ENOVA

Annual Report 2017

Contents

It’s worth it

Over just a couple of generations, global greenhouse gas emissions must come down to zero or less. This transition to a low-emission society is a joint global challenge. For Norway to deliver on its climate commitments while at the same time further develop the current prosperous welfare society, requires a considerable transition – a sustainable change.

On the path to the low-emission society, Norway must cut emissions, at the same time as businesses must create new values. In order to achieve this, many of us need to make tough decisions going forward, important decisions that create real change. Because the first and possibly most important change needs to happen inside our heads. The belief that a green transition is possible. The belief that this transition is not only a necessity, but an opportunity. The belief that the transition is worth it. Tough decisions must be taken through-out our entire society, in businesses and in each and every one of our homes.

Transition off to a good start

Some have already made significant progress with this transition, in fact, quite a lot are stepping up and leading the way. On a daily basis, Enova has the pleasure of cooperating with many of these pioneers and helping them to realize their projects. In 2017, we contributed to about 900 energy and climate projects in ambitious companies and public agencies, and to about 8 000 energy measures in Norwegian homes through the Enova Subsidy. The subsidy scheme for homeowners is still progressing well, and we increased disbursements from NOK 119 to 165 million from 2016 to 2017. Our commitment to developing energy and climate technology is robust and growing, and we granted support to 108 technology projects in 2017.

In total, Enova invested NOK 2.3 billion in projects in 2017. This is somewhat below the average for recent years, and is mainly due to the fact that the 2017 portfolio does not contain the truly major industrial technology projects, which usually make up a significant portion of Enova’s annual result. However, this is no great cause for concern. Some projects take a long time to mature, and annual variations are to be expected. We are already engaged in good dialogues for several major projects in 2018.

However, the numbers are not important in and of themselves. The long-term significance is more important, as well as the change that each individual project can create. Because the future’s green solutions must be the market’s preferred choice, and it is this market change that Enova will help create. Because the low-emission society is not something that Norway can regulate its way to or create through subsidies, it needs to be developed in a sustainable way – also in terms of economics. This must take place in an interaction between authorities and markets, with a broad range of instruments. In this scenario, Enova becomes a central driving force for the transition, and creating market change becomes our most important instrument.

New agreement, new strategy

more clear over the past year. 2017 was the first year of a new four-year agreement with the Ministry of Petroleum and Energy. The agreement confirms Enova's role as a policy instrument when it comes to cutting greenhouse gas emissions in the non-quota sector, developing the future's energy system and developing new energy and climate technology.

We know that, if we want to contribute to an optimal transition for Norway, Enova needs to adjust as well. Enova has a good history of producing excellent results, but we cannot necessarily use yesterday's recipe for success in increasing energy efficiency to solve today's challenge of emission cuts and technology development. That is why we started a process in 2017 to develop the efficient work processes that will characterize tomorrow's Enova.

Enova's strategy dictates that in order to achieve the ambitious goals in the agreement, Enova must have a global perspective. It is not enough to move emissions abroad, Norway has to cut emissions itself. In parallel with this, Enova must have a long-term perspective, where long-term effects are more important than short-term results. We must be bold enough to go big and stay the course. At the same time, we must create sustainable change here and now. Enova will therefore prioritize the technologies and solutions with the greatest potential on the path towards the low-emission society, but without allowing a far-sighted perspective to obscure the pressing need: Our work must make a difference in the short term for the change that society needs in the long term.

Castles in the air take physical shape

Enova has taken part in several such efforts in 2017, projects that are exciting today, but could have nearly unimaginable effects in the long term. In the transportation sector, last year's prime example was the logistics solution for Yara and Kongsberg Gruppen. The companies will now build an autonomous concept on Herøya which will ensure automatic and electric mooring, loading and offloading of ships.

> *"If the project is successful, this will mean a new era for maritime freight transportation"*

The container ship that is being built, Yara Birkeland, will not only become the world's first fully-electric, but the world's first autonomous ship. Ideas that were castles in the air just a few years ago are now becoming reality. The experiences from the Yara project will be important in the design of national regulations for autonomous vessels, and the outside world is watching with anticipation. It is scarcely possible to exaggerate the potential that this project has for further driving the development. If the project is successful, this will mean a new era for maritime freight transportation.

Industry is testing new solutions

The industry sector is also not resting on its laurels. In early 2017, Enova introduced new support programmes for development of new energy and climate technology, including support for pilot plants to test the technologies. Eramet in Sauda is one of the players that has taken advantage of this opportunity. The company will be testing gas engines that will convert furnace gas into electricity and heating. NorMag is another company that should be mentioned here, as they will build pilot plants for the world's first CO_2-free magnesium production on Herøya. Enova is very pleased that the process industry is responding well to the support programme and thus driving the development forward, both on behalf of themselves and society at large. We believe that this will bring more technologies out into the world.

Innovation is the key

In 2050, our lives, our homes and our transportation will need to be different from today – without greenhouse gas emissions. 2050 is only 32 years away, so the transition is urgent. Norway has started, but more powerful change is needed. The development must be faster. Although it will be important for us as a society to fully support technology development, we need to be aware that new energy and climate technology alone will not be enough. It will also be crucial that we organize parts of our lives in a way that results in a substantially smaller carbon footprint than today.

Above all, innovation is key: In addition to technological innovation, we must see more structural and social innovation. In structural terms, we are talking about changing how we plan and organize the physical structures in society, for example, how we locate homes, public services, jobs and recreational services in relation to each other. Social innovation is about new ways of satisfying the needs of our society through new types of markets and business models made possible, in part, by new technology. Different sharing economy solutions such as car sharing services are examples of this.

It is when we combine these types of innovation – for example in the form of sharing driverless vehicles in the cities of the future – that we can start seeing the contours of a low-emission society on the horizon. We know where we are going, but the roadmap is not yet fully drawn. Each year, Enova contributes to allowing more Norwegian enterprises to draw this map. We intend to continue these efforts in the years ahead.

Because it's worth it.
For the companies, for the climate and for our shared future.

Nils Kristian Nakstad
CEO

PART II
INTRODUCTION TO THE ORGANIZATION AND KEY FIGURES

Social mission

Enova SF is a state enterprise located in Trondheim. From its establishment in 2001 through 2017, Enova is owned by the Ministry of Petroleum and Energy (MPE).

The Ministry of Petroleum and Energy (MPE), on behalf of the State, has the primary task of facilitating a coordinated and comprehensive energy policy, and has the overarching goal of ensuring high value creation through efficient and environmentally friendly management of the energy resources. The MPE issues Enova's assignment letter and receives our reporting. As part of the Jeløya declaration from January 2018, the Government agreed to move the ownership of Enova SF from the MPE to the Ministry of Climate and Environment.

The four-year agreement between the State and Enova applies for 2017–2020 and sets the framework for the 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. The purpose of Enova and the Energy Fund is to contribute to reduced greenhouse gas emissions and strengthened energy security of supply, as well as technology development that also contributes to reduced greenhouse gas emissions in the longer term.

Enova shall promote:

a. Reduced greenhouse gas emissions that contribute to fulfilling Norway's climate commitment for 2030.
b. Increased innovation within energy and climate technology adapted to the transition to the low-emission society.
c. Strengthened security of supply through flexible and efficient demand and energy consumption.

Enova will establish instruments with the aim of achieving lasting market changes. The ultimate goal is that efficient energy and climate solutions should be preferred without support. The activity can be aimed at all sectors.

Enova's vision is *Vibrant 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.

- 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, sexuality, religion, nationality, ethnicity, societal group or political opinion.

Main objectives

Enova works to create market change for the solutions that will take us to the low-emission society. Market change has occurred when technologies and solutions are utilised to a significant degree, without public subsidies. This means that how a project contributes to market change becomes just as important as the individual project's quantifiable result in the form of reduced greenhouse gas emissions, increased innovation, reduced energy consumption or reduced peak demand.

Goal 1:

Reduced greenhouse gas emissions that contribute to fulfilling Norway's climate commitment for 2030.

Enova shall prioritize projects that yield reduced greenhouse gas emissions. The transport sector represents about one-third of Norwegian greenhouse gas emissions. The sector will therefore be particularly important to Enova in the work on adapting to the low-emission society. Within the sector subject to quotas, the EU's quota market is the primary policy instrument for reducing emissions.

Goal 2:

Increased innovation within energy and climate technology adapted to the transition to the low-emission society.
Enova shall prioritise its efforts where the possibilities for influencing the development are greatest, and towards technologies and solutions that are adapted to the low-emission society. When designing policy instruments, Enova facilitates global diffusion and subsequent emission reductions also outside Norway. Through consultation and financial support, we reduce the risk that players take and increase the pace of the energy transition towards more climate-friendly, energy-efficient and competitive sectors.

Goal 3:

Strengthened security of supply through flexible and efficient demand and energy consumption.
Enova will stimulate a faster pace of innovation and a development that supports and bolsters security of supply. We shall contribute to increased energy efficiency, particularly measures that lower electricity consumption during winter, and that yield increased flexibility in the demand for electricity.

The goals are linked

Reduced greenhouse gas emissions and energy supply are closely correlated factors. Even in a society where nearly all emissions have been eliminated, we will continue using energy. We must use the energy efficiently and it must be renewable. Efficient energy consumption and a reliable, renewable energy supply are therefore important prerequisites for reduced greenhouse gas emissions.

Another important prerequisite for the transition to a low-emission society where we still have high value creation and welfare, is the development of new technology. In order for the Norwegian society to succeed with such a transition, we must find more less costly and more efficient ways of solving our needs. The market change we will contribute to is a situation in which fossil-free solutions outstrip fossils based on performance, quality and price. Then we will know for sure that we are moving towards a low-emission society that is also financially sustainable.

Enova's policy instruments

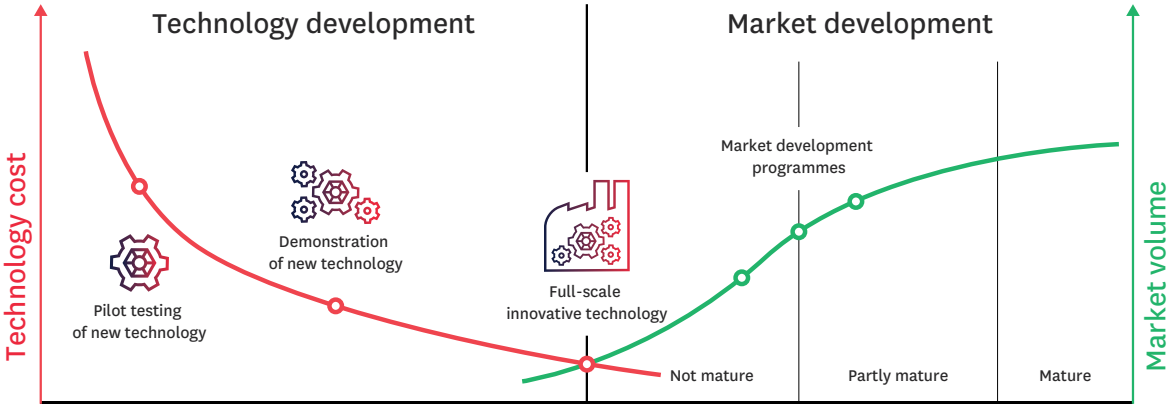
Enova's foremost policy instrument is financing. By providing investment support, and loans in some cases, we reduce the costs and risk for both the providers of efficient energy and climate solutions and those who demand them. And by highlighting what is possible while simultaneously spreading experience, we reduce the risk and make it easier for the next group to make good energy and climate choices.

Enova shall contribute to increased innovation so that new energy and climate solutions are developed and eventually become preferred in the market. The changes that are necessary in the transition to a low-emission society are not all about technology development. New solutions and technologies will not take us to the low-emission society if they are not used. Many of the technologies we will use in the future are already well-known today, but are not used widely enough.

Enova therefore has a broad range of support programmes. We mainly work along two main lines: technology development and reduced technology cost/increased performance on the one hand, and market development and volume on the other. This is illustrated in the figure below.

The technology programmes will contribute to reducing the technological risk and cost of new innovative energy and climate technology, so that more energy and climate technologies are assisted from the development stage and out into the commercial market. The market development programmes will help known technologies that are not widely used to test the market and contribute to changing the market.

Figure 2.1
Technology development and market development



Within both technology development and market development, the key is to allow the solutions with the greatest potential for a market breakthrough to have a shot. This is how Enova contributes to increased innovation where more technologies that the world needs in the low-emission society are developed and utilized.

Consultation and information are also important instruments for Enova. We give advice through the Ask Enova service for small projects, as well as information and guidelines on our website. In larger projects we work closely with the applicants over time. Through this dialogue, the projects benefit from the expertise of our consultants and the experience we have built up through managing a total portfolio of several thousand projects.

Market change

Enova's instruments shall contribute to creating lasting changes in the market. To ensure we are stimulating this, we stipulate market change goals within the sectors in which we work. A market change goal can be described as the turning point where the desired development is driven onwards by the market even without support. A good market change goal is a logical and good argument for a desired market change, where identified barriers and drivers are of such a nature that Enova's current or new policy instruments can contribute to the market change. The market change goals can be both short term or long term, and must be concrete and quantifiable over time.

The time it takes to reach the turning point can vary significantly from sector to sector, and between segments and technologies within a sector. The way in which different markets develop depends both on the players themselves and a number of framework conditions that affect them to varying degrees.

Barriers and drivers

Enova's role is to break down barriers and influence drivers so that the new solutions are demanded and used in the market on a large scale. This means that Enova can take part in a market development up to when the market has sufficient momentum to continue driving the development alone or together with regulatory and economic instruments, such as taxes and fees.

Often, multiple barriers and development phases must be overcome in order to achieve a lasting change in the 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.

Some barriers will always be there. Within technology development, for example, innovators will not be able to prevent the rest of the market from benefitting from all or parts of the new knowledge. There is thus a risk that the innovation will lose some of its value for the individual player, while the value for society increases. This is a contributing cause to a lack of or slow pace in development of innovation and new technologies for the low-emission society. Public stimulation will always play a role here.

Another barrier is the failure to price externalities, i.e. situations where the players only consider the costs they are carrying themselves – or the benefit they experience themselves – instead of focusing on the positive ripple effects that innovation has for society. Climate and security of supply can be considered collective goods where everyone will benefit equally from a better climate in the form of lower greenhouse gas emissions and increased security of supply, regardless of who carries the costs.

Enova has a lot of knowledge about the drivers and barriers for the development to which we are contributing. We need to be close to the market, understand how it works and know the players. Enova therefore monitors some key factors related to the sectors in which we work at a general level. These are presented in an annual market development report. The report provides us with important information about development trends within our focus areas.

Management

Nils Kristian Nakstad (behind, centre), from left; Øyvind Leistad, Audhild Kvam, Gunn Jorun Widding, Stein Inge Liasjø.

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.

Audhild Kvam[1]
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 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.

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.

1 *Audhild Kvam resigned from the position as Marketing Director on 1 December 2017. The position was assumed by Øyvind Leistad from the same date.*

Organization

Enova has been entrusted with an important responsibility – it shall manage considerable State resources in a manner that provides the best possible support for society. With this comes stringent requirements and great expectations for us and how we operate.

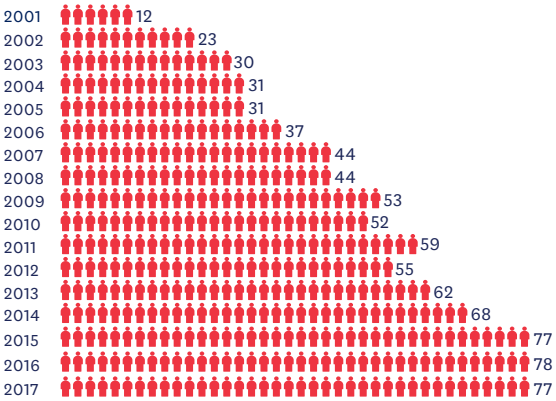
Enova's greatest asset is the expertise of each employee, and knowing how we can put this to use through good interaction in combination with the organization's systems and processes. Enova works with the goal of being an attractive workplace and endeavors to support each person's strengths and desires to do their best. The values (market-oriented, thorough, bold and always learning) set the guidelines for how each person is expected to behave. The company exercises strengths-based leadership, and works to integrate the values in all parts of the workday, related to decisions, how we act, prioritizations and involvement. Working in Enova shall be perceived as meaningful, regardless of your position and duties.

In 2017, Enova worked hard to adapt the organization to the new agreement. An expanded mandate and broader goals bring new requirements for Enova as an organization. During the year, we have worked to develop a shared understanding of our goals, to develop strategies, adapt our instruments and identify the need for expertise.

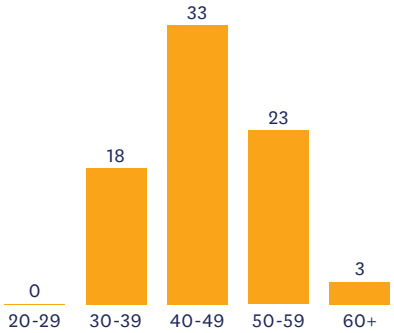
Enova has 77 permanent employees, divided among 39 women and 38 men. Our employees are aged between 30–60. The education and work experience varies within a number of disciplines. Enova sees the value of gender equality and diversity in the workplace, and believes this strengthens our ability to think broadly and embrace different perspectives. We have organized the business in four departments, each with special tasks and responsibilities:

- The **Development Department** develops programmes and follows up supported projects.
- The **Marketing Department** communicates Enova's services to the market, provides advice and handles questions concerning financing and applications for support.
- The **Enterprise Management Department** safeguards the 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.

Development in number of employees



Age composition



Key figures

Key figures for Enova SF

Key figures for Enova SF were prepared based on the standard for public enterprises. Because Enova SF is a State enterprise that adheres to other accounting standards and has a different economic model, the key figures will not be directly comparable with corresponding key figures for public enterprises.

Key figures	2017	2016	Description
Full-time equivalents	75,2	79,8	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.
Total allocation (NOK million)	140,3	129,9	Total allocation consists of administration remuneration, as well as earned equity at 1 Jan.
Utilization rate	93 %	96 %	The utilization rate is calculated as total operating expenses as a percentage of the administration contribution.
Administration contribution (NOK million)	125,2	120,8	The MPE stipulates a framework for administration remuneration for Enova SF. The framework is entirely financed with contributions from the Energy Fund. Amount does not include Value Added Tax.
Percentage of wages in administration contribution	69 %	71 %	The percentage of wages in administration contribution emerges as payroll costs and costs for hired capacity from staffing agencies, as a percentage of the administration remuneration. Payroll costs include all social costs this year (incl. pension costs). Figures for 2016 have been revised.
Payroll costs per full-time equivalent (NOK)	1 145 443	1 067 796	Payroll costs per full-time equivalent consist of wage costs and costs for hiring capacity from staffing agencies, divided among the number of completed full-time equivalents. Payroll costs include all social costs this year (incl. pension costs). Figures for 2016 have been revised.
Percentage of consultants in administration contribution	4,9 %	6,1 %	The percentage of consultants in the administration contribution consists of purchase of consultancy services, as a percentage of the administration remuneration.

Key figures for the Energy Fund

Key figures	2017	2016	Description
New commitments (NOK million)	2 582	2 570	New commitments shows how much Enova has allocated from the Energy Fund to support projects, contractual activities and administrative remuneration.
Disbursed from the Energy Fund (NOK million)	2 356	2 151	Disbursed from the Energy Fund shows how much has been disbursed to projects, contractual activities and administrative remuneration. Disbursements were made during the year to projects adopted during the period 2008-2017.
Added to the Energy Fund (NOK million)	2 659	2 290	The key figure shows how much was added to the Energy Fund through return from the Fund for climate, renewable energy and energy restructuring, parafiscal charge on the grid tariff and interest.
Number of projects	931	1 008	Number of projects allocated support from the Energy Fund, except measures funded through the Enova Subsidy.
Number of disbursements from the Enova Subsidy	8 123	6 468	Shows the number of implemented measures that have received a disbursement from the Enova Subsidy.

PART III
ACTIVITIES AND RESULTS FROM THE YEAR

Goal achievement 2017

2017 has been a good and productive year, and we have made good progress on the deliveries in the first year of the agreement term.

We see that several markets are changing, with an increased number of projects that contribute to reduced costs, increased expertise and reduced risk for those that are utilizing the solutions. We are also seeing more technology development projects that demonstrate that change can occur within markets that were previously not expected to handle the transition to the low-emission society.

In 2017, Enova adapted the arrangement of the support programmes to the new management agreement. In order to contribute to market change, Enova invests in projects that stimulate the desired changes in the best possible manner. In 2017, Enova received nearly NOK 2.7 billion and has granted support amounting to more than NOK 2.3 billion to more than 900 energy and climate projects. We have also supported more than 8 000 individual measures in Norwegian homes through the Enova Subsidy, a scheme that reimburses homeowners for a share of the expenses of investing in energy-smart solutions in their homes.

As one of many guidelines in the work to spur the development towards the low-emission society, we presume that the four contractual performance indicators will provide us with an early indication of whether we are prioritizing our efforts correctly and whether we achieve goals.

The following level is presumed for the performance indicators for the agreement term 2017-2020:

- climate results corresponding to 0.75 million tonnes CO_2 equivalents in the non-quota sector
- energy results corresponding to 4 TWh
- reduced peak demand results corresponding to 400 MW
- innovation results corresponding to triggered innovation capital of NOK 4 billion

In 2017, Enova has recorded 0.31 million tonnes of CO_2 equivalents in climate result, 1.9 TWh in energy result, 133 MW in reduced peak demand result and triggered NOK 1.7 billion in private innovation capital.

Enova finds that the results in 2017 are good for all performance indicators as compared to the contractual levels for the agreement term.

Energy Fund – management in 2017 and further development

Each year, the Energy Fund is supplemented with new funds. Up to and including 2017, revenues in the Energy Fund came from the return on deposits in the Fund for climate, renewable energy and energy restructuring, allocations in the national budget, and from the parafiscal charge on the grid tariff, as well as the interest income from the assets in the Energy Fund. Overall, these revenues amounted about NOK 2.7 billion in 2017.

Enova can allocate transferred funds from previous years and returned funds from cancelled projects. These items constituted just under NOK 1.7 billion in 2017. Enova thus had an overall framework of NOK 4.4 billion in 2017. In addition, Enova has been able to grant funding commitments totaling up to NOK 400 million beyond the available resources in the Energy Fund, pursuant to the commitment authorization.

The financing of the Energy Fund provides both market players and Enova with predictability in the long-term work of realizing the transition towards the low-emission society.

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 where Enova normally maintains a close dialogue with the players 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 timeline. 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.

Figure 3.1
Management of the resources in the Energy Fund

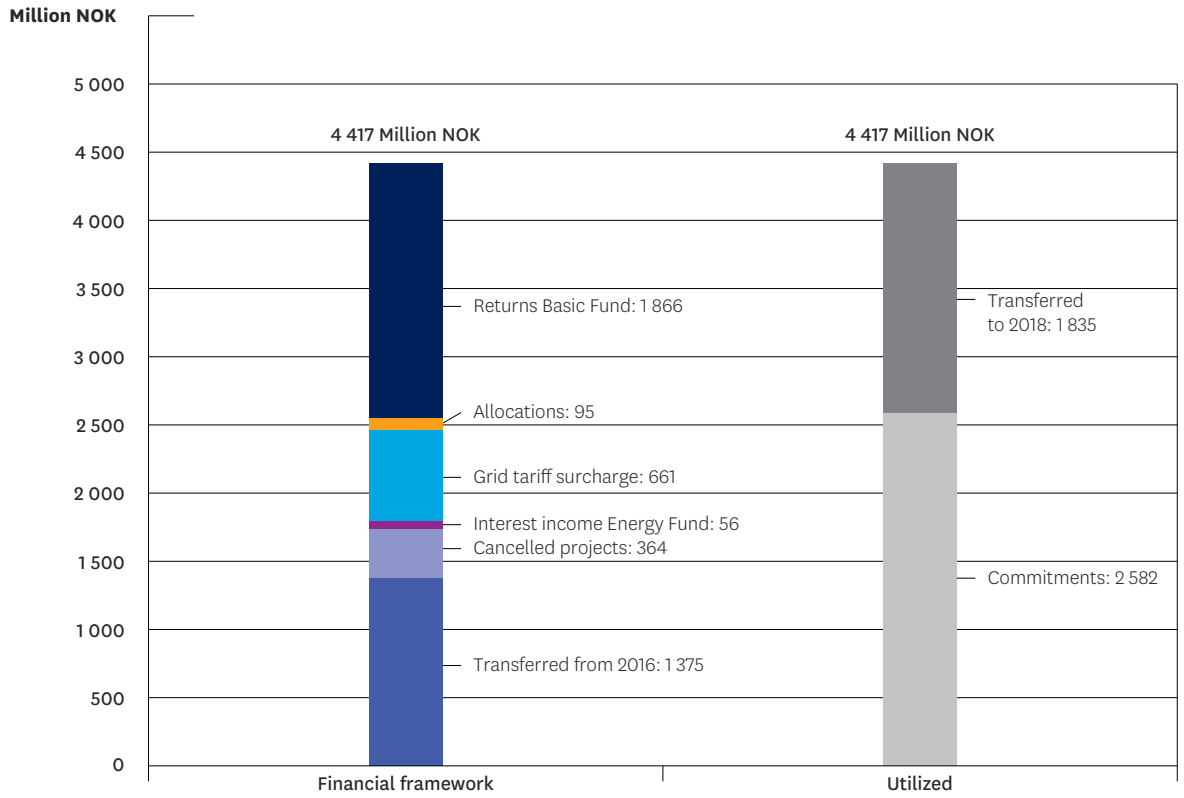


Figure 3.1: *The figure is a presentation of the Energy Fund's various sources of revenue and how revenue is managed. Cancelled projects and commitments does not include projects that were adopted and cancelled in 2017.*

Starting with 2018, the Fund for climate, renewable energy and energy restructuring will be phased out and the transfers to the Energy Fund will be replaced with ordinary allocations via the national budget. From this date, the Energy Fund will be renamed the Climate and Energy Fund. In the current agreement term, it has been indicated that the annual allocation to the Energy Fund will be increased to NOK 2 billion. Figure 3.2 shows an overview of allocated funds in 2017, and the development in expected available funds for the agreement term 2017-2020.

Figure 3.2

Allocations and expected available funds in the Energy Fund 2017-2020

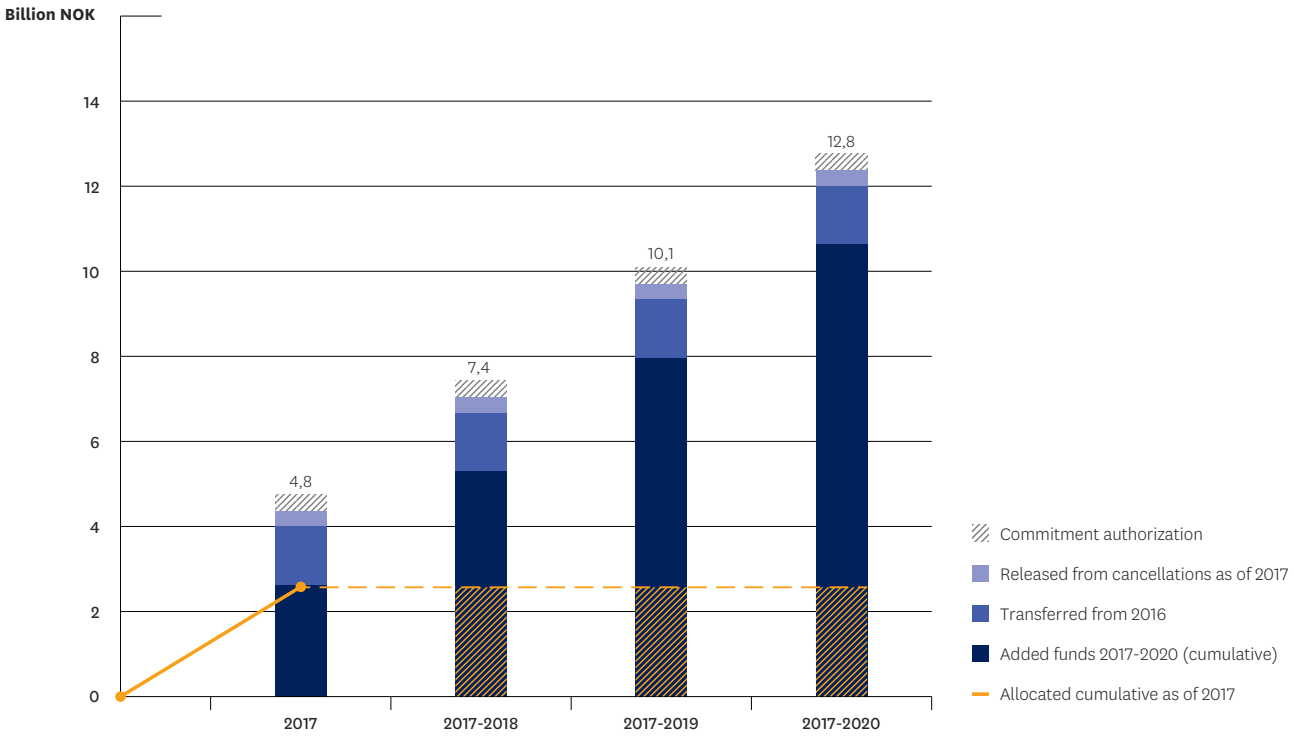


Figure 3.2: *The figure shows an overview of allocated funds from the Energy Fund in 2017, as well as expected development (cumulative) in available funds in the Energy Fund in the period 2017-2020. Added funds in 2019 and 2020 are according to agreement between Enova and the Ministry of Petroleum and Energy.*

Table 3.1

Energy Fund allocations

	2017
Sector/activity	**NOK million**
Industry	447
Transport	1 073
Energy system	192
Non-residential buildings and property	448
Households and consumers	165
International	2
Consultation and communication	58
External analyses and development measures	41
Administration remuneration	157
Total	**2 582**

Table 3.1: *The table shows funds allocated from the Energy Fund in 2017 distributed by sector, as well as other contractual activities and administration remuneration. The figures have been corrected for cancelled and final-reported projects as of 2017.*

Enova has granted funding commitments amounting to NOK 2.3 billion to projects in 2017. These projects are expected to trigger just under NOK 5 billion from the market. This will yield a total investment of more than NOK 7 billion in projects approved in 2017. About NOK 260 million is linked to annual administration remuneration for Enova for the management of the Energy Fund and other contractual activities.

Support was granted to 177 projects within the transport sector in 2017, with a total support level of about NOK 1.1 billion. This amounted to 46 per cent of the total allocations. Transport is the sector with the greatest potential for implementing climate measures outside the sector subject to quotas. The transport projects constitute the majority of the climate results in 2017, but also contribute a very significant share of the results within energy and innovation.

Non-residential buildings and property is the sector where most projects received support in 2017, with a total of 498 projects, and where support for existing buildings constitutes 235 of these. Overall, these projects received nearly NOK 450 million in support, which amounts to 19 per cent of the total allocations. The individual projects are small, but overall, this sector contributes particularly well to security of supply and somewhat to innovation.

Support was granted to 217 industrial projects in 2017. Measured in awarded support, the level is the same as for non-residential buildings and property, which is about NOK 450 million and 19 per cent of total allocation to projects. The sector is very relevant to Enova's purpose, and has a significant potential in all of the secondary goals, and particularly within innovation and security of supply. The industry projects supported in 2017 make strong contributions with results in all performance indicators. The sector triggers the biggest innovation result, and is the second largest contributor for climate and energy results.

Projects that further develop the energy system have received just under NOK 200 million in 2017, which corresponds to about 8 per cent of allocated funds. Of the 36 projects that received support, 35 are district heating projects. This sector contributes the greatest reduced peak demand results in Enova's portfolio, and is the sector that contributes the most to pure strengthening of Norway's security of supply.

Households and consumers is an important sector for creating broad-based involvement and a focus on implementation of energy and climate measures. It is also important in an energy system perspective to develop the interplay between energy system, transport and buildings. The sector is characterized by many small projects. The most important work here is the Enova Subsidy, which constitutes about 7 per cent of allocated funds in 2017. This sector contributes both energy and climate results.

The rights-based subsidy scheme for homeowners is showing good progress, and with 8920 applications in 2017, the number of applications increased by 16 per cent from the previous year. Disbursements have increased from NOK 119 to 165 million. A completely digital application process makes it easy for homeowners to register measures and receive subsidies. User surveys show that users are very satisfied with the programme.

Activity overview

Table 3.2 shows an overview of all applications in 2017, including the Enova Subsidy. A total of 10 153 applications were received. The increase is only linked to the Enova Subsidy. A total of 9 054 projects were supported.

In certain cases within a year, there could be more decisions than applications for a programme. This is because applications that are received at the end of the year could be fully processed in the following year.

When applications do not receive support, this is usually due to one or more of the following causes:

- The projects are too profitable to receive support.
- The projects are too expensive to receive support.
- The projects do not fulfil the criteria for support.
- The projects are not sufficiently documented.

Table 3.2
Energy Fund activity overview

Sector	No. of applications	No. projects supported	Contractual support
	No.	No.	NOK Million
Industry	**262**	**217**	**447**
Full-scale innovative energy and climate technology	15	11	83
Demonstration of new energy and climate technology	1	1	0
Pilot testing of new energy and climate technology in the industry	8	7	168
Pre-project full-scale innovative energy and climate technology in the industry	7	5	24
Support for energy and climate measures in industry and plants	126	71	120
Pre-project support for energy and climate measures in the industry	13	7	4
Support for introduction of energy management in transport, industry and plants	92	115	48
Transport	**264**	**177**	**1 073**
Full-scale innovative energy and climate technology	17	15	423
Support for production of biogas and biofuel	3	2	152
Support for energy measures in ships	41	23	110
Support for energy measures in ground transport	19	6	19
Support for energy measures in plants	2	2	1
Support for introduction of energy management in transport, industry and plants	62	58	31
Support for onshore power	44	27	162
Support for infrastructure for municipal and county municipal transport services	7	5	135
Support for charging infrastructure for electric cars	65	36	11
Hydrogen infrastructure	4	3	30
Energy system	**51**	**36**	**192**
Full-scale innovative energy and climate technology	5	1	12
Demonstration of new energy and climate technology	4	0	0
District heating	42	35	179
Non-residential buildings and property	**653**	**498**	**448**
Support for energy-efficient new buildings	34	24	191
Support for new technology for the future's buildings	11	4	3
Full-scale innovative energy and climate technology	1	0	0
Support for existing buildings	295	235	196
Mapping support for existing buildings	72	61	7
Support for concept assessment buildings	68	40	28
Support for heating plants	172	134	24
Households and consumers	**8 920**	**8 123**	**165**
Enova Subsidy	8 920	8 123	165
International	**3**	**3**	**2**
IEA Main Project	3	3	2
Total	**10 153**	**9 054**	**2 326**

Table 3.2: *The table shows an overview of the number of applications received and number of projects approved for support [1], as well as contractual support within Enova's programmes in 2017. The table only shows support for eligible programmes, and not allocations for other activities in the Energy Fund.*

1 *Number of projects approved for support has been corrected for cancellations. This applies to 28 projects for the 2017 portfolio.*

Status of project portfolio

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. When a project has progressed to the point where disbursement from Enova starts, it will have passed many critical decision points and the risk of the project being cancelled declines substantially. Four per cent of the projects that were granted support in 2017 have started receiving disbursements, but have not submitted final reports yet. These projects are relatively large and constitute 14 per cent of total granted support.

Figures 3.3 and 3.4 show the status of the project portfolio measured in number of projects and support granted, respectively. Figure 3.3. shows that nearly 10 per cent of the projects supported in 2017 have already been completed, and have submitted final reports to Enova. However, Figure 3.4 shows that the support granted to these projects is a quite small amount.

It is less than 1 per cent of the total support that was granted in 2017. This is natural, since it is the smallest projects that can be completed during the same year that they received support from Enova.

Most projects are active. This means that a support decision has been made and that the project is not finalized. This group constitutes 85 per cent of the project portfolio.

Some of the projects that receive support are cancelled, for example due to changed preconditions during the period from when the application was submitted until the start-up decision. Only 3 per cent of the projects were cancelled over the past year, and they only represented 1 per cent of the total granted support. We must expect that there could be cancellations in the portfolio in the upcoming year as well. The support that is earmarked for the project is then released for use in new projects.

Figure 3.3

Status of project portfolio, measured in number of projects

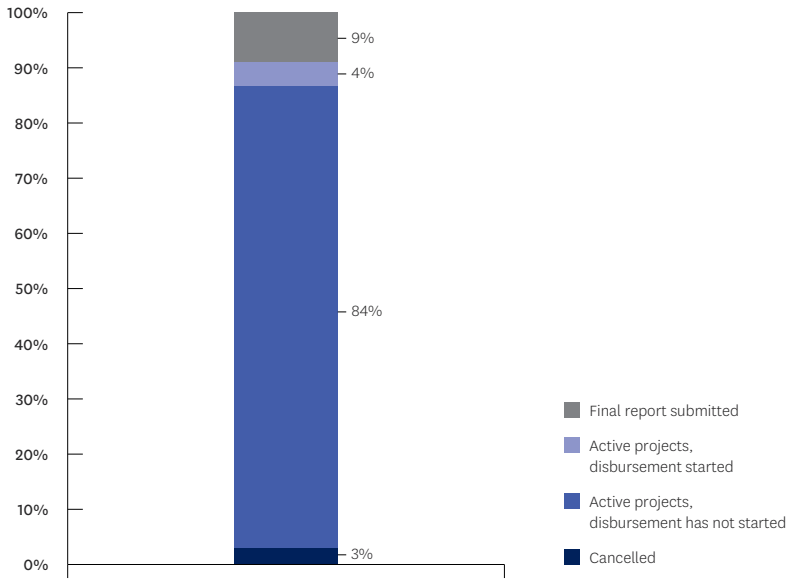


Figure 3.3: *The figure shows the percentage of final-reported, active and cancelled projects at the end of 2017, measured in the number of projects. The figure also shows the percentage of active projects where disbursement has started.*

Figure 3.4
Status of project portfolio, measured in contractual support

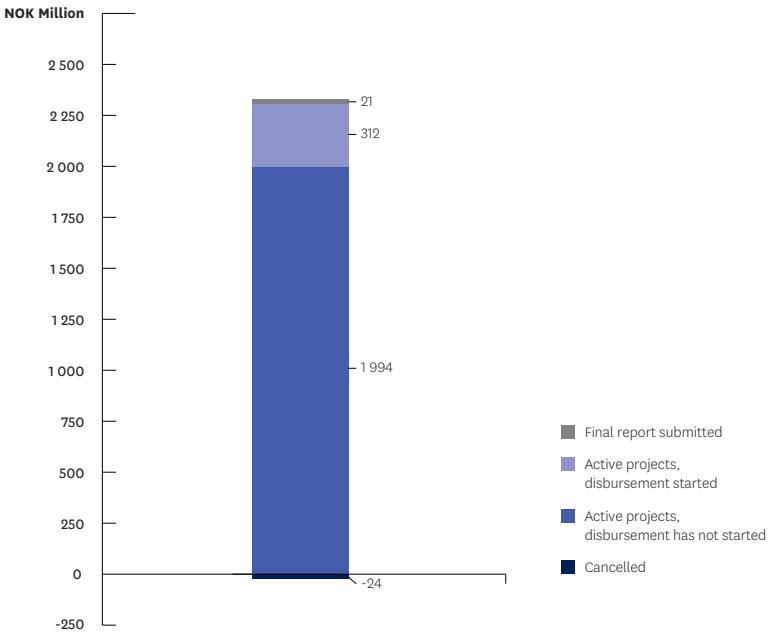


Figure 3.4: *The figure shows a status for projects approved in 2017 at the end of the year, measured according to contractual support. The figure shows the percentage of support granted that is related to final-reported, cancelled and active projects.*

Figure 3.5 shows a distribution of the project portfolio according to the size of support granted. We see that most projects are granted less than NOK 1 million and that these 675 projects amount to a relatively small share of the allocated funds, NOK 182 million. The 243 projects that are granted support between NOK 1 and 10 million received a total of NOK 723 million, about 33 per cent of total allocated funds. About 4 per cent of the projects were granted more than NOK 10 million in support and amount to about 55 per cent of the total support.

Figure 3.5
Projects distributed according to contractual support

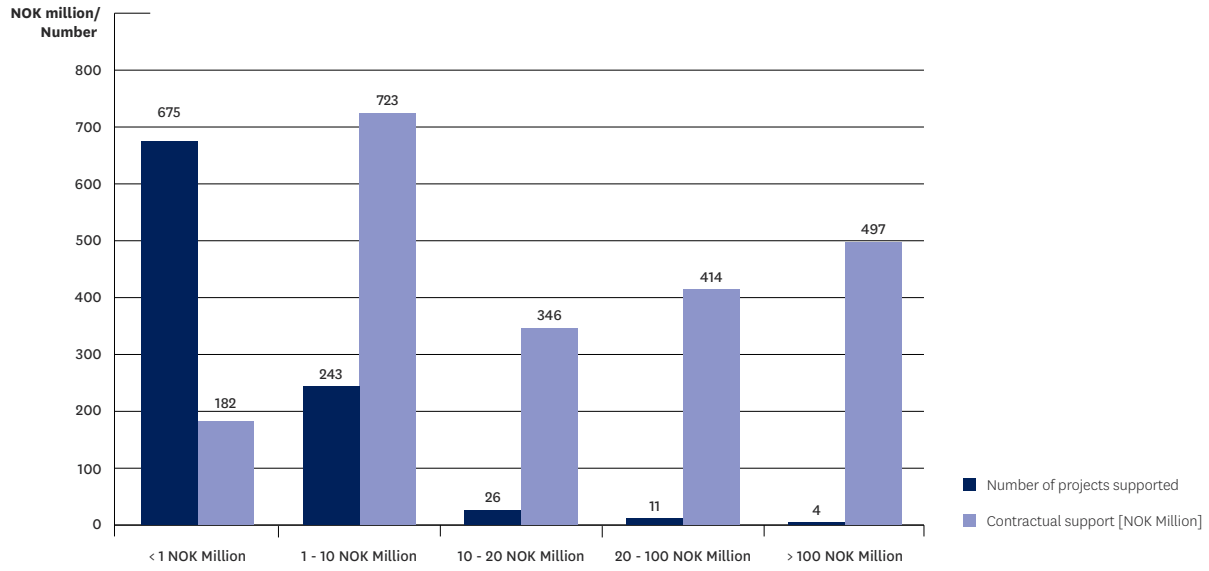


Figure 3.5: *The figure shows a distribution of projects that were granted support in 2017 grouped according to funding level. The Enova Subsidy is not included in this overview.*

Figure 3.6 shows a distribution of the project portfolio according to contractual end date. There is a correlation between the size of the project and its implementation time. Small projects normally have a much shorter implementation time than large projects. Small projects are usually related to energy management and smaller measures in buildings and industry, while the large projects involve significantly more engineering and investments in physical measures. Naturally, these require more time to complete.

It is expected that 75 per cent of the projects will be completed by the end of 2018. These small projects make up 35 per cent of the total support. By the end of 2020, about 97 per cent of the supported projects are expected to be complete.

Nearly 20 per cent of the support funds has been granted to projects that take longer to complete and will not be completed until 2021 or later. This represents a small number of projects, less than 3 per cent.

Enova is concerned with ensuring that projects that receive support follow a set and realistic schedule for project implementation. The implementation time can affect the risk of external factors changing for the project, and thus affect the risk of implementation.

Figure 3.6
Projects distributed according to contractual end date

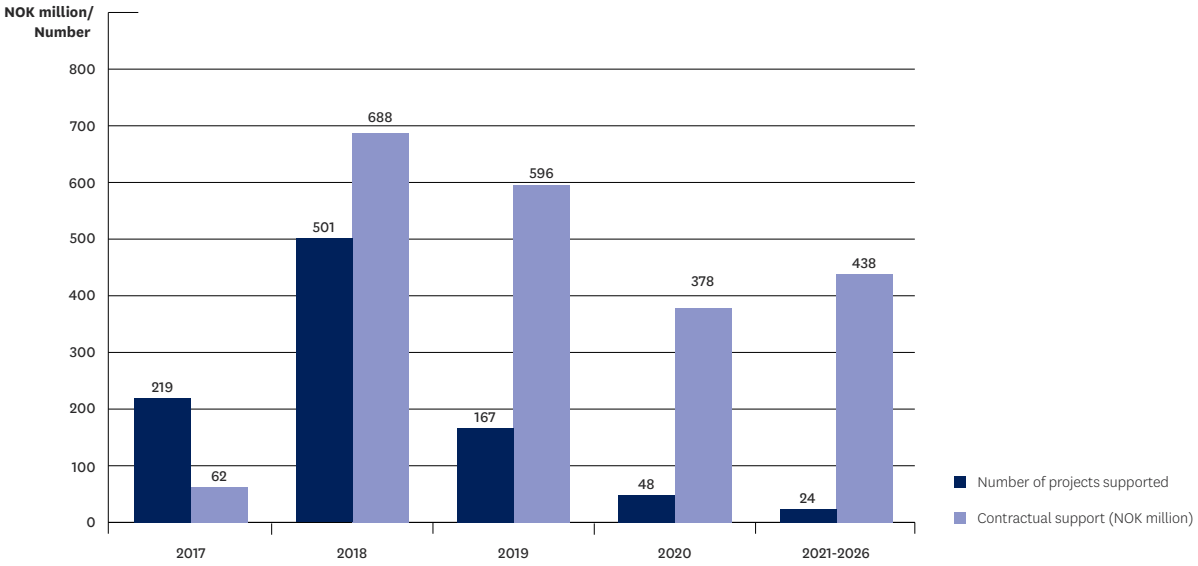


Figure 3.6: *The figure shows a distribution of projects started in 2017 distributed according to contractual end date for the projects. The Enova Subsidy is not included in this overview.*

Aktivities

The Enova Subsidy

Enova has granted support to more residential projects in 2017 than in previous years. More than 8 123 subsidies were disbursed last year. Many households carry out multiple measures at the same time. Liquid-to-water heat pumps and air-to-water heat pumps each represented 20 per cent of the subsidies over the past year, followed by retrofitting of balanced ventilation (14 per cent) and heat management systems (13 per cent). This ranking of measures is identical to that of the previous year.

The most extensive and energy-conserving individual measure is upgrading the building structure. 330 such subsidies were disbursed in 2017, which is a 65 per cent increase from 2016.

In 2020, use of fossil oil for heating will be prohibited. Through the Enova Subsidy, homeowners can receive support for removing oil burners and oil tanks while switching over to a heating solution based on renewable energy sources. The scheme will be gradually phased out leading up to 2020. In 2017, 1 044 homeowners received support for this, which is a 20 per cent increase from the previous year.

Figure 3.7

Number of subsidies within the Enova Subsidy, distributed by measure

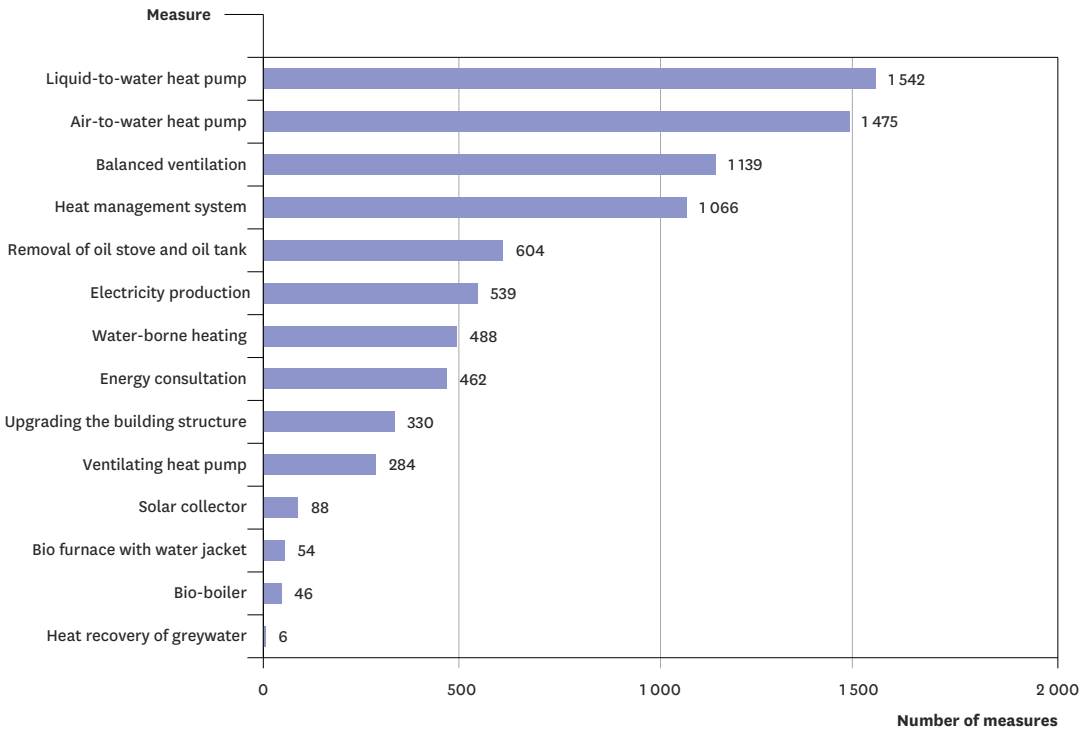


Figure 3.7: *The figure shows the number of subsidies within the Enova Subsidy in 2017, distributed according to measure. 1 044 households that received reimbursement for conversion to a heat pump, bio-boiler or bio-furnace also received subsidies for removal of oil boilers and tanks.*

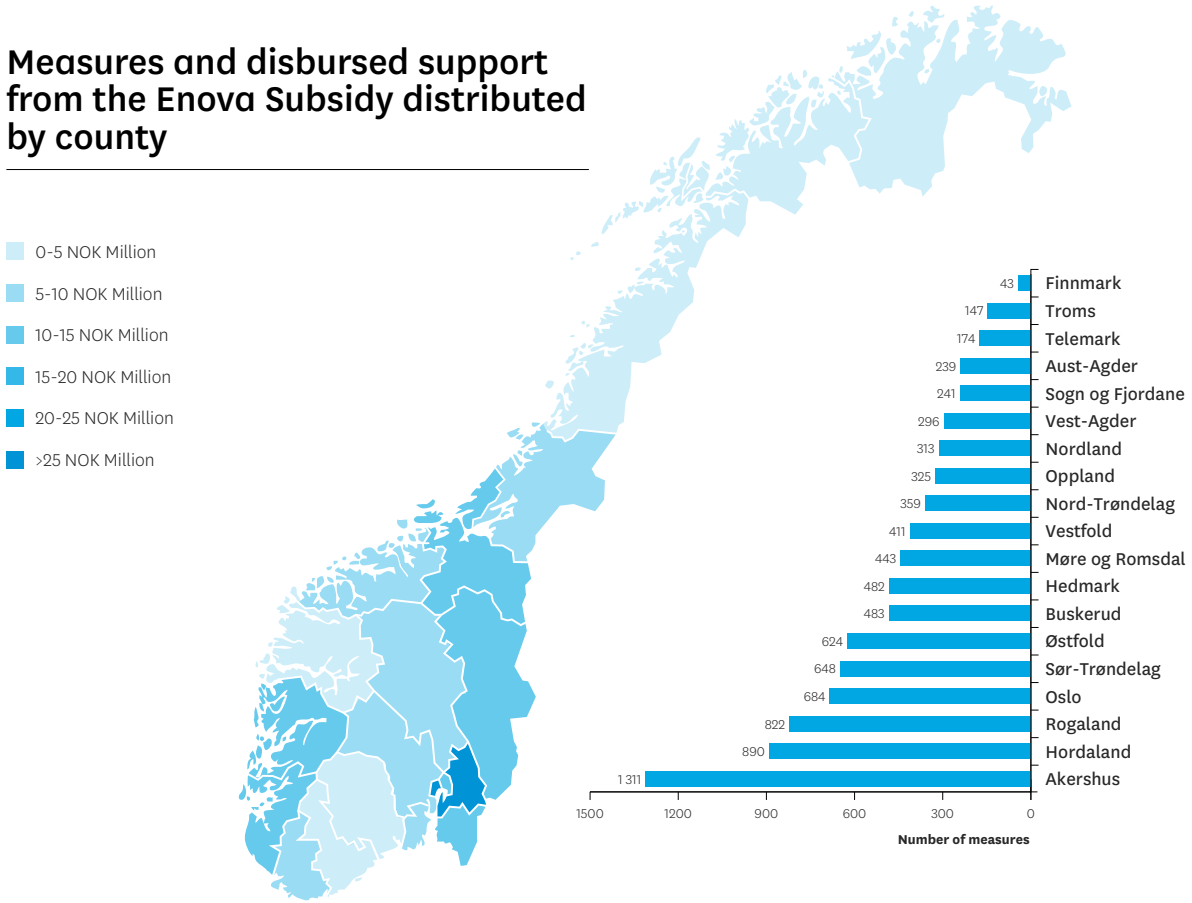


Table 3.3
Nationwide information services

Activity	Purpose of activity	2017
Ask Enova	Nationwide information and consultation via telephone, email and online chat to support the objectives of the Energy Fund.	**58 609**
Private individuals		43 573
Commercial players		15 036
Enova.no[1] (page views per day)	Information about Enova's services and consultation concerning energy and climate measures	**5 722**
Enova Subsidy (private market)		3 754
Commercial share		1 968

Table 3.3: *The table shows the number of inquiries to Ask Enova and number of page views per days for Enova's website.*
1 *Figures for Enova.no do not include application centre, registration portal and press centre.*

Enova provides advisory services for both commercial players and private individuals. For private individuals, there is a focus on the need to acquire information at an early stage in the decision phase before a project, as well as assistance with the actual application process. The advisory services are provided through a dedicated website and through the Ask Enova service.

Ask Enova received about 58 000 inquiries in 2017. This is on par with the previous year. There is a general interest in increasing energy efficiency and conversion to renewable energy sources in the population, questions concerning the Enova Subsidy, response to Enova's services. Enova's campaigns and questions from commercial players related to Enova's services.

Enova safeguards the operation and development of the Energy Certification Programme and programme for energy assessment of technical facilities. The goal of the programme is to provide relevant and well-facilitated information about energy standard and potential energy efficiency measures. The programme aims to be a useful tool for the players in the construction sector. Operation of the programme was transferred from the Norwegian Water Resources and Energy Directorate (NVE) in 2016. The purpose of the transfer was to further develop the programme and view it in context with other policy instruments.

Performance indicator for climate

Enova shall promote the reduction of greenhouse gas emissions that helps fulfil Norway's climate commitment for 2030.
The climate result is the sum of changes in greenhouse gas emissions as a result of various measures in the projects which Enova has supported. The calculation uses emission coefficients for the different energy carriers involved as a basis. The climate result is measured in tonnes of CO_2 equivalents per year. The conversion to tonnes of CO_2 equivalents takes place using internationally recognized GWP factors (Global Warming Potential).

In 2017, Enova supported projects that are expected to yield reductions of about 310 000 tonnes of CO_2 equivalents per year. When viewed in relation to the performance indicator of 750 000 tonnes of CO_2 equivalents, the climate result for 2017 is considered good, and constitutes 41 per cent of the level for the agreement term.

Figure 3.8
Development in climate results

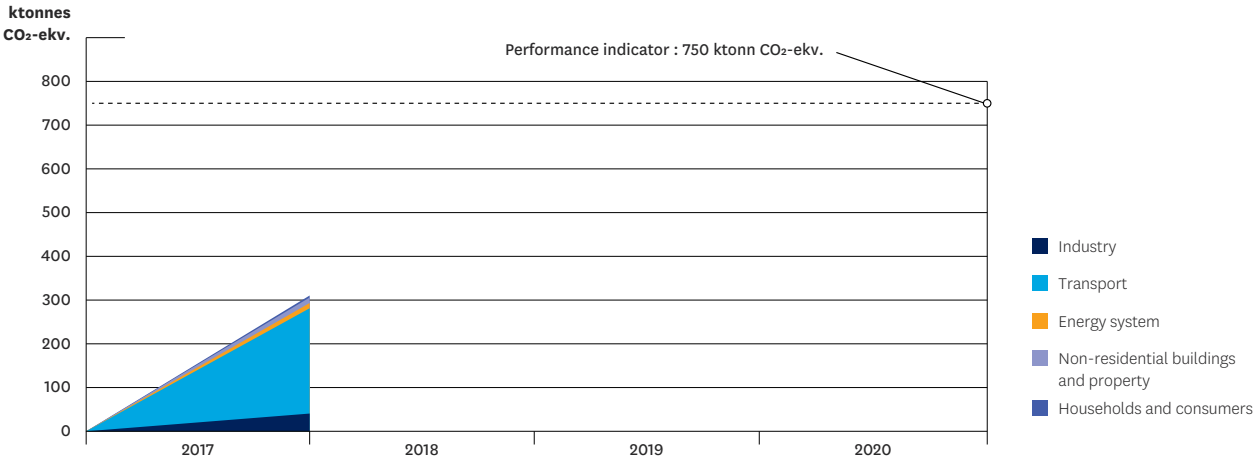


Figure 3.8: *The figure shows expected climate results (ktonnes CO_2 equiv.) in projects that were granted support from the Energy Fund in 2017. The results are from projects in non-quota facilities. For emission reductions subject to quotas, see Table 3.5.*

Greenhouse gas reductions of 240 000 tonnes of CO_2 equivalents come from the transport sector, distributed among about 130 individual projects. The majority of these results come from the maritime part of the sector, including maritime offshore, onshore power and ferries. Thirty-five per cent of the results are related to projects within new energy and climate technology.

A total of 139 industry projects are expected to yield annual reductions of about 40 000 tonnes of CO_2 equivalents. The largest share is related to energy and climate measures in industry, including aquaculture facilities and wood processing. These projects contribute about 30 000 tonnes of CO_2 equivalent reductions per year. Other climate results are related to energy management projects, which constitute 70 per cent of the projects and 26 per cent of the climate result.

Table 3.4
Climate results

	2017
Sector	**ktonnes CO_2 ekv.**
Industry	41
Transport	240
Energy system	12
Non-residential buildings and property	12
Households and consumers	5
Total	**310**

Table 3.4: *The table shows the climate result (CO_2 equiv.) from projects in non-quota facilities that were granted support in 2017. The results are distributed according to sector.*

Enova also supports measures that contribute to security of supply and innovation in facilities that are subject to quotas, and climate results from these measures are calculated. Such measures will contribute a reduction of 15 000 tonnes of CO_2 equivalents per year. In the short term, reduced emissions in one location could lead to increased emissions at another location, since the total emissions are determined within the quota system. The emissions covered by a quota requirement within the EU's quota system are therefore not included in Enova's climate results. Table 3.5 shows the number of projects and reduced greenhouse gas emissions in facilities that are subject to quotas.

Table 3.5
Emission reductions that are subject to quotas

	No. of projects	Climate result
Subject to quotas (EU-ETS)	No.	ktonnes CO_2 ekv.
Subject to quotas	**41**	**15**
Industry[2]	28	13
Transport	2	1
Energy system	6	1
Non-residential buildings and property [2]	5	-
Not subject to quotas	**890**	**306**
Total	**931**	**321**

Table 3.5: *The table shows the number of projects in 2017 where Enova supported measures at facilities subject to quotas (1) in accordance with the EU Emissions Trading System (EU-ETS), as well as support granted and climate result (CO_2 equiv.). The Enova Subsidy is not included in the overview (8123 measures overall 4.6 ktonnes CO_2 equiv.).*

1 *http://www.norskeutslipp.no/no/Komponenter/Klimakvoter/Kvoteutslipp/?ComponentType=kvoteutslipp#*
2 *Three of the five projects within non-residential buildings and property and six of the 28 projects within industry are assessment projects that do not yield direct climate results.*

Projects related to infrastructure

Enova shall contribute to the development of fuel infrastructure for emission-free ground and maritime transport, including electric and hydrogen. We also have a rights-based programme for support for publically available charging infrastructure for electric cars.

In 2017, we supported 27 onshore power projects along the coast from Finnmark in the north to Telemark and Buskerud in the south. This support totaled NOK 162 million. Another five projects were also supported in the amount of NOK 135 million related to infrastructure for municipal and county municipal transport services. The majority of the support, NOK 131 million, went to projects related to ferry infrastructure.

Three projects related to hydrogen infrastructure in Akershus and Oslo were supported. Another 36 projects related to charging infrastructure for electric cars were supported over the last year, distributed among 13 counties from Nord-Trøndelag and southward. Forty per cent of these are established in Western Norway.

Table 3.6
Enova's services aimed at fuel infrastructure for emission-free ground and maritime transport

Programme	No. of projects	Contractual support	Energy result[1]	Climate result[1]
	No.	NOK million	GWh	ktonnes CO_2 ekv.
Onshore power	27	162	110	29,4
Support for infrastructure for municipal and county municipal transport services	5	135	59	15,6
Hydrogen infrastructure	3	30	-	-
Support for charging infrastructure for electric cars	36	11	-	-
Totalt	**71**	**339**	**169**	**45,0**

Table 3.6: *The table shows the number of projects that were granted support within Enova's programmes aimed at emission-free ground and maritime transport in 2017. Energy and climate results are not calculated for hydrogen infrastructure and Support for charging infrastructure for electric cars.*

1) For onshore power, an annual theoretical energy and climate potential is calculated based on the port's call statistics, the vessels' average capacity demand and potential connection time at port.

Performance indicator for innovation

Enova shall promote increased innovation within energy and climate technology adapted to the transition to the low-emission society. ***Innovation results*** are recorded from projects that contribute to increased innovation within energy and climate technology, and these results are measured in triggered capital in NOK. Triggered capital means the part of the project's investment costs that is triggered through Enova's support, i.e. investment costs less support from Enova and other public players.

The goal of the technology projects is to harvest experience that contributes to knowledge development, innovation and dissemination of technology both nationally and internationally.

Enova offers support for technology projects in all sectors.

Many project owners still express that it is challenging to obtain risk capital. The support will contribute to triggering projects and investment in new technology development.

Enova invested a total of NOK 0.9 billion in projects within new energy and climate technology in 2017. We have found the response to the programmes to be satisfactory and that there is a willingness to innovate and develop technology in the market. The support is expected to trigger NOK 1.7 billion in the form of private innovation capital.

Compared to the performance indicator of NOK 4 billion during the agreement term, the results in 2017 are good and constitute 43 per cent of the level for the period.

Figure 3.9
Development in triggered innovation capital

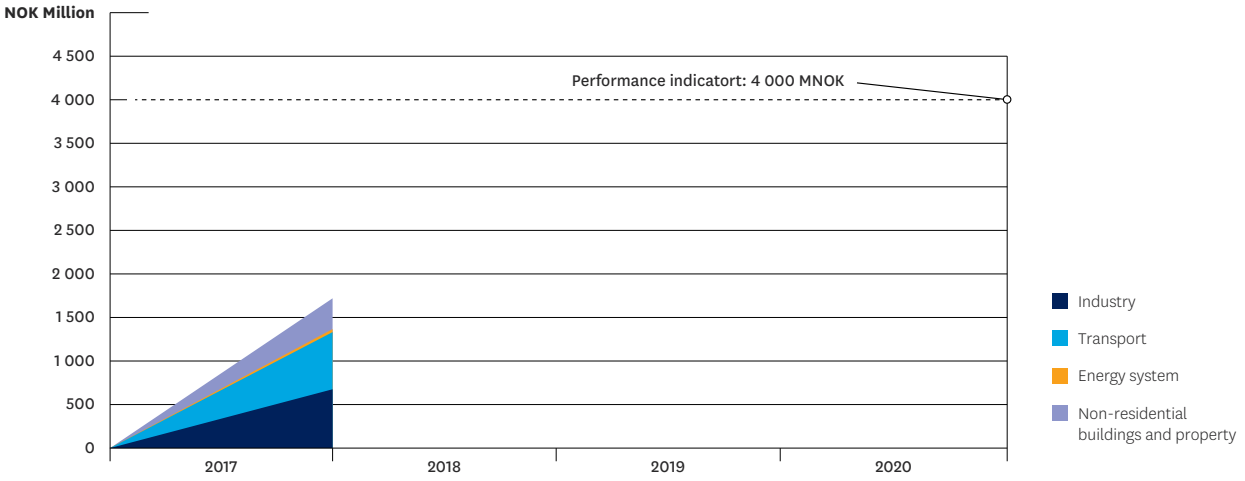


Figure 3.9: *The figure shows expected triggered innovation capital (NOK million) in projects within new energy and climate technology that were granted support from the Energy Fund in 2017.*

Projects within industry and transport triggered the most innovation capital in 2017. Each of these sectors represent about 40 per cent of the result, while non-residential buildings and property projects constitute about 20 per cent.

The 24 technology projects within industry represent a diverse range of industrial activity.

There are 15 technology projects within transport that contribute to the results, primarily from the maritime sector.

Energy-efficient new buildings, 24 projects, make up the majority of the results within non-residential buildings and property.

Table 3.7
Triggered innovation capital

Sector	2017 NOK million
Industry	676
Transport	657
Energy system	35
Non-residential buildings and property	354
Households and consumers	-
Total	**1 720**

Table 3.7: *The table shows expected triggered innovation capital (NOK million) in projects that were granted support in 2017, distributed by sector.*

The pilot projects within industry and full-scale projects within transport trigger the largest share of the innovation capital. These are challenging projects, requiring a lot of effort on the part of the players to implement and they depend on support for realization. Enova's technology programmes shall contribute to reducing technological risk and the technology cost of new innovative technology, so that the technology is assisted from the development stage and out into the commercial market.

Projects within buildings and plants constitute 68 of the 108 supported projects. Support for concept assessment buildings makes up 40 of these. These projects trigger a very small percentage of the private innovation capital, but are important for future potential projects. Some innovation projects are stranded at the idea stage because their associated uncertainty is too great. Through the concept assessment service, we enable the players to conduct more comprehensive planning before a final investment decision is made for innovative solutions.

Table 3.8
Support for new energy and climate technology

Sector	No. of projects supported No.	Contractual support NOK million
Industry	**24**	**275**
Full-scale innovative energy and climate technology	11	83
Demonstration of new energy and climate technology	1	0
Pilot testing of new energy and climate technology in the industry	7	168
Pre-project full-scale innovative energy and climate technology in the industry	5	24
Transport	**15**	**423**
Full-scale innovative energy and climate technology	15	423
Energy system	**1**	**12**
Full-scale innovative energy and climate technology	1	12
Non-residential buildings and property	**68**	**221**
Support for energy-efficient new buildings	24	191
Support for new technology for the future's buildings	4	3
Support for concept assessment buildings	40	28
Total	**108**	**931**

Table 3.8: *The table shows the number of projects and contractual support (NOK million) within new energy and climate technology in 2017, distributed by sector.*

Table 3.9
A selection of the largest projects within new energy and climate technology

Project owner	Project description	Approved support [NOK million]	Energy result [GWh/year]
Industry			
Silva Green Fuel	Pilot plant that will test new technology for production of second-generation biofuel from wood.	117	4
Normag AS	Construction of a complete 6 m3 pilot for production of "high-end" precipitated HDS silica and Mg Cl2 that will be used for production of magnesium and re-use of existing equipment from the former Hydro Magnesium Herøya.	20	0
Elkem AS, dep. Salten verk	Implementation of new technology at Salten verk with the main objective of increasing the profits within the finishing area.	16	22
Transport			
Yara Norge AS	Establishment of autonomous and fully-electric logistics concept for shipping containers from production hall at Herøya to terminals in Breivik and Larvik. The unmanned container ship "Yara Birkeland" is key in this solution.	134	3
Teekay Norway As	New design with objective of reducing fuel consumption and total environmental impact.	133	153
North Sea Giant AS	Realize solutions that take the current hybrid offshore vessels one step further with the latest within battery technology in maritime applications.	37	20
Energy system			
Brødrene Dahl AS	Realization of a new type of turn-key power plant that responds to the most important challenges within development of small-scale power.	12	4
Non-residential buildings and property			
Statsbygg	New research and education building belonging to UiO, consisting of a primary part with a basement floor and four floors above ground. The building is a major project with an area framework of 66 700 m².	32	12
Kultur- og idrettsbygg Oslo KF	Passive house ice hall that will replace the old Jordal Amfi (1951). The new Jordal Amfi will be able to seat about 5500 people, and will be built according to the current requirements for a national and international ice hockey arena.	23	4
Ruseløkkveien 26 AS	VIA will become a new office building of nearly 54 000 m². The building will be equipped with smart management of the energy systems and an energy solution that delivers efficient heating and cooling.	19	5

Table 3.9: *The table shows a selection of the largest projects within new energy and climate technology that were granted support in 2017. Approved support and contractual energy result have been corrected for final-reported results.*

Climate result [tonnes CO_2 eqv./year]	Project status	Innovation
1 065	Engineering	· The plant uses a technology that is called Hydrothermal Liquefaction (HTL), which efficiency converts chips to bio-oil, which can be further upgraded to other fuel qualities · The plant will be the largest of its kind in the world · The plant will be used to prove continuous operations and thus reduce the risk associated with scaling up to commercial-scale plants · The plant can also be used to test other organic raw materials
0	In progress	· SilMag technology with olivine as raw material
3 429	In progress	· Recycling of silicon from by-product flows, through use of new technology
772	Engineering	· "Yara Birkeland" will be an autonomous and fully-electric container ship · Electric straddle-carriers will transport containers from the production site to quay facility · Quay facility will be upgraded with charging infrastructure and an automatic mooring option for the container ship
68 326	In progress	· Newly developed motors with use of LNG/VOC · Installation of batteries on board that will provide the vessel with a hybrid energy system that will continuously provide support to the ship's power system
5 369	In progress	· Operation of vessel in dynamic positioning with only one diesel motor running, supplemented with batteries · Battery system that is also used for "Peak shaving" and support vis-à-vis existing diesel generator to handle additional load in the system · Arrangement for vessel to use onshore power at quay and for mobilisation
0	In progress	· Turbines adapted to small-scale and micro power plants located below ground that result in considerable noise reduction · Intake with short clearance which makes the water grating unique with regard to surroundings and fish. The intake is self-cleaning which leads to low operating expenses · Robust pipes that can be installed in the pipe rack without addition of gravel
1 288	Engineering	· Comprehensive solutions where known technology is composed in new ways · Daily storage tanks with phase change material for storage of heating and cooling · Highly efficient heat recovery unit in laboratories that combines traditional heat recovery and heating battery by connecting the heat exchanger in the recovery circuit · Advanced and flexible system for energy follow-up connected to SD system
187	Engineering	· Thermal storage in energy wells and free cooling · Optimized comprehensive energy systems for reduced energy demand, heat recovery/storage and needs-based management · Innovative, energy-efficient ventilation concept in the arena room · CO_2 refrigeration plant · CO_2 as secondary medium in the track bed in the arena · Sedum roof that reduces the cooling demand in the ice hall
100	In progress	· Smart regulation and monitoring of energy systems via cloud solution · Measures in the building structure that far exceed the passive house requirements · Efficient ventilation with short channels · Heat recovery from transformers, retention basin and cooling production

Table 3.9 provides information on results, the status of project implementation and innovation for a selection of the largest projects within new energy and climate technology that received support in 2017. More information about these types of projects, including the status for expertise development and realized dissemination of technology, can be found on Enova's website; enova.no.

Table 3.10

Largest projects within new energy and climate technology, measured according to contractual support.

Project owner	Project	Programme	Sector	County	Contractual support [NOK million]
Yara Norge AS	Zero emission logistical solution	Full-scale innovative energy and climate technology	Transport	Telemark	134
Teekay Norway AS	New Shuttle Spirit	Full-scale innovative energy and climate technology	Transport	Rogaland	133
Silva Green Fuel AS	Biofuel Demo Plant Tofte	Pilot testing of new energy and climate technology in industry	Industry	Buskerud	117
Color Line Transport AS	Color Hybrid. Energieffektiviseringstiltak	Full-scale innovative energy and climate technology	Transport	Vestfold	50
North Sea Giant AS	Hybridisering av North Sea Giant	Full-scale innovative energy and climate technology	Transport	Hordaland	37
Statsbygg	Livsvitenskapbygget UIO	Support for energy-efficient new buildings	Non-residential buildings and property	Oslo	32
Kultur- og idretts-bygg Oslo KF	Nye Jordal Amfi	Support for energy-efficient new buildings	Non-residential buildings and property	Oslo	23
Nordic Pharma Inc AS	Grønn Separasjon-Blå Ressurs	Full-scale innovative energy and climate technology	Industry	Troms	20
Normag AS	Pilotering av ny energi- og klimateknologifor produksjon av magnesium og silika med olivin som råvare	Pilot testing of new energy and climate technology in industry	Industry	Telemark	20
Ruseløkkveien 26 AS	VIA -Ruseløkkeveien 26	Support for energy-efficient new buildings	Non-residential buildings and property	Oslo	19

Table 3.10: *The table shows the ten largest projects within new energy and climate technology in 2017 measured according to contractual support.*

Table 3.10 shows the largest projects within new energy and climate technology that Enova supported in 2017. The overview shows a generally good spread, both geographically and between sectors.

Three projects received more than NOK 100 million in support. Two of these are related to new solutions within maritime transport, while the third relates to a pilot plant for industrial production of biofuel.

Performance indicators for energy and demand

Enova shall promote strengthened security of supply through flexible and efficient demand and energy consumption. Enova records ***energy results*** for the projects it supports. Energy results measure what the projects deliver per year, either through more efficient consumption of energy, increased production and/or use of renewable energy. Energy results are measured in kilowatt-hours (kWh). Enova can also record ***reduced peak demand results*** for projects that yield a reduced peak demand and increased flexibility in the power system. This e.g. includes measures that can limit winter loads and reduce short-term peak loads. Reduced peak demand results are measured in kilowatts (kW).

Security of supply means that society has secure access to the energy it requires – the desired quantity at the correct time at a predictable and sustainable cost. There are many aspects to security of supply. In the long term, we want access to energy sources that ensure sustainable growth and welfare – energy security. In the shorter term, elements related to electricity are emphasized, based on a desire for the security of good delivery quality and sufficient capacity available. As a society, we want to avoid interruptions in the electricity supply, because this could entail major societal costs. In the low-emission society, it is presumed that oil and gas production must largely be replaced

by other value creation, for example land-based power-intensive industry, to be able to maintain the prosperous welfare level in our society. A safe, efficient and renewable energy supply is crucial for achieving this.

Improvement of the long-term security of supply is measured in the form of energy volume (kWh), while we measure improvement of the short-term security of supply in the form of reduced demand in the power grid (kW). In 2017, Enova supported projects that are expected to yield 1.9 TWh in energy results and 133 MW in reduced peak demand results.

Energy results

The energy result of 1.9 TWh is considered good in relation to the performance indicator of 4 TWh over the course of the agreement term, and amounts to 46 per cent of the level for the term.

Figure 3.10
Development in energy results

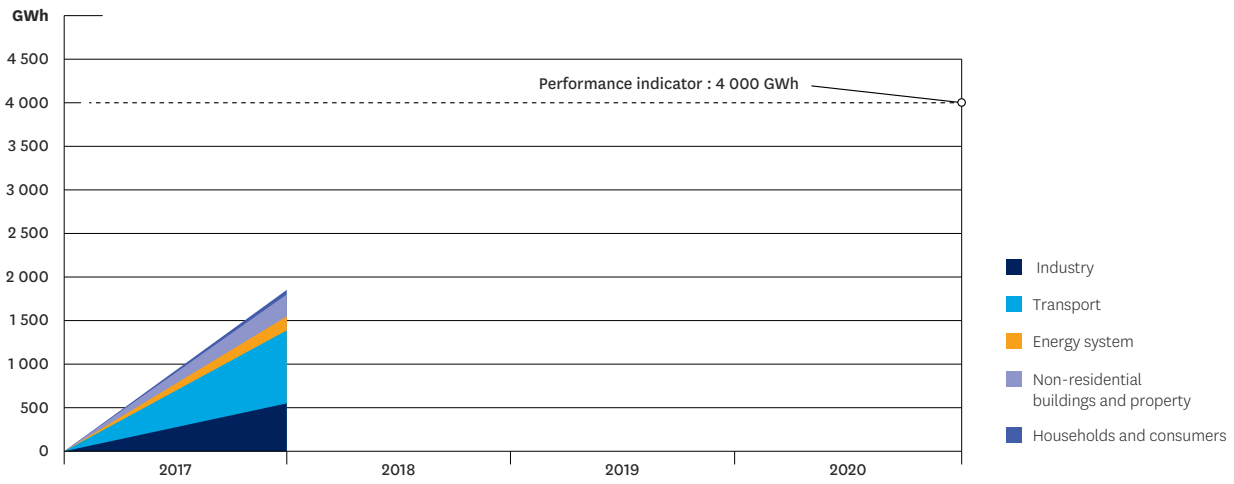


Figure 3.10: *The figure shows expected energy results (GWh) in projects that received support from the Energy Fund in 2017.*

The largest energy results come from the transport sector with 45 per cent, and the majority of this is linked to the maritime sector and production of biogas and biofuel. Of the 137 transport projects, 42 are related to energy management. Energy management deals with specifying the actions that each company can take to optimize energy use, operating costs and reducing emissions in the enterprise. The knowledge that the company gains through the mapping provides a good basis for assessing further energy and climate measures in the company.

Industry accounts for 30 per cent of the energy results. Of the 200 industry projects, energy management represents half and 55 per cent of the result. The industry projects yield the highest energy result in relation to support level in 2017.

The results within non-residential buildings and property account for 14 per cent, and the majority of the results from the nearly 400 projects come from measures in existing buildings.

Table 3.11
Energy results

	2017
Sector	**GWh**
Industry	554
Transport	838
Energy system	161
Non-residential buildings and property	254
Households and consumers	52
Total	**1 859**

Table 3.11: *The table shows expected energy results (GWh) for projects that received support in 2017, distributed by sector.*

The projects supported by Enova can be divided into four categories; production, energy efficiency, distribution and conversion.

Production projects include all projects where electricity or renewable heating is produced, either for sale or internal use. Establishment and expansion of district heating plants involves development of new infrastructure, and these projects are categorized as distribution projects.

Conversion projects involve changing energy carrier from electricity or fossil energy carriers to renewable energy carriers, for example based on bio-energy. A project that is converting from one energy carrier to another often comprises both conversion and increased energy efficiency. One example is electrification within transport, where diesel is replaced with electricity. An electric motor has a higher efficiency than the diesel engine. Enova therefore calculates an energy result related to the conversion from diesel, and an energy result from increased energy efficiency when an electric motor is used instead of a diesel engine.

Energy efficiency accounted for 70 per cent of the energy result in 2017, and has for many years been the most important energy result category. Table 3.12 shows how different types of energy results are distributed in each sector.

Table 3.12
Energy result distributed by project category

Sector	Energy efficiency	Production	Distribution	Conversion
	GWh	GWh	GWh	GWh
Industry	487	14	0	53
Transport	625	134	0	79
Energy system	0	7	155	0
Non-residential buildings and property	173	11	0	70
Households and consumers	13	3	0	36
Total	**1 298**	**168**	**155**	**239**

Table 3.12: *The table shows expected energy results (GWh) in 2017 distributed by project category and sector. The figures have been corrected for cancelled projects.*

Table 3.13
Energy result within production, distribution and conversion distributed by energy carrier

Energy carrier	Energy result
	GWh
Bio-energy,	317
Biomass	*134*
Chips	*119*
Pellets and briquettes	*14*
Other bio	*47*
Heat pump	91
Electricity	81
Waste	39
District heating	13
Waste heat	11
Other renewable	4
Solar	4
Geothermal	1
Wind	-
Total	**561**

Table 3.13: *The figure shows the energy result within production, distribution and conversion distributed by energy carrier.*

Table 3.13 shows the energy result from production, distribution and conversion distributed by renewable energy carriers that Enova has supported. In total, the energy result is 561 GWh.

Increased use of bio-energy accounts for more than half of the energy delivery in 2017, with 317 GWh. The next energy carriers are heat pump and electricity, with about 15 per cent each. The energy delivery from waste combustion, at 39 GWh, is relatively low in 2017 compared with previous years. The contributions from the other energy carriers were modest in 2017.

Reduced peak demand results

The reduced peak demand result of 133 MW is considered good in relation to the performance indicator of 400 MW, and accounts for 33 per cent of the level for the agreement term.

Figure 3.12
Development in reduced peak demand results

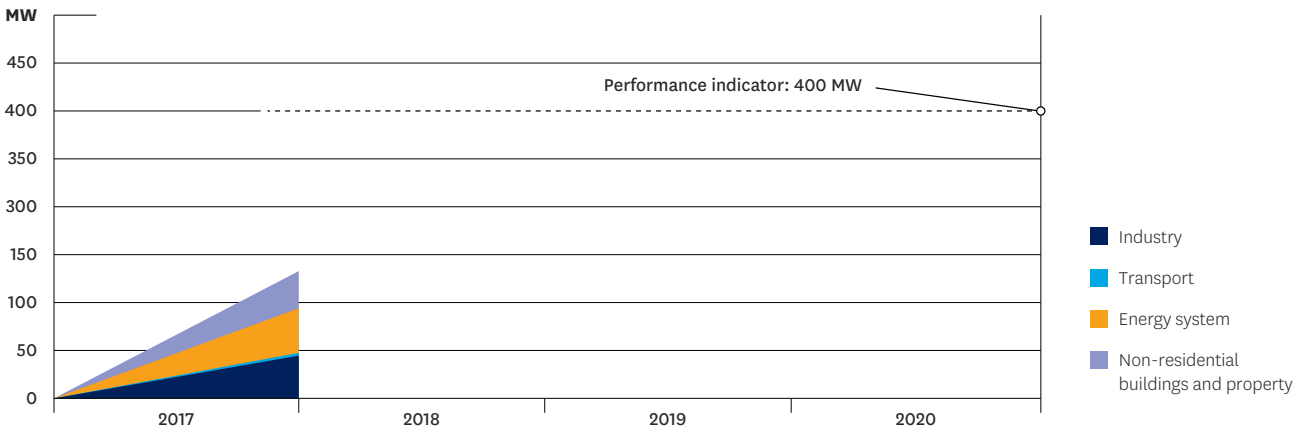


Figure 3.12: *The figure shows expected reduced peak demand results (MW) in projects that received support from the Energy Fund in 2017.*

Table 3.14 shows that the reduced peak demand results are fairly evenly distributed between the energy system, industry sector and non-residential buildings and property, each with about one-third of the result.

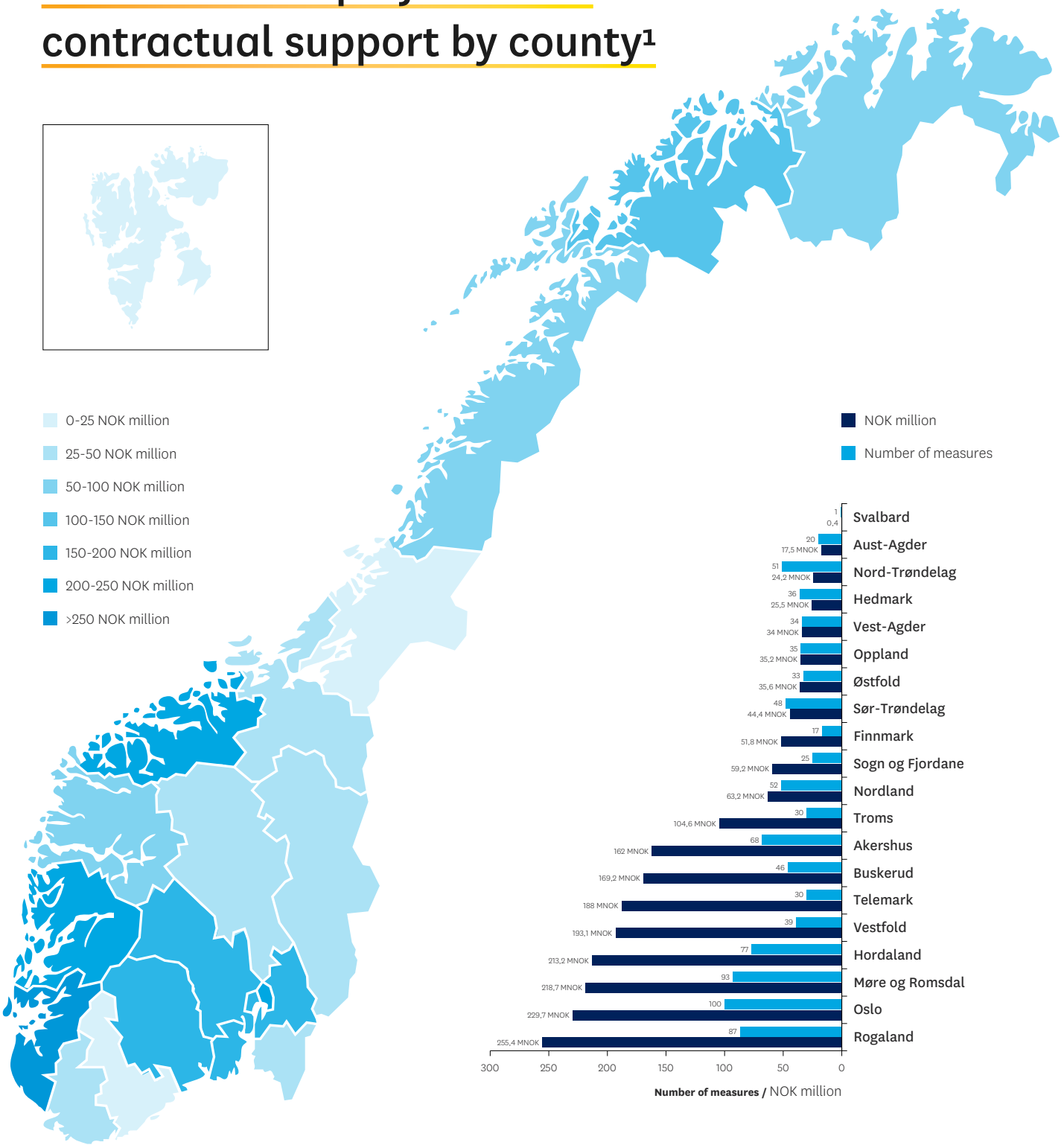
Of the 493 projects that yield reduced peak demand results, 30 are related to the energy system and involve development of district heating. For industry, 165 projects contribute a reduced peak demand result and 294 projects contribute for non-residential buildings and property. Within these sectors, the reduced peak demand results per project are relatively low, but the large volume of such projects still makes up a substantial share of the total reduced peak demand results.

Table 3.14
Reduced peak demand results

	2017
Sector	**MW**
Industry	45
Transport	3
Energy system	47
Non-residential buildings and property	39
Households and consumers	-
Total	**133**

Table 3.14: *The table shows expected reduced peak demand results (MW) for projects that received support in 2017, distributed by sector.*

Distribution of projects and contractual support by county[1]



In 2017, Enova supported more than 900 projects with a total of NOK 2.2 billion[1]. An overview and more information about these projects can be found at www.enova.no

1: : The Enova Subsidy is not included in the overview

PART III B | Reporting – Energy Fund 2012-2016

Energy results and allocations 2012-2016

Table 3.15 shows the allocation of funds from the Energy Fund and total energy results from the period 2012-2016, updated at the end of 2017, distributed by markets and year. These projects were awarded during the previous agreement term. In the event that projects are cancelled, the energy result is corrected for the year the contract was originally signed and recorded. These projects were assigned during the previous agreement term. The contractual support amount is released and returned to the Energy Fund for use in new projects.

Enova granted just under NOK 10 billion in support for energy projects during the period 2012-2016. The total private investments that this support shall trigger amounts to about NOK 25 billion. The size of Enova's subsidy varies from market to market.

Table 3.15
The Energy Fund's energy results and allocations 2012-2016

	2012		2013		2014		2015		2016		Totalt	
	GWh	NOK million	GWh	NOK million	GWh	NOK million	GWh	NOK million	GWh	NOK million	GWh	NOK million
Renewable heating	227	224	326	385	306	335	166	223	162	203	1 186	1 369
Renewable power	3	5	6	13	0,5	1	3	19	6	13	18	51
Industry	554	487	395	264	1 035	2 097	694	1 190	2 602	630	5 279	4 666
Transport	0	0	0	0	0	0	166	249	675	810	841	1 059
Non-industrial plants and facilities	21	12	12	34	31	30	62	81	22	21	149	178
Non-residential buildings	504	539	402	590	293	385	342	468	316	451	1 856	2 433
Residential buildings	24	77	26	104	19	52	92	151	46	119	207	504
International projects	-	3	-	7	-	2	-	4	-	3	-	19
Consultation and communication	-	57	-	65	-	55	-	54	-	62	-	292
External analyses and development measures	-	33	-	28	-	32	-	23	-	38	-	153
Administration	-	98	-	110	-	129	-	148	-	151	-	635
Total	**1 334**	**1 534**	**1 167**	**1 598**	**1 684**	**3 117**	**1 525**	**2 609**	**3 829**	**2 500**	**9 538**	**11 360**
Of which: :												
Ordinary energy projects	**1 327**	**1 276**	**1 112**	**1 230**	**1 542**	**1 168**	**1 147**	**1 053**	**3 621**	**1 748**	**8 749**	**6 474**
Projects within new technology	**7**	**45**	**55**	**149**	**142**	**1 726**	**378**	**1 324**	**207**	**499**	**789**	**3 743**

Table 3.15: *The table shows aggregated energy results and funds allocated from the Energy Fund during the period 2012-2016, corrected for cancelled and final-reported projects as of 2017. Projects within the programmes for new energy and climate technology are distributed in the respective markets. From 2015, the Support for biogas and biofuel programme is reported under the Transport market. This was previously reported under the Renewable heating market.*

Table 3.16
Energy results 2012-2016 distributed by markets

Market	Gross contractual result GWh	Contractual result GWh	Contractual corrected for final reported result GWh	Contractual corrected for final reported and realized result GWh
Renewable heating	1 454	1 202	1 186	1 187
Renewable power	56	20	18	18
Industry	5 231	4 919	5 279	5 279
Transport	971	849	841	841
Non-industrial plants and facilities	159	151	149	149
Non-residential buildings	2 148	1 879	1 856	1 846
Residential buildings	345	212	207	207
Total	**10 363**	**9 231**	**9 538**	**9 528**

Table 3.16: *The table shows the contractual energy result (in GWh) distributed by markets, both before and after correction for cancelled, final-reported and realized projects. The "Contractual result" column shows the energy result at the end of 2017 corrected for cancellations.*

Table 3.16 shows the contractual energy result for the period 2012-2016 distributed by market and year, before and after correction for cancelled, final-reported and realized results. Projects corresponding to about 10 per cent of the original contractual result were cancelled. We see that the contractual energy result is generally changed marginally in connection with correction for final-reported and realized results. The exemption is for industry, where the energy results are improved upon final reporting and subsequent measurement of realized results.

Figure 3.13
Percentage of final-reported projects approved during the period 2012-2016

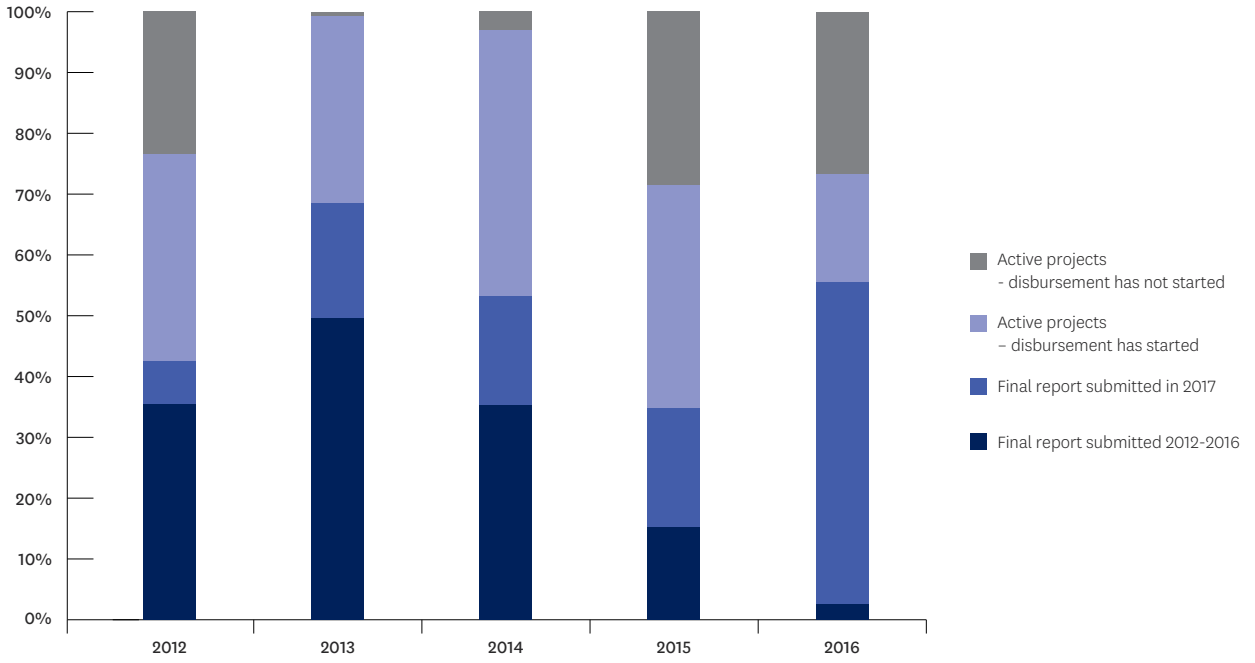


Figure 3.13: *The figure shows the percentage of final-reported and active projects at the end of 2017, distributed by approval year. The figure also shows the percentage of projects where disbursement has started. The percentages are calculated according to the projects' energy results.*

Figure 3.13 shows the percentage of final-reported projects for 2012-2016, measured according to the projects' energy results. We can see that the percentage of final-reported projects generally increases with time, this is clearly demonstrated for the period 2013-2016. For the 2012 projects, about 95 per cent of the projects have submitted final reports, but the last 4 per cent account for more than 20 per cent of the results.

The figure also differentiates between active projects where disbursement has started and active projects where disbursement has not started. The risk of a project being cancelled has turned out to be significantly lower when disbursement of support has started. Two and three per cent from 2012 and 2015, respectively, are active but have not yet received support.

For 2013 and 2014, virtually all of the projects that received support have now progressed to the stage where disbursement of support has started.

Enova actively follows up the projects' progress and completion. Systematic and good follow-up will contribute to ensuring the projects are carried out in line with the agreements. In those cases where projects will not be implemented for various reasons, close supervision ensures that the funds will not be unnecessarily struck in projects with no progress.

In 2017, about 2.9 TWh has been finally reported from projects that were approved in 2012-2016.

Figure 3.14

Realized results compared with contractual and final reported

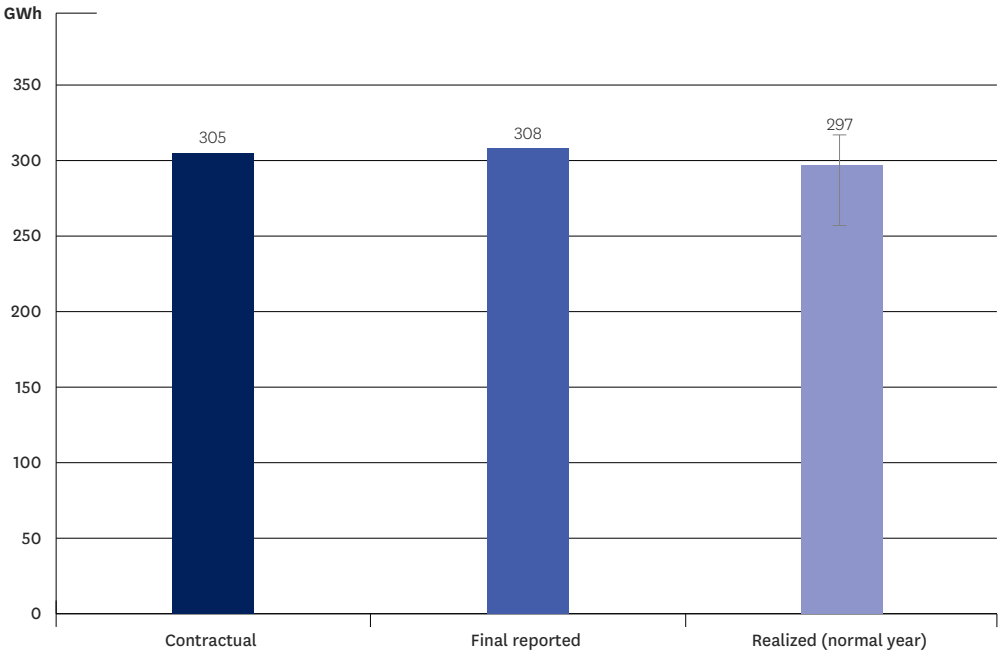


Figure 3.14: *The figure shows aggregated results as of 2017 for projects approved during the period 2012-2016 and where final reports were submitted before 31 Dec. 2014. The total contractual, total final reported and total realized during a normal year. For realized, natural discrepancies from a normal year are also shown.*

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

Enova obtains historical figures – realized results – from the projects three years after projects have been completed and the final report submitted. For projects that received support during the period 2012 – 2016, we have examined the results from about 500 of the projects that were completed and where the final report was submitted by the end of 2014. For these projects, the realized results are somewhat lower than the results in the final report.

Foto: Norsk Titanium AS

PART IV
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.

The provisions in the EEA Agreement concerning state aid form an important framework for Enova's operations. We base our support programmes on the provisions in the EFTA Surveillance Authority's (ESA's) guidelines on state aid for environmental protection and energy. The legal basis for our programmes is partly derived from schemes that are pre-approved by the ESA and partly from the General Block Exemption Regulation. If a funding commitment exceeds EUR 15 million, it requires special approval from the ESA. All our programmes are described in more detail at enova.no/esa.

Management of goals

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. We prepared a new strategy for risk management and internal control in 2017, which stipulates guidelines for the enterprise's overarching philosophy concerning risk management and internal control. The strategy helps Enova achieve its goals and provides sufficient assurance that risk is kept at a responsible level.

Risk management and internal control are integrated parts of the enterprise management in Enova. This e.g. means that the risk management is linked with management of goals and that reporting on risk will be an integrated part of the continuous reporting through both risk reporting and as a part of the quarterly review of the departments. A general risk assessment is sent to the Ministry of Petroleum and Energy each year in accordance with the requirements in the Assignment Letter.

An increased emphasis on technology development entails that Enova will be involved in an increasing number of projects that include critical commercial information for the project owner. It is important to Enova that we are perceived by market players as handling critical commercial information in a responsible and professional manner.

Enova develops policy instruments and supports projects that will contribute to changing the market and to leading Norway towards the low-emission society. One precondition for the funding to trigger changes in the market is that there is a general willingness and ability to invest in the market. If technology development takes place at a different pace than what is expected by Enova, this will affect the number of projects that Enova can support. We have a close dialogue with key players in the various sectors, and closely follow technology development and central framework conditions to detect any needs to adjust our services.

Project 42

Enova has started a project for comprehensive enterprise management and organizational development, Project 42, in order to anticipate future needs and requirements for flexibility in the delivery of the social mission. Enova receives earmarked funds for execution of the project.

In the preliminary work on the project, Enova has identified potential advantages through more use of modern technology and improved work processes. The project will firstly contribute to Enova being able to obtain, manage and share information in a way that provides new insight. Furthermore, it will make it easier for Enova to develop and manage more effective and accurate instruments. The project will ensure that Enova can work simpler, better and smarter.

Internal control

We consider the work distribution in Enova to be expedient for ensuring good internal control. Enova's values and ethical guidelines are anchored well in the company culture. Our control environment provides a good foundation for effective internal control.

Enova also 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 basic figures 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. What becomes subject to the verification is based on the systematic risk assessment we conduct during the year. The results are included in our work on continuous development and efficiency improvement. At the end of 2017, a decision was made to conduct agreed verifications of the processes related to public procurements.

The EU's General Data Protection Regulation (GDPR) will become Norwegian law in 2018. This means that we will have new rules for data protection in Norway. The new regulation will entail new requirements for enterprises and new rights for individuals. Enova established a data protection officer in 2015 and has, through this, had access over time to information and training from the Norwegian Data Protection Authority related to the new regulation. We are mapping the need for adaptations to GDPR. Measures will be carried out up to May 2018.

In 2017, 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 2017. 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.

Support system and tools

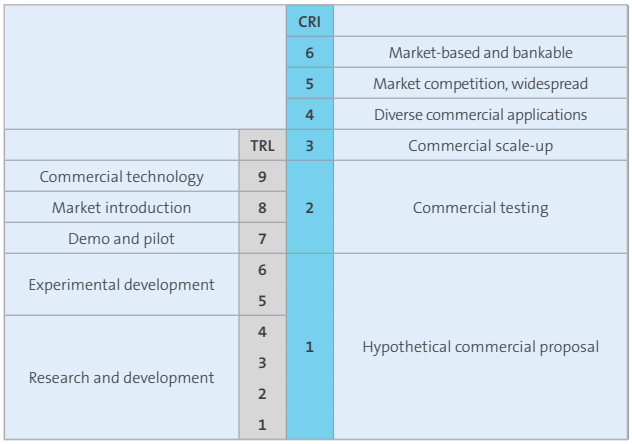
Enova processes and follows up an ever-growing number of projects, while society is becoming increasingly digitalized. This increases the significance of good data security, which requires sound control over IT systems, and raising the awareness of employees in the company.

An external service provider has tested the security of our solutions, both with regard to technical vulnerabilities and functional faults. The general impression is that the security for the most important applications is good, particularly the applications used by the public. We have worked to increase awareness related to security issues during the year and particularly as a part of the National Security Month.

Key case processing methods

Enova evaluates submitted applications related to the offered programmes and follows up projects that have been approved for invest- ment support or a loan. In this section we will describe a few key case processing methods related to applications and project follow up.

Figure 4.1
Technology maturity



Source: *NASA, ARENA.*

Method for evaluating immature technologies and innovation projects

The Technology Readiness Level (TRL)[2] and Commercial Readiness Index (CRI)[3] are vital in the work on assessing the degree of maturity for technologies in innovation projects.

Technology Readiness Level (TRL) is a widely used method for analyzing technology maturity. Maturity is assessed on a scale from 1 to 9, where the levels reflect the various development stages that a technology must complete on the road from basic research, via lab testing and demonstration, until the technology is introduced in the market. Although various technologies could be verified and ready for commercialization, they could have a different point of departure for competing on commercial market conditions, depending on costs and market maturity. This can be highlighted by supplementing the TRL rating with a so-called Commercial Readiness Index (CRI). CRI provides a broader assessment, which includes the technology's maturity, robustness in the cost assessments and financial terms, as well as the market maturity with regard to the player and competitive situation on the supply and demand side. The correlation between TRL and CRI is shown in the figure below.

Technology development projects are unique, and Enova therefore conducts project-specific assessments of, among other things, level of innovation, technological risk and proliferation potential. If necessary, third party reviews are used in the assessments. The figure below shows examples of scoring project applications.

2 *Developed by NASA – National Aeronautics and Space Administration in the US.*
3 *Developed by ARENA - Australian Renewable Energy Agency.*

Figure 4.2
Mapping of potential and risk

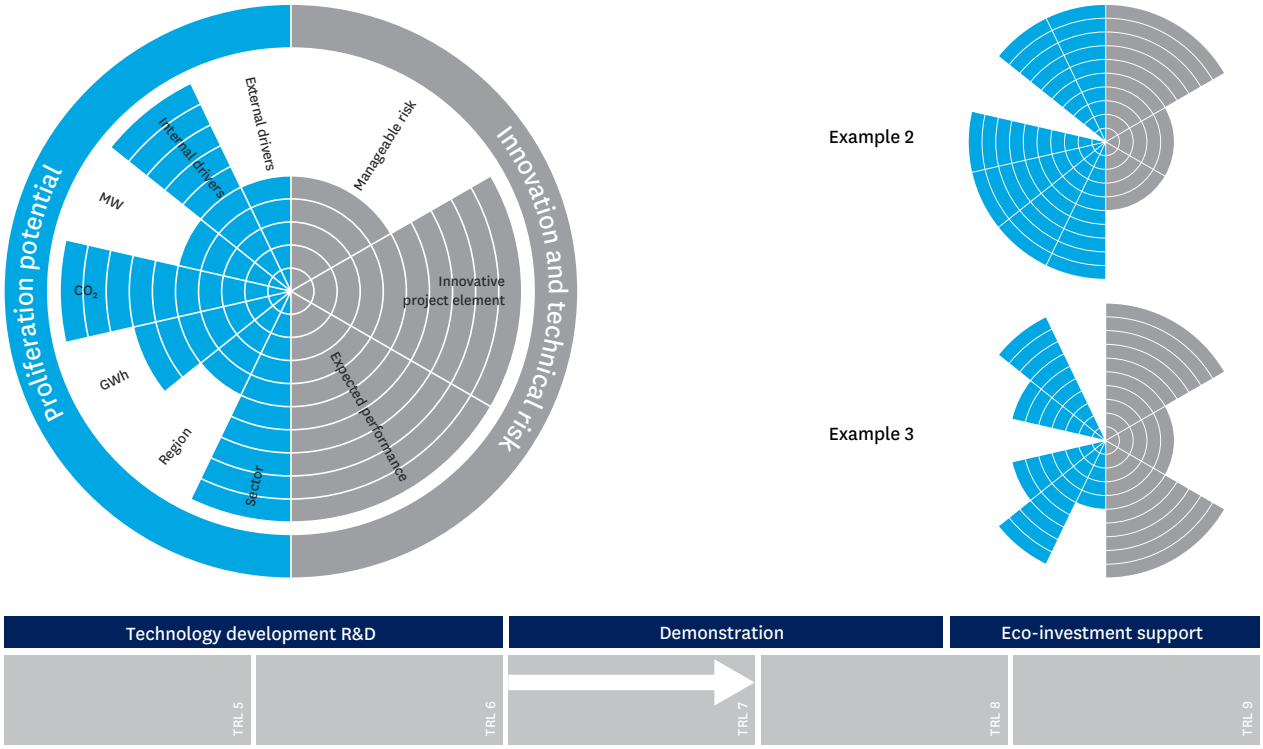


Figure 4.2: *The figure shows examples of scoring project applications. Source: Enova.*

Method for measuring quantitative results and documentation

In the application for support from Enova, the applicant must describe the result it expects to achieve if the project is implemented. The results can either be ***climate results*** (in the form of reduced greenhouse gas emissions), ***energy results*** (in the form of conserved energy or transition to renewable energy) or ***reduced peak demand results*** (in the form of reduced peak loads in the power grid).

Climate results and energy results are often closely correlated, while this is less the case for reduced peak demand results. The climate result takes a basis in standardized emission factors for the different energy carriers in the project. The results are reported in CO2 equivalents, which indicate the combined effect of all types of greenhouse gases. Enova deduces and reports results, in addition to the result that is agreed with the applicant. Technology development projects might have a major potential for energy and climate results, but they are first dependent on successful innovations and the direct results are often modest. For such projects, Enova primarily measures ***innovation results***, in the form of triggered private capital.

Enova quality-assures the result that the applicant has described 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.

Contractual result:
Upon entering into a contract, the support recipient pledges that the project will achieve a future result, for example an energy result. This pledge 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. Enova records the results from the project in the year the support is granted. This provides quicker reporting and enables closer follow-up from Enova. The results are then updated as the projects are completed.

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 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 climate, energy or reduced peak demand result.

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 and certified by the person responsible for finances in the subsidy recipient's organization.

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.

Realized result:
Final reported projects are followed up with measurement and verification of the results three years after the final report was submitted. For a selection of the largest projects, Enova uses third-party assessment to quality-assure the reported result. While the contractual and final reported energy results are based on expectations, the realized results are also based on observations.

Method for measurement of support and triggering funding level

Two main principles form the basis for our assessment of the funding level in projects in line with the requirements in 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, climate or demand-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.

- **Sufficient support:**
  The support must be sufficient to trigger changed behaviour. This entails that Enova must assess how much support is needed to trigger the project. If the funding level is too low, the project will not be carried out. 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, 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. External third-party assessments are also used if necessary.

Template versus project-specific assessment
Obtaining and assessing details and comprehensive information about technical and financial factors related to individual projects is very costly for both the project owner and Enova. In some markets, the potential volume of measures is significant, but each measure is relatively small. For certain project types, having programmes that are based on template assessments based on standardized values for a set of measures is more expedient. This makes the services offered to the market simpler, and reduces the costs related to documentation.

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 other words, the present value in the project must be positive, based on the company's required rate of return. The required rate of return thus affects the level of funding needed to trigger projects.

In the assessment of what is a reasonable required rate of return, Enova applies the required rate of return used by the enterprise in other corresponding projects or the requirement that can otherwise be documented as necessary to trigger the investment. If this information is not available, the required rate of return that is considered normal for the sector in question is used.

Enova uses a third party assessment of the normal rate of return in various sectors to determine the normal rate of return. Because different sectors have different degrees of associated risk, the reasonable rate of return could vary.

Major projects
For the largest projects, 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 a reasonability assessment of the energy result.

PART V
ASSESSMENT OF FUTURE PROSPECTS

The important decisions

The global community takes the climate challenge seriously, and acknowledges that we need to make some important decisions going forward to bring about a green transition. More and more countries are taking a proactive approach, where the transition is no longer something they must do, but something they want to do – because there could be significant value creation opportunities for those who adapt quickly.

At the United Nations Climate Change Conference in Paris (COP21) in December 2015, 195 of the world's countries agreed to enter into a legally binding climate agreement that will enter into effect from 2020. Every country must make a national plan with goals for emission cuts, and the goal must be updated with increasing ambitions every five years starting with 2020. Every five years starting from 2023, all countries must report their progress on emission cuts. The long-term goal is for the countries to become climate neutral during the period 2050–2100.

On 1 June 2017, however, it was announced that the US would withdraw from the agreement. The fact that the US, one of the world's superpowers, chose not to take part in the global climate cooperation garnered a lot of attention, and one could imagine that this might halt or stop the cooperation entirely. This has not happened. The US's decision has not affected the course. Far from being a ship with no captain, several countries have stepped up to the challenge. The global community has realized that important decisions will have to be made and active steps must be taken to avoid the worst consequences of climate change, but the path forward is not a dark one. It is a growing acknowledgement that leading the green transition could come with significant commercial opportunities. China, among others, has been proactive, and several states within the US have expressed that they will stand by the ambitions in the Paris Agreement, even if the US, overall, chooses not to participate.

A proactive Europe

The climate work is also persevering here in our part of the world. The governments in the EU see that Europe can fall behind in the global economy if the countries do not lead the way. The EU acknowledges that global changes in the production of and demand for energy have a significant impact on geopolitical conditions and international competition. The future low-emission society requires new technological solutions and services, and tomorrow's winners are the countries that can export these to the world. This presents major challenges for Europe, but also creates unique opportunities, and the EU explicitly[4] wants to step up its role as a global leader in the transition to renewable energy.

Europe is engaged in a transition from a fossil-based energy system. The energy mix in the EU is going in the right direction, and the EU is set to achieve its goal of being 20 per cent renewable in 2020. The separation between greenhouse gas emissions and GDP has continued, mainly driven by innovation. Economic growth is also not as linked to energy consumption as before, but the EU still needs to reduce its energy consumption in order to achieve its energy efficiency goals. The EU Commission has emphasized that a well-handled transition will be advantageous for the entire EU economy: The transition to the low-emission society will create new jobs, conserve energy and improve air quality. The EU therefore sees that the transition is not a necessary evil, but a process that will be worth the effort.

From necessity to opportunity

The development in Norway, both politically and in the market, is linked to the development both in Europe and the rest of the world. Important decisions are also being made here, as part of an acknowledgement that a transition is necessary, and that the transition to the low-emission society also constitutes an opportunity. Norway has unique expertise within several areas – such as climate technology in the maritime sector – and could benefit from exploiting such competitive advantages to create values that can benefit both Norwegian welfare and the global community.

On 2 June 2017, the day after the US withdrew from the Paris Agreement, the Norwegian Storting adopted the Climate Act. This established the adopted climate goals for 2030 and 2050 by law. The goal for 2030 is to reduce greenhouse gas emissions by at least 40 per cent from the reference year 1990. Further on, the goal is for Norway to be a low-emission society in 2050, where greenhouse gas emissions are reduced by about 80–95 per cent from the emission level in the reference year 1990.

2030 is only 12 years away. The Norwegian greenhouse gas emissions are currently above the 1990 level, not below, and we have not yet seen the development we need to see going forward. The total emission level in Norway has remained relatively stable since 1990.

As shown in Figuree 5.1, however, the distribution between sectors has changed somewhat. The mainland industry has become significantly more energy and climate efficient, while emissions from oil and gas production and transport have increased.

4 *European Commission (23.11.17): Third Report on the State of the Energy Union. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank.*

Figure 5.1
Greenhouse gas emissions in Norway

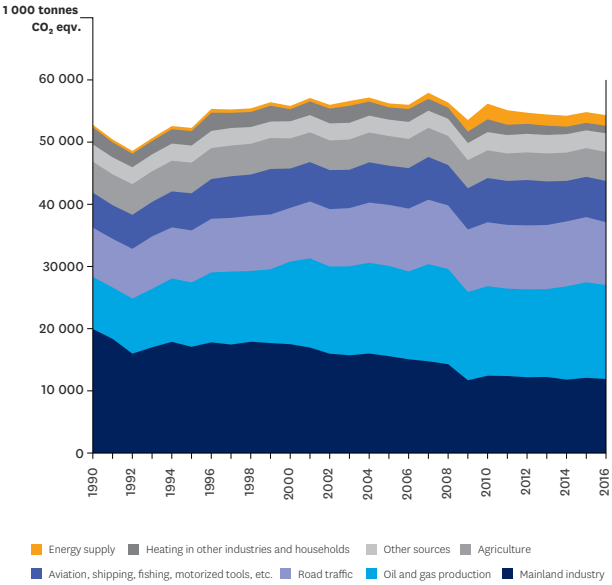


Figure 5.1: *The figure shows greenhouse gas emissions in Norway distributed by sector. Source: Statistics Norway.*

Figure 5.2
Development in Norway's GDP and CO_2 emissions

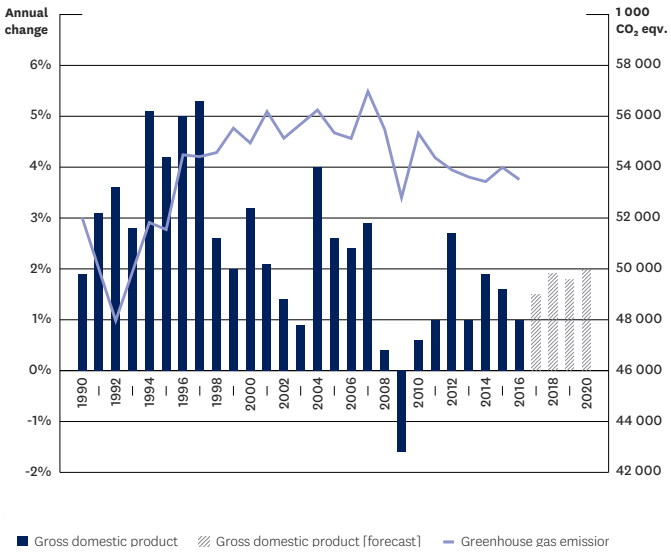


Figure 5.2: *The figure shows historical and expected (in per cent) development in Norway's GDP and CO_2 emissions. Source: Statistics Norway.*

The positive fact is that Norway – like the EU – is seeing economic growth without a corresponding increase in greenhouse gas emissions. Historically, there has been a clear correlation between the development in gross domestic product (GDP) and greenhouse gas emissions, also in Norway. This correlation is no longer as prominent, cf. Figuree 5.2.

This positive development is partly the result of changes in political framework conditions and extensive use of policy instruments to reduce greenhouse gas emissions. The price development for different energy carriers and CO_2 quotas affect both fuel choices and how attractive it is to implement energy-efficiency measures.

Innovation is key

Innovation, within both products and services, will be crucial for achieving the low-emission society. Developing and utilizing new technology is decisive in order to successfully adapt in a way that also safeguards Norwegian value creation. The faster we can develop new solutions and get the good solutions out in the market, the better Norway will handle the transition. Norway and the rest of the Nordic region score high on innovation within energy and climate technology. On the Global Cleantech Innovation Index 2017, Norway is 9th overall and 6th in Europe. Three Nordic countries hold the top-three spots. This shows that Norway and the Nordic region are well positioned for developing the solutions that the world needs.

At the same time, innovation is about more than technological creation, and the transition to a low-emission society is not just about technology development. The new products and production processes must be combined with both structural and social innovations. Society's physical structures must be facilitated in a way that solves basic tasks and functions in a manner that is more efficient and climate-friendly, for example in the organization of urban environments. We must also exploit the possibilities of new technology to develop new services and business models, of which car sharing services are an example. These innovations must be solved in parallel and in a context, and across sectors.

Norway has a good starting point

In order to contribute to the changes we need going forward, Enova must have good knowledge about the markets in which we operate. This is why we actively monitor the market and follow the status in the sectors and what affects them. In the following pages, you can read more about the sectors that Enova works with, both the current situation and how the development should be going forward. This affects how Enova can best interact with the market and develop relevant and targeted policy instruments that trigger lasting market changes in these sectors. There is a lot that needs to be done, and all good forces must unite in order to achieve the ambitious, but necessary goals that have been set for Norway.

The good news is that Norway has a particularly good basis for managing this transition. We have a stable economy, we have predictable political framework conditions and we have expertise that is highly relevant to the task at hand. Norway must exploit these advantages, and must channel the great minds and willingness to work through both industry, research communities, public activities and the public policy system. Our history – with the Norwegian oil adventure at the forefront – has proven that Norway is fully capable of achieving this.

Headed towards the low-emission society

- sector status and Enova's work

In the "Market Development 2017" report (Norwegian only), Enova provides a picture of how the market for energy and climate solutions is developing in the sectors in which we work. Read more at enova.no.

Households and consumers

Households play a crucial role in the transition to a low-emission society. The choices that every household makes, through residence, transport needs and consumption, influence national and international greenhouse gas emissions and security of supply for energy. In the low-emission society, individuals live and meet their transport needs in a climate-neutral way and with minimal strain to the power system.

Direct greenhouse gas emissions from households are relatively minor and are largely linked to use of a private car. In total, this represents about 10 per cent of the total greenhouse gas emissions. With the ban on use of fossil oil for heating that will enter into effect from 2020, Norway is taking a clear step towards the low-emission society. Presuming that Norwegian electricity is considered emission-free, there will be no greenhouse gas emissions from operation of Norwegian households after 2020. However, residences account for a significant portion of electricity consumption in Norway, and a considerable part of the demand both during the year and during the course of a day. This will increase further when the last oil heating plants are replaced by other heating sources, and as the number of chargeable vehicles are connected to the electrical system in Norwegian homes.

Enova has defined three areas where we want to stimulate market change: Upgrades with a high energy ambition, Renewable and flexible heating and Flexible demand consumption.

Upgrades with a high energy ambition

The majority of Norwegian residences are still single-family homes, and we believe this will remain the case in the future. Out of a total of 1.2 million Norwegian houses, 0.5 million were built during the period 1946–1980 and have a poor energy standard compared with the current requirements for new buildings. Each year, Norwegian homeowners spend about NOK 75 billion on renovations and upgrades, 62 per cent of this is related to single-family houses.

A survey carried out by Enova in 2015 shows that less than 50 per cent of the renovation projects complete energy upgrades as a part of the work. Changing the market so that this percentage increases represents a substantial potential. The more families who insulate and choose windows and doors with high energy quality when they renovate, the more robust Norway's residences will be in the future. Buildings with a low heating demand have a significant impact for energy and peak demand in the power grid, particularly during winter.

Enova shall stimulate the market so that energy upgrades with a high energy ambition will become standard for a renovation project. In order to achieve this, Enova stimulates the emergence of a market for energy advisers who can make a plan for energy measures before the upgrade starts. Furthermore, we grant subsidies to comprehensive upgrades with a high energy ambition, to develop both the buyer and supplier sides in the renovation market. Subsidies are also granted for retrofitting balanced ventilation with heat recovery. The funding scheme is coordinated with the Energy Certification Programme to highlight energy level and the value of an energy-efficient residence.

Renewable and flexible heating

Depending on the type and age of the residence, between 50 and 80 per cent of the energy consumption in residences comes from heating. Energy consumption is highest on the coldest days, and this is when the strain in the Norwegian power grid is highest. In order to reduce the high demand load in the power grid, it is important that the heating systems are flexible and can use other forms of energy than direct-acting electricity. It is also an advantage if the systems can accumulate heat so that the heat supply can be stopped during periods without coming at the expense of comfort. The possibility of using locally stored energy, such as wood and pellets, can also ease the strain on the power grid during potential peak periods.

As a part of the Climate Agreement in 2012, a ban on using fossil oil for heating in residences and buildings from 2020 was announced. Increased fees on fossil oil from 2014, along with support programmes from Enova, have motivated homeowners to replace the oil furnace with climate-friendly alternatives, but there are still about 100 000 residences with various forms of oil heating. If many hold off until the ban takes effect, the suppliers will not have sufficient capacity to deliver good replacement solutions to everyone at the same time.

Enova shall help make flexible heating systems the preferred solution in residences. It is particularly important that the many oil heating systems that are replaced as a result of the ban on fossil heating are replaced with solutions that place the least possible strain on the power grid. In order to achieve this, early replacement of oil heating systems is encouraged with increased subsidies, which will gradually be reduced leading up to 2020. Subsidies are also granted for various heating plants that supply water-borne heating, and for modification to a water-borne heating system in existing residences.

Flexible demand

Peak demand has increased significantly more than energy drawn from the Norwegian power grid over the last few decades. Since the two-tier price system for electricity in households was phased out in the 1980s, there have been no incentives for limiting maximum peak demand in residences. There is a major potential in extracting the flexibility in electricity consumption in Norwegian households.

Over the course of 2018, 2.5 million residences and about 320 000 holiday homes will be equipped with AMS meters. The meters will deliver data to a database "El-hub", and this new way of measuring power and peak demand will be an important facilitator for innovation and service development. The NVE has also submitted a regulation for consultation which will regulate peak demand tariffs in the households market.

Enova shall stimulate consumers to start using new technologies and services that will emerge in the aftermath of AMS and peak demand pricing. This is how the so far unused flexibility in demand consumption will be extracted. Enova's work must be coordinated with other instruments, and we will initially emphasize testing of technology and services based on the AMS technology. When AMS meters have been fully installed and peak demand pricing increases the interest in demand management, Enova will get involved in development of the market for technology and services.

Enova's programmes for Households and consumers

Enova offers the following programmes for private individuals:

Energy measures in residences
Enova offers support and/or consultation for measures to improve residences aimed at "houses built after 1987", "houses built between 1960 and 1987", "houses built before 1960", "new buildings", "historical houses", "apartments" and "holiday homes".

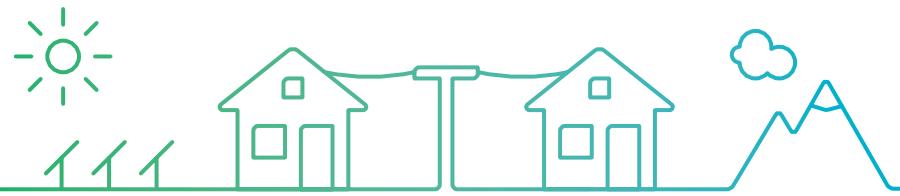
Enova offers the following programmes for housing cooperatives and co-owners:

Mapping support for existing buildings
Support for a comprehensive mapping of energy measures in buildings. The mapping will provide a better overview of the energy measures, how profitable they will be to execute and will provide a better basis for making decisions.

Existing buildings
Support for building owners who invest in the best available technology within solutions that conserve energy and convert from fossil to renewable energy sources. The programme is primarily aimed at players who complete energy-efficiency measures with a guaranteed energy result or energy management as a part of the project.

Heating plants
Support for heating plants is aimed at market players who want to install a heating plant to heat a building or for production purposes based on renewable energy sources.

Enova also offers consultation through enova.no and the advisory service Ask Enova, as well as the Energy Certification Programme.



From outdated house to modern home

A warm and pleasant indoor temperature year-round is the result after Andreas Kristiansen and his family upgraded their old wooden house in Bærum. Photo: Enova.

The Kristiansen family moved from a new apartment to an old wooden house, and the unpleasant indoor climate and oil furnace were part of the bargain. But the family has turned the outdated house from the 1960s into a healthy and modern home. A subsidy from Enova in the amount of NOK 74 000 helped them on the way.

Geothermal pump

"We moved into a house with poor ventilation, little insulation and a heating system that produced high power bills. We now have an indoor climate that even our guests comment on – and an environmental heating solution that saves us money."

This is according to Andreas Kristiansen, who took over the 280-square meter house in Bærum along with his wife Kristin and children aged 2 and 4 in May 2016. The house had been virtually unchanged since it was built in 1967, and the family was prepared to do some renovation.

Cutting energy costs with geothermal heating

Removing the oil furnace was at the top of the priority list. Because even though the previous owner had not used oil for heating in years, the furnace was still in the basement. There are still several thousand Norwegian homeowners who have not removed their oil furnace and tank, despite the upcoming ban on using oil for heating from 2020.

"The previous owner used the oil furnace for electrical heating with an electric insert. She lived alone, but still consumed 48 000 kWh of energy each year," says Andreas, who started looking into alternative solutions along with Kristin.

After reading Enova's website and talking to friends, they decided on a geothermal liquid-to-water heat pump. Over time, the family expects to earn back the high one-off cost for the heat pump.

One company to deal with

Before they could start the work, the couple obtained quotes from multiple companies. They wanted to find the company with the most expertise, and who could deliver from start to finish.

"The goal was to have one company organize removal of the oil furnace, drilling for the heat pump and installation of the heat pump and waterborne system in the floor. We wanted to deal with one company and one invoice." They found what they were looking for in the company Nek AS from Årnes, and according to Andreas, they were easy to work with from beginning to end.

An investment for the future

"It was also easy to apply for support through the Enova Subsidy. Shortly after we submitted the receipts and documentation, we received NOK 74 000 in our account. The subsidy from Enova was crucial in helping us complete the extensive project," says Andreas.

In addition to upgrading to a heat pump and water-borne floor heating with a heating management system, the family also insulated the house, replaced windows and installed balanced ventilation with heat recovery.

"The total price was about NOK 400 000, which means it is important to have a perfect final result. And that is what we got. The temperature inside the house is warm and pleasant, year-round. We only use the fireplace once in a while, simply for the cozy effect," says Andreas.

The family has become so accustomed to the good indoor climate that they forget all about it until guests come to visit.

"Most people comment on how comfortable it is at our house. This reminds us that we made an important investment for a better life," says Andreas.

Facts

Aggregated figures based on projects in 2017:
Project owner: **Privatpersoner i Norge**
Project: **A total of 8123 measures in residences**
Programme: **The Enova Subsidy**
Funding level: **NOK 165 million**
Energy result: **52 GWh**
Climate result: **4.6 ktonnes CO_2 eqv.**

Industry

The industry sector is both a cause of the climate challenge and an important part of the solution. Today, about 27 million tonnes of CO_2 equivalents per year, or more than 50 per cent of all greenhouse gas emissions in Norway, come from industrial activities – 23 per cent from land-based industry and 30 per cent from the petroleum activities on the Norwegian shelf.[5] A small number of industry companies account for most of these emissions.

Enterprises that use more than 50 GWh per year represent about 80 per cent of the energy consumption in the land-based industry. About half of the energy consumption is electricity, and there is a considerable element of fossil energy carriers, mainly coal and natural gas. In addition to the land-based industry there is the oil and gas industry, where the primary energy source is fossil.[6]

Norwegian industrial production generates significant values for society. It contributes 25 per cent of Norway's GDP and 8 per cent of employment.[7] Our modern society depends on industrial products such as oil, metals, chemicals and cement. Producing these and other products in Norway is usually more climate-friendly than producing them elsewhere.

The general situation in the industry currently shows that total greenhouse gas emissions have remained relatively stable since 1990.[8] When broken down, we can see considerable individual differences between the sectors. Emissions from the petroleum sector have increased by more than 80 per cent since 1990, driven by capacity expansions and a higher energy intensity in ageing fields. For mainland industry, however, emissions have dropped by nearly 40 per cent since 1990, as a result of both structural changes and systematic and continuous improvement of production processes. Production is increasing without accompanying increases in greenhouse gas emissions and energy consumption. The majority of the greenhouse gas reductions from mainland industry still come from other greenhouse gases than CO_2, for example methane, fluoride gases and nitrogen oxide. Overall, CO_2 emissions from land-based industry have remained about the same since 1990, and about 95 per cent of the remaining greenhouse gas emissions consist of CO_2. Reducing these remaining CO_2 emissions will require the development and implementation of new solutions.

Norway has a good basis for leading the way when it comes to emission-free technologies and industrial processes. Norwegian industry has an international orientation, and is in many areas a world leader with regard to electrification and improving energy efficiency. This puts the industry in a unique position to invest in the next generation of technologies. Norway also has highly skilled expertise in both industry and research environments, combined with a public policy system and stable framework conditions. Enova sees that some major industrial companies are leading the way with large investments, but generally, the risk associated with lengthy and major technology development courses is considered too high for many players. The long-term, cost-intensive projects that are necessary to arrive at the low-emission society must often yield to the short-term earning potential. This, in combination with a situation where the actual costs are carried by players other than those who cause the emissions, constitutes significant barriers to the industry. Industrial facilities have a long lifetime and innovation processes take a long time. It is therefore important that technology development happens now in order to reach the 2050 goal.

National goals for 2050 entail that the industry must be developed in the direction of virtually zero emissions. The industry's own road maps[8] for green competitiveness provide an indicator of the courses of technology that the industry imagines will provide the desired direction. The majority of the mainland industry is already electrified and Norway has the world's most renewable power sector. Bringing the industry towards the low-emission society will require a combination of increased application of technology that is already available and developing new technology. About 10 per cent of the necessary emission reduction can be achieved by utilizing mature technology that is already commercially profitable. Another 50 per cent of the necessary reduction can be achieved using technologies that are mature, but not yet profitable for individual companies.[9] This includes electrification of offshore oil and gas facilities, development and use of biofuels and many improvement measures within energy efficiency. The remaining 40 per cent of the emission cuts are contingent upon development and implementation of new technology and solutions that are not on the market today. In addition to making Norwegian industry more climate efficient, such technology could have a considerable market potential on a global basis and could yield new value creation in Norway.

Large parts of the industry's greenhouse gas emissions are covered by the EU's Emissions Trading System (ETS), which stipulates a price for emissions which will trigger measures to reduce them. Enterprises are required to report their emissions and the cap for emissions will be reduced every year. The current quota prices are low, but with reduced quota caps, the price could increase and influence the industry's decision-making processes going forward. Leading up to 2020, the number of quotas will be reduced by 1.74 per cent each year, and this will be increased to 2.2 per cent each year during the period 2021–2030.[10] However, industrial facilities have a long lifetime and development of new process technology in industry often takes several decades. It is thus necessary to use other policy instruments in addition to ETS to increase the pace of innovation. Enova organizes the instruments such that they support development of new technology, and lets the Emissions Trading System

5 *Statistics Norway; Table 08940: Greenhouse gases, according to source, energy product and component*
6 *Statistics Norway; Energy consumption in industry, statistics prepared for Enova*
7 *Statistics Norway; Table 11396: Employees as of the 4th quarter, according to workplace and industry*
8 *https://www.norskindustri.no/dokumenter/bransjedokument/veikart-i-norsk-industri/*
9 *Enova report "Norwegian industry on the path towards the low-emission society", prepared by McKinsey (2017)*
10 *https://ec.europa.eu/clima/policies/ets/revision_en*

be the instrument that stimulates application of climate-friendly solutions when they are mature.

Enova wants to stimulate the industry's path towards the low-emission society

Enova wants to contribute to assist the industry in changing and moving in the direction of the low-emission society. During the period 2017–2020, Enova will contribute to faster introduction of new energy and climate technology in industry through increasing support for projects at an early stage of the development course before full-scale implementation. We will contribute to reducing the technological risk before the enterprises take on a considerable financial risk. Enova's instruments are generally technology-neutral, so that the market itself can decide what it believes are the future-oriented technologies. The market change that must come in the industry is that the zero emission solutions become commercially available, and we can see that this is a long, challenging and risky process. It is important that this process starts now. We therefore have the goal for the period 2017–2020 for our instruments to contribute to the implementation of a substantial number of major pilot and demonstration projects within low/zero emission technology for the various industry segments so that they can be ready to be used before 2030.

In addition, we will work to reduce greenhouse gas emissions from non-quota plants. Important steps to achieve this are reducing the use of fossil energy carriers for heat production and contributing to the further development and implementation of technology for utilization of waste heat from industrial processes.

At the same time, Enova will establish new information and knowledge tools with the aim of contributing to establishing energy and climate management as an industry standard. This programme is primarily aimed at industrial companies with moderate energy consumption and greenhouse gas emissions where a lack of expertise and management focus are barriers for action.

In order to realize these goals, Enova is engaged in a close dialogue with key players in Norwegian industry and cooperates with other public policy agencies, such as the Research Council of Norway and Innovation Norway.

Enova is aware that a number of factors could affect the development. Economic cycles and raw material prices affect the ability and willingness to invest in the industry. In addition, national and international framework conditions, such as customs tariffs, import regulations and EU regulations can affect the countries in which international players choose to invest both in technology development and production. Changes can lead to both an increase and a reduction in the number of projects seeking support from Enova.

Metal industry

The metal industry in Norway mainly consists of primary aluminium, ferro-alloys and silicon. Growth is expected in all of the sectors, particularly within aluminium, which is increasingly being used to replace heavier materials. Global steel production will continue to drive the demand for the Norwegian ferro-alloy industry, and ferro-alloys and silicon are important input factors for aluminium, solar energy and the electronics industry, which are expected to grow. Emissions from the metal industry mainly come from the consumption of fossil reduction agents (coal and coke). Currently, there are no commercial-scale technologies that can radically reduce these emissions. This is why new technologies are required for production of metals in a low-carbon economy.

Technologies that can significantly reduce emissions from consumption of anode paste in the aluminium industry are not in commercial use today, but active research is being done on several identified technologies. These will typically require completely changing the current production process or replacing facilities and equipment. The alternatives include developing inert anodes, natural gas anodes or bio-based anodes to replace the current petroleum coke-based anodes. Another potential solution is carbothermic production in combination with carbon capture and storage or use (CCS/U).[8]

In the ferro-alloy and silicon industry, solutions that are related particularly to alternative reduction agents are in focus going forward. The current reduction agents are often fossil coal, which is the most significant direct emission factor from this industry. Research on replacing more of the fossil reduction agents with biomass is ongoing. However, a partial reduction is not enough to sufficiently cut emissions. In order to reach the low-emission society, fossil reduction agents will need to be completely replaced by bio-based reduction agents (preferably in combination with CCS/U) or hydrogen. In addition to technology advances in the actual production processes, this will require that the alternative reduction agents are produced in a fully sustainable manner.[8] There is also a need for considerable development here in the time ahead.

Technology to exploit waste heat for process or energy purposes could yield reduced greenhouse gas emissions, reduced energy consumption and more efficient processes. Low power prices, and thus low profitability, give weak incentives for investing. Although there has been a lot of positive technology development in recent years, there is still substantial un-exploited low-temperature heat in the process industry. For power production from heat sources with low temperatures (under 160 degrees) there is still a considerable need to develop improved and more cost-efficient solutions.[11]

Cement industry

The cement industry is a small industry in Norway. Globally, the development of the cement industry is closely linked with use of concrete in construction and development of infrastructure. Cement is a heavy and volume-intensive low-price product. High transport costs therefore mean that the production is typically located near the market. The production growth for the cement industry will therefore mainly be concentrated in growth markets such as China

11 *Enova report: "Technology mapping. Power recovery from low-temperature waste heat", prepared by Rambøll (2014)*

and India, and be driven by large-scale urbanization, city development and public investments in infrastructure. In mature markets, the growth is typically limited to areas with population growth and replacement of existing structures and infrastructure.

Emissions from cement production come from fossil fuels that are used in the cement kiln and process emissions from production of clinker. In the short-term, there are three conventional measures that can reduce emissions from cement production; substitution of clinker with other mineral components in the cement (for example fly ash and slag), increased share of biofuel in the energy mix that runs the cement kilns or increased energy efficiency and recovery of waste heat from the clinker furnaces. However, these technologies have a limited potential for directly reducing CO_2 emissions from cement production.[8]

No breakthrough technologies that can radically reduce emissions from the cement industry have been identified, beyond carbon capture and storage (CCS).

Chemical industry

The chemical industry in Norway is very diverse and has emerged as the result of excellent access to hydropower, gas and oil, but also as a natural consequence of the demand for chemical products from other industries. The majority of emissions in these industries in Norway come from refineries and production of petrochemicals and mineral fertilizer and wood processing.

Petrochemical

The petrochemical industry is the part of the chemical industry that uses oil and gas as raw material. The products are used for an array of purposes, for example plastic, paint, insulation materials, explosives and fuel. A lower demand for fossil fuel is expected in the future due to increasing electrification of the transport sector. There is a possibility that Norway, through its biochemical industry (wood processing), could take on an important role in replacing the petrochemical industry in a low-emission society.

Mineral fertilizer

Global demand for synthetic fertilizer is expected to grow somewhat towards 2030. The demand is driven by population growth that will require more efficient crops to produce more food in limited farmland. Due to high historical consumption, the market for nitrogen-based fertilizer is expected to see a lower growth rate in the future. The demand will most likely increase more for advanced and specially-adapted types of fertilizer.

Mineral fertilizer production is an energy-intensive process, and like the aluminium industry, energy efficiency is therefore an important competitive advantage. Emissions from the fertilizer industry mainly come from two sources: use of fossil energy carriers (primarily natural gas) as fuel and an input factor in the ammonia synthesis and N2O emissions from production of nitric acid. However, natural gas must be replaced with renewable alternatives (for example with hydrogen based on electrolysis) in order for the industry to be sustainable in a low-carbon economy. Emissions from the Norwegian mineral fertilizer industry have been significantly reduced over the past decades, driven by energy-efficiency measures and introduction of N2O-catalytic cleaning technology that has reduced emissions from nitric acid production by about 90 per cent.

In the short-term, there is a limited potential for further substantial emission reductions with the current production process. New technology breakthroughs related to the production process are therefore necessary to ensure a sustainable fertilizer industry in the low-emission society. CCS/U could also be an option for handling emissions from fertilizer production.[8]

Wood processing

The wood processing industry in Norway consists of producers of paper, cellulose, wood chemical products, wood pulp and fibre boards. The products are produced from renewable raw materials based on the main components of wood; wood fibre, binding agent and hemicellulose (sugar).

Greenhouse gas emissions from the wood processing industry are low and mainly come from combustion, but use of bio-based products can replace fossil input factors and reduce the greenhouse gas emissions in other industry segments. For example, bio-oil could directly replace oil without significant changes in operations. Furthermore, biochemical products could e.g. be used in the pharmaceutical industry, paint and lacquer, as well as special cellulose for the textile, construction and oil industry. Lignine can be used as an additive in concrete and ceramics. The wood processing industry produces biogas and bioethanol based on waste from ordinary production processes, as renewable alternatives to fossil fuels. Bio-based products such as charcoal could also be included as a reduction agent in other process industry.

Offshore oil and gas

Enova presumes that Norway will follow the global development with declining production growth in upcoming years. Norway will continue to produce oil over the next few decades, driven by new discoveries and development of major fields such as Johan Sverdrup, as well as new technology that increases the recovery rate on existing fields. Gas is expected to be the most rapidly growing fossil energy carrier and its share in the global energy mix will increase.

Emissions from oil and gas production in Norway mainly come from two sources; energy production as a result of combusting fuel gas in turbines that generate electricity and heating for use on platforms, as well as different process emissions, primarily linked to flaring, leaks and cold venting.

In the short term, there are several technologies that can contribute to reducing emissions from these sources. Generally, the measures involve reducing emissions from energy production, by improving energy efficiency on the platforms and by reducing

process emissions through optimizing operations, better control and upgrading to more energy-efficient facilities.

Bigger technology breakthroughs are needed to achieve the long-term goals. For the oil and gas sector, there are particularly two measures that could eliminate or reduce emissions to a minimal level; carbon capture and storage (CCS) in combination with hydrogen as energy carrier, as well as electrification of production facilities based on renewable power.

Food industry

This part of the industry represents less than 1 per cent of total industrial emissions.[5] Most emissions come from use of fossil fuels for heating, cooling and distribution. Apart from the distribution, the industry is already largely electric and produces relatively low emissions, but there is a potential for further electrification and energy-efficiency measures. For example, heat pump technology could solve the industry's need for both cooling and heating to low and medium temperatures.

Enova's programmes for the industry

In general, Enova's work shall contribute to innovation within energy and climate technology adapted to the transition to the low-emission society and strengthen security of supply through flexible and efficient demand and energy consumption. This is reflected in our programmes for the industry. Our programmes are:

Introduction of energy management in transport, industry and construction:
Support for analyses and establishment of action lists and systematic follow-up of the energy consumption in industry, construction and transport enterprises that motivate action.

Pre-project energy measures in industry:
Will increase the number and scope of larger investment projects and contribute to ensuring that projects applying for support from Enova have been assessed well and have the necessary preconditions clarified before the application.

Energy and climate measures in industry and construction:
Will contribute to making efficient energy and climate solutions more accessible in the market, and to be used more quickly and at a larger scope than would otherwise have been the case. In order to realize this, Enova offers support for increasing the efficiency of energy and demand consumption in industry, as well as reduction in emissions not subject to quotas.

New technology in industry and construction:
Pilot-testing of new energy and climate technology:
Will contribute to development of new technology in industry that will, over time, yield reduced greenhouse gas emissions, reduced peak demand or improved energy efficiency and that also lead to expertise development in enterprises and technology environments in Norway.

Enables planning of, investment in and testing of pilot plants as a basis for further development or as a foundation for utilizing the technology at a full-scale later.

Demonstration of new energy and climate technology:
Will contribute to more new technologies that can yield reduced greenhouse gas emissions, reduced peak demand, improved energy efficiency or increased production of energy from renewable sources in Norway or internationally, being demonstrated under real operating conditions and qualified for the market.

Provides the opportunity for demonstration under real operating conditions to lower technological, financial and commercial risk associated with utilizing new technology. The programme is technology-neutral and is open to projects in all sectors.

Pre-project new energy and climate technology in industry:
Will stimulate increased investments in innovative energy and climate technology in industry through support for pre-projects that are necessary for the applicant to make an investment decision.

The support is granted to studies and documentation of concrete and identified investment projects or demonstration projects that qualify for the programmes Full-scale innovative energy and climate technology or Demonstration of new energy and climate technology.

Full-scale innovative energy and climate technology in industry:
Will increase and accelerate commercial use of new and particularly innovative technology that yields significant reductions in greenhouse gas emissions, peak demand or specific energy consumption or increased production of energy from renewable sources.

The programme will contribute to developing expertise in Norwegian companies and technology environments and to reduce the costs and risk for enterprises that want to start using innovative technology or innovative system solutions. Technologies must be better than the commercially best available technology and the innovation must entail a significant improvement beyond what is common in the industry.

The programme is technology-neutral and covers all technology that contributes to the purpose. The programme is open to projects in all sectors. In addition, the industry can apply for our programmes for Biogas and biofuel, as well as heating plants.

The future site of a pilot plant for the world's first CO_2-free magnesium production

Herøya Industripark will test new groundbreaking climate technology. Photo: Herøya Industripark.

Enova has granted a funding commitment of NOK 19.5 million to NorMag AS, for construction of a pilot plant for energy and climate efficient production of magnesium and silica at Herøya. The plant will produce the world's first CO_2-free magnesium.

HERØYA

Evy Aspheim

8. september 2017

"The project's ambition is to create the world's most environmentally friendly and efficient magnesium production at Herøya," says Sverre Gotaas, director of Herøya Industripark AS.

Important for the green transition

The production is based on familiar Norwegian natural resources: olivine and electricity. Both products are important for implementing the green transition. The primary market is the global transport sector, where the products could contribute to lighter cars, electric cars and hybrid cars, fuel cells for hydrogen, environmentally friendly tyres, battery technology, etc.

"This is a very exciting technology leap for Norwegian industry. If this is successful, it could completely change how several metals are currently produced," says CEO of Enova, Nils Kristian Nakstad.

Purest in the world

The production technology will yield up to 95% lower CO_2 emissions and 60% lower energy consumption in magnesium production compared to the current dominant production methods, mainly located in China. The corresponding figures for the silica production are 20% lower CO_2 emissions and 35% less energy consumption than the existing production methods.

"At the same time as magnesium is becoming very important on the path to the low-emission society, it is a major challenge that today's production generates considerable emissions. The pilot at Herøya could be the beginning of the solution to this challenge," says Nakstad.

Next phase

Before the work on the pilot plant starts, a process is being completed to secure financing of the next phase of the project, which is estimated at NOK 3.4 billion. The total cost of the pilot plant is about NOK 80 million.

Sverre Gotaas says that agreements have been entered into with both local and international investors. He is optimistic about obtaining financing for the next phase so that the pilot can be started, with support from Enova, among others.

The project is being run by Herøya Industripark AS through the company MagSil, while the company NorMag will be responsible for construction and operation of the plant.

Facts

Project owner: **Normag AS**
Year funded: **2017**
Funding level: **NOK 19.5 million**
Planned completion: **2018**

About Normag AS

Normag AS has the purpose of conducting research and developing processes for production of metal and silica. Normag AS is owned by the Dutch AMG (Advanced Metallurgical Group Investment B.V.) and Magsil.

Transport

The transport sector is responsible for 30 per cent of greenhouse gas emissions in Norway and dominates the portion of our emissions that are not covered by the EU's Emissions Trading System. Emission cuts within the transport sector are therefore crucial for Norway to deliver on its international climate commitments. The objective of a low-emission society in 2050 entails that the transport sector must be developed in the direction of zero emissions. In order for Norway to succeed with this, a reduced scope of transport and use of climate-friendly modes of transport must be facilitated.

The general picture of the transport sector shows that the emissions per transport volume are declining, particularly at sea, but the climate effect is counteracted by the increasing transport volumes on roads, which are expected to continue growing in the years to come. Overall, the emissions have increased by 2 million tonnes of CO_2 equivalents since 2000. A decline in emissions will require the application of climate-friendly technology.

Efforts to reduce greenhouse gas emissions from the transport sector can principally be divided into three categories: 1) Reduce the scope of transport[12]. 2) Change how transportation is utilized to move towards more efficient means of transport such as public transport and freight transport by sea and rail. 3) Improve the technology for more climate-efficient means of transport and more efficient use of means of transport.

The largest reduction potential in the short and intermediate term lies in improving the means of transport through utilizing fuels and energy carriers without emissions. Some means of transport are experiencing a positive technology development today. This particularly applies to light vehicles, buses and ferries, which account for the majority of passenger transport. Other means of transport will require both significant technology development and biofuel with a good climate effect to become available at reduced prices and at an increased volume. This particularly applies to aviation, freight transport on roads and general shipping, which represent the majority of freight transport.

The development in the maritime sector is positive. Ferry routes are being established with low and zero emission solutions through fully electric or plug-in hybrid ferries. Fully electric, chargeable and battery-hybrid solutions have been installed within aquaculture, fisheries, offshore and cruise. There is a considerable potential for reducing emissions in the sector, and the Norwegian maritime industry has built up a leading expert cluster consisting of players covering the entire value chain.

The battery revolution has started, both on land and at sea. There are currently about 60 fully electric or battery-hybrid vessels globally[13]. An increasing number of vessels are being built or modified with batteries on board, and the technology is spreading to new segments of vessels. The development within battery technology is very rapid. Enova has triggered several projects where batteries will help relieve the generators, and projects are now also being established where the batteries play the leading role.

Enova will stimulate the transport sector's path towards the low-emission society

Efficient transport is a prerequisite for a well-functioning society and value creation in other sectors, and has a natural place in the low-emission society, as emission-free. The development of climate-friendly technologies has been rapid, but not rapid enough. Considerable efforts and investments will be required in order to achieve the 2050 goal. Emissions can be reduced through gradual improvements of the current solutions and through the development of new energy and climate technology for everything from propulsion systems to fuel. Enova will contribute to reducing the technological risk in the technology development. We will contribute to more new energy and climate technologies through raising good technologies and solutions up to a competitive basis. Enova's instruments are primarily technology-neutral, although some areas will receive specialized programmes.

During the period 2017–2020, Enova will stimulate development and cost reductions throughout the value chain related to battery hybrid and battery-electric solutions. We will support demonstrations of zero emission technologies and solutions for biogas for relevant vehicles within freight transport on roads, as well as testing of innovative distribution solutions.

We will stimulate a market-driven development of infrastructure for charging electric cars, and for fast charging to become available in the districts and along important roads. For hydrogen filling stations, we will stimulate establishment in the largest cities. We will facilitate a breakthrough for fully-electric buses in the cities, and the testing of new bus solutions.

Enova will stimulate continued development of efficient energy and climate technologies within the maritime part of the sector, and for battery technology to become competitive in relevant groups of vessels. We will facilitate the breakthrough of zero-emission technologies in the ferry sector, and for such technologies to be tested in other passenger vessels and for zero-emission components and autonomous concepts to be tested and demonstrated within local shipping. We will also contribute to the establishment of onshore power at all major ports and for the testing and demonstration of systems and solutions that can contribute to zero emissions. We will also contribute to technology development for biofuel production through pilot and demonstration plants.

12 *The scope of transport relates to how much and how far passengers and freight are transported and measured in passenger and tonne-kilometres.*
13 *Maritime Battery Forum, 2017.*
14 *Statistics Norway table 08940, downloaded 25 Jan. 2018.*

Enova is aware that there are elements that could affect the development. For most transport segments, particularly road transport, Norway is dependent on the international technology development. Changes in the global markets also have a substantial effect on the pace of development in the Norwegian transport sector.

Freight transport on roads

Emissions from delivery trucks and lorries (and construction machines) have increased significantly in recent years. Emissions in 2016 amounted to 5 million tonnes of CO_2 equivalents[14]. An increase in the use of transport services is expected in upcoming years. Population growth and social welfare development are two strong drivers behind the growth within freight transport. Increased centralization in urban areas will also entail increased freight transport in these areas.

About 270 million tonnes are transported each year on Norwegian roads. About 20 million tonnes of this is long-distance freight transport, which could thus be relevant for other modes of transport than lorries. Since 2000, greenhouse gas emissions from heavy vehicles and delivery trucks have grown by 35 per cent. A considerable portion of the driving, and thus emissions, takes place without return cargo.

Commercial means of transport have low or no tax incentives that stimulate low or zero emissions upon purchase. At the same time, there is a considerably narrower selection of zero emission vehicles available for this segment than for buses and passenger cars, which further delays the phase-in.

There is a substantial potential for continued increased access to and production of biogas in Norway[15]. Biogas will have a higher likelihood of breaking through in some parts of the market, initially within heavy transport and construction machines. In order for biogas to become a real alternative in such specific segments, increased capacity utilization within production, among other things, will be necessary. At the same time, biogas requires dedicated infrastructure and a supply chain that requires good utilization.

The Storting has signaled that they want to scale up the requirement for sale of biofuel from the current level at 7 per cent up to 20 per cent in 2020. This can be fully or partly solved with import, but there is also a potential for exploiting Norwegian sustainable raw materials. If parts of the biofuel demand will be covered with biofuel produced in Norway, this will mean that the technology must be developed in a way that makes the production sufficiently cost effective. Today, the sale requirement includes bioethanol and biodiesel, but not biogas.

Passenger transport on roads

In 2016, emissions from passenger cars in Norway totaled 5.3 million tonnes of CO_2 equivalents[16]. Within electrification of the passenger car segment, Norway has come further than most other countries, and there are about 130 000 electric cars on Norwegian roads today. There is now a selection of electric car models for passenger cars. The selection is somewhat limited for light delivery trucks, but more models are expected. Electric cars, along with plug-in hybrids, are taking an increasing market share when it comes to new car sales, but despite this, only constitute a small share (about 4 per cent) of the total passenger car fleet. Leading up to 2020, we expect a considerable increase in the selection for passenger cars. Several new models have arrived in recent years for plug-in hybrids, and the cars have an increasingly longer range on battery operation.

Battery-electric cars are still undergoing technology development to make them more competitive, primarily to reduce the battery costs while also increasing range, and for being able to charge more quickly at a higher output than the current fast charging.

Hydrogen has the potential of being used as an energy carrier in several types of transport. Buses and passenger cars currently satisfy technical requirements, but the selection of models and available vehicles is highly limited. Fifty-five new hydrogen cars were registered in Norway in 2017[17].

Several bus suppliers currently deliver battery-electric buses and articulated buses. The buses being delivered today are primarily best suited for cities and shorter routes, and continued technology development that will expand the areas of application is expected.

Development that is not related to propulsion technologies can also have a major impact on transport, and can facilitate increased use of alternative fuels. The most important development is related to self-driving cars and buses.

Maritime offshore

The Norwegian shelf is home to one of the world's largest offshore markets. This has functioned as a driving force for technology development for the Norwegian supplier industry. The offshore shipowners have the most advanced fleet in the world, a fleet that has been specially designed and developed for various assignments under conditions that can be highly challenging. The Norwegian offshore fleet includes nearly 600 ships of varying types. Examples of offshore vessels include oil tankers, construction ships, service ships and anchor handling vessels. Supply ships, along with anchor handling vessels, represent the largest percentage within the offshore segment, and is a modern fleet with an average age of about 13 years. Offshore transport is an important segment for increased efficiency and emission cuts. Many of these vessels are designed and constructed in Norway, with equipment delivered from Norwegian suppliers. Within this segment, there are substantial variations within fuel, propulsion systems and other equipment. Variations in fuel are heavy oil, LNG and dual-fuel (MGO/LNG). The propulsion systems vary between diesel-mechanical and diesel-electric. Battery-hybrid solutions are starting to arrive for ships with diesel-electric propulsion.

15 *"Opportunities and barriers for increased use of biogas for transport in Norway", Sund Energy 2017.*
16 *Statistics Norway, table 08940, downloaded 25 Jan. 2018.*
17 *OFV, Car Sales 2017, downloaded 25 Jan. 2018.*

There are significant potentials for improved efficiency, and the greatest barrier for implementing measures in the offshore sector is that the shipowners who invest in fuel-conserving measures often do not pay for the fuel themselves, and are thus not left with the savings from reduced consumption. The oil companies often pay for the fuel directly, and historically, there has been little willingness to pay higher day-rates due to energy-efficiency measures. This problem is about to change, and Statoil in particular has displayed a willingness to look at models for sharing the efficiency gains with the shipowners.

Continuous development of technology will result in reduced costs, and battery technology is a good example of this. The offshore sector, along with the ferry sector, have contributed most to the excellent market for battery development and battery deliveries in Norway.

The most relevant measures for improving efficiency and reducing emissions within the offshore segment are battery hybridization and direct current grid, as well as variable rpm[18]. This is explained in the operations profile for these ships and the potential for fuel reductions. With battery hybridization it is also important to consider other measures that can help reduce the demand to extract more of the battery capacity on board.

Fisheries and aquaculture

In 2016, the greenhouse gas emissions from the Norwegian fishing fleet amounted to nearly 1.1 million tonnes of CO_2 equivalents[19]. There are about 6 800 fishing vessels in Norway. The fleet is very complex, with small and large vessels and different tools adapted to different fisheries. The vessels are divided into inshore fishing vessels or seagoing vessels based on size and fishing rights. The average age of the fishing fleet is high, the largest vessels have an average age of about 20 years and we expect that a large portion of the fleet will be replaced. There are different barriers for completing energy-efficiency measures in the fishing fleet, for example, this fleet has low costs per liter of diesel due to reimbursement of CO_2 tax and ground rent. The shipowners therefore have few incentives to invest to reduce fuel consumption.

Fishing vessels have highly varying and unpredictable patterns of operation, and pure battery operation is still challenging within this segment. With the decline in the oil price and reduced offshore activities, fisheries have been subject to increased attention among shipyards and other players in the value chain. This means that a lot of the development that has taken place within the offshore sector is now being incorporated in fisheries, partially downscaled and partially changed.

Within aquaculture, different vessels are used for different tasks. Fish carriers are used to transport and process live fish. Feed barges transport feed from plants to the grow-out facilities. Work and service vessels are used in the daily operation of fish farms and varying types of service work, for example mooring. Several fish farms have established onshore power, but with the current development, fish farms are becoming larger and the distance to shore is growing. There is a potential for utilizing batteries for energy efficiency in diesel systems on feed barges. The operations being performed will become more challenging, and greater demands will be placed on future aquaculture vessels that must be adapted to the growing facilities. For work vessels, there is a potential for full or partial electric propulsion.

Local shipping

Local shipping is the transport of passengers and freight along the coast and to/from ports in Europe. In 2016, emissions amounted to about 1.8 million tonnes of CO_2 equivalents[20]. The Norwegian local shipping comprises about 1 000 vessels with a relatively high average age. Many of these sail outside Norwegian waters. Norwegian local shipping has about 14 000 employees at sea and on land[21].

Every year, about 270 million tonnes are transported on roads[22], and more secure, efficient and environmentally friendly freight transport is a political objective. A shift to sea (and rail) can contribute to reduced emissions. Other considerations such as traffic load, noise, accidents and local pollution would also be positively affected by such a shift. Maritime transport of freight has the advantage of being able to transport large quantities over long distances with less environmental impact than other alternative means of transport. However, only a small share of the freight transport on roads can be shifted.

Passenger ships comprise everything from small ferries to large cruise ships. The majority of emissions from passenger ships come from small ships that almost exclusively remain in Norwegian waters. These smaller ships have a high average age, about 29 years, and we expect a significant replacement of vessels within this segment. The state has considerable opportunities for steering local shipping in a more climate-friendly direction by stipulating environmental or emission requirements or incorporating environmental incentives in public tenders. The latter is particularly relevant for ferry tenders, and several county authorities have stipulated such requirements in their ferry tenders. The result is more electrified routes with associated technological development and cost reductions in the value chain for battery technology and for charging infrastructure.

In the same way as for road transport, development of technology that is not related to propulsion technology could play a large role for the future's transport and logistics concepts. Autonomy is a technology that could change a lot within today's shipping. Autonomous vessels can contribute to increased efficiency, increased competitiveness and a

18 *"Technologies and measures for improving energy efficient on ships", DNV GL 2016.*
19 *Statistics Norway, table 08940, downloaded 25 Jan. 2018*
20 *Statistics Norway, table 08940, downloaded 25 Jan. 2018.*
21 *"The bridge to Europe", Norwegian Shipowners' Association 2014.*
22 *NTP Freight analysis Main Report, 2015.*

possibility of using more alternative fuels. This is technology that is being adapted to ships today, and the first ship, "Yara Birkeland", is scheduled to start operations in 2020.

Maritime infrastructure

In order to facilitate a transition to more climate-friendly shipping, the necessary infrastructure must be available along the coast. The ports are an important step in the logistics chain and are important for industrial growth and regional development. More efficient loading and offloading operations, efficient terminal equipment and onshore power are measures that can help reduce emissions from ports.

Transition to climate-efficient fuel will require development of infrastructure. Biogas, onshore power and hydrogen require dedicated infrastructure, and such developments are often costly. Ports may in some cases be hesitant to invest in expensive infrastructure when they do not know the future scope of use. At the same time, shipowners do not want to invest in facilitation on board the vessels if ports cannot offer the necessary infrastructure. Technology development and further cost reductions for onshore power and charging technologies will be important for the electrification that takes place, particularly within the ferry segment that sets major requirements for fast charging due to the short turn-around time at dock.

Enova's programmes for the transport sector

Introduction of energy management in transport, industry and construction:
Support for analyses and establishment of action lists and in industry, construction and transport enterprises that motivate the enterprise to take another step towards well-anchored energy work.

Energy and climate measures in ships:
Will contribute to making efficient energy and climate solutions more available in the market and ensure that they are put to use more quickly and extensively than would otherwise be the case.

Demonstration of new energy and climate technology:
Will contribute to more new technologies that can yield reduced greenhouse gas emissions, reduced peak demand, improved energy efficiency being demonstrated under real operating conditions and qualified for the market. Provides the opportunity for demonstration of technology under real operating conditions to lower technological, financial and commercial risk associated with utilizing new technology.

Full-scale innovative new energy and climate technology:
Will increase and accelerate commercial use of new and particularly innovative technology that yields significant reductions in greenhouse gas emissions, peak demand or energy consumption. The programme will contribute to developing expertise in Norwegian companies and technology environments and to reduce the costs and risk for enterprises that want to start using innovative technology or innovative system solutions. Technologies must be better than the commercially best available technology and the innovation must entail a significant improvement beyond what is common in the industry. The programme is technology-neutral and covers all technology that contributes to the purpose.

Municipal and county municipal transport infrastructure:
Will contribute to increase and accelerate the introduction of technologies for battery-electric propulsion and thereby contribute to reduced emissions and reduced energy consumption. One of the objectives of the programme is to trigger projects with ambitious technology development and innovation goals. The programme will reduce costs and risks for municipalities and county municipalities that want increased energy efficiency, reduced greenhouse gas emissions and increased technology development in their procurements of transport services.

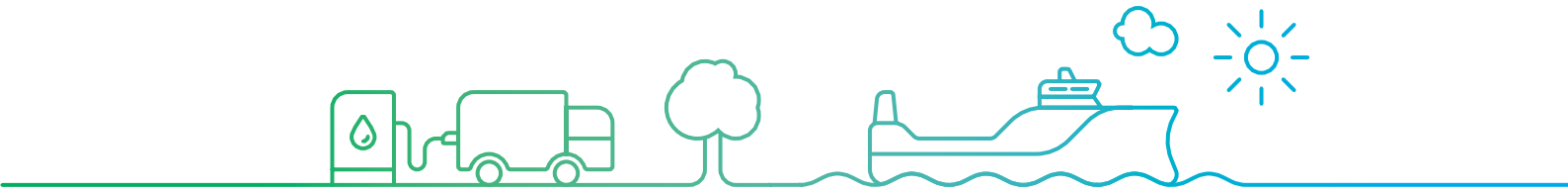
Onshore power:
Will contribute to increased energy efficiency and reduced greenhouse gas emissions when ships are at port. Increased access to onshore power at Norwegian ports will contribute to vessels being built or adapted so that they are facilitated for connection.

Energy and climate measures in ground transport:
Will contribute to making efficient energy and climate solutions more available in the market and that they are put to use more quickly and extensively than would otherwise be the case.

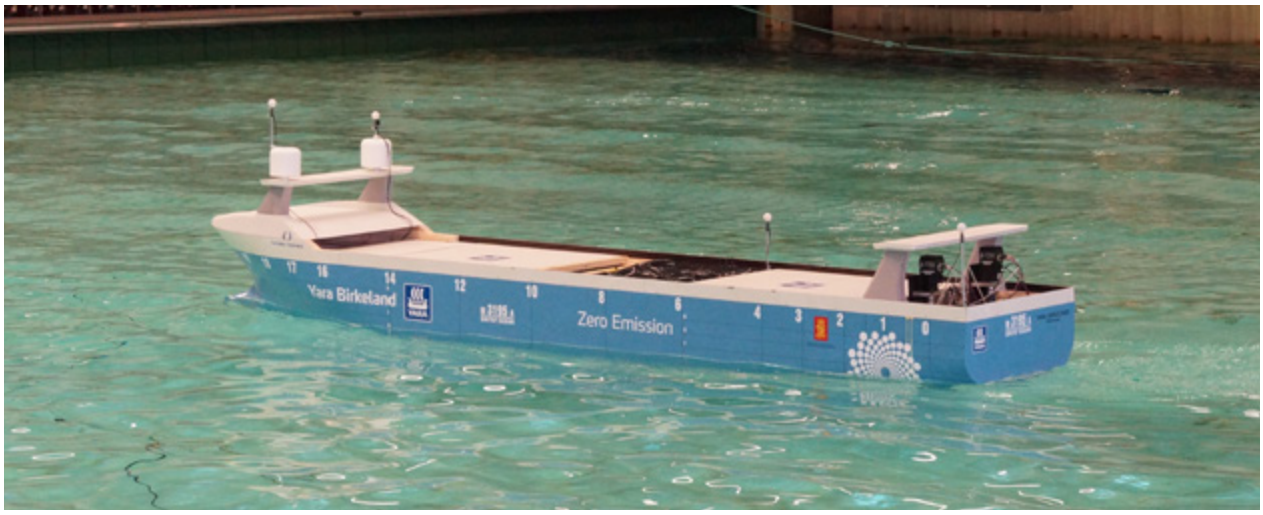
Fast charging:
Will contribute to reduced greenhouse gas emissions from the transport sector by better facilitating establishment of charging infrastructure for charging electric cars, and to the development being faster than would otherwise have been the case.

Hydrogen infrastructure:
Will contribute to learning from use of hydrogen as fuel in the transport sector, and reduce the risk and costs of utilizing hydrogen technology.

Biogas:
Will contribute to increased production of sustainable biogas and biofuel with a considerable market potential.



133 million for the world's first autonomous container ship



Yara Birkeland is the world's first self-driving and fully-electric container ship. Photo: Yara.

Yara and Kongsberg Gruppen take the lead in the competition to develop the world's first self-driving and fully-electric container ship.

HERØYA

Eiliv Flakne

28. september 2017

The companies are in the process of building an autonomous concept at Herøya Industripark in Telemark which will ensure automatic and electric mooring, loading and offloading of ships. Enova is contributing NOK 133 million in support for the project.

"If they succeed, this will mean a new era for maritime freight transportation," says CEO of Enova, Nils Kristian Nakstad.

Proliferation potential

There are currently no fully-autonomous vessels in the world and there are few fully-electric ships. At the same time, there is broad-based interest in such a concept, and the proliferation potential is therefore great.

The ship, which will be named Yara Birkeland, has a capacity of 105 TEU (twenty-foot equivalent unit containers) and will replace approx. 40 000 annual lorry trips with a combined driven distance of about one million kilometres. The solutions at sea and land will cut a total of 750 tonnes of CO_2 per year and considerably reduce energy consumption.

"For us in the private sector, it is a necessity and security to have the authorities on our side when we develop new technology and create new industries. This allows us to be bold," says CEO Svein Tore Holsether of Yara.

Paving the way

About one-third of greenhouse gas emissions in Norway are linked to transport, and the transport emissions must be reduced down to virtually zero on the path to the low-emission society. The Enova CEO believes that the innovative logistics concept will be a big step forward and will prove well worth the effort. "We need projects that are capable of changing the market and that have the potential for paving the way for others and increasing the pace of transition. That is exactly what we believe the world's first autonomous and fully-electric container ship will do."

The self-driving ship also challenges the regulations, or more accurately the lack of regulations. Yara is in a good dialogue with the Norwegian Maritime Authority and Norwegian Coastal Administration regarding the necessary dispensations for being able to launch a ship with no crew.

"Experience from the Yara project will be important in the design of national regulations for autonomous vessels. This makes the waters more predictable for future ships. And then we're talking market change!" says Nakstad.

Facts

Project owner: **Yara Norge AS**
Year funded: **2017**
Funding level: **NOK 133.6 million**
Energy result: **2.9 GWh**
Planned completion: **2020**

About Yara Norge AS

Yara Porsgrunn is part of Yara Norge AS, which is 100% owned by the listed Yara International ASA. Yara Porsgrunn is located in Herøya Industripark. The principal product at the plant is NPK, also called mineral or compound fertilizer.

Energy system

Compared with most other countries, Norway has vast renewable energy resources and a cost-effective power system. The power grid is well developed and has good regulation options. In 2017, the Norwegian power supply had an installed capacity of about 33 000 MW and a production of 148 TWh, of which 143.4 TWh came from hydropower, 2.1 TWh from wind and 3.5 TWh from heat[23].

The actual energy industry is fragmented, with many small companies, about 150 grid companies, 180 production companies and 100 power suppliers.

The general picture of the power sector shows a long-term trend with increasing peak demands in the power grid. In recent years, maximum peak demand has increased more quickly than energy consumption, in part due to more buildings, population growth, increasingly more power-intensive devices in households and more electric cars. This presents challenges for security of supply, and as the power grid must be dimensioned according to maximum peak demand, a continued increase in the peak demand will require very costly investments in the transmission lines.

In the low-emission society, much of oil and gas production must be replaced by other value creation in order to maintain the welfare level in a growing population. The oil and gas industry puts little strain on the power system, while the value creation in the low-emission society will to an increasing degree take place in a more power-intensive industry together with other business development. Therefore, it is highly probable that this transition will result in a situation where we go from having a surplus of power to having a potential deficit, even when excluding export.

The Norwegian power system is already changing. From a centralized power production based on hydropower, we are now seeing more decentralized, unregulated and renewable power in the form of solar and wind. Interconnectors and more exchange of power with the European system further reinforces this picture. The prices for technology for distributed production and storage continue to decline, while the market is growing in line with an urbanization trend that changes the energy and demand flow in the system.

Altogether, this sets new requirements for the energy system in both the short and long term, primarily the stability of power supplies, which is a design factor for grid capacity. Bottlenecks in the distribution grid, unstable reliability of supply and quality, as well as greater price variations throughout the day, are challenges that must be dealt with.

Utilizing new digital technology, automating work processes and utilizing new business models can increase the usefulness of existing infrastructure and reduce the need for grid investments. However, we are seeing that the energy industry is investing relatively little in innovation and that the flexibility in the system is only exploited to a limited extent. One reason for this is that players are only considering the costs they carry themselves, or the benefit they experience, instead of focusing on the positive ripple effects that innovation has for society. Security of supply can be considered a collective benefit; everyone will benefit equally from increased security of supply, regardless of who covers the costs. The same applies to innovation, where positive proliferation effects mean that more than the just the party that covers the costs can take part in the benefit. Demonstration projects where market players can verify that the technology or business model works under real operating conditions are therefore not realized since the development costs and risk is considered too great in relation to the gains for the investor. This contributes to a systematic underinvestment in innovation that could create increased security of supply for our society.

Another obstacle for the development is the lack of knowledge and experience regarding which technologies are available and the possibilities of utilizing them. We therefore need projects that help provide and spread such knowledge to relevant markets and players. Increased knowledge and experience in using new technology and solutions are also considered important to break down barriers.

The flexibility potential in the energy system is great, but spread among many stakeholders. Measures that, overall, could have a major impact on flexibility, could be too small for the individual building or individual household. New solutions and business models are required in order to aggregate and turn this potential into profitable products and services.

Safe and sufficient access to energy and power has been, and will continue to be, an important prerequisite in the transition to a low-emission society. Overall, the Norwegian energy system is well-positioned for the low-emission society, but the market players must take an active role in the sector's development going forward in order to achieve the goal of increased innovation in the energy industry and better exploitation of flexibility.

Enova will stimulate the energy system sector's path towards the low-emission society

Enova will design the instruments vis-à-vis the sector such that they stimulate an increased pace of innovation and a development that supports a future-oriented energy system where security of supply is safeguarded. Through pilot and demonstration projects, Enova will contribute to the development and commercialization of new business models and new technology, and that the industry exploits the opportunities offered by digital solutions. This is necessary to ensure security of supply in the face of increasing electrification and more power-intensive industry. In addition, we will use specific innovation programmes to support individual technologies that we believe have an important place in the low-emission society.

A flexible energy system where available resources are optimally exploited will reduce the peak demand consumption and

23 *Source; Statistics Norway electricity balance sheet*

consequently increase security of supply. Enova therefore wants increased interaction between the power system and the thermal energy system. A better interaction between them is necessary to ensure a future-oriented and cost-effective power system. While, for example, high-grade energy such as electricity should be used for high-grade purposes such as electrification of the transport sector, heating, insofar as possible, should take place with low-grade, less usable energy such as waste heat. This also ensures that we exploit more energy carriers and energy sources, which strengthens security of supply.

Within thermal energy, new business models must be realized and new technology must be put to use. New methods for central storage of energy, both through use of batteries and thermal solutions, are expected to be developed at an increasing rate. Enova will stimulate more rapid development of technologies that reduce peak demand.

Today, the market makes very little use of big data and the Internet of Things. Many potential measures can only be realized when digital smart meters (AMS) are installed over the course of 2018, as they will enable automatic management, disconnection and two-way communication. With AMS and Elhub, vast volumes of data will be available to a number of players. Enova will facilitate technological development that can contribute to changing consumer behaviour.

During the period 2017–2020, Enova will stimulate grid companies, technology suppliers and third party companies to jointly realize projects that utilize new business models and new technology that strengthens security of supply and exploits the flexibility in the system. Through demonstration and pilot projects, technological risk can be reduced enough for players to test and utilize new solutions at a large enough scale. During the same period, we will facilitate increased spread and application of new technology in district heating to relieve overburdened grids and to move energy and demand between areas. The thermal infrastructure can be exploited as a thermal storage, and district heating players can test management technology that increases the possibilities for "smart" thermal grids.

Grid companies

There are about 150 different grid companies in Norway. Each of these works as a monopoly within their geographical area with a given income framework. Costs related to investments and operations are covered through the grid tariff. The grid companies will have a key role in the future's low-emission society as renewable power will then also be a pillar in our energy system. It is important that the grid companies utilize the opportunities that arise for delivering on the demand for security of supply, reliability of supply and efficient operation of the grid in the future. Several of the nation's largest grid companies have already started testing new solutions for more efficient operation of the grid. Statnett is in a unique position, as it is the system operator responsible for developing, owning and operating the central electricity grid and transmission grid, including cables and interconnectors. Statnett experiences many of the same challenges as grid companies at lower grid levels.

District heating

The approximately 100 district heating companies in Norway contribute 5.2 TWh energy for heating each year. However, district heating's most important contribution in the energy system is not the volume of energy, but reducing the peak demand on the coldest days of the year. In Oslo and Trondheim, district heating now represents between 30-40 per cent of the total heating demand, and thus provides considerable relief for the electrical power system. This also releases capacity in our flexible hydropower system and facilitates use of renewable sources when rational.

District heating, like the grid companies, has a licence within an area regulated by the NVE. The largest companies within the district heating sector are also already looking at new opportunities, for example using district heating at construction sites, for cooling and for cruise ships.

Technology suppliers and third party players

The access to data from two-way meters increases the accuracy of management systems and provides new possibilities for use of e.g. artificial intelligence and machine learning. There is a substantial potential for flexibility within the industry, in commercial buildings and in households. We are seeing a growing number of system and technology players who offer management systems and other solutions for increased utilization of this flexibility. New business models that contribute to the same, such as markets for purchase and sale of flexibility, are already being tested. The digitalization of the energy system is a strong driver for these changes.

Enova's programmes for the energy system sector

District heating and cooling
Through the District heating programme, Enova grants support to players who want to establish new or further develop existing district heating. The programme will promote the development of district heating and cooling and strengthened security of supply through permanently phasing out electricity during peak periods.

Heating plants programme
The Heating plants programme is intended for players who want to install heating plants for heating buildings and production purposes, based on renewable energy sources.

Full-scale innovative energy and climate technology
Will increase and accelerate commercial use of new and particularly innovative technology that significantly reduces greenhouse gas emissions, peak demand or specific energy consumption or increases production of energy from renewable sources. The programme shall contribute to developing expertise in Norwegian companies and technology environments, and shall contribute to reducing the costs and risk for enterprises that want to start using innovative technology or innovative system solutions.

Demonstration of new energy and climate technology
Will contribute to more new technologies that can yield reduced greenhouse gas emissions, reduced peak demand, improved energy efficiency or increased production of energy from renewable sources in Norway or internationally, being demonstrated under real operating conditions and qualified for the market. The programme shall provide the opportunity for demonstration of technology under real operating conditions to lower technological, financial and commercial risk associated with utilizing new technology. The programme is technology-neutral and covers all technology that contributes to the purpose.

Cermaq will make biogas from sludge waste

Cermaq Forsan is utilizing new technology. Photo: Cermaq.

Sludge waste from smolt production has been a challenge for both the environment and fish farms for many years. Cermaq is utilizing new technology at the fish hatchery at Forsan in Steigen in Nordland to produce valuable biogas from the sludge waste instead of discarding it.

STEIGEN

Evy Aspheim

30. juni 2017

"If we are successful, there is a considerable potential for using the solution both internally in Cermaq, but also throughout the entire industry," says Marit Holmvaag Hansen, head of hatchery production in Cermaq.

Demonstration plant

Approx. 160 tonnes of sludge will be generated each year from the production of salmon smolt at Cermaq's hatchery at Forsan. The sludge consists of a mixture of fish feces and feed spillage. A process that uses bacteria will convert the sludge into methane, or biogas. Biogas production is often based on familiar technology, and there are many biogas plants in Norway. However, this is the first full-scale plant in Norway that is based on a compact technology that uses only fish sludge as raw material. The plant at Forsan could therefore be a demonstration plant for the entire aquaculture industry.

"In order to be competitive tomorrow we need to take steps today. We want the smolt and salmon we produce to be sustainable and produced with the highest standards with regard to quality and environmental impact," says Holmvaag Hansen from Cermaq.

The sludge that is generated at Forsan could create biogas in the volume of 500 000 kWh per year. This energy can be used to heat the water that flows through the facility, and the biogas could then replace oil or electricity.

NOK 6.3 million from Enova

Building a full-scale plant like this and utilizing new technology to convert sludge to biogas is a considerably more expensive investment than discarding the sludge waste. Enova is contributing NOK 6.3 million to cover some of the added costs of investing in new technology.

"The aquaculture industry is a future-oriented and important industry for Norway. The transition to the low-emission society will require new energy and climate technologies to reach the market, and we are pleased that Cermaq is utilizing technology that takes the industry in a more climate-friendly direction," says CEO Nils Kristian Nakstad in Enova.

Cermaq's sludge recovery plant at Forsan will be finished and start converting sludge to biogas in April 2018.

Facts

Project owner: **Cermaq Norway AS**
Year funded: **2017**
Funding level: **NOK 6.3 million**
Energy result: **0.6 GWh**
Climate result: **270 tonnes CO_2 eqv.**
Planned completion: **2018**

About Cermaq Norway AS

Cermaq Norway AS is one of Norway's largest salmon producers and is part of Cermaq Group AS. Cermaq Group is the world's second largest producer of salmon and trout, with operations in Norway, Chile and Canada.

Non-residential buildings and property

Existing commercial buildings in Norway consist of approximately 130 million square metres of buildings, and about 5 million new square metres are being built each year[24]. In addition to the commercial buildings, there are about 2.5 million residences. Buildings make up a significant share of both private and public assets, and the building and construction industry in Norway has an annual turnover of NOK 440 billion[25]. Of this, annual investments in renovation, modification and annexes in commercial buildings represent about NOK 80 billion.

Globally – also in Europe – buildings represent one-third of both energy consumption and carbon emissions[26]. The direct greenhouse gas emissions in Norway are considerably smaller, because the buildings largely use electricity from renewable sources. Gradually, oil boilers have been phased out as a heating source in Norwegian buildings, and this will be banned by law from 2020. This will eradicate the largest source of direct greenhouse gas emissions from the sector. The remaining emissions from the building sector in Norway will then be related to material selection and the actual construction processes.

Primarily, the buildings and property sector is indirectly significant for Norwegian greenhouse gas emissions through the potential for releasing energy for use in other sectors. However, the sector has a major impact on the security of supply: Due to use of electricity for heating, cooling and other electrical components, buildings represent a substantial portion of the maximum peak demand in the power grid on cold winter days.

Energy consumption in Norwegian buildings is extensive, and varies according to construction year, lifetime, type of building, operations and maintenance. About 80 TWh of energy is consumed each year in all buildings, including residences, which represents 40 per cent of energy consumption on the Norwegian mainland.

Norway has a major technical and financial potential for releasing both energy and demand from the building sector[27], but the renovation of existing buildings is taking place at a slower pace than desirable. For many property owners, energy is not a key focus. One reason for this is that the energy cost constitutes a relatively small share of the total costs. Within the private sector, it is a challenge that short leases make it less relevant for tenants to make long-term investments in the building. Correspondingly, building owners have a limited interest in financing energy measures in the building while the tenants are reaping the benefits in the form of reduced energy costs. This issue also applies to many public agencies, due to separate budgets for investments and operations. Furthermore, a low level of competence among both property owners and tenants, as well as high transaction costs, means that even profitable energy efficiency measures are not implemented.

When significant upgrades are actually implemented, it is important that there is a comprehensive assessment of measures with a positive impact on energy consumption, demand and climate. Enova finds that the motivation for energy and climate measures in buildings is increasing, in part as a result of the Paris Agreement and the agreement to establish a new buildings directive in the EU. At the same time, more enterprises are learning that their reputation can be affected by the energy and environmental profile of the buildings that they use. A growing number of tenants, also in the public sector, are requesting buildings with good energy qualities.

We have also found that the financial industry wants an energy and climate-friendly development of the building sector. Through loan and insurance terms, the financial industry can play a role in promoting buildings with higher energy quality.

In recent years, many innovative single buildings have contributed to further driving technological development. Several new buildings contain innovative solutions that far exceed the building standards, with radical improvements in construction processes, material selection and demand and energy consumption. Here best practice players have led the way and contributed to growth and development in the market for new energy and climate technology.

Going forward, digitalization of the energy system, construction processes and the roll out of two-way meters in all Norwegian buildings will be important drivers for development. Through this, new players can develop new technological solutions and business models that can contribute to realizing buildings and areas with rational use of energy and demand.

In order to realize the low-emission society, the buildings and property sector must contribute, and Norway has a significant potential for releasing both energy and demand from this sector[28]. This is energy and demand that we need for our growing population, for new business activity and for sectors that must convert from fossil energy sources to electricity in order to become emission-free. This is why continued energy efficiency improvements and a focus on innovation in new energy and climate technology solutions are important, also within the buildings sector.

24 *Source: Statistics Norway and Enova's market development report 2017*
25 *Source: Statistics Norway 2016*
26 *Source: IEA, 2012 and 2015*
27 *Source: Enova: Potential and barrier study (2012)*
28 *Source: Enova: Potential and barrier study (2012)*

Enova will stimulate the non-residential buildings and property sector's path to the low-emission society

Enova shall contribute to ensuring society's building needs are solved in the most energy and climate-efficient manner possible. Going forward, Enova will work on getting even more building and property players to join in the green wave that is driving the market forward.

When meeting the market players, Enova will emphasize the financial and commercial possibilities inherent in adopting a comprehensive perspective when selecting materials, construction, operation, renovation, demolition and re-use. Going forward, we must have buildings with low energy consumption, where buildings jointly utilize solutions for exchange of energy and load balancing, so that energy resources and systems are exploited in the best possible way. We will stimulate the most innovative players to push themselves further and exploit the infrastructure in the buildings – ceilings, walls, foundation, systems and outdoor areas – to produce and store energy from locally available renewable sources.

Over several years, Enova has granted support to projects that choose the best available technology for new buildings and upgrading existing buildings. This contributes to the players pushing themselves further when selecting new solutions with less profitability and greater technological risk. Enova will continue supporting early market introduction of new technology in the construction industry while the level for what constitutes the best available technology will be raised. A comprehensive approach to technologies that includes measures for energy, demand and climate is desired.

In order to extract a larger portion of the energy savings potential in the Norwegian building sector, Enova will stimulate business development in players that offer energy services with elements from EPC or OPS[29]. A Norwegian standard has been developed for EPC where contractors will guarantee energy savings in the measures that are mapped. From the public sector, Enova sees that players who complete mapping of the buildings such as EPC and perform their energy-efficiency measures in a comprehensive project, achieve their objectives with an average energy reduction of 30 per cent. This energy service market has a significant potential. Even including the measures that are profitable for the building owner, this is a market of several billion kroner per year.

Looking towards the low-emission society, Norway needs more renewable power and strengthened security of supply. In this perspective, Norwegian buildings must contribute through having low energy demands and putting as little strain on the energy system as possible. In order to get there, Enova will stimulate the pioneers to push themselves a little further to show the rest of the market what can be achieved.

During the period 2017–2020, Enova will prioritize players and projects that are early to utilize new energy and climate-friendly technology and innovative solutions. We will particularly support comprehensive projects that consider multiple buildings and entire areas at the same time. We will stimulate projects that result in less strain on the energy system and that pave the way for innovative solutions and business models. In this work, we will continue working to realize more of the potential for improving energy efficiency in existing buildings. We are planning to launch new programmes within this area in 2018.

Existing buildings and property

The vast majority of building owners and tenants do not see the value of renovating buildings beyond the upgrade that follows from wear, ageing and new tenants. Being able to affect the possibility of implementing measures while the buildings are in use will result in extracting a greater portion of the potential for energy savings and reduced peak demand. Here, tenants could help influence a development by stipulating energy performance demands for the buildings they lease.

Many measures in buildings will be profitable to implement today, but this is still not done on a wide enough scale. One reason for this is that building owners have insufficient information about the possibilities for the best available technologies. Few building owners actually have sufficient construction expertise and other technical competence to identify, implement and follow up extensive energy-efficiency measures. Most measures must also be coordinated with other activities, and the lessor often has to deal with many tenants. The measures must be coordinated with the tenants' plans and requirements in leases, and several different suppliers of equipment and services are usually involved, everything from construction workers and operating personnel to energy suppliers and banks. The individual building owner and tenant therefore face significant transaction costs.

It is estimated that more than 80 per cent of all buildings in Norway in 2050 have already been built. It is therefore important for the building sector's role in the low-emission society that the building renovations that are completed include measures that positively affect energy consumption, demand and climate. Turnover in the ROT market (renovation, modification and additions) constitutes between NOK 85 and 90 billion per year. There is a potential here for pushing the market over to products and solutions that contribute to higher energy quality and more efficient operation of buildings. The more who insulate and select windows and doors with high energy quality when they renovate, the more robust Norway's buildings will be in the future with regard to energy. Buildings with a low heating demand are very significant for the energy and demand load in the power grid, particularly during winter.

Existing buildings represent a major market for both profitable and less profitable measures that can substantially reduce

29 *EPC is an abbreviation for Energy Performance Contracting, i.e. energy savings contracts with guaranteed savings. OPS is an abbreviation for Public Private Cooperation, a method of cooperation where the State, over a long time horizon, pays private companies to finance, construct and maintain public buildings.*

energy consumption in existing buildings. The technologies are largely familiar, it is a matter of actually using them and further developing them.

New buildings

About 5 million new square metres are built every year in the commercial building segment. Figures from Statistics Norway show that the number of start-up permits for commercial buildings was marginally lower in 2017 compared with the previous year. This pace of construction is expected to remain stable in upcoming years. The building standards (TEK) stipulate minimum requirements for energy performance in buildings. The development in knowledge, technology and prices enables constant new progress to realize future-oriented new buildings that are in tune with the surroundings.

New buildings are becoming increasingly energy efficient, and an increased interest in energy-efficient buildings is reported from lessors, real estate agents and developers. In certain areas, this leads to an increased willingness to pay in the rental market. The model players find that energy-efficient and environmental buildings are a competitive advantage and important for reputation. At the other end of the scale, there are many players who erect new buildings without ambitions beyond the applicable regulatory requirements. The signals observed by Enova indicate a new buildings market that is experiencing positive change. We are seeing more and more pioneers pave the way, and we believe that some of the tested technologies will be so successful that they will be off the shelf for the next generation's renovations.

Another change is that the focus is shifting from individual buildings to a system mindset where multiple buildings are seen as part of a whole. This allows for completely new concepts and increased value creation. At the same time, developing entire areas is complex, and requires coordination between multiple players, comprehensive planning, innovation and new technology at several levels.

Many of the new buildings now have better energy quality than what is stipulated in technical regulations. In addition, Enova can see that already ambitious energy-efficiency projects are constantly pushing themselves further. Radical innovations in technology and solutions are easier to promote in new buildings than in existing buildings, and that is why it is mainly the new buildings sector that is driving technological development.

Enova's programmes for non-residential buildings and property

Introduction of new technology in buildings and areas
Through concept assessment and innovation support, Enova will stimulate the pioneers to push themselves further to show the rest of the industry what is possible. This applies to individual technologies, comprehensive solutions, areas and climate-friendly materials.

Commercial testing
Supporting a single project once, with a given technological solution, does not create significant market change in the property market. A new programme is therefore being established with the purpose of stimulating players who want to use the current best technology that has only been tested on a very small scale, to achieve significantly better buildings than the current TEK standard.

Concept assessment for innovative energy and climate solutions in buildings, areas and energy systems
In order to reach the low-emission society, we need increased interaction between buildings, energy systems and transport. This requires comprehensive planning, increased innovation and new technology within more areas and sectors. Certain such innovation projects end up stranded at the idea stage because of the considerable associated uncertainty. We therefore support building owners, developers and other players who want to push themselves further, but who need to prepare concept assessments before a final investment decision can be made.

Mapping support for existing buildings
Good mapping will provide a better overview of energy measures and how profitable they will be to implement. The support helps promote a better decision basis for making the right investments.

Support for existing buildings
Enova grants financial support to building owners who invest in the best available technology within energy-conserving solutions, and those who convert from fossil to renewable energy sources. We primarily grant support in projects with energy-efficiency measures with a guaranteed energy result or where energy management is a part of the project. What constitutes the best available technology will change and Enova will update the programme correspondingly.

Support for heating plants
Support for installing a heating plant for building heating or production purposes based on renewable energy sources.

New Jordal Amfi could become the world's greenest ice rink

New Jordal Amfi will give both players and the audience an optimal indoor climate, with the least possible environmental impact. Photo: Hille Melbye Arkitekter/Kultur- og idrettsbygg Oslo KF.

The construction of the new Jordal Amfi has started. By combining several exciting technological solutions, the energy consumption will be reduced to one-third of what the old Jordal Amfi used. Enova is contributing NOK 22 million to what will most likely become one of the world's most energy efficient ice rinks.

OSLO

Espen Sletvold

14. september 2017

"The City of Oslo shall be at the forefront and pave the way for good energy and environmental solutions for the future. That is what we are doing in this construction project," says CEO Eli Grimsby in Kultur- og idrettsbygg Oslo.

It is challenging to make an ice rink as energy efficient as our objective calls for in this project. The ice in an ice-hockey rink is highly dependent on stable temperature and correct air quality. Varying outdoor temperatures and different use of the rink makes this even more challenging. If the arena is at full capacity with more than 5000 people in the audience, a lot of cooling will be required, while heating could actually be required during a training session in an otherwise empty rink. Altogether, this contributes to a significant energy demand.

Exploits surplus heat

The rink is being built according to the passive house standard. This means that the building structure will be so well insulated that the effect from outside is minimized. However, it is not enough to dramatically reduce energy consumption.

"The key is exploiting surplus heat from the refrigeration system to heat up the rink when this is necessary. This is what will make the biggest difference in energy consumption compared with the old rink," says Grimsby.

The surplus heat from the refrigeration system will be stored in energy wells until it is required. Alone or in combination with heat pumps, this surplus heat will cover an impressive 97 per cent of the heating demand.

Enova support

It was not until Enova recently granted a funding commitment of NOK 23 million to the project that it was determined that the municipality can invest in all of the ambitious and innovative energy solutions.

"Sports are an important part of the Norwegian society and must also take part in the transition to the low-emission society. Oslo's new headquarters for ice-hockey will become the country's most modern and energy-efficient ice rink, and will set a new standard for how to build good ice rinks," says CEO of Enova, Nils Kristian Nakstad. "The technological solutions that are put to use here will be of the utmost interest to other ice rinks both in Norway and abroad, and some of them also have transfer value to other sports facilities."

The new Jordal Amfi, which is scheduled to be complete in the autumn of 2018, will also have a solar panels on the roof that will cover one-third of the energy demand.

Facts

Project owner: **Kultur- og idrettsbygg Oslo KF**
Year funded: **2017**
Funding level: **NOK 22.9 million**
Energy result: **3.4 GWh**
Planned completion: **2019**

About Kultur- og idrettsbygg Oslo KF
Kultur-og idrettsbygg Oslo KF is a municipal enterprise, established on 1 July 2015. The enterprise is responsible for building, owning, leasing, maintaining and managing culture and sports buildings in Oslo.


MARINE
VÅGØY

PART VI
ANNUAL REPORT AND ANNUAL ACCOUNTS FOR ENOVA SF

Part VI Annual report and annual accounts for Enova SF (page 72-84) has not been translated into English. For information about this, see the Norwegian version.

PART VII
ANNUAL ACCOUNTS FOR THE ENERGY FUND

Part VII Annual accounts for the Energy Fund (page 86-89) has not been translated into English. For information about this, see the Norwegian version.

PART VIII
APPENDICES

Definitions and 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. The calculation takes a basis in emission coefficients for the different energy carriers involved. The climate result is measured in tonnes of CO_2 equivalents per year. The conversion to tonnes of CO_2 equivalents takes place through using internationally recognized GWP factors (Global Warming Potential).

CO_2 equivalent
The greenhouse effect from CO_2 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 CO_2 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 with a one-tonne emission of CO_2 over a specified period of time, usually 100 years.

Contractual result
Contractual result is the annual 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 result for the year in question.

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

ESA
ESA is the abbreviation for the EFTA Surveillance Authority. The EFTA Surveillance Authority ensures that the EFTA nations, Iceland, Lichtenstein 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 result
The final reported result is an updated forecast of a project's expected realized annual result. Enova assesses whether the applicant's final reported result is reasonable.

Innovation results
Enova records innovation results from projects that contribute increased innovation within energy and climate technology. Innovation results are measured in triggered capital in kroner. Triggered capital means the part of the project's investment costs that is triggered through the support from Enova, which is investment costs less support from Enova and other public policy instruments.

Realized result
Realized 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.

Reduced peak demand results
Enova can record reduced peak demand results for projects that result in a reduced peak demand and increased flexibility in the power system. This includes measures that can limit winter loads and reduce short-term peaks. Reduced peak demand results are measured in kilowatt (kW).

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 landfills, 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.

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.

The Energy Fund

The purpose of the Energy Fund is contribute to reduced greenhouse gas emissions and a strengthened security of supply for energy, as well as technology development that also contributes to reduced greenhouse gas emissions in the longer term.

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.

Up to and through 2017, the grants to the Energy Fund mainly consisted of returns from the Fund for climate, renewable energy and energy restructuring. At year-end 2017, the capital in this fund was NOK 67.75 billion. Starting with 2018, the Fund for climate, renewable energy and energy restructuring will be phased out and the transfer to the Energy Fund will be replaced with an ordinary item of expenditure in the national budget. Starting with 2018, the annual transfer will be increased to NOK 2 billion.

From 2018, the Energy Fund will be renamed the Climate and Energy Fund.

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. Support from the Energy Fund must contribute to realizing projects that would not have been realized otherwise. For example, 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.

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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 Enovaworks 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

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