for processing collected data from sources inside and outside the wind turbine · New method for analysing data and presenting information, for use in operational and maintenance planning · Enables transition from calendar-based to condition-based maintenance, and early detection of nonconformities
Commissioning	· Management system with integration of measured values at high level of detail and with many functionalities for processing collected data from sources inside and outside wind turbines at the onshore wind farm · New method for analysing data and presenting information, for use in operational and maintenance planning · Reduce number of unforeseen downtimes by 50% · Enables transition from calendar-based to condition-based maintenance, and early detection of nonconformities
Commissioning	· Use of polyurethane foam as filling around buried pipe racks · Measurement and verification of the material's tensile properties and mechanic calculation assumptions · The technology contributes to reduced costs for new constructions and rehabilitation of existing hydropower plants that can help bring unprofitable projects within acceptable profitability · Reduced intervention in nature when laying pipes when foam replaces gravel and stones, due to considerably reduced volume to be transported to the plant area.
Under establishment	· Hybridisation of explorer ships for use in vulnerable Arctic area · Comprehensive solution in relation to ship design, propulsion system and consumption pattern to reduce energy demand as much as possible · Hybridisation with battery and integrated option for shore power
Under establishment	· Hydrogen-operated delivery trucks · Comprehensive solution with production of solar power for use in hydrogen production facility
Engineering	· Construction of hydrogen stations, and signed letters of intent to purchase hydrogen-operated passenger cars
Under establishment	· Pantograph chargers for charging at final stop, and "plug in" charging station at depot · 14–15-km route where 6 of 6 buses are battery electric · The electric buses replace the diesel buses 1-1
Operational	· Production of multi-crystalline solar cell ingots with minimum 31% higher filling rate in ingot moulds than the market standard · Production process' energy efficiency is improved by 30%, material loss and water consumption reduced by 2% and 80%, respectively · Demonstration of simplified furnace technology with the potential for cost reduction
Engineering	· Heat exchanger adapted to composition and temperature level of flue gas from electrolysis cells · Concept development, integration and optimization of heat exchange and power production unit · Verification of technology for both low and high temperature power production from waste heat from the electrolysis process
Under establishment	· Sawing ingots with a narrower diamond wire thickness of 40µm, which results in less discard per wafer. This results in reduced energy consumption per produced wager · Automatic gluing process for increased stability in mass production · Labelling of final product before gluing for traceability
Under establishment	· Ceramic membrane filtration and subsequent flash dampening, which increases the concentration of valuable nutrients from stickwater · Increased energy efficiency and production yield by recycling the flue gases from existing drying process on board to using a flash dampener · Membrane technology will remove 90% of the water before the mass is fed into the flash dampener
Engineering	· Comprehensive solution with goal of low energy demand (passive house level) · Installation of 90% transparent solar cells in glass façades · Expansion of existing heat pump facility to heating and cooling · Focus on heat recovery in all stages, incl. tap water heating in existing central block
Under establishment/ Engineering/ Under development	· Innovative system solution. Building with low energy demand, and supply from several renewable energy sources in an efficient energy system with low greenhouse gas emissions · Project comprises shading with electromagnetic glass, production of heating and electricity, heat recovery from greywater, CHP machine, geothermal heat pump and storage of produced electricity
Under development	· Comprehensive solution with a number of innovative elements composed in a new way · Robots with regeneration of electric J140 energi · CO_2 cooling and freezer system with accumulator tank switching between summer and winter operation modes · Production of electricity from solar cells with associated battery bank for storage of excess production · Prognosis management for balancing electric and thermal production against expected demand

In-depth reporting

Energy results

The contractual energy result is an estimate of what the annual energy results are expected to be when the supported project is completed. Completing a major project can take several years, and the results from the project are recorded in the year the support is granted. This provides quicker reporting and enables closer follow-up by Enova than waiting until the projects are complete. The energy results are updated as the projects are completed.

3 840 GWh was pledged in 2016. A few of these projects were cancelled during the year. These amounted to 19 GWh. The total contractual energy result at the end of 2016 thus ended at 3 821 GWh.

When a project is completed, a final report is prepared, containing an updated prognosis of the project's expected annual energy and climate result. Some of the projects that were contracted in 2016, were completed by the end of the year. These amount to about 93 GWh, and there is little difference between contractual and finally reported energy and climate results for these projects.

There is somewhat greater fluctuation in the project portfolio for 2012–2016. As a result of cancellations, the contractual energy result was reduced by 8 per cent from 10 363 GWh to 9 520 GWh. Furthermore, there have been some corrections in final reporting of projects, so the contractual energy result corrected for final reported results is 9 714 GWh for the project portfolio.

Table 3.8
Energy results 2012–2016 distributed by market

	2016			2012-2016		
	Gross contractual result	Contractual result	Contractual corrected for final reported result	Gross contractual result	Contractual result	Contractual corrected for final reported result
Market	**GWh**	**GWh**	**GWh**	**GWh**	**GWh**	**GWh**
Renewable heating	165	162	162	1 454	1 204	1 201
Renewable power	6,5	6,5	6,5	56	20	18
Industry	2 565	2 563	2 563	5 231	5 056	5 267
Transport	710	694	695	971	954	955
Non-industrial plants and facilities	26	26	26	159	156	155
Non-residential buildings	321	323	323	2 148	1 914	1 903
Residential buildings	46	46	46	345	217	215
Total	**3 840**	**3 821**	**3 821**	**10 363**	**9 520**	**9 714**

Table 3.8: *The table shows the contractual energy result (in GWh) distributed by market, both before and after correction for cancelled and final reported projects. The "Contractual results" column shows the energy result at the end of 2016 corrected for cancellations.*

Figure 3.4 shows the percentage of final reported projects for the years in the current agreement term. The percentage of final reported projects increases as the projects mature, with the exception of the project portfolio that was adopted in 2012, which has a lower percentage of final reported projects than in 2013 and 2014. The figure also differentiates between active projects where disbursement has started and not started. The risk of a project being cancelled has turned out to be significantly lower once disbursement has started. Here we can see that there are varying levels of progression for projects during the different years. Almost all projects adopted in 2013 are either completed or have started receiving disbursements. Most projects adopted in 2016 had not started receiving disbursements at the end of 2016.

Figure 3.4
Percentage of final reported projects approved during the period 2012–2016

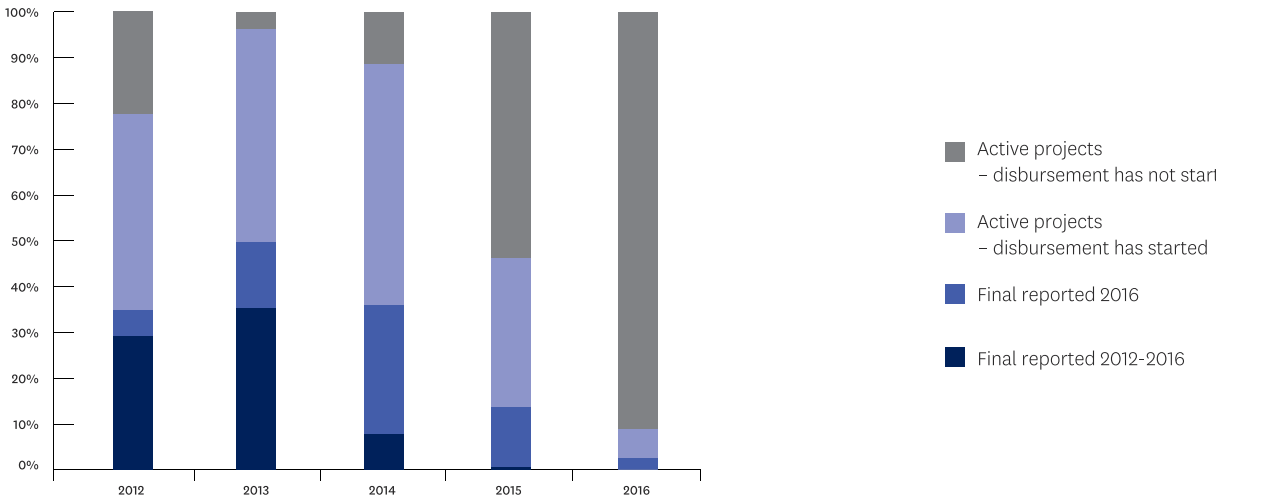


Figure 3.4: *The figure shows the percentage of final reported and active projects at the end of 2016, distributed by approval year. The figure also shows the percentage of active projects where disbursement has started. The percentages are measured according to the projects' energy results.*

Funding level

An important precondition for use of investment support is that the instrument is cost-effective. Enova should derive maximum value in the form of kWh for the support it provides. The funding level is measured as support per energy result (NOK/kWh). For energy projects in particular, the funding level is an important assessment criterion for Enova. For new energy and climate technology projects, the goal of the support is to contribute to reducing greenhouse gas emissions and to support the development of restructuring of energy end-use and energy production in the long term, through developing and utilizing new technologies and new solutions. For technology projects, expertise development, potential dissemination and innovation are highly relevant assessment criteria.

Funding for a project is calculated based on what is necessary to ensure the project is completed. If the project is considered profitable, it does not need support to be implemented. If the project is very unprofitable, it will need a high funding level. Enova prioritizes projects that require the least possible support per energy result, and ensures cost efficiency by rejecting the most unprofitable projects.

Overall, the funding level for energy projects in 2016 is NOK 0.50/kWh. This is lower than earlier years, which is due to oil and gas projects bringing down the average. For industry projects, including oil and gas, the funding level in 2016 was NOK 0.18/kWh. For other markets, the cost level has been stable or increasing in recent years.

The funding level for transport projects in 2016 was NOK 1.07/kWh on average. This is an increase compared to 2015, and means that transport projects now have about the same funding level as the market areas non-residential buildings, renewable heating and non-industrial plants and facilities. Transport projects represent a higher share of the energy result, and is the market with the biggest impact on the overall funding level in 2016.

Projects within the market areas of non-residential buildings and non-industrial plants and facilities have remained steady at a funding level just above NOK 1.00/kWh over the last three years. The funding level for non-residential buildings in 2016 is slightly below the average for the period 2012–2016, whereas it is slightly above the average for projects within non-industrial plants and facilities.

The funding level for projects within renewable heating declines somewhat from 2015 to 2016, but the level for 2016 is higher than the average for the period 2012–2016. The energy result generally consists of district heating projects, where the largest and most cost-effective projects have already been developed. A relatively high support percentage is therefore natural in this area. Since the energy result percentage is declining steadily, the change has a relatively minor impact on the total funding level.

For residential buildings, the Enova Subsidy in particular results in a somewhat higher funding level in 2016 compared with previous years. The residential market amounts to a relatively small share of the energy results, and the increase has a minor impact on the overall funding level.

For the entire portfolio overall, the 2016 projects show a relatively significant decline in funding level. The total funding level drops from NOK 0.97/kWh for the 2012–2015 portfolio to NOK 0.77/kWh for the 2012–2016 portfolio.

Table 3.9

Funding level within the Energy Fund 2012–2016 (excl. new energy and climate technology)

		2012		2013		2014		2015		2016		2012-2016	
		Distributed by contractual energy result	Lifetime-adjusted	Distributed by contractual energy result	Lifetime-adjusted	Distributed by contractual energy result	Lifetime-adjusted	Distributed by contractual energy result	Lifetime-adjusted	Distributed by contractual energy result	Lifetime-adjusted	Distributed by contractual energy result	Lifetime-adjusted
Market	Average lifetime	NOK 0.01/kWh		NOK 0.01/kWh		NOK 0.01/kWh		NOK 0.01/kWh		NOK 0.01/kWh		NOK 0.01/kWh	
Renewable heating	20 years	91	4,6	116	5,8	110	5,5	133	6,7	124	6,2	113	5,6
Industry	15 years	90	6,0	57	3,8	71	4,7	56	3,7	18	1,2	42	2,8
Transport	15 years	-	-	-	-	-		68	4,6	107	7,1	99	6,6
Non-industrial plants and facilities	15 years	52	3,5	80	5,3	99	6,6	105	7,0	100	6,6	94	6,3
Non-residential buildings	15 years	101	6,7	141	9,4	105	7,0	110	7,3	109	7,2	113	7,5
Residential buildings	15 years	209	14,0	372	24,8	230	15,3	230	15,4	261	17,4	259	17,3
Total		**96**	**6,2**	**113**	**6,9**	**90**	**5,6**	**89**	**5,6**	**50**	**3,2**	**77**	**4,9**

Table 3.9: *The table shows the funding level distributed by contractual annual result, as well as funding level measured over the average lifetime. The results are corrected for cancelled projects. Projects within new energy and climate technology are not included in the table.*

Enova looks at cost efficiency distributed over the project's lifetime. This makes it easier to compare projects with widely varying lifetimes. The longer a project's lifetime, the more years over which support can be distributed. Table 3.9 uses average lifetimes for the various markets as a basis. In the same way as there could be significant variation in funding level between projects in the same market, lifetime could also vary widely within the same market. The lifetime was included to illustrate annual levels. When taking into account the lifetime of projects, we can see that the average funding level among projects supported in 2016 was the lowest in the industry. The funding level vis-à-vis transport projects has grown, and is now on the same level as for non-residential buildings, renewable heating and non-industrial plants and facilities. Residential buildings have the highest funding level. Figure 3.5 shows the development in funding level measured over lifetime.

Figure 3.5

Development in funding level 2012–2016, measured over project lifetime

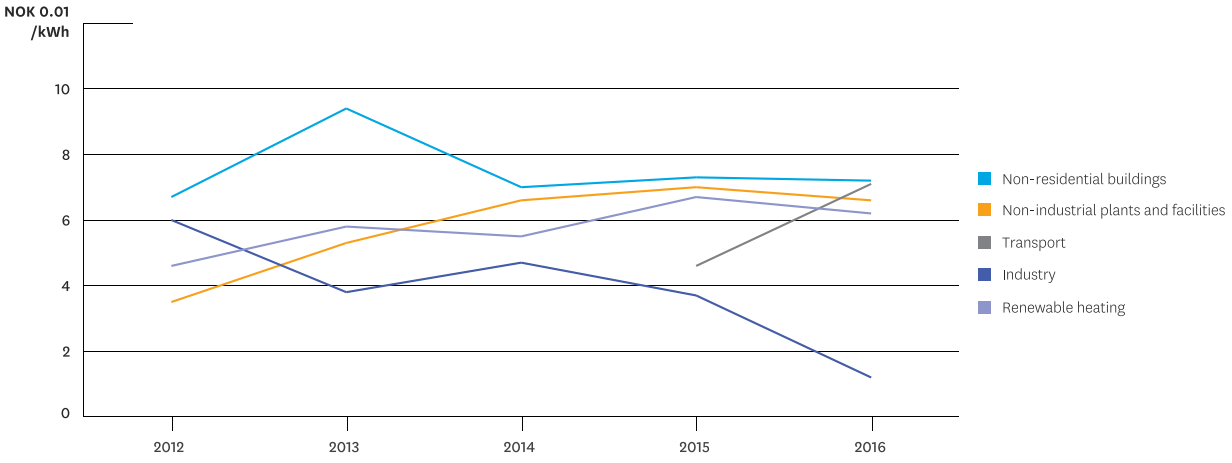


Figure 3.5: *The figure shows the average funding level for projects approved in 2012–2016, measured over the average lifetime. The results have been corrected for cancelled projects. Projects within new energy and climate technology and residential buildings were not included in the figure.*

Energy results by project category

The projects supported by Enova can be split into four categories: production, energy efficiency, distribution and conversion. Production projects include all projects where electricity or renewable heating are produced, either for sale or internal use. Establishment and expansion of district heating plants entails development of new infrastructure, and these projects are characterized as distribution projects. The conversion projects are projects where the energy carrier is changed from electricity or fossil energy carriers to renewable energy carriers based on, for example, bioenergy.

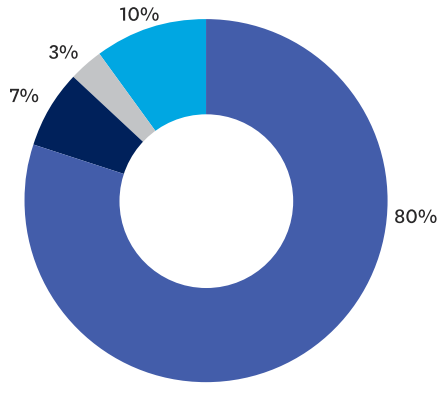
The majority of the energy result in 2016 comes from energy efficiency projects. These are projects with the goal of improving energy consumption with end-users. These types of projects constitute 80 per cent (3 053 GWh) of the overall energy result in 2016.

Table 3.10
Energy result 2016 distributed by project category

Market	Energy efficiency	Production	Distribution	Conversion
	GWh	GWh	GWh	GWh
Renewable heating	7	1	104	49
Renewable power	-	6	-	-
Industry	2 338	177	-	48
Transport	447	56	-	192
Non-industrial plants and facilities	24	1	-	-
Non-residential buildings	225	23	-	73
Residential buildings	12	1	-	35
Total	**3 053**	**265**	**104**	**398**

Table 3.10: *The table shows contractual energy results in 2016 distributed by project category and market. The figures are corrected for cancelled projects.*

Figure 3.6
Results 2016 distributed by project category



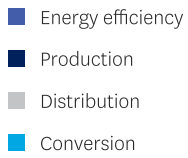
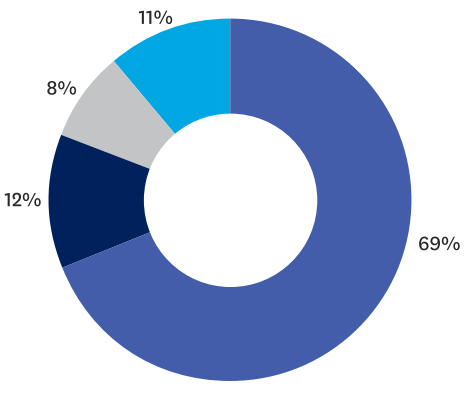


Figure 3.7
Results 2012–2016 distributed by project category



Figur 3.6: *The figure shows contractual energy results in 2016 distributed by project category. The figures are corrected for cancelled projects.*

Figur 3.7: *The figure shows contractual energy results in 2012–2016 distributed by project category. The figures are corrected for cancelled projects.*

Energy efficiency has accounted for more than half of the energy result every year since 2012 and has also been on the rise. The scope of production projects was high (34 per cent) in 2012, but the distribution between production, distribution and conversion evened out in the following years. The share of distribution projects fell to three per cent in 2016, which is related to the lower scope of district heating projects. Figure 3.6 and Figure 3.7 show that the share from energy efficiency was high in 2016. The tendency in recent years has been that the share of energy efficiency projects rises, whereas the share of production and distribution declines. This also applies to 2016.

Results distributed by renewable energy sources/carriers

Table 3.11 shows the energy result within production, distribution and conversion, distributed by energy carrier. Overall, the energy result is 766 GWh. This is an increase of 178 GWh from 2015. Nevertheless, this energy result amounts to a lower share of the total energy result than before.

Bioenergy represents the largest share in 2016, with 307 GWh. Normally, energy carriers for thermal energy have dominated with the highest levels, but increased use of electricity is the energy carrier with the second highest level in 2016 with 194 GWh. These results mainly come from projects that involve conversion from diesel through establishment of shore power and in marine transport projects.

Utilization of waste incineration has doubled since 2015, whereas the other categories have declined. There have been few projects related to exploiting solar power, wind power and geothermal energy in 2016.

Table 3.11
Energy results within production, distribution and conversion distributed by energy carrier

Energy carrier	Contractual energy result GWh
Bioenergy,	307
Chips	*184*
Biomass	*46*
Pellets	*46*
Other bio	*32*
Electricity	194
Waste	122
Heat pump	75
Waste heat	50
District heating	10
Other renewable	4
Solar	3
Wind power	2
Geothermal	0
Total	**766**

Table 3.11: *The figure shows energy results within production, distribution and conversion distributed by energy carrier.*

Portfolio composition

2016 is unique in that the portfolio contains five projects with more than 100 GWh in contractual energy result. Four of these are energy management projects in the petroleum sector. The energy management projects have also demanded relatively little in contractual support. If we disregard these, the project portfolio in 2016 is relatively evenly distributed, both as regards the number of projects, contractual energy result and contractual support. The distribution is shown in Figure 3.8.

It is still the case that the majority of projects that are supported have an energy result of less than 1 GWh, but Enova supported fewer small projects in 2016 than in 2015, as well as more projects within the project groups with higher energy results. The total number of projects supported in 2016 is on par with 2015. The largest projects of more than 100 GWh are very significant for the total energy result. These five projects amount to more than 40 per cent of the energy result in 2016.

Contractual support is generally quite closely related to the distribution of contractual energy results, as high funding amounts often coincide with major energy results. However, the funding profile over the two previous years has been influenced by the technology projects, which are cost-intensive without necessarily having large direct energy results. Major technology projects are not prominent in 2016. The figure shows that the largest projects amount to a small share of contractual support, but by far the largest share of energy results. The smaller projects, however, make up larger shares of the total support, and therefore have more expensive energy results.

Figure 3.8
Projects 2016 distributed by size

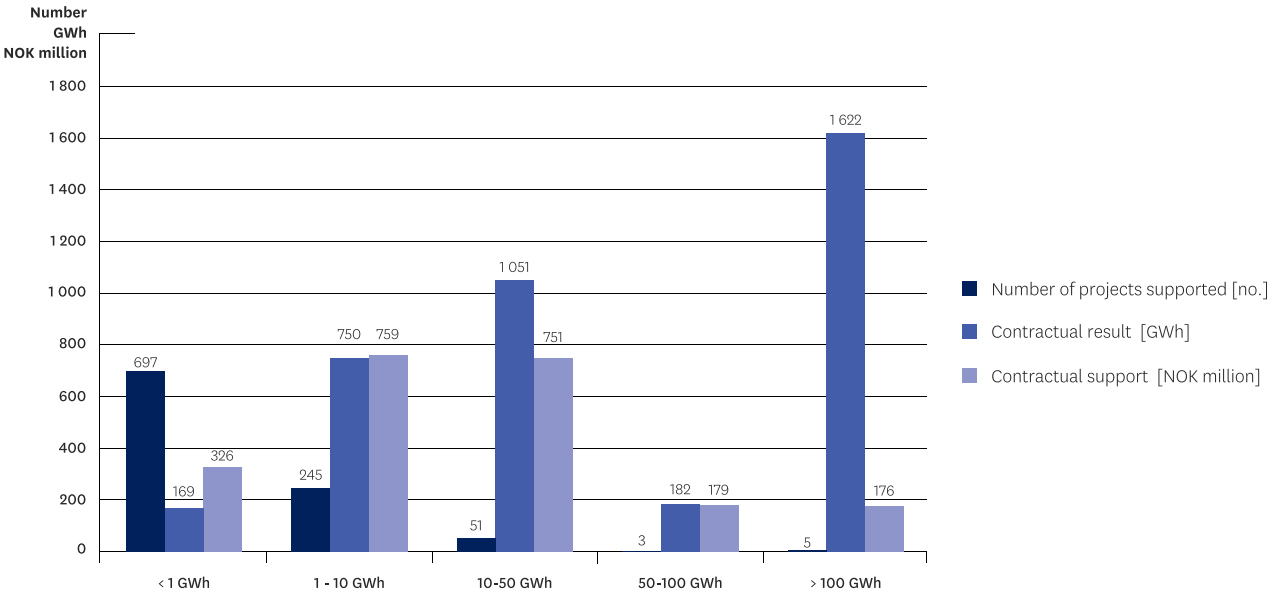


Figure 3.8: *The figure shows distribution of projects entered into in 2016 grouped by project size in GWh. The Enova Subsidy is not included in this overview.*

Figure 3.9
Projects 2012–2016 distributed by size

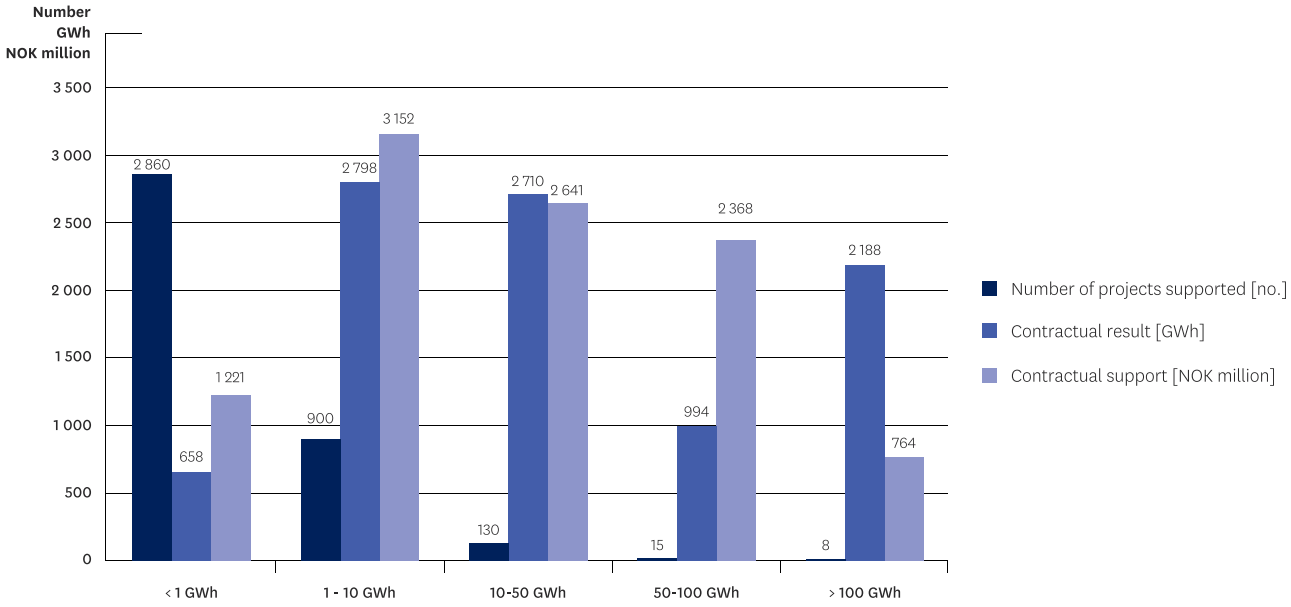


Figure 3.9: *The figure shows distribution of projects entered into in 2012–2016 grouped by project size in GWh. The Enova Subsidy and Energy measures in residences (2012–2014) are not included in this overview. Support for energy advisory service and Support for upgrading residences were included in the Enova Subsidy starting in 2015 and 2016, respectively. The projects that applied for this programme during 2013–2016 were removed from the overview.*

Figure 3.9 illustrates the same portfolio distributions for the entire period 2012–2016. The distribution profiles for the number of projects and contractual energy result are relatively similar from year to year, and this is reflected in the total project portfolio. After the 2016 portfolio has been taken into consideration, a substantially larger portion of the energy result will come from the largest projects. Otherwise, the three distributions have not changed significantly as a result of the 2016 portfolio.

The distribution for contractual support is mostly affected by the scope of technology projects with higher support intensity, but such projects, as mentioned, are not prominent in 2016.

There is a correlation between the size of the projects and implementation time. Small projects normally have a significantly shorter implementation time than major projects. Small projects are typically related to energy management and minor measures in residences, non-residential buildings and industry, while larger projects involve extensive engineering and investments in major physical measures. These naturally take longer to complete.

The small projects have an expected end date averaging one year after the approval date. Overall, 90 per cent of all projects approved in 2016 are expected to be finalized by the end of 2018. These constitute about 80 per cent of this year's contractual energy result and more than 50 per cent of this year's allocated support.

If we consider the entire project portfolio for 2012-2016, 97 per cent of the projects are expected to be finalized by the end of 2018. These projects constitute 86 per cent of the energy result and 76 per cent of allocated support.

Enova wants the supported projects to be carried out as quickly and efficiently as possible. Rapid implementation reduces the risk of external factors changing with a resulting negative impact on the projects, thereby reducing the risk of the project not being implemented.

Figure 3.10
Projects 2016 distributed by contractual final date

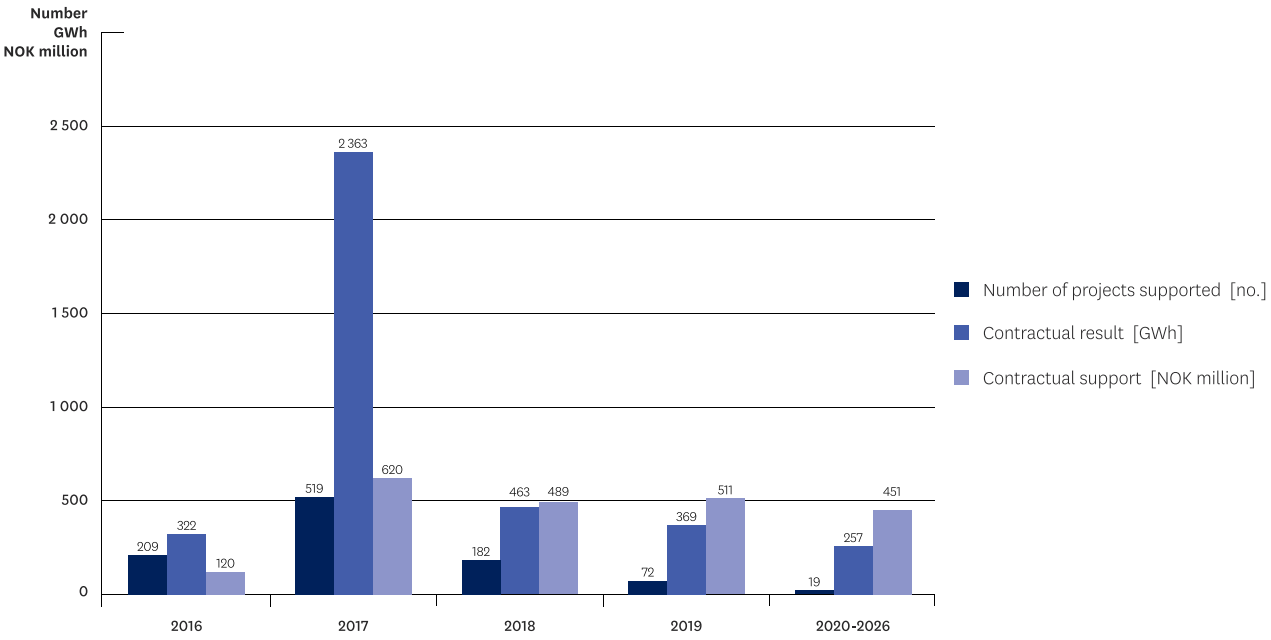


Figure 3.10: *The figure shows distribution of projects entered into in 2016 distributed by the project's contractual final date. The Enova Subsidy is not included in this overview.*

Figure 3.11
Projects 2012–2016 distributed by contractual final date

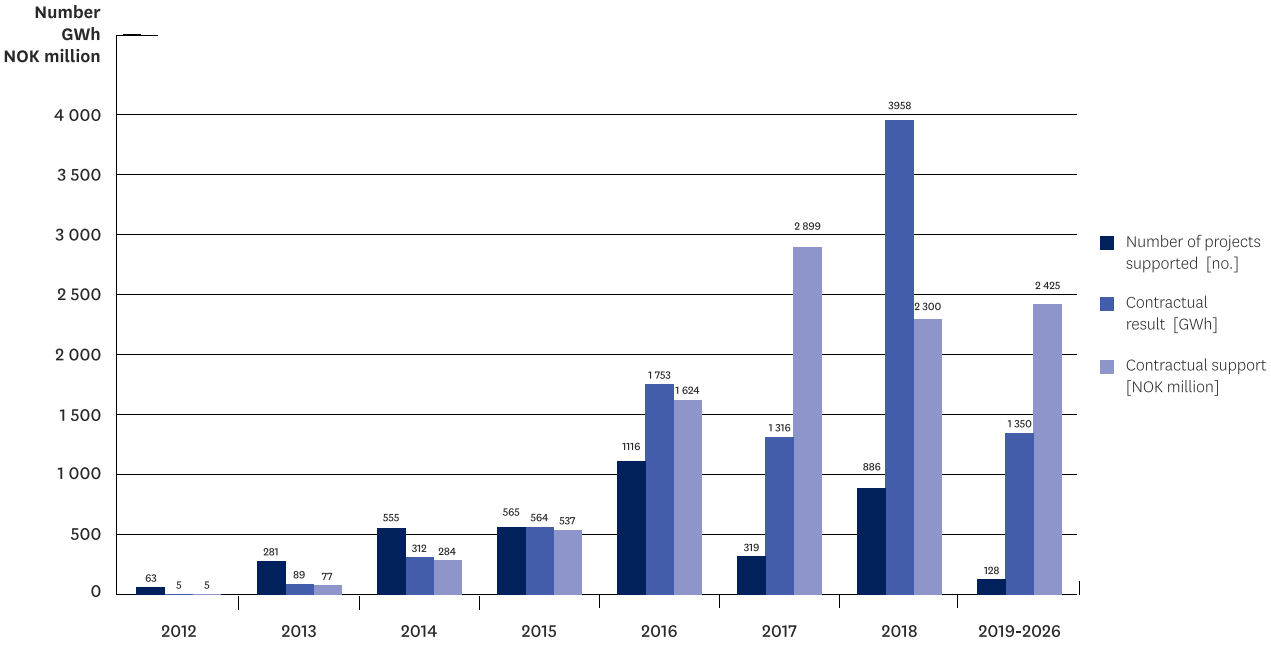


Figure 3.11: *The figure shows distribution of projects entered into in 2012–2016 distributed by the projects' contractual final date. The Enova Subsidy and Energy measures in residences (2012–2014) are not included in this overview. Support for energy advisory service and Support for upgrading residences were included in the Enova Subsidy starting in 2015 and 2016, respectively. The projects that applied for this programme during 2013–2016 were removed from the overview.*

Figure 3.12 shows the development in the number of received applications for the years 2012 to 2016, excluding the Enova Subsidy. In 2016, Enova received 34 per cent more applications than in 2015. All the largest markets had an increase in the application volume. The new programmes offered within transportation appear to have been popular, and the number of applications for support for transport projects has tripled from 2015. The application volume within renewable heating declined during the entire period, and we also received fewer applications for support for non-industrial plants and facilities in 2016.

Figure 3.12
Applications received in the period 2012–2016

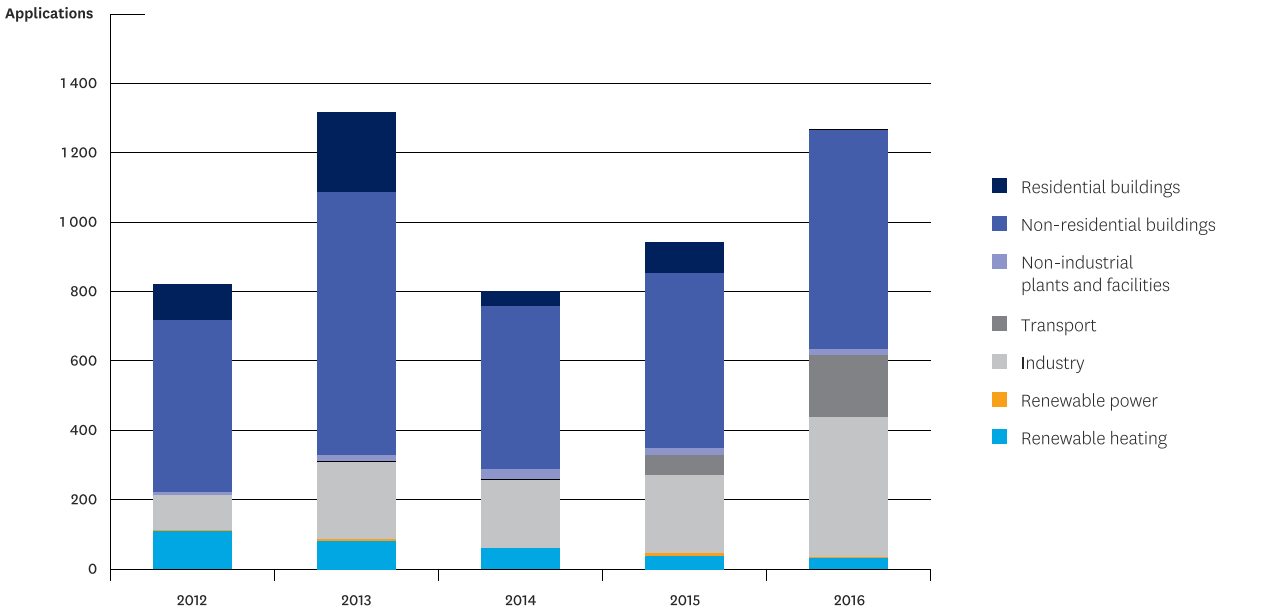


Figure 3.12: *The figure shows the development in number of applications in the period 2012–2016 and the distribution between the various markets. Energy measures in residences (2012–2014) and the Enova Subsidy (including Support for energy advisory service and Support for upgrading residences) were not included in this overview. For details regarding this service, see Table 3.13.*

Table 3.12 shows an overview of the entire application mass in 2016, including the Enova Subsidy. A total of 8 933 applications were received, which amounts to a 45 per cent increase from 2015.

The total application volume is dominated by residential applications for the Enova Subsidy. With 7 657 applications in 2016, this scheme increased by 50 per cent from the previous year. In 2016, the Enova Subsidy encompassed most of Enova's support services vis-à-vis homeowners. The support scheme is perceived as more streamlined than before, and users report high satisfaction. Case processing is efficient since the scheme is rights-based.

A total of about 6 500 subsidies were disbursed in 2016. The liquid-to-water heat pump and air-to-water heat pump each represented about 20 per cent of the subsidies in 2016, followed by retrofitting of balanced ventilation (15 per cent) and heat management systems (14 per cent). 200 subsidies were awarded for upgrading the building structure, which is an extensive and energy conserving measure.

There is a difference in the number of received and processed applications in a year, as applications received at the end of a year are often fully processed in the following year.

When applications are not granted support, it is usually due to one or more of the following causes:
- Projects are too profitable to support.
- Projects are too expensive to support.
- Projects fall outside the criteria for support.
- Projects are insufficiently documented.

Table 3.12
Activity overview Energy Fund 2016

Market	Number of applications received	Number of applications processed	Number of projects supported	Contractual energy result	Contractual support
	No.	No.	No.	GWh	NOK Million
Renewable heating	**31**	**29**	**24**	**162**	**203**
District heating	29	26	22	155	189
Support for introduction of new technology	2	3	2	7	14
Renewable power	**3**	**3**	**3**	**6**	**13**
Support for introduction of new technology	3	3	3	6	13
Industry	**403**	**339**	**307**	**2 563**	**647**
Support for energy measures in industry	162	151	138	434	367
Support for introduction of energy management in industry and facilities	190	141	139	1 999	68
Support for new energy and climate technology in the industry	13	11	7	125	189
Support for introduction of new technology	9	8	3	1	5
Heating plants expanded	4	4	4	3	2
Pre-project support for energy measures in the industry	21	21	14	-	10
Pre-project support for new energy and climate technology	4	3	2	-	6
Transport	**181**	**183**	**124**	**694**	**823**
Biogas	2	2	2	55	54
Support for energy measures in inland transport	2	2	-	-	-
Support for energy measures in ships	11	12	11	54	28
Support for energy measures in facilities	7	7	7	167	303
Support for introduction of new technology	2	2	2	1	23
Support for new energy and climate technology in transport	17	17	13	49	111
Support for charging infrastructure	20	21	9	-	40
Support for shore power	71	71	33	259	220
Support for municipal and county authority transportation services	1	1	1	12	16
Support for introduction of energy management in transport	48	48	46	98	28
Non-industrial plants and facilities	**16**	**14**	**14**	**26**	**26**
Support for energy measures in facilities	16	14	14	26	26
Non-residential buildings	**632**	**596**	**526**	**323**	**476**
Support for existing buildings	297	269	258	253	283
Support for new technology in the buildings of the future	10	9	7	1	14
Support for energy-efficient new buildings	19	18	12	24	113
Support for introduction of new technology	1	1	1	0,171	5
Support for heating plants	157	153	135	45	31
Support for concept assessment for innovative energy solutions in buildings and areas	58	56	28	-	21
Mapping support	90	90	85	-	9
Residential buildings	**7 663**	**7 593**	**6 475**	**46**	**120**
Enova Subsidy	7 657	7 579	6 468	46	119
Support for upgrading residences[3]	6	14	7	-	1
International work	**4**	**3**	**3**	**-**	**3**
Support for Norwegian participation in IEA projects – main project	4	3	3	-	2,7
Total	**8 933**	**8 760**	**7 476**	**3 821**	**2 311**

Table 3.12: *The table shows an overview of the number of applications received, processed (i.e.: a final decision on approval or rejection has been made), the number of projects supported[1], as well as funds granted[2] within applicable programmes and associated energy results[2] in 2016. The table only shows support for programmes that accept applications and not allocations for other activities in the Energy Fund. Applications for the programme "Support for introduction of new technology" are distributed by market area based on the type of project.*

1 *Number of projects approved for support is corrected for cancellations. For the 2016 portfolio, this applies to 20 projects.*

2 *Awarded support and contractual energy results have been corrected for cancellations.*

3 *From 1 Jan. 2016, the programme was included in the Enova Subsidy.*

Activities

Enova has awarded support to more residential projects in 2016 than in previous years. Many of the households implemented multiple measures simultaneously. Support for upgrading the building structure was launched in 2016 as a rights-based measure, and it became possible to receive support for upgrading the building structure to the current standard (TEK10). The number of residences that received subsidies for upgrades doubled from 100 projects in 2015 to 200 projects in 2016. A simple, fully digital application process makes it easy for homeowners to register measures and receive subsidies, and an evaluation shows that 90 per cent of the users in 2016 are satisfied with the Enova Subsidy.

Figure 3.13

Number of subsidies in the Enova Subsidy, distributed by measure

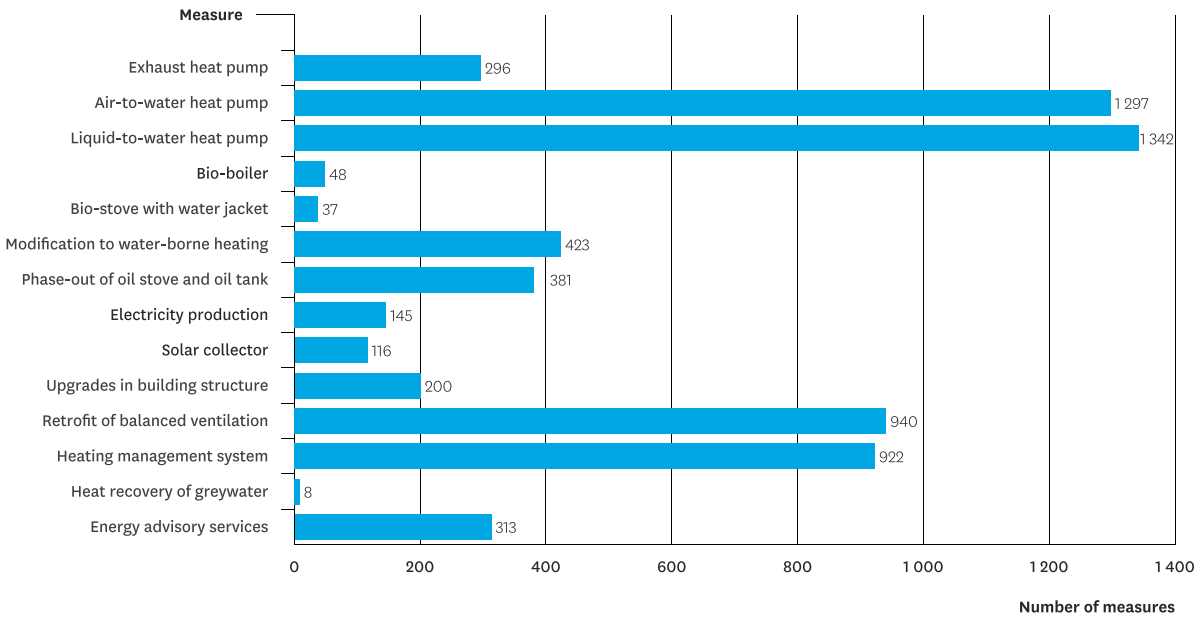


Figure 3.13: *The figure shows the number of subsidies in the Enova Subsidy in 2016, distributed by measure. 878 households that received a subsidy for conversion to a heat pump, bio-boiler or bio-stove also received a subsidy to remove oil boilers and tanks.*

Table 3.13

Programmes for private individuals

Programmes	Purpose	Measurement parameter	Goal 2016	2012	2013	2014	2015	2016
				No.	No.	No.	No.	No.
The Enova Subsidy/ Support for energy measures in residences[1]	More efficient and flexible use of energy, increased use of other energy carriers than natural gas and oil for heating, increased use of new energy resources, energy recovery and bioenergy	Number of applications	13 500	6 731	7 410	4 662	5 127	7 657
		Number of disbursements[2]	n/a	3 099	2 704	2 583	4 575	6 468
Support for energy advising[3]	More well-functioning markets for efficient energy, environmentally and climate-friendly solutions	Number of applications	0	-	326	603	-	-
Support for ambitious upgrades[4]	More efficient and flexible use of energy	Number of applications	0	-	32	107	118	6

Tabell 3.13: *The table shows Enova's programmes for private individuals, the purpose and goal figures for each programme, as well as their result in the period 2012–2016.*

1 *The Support for energy measures in residences was replaced by the rights-based Enova Subsidy programme starting in 2015.*

2 *A total of 831 of the disbursements in 2015 were made in connection with the Support for energy measures in residences programme.*

3 *The Support for energy advising programme was incorporated as a separate measure in the Enova Subsidy in 2015. The programme was launched in May of 2013.*

4 *The programme Support for ambitious upgrades was incorporated as a separate measure in the Enova Subsidy in 2016. The programme was launched in May of 2013.*

Children and young people

The Energy Challenge, Enova's digital learning platform about energy and climate, is anchored in the current digital classroom teaching and in the competence aims in the schools. The target group is upper primary level students and teachers. The Energy Challenge aims to provide children and young people with increased knowledge about energy and climate. Along with Junior Achievement - Young Enterprise Norway (JA-YE-Norway), Enova is organizing a National innovation camp for students in upper secondary school. Support for the competition has grown every year.

Table 3.14
Activities aimed at children and young people

Activity	Purpose	Goal	Measurement parameter	School year 14/15	School year 15/16	School year 16/17
Learning platform for use in school	Increased knowledge in society about the possibilities of using energy-efficient, environmentally and climate-friendly solutions	300 schools registered as users	Number of schools using Enova's Energy Challenge	192 schools	451 schools	651 schools
Enova's cooperation with Junior Achievement - Young Enterprise Norway "Energi for Fremtiden"	Increased knowledge in society about the possibilities of using energy-efficient, environmentally and climate-friendly	3500 students in upper secondary schools	Number of students participating in county and national innovation camps	3 754	4 142	4 334

Table 3.14: *The table shows activities within programmes aimed at children and young people.*

Advisory services for private individuals

Enova provides advisory services for private individuals, focusing on the need to acquire information at an early stage in the decision phase before a project and assistance with the application process. The advisory services are provided through a dedicated website and through the Ask Enova service.

Table 3.15
Advisory services for private individuals

		Goal	Result				
Activity	Purpose of the activity	2016	2012	2013	2014	2015	2016
Ask Enova	Nationwide information and advice via telephone, email and e-chat to support the goals of the Energy Fund.	40 000	28 215	41 792	38 748	43 749	42 337
Page views per day on the website	Information about Enova's programmes for homeowners, and advice related to energy measures in residences	n/a	1 806	2 667	2 926	3 402	3 486

Table 3.15: *The table shows advisory activities aimed at private individuals. The number of page views on the website includes the sections on enova.no aimed at private individuals and the portal for the Enova Subsidy (tilskudd.enova.no).*

Activities within communications and public relations

Targeted communication is a crucial tool in order for Enova to achieve its goals and strengthen its reputation. The communication work is based on the business strategy, and will contribute to Enova triggering desired market changes along with market players.

In 2016, much of the communication has been aimed at the professional market, also as a result of Enova's new efforts vis-à-vis the transportation sector. Enova's efforts within shore power were widely covered in the media, as well as the strengthened services offered for ground transportation. Enova's work for development of quick charging stations has also been discussed extensively, which contributes to bolstering Enova's position as a champion for the green transition. The popularity of the Enova conference shows that market players need a national arena for energy and climate technology. The conference was organized for the fifth time and gathered 700 participants from the private and public sector. Feedback from the participants shows that the conference provides both updates on recent developments and inspiration to develop and establish energy and climate-friendly solutions.

Enova has strengthened its reputation among professional players. At the same time, overall knowledge of Enova remains at a stable high level, both in the private and professional market.

Table 3.16
Activities within communications and public relations

	2012	2013	2014	2015	2016	Comments
Articles about Enova	3 344	2 636	3 140	4 450	5 435	The total number of mentions in 2016 increased by more than 20 per cent compared with 2015. Enova's work towards a more climate-friendly transportation sector, and particularly the development of quick charging stations, appears to generate substantial interest.
Inquiries Ask Enova	40 152	49 062	46 124	53 905	58 335	Ask Enova received about 58 000 inquiries in 2016. This is an 8 per cent increase from 2015. The increase is mainly due to the Enova Subsidy and response to Enova's campaigns, as well as an increased basic interest in energy efficiency measures and energy restructuring among the general public, and more questions from businesses for broad-based programmes within buildings and real estate, transport and industry.

Table 3.16: *The table shows activities within communications and public relations. The number of articles about Enova includes mention of Enova in Norwegian broadcasting, digital media, as well as paper-based media. The number of inquiries to Ask Enova includes both the private and professional markets.*

Geographical distribution and the largest projects

Over the course of 2016, Enova supported about 1 000 projects[9] distributed across all of Norway. The number of projects within each county varies, from two projects on Svalbard to 131 projects in Rogaland.

The county distribution for energy results in 2016 is dominated by the major energy management projects in the petroleum industry. Projects from Hordaland have pledged more than 1 TWh in 2016, and the largest project accounts for 74 per cent of this energy result. The three counties of Hordaland, Rogaland and Møre og Romsdal have the highest energy results, and are home to nine out of the ten largest energy projects in 2016. Projects from Oslo and Nordland County contributed lower energy results than in earlier years.

Sør-Trøndelag has received the most contractual support from Enova in 2016, where an industrial incineration facility accounts for more than 40 per cent. Hordaland also has a relatively high share of contractual funding in 2016, compared to the period 2012–2016 as a whole.

The distribution of energy result and number of projects largely reflects population density and financial activity in the various counties. Looking at the number of projects, Rogaland received funding commitments for a relatively high number of projects in 2016, while Akershus received less compared with previous years. Beyond this, the distribution of number of projects in 2016 is generally in line with the distribution for the 2012–2016 period.

In addition to the projects distributed by county, we use the categories of Svalbard, the Continental Shelf and Nationwide projects. The latter are projects involving measures in two or more counties. There were 46 such projects in 2016, with an energy result of 198 GWh.

9 *Enova has also granted subsidies to about 6 500 energy measures in residences in 2016.*

Figure 3.14

Energy result and support within the Energy Fund 2016 – distributed by county

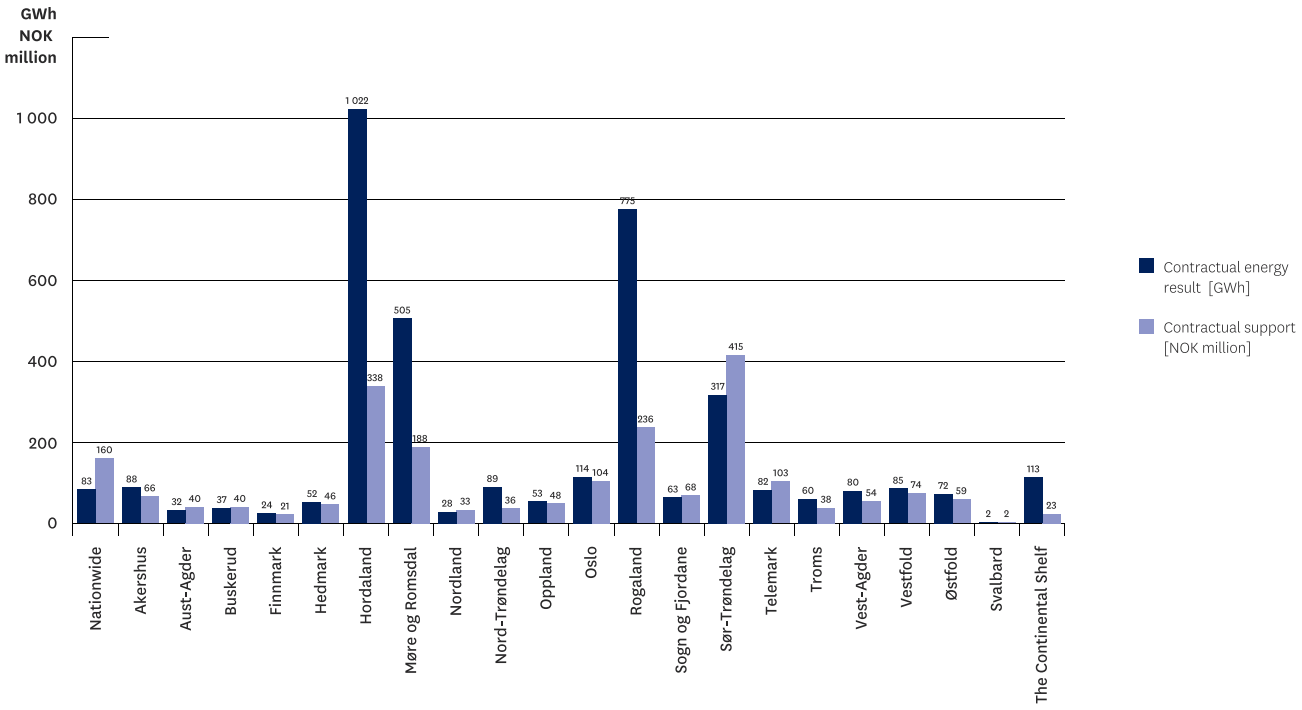


Figure 3.14: *The figure shows contractual results and contractual support in 2016 distributed by county. Projects that are characterized as "nationwide" apply to projects that involve measures in two or more counties. The Enova Subsidy is not included in this overview.*

Figure 3.15

Energy result and support within the Energy Fund 2012–2016 – distributed by county

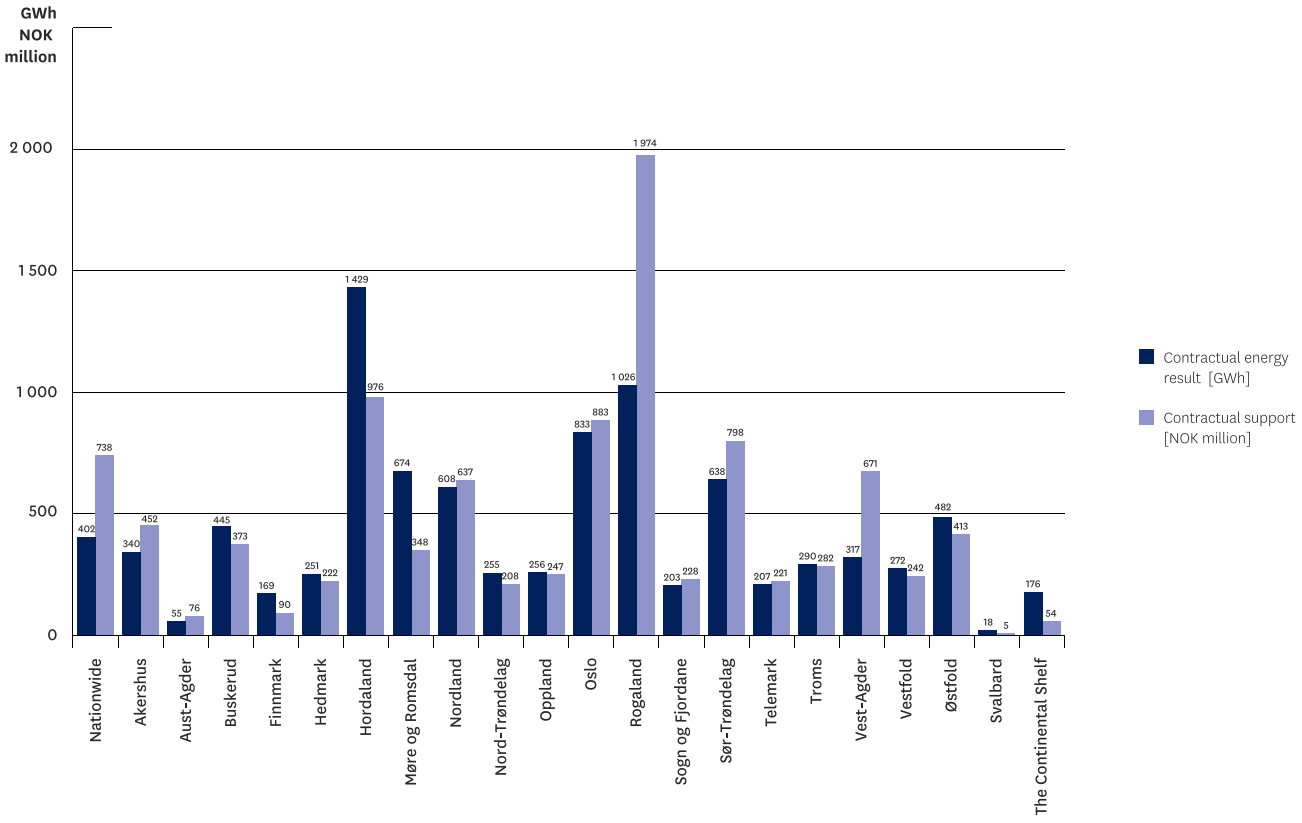


Figure 3.15: *The figure shows contractual results and contractual support in 2012–2016 distributed by county. Projects that are characterized as "nationwide" apply to projects that involve measures in two or more counties. The Enova Subsidy and Energy measures in residences (2012–2014) are not included in this overview. Support for energy advisory services and Support for upgrading residences were included in the Enova Subsidy starting in 2015 and 2016, respectively. The projects that applied to this programme during 2013–2016 were removed from the overview.*

Figure 3.16

Number of projects supported within the Energy Fund in 2016 – distributed by county

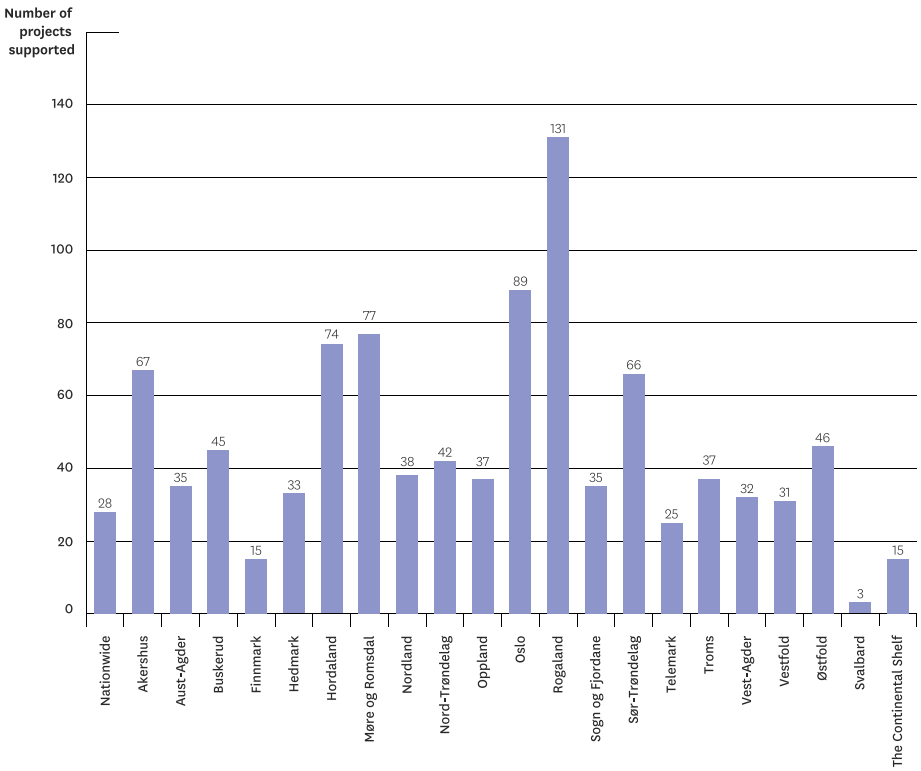


Figure 3.16: *The figure shows the number of projects supported in 2016, distributed by county. Projects that are characterized as "nationwide" apply to projects that involve measures in two or more counties. The Enova Subsidy is not included in this overview.*

Figure 3.17

Number of projects supported within the Energy Fund in 2012–2016 – distributed by county

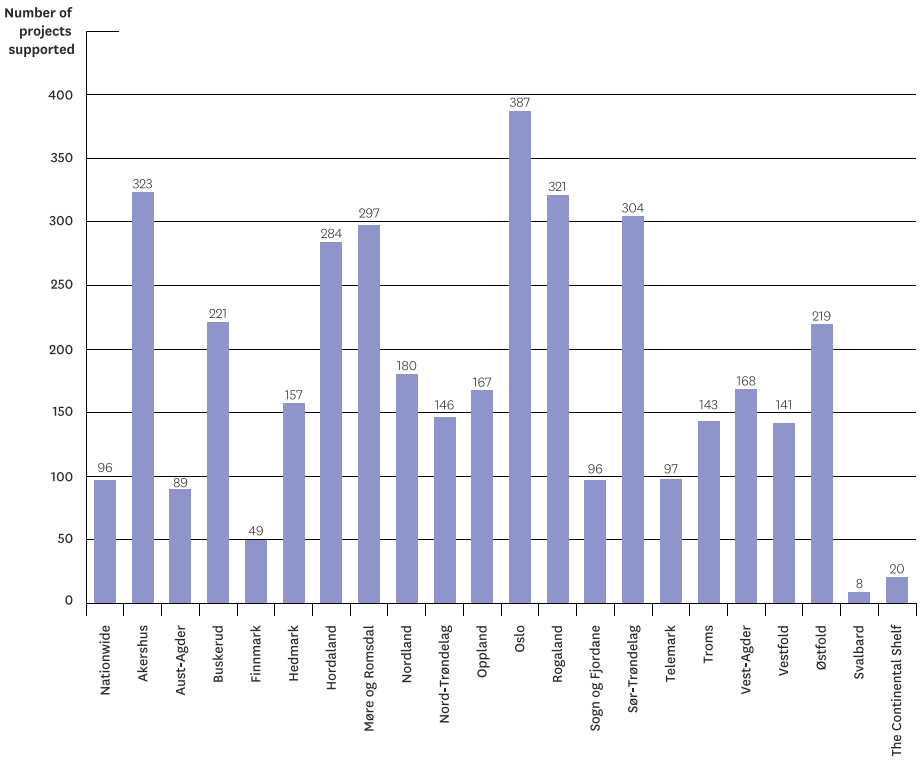


Figure 3.17: *The figure shows the number of projects supported in each county in 2012–2016. Projects that are characterized as "nationwide" apply to projects that involve measures in two or more counties. The Enova Subsidy and Energy measures in residences (2012–2014) are not included in this overview. Support for energy advisory services and Support for upgrading residences were included in the Enova Subsidy starting in 2015 and 2016, respectively. The projects that applied to this programme during 2013–2016 were removed from the overview.*

Table 3.17

Top 10 in 2016 – Projects with the highest awarded funding level

Market	Project description	Applicant	Contractual energy result (GWh)	Contractual support (NOK million)
Industry	Ranheim Energi – Application for support to build a co-incineration plant for energy measures in industry	Ranheim Energi AS	175	**172**
Transport	Infrastructure for charging ferries	Hordaland county authority	51	**90**
Transport	Zero/low emissions on the ferry routes Hareid–Sulesund and Magerholm–Sykkylven	Møre og Romsdal county authority	54	**88**
Industry	Modification and installation of 21 furnaces with associated pre and finishing treatment in plants 3 and 4 at Herøya	Elkem Solar AS	39	**72**
Transport	Investment in quay facility for reducing energy consumption in Flakk–Rørvik route	Sør Trøndelag county authority	26	**51**
Transport	Charging facility for ferries	Hordaland county authority	21	**51**
Non-residential buildings	Energy focus at 17 shopping centres	Thon Holding AS	38	**47**
Transport	Energy efficiency improvement through hybrid technology in new explorer cruise ships	Hurtigruten AS	18	**45**
Renewable heating	District heating and district cooling development from Jåttåvågen to Urban Sjøfront	Lyse Neo AS	30	**45**
Industry	Pilot for Heat Recovery and Power Production	Hydro Aluminium AS	2	**44**

Table 3.17: *The table shows the ten largest projects in 2016 measured by contractual funding level.*

Table 3.18

Top 10 in 2016 – Projects with the highest energy result

Market	Project description	Applicant	Contractual energy result (GWh)	Contractual support (NOK million)
Industry	Introduction of energy management at Statoil Mongstad	Statoil Refining Norway AS	**757**	1
Industry	Support for intensifying energy management in industry and facilities for Gassco Kårstø	Gassco AS avd Kårstø Prosessanlegg	**387**	1
Industry	Support for intensifying energy management at Statoil Tjeldbergodden	Statoil Metanol ANS	**183**	1
Industry	Ranheim Energi – Application for support to build a co-incineration facility for energy measures in industry	Ranheim Energi AS	**175**	172
Industry	Introduction of energy management at Statfjord	Statoil Petroleum AS Statfjord	**120**	1
Industry	Establishment of energy management for Draugen	A/S Norske Shell Kons 093 Draugen L	**77**	0,4
Transport	Zero/low emissions on the ferry routes Hareid–Sulesund and Magerholm–Sykkylven	Møre og Romsdal county authority	**54**	88
Transport	Infrastructure for charging ferries	Hordaland county authority	**51**	90
Industry	Introduction of energy management and development of dashboard	Statoil Petroleum AS Snorre	**49**	1
Transport	Averøy Industripark	Averøy Industripark AS	**42**	8

Table 3.18: *The table shows the ten largest projects in 2016 measured by contractual energy result.*

International activities

International work is a learning arena for expertise sharing and exchange of experience. Enova shares experience and learns from other players through international cooperation. We use this knowledge to design and improve national policy instruments.

Enova has representation in the following international forums:

- Participation in five of the International Energy Agency's (IEA's) management groups, so-called Technology Collaboration Programmes (TCP) and projects organized by these groups.
- Participation in the European Energy Network (EnR) – a European network for Enova's sister organizations.
- Participation and board membership in the European Council for an Energy Efficient Economy (ECEEE).

Table 3.19 provides an overview of IEA activities where Enova represents and/or contributes resources.

Enova provides support for the preparation of new projects for participation in the IEA's Technology Collaboration Programmes, which is in line with Enova's goals. The objective of the IEA's support programme is to facilitate the establishment of more IEA projects that are relevant for Norway with Norwegian participation and leadership.

In 2016, Enova was a member of the steering committee (Troika) in the European Energy Network (EnR). EnR is a European network of organizations with national responsibilities within energy efficiency and renewable energy production. EnR is an arena for exchanging knowledge and experience. EnR delivers input to the European Commission from its members for hearings within energy and climate.

Table 3.19
International work

IEA Technology Collaboration Programme (TCP) – representation by Enova	
IA (Implementing Agreements)	**TCP Title**
IEA EEWP	IEA Energy Efficiency Working Party (EEWP)
End-user technologies (EUWP)	
EUWP 05	Demand Side Management (DSM)
EUWP 09	Industrial Energy-Related Technologies and Systems (IETS)
Renewable energy (REWP)	
REWP 16	Renewable Energy Technology Deplyment (RETD)
Bioenergy	
CS 22	IEA Bioenergy
IEA Tasks/Annexes – representation by Enova	
Task/Annex	**TCP tittel**
IEA HPP Annex 40	Heat pump concepts for near zero-energy buildings
IEA HPP Annex 49	Multifunctional heatpumps in near zero-energy buildings
IEA DSM Task 16	Innovative Energy Services
IEA DSM Task 24	Closing the loop - Behaviour change in DSM, from theory to policies and practice
IEA DSM Task 25	Business Models for a more effective market uptake of EE Energy Services.
IEA IETS Annex 15	Industrial Excess Heat Recovery pt. 2
IEA RETD Re-cri	Commercial Readiness Index (CRI) assessment – using the method as a tool in renewable energy policy design
IEA RETD Re-industry	Renewables and Clean Energy for Industries
IEA RETD Rewind offshore	Comparative Analysis of International Offshore Wind Energy Development
IEA Bioenergy Task 36	Integrating Energy Recovery Into Solid Waste Management Systems
IEA Bioenergy Task 40	Sustainable International Bioenergy Trade - Securing supply and demand

Other International activities (apart from IEA and IEE)

Forum	**Title**
ECEEE	European Council for an Energy Effeicient Economy
EnR	European Energy Network
ISO (international standardization organization)	Strategic Advisory Group on Energy Efficiency

Table 3.19: *The table shows an overview of IEA activities and other forums where Enova represents and/or contributes financing.*

PART III B | Reporting – the Energy Fund 2001–2011

Energy results and allocations 2001–2011

Table 3.20 shows the allocation of funds from the Energy Fund and total energy results during the 2001–2011 period, updated at the end of 2016, distributed by market and year. This table takes a basis in the year the funds were allocated, not the year the framework was awarded. Cancelled projects must be corrected for energy results for the year the contract was originally signed and recorded. The contractual support amount will be released and returned to the Energy Fund so it can be put into new projects. The fact that cancellations are corrected with retroactive effect, results in released funds and transfer of resources between years.

Enova awarded about NOK 8 billion in support for energy projects during the 2001–2011 period. The total investments which the support will trigger amount to more than NOK 40 billion. Enova's support percentage varies from market to market. In building, heating and industry projects, the support averaged less than 20 per cent of the projects' total investments during the agreement period. Within new technology projects, the support constituted between 25 and 50 per cent of investments.

Table 3.20
Energy results and allocations 2001–2011

	2001		2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		Totalt	
Market	GWh	MNOK	GWh	MNOK	GWh	MNOK	GWh	MNOK	GWh	MNOK	GWh	MNOK	GWh	MNOK	GWh	MNOK	GWh	MNOK	GWh	MNOK	GWh	MNOK	GWh	MNOK
Renewable heating	328	-	173	49	233	31	135	69	167	64	572	278	367	161	684	345	660	511	550	278	363	292	4 231	2 078
Biofuel production	-	-	-	-	154	3	255	14	162	6	100	4	167	5	67	3	-	2	-	-	-	-	906	38
Renewable power	120	-	80	35	127	27	441	186	334	137	-	-	-	-	55	80	453	1 041	498	916	-	-	2 107	2 422
Industry	300	-	157	19	136	16	360	56	248	34	556	92	573	106	206	42	807	315	183	69	84	39	3 610	787
New technology	28	-	1	19	-	-	-	9	-	2	2	7	8	71	1	13	2	45	15	51	9	20	66	236
Non-residential buildings[1]	44	-	147	56	300	65	265	65	556	112	363	101	191	67	351	132	246	487	170	149	504	461	3 137	1 696
Residential buildings[2]	-	-	-	-	-	12	-	12	-	14	-	36	10	45	-	56	-	61	-	68	41	105	52	409
Analyses, development and strategy	-	-	-	7	-	6	-	6	-	5	-	8	-	11	-	9	-	9	-	17	-	28	-	106
International work	-	-	-	6	-	7	-	7	-	12	-	11	-	6	-	4	-	8	-	8	-	5	-	73
Communications and public relations	-	-	-	112	-	40	-	26	-	47	-	19	-	21	-	43	-	25	-	24	-	56	-	412
Administration	-	-	-	42	-	36	-	41	-	45	-	47	-	61	-	75	-	100	-	93	-	95	-	635
NVE contracts (2001)*	-	385	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	385
Total	**820**	**385**	**557**	**346**	**949**	**243**	**1 456**	**491**	**1 468**	**478**	**1 593**	**602**	**1 316**	**553**	**1 364**	**803**	**2 167**	**2 605**	**1 415**	**1 672**	**1 002**	**1 101**	**14 108**	**9 279**

Table 3.20: *The table shows aggregated energy results and funds allocated from the Energy Fund in the period 2001–2011, corrected for cancelled and final reported projects as of 31 Dec. 2016. Funds for the NVE projects from 2001 (NOK 385 million) have not been distributed by the various markets. The associated energy result has been distributed by market and totals 820 GWh.*

1 *For the 2001–2011 portfolio, non-residential buildings also includes non-industrial plants and facilities.*
2 *The household subsidy programme for electricity conservation was incorporated in the Energy Fund from 1 July 2011, and the results are recorded from this time.*

Table 3.21

Energy results 2001–2011, corrected for cancellations, final reporting and realized results

	Gross contractual result	Contractual result[1]	Contractual corrected for final reported result	Contractual corrected for final reported and realized result
	2001-2011	2001-2011	2001-2011	2001-2011
Area	GWh	GWh	GWh	GWh
Renewable heating	6 676	4 704	4 231	4 393
Biofuel production	1 035	891	906	773
Renewable power	3 750	1 728	2 107	2 011
Industry	5 670	3 779	3 610	3 284
New technology	213	116	66	75
Non-Residential-Buildings[2]	3 648	3 099	3 137	3 270
Residential Buildings[3]	90	52	52	52
Total	**21 083**	**14 369**	**14 108**	**13 858**

Table 3.21: *The table shows the contractual energy result (in GWh) distributed by market and year, both before and after correction for cancelled, final reported and realized projects.*

1 *Contractual results show the energy result at the end of 2016 corrected for cancellations during the period 2001–2016.*

2 *In the period 2001–2011, non-residential buildings also includes non-industrial plants and facilities.*

3 *With the exception of certain measures in 2007, energy results within the Residences market area were not contractual until 2011. The household subsidy programme was incorporated in the Energy Fund from 1 July 2011, and the results are recorded from this time.*

Table 3.21 shows the contractual energy result for the 2001–2011 period, distributed by market and year, before and after correction for cancelled, final reported and realized results. The contractual energy result is about 30 per cent lower than the gross contractual energy result. The contractual result has been corrected for cancelled projects. We see that the total contractual energy result changes marginally with correction for final reported and realized results. There are some individual differences on the market level. While projects in renewable heating and non-residential buildings consistently have better energy results measured after a few years of operation, renewable power and biofuel processing show the opposite development.

Figure 3.18

Percentage of final reported projects approved in the period 2001–2011

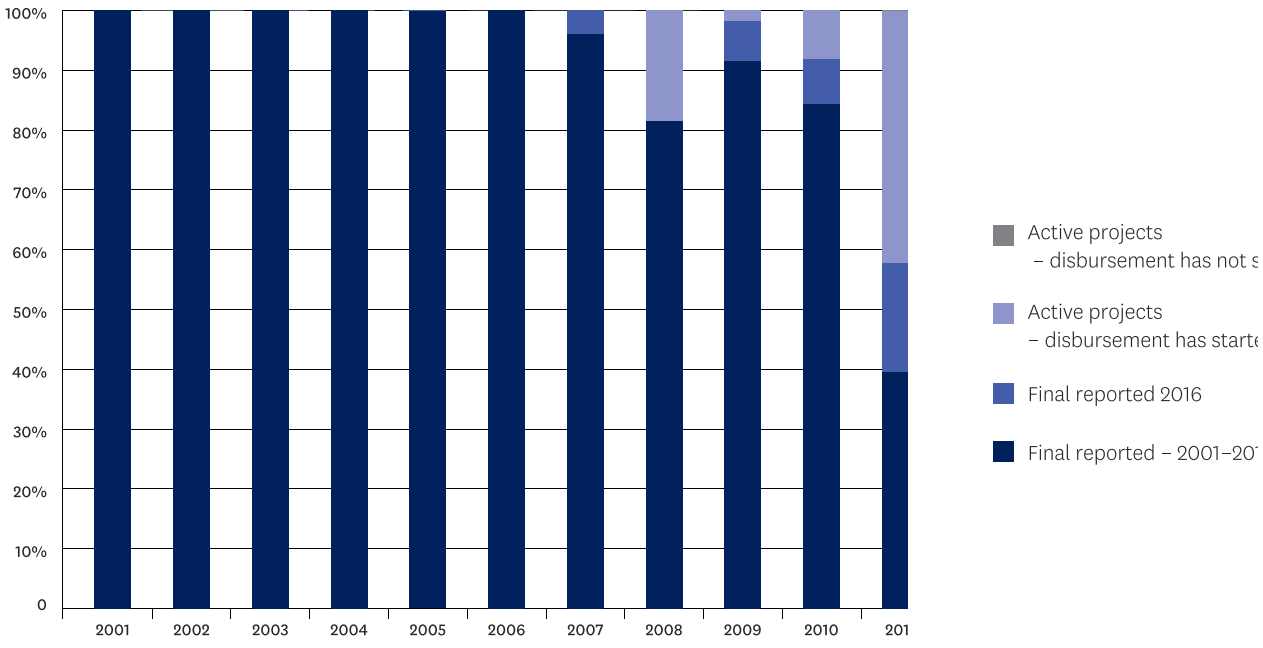


Figure 3.18: *The figure shows the percentage of final reported and active projects at the end of 2016, distributed by the year the project was approved. The figure also shows the percentage of the active projects where disbursement has started. The percentages are measured according to the projects' energy results.*

Figure 3.18 shows the percentage of final reported projects for the years going back in time. We can see that the percentage of final reported projects increases with the age of the projects. The figure illustrates the timeline for Enova's investment support. Final reports have been submitted by 2016 for all projects from 2002–2007. The percentage of final reported projects is also high for other years, with the exception of 2011, with an average of more than 90 per cent.

The figure also differentiates between active projects where disbursement has started and active projects where disbursement has not yet started. The risk of a project being cancelled has turned out to be significantly lower when disbursement of support has started.

Enova carries out active follow-up of the projects' progress and rate of completion. Systematic and sound follow-up will contribute to the projects being implemented in line with the agreements. In those instances where projects for various reasons will not be implemented, close follow-up ensures that we prevent funds from being unnecessarily tied up in projects without any progress.

Final reports have been submitted for about 0.5 TWh in 2016 from projects whose contracts were entered into in 2001–2011.

Figure 3.19

Energy results and cancellations per contract year 2001–2011

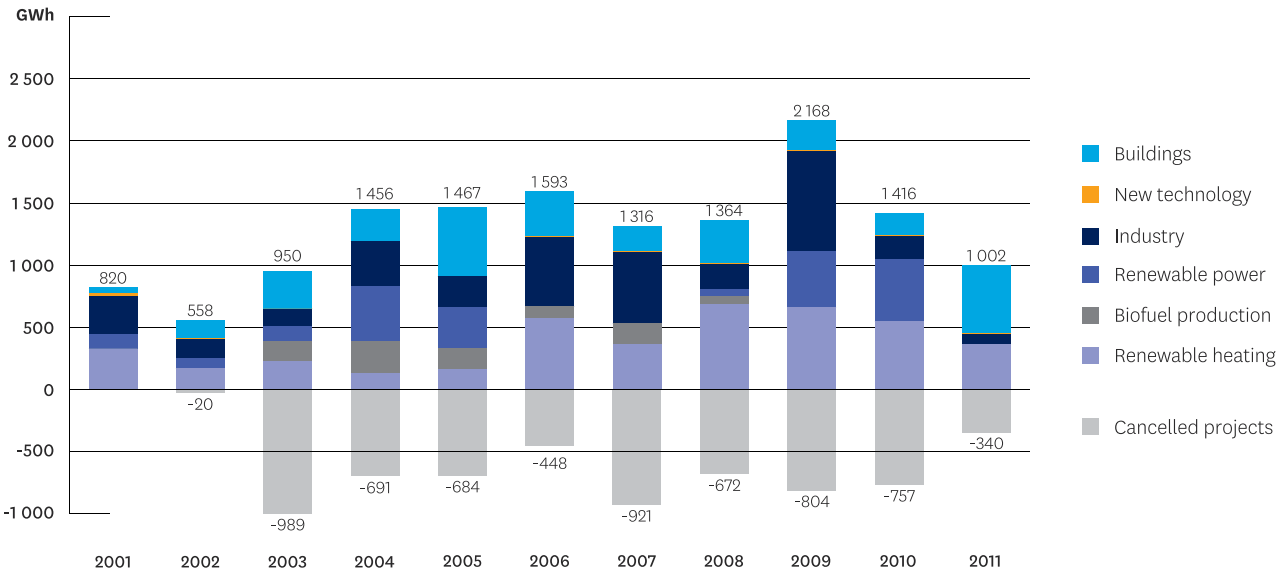


Figure 3.19: *The figure shows the contractual energy results for 2001–2011, distributed by contract year. The figure shows how cancelled contracts impact annual net energy results. Overall, the columns show the contractual energy result for each year. Cancellations contribute to an annual accumulated deduction (the negative part of the columns) from Enova's net energy result (the positive part of the columns). The figures are corrected for changes in the energy results in final reported projects.*

Figure 3.19 shows the contractual energy result from contracts signed in the period 2001–2011, distributed by contract year. The figure shows how cancellation of contracts retroactively affects annual net energy results.

The figure shows that the scope of cancellations varies between years. The scope of cancellations within 2011 is 25 per cent, and the average is 30 per cent.

Realized results

When Enova supports a project, the support recipient commits to achieving a certain energy result in the future. It takes time from project application until energy results can be harvested after project implementation. Implementation takes several years for the largest projects supported by Enova. The results, in the form of energy saved or renewable production, then vary from year to year.

Enova was established in 2001, and the oldest projects in our portfolio have accumulated sufficient operational experience to report what results they have actually realized. We have examined the results from the 3 800 projects that were implemented in the period from 2001 to 2011. Of these projects, the percentage completed within the period are the relevant source of empirical data – realized results.

Main results

In a normal year, these projects expect to achieve a somewhat lower energy result overall than their final reported result. Most of the projects, roughly two out of three, have realized the results they expected to, or more. Some projects achieve lower results than is recorded in the final reports, for example the wind power projects. Enova has phased out its wind power programmes.

Overall, the projects expect result fluctuations between –20 per cent and +10 per cent from year to year.

Figure 3.20
Realized results compared with contractual and final reported results

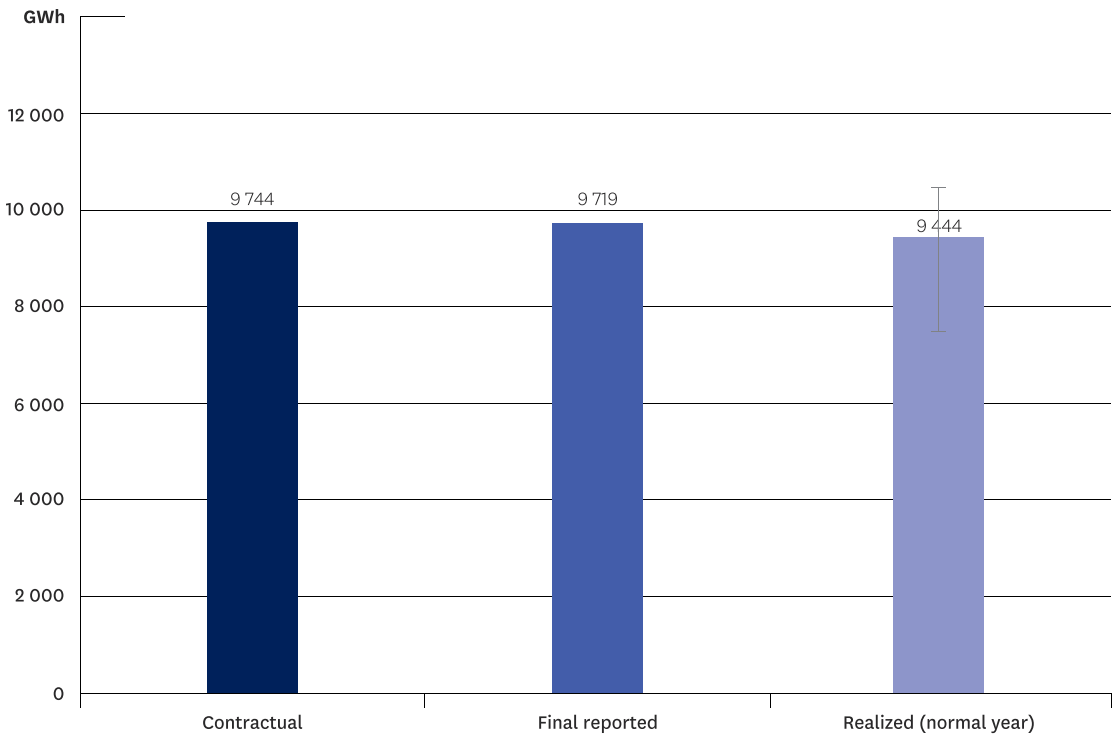


Figure 3.20: *The figure shows aggregated results as of 2016 for projects subject to final reporting before 31 December 2013. The figure shows both the total contractual, final reported and realized in a normal year. Natural discrepancies from a normal year are also shown for realized results.*

Realized results within market areas

Figure 3.21 shows the contractual and final reported energy results for each market area, and the realized energy result during a normal year. The expected interval for variation in energy results from year to year is indicated by lines on the column for the realized result. Each project has reported the annual energy result they expect in the best and worst case scenarios, and the intervals are derived from this.

Projects within renewable heating realize energy results that are on average 6 per cent higher than expected when the projects are completed. The projects expect considerable variations from year to year, but the energy results predicted upon completion will usually be higher – as much as 25 per cent higher than expected in some cases.

Figure 3.21
Realized results per market compared with contractual and final reported results

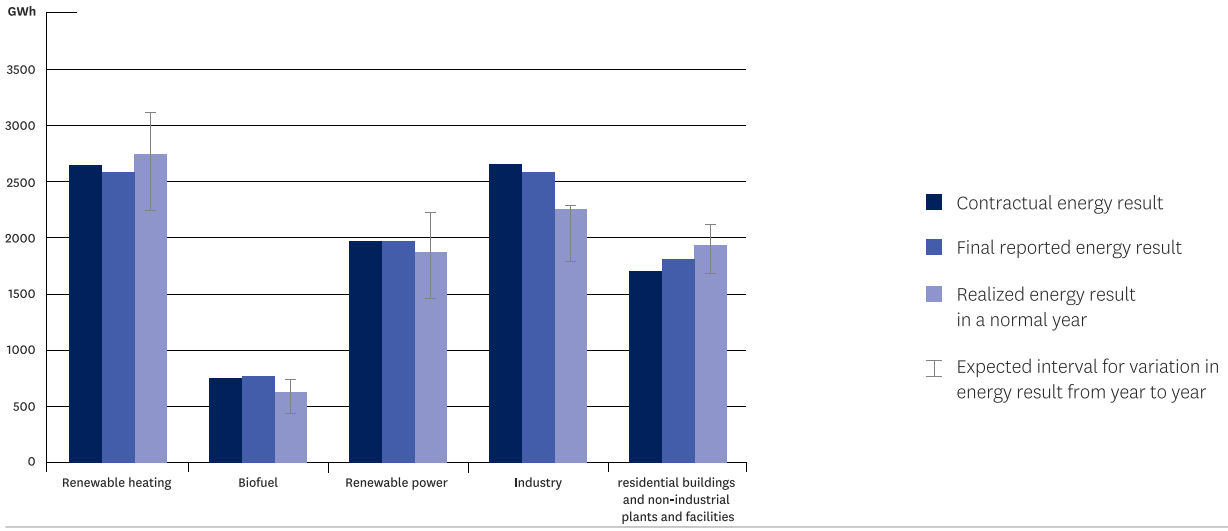


Figure 3.21: *The figure shows realized results in a normal year per market as of 2016, compared with contractual and final reported result for projects subject to final reporting before 31 December 2013. The expected interval for variation in energy result from year to year is indicated with vertical lines on the columns for realized results.*

Wind power projects (renewable power) deliver somewhat lower results than expected at final reporting, but we are seeing a substantial improvement from measurements in previous years. On average, the projects deliver 5 per cent lower results in a normal year in this year's measurement, compared with between 15 and 20 per cent lower in previous measurements. The improvement is related to new projects that have been included in the measurement, as well as a year with generally good wind conditions (measurement year 2015). During good years, it will be possible to produce the volume of energy that was expected when the projects were completed

For industry projects, the lower realized energy result is mostly related to a single large project where the observed energy effect of the measures was lower than the final reported. Biofuel projects are unable to deliver the expected results, and the projects report a high risk of not delivering enough results. At worst, the result is 40 per cent lower than expected when the projects were completed.

Composition of Enova's overall energy results

Figure 3.22 shows how Enova's overall energy results are distributed across projects with varying maturity. One year could include both contractual results from projects still in the initial phase, as well as realized results from completed projects that have been operational for several years. The earlier the year, the larger the percentage of final reported and realized energy results.

Figure 3.22
Contractual, final reported and realized energy results 2001–2011

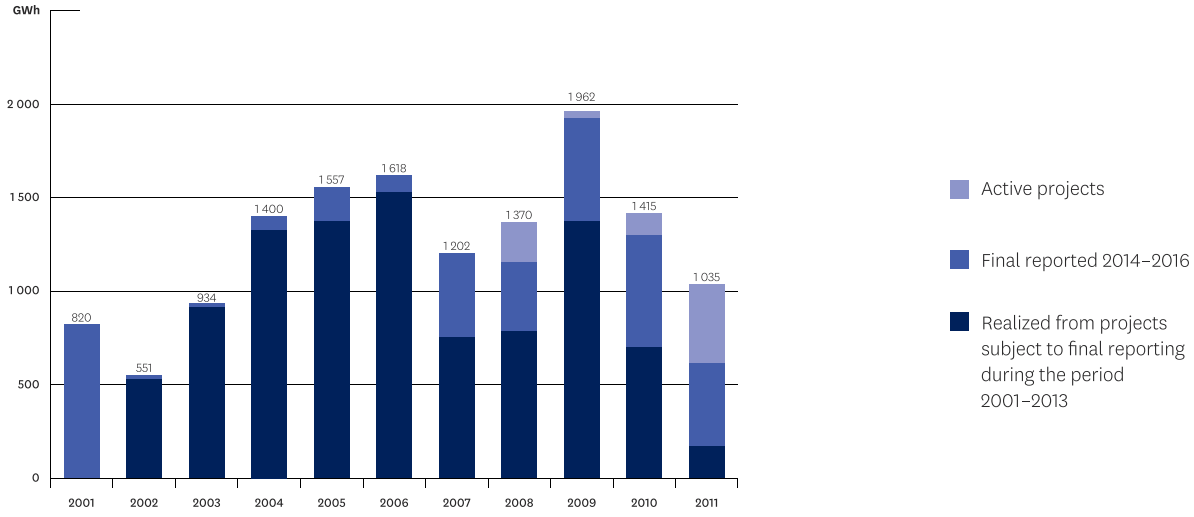


Figure 3.22: *The figure shows the net contractual, final reported and realized energy results distributed by the year the contract was entered into. The figures are corrected for changes in energy result in final reported and realized projects.*

Climate reporting

This chapter summarizes the estimated volume of annual greenhouse gas emission reductions from Enova's project portfolio for the 2001–2011 period.

In 2012, Enova further developed its database to show both the energy and climate result for each project. The climate accounts for the agreement period 2012–2016 take a basis in the figures for contractual energy result (kWh) in Enova's database and emission factors (gram CO_2 equivalents/kWh) for the various energy carriers in the project. The climate accounts for the period 2001–2011, however, are based on a template assessment of the volume of oil reduction achieved for each market. It is assumed that half of the energy result from projects within renewable heating will replace oil and half will replace electricity. Each kWh in energy result from industry leads to an estimated reduction in oil consumption of about 34 per cent on average for the period 2001–2011. The energy results from renewable power and new technology are presumed to have a 100 per cent impact via electricity as an energy carrier. That is why the reduction in oil consumption is estimated as zero in these areas. Projects within buildings are expected to result in a proportionately smaller reduction in oil consumption, about 12 per cent. As a result of the above, there is significant uncertainty associated with estimated climate results for the project portfolio from 2001–2011. For example, Enova has supported projects that involve reduction or conversion from other fossil fuels than oil, such as natural gas or propane. The climate impact of such measures has not been taken into consideration here, only estimated greenhouse gas reductions from improving the efficiency of oil consumption.

With a basis in energy results for 2001–2011, we estimate that projects supported by Enova during this period have a climate result of about 1 129 kilotonnes of CO_2 equivalents.

Table 3.22

Climate result from estimated reductions in oil consumption for projects supported by Enova during the period 2001–2011

Market	Energy result GWh	Climate result from reduced oil consumption ktonnes CO_2 eqv.
Renewable heating	4 231	641
Renewable power	2 107	-
Industry	3 610	372
New technology	66	-
Non-Residential buildings[1]	3 137	114
Residential buildings[2]	52	2
Total	**13 203**	**1 129**

Table 3.22: *The table shows the total energy result and the estimated reduction in greenhouse gas emissions as a result of reduced oil consumption from projects approved during the period 2001–2011. Biofuel production is not included in this table.*

1 *In the period 2001–2011, non-residential buildings also includes non-industrial plants and facilities.*

2 *With the exception of certain measures in 2007, energy results within the Residential buildings market area were not made contractual until 2011. The household subsidy programme was incorporated in the Energy Fund from 1 July 2011, and the results are recorded from this time.*

Climate result from estimated improved oil consumption efficiency

Table 3.22 shows the energy result distributed by market, and the corresponding estimated reduction in greenhouse gas emissions as a result of measures that have helped reduce oil consumption. The emission coefficients for oil were taken from the Ecoinvent database[10].

Reduced oil consumption accounts for the largest share of the energy result within renewable heating and industry. These markets also achieve the largest reductions in greenhouse gas emissions.

Overall climate result from the period 2001–2011

Enova supports projects that help improve the efficiency of electricity consumption, or conversion from electricity to renewable energy sources. The climate result from these types of measures will be dependent on the system limit used as a basis, cf. climate reporting in Part III A. To calculate changes in greenhouse gas emissions as a result of measures that result in reduced electricity consumption, we take a basis in four different electricity scenarios and corresponding emission intensities: Norwegian power consumption mix, Nordic power production mix[11], European power production mix and coal power (EU average). The emission intensities for the power mixes came from the European Environment Agency (EEA)[12] and from the IEA[13] for coal power. The emission coefficients for oil were taken from the Ecoinvent database[14]. The results are contingent upon the assumptions used as a basis for the alternative power supply.

Table 3.23 shows the overall climate impact of the projects, including both the impact from reduced oil consumption and from more efficient electricity consumption. Using the European power production mix as a basis, the projects from 2001–2011 achieve a climate result of about 4 881 kilotonnes of CO_2 equivalents.

Table 3.23

Overall climate result (from reduced oil consumption + more efficient use of electricity or conversion from electricity to renewable sources) from projects approved in the period 2001–2011

Market	Norwegian power consumption mix[1] ktonnes CO_2 eqv.	Nordic power production mix[2] ktonnes CO_2 eqv.	European power production mix[3] ktonnes CO_2 eqv.	Coal power (EU average)[4] ktonnes CO_2 eqv.
Renewable heating	671	817	1 479	2 505
Renewable power	30	175	834	1 857
Industry	405	570	1 315	2 471
New technology	1	5	26	58
Non-Residential buildings[5]	153	343	1 207	2 546
Residential buildings[6]	3	6	20	42
Total	**1 263**	**1 916**	**4 881**	**9 479**

Table 3.23: *The table shows the estimated reduction in greenhouse gas emissions from measures that contribute to reduced oil consumption and reduced electricity consumption from projects approved in the period 2001–2011. Biofuel production is not included in this table.*

1 *14 $gCO_2eqv./KWh$ (source: European Environment Agency) eqv*
2 *83 $gCO_2eqv./KWh$ (source: European Environment Agency)*
3 *396 $gCO_2eqv./KWh$ (source: European Environment Agency)*
4 *881 $gCO_2eqv./KWh$ (source: European Environment Agency)*
5 *In the period 2001–2011, non-residential buildings also includes non-industrial plants and facilities.*
6 *The subsidy programme for electricity conservation in households was incorporated in the Energy Fund from 1 July 2011, and the results are recorded from this time.*

10 *http://www.ecoinvent.org/*
11 *The emission intensity for the Nordic power production mix is based on electricity production in Norway, Denmark, Sweden and Finland.*
12 *http://www.eea.europa.eu/data-and-maps/figures/co2-electricity-g-per-kwh/co2-per-electricity-kwh-fig-1_2010_qa.xls*
13 *http://www.iea.org/media/workshops/2011/cea/topper.pdf*
14 *http://www.ecoinvent.org/*

The traditional maritime industry must take advantage of the potential for efficient climate technology

Maritime industry – by the numbers

The maritime industry in Norway encompasses a wide range of businesses, from the largest cargo ships to shipyard industry and specialized equipment suppliers. The industry is among Norway's oldest, and along the coast are many clusters with their own fields of expertise. The entire value chain is represented, from research institutions to large shipping companies.

This means that Norway can implement new technologies and solutions all the way from the research stage to market demonstration and commercialization. Shipping is a global industry, and Norwegian players are competing in an international market. Export from the industry therefore generates vital income for Norway. The maritime sector has long traditions that have been meaningful for Norwegian value creation, and is currently an industry with proactive players that are drivers for development of new solutions and internationally significant technologies.

Table 3.24
Key figures for Norwegian maritime industry

Indicator	Description	Size
No. of employees	**Total onshore and offshore**	112 000
	At sea	32 000
Turnover	**Total**	499,7 mrd. kr
	Shipowners	265,2 mrd. kr
	Services	97,3 mrd. kr
	Equipment	99,9 mrd. kr
	Shipyards	37,4 mrd. kr
Value creation (2014)	**Total**	190 mrd. kr
	% of Norwegian businesses[1]	12 %
Emissions	From Norwegian domestic shipping	3,4 Mt CO_2
Traffic in Norwegian waters	**Total**	6 700 fartøy
Fuel consumption	**Total**	2,3 mill. tonn
	At harbout	160 000 tonn
Export	**Total**	220 mrd. kr
	Norwegian ship equipment (2012)	45 mrd. kr

Tabell 3.24: *The table shows key figures for the Norwegian maritime industry. The reference year is 2013, unless otherwise indicated.*
Sources: Maritime value creation book 2015 (Menon) and Reduction of greenhouse gas emissions from Norwegian domestic shipping 2016 (DNV GL).
1 *Excluding the oil companies*

90 per cent of global trade involves seafreight[15]. Transport by sea is and will continue to be important for passenger and freight transportation, both nationally and internationally. It is therefore a precondition for the low emission society that the shipping fleet is energy efficient and climate friendly.

Figure 3.24 provides an overview of the development in greenhouse gas emissions from shipping since 2000. Emissions dropped from 2013–2014 due to reduced fuel consumption within fishing and domestic shipping.

Figure 3.23
Greenhouse gas emissions from shipping 2000–2014

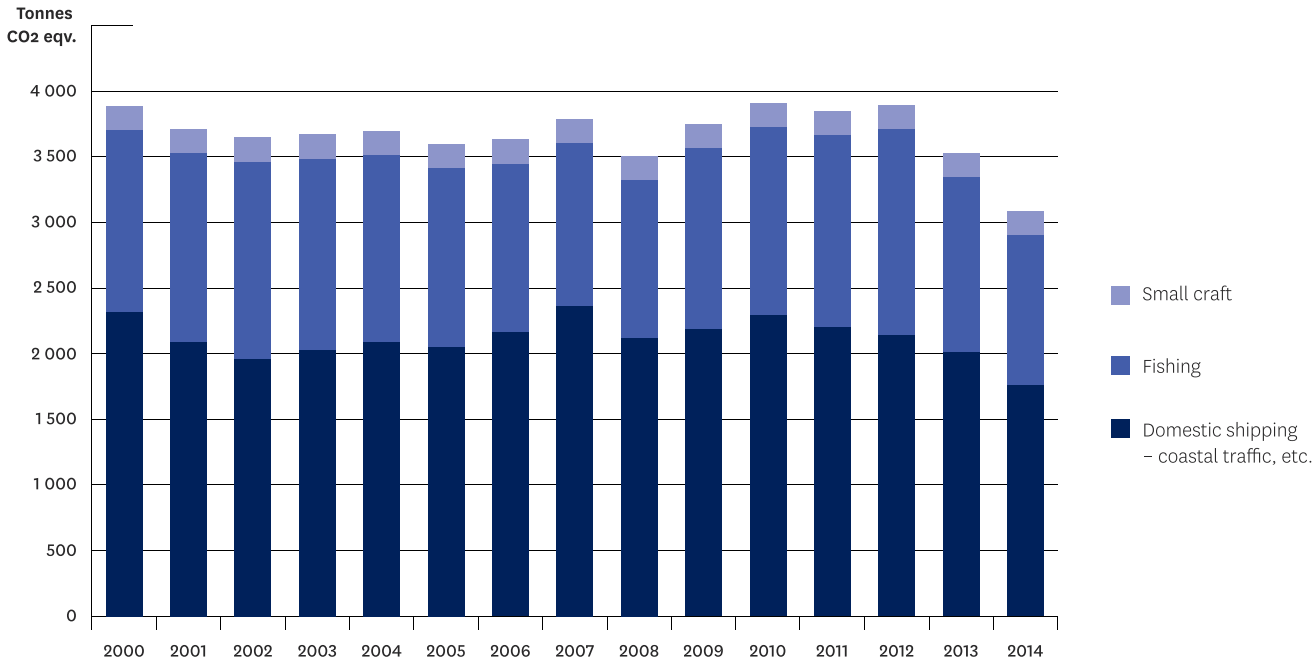


Figure 3.23: *The figure shows greenhouse gas emissions from the shipping sector since 2000. Source: Statistics Norway.*

Characteristics of the Norwegian maritime industry in 2016

The Norwegian maritime industry is characterized by high expertise, and holds a strong position in markets all over the world. The industry is leading within the development and use of green technologies and solutions, and is among the largest industries in Norway, with more than 100 000 employees. After oil and gas, the maritime industry is also Norway's largest export industry, and represents one-third of total Norwegian exports, if petroleum products are excluded.

Offshore oil and gas, freight and passenger transportation, aquaculture and fisheries are the largest segments within maritime industry. Sea transport is the dominant type of freight transportation between Norway and other countries, at 83 per cent. Domestic traffic accounts for 55 per cent of total fuel consumption in Norwegian waters, and is dominated by passenger ships (including ferries), offshore ships and fishing vessels. In international traffic, cargo ships are the dominant segment.

Ships are responsible for substantial greenhouse gas emissions in Norway. Emissions from domestic shipping amount to 9 per cent (DNV GL, 2014a[16]) of total Norwegian CO_2 emissions. Shipping also generates significant NOx and SOx emissions, which affect local air quality. Figure 3.24 shows that passenger ships, offshore supply ships and fishing vessels are the ship segments that contribute to the largest emissions in Norwegian waters. Ships sailing under a Norwegian flag account for nearly half of total fuel consumption in Norwegian waters.

15 *Norwegian Maritime Authority, 2016. https://www.sjofartsdir.no/sjofart/fartoy/miljo/*
16 *DNV GL, 2014a Overview of basic data concerning current shipping and fuel consumption.*

Figure 3.24

CO_2 emissions (tonnes) in Norwegian waters in 2013, distributed by ship type and traffic type

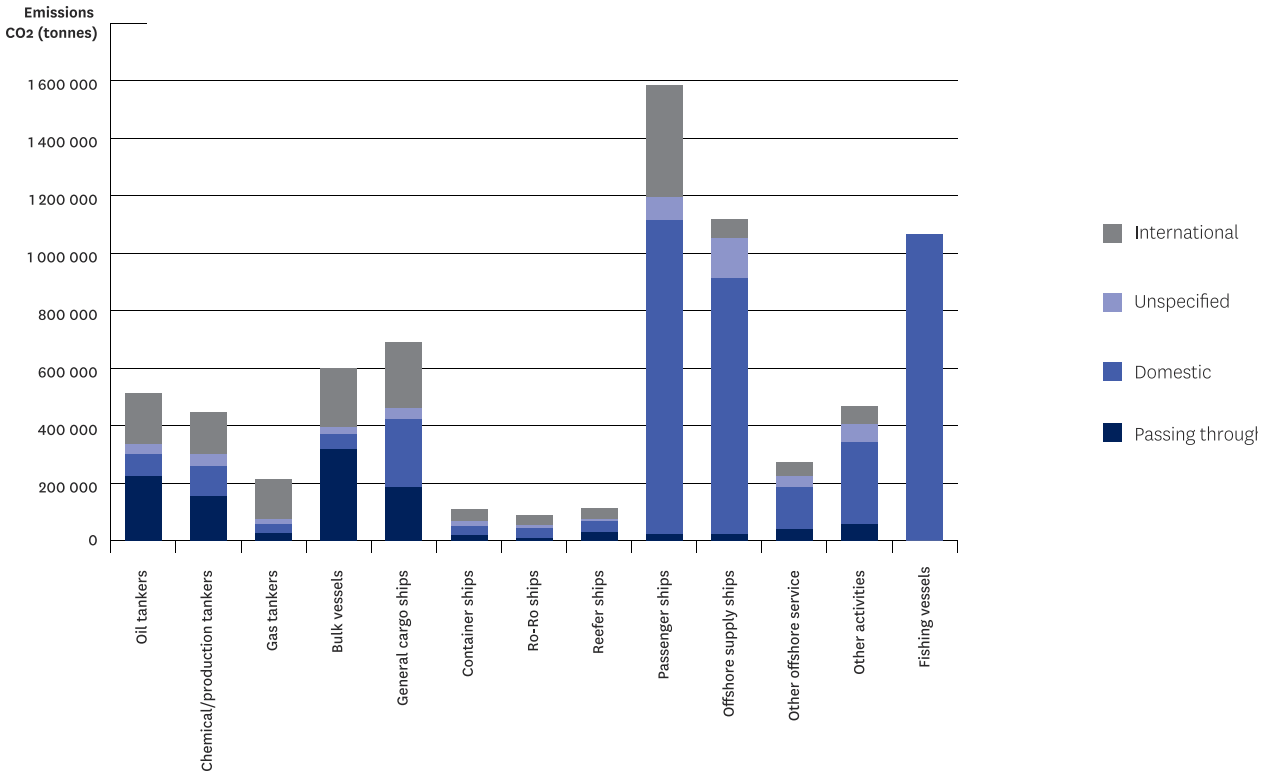


Figure 3.24: *The figure shows CO_2 emissions in tonnes in Norwegian waters in 2013, distributed by ship type and traffic type. Source: DNV GL, 2016*

Going forward, major readjustments and changes will be required in the ship fleets to reduce emissions. At the same time, we know that there is a significant potential for cutting emissions through upgrading the fleet. The Norwegian local ship fleet is old, with an average age of 30 years.

A continued low or declining investment level on the Norwegian shelf over the next years leads to uncertain market prospects, as about 70 per cent of the Norwegian maritime industry is offshore-related[17]. A declining oil price has led to fewer investments and efforts to reduce operating expenses, for example through a reduced activity level. For offshore shipping companies, this decline can mean low day rates for the ships, whereas Norwegian shipyards are being pressured on price and have considerable free capacity. For international shipyards, day rates have not yet recovered from the financial crisis. This is because the fleet has grown faster than the demand. Tankers have good market conditions, whereas container, dry bulk and offshore ships are struggling with surplus capacity.

In recent years, the large Norwegian shipyards and equipment suppliers have almost exclusively invested in offshore vessels. In 2015, Norwegian shipyards experienced a 15 per cent decline in order value compared to 2014, primarily as a result of the reduced oil price. Over the past few years, Asian and Turkish shipyards have also become strong competitors for construction of new vessels.

In a globalized maritime industry, Norway is a high-cost country, and Norwegian market players face challenges when it comes to competing on price. Norway's market advantage is related to quality, innovation and customer adaptation. Greenhouse gas emissions from the sector must be reduced in the future, which means that Norwegian players must exploit their advantages to develop new, sustainable solutions that can contribute to a strengthened global position and increased value creation from the sector. We would then be able to see a shift from offshore-dominated order books to far more assignments within for example aquaculture, fisheries and ferries. In upcoming years, many ferry routes will be submitted for tender, with stricter requirements related to the environment and greenhouse gas emissions. This will most likely result in many new constructions. Norwegian shipyards have experience from ferry construction, and this could result in desirable and important contracts for shipyards and equipment suppliers.

17 *Menon publication no. 11/2016.*

The potential for energy efficiency improvements in Norwegian maritime industry

Ship segments with the potential to improve energy efficiency

In 2016, DNV GL mapped[18] which technologies have the greatest potential for improved energy efficiency and emission reductions. The ship types with the greatest expected emission reductions, are where the fleet is old and there is also a potential for many new constructions in upcoming years. Figure 3.25 shows the age profile of the ship segments in Norwegian waters in 2013.

Figure 3.25
Average age (years) by ship type

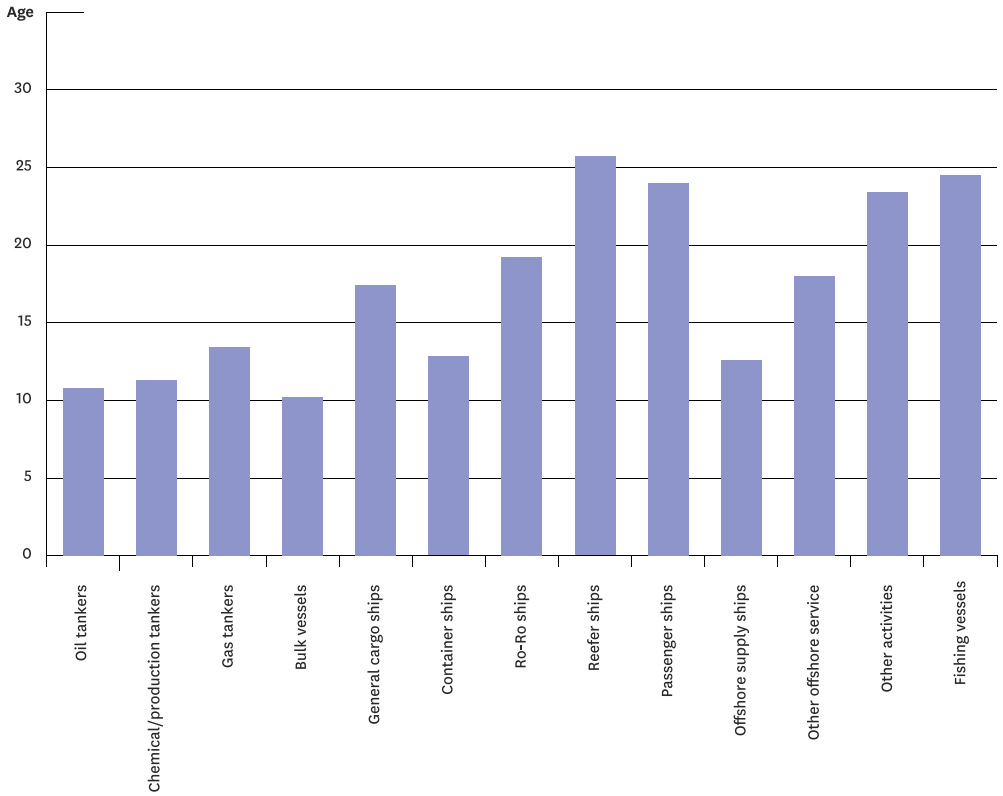


Figure 3.25: *The figure shows the average age of the different ship segments in Norwegian waters in 2013. Source: DNV GL, 2014.*

The age profile provides an indication of the potential for replacement, but this only happens if there is a demand and a market for the services that the ship performs. According to DNV GL, the following ship types have the largest potential for energy efficiency improvements:

- **Fishing vessels:** These spend a lot of time in Norwegian waters, and the total energy consumption level is high. Strong long-term growth is not expected, but the vessels have a high average age. Even a stable activity level could yield many new constructions.
- **Offshore:** There are many ships in this segment, and they spend considerable time in Norwegian waters. Overall energy consumption is high.
- **Tankers and bulk vessels:** There are many ships in this segment, but they spend little time in Norwegian waters. As a result of the ship size, they contribute to a high level of energy consumption, and the potential on individual ships is considerable.
- **General cargo:** There are many ships in this segment, but they have few port calls in Norway. The ships have a high level of energy consumption, and the potential in individual ships is somewhat significant.
- **Specialty ships:** There are many ships in this segment, and they spend considerable time in Norwegian waters. Despite the small size of the ships, overall energy consumption is substantial.

18 *DNV GL, 2016 Mapping of technology status – measures for improving energy efficiency in ships.*

Categories of measures to reduce emissions

It is challenging to have an impact on emissions from ships, as there are many players, different business models and contractual conditions. The ships also have long lifetimes, and the technology choices that are made today will therefore be significant for greenhouse gas emissions from shipping for a long time into the future.

We categorize emission reducing measures as follows:

- **Technical measures** relate to optimization of hull shape, propeller and propulsion machinery, and includes battery hybridization and shore power. The measures involve physically changing the ship.
- **Operational measures** reduce the ship's emissions without making physical changes to the ship. The measures contribute to more energy-efficient operations, for example through adjusting speed, cleaning the hull or optimizing draught.
- **Fuel measures** include all alternatives to the current versions of fossil diesel. For example electricity, hydrogen and biogas.

Operational measures can be implemented in both new and existing ships. Some technical measures and fuel measures will yield the best results in new ships. Some measures that are suitable for both new and existing ships, will often be more expensive to implement on existing ships.

Technologies with the potential to improve energy efficiency

When we look at the overall potential for improved energy efficiency and reduced greenhouse gas emissions from Norwegian domestic shipping, battery hybridization and a direct current grid with variable rotational speed[19] appear to be the two technologies with the greatest potential for improved energy efficiency.

Installation of a battery system will reduce fuel consumption through propulsion support and more optimal operation of principal machinery by covering peak loads and replacing use of auxiliary machinery on board. The battery is charged by storing generated excess power from the principal machinery[20]. By implementing battery hybridization in the current fleet, DNV GL has calculated an indicative potential to reduce emissions by 330 000 tonnes of CO_2.

In modern offshore and fishing vessels with diesel-electrical propulsion, electricity is often distributed through an alternating current grid (AC) with 60Hz distribution. This means that engines and generators must run with a fixed rotational speed in order to deliver standard frequency. In a direct current grid (DC), engines and generators can operate at a variable rotational speed and load, as a rectifier ensures that the preferred voltage is delivered to the DC grid. A DC grid is not very sensitive to load variations and consumers can be operated independent of each other, which could generate significant savings. An indicative potential for reduced greenhouse gas emissions from implementation of a direct current grid with variable rotational speed is around 220 000 tonnes of CO_2.

Both of these measures have high investment costs. Costs may be between NOK 7 000–13 000/kWh if the battery solution is implemented during the new construction phase. For a direct current grid with variable rotational speed, DNV GL has estimated that the costs may be around NOK 7–12 million.

Barriers and drivers for green shipping

In order to invest in energy and climate measures, many shipping companies depend on the market being willing to pay for greener and more environmentally friendly ships. The current situation is such that the willingness to pay among buyers of transportation services is low, and shipping companies therefore refrain from investing. For older ships, the energy efficiency measures must result in increased earnings through leasing, otherwise they cannot be expected to be implemented.

Another barrier is the price of the actual investment. Even if the willingness to invest was present, this may not necessarily be true for the financing and access to capital. The current demanding market situation entails that many shipping companies have limited financial capacity to undertake major investments in order to upgrade the fleet. Although investments in technology that reduces energy consumption, greenhouse gas emissions and maintenance costs can be justified in the long run, weak market forecasts result in little incentive to conduct large-scale investments.

Utilizing new technology entails an increased technical risk compared to commercial and available technology. This risk affects the calculation of the sales value of the ship, and can also have consequences when the banks are considering loans.

There is a wide array of contract types in the maritime sector, and some of these could represent an obstacle for investing in greener shipping. The contracts between shipping companies and operators are often designed such that the operator has to pay for the ship's fuel. If the shipowner implements measures that reduce fuel consumption, the gains from this would benefit the operator, not the shipowner. This makes it less probable that shipowners will invest in energy efficiency measures.

In the aquaculture industry, salmon louse is a challenge that requires both time and resources that could have been

19 *A precondition is that the ships have diesel-electric systems with an installed capacity of less than 20 000 kW.*
20 *If plug-in, the battery can be charged with power from shore.*

spent on development projects. In practice, this results in fewer investments in technology that can reduce energy consumption.

Through a growing awareness of climate both nationally and internationally, new regulations and emission reduction requirements will promote more environmentally friendly shipping. Increasingly strict environmental requirements going forward will be an important driver for innovative solutions in the industry.

Norway has several advantages for successful technological development. Norway is a major and important shipping nation, with the world's sixth largest fleet, based on value. We have leading specialist environments within maritime R&D, high expertise from the industry and the maritime clusters along the entire coast. This provides good prospects for Norwegian players to assume a strong leading position when it comes to the development of new climate and energy technology for use in a global maritime industry.

Norwegian policy instrument players support the development

The Norwegian funding agencies constitute an important pillar for the maritime industry in the restructuring work towards an emission-free Norwegian maritime industry:

Enova provides investment support through the following services:

- Support for energy measures in ships
- Support for new energy and climate technology in transportation
- Support for shore power
- Support for infrastructure in municipal and county municipal procurement of transportation services

The Research Council of Norway e.g. provides support through MAROFF. **Innovation Norway** provides subsidies and loans, particularly in connection with business development, as well as industrial and commercial development. In addition to this, the business sector's **NO_X fund** offers support for NOX-reducing measures.

In 2016, the Research Council of Norway, Innovation Norway and Enova launched a new joint support scheme called Pilot-E, which is intended to promote the truly groundbreaking ideas. Maritime technology was the theme of the announcement in 2016, where the business community was mobilized to develop ambitious and innovative solutions for emission-free sea transport. Five consortia headed by the companies Brødrene Aa, Fiskarstrand, Siemens, Kongsberg Maritime and Wärtsilä are now starting technology projects with follow-up and financing from the funding agencies.

Innovation and technology – hybridization is spreading

Previously, little attention was dedicated to greenhouse gas emissions from domestic shipping, but this is now being increasingly emphasized in the industry. Maritime companies must take their share of the responsibility for realizing the low emission society. The potential is significant, and many positive developments are already underway, of which the development within battery hybridization is a good example. Hybridization is increasingly spreading throughout the maritime industry. The technology can be implemented on all ships, regardless of type and size. The effect on vessels with varied and power-intensive operating patterns will be particularly good, where a battery solution can contribute to propulsion support and an optimization of the engine load on the principal machinery. Such operating patterns are typical for fishing and offshore vessels.

In addition to supporting battery installations on board ships, Enova also supports onshore infrastructure to facilitate increased hybridization of ferry transportation. This helps support technological development in the industry.

Fishing vessels – new constructions with battery technology

In 2013, DNV GL registered nearly 1 000 large and 5 000 smaller fishing vessels in Norwegian waters. The fleet has an average age of 24 years. Strong long-term growth is not expected going forward, but the high average age of the ships and maintaining the activity level are presumed to result in many new constructions in the future. The segment has a significant potential for improved energy efficiency[21], as it consists of a high number of ships that spend considerable time in Norwegian waters, while also having a high overall level of energy consumption.

Trawlers are a key vessel group. They vary in size, where the largest ships are plants that both catch and slaughter the fish on board. The vessels are usually specially designed according to the shipowner's needs. The actual trawling amounts to about half of the total fuel consumption. The vessels have a power-intensive and varied operating pattern that could benefit greatly from the properties of a battery system. The battery could even out major fluctuations in power output, so that the principal machinery can run on a more optimal load. If all relevant trawlers were to implement a battery system, this could potentially result in a CO_2 reduction of about 160 000 tonnes (DNV GL 2016).

21 *DNV GL 2016, Kartlegging av teknologistatus.*

Battery hybridization will also be relevant for other vessel types than trawlers in the fishing fleet. For example, Enova has granted support to SalMar Farming AS, which is constructing a new site-specific boat with hybrid propulsion and plug-in charging. This is the world's first aquaculture vessel with a propulsion system based on batteries as energy storage, with the possibility for charging from shore and feed rafts. When the hybrid vessel is launched and operational, it will run on battery power 90–95 per cent of the time. This project shows a player that, in cooperation with an innovative shipyard and a competent technology supplier, dares to forge a new path. Projects such as this will pave the way for the rest of the aquaculture industry through sharing expertise and experience.

Offshore vessels – young fleet with potential

The offshore vessels are another ship segment with a significant potential for energy efficiency improvements. There is a high number of offshore vessels in Norwegian waters, including specialty ships. An offshore supply vessel (PSV) transports tools and equipment to and from oil platforms. PSVs are one of the most common vessel types within the offshore segment. A PSV is often on standby near the platform, either waiting due to weather conditions or loading and offloading, and more than half of the fuel consumption happens here. Offshore ships have a varied operating profile with regard to required power from the machinery, and, like trawlers, could benefit from a battery system.

One example of offshore hybridization is Olympic Green Energy KS, which are installing a battery on their offshore vessel Olympic Energy with support from Enova. The battery bank being installed will be used in all operating scenarios. This will result in more optimal operation of the running engines, which will in turn lead to saved costs related to both fuel and maintenance. The battery bank will also be integrated in a shore power solution. This has not been done before for any vessel, and will result in substantial emission reductions when the vessel is at harbour. The project shows that installation of a battery system is also relevant for existing vessels, and is a good demonstration project for the rest of the segment.

Through the examples of SalMar and Olympic Green Energy, we are seeing players who will invest in new energy and climate technology. There are also players within other ship segments that are willing to lead the way and invest in new technology. Hurtigruten AS has started building two new expedition vessels with hybrid technology. The technology entails that the ships can sail on just battery power during periods in areas that are particularly vulnerable to emissions and noise. In addition to installation of the actual battery pack, several other energy-saving measures will be implemented in order to ensure the most efficient utilization possible of the hybrid solution.

Further development

The Norwegian maritime industry is in a unique position, and has good preconditions for being able to contribute to sustainable change both nationally and in a global context. The potential is great for commercial development and development of new technology with global applications, but mobilization and increased efforts are required to trigger this. Norway needs a maritime transportation industry that is bold and willing to lead the way in the transition towards the low emission society and an emission-free Norwegian maritime industry. Successful demonstration projects and market introduction of new technologies are an important step towards the low emission society, and are a necessity for the rest of the market to follow suit and start using more climate and energy-efficient technology.

Going forward, Enova will contribute to reduced technology costs and market-driven infrastructure development so that low and zero emission technology is put to use in the maritime industry both faster and in a larger scope. Batteries will play a major role in most segments, either alone or in a hybrid solution. Enova will also prioritize supporting development of shore power facilities to facilitate energy-efficient and climate-friendly shipping. Shore power will enable more ships to use power from shore when they are at quay, rather than using the ship's auxiliary engines.

Along with the other funding agencies, Enova will collaborate with the industry as they are making the transition from fossil to renewable, but it is up to the industry and the companies themselves to implement the necessary investments that will contribute to sustainable change.

Both ships and passengers can recharge their batteries here

Hurtigruten's new expedition vessels MS Roald Amundsen and MS Fridtjof Nansen (Illustration: Rolls-Royce).

Never before has a ship of this size been able to operate on pure electric propulsion. Hurtigruten's new polar ships will be 140 metres long, can accommodate 530 passengers – and can sail using only batteries for up to 30 minutes at a time.

TROMSØ

Daniel Milford Flathagen

8 September 2016

In the summer of 2016, Hurtigruten entered into an agreement with Kleven Shipyard concerning the construction of two hybrid ships that will take tourists along on expeditions to remote corners of the world. The ships – with support from Enova – will be constructed using groundbreaking technology that will allow them to run on batteries for up to 30 minutes at a time.

"There is no doubt whatsoever that ships in the future will be both quiet and emission-free. We will use our new expedition ships as icebreakers for this technology and show the world that hybrid operation on major ships is possible even now," says Chief Executive Officer Daniel Skjeldam in Hurtigruten.

Could become important for maritime development

Enova is granting NOK 45.1 million to the project, and has high expectations:

"These two ships could become very important for maritime development. This is the first time ships of this size are being launched with the possibility of using pure battery operation. If experience from this project is good, it will open the doors for similar solutions in cruise ships all over the world, but also in the coastal fleet where the combination with shore power will be even more relevant," says Enova CEO Nils Kristian Nakstad.

Batteries also provide advantages when the diesel generators are running the propulsion. Generators run optimally when they have a steady load, but the ship occasionally requires energy beyond this. Instead of increasing the load in one generator or starting more generators, batteries can cover the extra energy demand. Correspondingly, when the generators produce more energy than the ship needs, this surplus energy will charge the batteries rather than going to waste.

Lower diesel consumption

In addition to the batteries, Enova supports the ships' highly efficient propulsion system, including efficient engines and propellers. Overall, the Enova-supported measures will yield a diesel consumption that is about 15 per cent lower than in corresponding ships. Annual energy consumption will be 17.9 GWh lower, a difference corresponding to the energy consumption in nearly 900 Norwegian households.

"Leading the way in technological development is expensive. This project would not have been possible without the support of a proactive Enova," says Skjeldam in Hurtigruten.

The hybrid ships are being constructed so that larger battery packs can be installed once the technology has been developed further. The first of the two the ships will be delivered in July 2018, the second in July 2019.

Facts

Project owner: **Hurtigruten**
Year funded: **2016**
Funding level: **NOK 45 102 723**
Energy result: **17 933 671 kWh**
Planned completion date: **2018/2019**

About Hurtigruten

Hurtigruten is the original Norwegian coastal ferry since 1893 and transports freight, local passengers and tourists to 34 harbours along the Norwegian coast between Bergen and Kirkenes, every day, year-round. Hurtigruten's expedition ships also sail in the Antarctic, near Spitsbergen and Greenland.

PART IV
MANAGEMENT AND CONTROL IN THE ORGANIZATION

Management and control in the organization

Management and control in the organization

Enova manages the Norwegian state's resources on behalf of our society. Enova's tasks must be performed in an orderly and professional manner, and the management of the Energy Fund must take place in accordance with objective and transparent criteria. Enova sets requirements for its employees' integrity and business morals through value-based management and ethical guidelines.

Management of goals and results

Enova follows a goal management model designed to help Enova achieve its strategic goals. The model is used in addition to traditional accounting and financial management. The model lists goals and key figures concerning results and processes within four perspectives: results/economy, customer/market, internal processes/case processing and organization/working environment. Goal achievement and results are systematically followed up by evaluating results in all units in relation to the goals every quarter. This process promotes learning and continuous improvement in the organization.

Enova completes systematic evaluations of all policy instruments. The support programmes are evaluated both during the early phase and at a later stage in the programme's lifetime. The results from these evaluations allow for adjustments, thereby increasing the probability of achieving the desired result.

Risk

Good risk management is an important precondition in order for Enova to achieve its goals. Enova conducts regular risk mapping to assess risk that can affect goal achievement related to efficient operations, reliable reporting and compliance with statutes and regulations. An annual general risk assessment is submitted to the Ministry of Petroleum and Energy in accordance with the requirements in the Assignment Letter.

Enova depends on access to relevant projects in the market in order to achieve its goals. Enova believes that the current handling of risk related to sufficient access to projects is good, although there is some risk related to general market development and economic downturn.

In order to ensure goal attainment, it will be important in 2017 to define what makes a project suitable in Enova's new goals, and to communicate this both internally and externally in the market. Enova considers the risk associated with internal aspects such as application processing, case processing and compliance to be low. There is little risk associated with Enova's core systems for application processing and project follow-up in the short-term, and risk handling measures will be a key issue in the development of new IT systems in the longer term.

Internal control

We consider the work distribution in Enova to be expedient for ensuring good internal control. Enova has an appropriations committee that is independent of the line organization, in addition to verifications that are incorporated in the case processing systems and routines. The committee comprises employees that have not participated in the case processing, but that quality assure, process and make decisions in appropriation cases in accordance with delegated authorizations.

Enova has various internal control functions with specialized responsibilities within follow-up of the project portfolio, allocations over the Energy Fund and operation of the company. A dedicated function also has overall responsibility for risk management and internal control in the company. Enova conducts regular external quality assurances of numbers and reporting of results in relation to the goals.

Agreed-upon verification assignments are carried out by an external auditor when necessary for objective and independent assessment of the company. In 2016, the Enova Subsidy, Enova's rights-based subsidy scheme for homeowners, was subject to verification. The auditor has assessed work processes and routines, whether the process is appropriate in relation to support systems, organization, training/expertise and effectiveness, as well as compliance and continuous development of the case processing and disbursement process. The auditor confirms that processes, process descriptions, guidelines and routines appear to be well-documented and appropriate. The auditor finds that there is a considerable focus on avoiding incorrect disbursements, and that the verification level is high. Assessing measures to increase the number of automatically processed cases is recommended as an improvement area. The results of these agreed-upon verifications are included in our work on continuous development and improving efficiency.

In 2016, Enova received a clean auditor's report for both management of the Energy Fund and for Enova SF. No significant nonconformities were identified in connection with the internal control in 2016. Based on the results from external controls over time and follow-up from Enova's own internal controls, Enova is considered to have an expedient internal control process for ensuring responsible and efficient management and operations. Enova's values and ethical guide-lines are

clearly communicated by management and are wellanchored in the company culture. Enova's control environment thus provides a solid foundation for efficient internal control.

Support system and tools

Enova processes and follows up an ever-growing number of projects, while society is becoming increasingly digitized. This increases the significance of good data security, which requires sound control over IT systems, and increasing the awareness of employees in the company. Enova conducted extensive analyses of our core systems in 2016. We conducted a detailed analysis and redesign of our core processes and viewed this in the context of IT systems, internal control and future expertise needs. Enova has established strategies to extract the potential that lies in increased digitization for development of the organization.

A well-functioning IT platform is a precondition for successful digitization. In order to ensure efficient and safe operations, Enova implemented a new agreement with an external supplier in 2016 concerning a new IT platform service.

Long-term effects in the market

Enova's goal is to promote an environmentally friendly energy restructuring that contributes to increased security of supply and reduced greenhouse gas emissions. The markets in which Enova operates will look different in the future than they would have otherwise, as a result of Enova's activities.An assessment of potentials and barriers forms the foundation when Enova develops strategies to create its programmes for the market. With this basis, Enova stipulates goals for which market changes we will contribute towards and what programmes will stimulate this change. The extent of the potential and which barriers exist will vary between different markets.

There are often several barriers that must be overcome to create lasting change in a market. Barriers and market failure are found both on the supply and demand sides. Some challenges can be solved simultaneously, while others must be solved in a specific sequence. As an example, it could hurt the market to stimulate a growth in demand without there being sufficient capacity on the supply side.Changing markets usually takes a long time, and there is uncertainty related to how long it takes to counteract specific barriers to achieve lasting change. As a policy instrument player, Enova needs to be very familiar with the market, use the opportunities at our disposal and target the instruments so that they trigger the desired market changes.

Figure 4.1
Market change barriers – when to stop influencing the market?

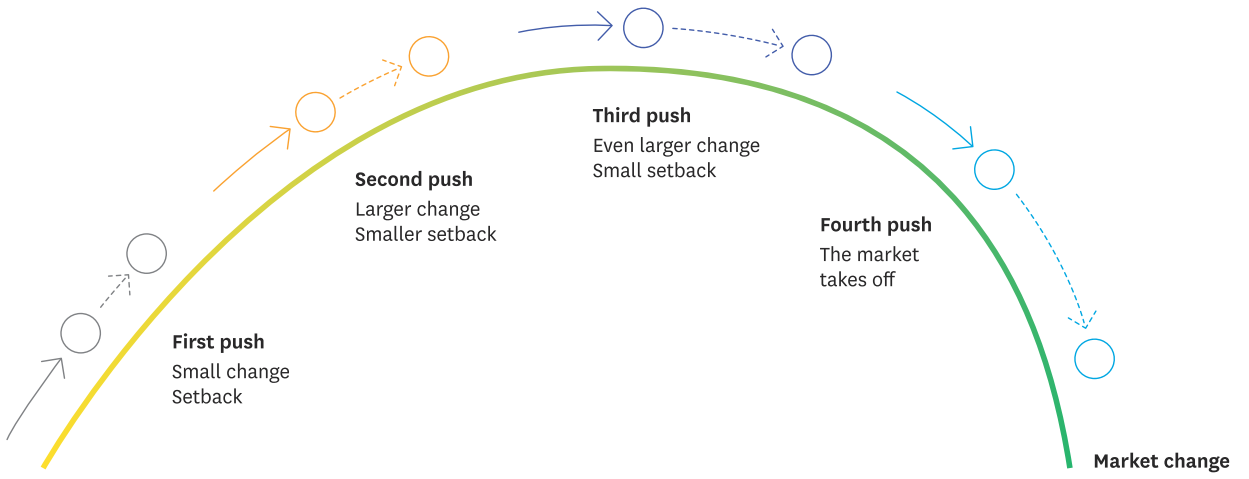


Figure 4.1: *The figure shows the phases of market change.*

Some barriers are always present. Within technology development for example, the innovator will never be able to prevent the rest of the market from gaining access to all or parts of the new knowledge. The innovation therefore loses some of its value for the individual market player, while the value increases for society. The consequence is that each market player invests less than is optimal for society. Government support will always play a role in this connection.

Key methods in project portfolio management

Enova's project portfolio is growing, with a significant portion of active projects in progress. The projects supported by Enova range from simple household measures to major, complex technology development projects in various industries. The reporting and accounting of results increases in scope and complexity with every year, in line with the portfolio.

Performance monitoring and documentation method

When applying for subsidies from Enova, the applicant must describe the energy result the project expects to achieve upon completion. Enova quality assures the estimated energy result as part of the case processing procedure. If established standards exist, they are used. For example, we use Standardisert metodikk for beregning av energibruk i bygg (standardized method for calculating energy consumption in buildings) as a basis for estimated energy results for programmes within buildings. In other cases, Enova uses empirical data from our extensive project portfolio. In some cases, particularly in connection with large projects, we use a third party assessment to verify the expected energy result.

The support recipient must report energy results at three stages; upon entering into the contract, upon final reporting to Enova and generally 3 years after the final report is submitted. Upon Enova's request, the subsidy recipient shall cooperate with Enova on performance monitoring and evaluation of the project for a period of up to ten years after the final report is submitted.

The projects supported by Enova may yield climate results. The climate accounts are based on the energy result from each project and standardized emission factors for the various energy carriers. The results are reported in CO_2 equivalents, which indicate the combined effect of CO_2 and other types of greenhouse gases. Through the process from entering into a contract until evaluation and completed project, Enova operates with three different methods for recording energy results: contractual, final reported and realized energy result.

Contractual energy result:
Upon entering into a contract, the support recipient pledges that the project will achieve a future energy result. This pledge, a contractual energy result, is quantified in the funding commitment letter. The contractual energy result is an estimate of the expected annual energy result after the project is completed. Completing a project can take several years, and the results from the project are recorded in the year the support is granted. This provides quicker reporting and enables closer follow-up from Enova, rather than waiting until the projects are complete. The energy results are then updated as the projects are completed. Enova follows up all projects closely. If the project follows the progress plan, support is disbursed in arrears in accordance with incurred costs. Material deviations from the agreement could result in Enova demanding repayment of all or parts of the support amount.

Final reported energy result:
When the project is completed, the project owner must submit a final report. The final report summarizes the project and contains an up-to-date prognosis of expected realized annual energy and climate result. The final report is enclosed with documentation of project costs. Documentation requirements are contingent on the size of the subsidy. If the subsidy exceeds NOK 1 million, the final progress and accounting report must be confirmed by an auditor. The auditor must confirm that audit procedures have been conducted. The report shall be certified by the person responsible for finances in the subsidy recipient's organization, and signed by the subsidy recipient's representative. Enova assesses whether the final reported energy result is reasonable, and whether documentation is sufficient. The final support amount is disbursed when the final report is approved, if all terms and conditions have been met.

Realized energy result:
Final reported projects are followed up with measurement and verification of energy results. This takes place after the fact, and is carried out three years after the final report has been delivered. The project owner will deliver the final report through Enova's digital application and reporting centre. Enova uses third party assessment for certain large projects to verify the quality of the reported result.

Realized energy results are measurements or estimates of achieved energy results after a measure has been completed, and its effects can be observed. Unlike contractual and final reported energy result, the realized energy result is based on observations, not expectations.

Method for measurement of support and triggering funding level

To ensure the most efficient utilization of Norway's resources, it is crucial that Enova's programmes effectively handle barriers, and also trigger projects using the smallest support amounts necessary. Two main principles form the basis for our assessment of the funding level in projects; The support must be necessary to trigger the project in question, and the support must be sufficient. These two criteria reflect the requirements in the guidelines for state aid.

- *Necessary support:*
  A fundamental principle for subsidizing projects through various types of support is that support changes behaviour. For our projects, this entails that the project owner will choose a more energy or climate-friendly project with the benefit of support than the project owner would choose without support. This means that Enova cannot support measures that the project owner will or must carry out for other reasons, such as regulation. This also means that we cannot support projects that have already been implemented. As a steward of Norway's resources, we have an important responsibility for managing these resources so they yield the greatest possible benefit for society. It is important to avoid granting support to projects that would have been implemented in any case. In such cases, the support from the Energy Fund is not necessary to trigger the project.

- *Sufficient support:*
  The support must be sufficient to trigger changed behaviour, but no more. This entails that, after Enova has determined support is necessary to implement the project, we need to assess how much support is needed to trigger the project. If the funding level is too low, the project will not be carried out and the support was insufficient. If the funding level is too high, the project received more than necessary to change behaviour.

Method for assessing profitability

The basis for assessing necessary and sufficient support is a profitability assessment of the projects. The method used for the assessment is a standard net present value assessment, where the project-specific risk is reflected in the cash flows while the return requirement must reflect the applicant's market risk. This approach forms the basis for all ordinary support measurement in Enova, but the application will vary somewhat depending on the market and project size.

Information asymmetry

When assessing necessary and sufficient support, either through a present value assessment or otherwise, Enova and the project owner will always have different information. This applies to technical and financial details in the project, as well as knowledge about the market in which the project takes place. Enova aims to minimize this information asymmetry as much as possible during the case processing by obtaining information from the project, and also sharing knowledge that Enova has gained in connection with the project. Even if the information basis is as equal as possible, Enova and the project could assess this information differently. This means that, in some cases, Enova will consider the projects more attractive than the project owner, and occasionally the other way around.

Template versus project-specific assessment

Obtaining and assessing details and comprehensive information about technical and financial factors related to individual projects is costly for both the project owner and Enova. In some markets, such as the buildings market, the potential volume of measures is significant, but each measure is relatively small. This can make it relatively expensive for the project owner to obtain enough information for Enova to conduct a sound, project-specific assessment. For certain project types, having programmes that are based on standardized assessments is more expedient. This makes it easier for the market to use the programmes, and reduces the costs related to documentation as a barrier. In these cases, the profitability assessments and evaluation of necessary and sufficient support are based on standardized values for a broad set of measures. For projects where standardized assessments are not suitable, Enova will carry out project-specific assessments. This largely applies to industrial projects, technology projects and major construction/building projects.

Reasonable returns

In order to ensure the support is sufficient for the projects to be completed, the project owner must consider the gains of the project to be higher than the costs. In a present value assessment, this is reflected by the present value in the project being positive, given the company's required rate of return. The required rate of return thus affects the level of funding needed to trigger projects. High rates of return require significant support.

To assess whether the funding level is sufficient, Enova must therefore also assess whether the required rate of return used by the project owner as a basis is reasonable. Enova uses a third party assessment of the normal rate of return in various sectors to conduct this evaluation. As different sectors are associated with varying degrees of risk, a reasonable required rate of return could vary between sectors.

There is often a difference between what returns you can expect within a sector after the fact, and what is necessary to trigger a new investment decision. Enova and the state aid regulations therefore allow approval of a different required rate of return for the project owner, if this can be sufficiently documented. Special required rates of return can either be project or company-specific. The state aid regulations and ESA guidelines for state aid for energy and the environment provide key premises for Enova's activities.

Major projects

For the largest projects, typically within industry and new technology, Enova carries out very thorough analyses of the project economy. This involves sensitivity analyses, assessment of market position and potential strategic assets in the projects. Third party assessments of critical factors for the project economy are also obtained for major projects. This may include perspectives regarding future price development for intermediate goods and products, and, as previously mentioned, a reasonability assessment of the energy result. Projects that receive support exceeding EUR 15 million must be approved by EFTA's Surveillance Authority, ESA. All projects supported by Enova with an amount exceeding the limit for special approval by the ESA have been approved.

PART V
ASSESSMENT OF FUTURE PROSPECTS

Pioneering spirit

Over the course of a couple of generations, global greenhouse gas emissions must be reduced to around or below zero. This transition to a low emission society is a joint global responsibility. In order for Norway to deliver on its end while also further developing the current welfare society, a significant adjustment is required – a sustainable change. This is our mission, this is our vision.

Over the last few decades, Norway has become increasingly more energy and climate efficient. Both the population and economy have grown substantially without energy consumption and greenhouse gas emissions growing to match. Three important factors that helped make this possible are emission-free and renewable power production, a robust

Figure 5.1
Population, energy consumption and greenhouse gas emissions 1990–2015

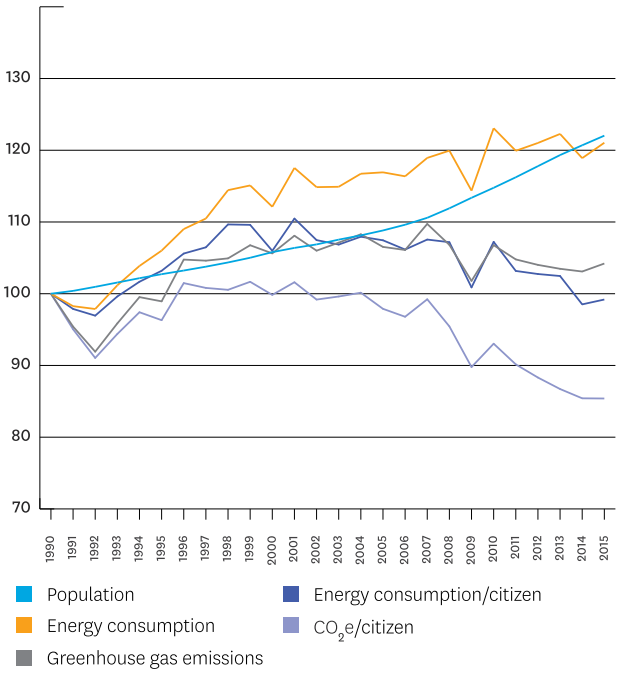


Figure 5.1: *The figure shows the development in population, energy consumption and greenhouse gas emissions from 1990–2015. Source: Statistics Norway.*

Figure 5.2
GDP, energy consumption and greenhouse gas emissions 1990–2015

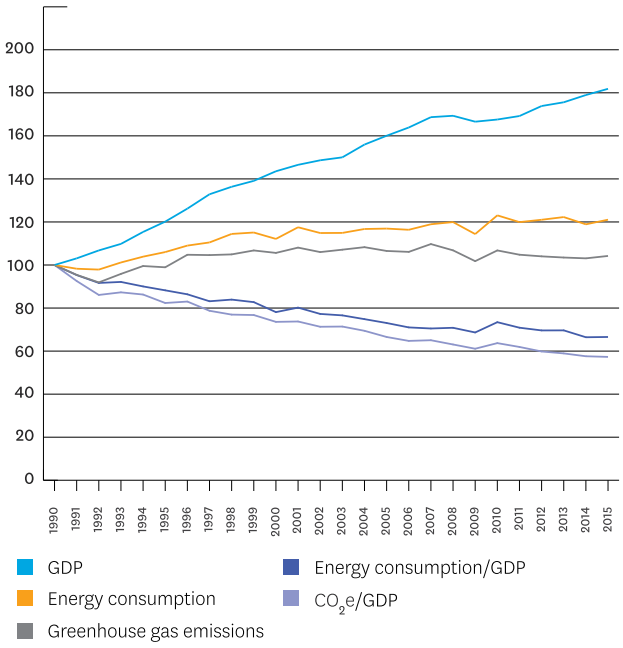


Figure 5.2: *The figure shows the development in GDP, energy consumption and greenhouse gas emissions 1990–2015 (1990 = 100). Source: Statistics Norway.*

The challenge is that we cannot achieve a low emission society just by halting the increase of greenhouse gas emissions – emissions must come down.

Pioneering spirit and knowledge

Norway's ambition for 2050 is to contribute to an emission reduction corresponding to 80–95 per cent of the Norwegian emissions in 1990. This is within reach.

One way to achieve this objective is to stretch the latitude in our international commitments to the furthest limit. This approach would be the cheapest – in the short-term. The challenge is that we as a nation risk becoming stagnant, while the rest of the world creates the future's jobs and values – a concern that was also highlighted by the committee for green competitiveness in the autumn of 2016. Norway has a better starting point than most for successfully adapting to the low emission society, but we must choose to invest in the opportunities that this adaptation will create. Many of the stories we are most proud of as a nation are in fact characterized by seizing the opportunities and challenging boundaries – the pioneering spirit.

It was the pioneering spirit in combination with knowledge that took the Vikings to America, Nansen over Greenland and Amundsen to the South Pole. The same combination of knowledge and pioneering spirit has laid the foundation for much of today's value creation within the maritime sector, oil and gas production, land-based industry and the energy sector. The combination of pioneering spirit, knowledge and correct framework conditions is also the key for a successful transition

to the low emission society, but we as a nation must make an active choice between whether this transition to the low emission society is a cost or an investment opportunity.

A good starting point, but not easy

Despite Norway's good starting point, there are several factors that could make the transition challenging. One factor is that the population in Norway will be significantly higher towards the end of the century, and the percentage of elderly people will have increased substantially. This normally means an increased energy demand, increased greenhouse gas emissions and increased need for welfare services. The other factor is that the oil and gas activities, Norway's most important export industry, will, over time, contribute less to overall value creation. The available resources will decline, and the global transition to a low emission society will mean gradually reduced demand. Over time, other industries must take over the role that oil and gas production currently holds so that we can further develop today's welfare society.

New value creation results in increased energy demand. Whereas value creation from oil and gas production has not entailed a significant strain on the land-based energy system, new value creation on the mainland will involve an increased need for secure access to energy. An efficient and climate-friendly energy supply has been vital in the development towards today's society, and is a precondition for value creation and welfare on the road to a low emission society.

Figure 5.3
GDP, fixed investments, export and power consumption by sector

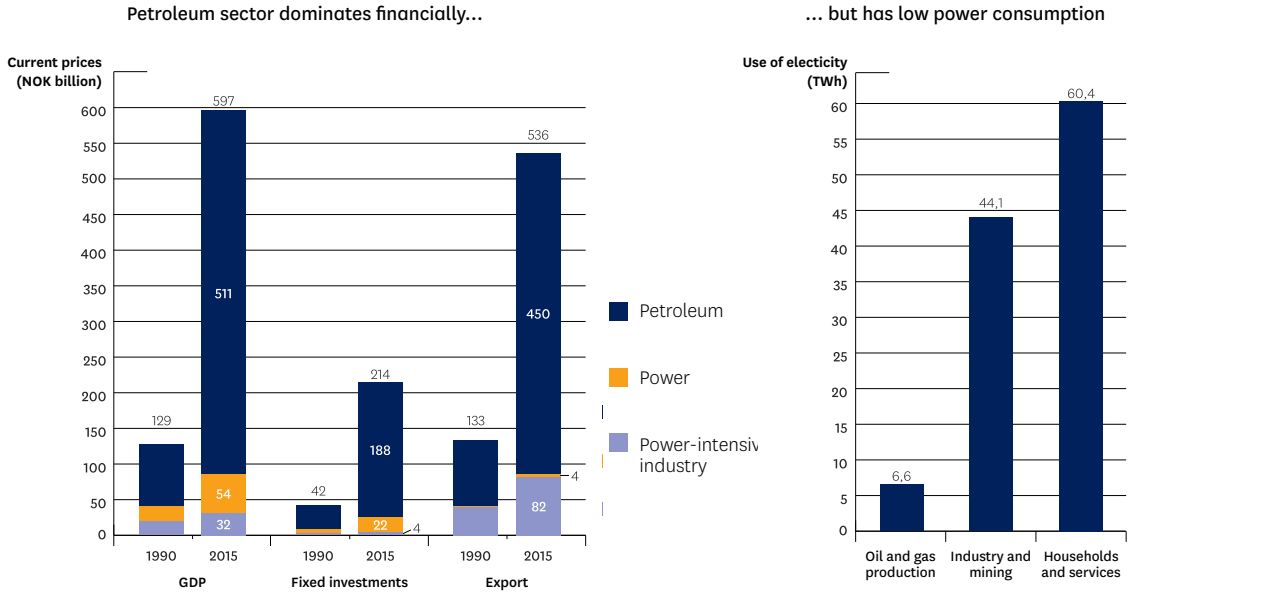


Figure 5.3: *The figure shows GDP, fixed investments, export and power consumption by sector. Source: Statistics Norway, facilitated by Thema Consulting Group.*

The three pillars in the energy policy since the 1970s – the environment, value creation and security of supply – are thus essential also in the transition to a low emission society. The Storting and Government has appointed Enova as a central instrument for this transition.

The road towards a low emission society

The basis for the Paris Agreement is that the climate challenge is global and must be handled with a united front. This means that emission reductions in one country only contribute to the transition to the low emission society if it actually entails global emission reductions. For Enova, this means that although our mission is related to projects in Norway, we must still consider the global perspective when designing our policy instruments and assessing projects. This particularly applies to technology projects within energy and climate.

On the road towards the low emission society, it may be rational in the short-term to increase the emissions in one country, one sector or one point in the value chain. Electrification of the transportation sector is one such example. Emissions in the transportation sector decline, while emissions in the energy sector may increase depending on the generation mix in the country in question. Postponing electrification of the transportation sector until the energy sector is decarbonized would put the technology and market development in the transportation sector on hold for decades.

Another example is increased emissions from Norwegian processing industry where this is a result of increased production in existing facilities, or from new establishments that will replace equivalent production in other locations where

the environmental footprint is significantly larger. This has an unfortunate impact on Norwegian climate statistics, but is positive for the global greenhouse gas emissions.

Although it may in some cases be rational for emissions to temporarily increase in Norway, the long-term perspective is transition to a low emission society. This means that the solutions we invest in today – whether they are technologies, products or services – must be credible in this perspective. For Enova, this means that we must set ambitious requirements related to both the level of innovation and future market potential for new solutions.

Energy and climate technology for the low emission society

Technology development is absolutely essential in order to succeed in the transition to a low emission society while also laying the foundation for new value creation. This transition has a deadline which entails that the faster we can develop new solutions and bring the good solutions out into the market, the better we will be equipped for the transition. Enova therefore believes it is important to prioritize technology projects where the ambition level, possibilities for further development and national or global market potential, are credible. This means that the potential for making a difference in the direction of a low emission society is important. Enova will expand technology investments to also include pilot projects, as well as projects that demonstrate individual components. The objective of this shift is to trigger more technology development projects that can bring us closer to a low emission society.

Start using future-oriented energy and climate solutions

The transition to a low emission society is not just about technological development. The good solutions and technologies will not take us all the way if they are not used in the market.

There are often a number of barriers dominating the drivers for market development. Enova's role is to break down these barriers and influence drivers so that the new solutions are used in the market – we will trigger market change.

Market change requires patience and whole-hearted efforts. Enova must be bold enough to invest the necessary amount and stay the course even if the short-term results are not visible. This requires clear strategies for when we should enter markets and when we should leave them and hand over the responsibility for further market development to the market itself, or other policy instruments such as regulations.

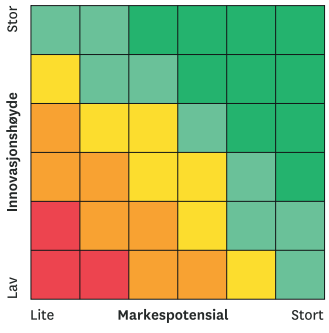
Efficient policy instruments along with the market

So far, Enova has used investment support and information to trigger increased innovation and market change within the areas of renewable energy, energy efficiency and reduced greenhouse gas emissions. We expect that these policy instruments will continue being important going forward. At the same time, there are barriers where the investment support is not effective enough. For projects where profitability is not the most important barrier, but where technological risk or lack of financing are bigger challenges, other policy instruments such as loans and guarantees may be more suitable. By increasing available capital in the market and taking larger risks than commercial players, Enova can contribute to the realization of more projects.

The transition to a sustainable and competitive future will involve tough decisions and crossroads. Enova will make its policy instruments available, but the transition to a low emission society will take place in the market – in the industry, in households, in the transportation sector and so on. A successful transition to a low emission society is dependent on good interaction with the market. In order for the market to choose to invest in sustainable solutions, it must see a long-term value creation potential in replacing fossil alternatives with renewable solutions. This is how good climate-friendly solutions become financially viable. Enova's role is to cooperate with the market so that more players will equate value creation with low emissions.

Level of innovation and market potential

Enova uses the term "level of innovation" to indicate the scope of technological progress in a project. If the project only entails a marginal improvement of existing technology, the level of innovation is low. If the project is a complete departure from previous technologies while also delivering significant improvements, the level of innovation is high.



The level of innovation alone is not enough for a project to be considered attractive for Enova. The potential for using the technology beyond that single project is important. If the market potential is great, which means that the technology can be used by many, it is more interesting to Enova than if these possibilities were limited.

The smaller the market potential for the technology, the greater the level of innovation must be in order for the project to be interesting in the transition to a low emission society.

Market descriptions

In the "Market development 2016" report, Enova provides an overview of how the market for energy and climate solutions is developing in the sectors that have been our main focus areas. Here is a brief summary and our thoughts concerning the future outlook. Read the report on enova.no.

Renewable thermal energy

District heating is spreading and becoming even more renewable

- **Increasingly more district heating is being delivered in Norway, and the share of renewables is growing. Waste heat from waste incineration is still the most important fuel**
- **More energy-efficient buildings has resulted in a declining heating demand, but cooling demand is increasing**
- **Investments in district heating plants are decreasing, and going forward we are expecting expansions and compaction of existing plants rather than new establishments**
- **Consumption of district cooling is increasing, but still constitutes a small share of the cooling demand in buildings**

Renewable thermal energy comprises both heating and cooling, based on renewable energy sources or waste heat and cooling. By supplying buildings and industry with heating and cooling, the renewable thermal energy market plays an important role in the overarching power system through output replacement and contributions to security of supply and flexibility in the power system.

Enova's goal is to

- help increase flexibility in the energy system by supporting the construction of production capacity and infrastructure for distribution of renewable heating and cooling
- stimulate increased use of new technology and innovative solutions

Opportunities in expansion and compaction of existing infrastructure

Electrification is one of the biggest steps in the transition to a low emission society. At the same time, we are seeing that output consumption is increasing faster than energy consumption, and increasing electric car charging, as well as other power-intensive components in households, will reinforce this picture. Good and secure access to renewable energy is a precondition for being able to achieve the goal of a low emission society, and renewable thermal energy in general and district heating in particular, will be an important part of the solution. In addition to contributing to output replacement on the coldest days, thermal storage and disconnection will contribute to reducing output peaks that occur during certain hours of the day. Flexibility in the district heating grid will provide an opportunity for optimal resource use, as surplus heating or cooling can be delivered to the grid. Good interaction between the power system and thermal energy systems will be key going forward. District heating is a vital part of the renewable thermal heating market. The major basic investments in new district heating plants and heating plants have already been made, and district heating has now been established in about 90 per cent of the major cities. The opportunities for continued growth are primarily related to expansion and compaction of the existing infrastructure. The basic investment is expensive, and once it has been made, players will primarily focus on increasing the volume. This is because the marginal cost is very low, and cost efficiency increases in line with the volume. The majority of residential development and commercial development in the future is expected to take place in major cities and densely populated areas, so the development with expansions and compaction will continue.

For areas where the heating density and overall volume do not justify district heating development, other heating plants, such as local heating systems and standalone plants, may play a role in the thermal energy system. Standalone heat pumps could, for example, contribute cooling during the summer, which we expect to see more of in the future. The prohibition against using fossil oil for heating in buildings is expected to enter into force in 2020, and will stimulate replacement of heating sources with renewable alternatives in the buildings that still use fossil oil.

The sector has undergone a consolidation process over the past few years. A reduction of the number of players in the market could improve profitability, and result in a more professional industry and new business opportunities. Although some players are contributing new innovative solutions, further initiatives are required. There are opportunities in automation, digitization and new solutions for distributed production and storage. To ensure optimal energy transmission, energy-efficient buildings and energy-plus houses need to improve interaction with existing infrastructure. This triggers a need to develop technical components, such as improved heat exchangers and management systems, which can better exploit existing resources and infrastructure.

Enova will continue its work in the area, with the goal of renewable thermal energy becoming the preferred heating and cooling method. Apart from continued development of infrastructure to increase the percentage of buildings that convert from full electrical heating to flexible thermal systems, innovation and introduction of new technology are important areas to stimulate. Increased use of new technology is important for making thermal energy more competitive on the road towards the low emission society.

Industry and non-industrial plants and facilities

Mainland industry is becoming increasingly energy efficient, while energy consumption increases on the Norwegian shelf

- **Norwegian mainland industry is becoming increasingly energy efficient and is using more renewable energy**
- **Overall energy consumption and greenhouse gas emissions in mainland industry have grown modestly**
- **Changes in industrial structure contribute to increased energy consumption**
- **The oil and gas industry's overall energy consumption increased somewhat in 2015, as well as greenhouse gas emissions**
- **The oil and gas sector is now also placing more emphasis on energy efficiency improvements and measures to reduce greenhouse gas emissions**

Mainland industry comprises small and large companies, from small plants without employees to process facilities with several hundred employees, whereas the non-industrial plants and facilities market includes everything from roads and aquaculture facilities to water, sewage and waste plants. Recently, Enova has also directed its focus towards the oil and gas sector.

Enova's goals are

- to contribute to a more energy-efficient mainland industry that is supplied with renewable energy to the greatest extent possible
- that new technology will reduce energy consumption and emissions from the oil and gas sector as much as possible, while also having a transfer value for new value creating industry in other sectors
- for more of the potential for energy efficiency in the non-industrial plants and facilities market to be extracted

Many energy projects in store

The industry of tomorrow will depend on new technology to contribute to increased value creation while also reducing emissions on the path towards a low emission society. With new climate-friendly technology and more efficient energy consumption, Norwegian industry could have a global significance in the transition to a low emission society, through export of products produced with low or no emissions, and through exporting technology. The industry must find new production processes without emissions where possible, and otherwise start using renewable input factors as much as possible.

Important drivers and barriers for industrial development and success in the market are cost level, risk capital, market access and public regulations. Low prices for energy and emission allowances also contribute to low profitability in energy and climate measures. More support is required to trigger projects, and the risk of them not being executed increases. At the same time, with its stable and predictable framework conditions, Norway is a safe place for long-term investment decisions[22]. A short distance between management and workers and relatively cheap and high-tech expertise, provide good competitive advantages when large market players select a location for development and construction of new capacity. This means that international companies could also benefit from investing in Norway. In a global market, Norwegian industry must reduce its costs to ensure it is still competitive. Increased competition has a negative effect, making earnings lower and future investment budgets smaller. At the same time, competition does force innovation and therefore contributes to investments in developing new energy and climate technology. Long-term climate and innovation strategies are becoming more common among large market players, while more smaller industry players are starting to implement energy and climate measures. We are seeing signs of increased emphasis on energy and climate measures within non-industrial plants and facilities, particularly within the aquaculture industry.

Both energy consumption and greenhouse gas emissions increased over the last year within oil and gas, despite a slightly lower production level[23]. The relatively low oil price means that the industry has a lower willingness to invest than before. At the same time, the oil and gas industry is now placing more emphasis on energy efficiency improvement and measures to reduce greenhouse gas emissions. We have seen increased efforts in 2016, where most operators have intensified the work on energy management and have set ambitious goals within this area. Through this work they are identifying far more energy and climate projects in their activities, both offshore and in onshore processing facilities. Looking towards a low emission society, it will be important to also use the expertise and knowledge developed offshore, and turn this into sustainable activity and industry on shore.

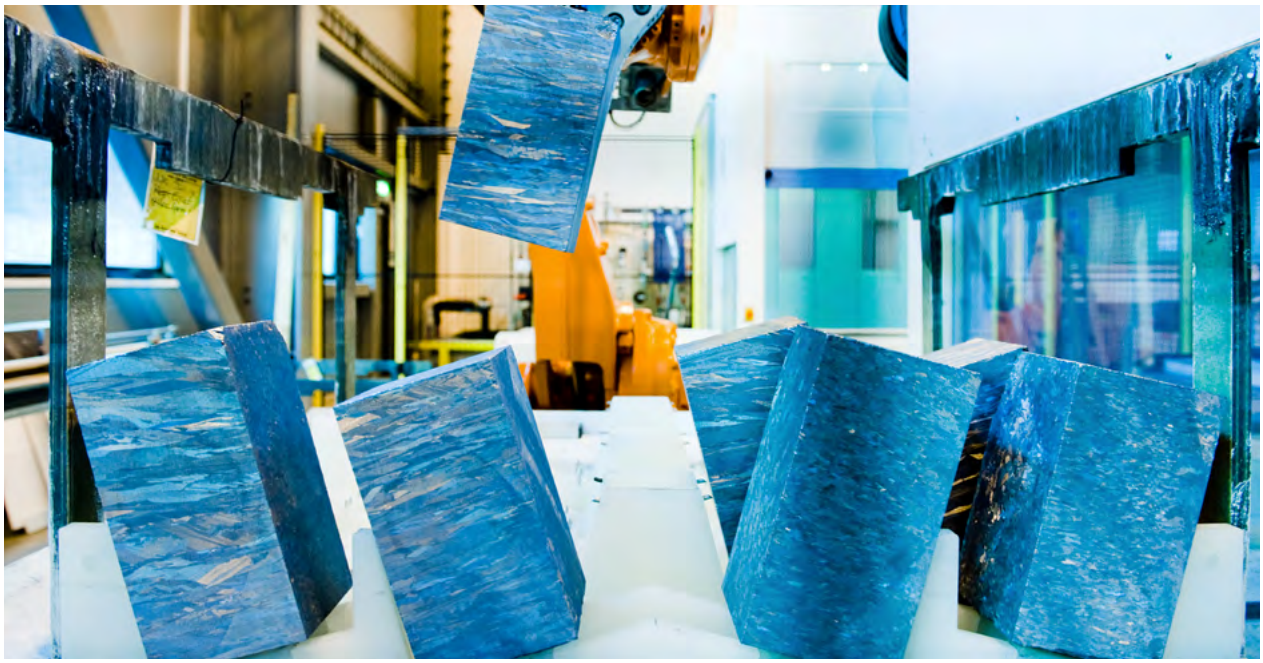
With establishment of energy management in a company follows mapping of energy consumption and preparation of action plans with specific energy measures. There is a substantial increase in the number of industrial companies that are introducing energy management, both in mainland industry, offshore, and in non-industrial plants and facilities. One example is Sibelco at Åheim, where the mapping pushed them to now implement further measures to improve the energy efficiency of the olivine production process. The industry's interest in energy management is expected to trigger many green projects in upcoming years.

Enova will help Norway to establish a competitive and climate-neutral industry with world-leading energy and climate technology. We will reduce the risk for players along multiple stages of the technological development, and thereby increase the pace of transition in the industry towards a low emission society.

22 *Carbon Limits (2014): Consequences of low quota prices in EU ETS*

23 *Norwegian Oil and Gas (2015): Environmental Report 2015*

Solar cell industry rises again at Herøya



Production of solar cell blocks (Photo: Elkem Solar).

In REC's former plant at Herøya in Porsgrunn, Elkem Solar will test a new furnace technology that could, over time, reduce the cost of solar power. Enova is investing NOK 72 million in the project.

HERØYA

Eiliv Flakne

19 February 2016

– With this project, Elkem Solar is taking an important step in pushing the furnace technology in a more energy-efficient and environmentally friendly direction, says CEO of Enova, Nils Kristian Nakstad.

Elkem Solar produces silicon for solar cells in Kristiansand. At Herøya, the silicon from Kristiansand will be melted down into blocks and sent to REC Solar's plant in Singapore. The production in Kristiansand is already at the forefront when it comes to energy efficiency and climate friendliness. Now, new furnace technology at Herøya will help make the production process even more efficient.

– We have decided to start production in the plant at Herøya. We are developing our renewable technology further and creating around 70 new jobs, says Elkem Solar CEO, Inge Grubben-Strømnes.

This work will also create more than ten indirect jobs, with room for further growth.

Strengthened value chain

Elkem Solar announced a desire to take over the REC plant in September 2015. The following months were spent creating an overview of the need for technological development and verification of the competitiveness of the current plant.

– The work at Herøya will strengthen our existing production and will be part of the world's most energy and cost-effective value chain for solar cells, says Grubben-Strømnes.

Proliferation potential

The proliferation potential for the new development within furnace technology is significant. If the project is successful, this could mean that the rest of the market will follow.

– It is precisely this proliferation potential that is an important criterion for our support for new energy and climate technology, says Nakstad in Enova.
– Elkem Solar at Herøya will produce multicrystalline silicon, a type of silicon that accounts for 50 per cent of the total solar market. We hope that this project will help speed up the development of larger and more energy-efficient furnaces for such production.

Fakta

Project owner: **Elkem Solar**
Year funded: **2016**
Funding level: **NOK 72 000 000**
Energy result: **39 GWh**
Planned completion date: **2017**

About Elkem Solar
Elkem Solar produces solar cell silicon and solar cell blocks. The company is owned by Elkem and Guangyu International Investment Company, with 50 per cent each.

Transportation

Increasing emissions, but more efficient vehicles

- **The transportation sector accounts for one-third of all Norwegian greenhouse gas emissions, and emissions have been growing since 1990**
- **Emissions per transport volume are declining, but transport volumes continue to increase, particularly on roads**
- **Passenger cars are the largest single source of greenhouse gas emissions from transportation. Electric vehicles represent a significant share of new car sales, and access to charging infrastructure has improved. Nevertheless, electric cars constitute a small share of the total passenger car fleet. Chargeable hybrid cars have experienced a strong increase over the last few years**
- **Emissions from sea transport have been on the decline since 2012**

Enova's goals are to

- reduce greenhouse gas emissions from this sector
- contribute to more environmentally friendly use of energy, more climate-friendly methods of transportation and a reduced scope of transportation

Electrification continues with increased vigour

Electrification is well under way. The passenger car market has come far, and every fifth new car sold is electric. Beneficial advantages such as free parking and tolls, as well as a VAT exemption have been important drivers. More and more chargers are being deployed, and the range of the cars is growing. The market is also moving for medium-sized vehicles and buses. Several cities have and are planning to add battery electric buses to regular routes.

The development in the maritime sector is good. In 2016, 22 ferry routes were announced with requirements for low and zero emission solutions – which means fully electric or plug-in-hybrid ferries. Fully electric, chargeable and battery hybrid solutions have also been installed within aquaculture, fisheries, offshore and cruise, and a growing number of segments are considering doing the same. Shore power is being planned and developed at several harbours, which means that ships can switch off the diesel generators when they are at quay. At the same time, several ships are installing technology so that they can connect. In addition, new energy-efficient and climate-friendly solutions are being used in a growing number of markets.

Production and consumption of biogas is on the rise, but the access to high-quality liquid biofuel is low in Norway so far, due to limited production. Within hydrogen, filling stations are being built in Bergen and Oslo, and ASKO is investing in hydrogen lorries, trucks and a filling station in Trondheim. Further energy efficiency measures and a switch to more energy-efficient transportation methods when possible are necessary in order to achieve sufficient reductions in greenhouse gas emissions from the sector. In addition, near zero emission solutions must be phased in for all transportation methods. This will require significant technological development, where a large portion can take place in Norway. In particular, Norway has a potential within maritime industry, where a strong and competent maritime environment can develop new solutions. However, the need for innovation relates to the entire value chain and the entire transportation sector, including charging technology, battery and vehicle development, and for hydrogen also infrastructure, production and storage.

Electric operation is becoming relevant for increasingly larger parts of the sector, and electrification will continue to accelerate. More people will switch from a combustion engine to an electric engine and battery, thanks to continued development of battery technology. The deployment of quick charging stations along the main arteries will help make it easier to use electric cars for long trips. For freight transportation, electrification, which has just barely started within local distribution of goods, will likely continue. For sea transport, it is likely that batteries and power electronics between diesel engines and electric engines will become the norm in various types of vessels. Many vessels could also have charging options so they can run exclusively on batteries all the time, or when they are near shore.

Alternative fuels such as hydrogen could become important on the road towards emission-free transportation, particularly where a long range or fast fueling are requirements. Efficient production and distribution are required to speed up the hydrogen market, but the development of vehicles and vessels that can use hydrogen as fuel is at least as important. Biofuel can be used in both inland transport, at sea and in aviation, but should be prioritized in the sectors where use of electrification and hydrogen are challenging. Large-scale industrial production of biofuel, increasing availability and lowering the costs down to the fossil fuel level are required to speed up this market.

Transportation is one of the cornerstones in society, and efficient transportation is a precondition for value creation in other sectors. The sector therefore also holds an important position in a low emission society, but needs to become innovative, energy efficient and virtually emission free on the path there. In order to accomplish this, new technology that can provide emission-free solutions for propulsion systems as well as for fuel must be developed and put to use. Enova will continue stimulating a green transition in the transportation sector through supporting projects that reduce greenhouse gas emissions.

ASKO invests in hydrogen and electric

The nation's first fully electric delivery truck (Photo: Erik Norrud).

Four hydrogen lorries and a dedicated hydrogen production facility that runs on their own solar cells. This is the beginning of ASKO's hydrogen investment. Their first electric delivery truck has already hit the roads in Oslo.

TRONDHEIM/OSLO

Daniel Milford Flathagen

24 April 2016 / 13 September 2016

– Electricity and hydrogen are the future. We will mostly produce our own electricity from our solar cell facilities. We want to be at the cutting edge and a champion for introduction and use of environmentally friendly technology. In just a few years we will have realized our ambition to have renewable fuel in our entire vehicle fleet, says Managing Director Jørn Arvid Endresen in ASKO Midt-Norge.

The hydrogen will be produced from solar cells installed on ASKO Midt-Norge's roof in Trondheim, and will be stored in a dedicated tank in the facility. This hydrogen pilot will be tested during the period 2017–2019 on 4 hydrogen cars and 10 trucks for internal logistics.

Very important project

Enova is contributing just over NOK 19.6 million to the project through supporting ASKO's investments in vehicles and the hydrogen production facility.

– ASKO has been a champion for new climate solutions in freight transportation for many years, and is demonstrating once again that they are ahead of the curve when it comes to testing and phasing in new and environmentally friendly technology. Hydrogen is a very interesting alternative to fossil fuel in ground transport, especially for buses and lorries that drive long distances where battery operation is less optimal, says Marketing Director Audhild Kvam in Enova.

Electric delivery trucks on the roads

The hydrogen project will follow up ASKO's investment in electric vehicles. The first Norwegian battery electric delivery truck rolled out of the terminal at Kalbakken in September 2016, and ASKO is planning for more in Bergen and Kristiansand as well. Enova contributed NOK 2.25 million to this.

– We are pleased that ASKO also wants to lead the way within batteries, and are happy to participate and contribute, says Kvam.

Facts

Electric delivery trucks

Project owner: **ASKO Norge**

Year funded: **2015**

Funding level: **NOK 2 250 000**

Energy result: **349 500 kWh**

Planned completion date: **2017**

Hydrogen vehicles

Project owner: **ASKO Midt-Norge**

Year funded: **2016**

Funding level: **NOK 19 620 000**

Energy result: **944 000 kWh**

Planned completion date: **2018**

About ASKO

ASKO is NorgesGruppen's wholesale business. With 600 lorries making deliveries all over Norway, they are one of the nation's largest transportation companies.

Buildings

Total energy consumption is increasing, but energy consumption per area is lower

- **Total energy consumption in buildings is increasing**
- **Construction of both residences and non-residential buildings is increasing**
- **Energy consumption per square meter is declining: New buildings require less energy than older buildings, and older buildings are being renovated**
- **Renewable heating solutions constitute an increasing share of energy consumption, particularly in new buildings**

The construction industry is a fragmented and complex industry. Non-residential buildings are distributed among the private sector (primarily office, business, hotel and warehouse buildings) and the public sector (primarily schools, day-care centres, care facilities, cultural buildings, hospitals and sporting facilities). The construction market includes construction of new buildings, as well as renovation, reconstruction and additions (ROT).

Direct greenhouse gas emissions from Norwegian buildings and residences are minor, but the impact on the energy system is substantial. The sector accounts for a significant portion of output during the coldest days of the year.

Enova's goals are for

- the non-residential buildings' impact on the energy system to be reduced, and that energy consumption is made more efficient so that energy is freed up for other purposes such as industry and transportation
- more energy-smart solutions to be competitive in the residential market, both through developing the market for energy-efficient residences and increasing the application of modern technical energy solutions

Major opportunities for improving energy efficiency in non-residential buildings

Energy is not at the top of the list of priorities for property owners. This is mainly because energy costs make up a relatively small share of the overall living expenses. Moreover, it is often the lessees in the private sector that end up with the energy bill, and short leases do not incentivize lessees to carry out long-term energy measures in the building. As for the building owners, they do not want to invest in measures that will not be profitable in the form of increased rental income, and therefore do not prioritize energy measures. Enova wants to reduce this barrier, for example by offering investment support to the trailblazing building owners and lessees that want to upgrade their building. In 2016, Grønn byggallianse and Enova also launched a lessee requirement specification, which will make it easier for lessees to set specific requirements related to the energy performance of the building they want to rent.

At the same time, we are seeing that more players are paying attention to how their reputation can be affected by the energy and environmental profile of their building. For new buildings, Enova is seeing a growing number of projects in both the public and private sector with ambitions beyond Energy Label A or passive house. They involve using innovative technologies or system solutions, as well as some degree of independent power production. The trailblazers are often major building owners that are investing in green buildings to be competitive in the future rental market. The smaller players do not have the same long-term view as regards green buildings, but are still investing in certain measures, particularly within existing buildings.

The revised technical regulations from 1 January 2017 will result in all new buildings eventually being at a passive house level, which means they will have a very low energy demand compared to the current average building. At the same time, existing buildings will primarily remain the same, which represents a substantial potential for energy reduction.

Much of the potential for increasing the efficiency of energy consumption and reducing power output required by buildings can be triggered by using known solutions and exploiting the opportunities in increased diversification and digitization of the energy system. In addition to good energy and climate solutions for the operations phase, new technology and improved construction processes can contribute to selection of materials and construction processes with low greenhouse gas emissions.

Increased emphasis on a system mindset, comprehensive solutions and area development, could open up the field for completely new concepts and increased value creation. Local consumption and energy exchange between buildings provide flexibility and relieve the energy system. This is an opportunity that can be better exploited using local energy production, as well as management and moving consumption from the most strained times of the day. Exploitation of local, thermal energy will also play an important role, as will batteries and accumulation of thermal energy in tanks or the bedrock. In the spring of 2016, Enova launched a new programme aimed at building

owners during the concept phase, where the objective is to provide support to assess innovative solutions for buildings and areas.

Enova expects both public and private property players to place more emphasis on energy and climate going forward. The forward-thinking players realize that the transition to a low emission society represents new opportunities and increased value creation. Among private players we will first see this shift in players with large portfolios in the biggest cities. At the same time, we are seeing individual players that use the environment as part of the strategy to strengthen their position outside the major cities as well.

Norway needs more renewable power in a low emission society. Better area solutions and improved energy efficiency can release energy for other purposes. This reduces greenhouse gas emissions and offsets output usage. Enova will work to encourage even more property players to drive the market in the right direction. We will stimulate projects that result in less strain on the energy system, and emphasize innovative solutions and business models. Comprehensive climate and energy-efficient solutions within area development, which also facilitate future-oriented transportation solutions, will be particularly important when constructing a low emission society.

More need to implement energy measures at home

Energy consumption in Norwegian residences is high, and energy efficiency improvements can release power for other purposes. This also helps secure Norwegian security of supply if we cut energy consumption during periods when the energy system experiences heavy loads.

In just a few years, digital electricity meters will be installed in every Norwegian home. They can be combined with wireless communication solutions where the end-user can follow consumption in virtual real time, with new possibilities for automation as well. Enova expects more electricity suppliers to introduce solutions to the market that exploit the potential in the digital electricity meters. Experience from other countries shows that this can reduce energy consumption in residences by 10 per cent24.

In 2016, the rights-based Enova Subsidy contributed to the implementation of about 6 500 energy measures in Norwegian residences. This is a positive development from previous years. Enova expects that attention will continue to rise as the service becomes even more known. The interest in major upgrade projects has remained stable over the past few years. Support for upgrades was included in the Enova Subsidy as a rights-based measure in January 2016. Enova finds that this service has increased the interest in energy upgrades in the renovation market. Enova wants housing cooperatives that are renovating to also take positive action when it comes to energy when they are already making improvements.

Strong population growth in and around the major cities is expected in upcoming years. Apartments and terraced houses will represent an increasingly larger share of newly-built residences25. Energy-efficient cities will lessen the strain on the climate and play an important role in the transition to a low emission society. Going forward, Enova will emphasize stimulating development of areas that contributes to increased flexibility, also with regard to sustainable living and transportation habits. The solutions that are chosen for the individual residences and for development of larger areas set the premises for energy consumption for many decades in the future. This means that the choices that are made today will affect the low emission society, which emphasizes the importance of comprehensive solutions that facilitate low energy and output demand. Market development and service innovation are the biggest requirements for energy solutions. The technological solutions have largely been developed. The challenge lies in using the solutions in a large enough scope.

In the future, private individuals must live in climate-neutral homes, with minimal strain on the power system. Norway will need comprehensive area solutions that interact well with the energy system and facilitate the transportation solutions of tomorrow. In order to get there, Enova will continue to work to make future-oriented solutions the preferred choice, and to make it more common to implement energy upgrades in residences once renovations are already being planned. We will also continue supporting technologically mature energy solutions that do not yet have a sufficient foothold in the market. Together, this will contribute to future-oriented energy and climate solutions finding their way into more Norwegian homes.

24 *The Norwegian Water Resources and Energy Directorate (NVE)/VaasaETT (2014): Smart electricity meters (AMS) and feedback / VaasaEtt (2014): http://webby.nve.no/publikasjoner/rapport/2014/rapport2014_72.pdf*

25 Prognosesenteret, Prognosis New residences, September 2016

Building Norway's most energy-efficient school

Starting from the beginning of the 2018 school year, students at Heimdal Upper Secondary School will be attending a school built for the low emission society (Illustration: Skanska/Rambøll).

The new Heimdal Upper Secondary School and multipurpose hall in Trondheim will become one of the country's most energy-efficient buildings once it is finished in time for the beginning of the school year in 2018.

TRONDHEIM

Espen Sletvold

1 November 2016

– The county authority has an ambitious climate and energy plan, where the county will reduce greenhouse gas emissions in its own organization by 50 per cent within 2020. It is therefore important to use occasions such as this to take a proactive approach. With the support from Enova in place, we will construct a building that reduces energy consumption by almost two-thirds compared to current regulations, says chair of county council Tore O. Sandvik

Minimizing energy consumption was emphasized throughout the planning process, both through well-isolated outer surfaces and in the chosen technical solutions. A number of contractors and consultants have been involved in order to develop the best solutions. The result is an estimated energy consumption of about 37 kWh/m² per year in the school building, where the most recent building requirements in the technical regulations stipulate 110 kWh/m².

Solar energy, biogas and geothermal

The building satisfies all passive house requirements, but the county authority has also taken a step further by requiring the building to produce local energy corresponding to the climate strain from the energy the school actually consumes.

– We will exploit the energy from the sun and have placed just under 2 000 m² solar cells in a solar cell station on the school's rooftop

The building has a low heating demand, and will mostly obtain the heating it requires from the bedrock underneath the building. Heat pumps will be used, where each kWh of electricity will yield four kWh of heating. In addition, a biogas-operated thermal power machine will produce heating and electricity. The surplus heating is delivered to the school's nearest neighbour, the Husebybadet swimming facility.

Leading the way

Enova believes that the energy and climate solutions being utilized in the school building will have a significant transfer value to other buildings and construction clients, and is therefore supporting the project with approx. NOK 21.5 million.

– Through this project, Sør-Trøndelag county authority is leading the way for other public players and the entire construction industry. With innovative, sustainable and energy friendly solutions, they are building for the low emission society. Students who choose Heimdal Upper Secondary School can go to school knowing that the county has done everything they can to reduce climate impact. We are proud to contribute to making this excellent school building a reality, says Enova Marketing Director Audhild Kvam.

In order to secure the high energy ambitions in the project, the county authority is now entering into an energy performance contract (EPC) for this project. This means that the general contractor Skanska guarantees that the building will not use more energy than agreed.

Facts

Project owner: **Sør-Trøndelag county authority**
Year funded: **2016**
Funding level: **NOK 21 479 000**
Energy result: **3 111 214 kWh**
Planned completion date: **2018**

About Heimdal Upper Secondary School

The school will have 1140 students and 200 employees. The school, culture and local community area will be 18 500 m² and there will be a 7 500 m² multipurpose hall.

New energy and climate technology

Investment level is stable, but Norway is losing ground

- **Norway is ranked last in the Nordic region for innovation within energy and climate technology**
- **Energy and climate technology amounts to only 3 per cent of Norwegian export**
- **There is a positive trend for research, development and demonstration within new energy and climate technology**
- **The percentage of Norwegian patent applications within energy and climate technology is still low**
- **The power industry is investing the most, but researching the least**

The term "new energy and climate technology" means innovative technological solutions or process improvements that contribute to reducing energy consumption or greenhouse gas emissions. This is necessary in all sectors in society in order to realize sustainable growth.

Enova's goal is to

- contribute to the realization of more highly innovative projects, so that more technologies or process improvements that reduce energy consumption or greenhouse gas emissions reach the market

More need to see the potential in green innovation

Norwegian energy and climate technology could bring Norway and the world into a low emission society. Norway has unique access to renewable power, high productivity and a high level of expertise. Combined with stable politics and a well-functioning range of instruments, this gives Norway an advantage in the race for the green technology of the future. Perhaps particularly within industry and maritime transportation Norway could be poised to take a strong position as a global investor and supplier of new energy and climate technology. At the same time, low commodity prices are reducing the willingness to invest both in the mainland industry and oil industry, which have been the major locomotives within Norwegian technological development. We have also seen that operating expenses for R&D and the number of patent applications within renewable energy and CO_2 capture have declined in recent years[26].

Both the volume and pace of innovation must increase in order to allow more new solutions that can increase value creation to reach the market. Going forward, more ideas must be developed and the pace of innovation must increase, so that more climate-friendly products and services are supplied and demanded in the market.

Market forces alone will often yield less innovation than what society needs. Long innovation processes require a longer time horizon for investments than most private investors are comfortable with. At the same time, the gains from driving innovation are uncertain, and there is a risk that others than those who carry the costs will benefit from the results. The willingness to innovate can be stimulated by society financially compensating companies to innovate more than they would have otherwise. Public support has turned out to be particularly important within new energy and climate technology. Funding agencies cover the entire development course from research to commercialization of new technology. In 2016, the Research Council of Norway, Innovation Norway and Enova launched a new joint support scheme called Pilot-E, which is intended to promote the truly groundbreaking ideas.

Competitive advantages do not last forever. Regardless of industry, market players must challenge their own business models. Disruptive services and solutions associated with for example digitization, automation, circular economy and sharing economy can quickly change the market and demand going forward. Companies cannot just assume that their existing product portfolios and the current value chains will remain relevant in a low emission society, and those that are unwilling to adjust in time, risk being left behind by the competition. Openness to new business models and methods of cooperation, and the ability to develop and utilize new green technology and expertise across sectors, will determine who succeeds.

In recent years, Enova has increased its efforts within new energy and climate technology, and it is clear that a growing number of players are realizing the business opportunities of developing new green technology. We are seeing technology projects within more markets than before, and the projects are more closely linked to long-term strategy processes in the companies. One example is Elkem Solar, which, in 2016, started groundbreaking energy-efficient production of solar cell silicon blocks in REC's previously shut down facility at Herøya. Major industrial players are completely dependent on continuous innovation such as this to remain competitive.

New energy and climate technology will become a very important focus area for Enova going forward. It may not be easy to measure the results we contribute to in specific figures going forward, but through supplying capital, Enova will contribute to the realization of even more of the future-oriented ideas in concrete projects. We shall ensure that those who have the capacity and willingness to take the lead receive the necessary help along the way. We will also enter the innovation process at an earlier stage and work to trigger more early-phase technology development, which can in turn lead to the demonstration and implementation of more projects

26 *Enova's 2016 market development report: http://viewer.zmags.com/publication/81329f6f#/81329f6f/11*

Bioenergy

Small steps in the biofuel market

Market, potential and goals

Bioenergy is biomass – for example trees, plants and organic waste – that is used for energy purposes. Through refining and processing, the biomass is converted into fuels, both solid and liquid form. The bioenergy can be used to produce heating, electricity and fuel. The resource potential for bioenergy in Norway is estimated at more than 30 TWh per year[27]. Forests account for the majority of this, whereas other important resources include waste, for example from agriculture and industry. Enova will stimulate the phase-out of fossil fuels. We therefore want to contribute the financial support necessary for companies that want to establish biogas and biofuel facilities to achieve sufficient profitability.

Market situation

Consumption of bioenergy declined during the period 2010–2014[28]. One reason for this is the shutdowns in the wood processing industry and mild winters that have resulted in a lower heating demand. Heat pump sales and more efficient wood-burning stoves may also have contributed to the development. Furthermore, the prices of alternative energy products – electricity and fuel oil – have been historically low and have led to a lower willingness to pay for bioenergy compared to a few years ago. This particularly applies for bioenergy in the heating market, where competition from electricity has been quite substantial. It has thus become more challenging to make new bioenergy projects profitable. In 2015, however, consumption increased by about 7 per cent compared to the preceding year, mainly due to increased wood consumption[29]. In the transportation sector, the trading requirement, which stipulates that a certain share of sold fuel must consist of biofuel, is a considerable driver for the consumption of biofuel. The trading requirement was increased from 3.5 per cent to 5.5 per cent from 1 October 2015. The use of biofuel for transportation has increased as a result of this[30].

Despite somewhat demanding market conditions, there are several initiatives for biofuel production in the market. Examples of this include Den Magiske Fabrikken in Tønsberg and Biokraft at Skogn.

Prospects

In the low emission society, Norway needs solutions that utilize renewable energy resources effectively, and heating production based on bioenergy could have a positive impact on security of supply. Through use of bioenergy, we can phase out fossil energy both in the transportation sector and otherwise, thus contributing to reduced greenhouse gas emissions.

In the short scenario we expect that use of bioenergy will level off, or modestly increase. Low power and oil prices are expected going forward, which makes it challenging to achieve profitability in bioenergy projects. Since 2010, we have also seen downscaling and shutdowns within industries that have traditionally used a lot of biomass, such as wood processing. However, several biogas facilities are under construction and scheduled for completion over the next few years. Along with existing facilities, these facilities contribute to a growing supply of biogas. This enables increased use of biogas in the transportation sector, among others. The trading requirement will also contribute to increased bioenergy consumption.

In the slightly longer term, new areas of application for use of biomass could contribute to increased demand. In ground and air transport, bioenergy could play a role on the road to a low emission society. There is increasing interest in developing second-generation biofuel[31], which in a Norwegian context would primarily be based on cellulose from wood. If the efficiency and profitability in the chemical recovery process are improved, we can expect that demand for wood as fuel will increase. There is also reason to believe that the percentage of bio within district heating and heating plants will increase as restrictions are imposed on fossil-based heating.

Enova will continue to stimulate the desired market development, and supports production of biofuel to increase access. Good programmes for bioenergy aimed at new technology and innovation within both transportation and district heating will also be important in the future. This could help make bioenergy competitive enough to inspire growing demand on the road towards a low emission society.

Bioenergy 2016

Bio-based heating delivery and production of biofuel supported by Enova in 2016:	**429 GWh**
of which:	
Biogas production:	**55 GWh**
Chips:	**184 GWh**
Waste energy:	**122 GWh**
Pellets:	**46 GWh**
Other biopower:	**16 GWh**
Biomass:	**7 GWh**

27 *NVE, Bioenergy in Norway http://webby.nve.no/publikasjoner/rapport/2014/-rapport2014_41.pdf. Various studies show that the potential for increased production of bioenergy for energy purposes is between 15–35 TWh per year*

28 *Statistics Norway: Table: 09380: The energy balance. Access and consumption, according to energy product.*

29 *Statistics Norway: Table: 09380: The energy balance. Access and consumption, according to energy product.*

30 *Statistics Norway: http://www.ssb.no/energi-og-industri/statistikker/energibalanse*

31 *Statistics Norway: Energy balance for Norway. 2016. http://www.ssb.no/energi-og-industri/statistikker/energibalanse/aar-endelige/2016-10-18?fane=tabell&sort=nummer&tabell=280906*

More green gas is changing the fuel market in Vestfold and Telemark

Greve Biogass is increasing production of climate-friendly biogas at the colourful facility in Tønsberg (Photo: Greve Biogass).

Den Magiske Fabrikken will now produce 75 per cent more biogas, and Enova is contributing NOK 36.5 million to the expansion of the facility.

TØNSBERG

Evy Aspheim

13 September 2016

In Vestfold and Telemark, 75 buses are already running on biogas from Den Magiske Fabrikken. The expansion of the facility will allow even more buses to switch from fossil to renewable fuel. The support from Enova comes on top of the NOK 44.5 million that Enova has already invested in the establishment of Den Magiske Fabrikken. Tønsberg municipality owns and funds the production facility.

Even today, biogas production at this facility can replace 6.8 million litres of diesel each year. In addition to supplying buses and garbage removal trucks with environmentally friendly fuel, the biogas is also used for heating and in industrial processes.

– Business models such as this, where multiple resources are recycled, are completely essential in order to achieve a sustainable change, says Enova CEO Nils Kristian Nakstad

So far, Enova has invested more than NOK 440 million in new biogas production facilities all over Norway. Together, the biogas from these facilities can replace 60 million litres of diesel each year.

– Food waste and animal manure can emit large quantities of greenhouse gases. Exploiting these resources for environmentally friendly fuel, is one of the smartest things we can do on the road towards the low emission society. This cuts emissions in the waste industry, agriculture and transportation sector all at the same time, says Nakstad in Enova.

– If the climate-friendly fuel market develops in a positive direction going forward, Den Magiske Fabrikken could produce 30 million Nm³ of climate-friendly fuel in 2020, says Andreas Gillund, General Manager in Greve Biogass. – This will contribute to further development and green growth in what is already very climate-friendly food production in the region.

Facts

Project owner: **Tønsberg municipality**
Year funded: **2016**
Funding level: **NOK 36 530 000**
Energy result: **39.4 GWh**
Planned completion date: **2018**

About Grenland og Vestfold Biogass
Grenland og Vestfold Biogass (Greve Biogass) is a municipal company that ensures local recycling of food waste and sludge. The company has constructed the biogas facility Den Magiske Fabrikken, which produces biogas from drain mud, de-icing fluid from Torp airport and raw material from the food industry. Tønsberg municipality is the formal owner of the facility.

DEL VI
DIRECTORS' REPORT AND ANNUAL ACCOUNTS FOR ENOVA SF

This part is not translated and is not included. For information look to Enovas Årsrapport 2016.

PART VII
ANNUAL ACCOUNTS FOR THE ENERGY FUND

This part is not translated and is not included. For information look to Enovas Årsrapport 2016.

PART VIII
APPENDICES

APPENDIX C

Assignments outside the Energy Fund

Natural gas

On behalf of the Ministry of Petroleum and Energy (MPE), Enova has administered the funds of the support programme for natural gas infrastructure during the 2003–2009 period. The last allocation over the national budget was in 2009. The objective of this arrangement was to facilitate increased domestic use of natural gas, and particular emphasis has been placed on ensuring that the use of natural gas has a positive impact on the environment. Conversion from heavier fuels in industry, shipping and transport were prioritized market areas. This assignment was phased out in 2016 and remaining funds have been returned to the Treasury.

Publications

Enova's Results and Activities 2015
Enova report 2016:1

Enova Annual Report 2015
Enovarapport 2016:2

Marked development 2016
Enova report 2016:3

Enova Building Statistics 2015
Enova report 2016:4

Heating facts 2015
Enova report 2016:5

Definitions and explanation of terminology

Climate result
A climate result is calculated for each project supported by Enova. The climate result corresponds to the total change in greenhouse gas emissions as a result of various measures in the project (energy efficiency measures, conversion, production or distribution). The calculation takes a basis in the project's energy result (kWh) and emission coefficients for various energy carriers. The climate result is measured in CO2 equivalents.

Contractual energy result
Contractual energy result is the annual energy result a project is expected to realize in the future. The energy result is included as part of the contractual basis between the support recipient and Enova. All decisions within a calendar year are included in the calculation of gross contractual energy result for the year in question.

Cost efficiency
One of the objectives when establishing Enova was to achieve a more cost-effective effort in renewable energy and efficient energy end use. Enova prioritizes projects based on the size of the support need in relation to the energy result (NOK/kWh), given the project's lifetime and the goals stated in the agreement with the MPE.

CO_2 equivalent
The greenhouse effect from CO2 is used as a unit of measurement to describe the greenhouse effect of different greenhouse gases. The greenhouse effect from other greenhouse gases is converted to CO2 equivalents in accordance with their global warming potential (GWP) over a given period. The GWP value for a gas is defined as the accumulated impact on the greenhouse effect from a one-tonne emission of the gas compared to a one-tonne emission of CO2 over a specified period of time, usually 100 years.

The Energy Fund
The purpose of the Energy Fund is to be a predictable and long-term source of financing for the environmentally friendly restructuring of energy end-use and energy production and development of energy and climate technology.

The Energy Fund is based on Section 4.4 of the Act relating to amendment of Act No. 60 of 29 June 1990 relating to the generation, conversion, transmission, trading, distribution and use of energy, etc. (Energy Act), cf. Odelsting Proposition No. 35 (2000–2001) and Recommendation to the Storting No. 59 (2000–2001). The Ministry of Petroleum and Energy (MPE) determines the statutes for the Energy Fund.

The Energy Fund is financed through grants in the national budget and a parafiscal charge on the grid tariff for withdrawing power in the distribution grid.

The grants to the Energy Fund mainly consist of returns from the Fund for climate, renewable energy and energy restructuring. At year-end 2016, the capital in this fund was NOK 67.75 billion. In connection with the Climate Compromise in 2012, a decision was made to strengthen the Fund for climate, renewable energy and energy restructuring with a capital contribution of NOK 25 billion over the period from 2013–2016. In the revised national budget for 2014 (Storting White Paper No. 2 (2013–2014), Recommendation to the Storting No. 260 S (2013–2014)), a decision was made to increase capital in the Fund by NOK 4.25 billion beyond the contribution approved in the Climate Compromise. This was continued in 2015 and 2016. An additional increase of NOK 5 billion was approved for the 2016 national budget. It is not given that the entire returns from these new contributions will be added to the Energy Fund.

Energy restructuring
The contract between the MPE and Enova stipulates that the Energy Fund will be used to promote an environmentally friendly restructuring of energy end-use, energy production and development of energy and climate technology. The energy restructuring is a long-term effort in the development of the market for efficient and environmentally friendly energy solutions that help strengthen the security of energy supply and reduce greenhouse gas emissions.

Energy result
The energy result is a goal (in kWh) for what the projects we support will deliver (per year) through more efficient energy consumption, increased production and increased use of renewable energy.

ESA
The EFTA Surveillance Authority (ESA) ensures that the EFTA nations (Iceland, Liechtenstein and Norway) comply with their obligations under the EEA Agreement. The EFTA Surveillance Authority also enforces the general ban against state aid, and assesses national support programmes vis-à-vis the EEA rules and has the authority to demand that illegal support be returned.

Final reported energy result

The final reported energy result is an updated forecast of a project's expected realized annual energy result. Enova assesses whether the project's final reported energy result is reasonable when the final report is submitted.

Lifetime

A key issue related to new production of energy and reduced energy end-use is how long we will reap benefits from the results. Here one can differentiate between technical and economic life. The technical life is connected to how long the equipment can function with normal maintenance, while economic life is related to how long it will take before it will be more profitable to replace the equipment with new and improved technology. Enova bases its lifetime consideration on economic life. This is also reflected in Enova's investment analysis. In addition to the importance of project lifetime as a parameter in the assessment of the support need, it also expresses how long we will benefit from the energy result provided by the project. The project's lifetime multiplied by annual energy result [year*kWh] will express the project's total energy result over its lifetime. Similarly, the energy cost is also expressed over the lifetime [NOK/[year*kWh]].

Maritime industry

- **Fishing vessels** – a highly varied segment with several ship types, e.g.: trawlers, small smacks, seiners.
- **Offshore ships** – the most common vessels are anchor handling tug supply vessels and PSVs (platform supply vessels). The offshore ships are often fitted with advanced dynamic positioning systems and are characterized by a large deck area.
- **Tankers and bulk ships** – vessels that transport liquid cargo in bulk, for example crude oil.
- **General cargo ships** – ships that transport various types of freight. There are several types of ships depending on the cargo being transported. Some have hatches on the deck, while others have side gates with ramps so that lorries or trucks can drive on board to deliver/collect the cargo.
- **Specialty ships** – the segment consists of many ships with many different activities, and that spend considerable time in Norwegian waters. Examples of ship types include well boats, tugboats and coast guard vessels.
- **Domestic fleet** – shipping between Norwegian harbours/offshore installations regardless of the ship's flag.
- **Foreign-going fleet** – traffic from/to harbours outside Norwegian national territories/waters to/from Norwegian harbours/offshore installations.
- **Through traffic** – international traffic (foreign-going fleet) that passes through Norwegian waters.

Passive houses/buildings

Passive houses/buildings are buildings which, through passive measures, i.e. optimal insulation and sealing, have a reduced energy consumption for heating. Separate Norwegian standards have been established that describe the passive house requirements both for (passive) residences (NS3700) and (passive) commercial buildings (NS3701), adapted to Norwegian climatic conditions.

Programmes

Enova has chosen to focus the use of policy instruments through programmes. A programme is an instrument directed towards one or more specific target groups, with set application criteria.

Realized energy result

Realized energy results are measurements or estimates of achieved energy results after a measure has been completed, and its effects can be observed. It takes time from when the measures are implemented until realized results can be reported.

Renewable energy

Enova uses the same definition of renewable energy used in the EU's Renewables Directive (2001/77/EC). In the directive, renewable energy is defined as renewable, non-fossil energy sources (wind, solar, geothermal energy, tidal energy, hydropower, biomass, gas from treatment plants, gas from cleaning facilities and biogases). Biomass is furthermore defined as biologically degradable fractions of products, waste and agricultural remnants (plant or animal-based), forestry and associated industries, in addition to biologically degradable fractions from industrial and municipal waste.

Triggering effect

As an administrator of public resources, it is important for Enova to ensure that the resources we manage are used in the best possible manner. This principle is stipulated in the agreement between Enova and the MPE in that support must contribute to realizing projects that would not have been realized otherwise. Projects with a low cost per generated or reduced kWh will often be profitable by themselves, and therefore do not require support from the Energy Fund. Support is also considered to be triggering if it advances a project in time, or if a project has a larger scope than it otherwise would have had.

ENOVA

Enova works to promote Norway's transition to the low emission society. The transition will require us to cut greenhouse gas emissions, safeguard security of supply and create new values. That is why Enova works to bring the good solutions out in the market and contributes to new energy and climate technologies.

Enova's reports can be found at www.enova.no

For more information, contact:
Tel. +47 73 19 04 30 / svarer@enova.no

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Enova SF
Professor Brochs gt. 2
N-7030 Trondheim
NORWAY