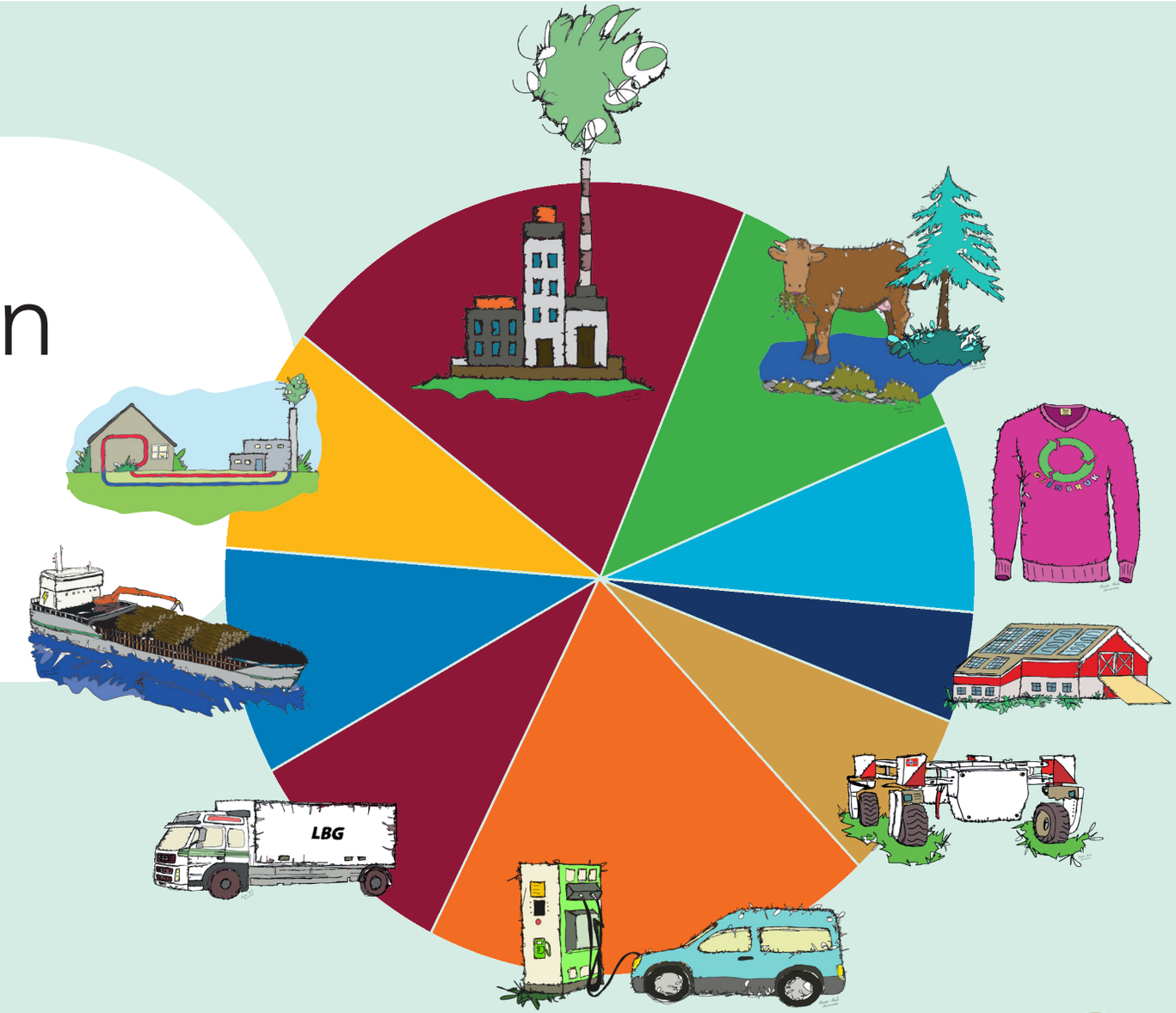
ØSTFOLD
FYLKESKOMMUNE

Regional Plan
2019-2030

Climate and Energy



Grenseløse Østfold

Figures are based on statistics from the Norwegian Environment Agency. Illustrations: Karen Marie Aanonsen, Klima Østfold

Content

Main objectives

Greenhouse gas emissions in Østfold County are to be reduced by 60 % compared with 2016.

By 2030, at least as much energy in Østfold County shall be produced as is consumed through increased production of more than 3000 GWh of renewable energy, energy efficiency improvements and increased production of district heating.

By 2050, all energy produced and used in Østfold County shall be fossil free or plantbased. By 2050, Østfold County shall not discharge more greenhouse gases than we can bind (net-zero).

To contribute to the global low-emission society by 2050, Østfold County shall reduce consumption and reduce our carbon footprint from the goods and services we buy.

Glossary

- Greenhouse gases: contribute to global warming such as CO_2 (carbon dioxide), CH4 (methane) and N2O (nitrous oxide)
- GWh: Unit of energy. 1GWH=1 000 000 kWh
- Net-zero emissions: We will not emit more greenhouse gases than we can bind in any given area
- Climate neutral: a term with many meanings that can correspond to net-zero or allow for higher emissions through thepurchase of climate quotas. Due to its many meanings we will avoid using this term in the Plan
- Emission-free: mostly used to describe electricity and hydrogen that do not have emissions, but may in some cases include things like biogas with a very low carbon footprint
- Circular economy: a system where resources are used again and again, rather than becoming waste
- Carbon footprint: calculation of the total climatic influence a person, business, product or service has – from production to use and disposal or being prepared for recycling.
- LCA: Life Cycle Assessment which shows the total environmental impact from production to use and disposal
- Environmental Product Declaration (EPD): an LCA-based declaration of the environmental impact of a product

UN Sustainability Goals

Goal 1
End poverty in all its forms everywhere.

Goal 2
End hunger, achieve food security and improved nutrition and promote sustainable agriculture

Goal 3
Sikre god helse og fremme livskvalitet for alle, uansett alder.

Goal 4
Ensure healthy lives and promote well-being for all at all ages.

Goal 5
Achieve gender equality and empower all women and girls..

Goal 6
Ensure availability and sustainable management of water and sanitation for all.
.

Goal 7
Ensure access to affordable, reliable, sustainable and modern energy for all for everyone.

Goal 8
Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all work for everyone.

Goal 9
Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Goal 10
Reduce inequality within and among countries.

Goal 11
Make cities and human settlements inclusive, safe, resilient and sustainable.

Goal 12
Ensure sustainable consumption and production patterns.

Goal 13
Take urgent action to combat climate change and its impacts.

Goal 14
Conserve and sustainably use the oceans, seas and marine resources for sustainable development.

Goal 15
Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

Goal 16
Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

Goal 17
Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Secondary objectives

Energy:

- By 2030, at least as much energy in Østfold County shall be produced as is consumed by increasing production to more than 3000 GWh of renewable energy along with efficiency improvements and more production of district heating.
- By 2050, all energy produced and used in Østfold County shall be fossil free or plant-based.

Land use, development and construction:

- By 2030 Limit and reduce the building of infrastructures and housing radically in areas where carbon can be stored like forests, marshes and agricultural land. Net carbon retention in soil and forests will increase by 20% compared with 2010.
- Energy sources used for construction and plant processes in the county should be fossil free.
- Reduce energy used for construction in the county by 10 % per capita compared to 2016.
- Energy consumption in county municipality buildings shall be reduced by 20 % compared to 2016.
- By 2050, the materials used in the construction industry and at industrial plants in Østfold County shall have low carbon footprints, increased degree of re-use and be fossil free.

Transport:

- By 2030, all transport in Østfold County shall be fossil free. The percentage of passengers using public transport will reach 10 %. The percentage of bicycle users should be 15 % for urban areas and 8% in rural areas, for a total of 10 %.
- By 2025, public transport, all county municipality vehicles and machinery, and public transport services pur chased by the county will use sustainable fossil-free fuel, predominantly electric, hydrogen or biogas.
- By 2030, just as much sustainable fuel should be produced in Østfold County as is used.
- By 2030, everyone in Østfold County shall have sufficient access to renewable fuels. There will be filling stations for biogas and hydrogen in the vicinity of the E6 and E18 freeways, and at least one public charging station per 10 rechargeable cars.

Business and industry:

- By 2030, reduce CO_2 emissions from industry by at least 40% per produced unit compared with 2016.
- All energy consumed in the industrial sector in Østfold County shall be fossil free or plant-based by 2050.

Consumption, waste and sewage:

- Østfold County shall be a driving force circular economy with a focus on re-use, recycling and eco-friendly use of resources. By 2030:
- consumption in Østfold County shall be reduced, so the total amount of waste in the county is reduced by 20 % and the degree of waste recycling should be at least 70 % throughout the county.
- water and sewage plants shall cut their net energy consumption in half by 2030 compared to 2016.
- the production of biogas in Østfold County shall be doubled and flaring is to be reduced by 90%.

Agriculture:

- Energy consumption in agriculture in Østfold County shall be fossil free by 2030.
- Food production in Østfold County shall increase by 20 % by 2030, but emissions per produced unit will be 20 % lower than in 2016.
- Carbon retention in forests, marshes and soil should be at least equal to the biological emissions from agriculture in Østfold County by 2050.

Introduction

Climate goals for youth
Østfold County will host Climate Week once a year.

Climate-Smart Østfold
Østfold County has been a driving force among Norwegian counties in many ways where the green shift and renewable energy are concerned. Agriculture and food production are very important and we have many climate-smart farmers who produce with a low greenhouse gas emission per unit and who actively generate renewable energy while phasing out fossil energy. Business and industry in our county do not depend much on the oil sector or fossil fuels. Many farmers began the green shift towards a circular economy years ago and started producing goods and services based on low emissions. The municipalities and the county municipality have been collaborating for years on sustainability goals through the Klima Østfold scheme.

Organization of work
The first municipal climate plans for Østfold County were adopted almost 20 years ago. The county municipality chose to integrate climate change as a priority area in the county master plan but finally decided in 2016 (Regional Planning Strategy, PS80/2016, updated PS88/2018) that the county needed a plan dedicated entirely to climate issues. This plan has its legal basis in the Norwegian Planning and Building Act, which is the foundation for state and regional climate and energy work. Many municipalities had climate plans that sorely needed an update, so we chose to collaborate with several municipalities to create new plans.

Klima Østfold allowed us to combine resources more efficiently and achieved good interaction with county residents and local businesses. The Climatic Plan aims to restructure our whole community: residents, business, research and education, voluntary organizations and public agencies. We established work groups in various disciplines to take responsibility for acquiring knowledge and arranging meeting places to get as many people involved in the work as possible. A long series of meetings, seminars and workshops were held on different topics in 2018 (see the Klima Østfold Annual Report for 2018 for an overview).

The Energiforum/Klimapartnere Østfold network established a board of representatives with participants from private businesses, energy companies, academia, trade unions and non-governmental organizations as the reference group for this work. We are grateful to everyone who took the time to share their knowledge and provide input for the plan at these meetings or who collaborated digitally through our websites and social media.

We want to especially thank all the children and young people who have been discussing climate solutions in classrooms around the county, on the streets and, not least, in the county's youth council. The youth council requested an annual Climate Week for Østfold County to ensure continued focus on this work.

Klima Østfold has received grants from EU Horizon 2020 to exchange knowledge and experience with other municipalities and regions in Latvia, Belgium, Croatia and Spain due to the innovative way we work with climate and energy plans in the county.

Organization of work
The Østfold community has committed itself to several goals and strategies to meet the challenges of climate change, through its work on the county master plan, which was adopted in 2018. This plan is also the basis for the Regional Climate and Energy Plan. The most relevant milestones for climate and energy work in the county master plan are:

Østfold shall be a county that protects the climate, natural environment, cultural heritage and cultural landscapes and takes environmental considerations into account in the public and private sectors. By 2050, all energy consumption in Østfold County will be based on renewable sources. Agriculture and industry will lead the way in minimising other types of

greenhouse emissions per produced unit. Østfold County shall be a low-emission society with a high degree of energy efficiency and optimal use of resources. We have set milestones for the years 2020, 2030 and 2040 to reach this goal by 2050. The transport sector in Østfold County shall be fossil free by 2030. This goal applies to all means of transport.

The county master plan also contains land-use strategies and guidelines for land use and energy and planning provisions which are specific means to achieve an eco-friendly and climate-friendly future.

Many countries around the world have signed the 2015 international climate accord (Paris Agreement) as a commitment to limit global warming to 1.5 °C. The UN Sustainable Development Goals were also an important guideline for the upcoming merger of several municipalities into the new Viken county municipality. The government of Norway is working to meet the goals of the Paris Agreement and together with the European Union has set a goal of cutting emissions by approximately 40 % by 2030.

Klima Østfold hired the Cicero Center for Climate Research to calculate how the county can meet the Paris Agreement. The most important conclusion of this report is reaching net-zero emissions by 2050. That is to say, we cannot emit more greenhouse gases than our county is able to retain in its forest, marshes and vegetation or by another means of carbon capture. Cicero's study clearly shows that a 40% reduction in CO_2 emissions by 2030 is far from adequate: if we want to maintain, or preferably increase, food production in the county (which entails emissions of methane and nitrous oxide). That is why CO_2 emissions need to be cut considerably more. We have already set an ambitious goal for the county to be fossil free within the transport sector by 2030. Several institutions within the agricultural sector are working towards fossil-free agriculture by 2030 and many industrial companies are planning major investments to reduce emissions considerably. Altogether, this means it may be possible to achieve a 60% cut in greenhouse gas emissions in Østfold County by 2030.

However, to reach global goals to reduce greenhouse gas emissions, it is transport of goods and services from other regions and countries are also sources of emissions outside the county for which we are responsible. We need to set more stringent environmental requirements for public procurements, but we can also help private operators and citizens in the county change their patterns of consumption. In the long term, all business and industry must make new and old business ventures compatible with a low-emission society.

Climate budgets and action plans

The following chapters of the Climatic Plan will provide an overview of the current situation and explain various measures and strategies that can be used to reach our goals. Implementation of the plan will be clarified in the annual climate budget. This action plan can be integrated into the county municipality's economic plan and annual budget, and give us the opportunity to prioritise the measures that work best. Thus, environmental management will be well-integrated into all other management systems in the county. The climate budget provides an outline and overview of measures, costs, deadlines and responsibilities, and it explains the impact each measure will have on greenhouse gas emissions in the region. As a whole, the national initiatives and measures from regional and local climate budgets the next 10 years will be enough to meet the goal of 60% reduction of emissions in Østfold County by 2030, and help us reach the goal of Net Zero Emissions by 2050.

Climate change adaptations

Climate change is here, and it is happening now. As we work to reduce greenhouse gas emissions we also need to adapt to a wilder, warmer and wetter climate with higher sea levels and increased risk of flooding and landslides. In Østfold County we look at climate change adaptation as a prerequisite for risk assessment and emergency preparedness, focusing specifically on this through FylkesROS 2017, Our risk and vulnerability analysis for the county, which is part of the county master plan.

Background Info

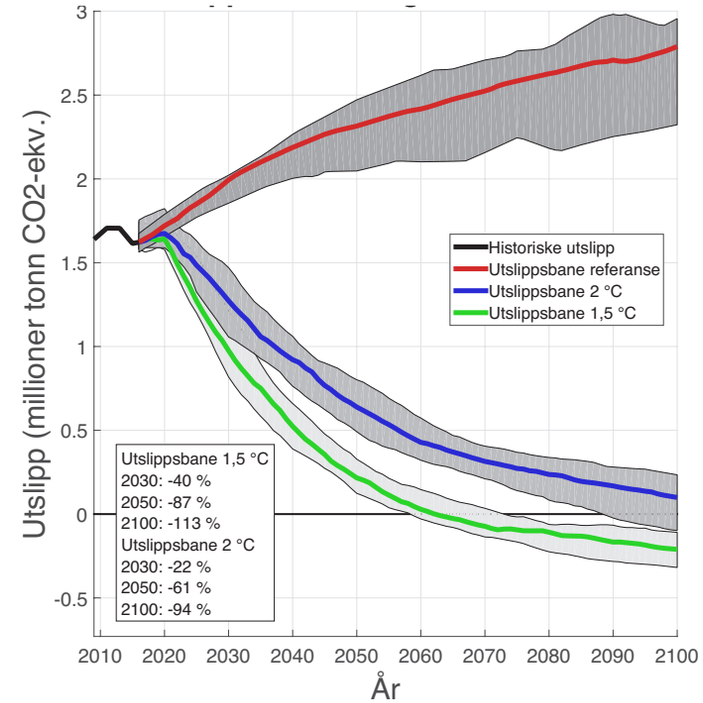
Greenhouse gas emissions in Østfold County have actually gone slightly down since 2011 (black line). To avoid catastrophic global warming, we should contribute to a significantly faster reduction of local, regional and global emissions. The figure to the right shows the extrapolation for Østfold County's share of global greenhouse gas emissions if we fail to act (red line), what efforts are needed in the county if we are to limit warming to 2 °C (blue line) and if we want to reach our goal of 1.5 °C (green line). The figure shows the sum of all the different types of greenhouse gases. We do not plan to eliminate agriculture and industry from the county, so methane and nitrous oxide emissions will never reach zero. That is to say that emissions of CO_2 must be reduced even quicker, and we need to find ways to trap CO_2 long before 2050. The faster we manage to reduce emissions, the less dependent we become on carbon capture and storage in the future. Although the Paris Agreement says that rich countries should take the lead in working to cut emissions, this figure is based on all countries cutting their emissions equally regardless of whether they are rich or poor and regardless of how much they have contributed to global warming in the past.

Almost half of the emissions in Østfold County come from transport, but industry (21 %) and agriculture (12 %) are also important sources of emissions. Greenhouse gas emissions in Østfold County have gone down by almost 13 % from 2009 to 2017. We see the largest decreases in road transport (−20 %) and industries (−24 %). Although some of this is due to businesses closures, and mixing biofuels that are not always sustainable, much good work has gone into improving energy efficiency and restructuring locally-produced bioenergy and power, in both the transport sector and industry in Østfold County.

Some sectors, such as transport and agriculture, have seen an increase in carbon emissions since 2009. This may partly be an indication of increased food production and increased maritime transport to and from the ports in Østfold County, and not necessarily just a negative trend. It does however tell us that we need to focus on these areas in future work.

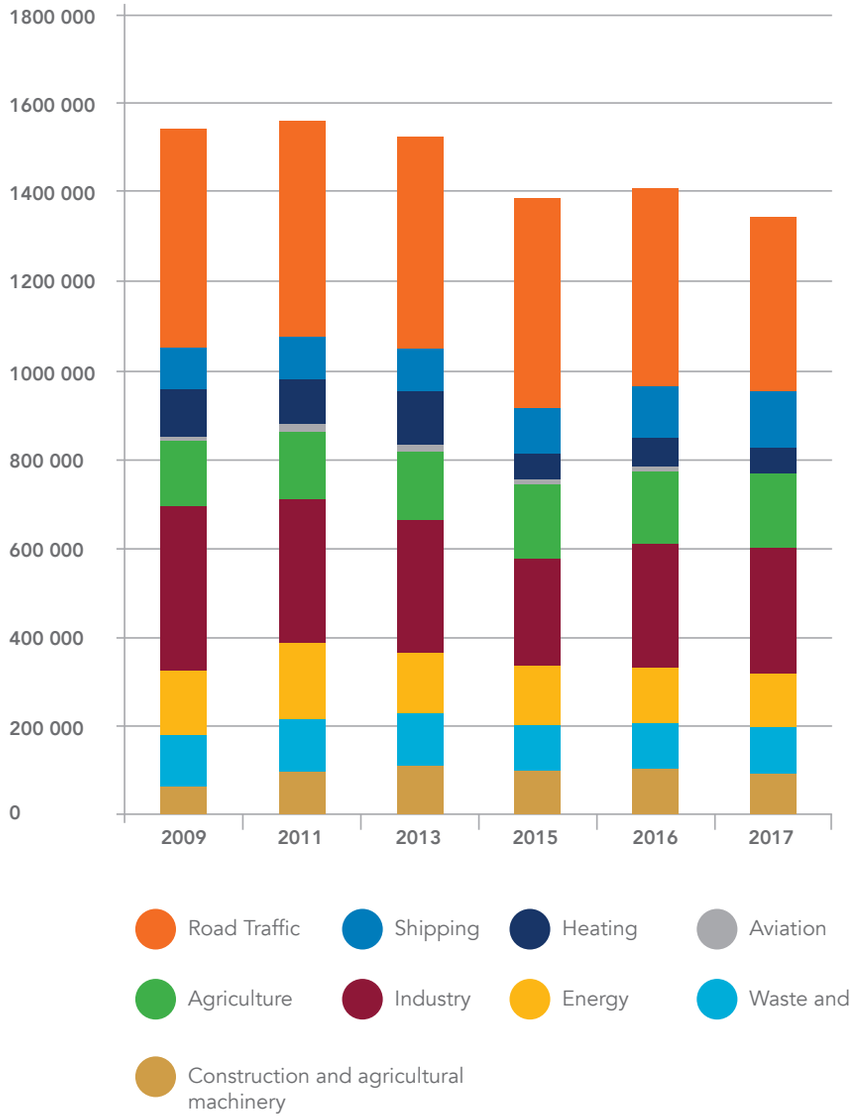
Within heating, energy supply, waste and sewage, we will probably see major changes in times to come when the fossil fuel oil ban comes into force on 1.1.2020, and the requirements for higher degrees of recycling of waste take effect.

Emissions of greenhouse gases in Østfold



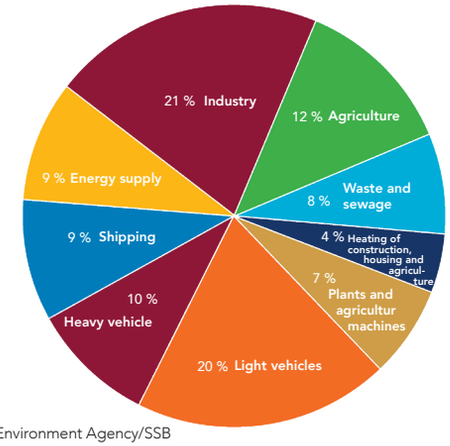
Extrapolation of total greenhouse gas emissions in Østfold (CO2, N2O, CH4). The figure is based on an average of many scientific studies, and the field around the lines shows uncertainty of calculations.
Source: Cicero

Greenhouse gas emissions in Østfold 2009-2017



Source: Norwegian Environment Agency/SSB

Greenhouse emissions for 2017 (tons/ CO_2-equiv)



Source: Norwegian Environment Agency/SSB

Energy balance

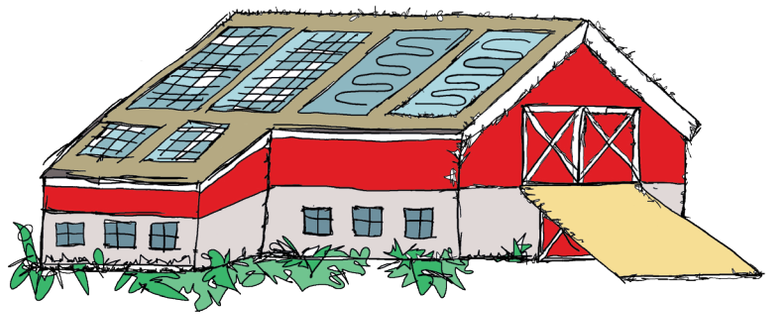
	Produksjon (GWh)	Forbruk (GWh)
Totalt	**7600**	**11600**
Elektrisitet	4900	6200
Annen energi til industriprosesser	900	1700
Varme til næringsbygg, landbruksbygg og boliger	600	600
Drivstoff til transportsektoren	1200	3100

Production and consumption of energy in Østfold County are complex, and there are no good aggregate statistics. The table shows an estimate for the four main areas based on information from Statistics Norway, NVE, individual companies, Nobio, Småkraftforeningen, the Norwegian Environment Agency and some others.

Østfold has a combined degree of self-sufficiency of around 79 % for electricity and about 65% if one includes heat, energy for industrial processes and fuel for the transport sector. Feedback from energy producers and industry suggests that the potential for new renewable energy production is at least 3000-4000 GWh from solar, wind, hydro, bioenergy and energy-recycling. Source: Norwegian Environment Agency/SSB.

Energy

Norway had an annual production of 139 000 GWh in 2016; approximately 5000 GWh higher than its consumption. Surplus power is exported to the rest of Europe. Normal power generation in Østfold County is approximately 5000 GWh, nearly all of it renewable. Our 18 hydropower plants produce around 4644 GWh/year. In addition, both wind power and solar energy are growing. Wind farms in the Municipality of Marker will generate 255 GWh when they become operational in 2019. Some power comes from small-scale wind turbines and solar cells, waste incineration and biogas, but there are no useful statistics on those amounts.



Solar energy is a market in rapid growth, and Østfold County started developing large plants at an early stage for warehouses, and forward-looking consumers who laid solar panels on their own roofs. Several of the municipalities and the county municipalities have taken the initiative to increase production of solar energy, either on own buildings or by supporting private endeavors of our inhabitants. The total production of solar energy in Østfold County is probably less than 5 GWh/year.

The energy sector in Østfold County is an important industry requiring expertise, a high degree of research and innovation and a lot of skilled workers – especially within electricity and plumbing. The industry is facing comprehensive digitisation and we will need many more competent workers in the future. Electricity is flexible and can be used for everything from industrial processes to transportation and heating. Other types of energy such as hot water are only suitable for heating. Electricity can be freed up here for other uses by using alternative heat sources such as solar power, bioenergy and waste heat from industry.

Output is an expression of how much energy is used at a given time. The power grid in the county is dimensioned for the highest output needs; if power peaks increase, we will see development costs rising that must be paid via network tariffs. Building out an electric grid often conflicts with other interests such as biodiversity, cultural heritage and outdoor recreation.

Increased peaks can be challenging for power production. Small-scale hydropower plants, solar panels and wind turbines are considered non-adjustable power, which produce when water, sunshine or wind are there. If one only bases the electricity system on this type of power, we are certain to face challenges in meeting power demands at any given time, and at certain periods we produce more energy than we can use. In Norway, production of wind power will often be greater when much power is being used, while solar energy has the potential to produce energy in periods of low power consumption. The large water reservoirs can be used to balance power and regulate production by releasing more or less water through the power plants as needed. Other considerations to nature will limit the extent to which we can empty the reservoirs to balance out the power being fed to the power grid. It is possible to use bioenergy, batteries, heat retention in water or in the ground or hydrogen as buffers to balance output needs.

Examples of strategies

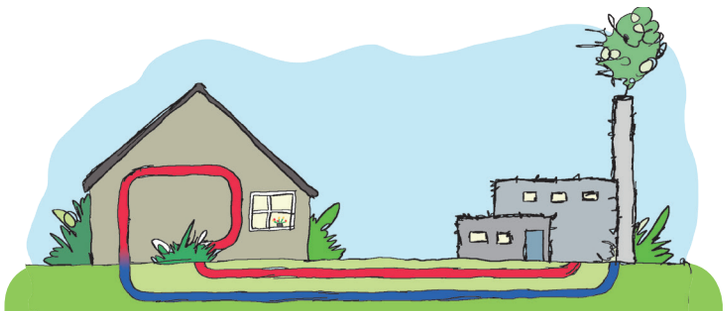
- Draw up a heat/cooling plan for Østfold County.
- Strengthen our focus on energy efficiency.
- Support more renewable energy development projects.

Increasing the use of district heating and cooling will also help balance the energy system. The power grid in Østfold County generally has good capacity and there is room for more production of renewable energy, although there are limitations to the distribution network as cables get closer to the consumers. New smart solutions for managing and storing energy can provide opportunities in areas that were previously considered challenging. Businesses that deliver or require a lot of power should be built in areas where there is good grid capacity.

Hydroelectric plants in Østfold are primarily built along the major rivers, of course, although there are many small power plants in the county as well. Two concessions have been granted for small-scale hydropower plants (for a total of 3.93 GWh) but these have not been built yet. The potential for new hydroelectric plants in the county beyond this is limited. Upgrading and expanding the existing plants has in recent years provided several hundred GWh of increased production, but full potential here has been reached.

Development of wind farms in Østfold County would be profitable in a number of locations. The Regional Plan for Wind Power in Østfold County (2012) points out some locations where this would be suitable based on wind conditions and limited conflicts of interest. Later studies indicate that wind conditions in Østfold are better than expected, and that the cost of building wind farms has gone down. With the reduced cost, development of single mills in industrial areas and on farms would also be profitable. Overall, there is a sustainable potential for at least 1000-2000 GWh of wind power in Østfold County. There are still major conflicts related to wind farm developments that can keep these projects from getting off the ground. In contrast to wind and hydropower, solar energy plants could be built without substantial conflict of interest. This applies in particular where panels are added to existing roofs. Calculations from NVE suggest that if all suitable roofs and façades in Norway were exploited for the production of solar energy, potential could reach 21 000 GWh/year from solar thermal collectors and 9000 GWh/year from solar cells. Østfold has some of the best sun conditions in the country, so the theoretical potential for solar energy production is probably at least 1000 GWh. However, this will require a large number of firms and households that choose to invest in solar cells on their roofs. Expanding the use of solar cells is currently limited by high investment costs, but costs are dropping rapidly. In other parts of Europe we see solar plants being built on large fields. With respect to how much space these plants would consume, this option is considered less applicable to Østfold County.

Despite increasingly stringent building regulations and a lot of new technology, there is still much energy being wasted in Norway on the whole. Increased awareness would help. Many households could make simple and cost-effective changes and upgrade insulation to save around 20 % of domestic energy. Municipalities that initiate large energy efficiency projects such as energy saving contracts have managed to save up to 40-50 % in some buildings



District heating is an efficient way to distribute and reuse heat. There are 9 district heating plants in the county with annual production of nearly 150 GWh from energy recovery, waste incineration, and bioenergy – in addition to heat pumps. Some fossil oil and gas are still in use at the district heating plants, which will be important to phase out as quickly as possible.

Energy (continued)

Bioenergy

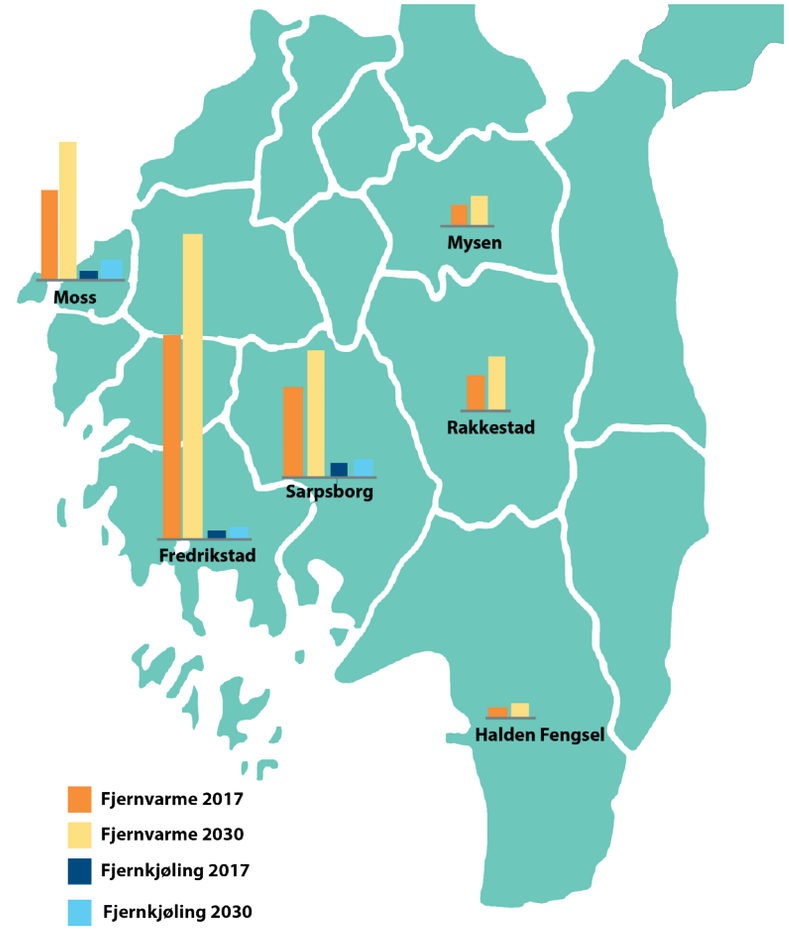
Bioenergy is an important source of heat, and most detached houses in Norway have a wood stove or fireplace. The county estimates that wood heating contributes with around 450 GWh in private households in the county today. National sales and consumption of firewood has gone down in recent years as the number of heat pumps have increased. Other types of bioenergy such as straw, wood chips and firewood are being used at 150-200 farm-heating facilities built in Østfold (norskebioenergianlegg.no). This amounts to a total of at least 50 GWh. There are other biofuel-based industries in Østfold County that generate more than 600 GWh of heat by burning oat hull, sludge, waste liquor and other types of residues and waste from own production

District heating and heat pumps

Electrical energy can be used as direct heating through electric boilers or electric panel heaters, or used in heat pumps to collect energy from i.a. holes drilled in rock, or from air or water. Heat pumps can produce a lot of heat from limited amounts of power, especially in large or small heat plants.

Better insulated buildings, with ever more technical equipment, increase the demand for cooling – especially in offices and commercial buildings. But we also see air conditioning being used increasingly more in households, often assisted by previously installed heat pumps. Climate change will reinforce this development. Several of the district heating plants and heating plants in Østfold County offer district cooling based on renewable energy, and there is a huge potential to increase this production. The district heating companies in the county are working to develop new solutions for energy storage. In that way, the district heating network will not only be able to distribute energy between various users, it can also reduce energy losses throughout the year. A heating and cooling plan for the county would be a good tool in utilising more of the potential that lies in district heating and cooling in the county.

District heating and district cooling in Østfold



District heating is an energy efficient solution that can help us utilise energy that would otherwise be wasted, or allow us to invest in larger and more efficient production plants based on bioenergy. The production of district heating from renewable sources has a huge potential for increase, and it is particularly interesting to look at the possibilities for increased use of district cooling and waste heat from industry.

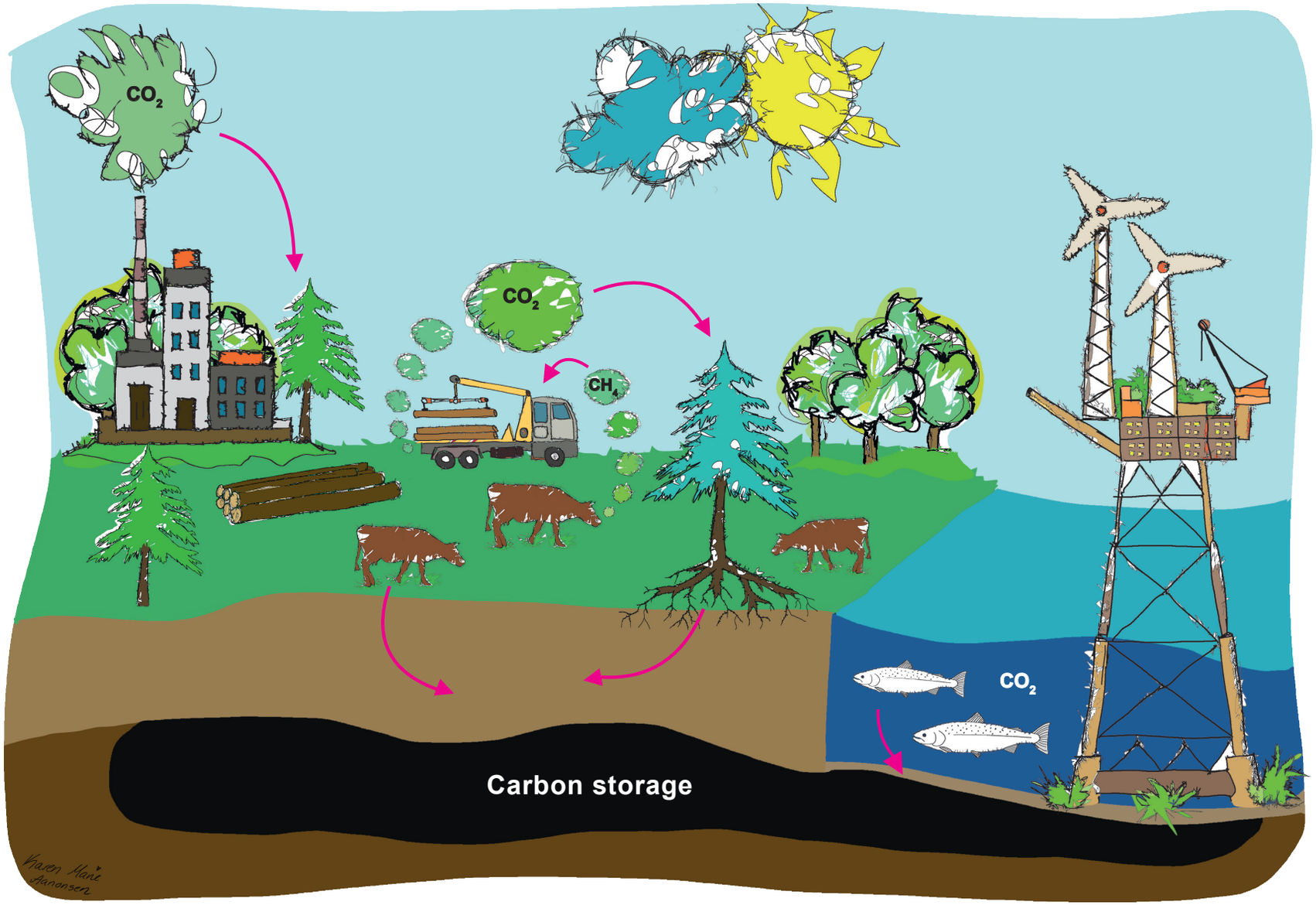


Illustration: Karen Marie Aanonsen, Klima Østfold

Business and industry

Sustainability

Business and industry in Østfold County have the wherewithal to lead the transition to a sustainable low-emission society. Many of the companies already produce the products we need such as insulation, electric cars, power cables, chemicals and fuels from renewable raw materials. Skilled professionals and advanced knowledge environments within environmental and resource efficiency, circular economy and smart energy management come together with skilled entrepreneurs in the solar, bio-energy and food industries as a foundation for forward-looking innovation, research and development. The potential for new climate-friendly jobs in Østfold County is great, and the public sector can lay the groundwork for development at a local and regional level to promote relevant meeting places and collaborations that can search for climate solutions – and through targeted requirements and support systems.

Greenhouse gas emissions

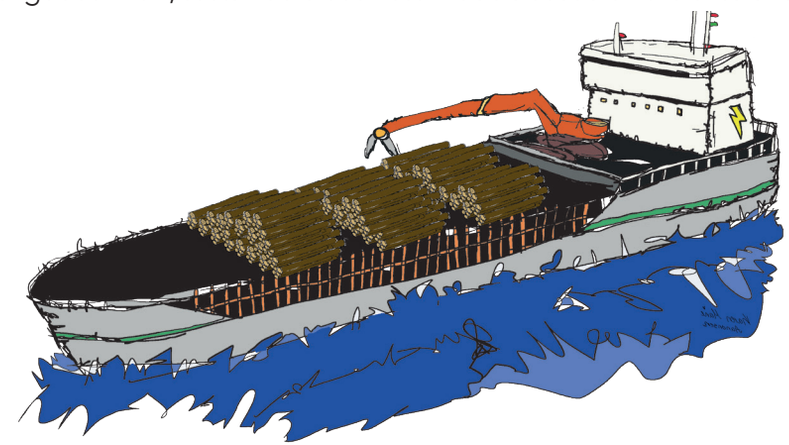
Greenhouse gas emissions from industries in Østfold County come mainly from the use of fossil fuel energy in production processes and transport. Industrial companies in the county have already taken big strides to convert to renewable energy. 80 % of the greenhouse gas emissions from industries in Østfold County come from eight companies that are associated with the EU quota system, where emissions beyond the free allowance quotas are becoming more and more expensive. Several of the major industrial companies have set their own climate targets, often associated with international initiatives such as the Carbon Disclosure Project or Science-Based Target Initiative.

Emissions from energy use and processes at factories in Østfold County accounted for 21 % of all emissions in 2017. Those industries produce important goods and services that are needed in a low-emission society, and it is important to facilitate growth. At the same time, all fossil energy used by industries should gradually be phased out to cut emissions by 40% by 2030, and by 2050 only renewable or waste-based raw materials will be used. As there is greater demand for the products we need to convert to a low-emission society, increased production may in periods lead to increased emissions at a local level.

Regional and local authorities together with industry will be the driving force to get national and international frameworks in place to facilitate a more rapid and profitable change in our community and industries.

Trade and other service industries employ the most people in Østfold County. Trade at a local level, downtown, and localised cultural services make locations attractive and reduce the need for car journeys; it is therefore important to maintain and develop these. The trade's largest source of emissions in the county is the transportation of goods. Local goods distribution hubs that offer fossil-free transport can reduce transport and greenhouse gas emissions.

Overall, however, most emissions from commerce are related to the production of goods. New, sustainable business models based on the circular economy



Heavy road transport that carries goods in and through the county accounted for 10 % of greenhouse gas emissions in 2017. Even if it is financially and technologically challenging, good public framework conditions could make it possible to reach the fossil-free goal for goods transport by 2030. It is important to transport more goods by ship and railway and make these fossil free. If more petrol stations are built, biogas as a filling option would contribute to a rapid reorganization of heavy vehicle transport, because these vehicles are available on the market.

are under development in several places in Norway. A good network and reuse can help reduce consumption while the demand for quality products that can be repaired increases.

Carbon captureure

While carbon capture in other sectors deals with trapping carbon using natural processes such as trees, marshes or soil, industries must use technological solutions to extract CO_2 as in flue gases, or by upgrading to biogas as fuel. Emissions are considered green if companies use bio-fuels or waste with a large share of renewable raw material. Carbon dioxide is an important resource, and green CO_2 can be used to replace fossil CO_2 in beverages, slaughterhouses, horticultural and other food production, or replace diesel-powered refrigeration units. Carbon used in this way is not captured but returned to the cycle. To trap CO_2 for a long time, the best solution available today is to pump it into deep reservoirs below the seabed. If this is done with green CO_2 the emissions are considered negative, meaning that more than 100 % of the emissions are captured and bound.

Energi

Various industries in Østfold County have already implemented major energy efficiency programmes and started using waste products from own processes or those of others to replace several hundred GWh of fossil fuel energy.

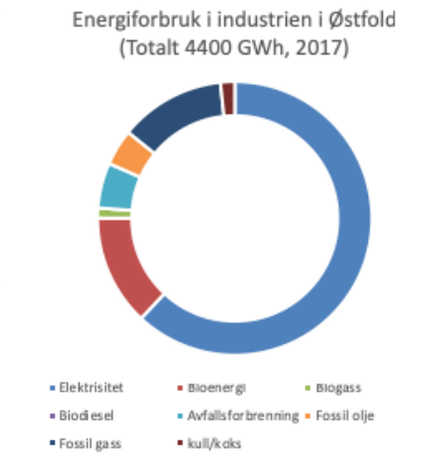
Industrial zones and commercial properties can benefit from sun and wind and wind energy that does not conflict with other interests. Compared with other counties, biogas production in Østfold is extensive; there is a lot of untapped biogas below and near industrial plots that can be used to replace fossil gas. Biogas energy can be more than doubled in the county by making better use of waste and other raw materials from industry and trades such as fertiliser and food waste.

There are large amounts of surplus heat being generated at industries which could be used in district heating at other businesses, public buildings and in homes. Own energy production, and increased interaction with neighbouring companies, could help industries in Østfold phase out all fossil energy consumption well before 2050.

Consumer and commerce trades have undergone considerable energy-efficiency measures in recent years, by lowering cooling needs, making lighting more efficient and improving energy management. Many businesses are small and therefore not eligible for public support. Still, there is considerable potential for further improvements here. Retail and service businesses are often tenants, but even if they can't carry out measures directly it is possible to demand more energy efficient premises

Examples of strategies

- Promote relevant meeting places and cooperation.
- Call for climate solutions.
- Develop targeted demands and support systems.



Gross energy consumption at the largest industrial companies

Land use, development and construction

Sustainability

How we live and how we build are crucial factors for carbon emissions in a community. The county master plan states that we should emphasise the development of good, compact populated urban areas and cities in Østfold County. Land use planning and the design of residential areas can increase well-being, physical activity and security. Putting homes and businesses in the right place reduces the need for mobility and makes walking, cycling and public transport more attractive.

Construction is the sector with the highest value creation in Østfold County right now. The business community here has been at the forefront of developing sustainable building materials and our builders are highly skilled. The expertise of contractors and builders is essential to unleashing potential energy efficiency in the construction industry. This type of expertise is increasingly sought after.

Thus, a stronger focus on climate and the environment through ambitious requirements and an increased focus on energy efficiency and upgrading could result in even greater value creation in our region.

Greenhouse gas emissions

The size and location of buildings and dwellings is very important for creating a low-emission society in the long run. But the vast majority of buildings to be used in a low-emission society are already built. In some cases, it would be best to demolish buildings and replace them with more climate-friendly, energy-efficient and space-efficient new buildings. But material production, construction and transport consume resources and energy, creating greenhouse gases and waste. That is why good operation, maintenance and energy-efficient upgrades on existing buildings are often better alternatives. When renovating old buildings and building new ones, one should consider the reuse of the heaviest structures and materials.Buildings with conservation value are a non-renewable resource. Upgrading these in line with the guidelines set for preservation of cultural heritage monuments can make old buildings more eco-friendly and user-friendly.

It is important to utilise space effectively in cities and densely populated areas, but also in each building. Co-use is a good solution: if schools and other public buildings are used in the evenings by volunteer organizations, arts and culture, and by the local community, we can reduce the carbon footprint of each building instead of each activity having its own building.

The building sector accounts for a considerable amount of transport of goods and materials to, from and within Østfold County. The vast majority of delivery vans belong to builders, and less than 1 % of these use biogas or electricity. Better and more eco-friendly materials and construction equipment are being developed. To be competitive, the public and private sectors must facilitate the green shift and demand fossil-free construction sites and district heating and renewable electricity right away. Purchasers should choose re-use, renewable materials and materials with the lowest possible carbon footprint, preferably those with an Environmental Product Declaration (EPD).

Digging, removal and disposal of materials are significant causes of greenhouse gas emissions in many construction projects. We can reduce emissions by reusing materials from the site or looking at the option of removing smaller quantities. Solutions are being developed in some industries, such as water and sewerage, that require minimal digging.

Examples of strategies

- Optimising the utilisation of existing buildings and land already in use.
- Strengthen the focus on maintenance.
- Require fossil-free construction and plant processes.

Carbon retention

Forests, marshes and agricultural land in Østfold County retain large quantities of carbon. Emissions increase and less carbon is retained when these areas are used to build homes or roads. It is very difficult to move arable land, and other restriction on nature zones put limitations on land reclamation in forests. Marshes and swamps take thousands of years to build up and should be preserved whenever possible. This is yet another reason why it is important to utilise or co-use areas that are already developed. Densification based on quality designs and by transforming spaces so they can be used in new ways.

Buildings can also retain carbon. A wooden house retains about 700-900 kg of CO_2/m3 in its wood. For a traditional residential building, this corresponds to 11-16 tons of CO_2, while a school designed with a lot of wood materials will be able to bind around 1000 tons of CO_2. Carbon is emitted when a building is demolished unless the materials are reused. Other building materials often have a higher climate footprint than wood, but the concrete industry has plans to reduce its climate footprint through carbon capture and storage at production plants, and the Norwegian steel industry has been working hard on energy efficiency.

Energy

Heating based on fossil fuels will be prohibited by 2020, which means greenhouse gas emissions from energy used in buildings in Østfold County will be very low after that. In the long term, all fossil gases should be phased out.

Ever more energy efficient buildings are being built that emit renewable energy that can be used for other purposes, whether we are talking about small, energy conservation measures in a residential building from the 50s, or a newly built low-energy home. District heating should be prioritised wherever this is possible, but one can also facilitate the exploitation of local energy sources through energy production from the sun, ambient heat and the like. The best solutions should be chosen through an integrated energy design process. The county municipality's own buildings and facilities have great potential for energy production and energy efficiency. We currently compare energy consumption by square meter these days. Increasing co-use would be beneficial, and we could calculate energy consumption compared with the number of users of a building.

In the course of its life, one tree can retain up to 1 ton of CO_2. Planting trees in cities, towns and residential areas can never compete with forests when it comes to carbon retention, but research shows that green spaces do improve well-being and the living environment, and they are important for animals and insects.

Transport

Sustainability

Transport is not a goal in itself, but eco-friendly transport systems are a prerequisite to building a sustainable low-emission society. By increasing walking and cycling solutions and making public transport attractive and easily accessible, we can ensure better mobility for many groups in society. The transition from fossil fuel to renewable fuel not only reduces greenhouse gas emissions, it also contributes to cleaner air, increased local energy production and local jobs from fuel and vehicle production.

Greenhouse gas emissions

The green shift towards a low-emission society leaves no room for emissions from the transport sector. Transport involves direct emissions from within the municipality and indirect emissions from the production and distribution of cars and fuel. The transport sector accounts for around half of all emissions in the county, of which 60 % is road transport. Since 2009, the emissions from road transport have been reduced by 20 %, while emissions from sea transport have gone up.

A larger population needs more passenger and goods transport, and the more we earn the more we are willing to spend on travel, travel more and travel more effectively. The eco-friendliest trip is the one not being made. By facilitating home offices, teleworking and digital meeting solutions, we can help reduce commuting and business travel of own employees and visitors.

Most journeys in Østfold County take place by car; public transport only accounts for 5 % of all journeys – while bicycles account for 6 %. In a county with significant population growth, it will be important to change this trend. The national bicycle commuting goal is 8%, and the climate and geography of Østfold County make it possible for more people to ride a bike to work or school etc. The county and the municipalities own a large share of the roads in the region and play an important role in facilitating the use of fossil-free fuels and effective and safe walking and cycling infrastructures. In addition to electric trains, public transport in Østfold generally runs on biogas. Fossil fuel is still used in the buses in Halden and Indre Østfold, in chartered transport and on the ferries. The buses and several of the municipal and county ferries will be rebuilt for low-emission or fossil-free fuels in the course of 2020.

Where more eco-friendly modes of transport do not cover the need, passenger cars will still play a role. Ships and trains are preferred for goods transport, but trucks and semis will also be required for much of the transport work in the future. To reduce greenhouse gas emissions from the transport sector, it will be necessary to get cars to use sustainable/renewable fuel as quickly as possible.

Energy

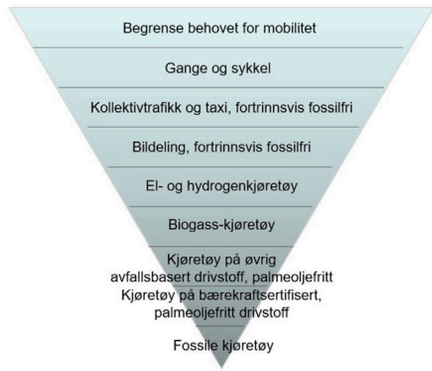
About 3000 GWh of fuel is currently sold in Østfold County, where virtually everything comes from fossil fuels. But the county is already producing many future fuels: approximately 1200 GWh of biofuels such as biogas, bioethanol and biodiesel, in addition to renewable electricity. Hydrogen can also be produced in Norway using local raw materials. Energy consumption will be greatly reduced as we transition to electric vehicles and eliminate vehicle emissions. Biogas and bioethanol are in a unique position from the standpoint of sustainability, as they are produced locally from waste from residents and industry. There is great potential to increase biogas production, which will increase value creation via employment by around 1.3 jobs per GWh.

Examples of strategies

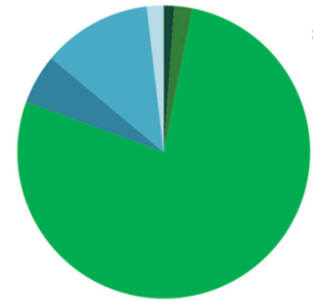
- Make it easier to choose eco-friendly transport.
- Build out infrastructures for fossil-free transport.
- Demand fossil free transport.

We need enough filling and charging stations in the country to make use of renewable fuels. Bioethanol and biodiesel can be filled using conventional fuel pumps, while biogas and hydrogen need their own filling stations. There are several filling stations for biogas in Østfold County already, and plans are in the making to build hydrogen stations but making these fuels a realistic alternative will require a continuous network of filling stations – nationally and throughout Europe.

The network of charging stations for electric vehicles in Norway is relatively well developed, but the number of rapid chargers and normal chargers must multiply to keep up with demand. The lack of normal chargers for people living in housing cooperatives and joint ownership associations, and others who do not have their own garage is a challenge already today.



Klima Østfold's plan to develop the Norwegian Environment Agency's fuel hierarchy (2018). Fossil free this refers primarily to electricity, biogas and hydrogen, and secondly to waste-based and possibly other types of sustainable and certified palm oil free fuel.



Distribution of greenhouse gas emissions for light vehicles: Passenger cars and delivery trucks

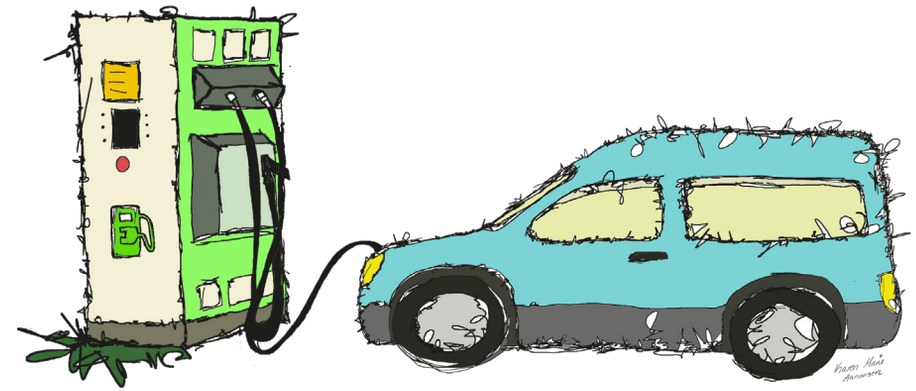
266 000 tons CO_2 - equivalents

Passenger cars: 81 %

- Taxis
- Rental cars
- Other passenger cars

Passenger cars: 81 %

- Private driving, delivery trucks
- Craftsmen
- Distribution and goods delivery



Electric motors are more energy efficient than internal combustion engines. An electric vehicle typically uses 2000-3000 kWh a year, while a car running on petrol normally uses 5-6000 kWh of fuel. In 2018, there were 7475 electric vehicles in Østfold County, which corresponds to power consumption of about 15-20 GWh. If all cars in the county were electric, electricity consumption would increase to approximately 400 GWh, and reduce petrol and diesel consumption by approximately 1000 GWh.

Consumption, waste and sewage

Sustainability

We live in a consumer society that is still not sustainable, where we use more raw materials than the earth manages to produce. Household consumption causes approximately 60 % of global greenhouse gas emissions and rich countries have significantly higher emissions than developing countries. There are large differences in the consumption patterns in Norway as well. By focusing on fair trade and reducing consumption the business sector, public agencies and the residents of Østfold County can make the planet more sustainable, lower poverty and lessen inequality.

Much of our consumption turns quickly to waste. If we convert to a circular economy, today's waste will become the resources of the future. Østfold County has substantial expertise within the recycling value chain from energy production to recycling, reuse and waste reduction, and in research and innovation for practical implementation. Yet, we have a long way to go before we reach the international goal of 60-70 % degree of effective recycling by 2030.

Greenhouse gas emissions

Goods and services used in Norway create huge greenhouse gas emissions throughout the world, both from production and transportation. Less consumption is the best way to reduce these emissions through e.g. buying fewer things, focusing on quality, repairing what you already own or buying used. The municipality and the county municipality can support local initiatives such as repair shops, garage sales, neighbourhood cultivation, educating about sustainable consumption, etc. Reuse can be organized at existing waste receiving stations, in addition to decentralised solutions.

1/3 of the food produced in the world goes straight to the garbage. Norway discards 385 000 tons of food annually, and there is huge wastage in all stages from production to stores and consumers. The government has set a target of cutting food waste in half by 2030; we have already seen a positive trend in 2018 with a 13 % reduction compared with 2015. Food constitutes a significant share of our climate footprint, so it is important to continue efforts to reduce food loss and food waste at all stages of the value chain.
Public operators in Norway spend 500 billion kroner every year on purchases. Focusing more on re-use and setting good climate and environmental standards will allow municipalities and county municipalities to lower consumption and lower the climate footprint from goods and services.

Carbon capture

As with industries in Østfold County, the recycling trade has great potential for carbon capture from waste incineration plants and from plants that produce and upgrade biogas.

Energy

After prohibiting disposal of biological waste in Norway, emissions from landfills gradually decreased, but methane and other greenhouse gases are still escaping from the old landfills. Some of this can be collected and used for the production of biogas, but as the dumps get older it is increasingly more challenging to collect the gas.

Water and sewage services accounted for 11 % of municipal energy consumption on a national basis in 2014, and 1/3 of drinking water is lost in leaking pipes.

Examples of strategies

- Reduce unnecessary consumption.
- Facilitate reuse and sharing.
- Increase production of waste-based energy

Water and sewage in some municipalities in Østfold County is pumped over long distances, which increases energy consumption. We can reduce energy consumption dramatically by stopping leaks in the drinking water grid, insulating and introducing energy management into buildings and removing incrustation and growth in sewage pipes. The piping grid is in dire need of maintenance and upgrading. There is also a great opportunity here for energy production through solar energy on roofs, heat recovery and biogas.

Biogas production from bio-waste and sludge is a very good method to recover nutrients and energy from waste products. Biogas is being produced from food waste in Østfold County and being used as fuel, much of the gas being produced is burned off at the sludge treatment plants by flaring. That means it is burned before even being used without taking advantage of the energy for heat or electricity. Some flaring is necessary for safety reasons, but a greater demand for this gas would reduce flaring dramatically.

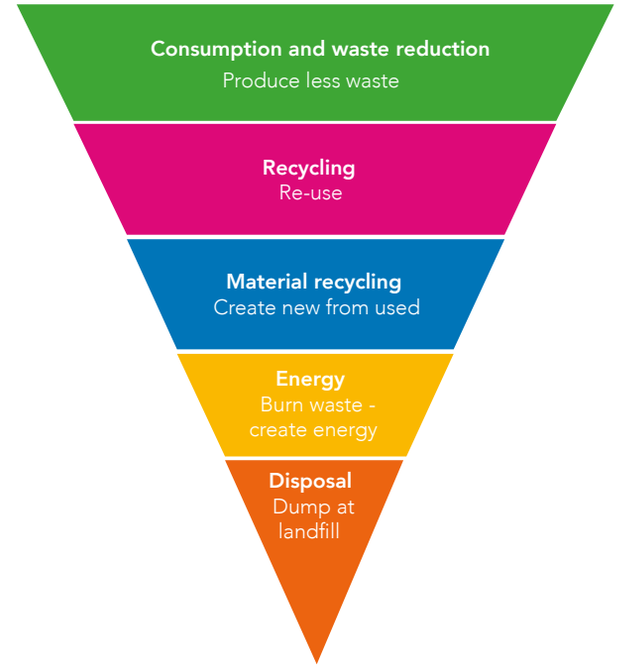
We currently produce in excess of 100 GWh of biogas in Østfold County and several new plants are under consideration.

Waste which cannot be reused or recycled can be burned to produce energy for industrial processes or district heating. As we reduce fossil-based raw materials in our waste, emissions from waste incineration will reduce proportionally.

Sorted waste in Norway and Østfold for 2017. (SSB).

	Levert til material-gjenvinning	Levert til kompostering	Levert til biogass-produksjon	Levert til forbrenning	Levert til deponi	Levert til annen håndtering
Østfold 2017 (tonn)	27 000	5 000	2 000	84 000	2 000	1 000
Andel av total avfallsmengde	22 %	4 %	2 %	69 %	2 %	1 %
Norge 2017 (tonn)	548 000	224 000	108 000	1284 000	69 000	21 000
Andel av total avfallsmengde	24 %	10 %	5 %	57 %	3 %	1 %

Waste pyramid



Agriculture

Sustainability

Agriculture is key aspect of the Sustainable Development Goals which i.a. focuses on producing more food while preserving biological diversity. Agriculture is a part of the solution in several areas, which can contribute by making water and soil cleaner, increasing renewable energy production and creating important local jobs.

Greenhouse gas emissions

Agricultural greenhouse gas emissions come from two types of sources: use of fossil energy and biological or chemical processes. Fossil energy consumption is primarily related to agricultural machinery and transport, but it is also used as oil and gas in horticulture and nurseries, for heating of barns and for drying grains. Several agricultural organizations and businesses have set goals to phase out fossil fuels by 2030.

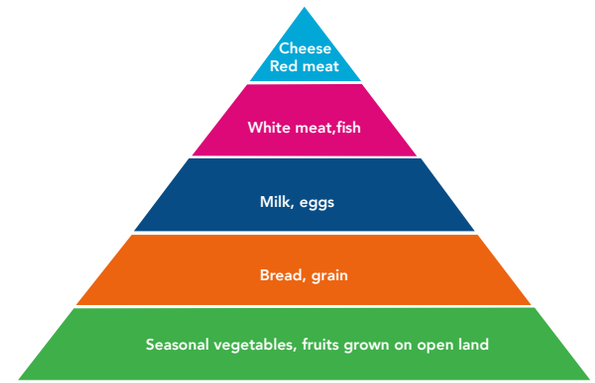
Of the biological and chemical processes that emit greenhouse gases in Norway, methane emissions from ruminants such as cows and sheep are particularly high, and nitrous oxide (N2O) from soil processes is a significant source of emissions. These gases have between 24 and 298 times as much influence on the climatic as CO2, so even small changes can have major impact. These emissions are part of nature's own cycle and cannot be reduced in the same way as fossil emissions. But by applying principles for good animal health, agronomy, breeding, efficient use of land and choosing the right feed, food production in Østfold County can increase without increasing emissions. However, emissions are not the same for all types of food (see the figure).

Meat consumption in Norway has doubled since the 1960s. You can help lower greenhouse gas emissions by following nutritional guidelines and reducing meat consumption. Østfold County is well suited for food production. Around 19 % of the land area here is cultivated, compared with 3 % for the country as a whole. Most parts of Norway are more suited to grazing. Much of the land in Østfold County is only suitable for grazing.

But cultivating conditions in large parts of Østfold County make it possible to increase the production of the most climate-friendly food such as cereals and vegetables. This is labour-intensive work, but it would have a positive influence on the climate and increase value creation and employment in the primary industries.

Carbon retention

Agriculture in Østfold County already retains large amounts of carbon in grassland and pastures as well as in the growth of forests. Photosynthesis binds carbon in living biomasses in forests and through plant production in agriculture. The agricultural industry has conducted several soil carbon studies which suggest that increased retention of carbon is not only possible, but is also good for the soil. At the same time, changes in how we use soil, such as less grassland, land reclamation or withdrawal of peat from marshes can lead to increased greenhouse gas emissions. Land use changes such as asphalting and developing farmland, grazing areas or forests are negative where greenhouse gas emissions are concerned. The work generates emissions and we lower carbon retention, and there is less biological diversity afterwards. Topsoil is a non-renewable resource. Good operation and conservation of forests and arable land is thus a very important aspect of environmental and climate protection. Østfold County should have a zero-tolerance vision for re-use of marshes and arable land.



Eco-friendly food pyramid. Source: Østfoldforskning

Energy

Agriculture in Østfold County currently produces at least 500 GWh of energy primarily related to bioenergy in wood, wood chips and straw, but also solar and biogas. There is potential for small-scale hydropower plants at farms or small or larger wind farms.

Farmers in Østfold County have a high level of expertise and great interest in renewable energy. With the appropriate tools and support (such as facilitating energy cooperatives and creating support schemes for solar energy and biogas production from fertilisers) the government can help the county increase energy production in the agricultural sector. This will increase the use of renewable energy and create jobs without harming biodiversity or other interests.

Estimated emissions of greenhouse gases from agriculture in Østfold County divided by source (Nibio 2019, Notes from Klima Østfold)

	CO_2-ekvivalenter, 1000 tonn		
Kilde	CH_4	N_2O	Sum
Husdyr – fordøyelse	47	0	47
Lagring av husdyrgjødsel	11	13	24
Mineralgjødsel	0	32	52
Restavlinger	0	8	8
Nedfall av ammoniakk	0	3	3
Avrenning	0	24	24
Avløpsslam	0	1	1
Dyrket myr	0	5	5
Sum	**58**	**87**	**165**

Forests make up 65% of all land area in Østfold County, and 90 % of this is productive forest. Proper care and management of planted forests is an important part of carbon retention. Among other things, it is important to wait with logging until the forest is mature. Planting quickly after logging and planting trees in denser clusters can increase carbon retention in our forests. Replanting forests and fertilisation may also be possible measures, but there are some legal challenges to this and there is some uncertainty related to the effectiveness and the consequences for biodiversity; these measures should therefore be studied further before they are implemented.

Examples of strategies

- Promote good agronomy and forestry
- Strengthen focus on carbon retention in forests/soils
- Zero-tolerance for land use of marshes and arable land

Winner of drawing competition, Anne Sofie Johansen. Pupils in grades 5 and 7 from Alvim Primary School in Sarpsborg were commissioned to draw images of environmental improvements. How do things look now, and how will they look in the future?

THE PENTAHELIX PROJECT

KLIMA ØSTFOLD
TID FOR HANDLING

Co-funded by the Horizon 2020 - programme (European Union)

The Climatic Plan is part of a project funded by EU through Horizon 2020 Grant Agreement No. 784994. Disclaimer: The sole responsibility for the content of this report lies with the authors. It does not necessarily reflect the opinion of the funding authorities. The funding authorities are not responsible for any use that may come from the information contained therein.