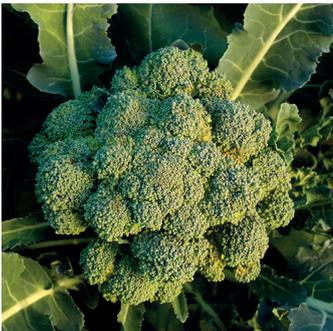




Norwegian Ministry
of Climate and Environment

Meld. St. 41 (2016–2017) Report to the Storting (white paper)

Norway's Climate Strategy for 2030: a transformational approach within a European cooperation framework





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*Recommendation of 16 June 2017 from the Ministry of Climate and Environment,
approved in the Council of State the same day
(white paper from the Solberg Government)*

1 Introduction

The Norwegian Government is working towards joint fulfilment of its Paris commitment together with the European Union (EU). Joint fulfilment will make it possible to achieve the 2030 reduction target for emissions that fall outside the scope of the EU Emissions Trading System (EU ETS) mainly through domestic emission reductions, and with the use of EU flexibility mechanisms as necessary. The main sources of non-ETS emissions are transport, agriculture, buildings and waste, but also manufacturing and the petroleum sector. The Government's strategy for 2030 is intended to open the way for substantial domestic emission reductions.

Chapter 2 describes a changing world. Climate change is one of the greatest threats of our time. Global warming is resulting in new rainfall patterns and affecting life both in the sea and on land. At the same time, there is rapid technological development of climate-friendly solutions for example using solar and wind energy. There has been a phenomenal increase in the number of

electric cars. The Paris Agreement and events since show that the attitudes of a clear majority of the world's politicians are changing. However, unless the world succeeds in cutting emissions substantially in the next few years, there is a very high risk that climate change will have serious and far-reaching consequences. Global emissions must be reduced. A transformation process is needed to develop a greener global economy, and we must prepare to deal with unavoidable climate change.

The Government is working towards joint fulfilment of its 2030 commitment together with the EU. Chapter 3 presents the Government's strategy for achieving this. Norway is already cooperating with the EU to reduce emissions from ETS sectors. Given an agreement on joint fulfilment of the 2030 target, Norway would also cooperate with the EU on reducing non-ETS emissions covered by the proposed Effort Sharing Regulation. Norway would be allocated a separate target for

these emissions. These emissions are mainly from transport, agriculture, buildings and waste management, but also include non-ETS emissions from manufacturing and the petroleum sector.

The Commission's proposal estimates that Norway would be attributed a target for reduction of non-ETS emissions of 40 % below the 2005 level in 2030. The target for non-ETS emissions would be expressed as a budget for the whole period 2021–2030. The gap between projected emissions in Norway and Norway's emission budget is estimated at 30 million tonnes CO₂ equivalents (CO₂-eq) over the period 2021–2030. This estimate is uncertain. Based on the proposed regulation, Norway is likely to be able to use between 5.5 and 11 million ETS emission allowances to cover part of the gap in the emission budget (this is further discussed in Chapter 4.5). The Government will make use of this flexibility. Further emission reductions totalling 20–25 million tonnes would be required during the period.

The Government intends to achieve its 2030 target mainly through domestic emission reductions, and with the use of EU flexibility mechanisms as necessary. The Government will promote the use of cost-effective mitigation measures to meet the 2030 commitment. The Government's strategy for 2030 is intended to facilitate substantial domestic emission reductions. Before the commitment period starts in 2021, the details of the legislation will be known and the consequences for Norway will be clearer. However, well into the commitment period 2021–2030 there will be considerable uncertainty related to emission trajectories, the effects of climate policy, technological developments and the costs of emission reductions. This is why the strategy needs to be both ambitious and flexible. The Government is allowing for uncertainty by strategic planning to ensure the necessary flexibility to achieve the emission budget. Use of the EU flexibility mechanisms will contribute to emission reductions elsewhere in Europe within the common overall emission ceiling, and thus contribute to real global reductions in the same way as emission reductions in Norway.

The Government has already implemented a range of mitigation measures and strengthened national climate policy together with the parties with which it is cooperating in the Storting (Norwegian parliament). In addition, decisions made by the Storting and ambitions and goals that have been formulated will play a part in bringing about emission reductions in the years ahead. This applies in particular to the targets for zero-emis-

sion vehicles as a share of the vehicle park set out in the white paper *Norwegian National Transport Plan 2018–2029* (Meld. St. 33 (2016–2017)); the decision to increase the biofuel quota obligation (the required proportion of biofuels in annual sales of road traffic fuels) to 20 % in 2020; and a decision by the Storting to request the Government to introduce a standard carbon tax rate for non-ETS emissions.

In the strategy described in the present white paper, the Government shows that the estimated emissions gap of 20–25 million tonnes can be closed by means of domestic emission reductions. The white paper presents mitigation measures that the Norwegian Environment Agency estimates have the overall potential to reduce emissions by more than is needed to close the emissions gap. The Government considers it appropriate to consider a broad range of mitigation measures because estimates of the emission reduction potential and costs of measures are highly uncertain. This strategy takes into account the possibility that some of the emission reduction potential may not be realised. The strategy does not present a final list of mitigation measures or policy instruments to achieve emission reductions by 2030. It will be important to be able to adjust the use of policy instruments throughout the period, for example to take into account technological developments and the costs of deploying zero- and low-emission technology. The strategy therefore charts a course for the use of policy instruments in the years ahead and indicates mitigation opportunities within each sector.

The Norwegian Environment Agency has estimated that action to achieve political goals and ambitions can result in emission reductions of the order of 16 million tonnes over the period 2021–2030. In its analyses, the Environment Agency has divided mitigation measures into several cost categories. Mitigation measures related to policy objectives and ambitions for the transport sector vary greatly in cost. Cost levels will depend to a large extent on further developments in low- and zero-emission technology for the transport sector. This technology is mainly being developed outside Norway.

The Environment Agency has estimated that there is an additional potential for reducing non-ETS emissions by about 18 million tonnes at an economic cost of less than NOK 500 per tonne CO₂-eq in sectors including transport, agriculture, industry and petroleum. The estimated emission reduction potential and costs are uncertain and sensitive to the underlying assumptions. Develop-

ments in costs and in the feasibility of implementation will determine which mitigation measures are actually implemented. The Environment Agency has not assessed the policy instruments that would be needed or how they should be applied, and this is another source of uncertainty.

The Government considers it important to strengthen knowledge about possible mitigation measures, their costs and the effects of policy instruments that are designed to ensure that Norway meets its 2030 commitment and continues the transition to a low-emission society in 2050.

Chapter 4 of this white paper describes EU climate policy and its implications for Norway. If joint fulfilment of the 2030 climate target is agreed, the proposed EU regulations on effort sharing¹ and on land use, land-use change and forestry will become relevant for Norway. The Government is allowing for uncertainty, including cost uncertainty, by strategic planning to ensure the necessary flexibility to achieve the emission budget. Norway expects to achieve sufficient flexibility through bilateral agreements with EU countries. The Government will seek cooperation with EU countries on joint implementation of mitigation measures through bilateral agreements. Cooperation on emission reductions between EU countries is an important part of the EU legislation for achieving the 2030 target.

Chapter 5 describes efforts and plans for reducing non-ETS emissions in Norway. It gives an account of emission trends and the use of policy instruments at national level. Chapter 5.2 describes key principles for Norway's use of policy instruments. The main instruments of Norwegian climate policy are taxes and emissions trading, which are cross-sectoral economic instruments. *The Government will promote the use of cost-effective mitigation measures to meet the 2030 commitment.* If the carbon tax is not considered to be an adequate or appropriate instrument, other instruments that provide equally strong incentives to reduce emissions will be considered, including direct regulation under the Pollution Control Act and voluntary agreements. The Government will also take steps to ensure that the policy instruments used continue to be effective and well-coordinated. A number of publicly-funded grant schemes have been established to promote zero-

and low-emission solutions, for example through Enova, the 'Klimasats' arrangement for counties and municipalities, and Innovation Norway. In addition, the Government will continue to focus on research and development and the deployment and dissemination of low-emission technology, and will ensure that the public sector as a customer supports the adoption and development of new environmentally friendly technologies and solutions.

Chapter 5.3–5.10 presents emission reduction potentials and possible mitigation measures and policy instruments to reduce emissions in various sectors. Estimates provided by the Norwegian Environment Agency indicate that emissions in the period 2021–2030 can be reduced by approximately 35 million tonnes CO₂-eq by following up political decisions and ambitions, and through measures with an economic cost of less than NOK 500 per tonne CO₂-eq.

The transport sector is an important element in the transition to a greener economy. The sector accounts for about 60 % of non-ETS emissions in Norway, and a large proportion of domestic non-ETS emission reductions must therefore be achieved in this sector. Meanwhile, the development of low- and zero-emission technology in the transport sector is proceeding rapidly. To support efforts to reduce emissions in the transport sector, the Government has set a working target of a cut of 35–40 % in emissions from the transport sector by 2030 compared with 2005. This target is based on the assumption that the technological maturity of zero-emission solutions in different transport segments will improve so that they become competitive with fossil-based transport solutions.

Chapter 6 assesses the economic and administrative consequences of the 2030 target. Achieving the 2030 and 2050 climate targets is bound to entail costs. The costs of reaching the 2030 target have previously been discussed in the white paper *New emission commitment for Norway for 2030 – towards joint fulfilment with the EU* (Meld. St. 13 (2014–2015)) and in a recent bill proposing a new Act relating to Norway's climate targets (Prop. 77 L (2016–2017)). Norway will have to go through the impending transformation process in the face of great uncertainty, both as regards its costs and social impacts, and as regards the speed of technological developments in different areas.

¹ The proposed Effort Sharing Regulation includes binding emission reduction targets for non-ETS emissions for each country.

2 A changing world

2.1 A more proactive climate policy globally and green transformation in Norway

It can be difficult to imagine what a warmer world will be like. However, we do know what the world was like when temperatures were four to five degrees lower than today. Norway, northern Europe and Canada were covered by an ice sheet that was 2 000 metres thick. The rest of Europe north of the Alps and the Pyrenees consisted of tundra. This shows that a change of four to five degrees in global temperatures can have dramatic effects.

The world is now facing a race against time to respond to climate change. Anthropogenic greenhouse gas emissions have risen since the Industrial Revolution, and are now higher than ever before. This is resulting in global warming and changes in precipitation patterns, and is affecting life both in the sea and on land – and the climate is changing rapidly. However, the pace of technological development is also rapid, and this may provide us with the tools we need to deal with climate change and its impacts. The markets for climate-friendly technologies such as solar and wind energy and electric vehicles are growing at a phenomenal rate. And last but not least, the attitudes of a large majority of the world's politicians are changing. The US Administration's decision to withdraw from the Paris Agreement was a setback, but world leaders have responded in a way that shows that they intend to work together to implement the agreement. Many states and larger cities in the US have also made it clear that they will continue to pursue their ambitious climate policies. Norway is cooperating with US actors on an active climate policy, and will also work closely with other Nordic countries in support of strong European leadership in global climate negotiations.

Climate change is one of the greatest threats of our time. It is occurring as a result of greenhouse gas emissions from sources including energy use, industry, transport, agriculture and forestry. Unless the world succeeds in cutting

emissions substantially in the near future, there is a very high risk that climate change will have serious and far-reaching consequences. And it may not be possible to reverse these consequences at a later date.

Greenhouse gas emissions are resulting in global warming across both land masses and oceans. Snow and ice are melting, sea levels are rising, and extreme weather events, flooding and drought are becoming more frequent. Flooding and drought are threatening water supplies in parts of the world and making it more difficult to produce enough food. Much of the increase in greenhouse gas emissions is being absorbed by the oceans, and this is causing ocean acidification and threatening marine life.

Global warming is undermining food security, economic progress and social stability, and intensifying existing security threats in many vulnerable states and regions. And the greater the change in climate, the more the risks increase. It is easy to conceive how climate change could cause or exacerbate major humanitarian disasters. In the worst case, drought and famine could displace millions of people. Rising sea levels may make low-lying coastal areas and islands uninhabitable, and if extreme weather events are more frequent, humanitarian disasters may also occur more often. We have already seen that climate change can cause conflict or worsen existing conflicts in vulnerable countries with unstable governance. This can lead to unrest, civil war and flows of refugees, or create a breeding ground for violence and terrorism.¹

Climate change is already strongly affecting the polar regions. For example, the temperature in the Arctic is rising about twice as fast as the global average. There have been several unusually warm years in Svalbard^{2,3}, particularly after 2000, and a number of records have been set. In 2016, the average temperature in Svalbard was

¹ Climate Diplomacy (2016). *Insurgency, Terrorism and Organized Crime in a Warming Climate*. <https://www.adelphi.de/en/publication/insurgency-terrorism-and-organized-crime-warming-climate>

6.6 °C above normal. The glaciers are melting and retreating rapidly. Areas of sea that used to be ice-covered are no longer freezing over. New fish species are expanding into the Arctic from further south and displacing Arctic species.

The wider picture is even more dramatic. More and more research results are suggesting that higher air temperatures, rising ocean temperatures and rapidly melting snow and ice in the Arctic are in turn influencing global wind and weather systems. These changes are influencing the development of storms, precipitation and winter weather in the northern hemisphere. Changes in the Arctic may have a bearing on weather phenomena as far away geographically as the South-East Asian monsoon, and thus affect food production and food prices.

Anthropogenic greenhouse gas emissions have played a part in the climate change over the past 100 years, and these emissions will continue to have an impact on all continents and all oceans in the future as well. Greenhouse gases accumulate in the atmosphere. World temperatures will therefore not drop again in the foreseeable future even if we are able to halt greenhouse gas emissions. However, they can be stabilised over time.

Since global warming is affecting the Arctic both earlier and more strongly than other regions, the changes here are a forewarning of what is likely to happen in other parts of the world as well. Greenhouse gas emissions may result in permanent environmental changes, and these changes may be amplified by positive feedback mechanisms. We cannot restore the environment to its previous state, and there may be uncontrollable, runaway impacts. There are strong indications that this may apply to some particularly vulnerable, unique ecosystems. For example, as ocean temperatures rise, the sea ice that is being lost in the Arctic will not re-form. The coral reefs that appear to be dying and lost to erosion as global warming approaches around two degrees will disappear permanently. We may reach tipping points beyond which climate change becomes irreversible. It is uncertain how much the climate can change before rapid, irreversible change is trig-

gered. But the more the climate warms, the greater the risk that such thresholds will be crossed.

This explains why we urgently need to reduce global emissions and take steps to adapt to unavoidable climate change. The good news is that it is not only climate change that is accelerating: so is the pace of technological change. In this race against time, we need to develop new technology rapidly and ensure that it is quickly deployed in the markets. A policy that supports research, technology development and innovation both in Norway and in other countries is therefore a vital part of efforts to combat climate change. Putting a price on emissions shifts both production and demand in a climate-friendly direction. It also provides incentives for the development and deployment of climate-friendly technology. The transition to a low-emission society also requires an integrated research and development effort and cross-sectoral cooperation between the social sciences, humaniora, technology and the natural sciences. Norway must design educational programmes to give people educated here the right expertise to lead the way and play a key role in the transformation of society.

The pace of technological change is clearly illustrated by developments in solar and wind power. The costs of solar cells have fallen by 80 % since 2009, and wind turbines are now 30–40 % cheaper.⁴ According to sources including Bloomberg New Energy Finance, renewable electricity production is becoming competitive with fossil-based production in a growing number of areas and applications.⁵ World coal consumption has levelled off, and from 2014 to 2015 it sank for the first time after many years of growth. Energy production from renewable sources grew by almost 25 % in the period 2010–2014. In the electricity sector, renewable sources accounted for more than 60 % of new capacity worldwide in 2015.⁶

Production costs for electric vehicle batteries have dropped steeply in recent years, and consultancies, companies and international organisations are predicting a continued steep decline in costs in the years ahead. According to Bloomberg New Energy Finance, the price of lithium-ion batteries has dropped by more than 70 % since the

² Nordli et al. (2014). Long-term temperature trends and variability on Spitsbergen: The extended Svalbard Airport temperature series, 1898-2012. Polar Research. doi:<http://dx.doi.org/10.3402/polar.v33.21349>.

³ Miljøovervåking Svalbard og Jan Mayen (MOSJ) [Environmental monitoring programme for Svalbard and Jan Mayen: air temperatures and precipitation]. <http://www.mosj.no/no/klima/atmosfare/temperatur-nedbor.html>

⁴ IEA/IRENA (2017). Perspectives for the energy transition 2017.

⁵ See for example Bloomberg New Energy Finance, 1H 2007 Global LCOE update.

⁶ IRENA (2017). Rethinking Energy 2017.

Nissan Leaf was launched in 2010, from about USD 1000 per kWh to around USD 270 per kWh in 2016. Further reductions in costs are expected. Using existing analyses of cost trends as a basis, the Norwegian Environment Agency estimates that battery prices will be reduced by 9 % per year up to 2022, and by 4 % per year after that.⁷

The reduction in battery costs is essential to the future of battery electric transport. It is still considerably more expensive to manufacture an electric vehicle than a fossil fuel vehicle, but this is changing rapidly. Bloomberg New Energy Finance estimates that the production costs of electric passenger cars will have dropped to the same level as for comparable fossil-fuel vehicles between 2025 and 2029, depending on car size and geographical market. In 2030, Bloomberg expects electric vehicles to be up to 15 % cheaper than comparable conventional vehicles.⁸ These estimates are uncertain. It should also be noted that they are based on pre-tax prices and do not take into account the considerable savings that will be possible on fuel and maintenance costs.

Digitalisation will also be important for future transport and energy solutions. The Norwegian National Transport Plan for 2018-2029 refers to studies indicating that digitalisation may lead to the development of transport systems that are radically different from those in use today. Digitalisation of the transport sector may improve traffic flows and reduce emissions, but may also result in an increase in road traffic. The Government will give considerable weight to strengthening the knowledge base on how technological advances will affect the need to increase the capacity of transport infrastructure. It will be vital to monitor technological developments closely in the years ahead so that robust and sustainable investment choices are made for the future.

The transition to a low-emission society will require a green, smart and innovative business sector. Zero- and low-emission technologies will be the winners with a tighter global climate policy. Costs will drop rapidly, new solutions will function better and the transformation process will pick up speed. A number of companies are now in the process of establishing production plants for batteries

for the maritime sector in Norway. Norway is also playing an active part in developing autonomous maritime technology, and has opened a test bed for autonomous shipping in the Trondheimsfjord. There are also Norwegian participants in several segments of the hydrogen value chain.

Climate change is a worldwide problem that can only be resolved through deep cuts in global emissions. This will require cooperation at every level – global, regional, national and local. The developed countries are responsible for most of the greenhouse gas emissions that have already entered the atmosphere. More recently, however, emissions from developing countries with rapidly growing economies have been rising steadily. At present, developing countries account for about two thirds of annual global emissions, and this proportion is expected to rise. This means that all countries share the responsibility for acting to reduce emissions.

One of the UN Sustainable Development Goals is specifically about action to combat climate change, and refers to the United Nations Framework Convention on Climate Change (UNFCCC). The Paris Agreement was a turning point in international climate cooperation. Norway played a key role in the negotiations, and was instrumental in the adoption of the agreement in December 2015. The agreement aims to strengthen the global response to the threat of climate change, including by holding the increase in global average temperature to well below 2 °C and pursuing efforts to limit it to 1.5 °C. All countries have undertaken to communicate their nationally determined contributions to emission reductions every five years and to strengthen their ambitions over time.

The Paris Agreement gave a clear message to the world that greenhouse gas emissions must be drastically reduced. The Agreement will have significant consequences in Norway too. Norway has recently adopted its (Climate Change Act), which includes Norway's transformation to a low-emission society as a statutory target. The Act introduces a system of five-year reviews of Norway's climate targets, on the same principle as the Paris Agreement. Norway strengthened its climate policy ambitions when, like other countries, it submitted its intended nationally determined contribution (INDC) for 2030 to the UNFCCC in advance of the Paris summit. In February 2015, the Government and the parties with which it is cooperating in the Storting proposed a target of reducing domestic greenhouse gas emissions by at least 40 % below the 1990 level by 2030. The Government is working towards joint fulfilment of

⁷ Norwegian Environment Agency (2016). Tiltakskostnader for elbil. Samfunnsøkonomiske kostnader ved innføring av elbiler i personbilparken. [Costs of phasing in electric vehicles. The economic costs of phasing in electric passenger cars.] Report M-620.

⁸ Bloomberg New Energy Finance (2017). When will electric vehicles be cheaper than conventional vehicles? 12 April 2017.

Box 2.1 The Paris Agreement

The adoption of the Paris Agreement was a turning point in international climate cooperation. It was adopted in December 2015 after several years of negotiations, and entered into force at record speed, becoming effective on 4 November 2016, after less than a year. Almost 150¹ countries have already ratified it. Although the US has announced that it will be withdrawing from the agreement, the international reactions to this decision have demonstrated that there is global support for the Paris Agreement, and that its implementation will continue. Both the EU and China have clearly indicated that they are giving high priority to implementation of the agreement. Many non-federal US entities, including the states California, New York and Washington, have also announced that they intend to continue their climate change work.

On 14 June 2016, the Storting (Norwegian parliament) gave its consent to Norway's ratification of the Paris Agreement², and on 20 June the same year, Norway ratified the agreement.

The overall objective of the Paris Agreement is as follows:

'This Agreement, in enhancing the implementation of the Convention, including its objective, aims to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by:

1. holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C;
2. increasing the ability to adapt to climate change, and fostering climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production;
3. making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development.'

The second commitment period under the Kyoto Protocol runs from 2013 to the end of

2020, and the Paris Agreement will apply after this. It is intended to result in a stronger global response to climate change in order to prevent dangerous anthropogenic interference with the climate system. The agreement establishes both legally binding obligations and policy guidelines. The agreement and the decision adopting it also require efforts to be intensified over time, and nationally determined contributions to the global response are to be communicated and updated every five years.

The agreement sets out a common aim for greenhouse gas emissions to ensure that the goal of limiting the global rise in temperature can be achieved. This is to reach global peaking of greenhouse gas emissions as soon as possible and then reduce them rapidly so as to achieve a balance between anthropogenic greenhouse gas emissions and removals by sinks in the second half of this century. A balance between emissions and removals is called carbon neutrality.

The Paris Agreement also recognises the importance of maintaining and, as appropriate, enhancing carbon stocks. The agreement emphasises the importance of ensuring ecosystem integrity and the conservation of biodiversity when taking action to address climate change. Moreover, the agreement establishes – for the first time – legally binding obligations for all parties to prepare, communicate and maintain successive nationally determined contributions that they intend to achieve. Parties must also implement domestic mitigation measures with the aim of achieving their contributions.

An important factor behind the success in achieving global participation in the Paris Agreement was the decision to base it on nationally determined emission reduction contributions. This means that each country decides which contributions to communicate and the level of ambition for its contributions. Parties' successive contributions will represent a progression beyond their previous contributions and reflect each party's highest possible ambition.

Box 2.1 (cont.)

The Paris Agreement establishes the global goal of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change. Each country is required to take individual responsibility for engaging in planning processes to adapt to climate change, and to implement adaptation measures as appropriate. The agreement requires developed countries to provide financial resources to assist developing countries in implementing mitigation and adaptation actions, in continuation of their existing obligations under the UNFCCC. Other countries are encouraged to provide such support on a voluntary basis. In addition, the agreement provides for capacity-building activities.

All parties are also required to provide regular inventory reports on their emissions and to report on progress in implementing and achieving their nationally determined contributions. Developed countries must in addition provide information on their support to developing countries under the agreement. An expert-based committee has been established to facilitate implementation and promote compliance. The agreement also provides for a global stocktake of collective progress towards its goals, to be carried out every five years.

¹ 147 countries had ratified the agreement by 1 May 2017.

² Documents submitted to the Storting were the draft resolution Prop. 115 S (2015–2016) and the recommendation Innst. 407 S (2015–2016).

this target together with the EU. A broad majority in the Storting endorsed the target in spring 2015. The adoption of the 2030 target marked the beginning of a new era in Norwegian climate policy. Norway has never before had such a binding climate target.

Climate change is influencing global political and economic trends. The World Economic Forum has identified the changing climate as one of the top trends in the risk landscape that are determining global economic development for the decades ahead.⁹ Extreme weather events and natural disasters, both of which are considered to have a high likelihood of occurring, will have major economic impacts. According to the Bank of England, climate change may destabilise global financial markets, both because of the losses companies suffer from physical damage and the effects on trade, and because the transformation to a low-emission society may affect the prices of many financial assets and investors may suffer major losses as a result.¹⁰ Greater uncertainty may in itself exacerbate the financial impacts.

However, the costs of an ambitious climate policy can be offset by longer-term avoidance of costs

if policy instruments are used appropriately. According to the IEA,¹¹ the additional costs of the two-degree scenario will be more than offset by future fuel cost savings. It is estimated¹² that in China, the health and mortality burden of air pollution has economic costs equivalent to more than 10 % of the country's GDP. This demonstrates the huge human and economic impacts of pollution.

Unclear policy signals on the future prices of emissions or on regulatory measures may hinder the adoption of the most cost-effective climate-related measures.¹³ The result will be that the costs of the transformation process are higher than necessary. In a recent report, the OECD¹⁴ lays out a case showing that the G20 countries can achieve more growth and at the same time a shift towards a low-emission pathway by combining climate action with fiscal initiatives and structural reforms.

The report estimates that the G20 countries can increase GDP by 2.8 % in the long term if they combine a cost-effective climate policy with sound economic reforms. In addition, they would enjoy the benefits of avoided climate change impacts, which are estimated at more than 2 % of GDP. Delaying climate action until after 2025 would

⁹ World Economic Forum (2017). The Global Risks Report 2017, 12th Edition.

¹⁰ Governor Mark Carney, Bank of England (2015). Breaking the tragedy of the horizon – climate change and financial stability, Speech given at Lloyd's of London, September 2015.

¹¹ IEA (2015). Energy Technology Perspectives 2015.

¹² New Climate Economy (2014). Synthesis Report.

¹³ See for example New Climate Economy (2014).

¹⁴ OECD (2017). Investing in Climate, Investing in Growth

Box 2.2 The UN Sustainable Development Goals

In autumn 2015, the UN member states adopted 17 sustainable development goals for the period up to 2030. They take an integrated approach to the environmental, economic and social dimensions of sustainable development. Three of the goals are to eradicate extreme poverty, reduce inequality, and take action to combat climate change. There are separate goals focusing on climate and environment, and in addition these matters are an integral part of other goals. The goals apply to all the world's countries, and provide a roadmap for global efforts to achieve sustainable development.

The Government is working to achieve the goals, and Norway was one of the first countries to present a voluntary review of its progress to the UN. The Government has decided that all ministries are to report on the status of their efforts to follow up the goals for which they are responsible in their budget proposals, and this was done for the first time in the 2017 budget proposals. Norway is on track to achieve most of the goals, but Norway too will find it relatively demanding to achieve some of them. Norway is playing an active part in international implementation of the goals. Prime Minister Erna Solberg has been given a leading role in this work by the UN Secretary-General.

increase the cost of achieving the climate targets by an estimated 2 % of GDP.

It is important to send clear signals about what trajectory emissions should follow later in this century, from 2050 and onwards. The authorities need to pursue a credible climate policy that gives clear, predictable signals to the private sector about the future costs of greenhouse gas emissions (see Chapter 5, Box 5.3 on the Green Tax Commission). This will reduce project risk for investors, encourage the right economic choices today and help to avoid unsound investment, thus laying the foundation for a transformation process that is as cost-effective as possible.

Global trends have a major impact on developments in a small open economy like Norway. In June 2017, the Storting adopted the Act relating to Norway's climate targets (Climate Change Act),

which makes Norway's target of becoming a low-emission society by 2050 legally binding. This was done in order to promote the long-term transformation of Norway in a climate-friendly direction. According to the Act, Norway's target is to reduce greenhouse gas emissions by 80–95 % by 2050 relative to the 1990 level. However, as a small open economy, Norway is dependent on a similar shift in global development if it is to maintain its ability to make full, effective use of labour and other resources and achieve its climate and environmental policy goals. The Climate Change Act introduces a system of five-year reviews of Norway's climate targets, on the same principle as the Paris Agreement. As a party to the Agreement, Norway has undertaken to prepare, communicate and maintain successive nationally determined contributions that it intends to achieve. The Agreement requires a global stocktake of progress every five years, and this will ensure that international climate policy is steadily tightened. A sound climate policy will improve conditions for people around the world. Making the transition to a low-emission society will not only make it possible to prevent the dramatic impacts of climate change, but will also improve most people's everyday lives. There will be cleaner air, less congestion, more effective production and smarter everyday solutions. The risk is highest for those who make the first move, but they will also have the opportunity to reap the greatest benefits from green competition. The Government will assist Norwegian innovators and companies to profit from such opportunities.

A green shift to sustainability will alter the framework for business and industry all over the world, particularly for producers of coal, natural gas and crude oil. During the past 40–50 years, petroleum has become Norway's largest industry, but production has probably already peaked. Although the petroleum industry will continue to be important for several decades, it will not contribute to growth in other sectors of the Norwegian economy in the same way as it has done before. In the last few years there has been a drop in demand from the petroleum industry which illustrates this, and also highlights the importance of new jobs in other sectors. The profitability of the Norwegian petroleum industry will also be influenced by global climate policy. Implementation of the Paris Agreement will result in lower demand for fossil fuels, and put downward pressure on prices.

Growing competition from renewable energy sources will also put pressure on the oil and gas

Box 2.3 Long-term low-emission strategies

Under the Paris Agreement, all parties have been invited to formulate and communicate long-term low-greenhouse gas development strategies by 2020, using 2050 as the time horizon. When it was considering the ratification of Norway's emission reduction commitment, the Storting asked the Government to put forward plans for developing a long-term low-greenhouse gas strategy for Norway. The Government will propose a long-term low-greenhouse gas strategy for 2050 well before 2020. The strategy will be considered in conjunction with other relevant processes.

A few countries have already published their strategies and communicated them to the UNFCCC. These are the US, Mexico, Canada, Germany, France and Benin. Other parties, including the UK, Peru, Ethiopia and the EU, are in the processes of developing their strategies. The EU is linking its strategy to other relevant processes for the period up to 2050, including the Energy Roadmap 2050. The purpose of the long-term strategies that have been published so far has been to improve market predictability and encourage the inclusion of long-term climate risk as a factor in public- and private-sector investments.

industry in the time ahead. At the same time, the Norwegian petroleum sector has in the past proved to be profitable across a wide range of oil prices. In a high-cost country like Norway, growth has to be based on knowledge. To maintain pay levels that are higher than in almost all other countries, Norwegians must be more productive than other people. Norway needs to make commercial use of new knowledge and new technologies better and more quickly than neighbouring countries.

Norway must be prepared for a gradual, lengthy transformation process. It will be vital to exploit any opportunities that arise as a more ambitious climate policy is introduced globally. We must ensure that there is room for many different branches of industry, and enable enterprising business leaders and employees to make use of Norway's natural advantages to create growth. This will make Norwegian value creation more

sustainable as more effective mitigation and adaptation instruments are introduced nationally and globally.

2.2 Norway's climate targets

Norway has ambitious climate targets that are set out in various policy documents. These are the updated cross-party agreement on climate policy from 2012 (published as a recommendation to the Storting (Innst. 390 S (2011–2012)) in response to the white paper on Norwegian climate policy from the same year (Meld. St. 21 (2011–2012)); the white paper *New emission commitment for Norway for 2030 – towards joint fulfilment with the EU* (Meld. St. 13 (2014–2015)) and a subsequent recommendation to the Storting (Innst. 211 S (2014–2015)); the documents relating to the Storting's consent to ratification of the Paris Agreement (Innst. 407 S (2015–2016) and Prop. 115 S (2015–2016)); and the Climate Change Act that the Storting adopted in June 2017.

1. Norway will reduce global greenhouse gas emissions by the equivalent of 30 % of its own 1990 emissions by 2020.
2. Norway has conditionally undertaken a commitment to reduce its emissions by at least 40 % by 2030 compared with the 1990 level.
3. Norway will be climate neutral by 2030.
4. Norway has adopted a legally binding target of being a low-emission society by 2050.
5. Greenhouse gas emissions from deforestation and forest degradation in developing countries will be reduced in ways that contribute to sustainable development.
6. As a political goal, Norwegian society will prepare for and adapt to climate change.

Norway's 2020 target is being followed up under the Kyoto Protocol, while the 40 % target for 2030 has been communicated to the UN as Norway's contribution under the Paris Agreement and has been made legally binding in the Climate Change Act. Norway's target of being a low-emission society by 2050 has also been made legally binding in the Climate Change Act.

Norway will reduce global greenhouse gas emissions by the equivalent of 30 % of Norway's own 1990 emissions by 2020

The commitment Norway has undertaken under the Kyoto Protocol means that it must ensure

Box 2.4 Level of ambition for domestic emission reductions up to 2020

Norway's original cross-party agreement on climate policy, adopted in 2008, states that the parties consider it to be a realistic target to reduce Norwegian emissions by 15–17 million tonnes CO₂-eq relative to the baseline projections presented in the 2007 National Budget. This included net CO₂ uptake by forests, 3 million tonnes in Norway's greenhouse gas inventory for 2020. This was expressed as a ceiling for Norway's domestic emissions when the Storting considered the 2016 white paper on Norwegian energy policy (Meld. St. 25 (2015–2016)), and the subsequent recommendation to the Storting (Innst. 401 S (2015–2016)) specifies that domestic emissions are not to exceed 45–47 million tonnes CO₂-eq in 2020. Since then, technical adjustments have been made, among other things to take into account changes in the guidelines for estimating emissions, and the interval is now 46.6–48.8 million tonnes CO₂-eq (presented in the budget proposal for 2017 from the Ministry of Climate and Environment, Prop. 1 S (2016–2017)). This does not include uptake by forests. Any contribution from uptake by forests would be additional and would increase Norway's level of ambition. However, under the Kyoto accounting rules, Norway can only include a limited proportion of CO₂ uptake by

forests towards its emission commitment for 2020. When emissions from deforestation etc. are included, the sector is not expected to make any contribution towards the 2020 emission commitment.

The target for domestic emission reductions in 2020 set out in the 2008 cross-party agreement was based on mitigation analyses drawn up by the Climate and Pollution Agency (then called the Norwegian Pollution Control Authority), current policy instruments and sectoral climate action plans. At the same time, it was made clear that the sector targets were based on estimates, and would have to be reviewed in response to any changes in projections, costs, technological advances and other relevant factors. Both the 2008 cross-party agreement and the updated 2012 agreement emphasise that there is a high level of uncertainty both as regards economic and technological developments and as regards the effects of policy instruments. The 2012 agreement mentions that technological advances, the costs of mitigation measures, economic growth and emission trends in the petroleum industry will all have a bearing on when the target can be achieved. These factors must be taken into consideration when assessing progress towards the 2020 target.

that annual greenhouse gas emissions for the period 2013–2020 are on average 16 % lower than in 1990. This establishes an emission budget for Norway for the period 2013–2020 under the Protocol that is also in line with Norway's 2020 target of cutting global greenhouse gas emissions by the equivalent of 30 % of its own 1990 emissions by 2020.

Within the framework of the Kyoto Protocol, Norway has long experience of using flexibility mechanisms, particularly project-based cooperation in developing countries under the Clean Development Mechanism (CDM). By using these mechanisms, Norway can fund reductions in greenhouse gas emissions in countries such as Brazil or Uganda, and be credited for these reductions in its greenhouse gas inventory under the Kyoto Protocol. Since climate change is a global problem, it does not matter whether emissions are reduced in Brazil, Uganda or Norway. What mat-

ters is the overall reduction in global emissions. By using such international mechanisms, Norway has so far more than met its commitments under the Kyoto Protocol.

Norway's original cross-party agreement on climate policy, adopted in 2008, sets out the level of ambition for the proportion of the 2020 emission reduction target Norway aims to achieve through domestic cuts in emissions. This translates into a reduction in domestic emissions in 2020 from the estimated 60.6 million tonnes CO₂ equivalents (CO₂-eq) in the baseline projections to 46.6–48.6 million tonnes. Box 2.4 explains this in more detail.

Norway will reduce emissions by at least 40 % by 2030 compared with 1990

The 2030 target is a conditional commitment for Norway to reduce its emissions by at least 40 % by

2030 compared with the 1990 level.¹⁵ The Government is working towards joint fulfilment of this commitment together with the EU, as further described in Chapter 2.3 and Chapter 4. The 2030 target has been made legally binding in the Climate Change Act.

If it is not possible to achieve joint fulfilment with the EU, the target of reducing emissions by at least 40 % by 2030 compared with 1990 will still be Norway's nationally determined contribution under the Paris Agreement. This target is conditional on the availability of flexibility mechanisms under the new climate agreement and on Norway being credited for participation in the EU Emissions Trading System (EU ETS) so that this counts towards fulfilment of the commitment. If no agreement is reached with the EU, the Government will consult the Storting at a later date on the determination of a national target for the non-ETS sector. In this case, it will also be necessary to decide on accounting rules for emissions and removals from forest and other land categories in connection with Norway's emission commitment, depending on the international rules that are drawn up for this. Norway will advocate international accounting rules for forest and other land categories that are in line with the principles set out in the Paris Agreement and in Norway's nationally determined contribution to the Paris Agreement, which was drawn up in line with the white paper *New emission commitment for Norway for 2030 – towards joint fulfilment with the EU* (Meld. St. 13 (2014–2015)) and a subsequent recommendation to the Storting (Innst. 211 S (2014–2015)).

Norway will be climate neutral by 2030

In connection with its consent to ratification of the Paris Agreement, the Storting asked the Government to work on the basis that Norway is to achieve climate neutrality from 2030. This means that from 2030, remaining Norwegian greenhouse gas emissions must be offset by climate action in other countries through the EU ETS and international cooperation on emission reductions, emissions trading and project-based cooperation.

The Standing Committee on Energy and the Environment has pointed out that because the Kyoto Protocol system provides for cooperation between countries, it has been possible for Nor-

way to take on greater commitments and contribute more to global emission reductions than would otherwise have been the case.¹⁶ It is important to assess on an ongoing basis whether there are other international mechanisms that could be used to achieve the Storting's targets.

Follow-up of the Storting's decision on climate neutrality from 2030 is closely linked to the process of achieving joint fulfilment with the EU and to negotiations under Article 6 of the Paris Agreement on international cooperation. The Government will provide the Storting with an account of its follow-up at a suitable time, once the rules for implementation of the EU Effort Sharing Regulation are in place.

Norway has adopted a legally binding target of being a low-emission society by 2050

Norway's target of being a low-emission society by 2050 has been made legally binding in the recently adopted Climate Change Act. The purpose of this was to promote Norway's long-term transformation in a climate-friendly direction. The Act describes a low-emission society as one where greenhouse gas emissions, on the basis of the best available scientific knowledge, global emission trends and national circumstances, have been reduced in order to avert adverse impacts of global warming, as described in the Paris Agreement. In quantitative terms, the target is to achieve emission reductions of the order of 80–95 % from the level in the reference year 1990. The effect of Norway's participation in the EU ETS is to be taken into account in assessing progress towards this target. The interval specified above is the same as that used in the EU's conditional goal for reduction of EU-wide emissions by 2050.

Norway's target of becoming a low-emission society is set out in the 2012 cross-party agreement on climate policy (recommendation to the Storting (Innst. 390 S (2011–2012))) and the white paper *New emission commitment for Norway for 2030 – towards joint fulfilment with the EU* (Meld. St. 13 (2014–2015)). In the cross-party agreement, the parliamentary majority also pointed out that an ambitious national policy must also be rational in an international situation where the overall goal is to reduce global greenhouse gas emissions. This means that policy development needs to take into account the consequences of the Emissions

¹⁵ *New emission commitment for Norway for 2030 – towards joint fulfilment with the EU* (Meld. St. 13 (2014–2015)) and the subsequent recommendation to the Storting (Innst. 211 S (2014–2015)).

¹⁶ Recommendation to the Storting concerning consent to approval of amendments to the Kyoto Protocol (Innst. 60 S (2013–2014)).

Trading System, the risk of carbon leakage and the competitiveness of Norwegian industry. This will have a bearing on the use of policy instruments to reduce domestic emissions in the period up to 2030 and 2050. To become a low-emission society, Norway will need support from a similar shift in global developments

The Climate Change Act does not preclude joint fulfilment with the EU of climate targets set out in or adopted under the Act, either before or after 2030. Norway's climate policy is closely integrated with EU climate policy. The EU has adopted an ambitious roadmap for moving to a low-carbon economy in 2050. Cooperation with the EU on joint fulfilment of climate targets can be an important way of contributing to systematic, internationally verifiable implementation of Norway's national emission commitment, and to the long-term transformation of Norwegian society that the Climate Change Act is intended to promote.

Greenhouse gas emissions from deforestation and forest degradation in developing countries will be reduced in ways that contribute to sustainable development

The global target of holding global warming to well below 2 °C and pursuing efforts to limit the temperature increase to 1.5 °C cannot be achieved unless emissions from tropical forests are reduced. Norway's contribution to these efforts, its International Climate and Forest Initiative, was launched at the climate summit in Bali in 2007. One of its goals was for tropical forests to be included in the international climate agreement. This goal was achieved with the adoption of the Paris Agreement in 2015. Since the updated cross-party agreement on climate policy was adopted in 2012, reducing emissions from tropical forests has also been one of the national targets of Norwegian climate policy. This target has three parts: the Climate and Forest Initiative is intended to play a part in making the international climate regime an effective instrument for reducing emissions; to take early action to achieve cost-effective and verifiable reductions in greenhouse gas emissions; and to promote the conservation of natural forests to maintain their carbon storage capacity.

As a political goal, Norwegian society will prepare for and adapt to climate change

The climate is changing, and these changes are having impacts on both nature and society. This is the reason for the political goal that Norwegian

society will prepare for and adapt to climate change, which was first adopted in the budget proposal for 2014 (Prop. 1 S (2013–2014)). A climate-resilient society is one that is able to limit or avoid the negative impacts of climate change, and that can also make use of the opportunities offered by a changing climate.

New projections of the future climate were presented in the report *Climate in Norway 2100*,¹⁷ and provide updated information on how the climate may change in Norway in the years ahead. The projections are based on several different emission scenarios, and show that if the rapid rise in global greenhouse gas emissions continues, we must expect a marked temperature rise, more severe and more frequent extreme rainfall events, and changes in patterns of flooding. The report also explains that the changes will be considerably smaller if global greenhouse gas emissions are reduced. Norway's policy on adaptation to climate change is based on the report *Adapting to a changing climate* (NOU 2010: 10) and the white paper *Climate change adaptation in Norway* (Meld. St. 33 (2012–2013)). A fundamental principle of climate change adaptation in Norway is that the actor responsible for the work is the actor responsible for the task or function affected by climate change. The Ministry of Climate and Environment is responsible for overall coordination of the Government's integrated climate change adaptation work. Norway has been pursuing an active climate change adaptation policy for some years. It is a challenging task both to identify the action that is needed and to measure how effective adaptation measures are in practice. Norway's new Climate Change Act includes a requirement for regular status reports on preparation for and adaptation to climate change in Norway. This will provide a basis for longer-term and better integrated work on climate change adaptation.

2.3 Cooperation with the EU on the 2030 emission reduction commitment

The Government has chosen to enter into a dialogue with the EU on joint fulfilment of the 2030 emission reduction commitment. Both Norway

¹⁷ *Climate in Norway 2100 – a knowledge base for climate adaptation*, NCCS report no. 1/2017 [Condensed English version of NCCS report no. 2/2015, CM-406/2015, updated in 2015]

Box 2.5 EU climate policy for 2021–2030

The EU has set itself the target of reducing its overall greenhouse gas emissions by at least 40 % from 1990 to 2030, which is also its EU contribution under the Paris Agreement. The EU intends to achieve this through three main pieces of climate legislation:

1. *The Emissions Trading System (EU ETS)*, which regulates emissions from industrial plants, power plants, the petroleum industry and aviation.

Target: Overall emission cuts of 43 % by 2030 compared with 2005.

2. *The proposed Effort Sharing Regulation*, which sets binding national targets for non-ETS emissions, i.e. emissions from transport, agriculture, buildings and waste management, and non-ETS emissions from manufacturing and the petroleum sector.

Target: Overall reduction of 30 % by 2030 compared with 2005.

3. *The proposed Land Use, Land-Use Change and Forestry (LULUCF) Regulation*

Target: According to the proposed rules, countries will have to ensure that recorded emissions from the sector do not exceed the recorded removals of CO₂ (known as the 'no debit rule').

Since 2008, Norway has taken part in the EU ETS on the same terms as EU member states. Closer cooperation with the EU in the period 2021–2030 would make the provisions of the Effort Sharing Regulation and the LULUCF Regulation relevant to Norway as well.

Joint fulfilment of climate targets for 2030 by Norway and the EU would involve cooperation to reduce greenhouse gas emissions by at least 40 % from 1990 to 2030. The EU's climate policy is based on three pieces of legislation: the Emissions Trading System (EU ETS) and the proposed Effort Sharing Regulation and Land Use, Land-Use Change and Forestry (LULUCF) Regulation. Cooperation with the EU would make the provisions of the Effort Sharing Regulation (which covers emissions from transport, agriculture, buildings and waste management, and non-ETS emissions from manufacturing and the petroleum sector) and the LULUCF Regulation relevant to Norway as well. This legislation would therefore be an important basis for Norwegian climate policy in the years ahead. EU climate policy and its implications for Norway are further discussed in Chapter 4.

Various EU legislative acts covering non-ETS emissions already apply to Norway, but joint fulfilment of the 2030 target would entail wider cooperation and stricter control of Norway's climate policy than previously. The Government views this as an important means of achieving Norway's climate targets. Cooperation with the EU on climate action would give Norway a much more binding responsibility for reducing non-ETS emissions. In the Effort Sharing Regulation, the European Commission has proposed several forms of flexibility to assist countries to meet their targets. The most important of these for Norway are the flexibility to access a limited number of allowances from the EU ETS, and the opportunity to trade emission units with other countries.¹⁸ Flexibility under the Effort Sharing Regulation is further discussed in Chapters 4.3.4 and 4.5.1. The flexibility mechanisms will make it possible to achieve the national emission targets for 2030 cost effectively.

The legislative procedures for the proposed new EU legislation will have to be completed before Norway and the EU can conclude an agreement on joint fulfilment of the 2030 emission commitment. The European Commission's proposals are being considered by the European Parliament and the Council, and the new legislation is not expected to be adopted before the end of 2017 at the earliest. The Norwegian Government has pro-

and the EU consider the implementation of mitigation measures to be part of a long-term transition to a low-emission society. In its roadmap for 2050, the EU has set out its ambition for the transition to a competitive and cost-effective low-carbon economy in 2050. Norway has adopted a legally binding target of becoming a low-emission society.

¹⁸ Under EU climate legislation, countries' emission targets are converted into emission budgets for the period 2021–2030. Under the proposed Effort Sharing Regulation, each country will receive an annual emission allocation (AEA) free of charge for each year of the period 2021–2030. For each year, a country must transfer an emission unit to its compliance account in the registry corresponding to each tonne of emissions in the relevant sectors. The size of a country's AEA depends on its emission target.

Box 2.6 Is the EU Emissions Trading System really working?

The EU Emissions Trading System (EU ETS) puts an overall limit, or cap, on emissions from the installations and sectors to which the system applies. Norwegian companies have been part of the system since 2008 under the EEA Agreement. About half of Norway's emissions are included in the EU ETS, mainly emissions from the petroleum and manufacturing sectors.

The EU ETS has effective sanctions to prevent emissions from exceeding the cap, or the total number of emission allowances made available to companies and sectors. Because emissions are not permitted to exceed the cap, the ETS is an important instrument for ensuring that climate targets are met. However, its effect is limited by the level of ambition of European climate policy.

The EU is on track to reduce its emissions by more than the 2020 target of a 20 % cut from the 1990 level. This is good news for the climate, but means that there is a large surplus of emission allowances in the system. As a result, the price of emission allowances (the carbon price) is low. Low prices make the ETS less effective at promoting technological advances and a long-term transformation process. A tighter cap, for example as a result of a more ambitious climate policy, would make fewer emission allowances available, and carbon prices would be higher.

There have been discussions in the EU about what should be done so that the EU ETS contributes more to technological developments and transformation. Norway has argued for tightening the cap to raise carbon prices in the

short term. However, there has not been a political majority for this approach within the EU. Instead, technical measures have been introduced to strengthen the system, including the establishment of a market stability reserve. This will remove surplus emission allowances temporarily from circulation, and fewer allowances will be available to installations in the system. Once there is no longer a surplus, allowances will gradually be released back into the market. This arrangement will have a limited long-term effect on carbon prices, since the overall number of allowances is not reduced.

The progressive annual tightening of the emissions cap is more important for carbon prices and the effect of the ETS. The continual reductions in the number of emission allowances available mean that in the longer term, the ETS will bring about substantial cuts in emissions. Under the current rules, the number of allowances available is being reduced by almost 40 million per year. The European Commission has proposed that the cuts should be increased to almost 50 million tonnes a year after 2020. If this is done, the number of allowances available per year will have been reduced to 365 million in 2050, about 86 % lower than the volume of emissions in 1990. This proposal is being considered by the European Parliament and the Council, and there appears to be a prospect of achieving a majority for the Commission's proposal for more ambitious cuts in emissions after 2020.

The EU ETS is working since it ensures that the EU's climate targets are achieved.

vided written input and put forward Norwegian views at a number of bilateral meetings, at informal ministerial meetings and through membership of the ministerial Green Growth Group.¹⁹ Efforts to influence EU decisions will continue until development of the 2030 policy has been completed.

Since 2008, Norway has taken part in the EU ETS on the same terms as EU member states. The

ETS is a 'cap-and-trade' system, in which there is an overall limit, or cap, on emissions from the installations covered by the system, and the total number of emission allowances is reduced each year. The continual tightening of the emissions cap will bring about the necessary emission cuts in the ETS sector in the EU and Norway by 2030.

The long-term transformation to a low-carbon economy in Europe will require deep cuts in emissions in the ETS sector up to 2050. If the European Commission's proposal for annual tightening of the emissions cap is followed, the total number of emission allowances available to companies in 2050 will be 86 % lower than the volume of emis-

¹⁹ The informal ministerial Green Growth Group has members from EU countries that are advocating ambitious climate targets and a more effective ETS. Norway was invited to join in early 2014.

sions in 1990. There will be fewer and fewer emission allowances available to companies in the sectors covered by the ETS. The price of emission allowances will probably be much higher than it is today. The constant tightening of the cap will drive a transition involving greater and greater use of climate-friendly solutions.

Norwegian installations in sectors covered by the EU ETS will also have to be prepared to pay far more for their remaining emissions. The present white paper sets out a strategy for cutting non-ETS emissions in Norway, but the Government also considers it very important to promote technology development in the ETS sector. In the white paper *New emission commitment for Norway for 2030 – towards joint fulfilment with the EU* (Meld. St. 13 (2014–2015)), the Government presented the five priority areas of Norwegian climate policy. The most important of these for the transformation process in the ETS sector will be the focus on the development of low-emission industrial technology. Enova's budget has been strengthened in this area and the allocation for Innovation Norway's grant scheme for environmental technology has been increased, both of which will play an important role in technology development.

It will be important to maintain the focus on long-term technology development to reduce process emissions from Norwegian industry. The Norwegian process industries have delivered a roadmap for a low-emission path of development to a Government-appointed expert committee on green competitiveness, which includes a proposal to establish a strategic forum called Prosess21. In a recent white paper on industrial policy, *A greener, smarter and more innovative industry* (Meld. St. 27 (2016–2017)), the Government announced that it intends to establish a long-term strategic forum for the process industry sector. Prosess21 will be asked to provide input on how best to combine the reduction of emissions from the process industries to a minimum by 2050 with sustainable growth in the sector. The white paper on industrial policy also gives an account of emissions from Norwegian industry, how they can be reduced, and the challenges involved in this. Policy development in this field must take into account the effects of the Emissions Trading System, the risk of carbon leakage and the competitive position of Norwegian industry. Under the Emissions Trading Directive, EU states may up to 2020 compensate sectors that are considered to be at significant risk of carbon leakage for higher electricity prices resulting from the operation of

the EU ETS. The Norwegian Government is seeking to ensure that compensation arrangements continue after 2020. These arrangements must be designed to ensure that the ETS is effective and continues to provide incentives for cost-effective emission cuts. This is in line with the purpose and design of the EU Emissions Trading System.

2.4 The Norwegian Government's climate policy

Over the last five years, the Government has followed up and strengthened the 2012 cross-party agreement on climate policy. Norway's non-ETS greenhouse gas emissions were reduced from 28.1 million tonnes CO₂-eq in 2013 to 27.4 million tonnes in 2016. Total Norwegian greenhouse gas emissions were reduced by 1 % from 2015 to 2016. The white paper *Long-term Perspectives on the Norwegian Economy 2017* (Meld. St. 29 (2016–2017)), published in March 2017, presents projections of a continued decline in Norway's greenhouse gas emissions up to 2020. The trend is expected to continue up to 2030, probably with the largest reductions in the road traffic sector. Particularly important factors here are Norway's electric vehicle policy and the plan for increasing the proportion of biofuel used by road vehicles.

The 2008 cross-party agreement on climate policy set a target of reducing emissions in Norway by 15–17 million tonnes CO₂-eq by 2020. This figure included 3 million tonnes in CO₂ uptake by forests, giving a net reduction of 12–14 million tonnes CO₂-eq in emissions. Expressed as an emission ceiling, this meant that Norway's total emissions were not to exceed 45–47 million tonnes CO₂-eq in 2030. There has since been a technical adjustment of this figure, and the interval has been altered to 46.6–48.8 million tonnes CO₂-eq (presented in the budget proposal for 2017 from the Ministry of Climate and Environment (Prop. 1 S (2016–2017)): see Box 2.4). When the present Government took office in 2013, it commissioned a report from the Norwegian Environment Agency on progress towards the 2020 target.²⁰ The report indicated that there was a gap of about 8 million tonnes CO₂-eq between the target and projected emissions in 2020. Using more

²⁰ Norwegian Environment Agency. Faglig grunnlag for videreutvikling av den nasjonale og internasjonale klimapolitikken. Klimatiltak mot 2020 og plan for videre arbeid [Scientific basis for further development of Norwegian and international climate policy. Mitigation measures up to 2020 and further plans], report M-133.

recent projections, this gap is now estimated at about 3 million tonnes CO₂-eq. If the expected increase in biofuel use is taken into account, the gap is reduced to about 2 million tonnes CO₂-eq. As a result of steps that have been taken to strengthen climate policy, projections now suggest for the first time that Norway's emissions will decline up to 2020, even though other factors such as a growing population are making it more difficult to achieve the 2020 target.

In its 2017 budget proposal, the Government included a green tax shift in response to the recommendations of the Green Tax Commission. Its purpose is to promote more climate-friendly action and consumption. The proposed green tax shift was strengthened in the budget agreement between the Government parties and the Christian Democratic Party and the Liberal Party. Fuel taxes and taxes on greenhouse gas emissions have been increased, while other taxes have been reduced. In all, environment- and energy-related taxes have been increased by almost NOK 5.5 billion since the Government took office.

The budget proposal for 2017 and the budget agreement between the Government parties and the Christian Democratic Party and the Liberal Party in autumn 2016 also strengthened the cross-party agreement on climate policy through specific measures such as the planned stepwise increases in the biofuel quota obligation, continued preferential treatment of electric vehicles, the promotion of carbon capture and storage (CCS), forest fertilisation and the restoration of peatlands and other wetlands.

The Government has identified five priority areas for Norway's climate policy: reducing emissions from the transport sector, strengthening Norway's role as a supplier of renewable energy, the development of low-emission industrial technology and clean production technology, environmentally sound shipping and carbon capture and storage. These are all fields where emissions must be greatly reduced. Another aim is to lay the foundation for new industrial development and a forward-looking business sector.

The Government and the parties with which it is cooperating in the Storting are giving high priority to the railways and public transport. During the first four years of the plan period for the current National Transport Plan (2014–2023), allocations to the incentive scheme for urban areas to improve public transport have been 30 % higher than originally planned. Allocations to the railways have also exceeded the amounts original planned. In the new National Transport Plan for 2018–2029,

the Government is giving even higher priority to improving the railways, and intends to make investments of NOK 18 billion in goods transport by rail to promote a shift from road to rail. The Government also proposes an allocation of NOK 66 billion for measures to encourage walking, cycling and the use of public transport in Norway's largest towns. The new transport plan also proposes new, ambitious targets for phasing in zero-emission vehicles. One of the targets of the 2012 cross-party agreement on climate policy is that average greenhouse gas emissions from new passenger cars in Norway should not exceed 85 g CO₂/km by 2020. Norway is on track to achieve this well before 2020, and perhaps as early as 2017.

In spring 2016, the Government presented a white paper on Norway's energy policy (Meld. St. 25 (2015–2016)). Its main message is that a coherent approach to security of energy supply, climate change and industrial development is needed to ensure that Norway has an effective energy supply system. Norway already derives a large share of its energy supplies from renewable sources. The electricity generation sector is virtually emission-free. However, energy use in transport, manufacturing, oil and gas production and for heating still results in greenhouse gas emissions. In the white paper, the Government defined four main priorities for its energy policy: improving security of supply; profitable development of renewable energy; more efficient and climate-friendly energy use; and value creation based on Norway's renewable energy resources.

Enova's budget has been considerably strengthened, and funding for Innovation Norway's grant scheme for environmental technology has been almost tripled. The Government has also started the establishment of a long-term strategic forum, Prosess21, for the Norwegian process industries. The aim is to combine the reduction of emissions from the process industries to a minimum by 2050 with sustainable growth in the sector

Norway is a coastal state. The Government is giving high priority to environmentally sound shipping. A green shift in the shipping industry is being promoted through the introduction of grant schemes for renewal of the short sea shipping fleet, including grants towards scrapping vessels and innovation loans, and funding for the development and deployment of low- and zero-emission technology in the shipping industry. By introducing climate-related criteria in public procurement and providing funding through Enova, the Gov-

ernment has ensured that many new low- and zero-emission car ferries will be deployed along the Norwegian coast in the years ahead. The Government will continue this work by ensuring that all new car ferries that are part of the national road system use low- or zero-emission solutions and promoting the use of such solutions in car ferries and high-speed vessels that are part of the county road system. In the National Transport Plan for 2018–2029, the Government has announced that by 2030, its aim is for 40 % of the short shipping fleet to run on biofuel or be low- or zero-emission vessels. This will reduce greenhouse gas emissions and promote the development of green technology and employment along the coast.

Carbon capture and storage (CCS) could provide part of the solution to the problems of climate change. The overall goals of the Government's work in this field is to play a part in making CCS a cost-effective approach to combating global climate change. Achieving this will require technology development and cost reductions, for example through the construction of full-scale CCS demonstration facilities. The Government presented its CCS strategy in the 2014 budget proposal from the Ministry of Petroleum and Energy (Prop. 1 S (2014–2015)). Measures in the strategy include research, development and demonstration, and the implementation of a full-scale project using technology that has a potential for widespread diffusion. The strategy also includes international efforts to promote CCS as an important mitigation measure.

Internationally, Norway is involved in several courses of action to realise the ambitions of the Paris Agreement. The most important of these is Norway's International Climate and Forest Initiative, which pays for reductions in emissions from deforestation and forest degradation in developing countries. In theory, as much as one third of emissions reductions needed to solve the global climate problem could be achieved through cuts in emissions from deforestation and forest degradation. Through the Climate and Forest Initiative, Norway has entered into partnerships with Brazil, Indonesia and other countries with the aim of promoting sustainable rainforest management. These efforts reduce CO₂ emissions through the conservation of forest, safeguard valuable biodiversity and contribute to sustainable development for people who live in and depend on forests.

There is agreement in the Storting that the current level of funding for the Climate and Forest Initiative is to be continued until 2020. In a recent

white paper on Norway's development policy, *Common Responsibility for Common Future* (Meld. St. 24 (2016–2017)), the Government called for broad agreement from the Storting to maintain a high level of funding for the Climate and Forest Initiative through the aid budget until 2030. The Government has intensified cooperation with the business sector on forest conservation, among other things by launching a new fund to support deforestation-free agriculture, with the support of the Climate and Forest Initiative. This is an example of the innovative role the Climate and Forest Initiative can play in development policy.

The Government will continue its international work both through the Climate and Forest Initiative and through other international efforts to assist developing countries in implementing their own low-carbon development plans and climate change adaptation plans.

Norway also provides substantial funding for climate change adaptation and support for renewable energy in developing countries. Between 2015 and 2018, Norway will contribute NOK 1.6 billion to the Green Climate Fund, which is the key multilateral channel for funding to support implementation of developing countries' national climate targets. The developed countries have committed themselves to the goal of mobilising USD 100 billion annually by 2020 towards climate action in developing countries, to be obtained from a mix of public and private sources.

The need for climate finance is growing. In the years ahead, emissions will primarily rise in developing countries, and these are also the countries that will be hardest hit by climate change. If the world is to achieve the targets of the Paris Agreement, it will be vital for developing countries to have access to funding. Many of their nationally determined contributions are also conditional on the availability of international climate finance. According to the Paris Agreement, developed countries should continue to take the lead in mobilising climate finance from a variety of sources, instruments and channels, as part of a global effort. In line with this, Norway intends to increase the level of climate funding it provides.

Article 6 of the Paris Agreement provides for market-based cooperation between countries to enable them to set more ambitious mitigation targets. Norway is already funding mitigation measures in developing countries through the Clean Development Mechanism (CDM). Through the Transformative Carbon Asset Facility (TCAF), Norway is involved in pilot programmes to test new market mechanisms. Norway is also promo-

ting a green shift in developing countries through various international partnerships both within and outside the UN, and through the Norwegian Carbon Credit Procurement Programme.

These market-based initiatives are a key element of international climate action because they also involve systematic sharing of expertise on sustainable management and renewable energy, and partner countries become more aware of the value of improvements in energy and resource

efficiency. Such initiatives are most likely to succeed when countries themselves request support, and can be confident that it is possible to shape the economic framework to improve long-term results. Internationally, Norway is thus involved in several courses of action to realise the ambitions of the Paris Agreement. Norway intends to play a leading role in efforts to put an international price on greenhouse gas emissions and develop effective international carbon markets.

3 Norway's climate strategy for 2030 and the transition to a low-emission society

3.1 A strategy to ensure that Norway achieves its targets

The Government intends to achieve its 2030 target mainly through domestic emission reductions, and with the use of EU flexibility mechanisms as necessary. The Government's strategy for 2030 is intended to facilitate substantial domestic emission reductions.

Both Norway and the EU are giving high priority to climate policy. The Government has chosen to enter into a dialogue with the EU on joint fulfilment of the 2030 emission reduction commitment in order to contribute to the wider international cooperation on global climate solutions. Joint fulfilment with the EU could open up more opportunities for Norwegian companies to provide innovative solutions for the green shift in the economy that has already begun both in the EU and in Norway. Norway is already cooperating with the EU to reduce emissions from sectors covered by the EU Emissions Trading System. Given an agreement on joint fulfilment of the 2030 target, Norway would also cooperate with the EU on reducing non-ETS emissions covered by the proposed Effort Sharing Regulation. These emissions are mainly from transport, agriculture, buildings and waste management, but also include non-ETS emissions from manufacturing and the petroleum sector. Under an agreement on joint fulfilment of climate targets with the EU, Norway would be assigned its own target for reduction of non-ETS emissions. The Commission's proposal estimates that Norway would be attributed a target of a 40 % reduction of emissions that come within the scope of the Effort Sharing Regulation. Norway would thus be a full participant in collective European efforts to reduce emissions. After the US decision to withdraw from the Paris Agreement, it is first and foremost the EU that will have to lead the way in the international climate negotiations. This makes Norway's decision to cooperate closely with the EU even more important.

Given joint fulfilment with the EU, Norway's commitment for emissions covered by the Effort Sharing Regulation would be expressed as a bud-

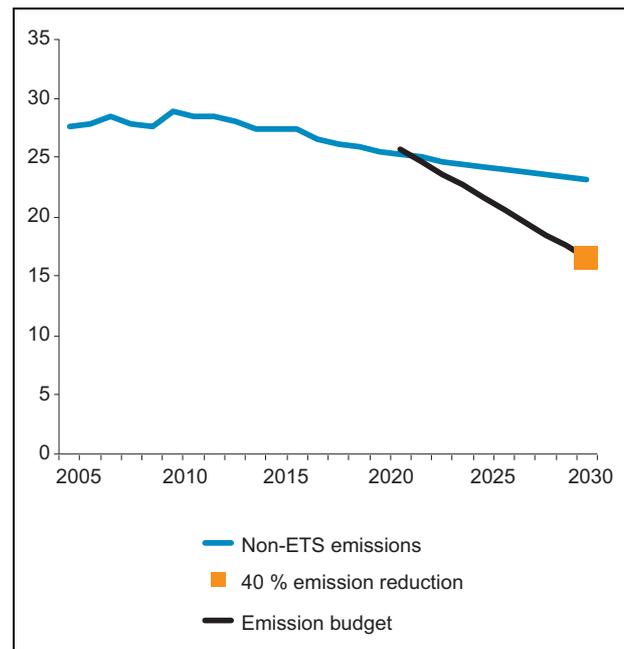


Figure 3.1 Emission projections and Norway's emission budget for non-ETS emissions (million tonnes CO₂-eq)

Sources: Statistics Norway, Norwegian Environment Agency, Ministry of Finance and Ministry of Climate and Environment.

get for the whole period 2021-2030. This budget would specify not only a ceiling for total emissions over the period as a whole, but also the maximum permitted emissions for each year. However, we know that it is difficult to calibrate greenhouse gas emissions closely from year to year. Economic activity fluctuates and the population may change. The speed of developments in climate-friendly technology is uncertain, and the costs of deploying such technology are therefore also uncertain. The Government's strategy has been designed to deal with the interplay between an emission budget including specified annual targets and greenhouse gas emissions that are influenced by the actions of several hundred thousand companies and millions of people.

The emission budget Norway would be allocated under an agreement with the EU has not

Table 3.1 Estimated emission budget and emissions gap for Norway (million tonnes CO₂-eq)

Estimated emissions gap ¹	30
Expected access to allowances from the EU ETS	5.5–11
Estimated need for emission reductions (emissions gap)	20–25

¹ For calculation purposes, the contribution of the land use, land-use change and forestry (LULUCF) sector is set at zero.

Source: Norwegian Environment Agency

been finally settled, and will depend on the EU legislation as finally adopted. On the basis of the figures available at present, the gap between projected emissions in Norway and Norway's emission budget is estimated at 30 million tonnes CO₂-eq for the period 2021–2030. This estimate is uncertain. The gap can be closed by domestic emission reductions and cooperation with EU countries on emission reductions.

In the Effort Sharing Regulation, the European Commission has proposed several forms of flexibility to assist countries to meet their targets. Some countries will have the flexibility to access a limited number of allowances from the EU ETS. Based on the proposed regulation, Norway is likely to be able to use between 5.5 and 11 million EU ETS emission allowances to cover part of the gap in the emission budget (this is further discussed in Chapter 4.3.4 and 4.5.1). The Government will make full use of this flexibility. Further emission reductions totalling 20–25 million tonnes would be required during the period to cover the remaining gap. The estimated need for emission reductions is uncertain.

If the Commission's legislative proposals are adopted, joint fulfilment by Norway and the EU would mean that Norway too would be assigned the target of ensuring that recorded emissions from the LULUCF sector (land use, land-use change and forestry) do not exceed the recorded removals of CO₂. If the Commission's proposal is adopted, Norway is likely to have to record net emissions from the sector. This means that Norway's emission commitment may increase above the level that follows from the Effort Sharing Regulation, despite the large net uptake of CO₂ by forest in Norway; see Chapter 4.4 for further details. Various alternatives to the Commission's proposal are now being discussed. Norway will work together with other European countries that have large areas of forest to promote an alternative model for the EU. The final design of the accounting rules is still very uncertain. The contribution of the LULUCF sector is therefore considered to be zero for the purposes of the present calcula-

tions. The calculated gap of 20–25 million tonnes in the emission budget has therefore been used as a basis for assessing the need for further cuts in emissions, see Table 3.1. If the emissions gap turns out to be higher than this as a result of the rules for the LULUCF sector, it will probably be possible to cover the difference by using bilateral flexibility mechanisms.

The Government intends to achieve its 2030 target mainly through domestic emission reductions, and with the use of EU flexibility mechanisms as necessary. The Government's strategy for 2030 is intended to facilitate substantial domestic emission reductions. Chapter 3.2 describes national action that Norway can take to satisfy the need for emission reductions. Before the commitment period starts in 2021, the details of the legislation will be known and the consequences for Norway will be clearer. However, well into the commitment period 2021–2030 there will be considerable uncertainty related to emission trajectories, the effects of climate policy, technological developments and the costs of emission reductions. This is why the strategy needs to be both ambitious and flexible. The Government is allowing for uncertainty by strategic planning to ensure the necessary flexibility to achieve the emission budget. Norway expects sufficient flexibility to be available through bilateral agreements with EU countries. If it is necessary and proves to be cost-effective, the Government also plans for Norway to be able to make use of flexibility in the form of direct purchases of emission allowances from other countries. Use of the EU flexibility mechanisms will contribute to emission reductions elsewhere in Europe within the common overall emission ceiling, and thus contribute to real global reductions in the same way as emission reductions in Norway.

To ensure that the targets are achieved by 2030, the Government's strategy incorporates sufficient flexibility to allow for adjustments as new knowledge becomes available and conditions change, for example as a result of technological advances. Thus, in the present white paper, the

Government is presenting a realistic and dynamic strategy for tackling the climate policy challenges we are facing in the period up to 2030, and one that will contribute to a green shift and green competitiveness in Norway.

3.2 Continuing and strengthening Norway's national efforts

The Government has already implemented a range of mitigation measures and strengthened national climate policy together with the parties with which it is cooperating in the Storting (Norwegian parliament). In addition, decisions made by the Storting and ambitions and goals that have been formulated will play a part in bringing about emission reductions in the years ahead. This applies in particular to the targets for zero-emission vehicles as a share of the vehicle park set out in the Norwegian National Transport Plan 2018–2029; the decision to increase the biofuel quota obligation (the required proportion of biofuels in annual sales of road traffic fuels) to 20 % in 2020; and a decision by the Storting to request the Government to introduce a standard carbon tax rate for non-ETS emissions. Negotiations are also in progress on a CO₂ fund for commercial transport.

In the strategy described in the present white paper, the Government shows that the estimated emissions gap of 20–25 million tonnes can be closed by means of domestic emission reductions. The white paper discusses mitigation measures that the Norwegian Environment Agency estimates have the overall potential to reduce emissions by more than is needed to close the emissions gap. The Government considers it appropriate to consider a broad range of mitigation measures because estimates of the emission reduction potential and costs of measures are highly uncertain. This strategy takes into account the possibility that some of the emission reduction potential may not be realised. The strategy does not present a final list of mitigation measures or policy instruments to achieve emission reductions by 2030. It will be important to be able to adjust the use of policy instruments throughout the period, for example to take into account technological developments. The strategy therefore charts a course for the use of policy instruments in the years ahead and indicates mitigation opportunities within each sector. Mitigation measures are discussed in more depth in Chapter 5.

The transport sector accounts for about 60 % of non-ETS emissions in Norway, and a large pro-

portion of domestic emission reductions must therefore be achieved in this sector. A good many political ambitions and goals have been formulated for the transport sector in recent years. The National Transport Plan 2018–2020 presents various quantitative targets for new zero-emission vehicles for 2025 and 2030. Analyses show that ambitious targets for emission cuts in the transport sector will not be achieved without the use of incentives. Policy instruments already adopted by the Government are expected to contribute significantly to achievement of the quantitative targets. The targets are based on the assumption that the technological maturity of zero-emission vehicles in different segments will improve so that they become competitive with fossil-based transport solutions.

The biofuel quota obligation is to be increased in line with the 2016 budget agreement. However, if biofuels are produced in Norway, emissions from their production may be included in Norway's emission inventory, primarily in the ETS sector (manufacturing) and/or the LULUCF sector.

To ensure judicious use of policy instruments and cuts in emissions in urban areas, Norway has established arrangements for urban environment and urban development agreements for the larger urban areas. These are now to be coordinated in a single system of integrated urban land-use and transport agreements. These agreements are intended to be instrumental in achieving the target of using public transport, cycling and walking to meet the growth in the volume of passenger transport (giving zero-growth in passenger car traffic) in the larger urban areas that are included in these arrangements.

Decisions have also been made that may reduce non-ETS emissions in sectors other than the transport sector. The Government will ensure that the prohibition on the use of mineral oil for heating buildings from 2020 also includes the use of mineral oil to provide peak-load capacity. The Government also intends to extend the prohibition further to include farm buildings and temporary buildings. Furthermore, the Government will review possibilities for reducing emissions from the use of natural gas to heat buildings. Another goal must be to ensure that construction sites are as fossil-free as possible in future. In the course of 2017, the Government will therefore review ways of reducing the use of mineral oil for heating and drying buildings during construction. In addition, the Government is working on an action plan for fossil-free construction sites in the transport sector.

The Norwegian Environment Agency has estimated that action to achieve the political goals and ambitions mentioned above can result in emission reductions of the order of 16 million tonnes CO₂-eq over the period 2021–2030. In its analyses, the Environment Agency has divided mitigation measures into several cost categories. Mitigation measures related to policy objectives and ambitions for the transport sector vary greatly in cost. Cost levels will depend to a large extent on further developments in low- and zero-emission technology for the transport sector. This technology is mainly being developed outside Norway.

The Environment Agency has estimated that there is an additional potential for reducing non-ETS emissions by 18 million tonnes at an economic cost of less than NOK 500 per tonne CO₂-eq in sectors including transport, agriculture, industry and petroleum. The estimated emission reduction potential and costs are uncertain and sensitive to the underlying assumptions. Developments in costs and in the feasibility of implementation will determine which mitigation measures are actually implemented. The Environment Agency has not assessed the policy instruments that would be needed or how they should be applied, and this is another source of uncertainty.

The Storting has adopted a decision requesting the Government to introduce a standard carbon tax rate for non-ETS emissions. The Government intends to follow this up in the 2018 budget. A standard carbon tax rate for all sectors may result in emission reductions in addition to those already included in the baseline projections. Almost 60 % of non-ETS greenhouse gas emissions are currently subject to the standard tax rate of NOK 450 per tonne CO₂. However, certain industries and uses are exempted from the carbon tax or are taxed at a reduced rate. In non-ETS sectors, these include the use of natural gas in greenhouse nurseries; domestic maritime transport (goods and passengers); fisheries less than 250 nautical miles from the coast; and offshore vessels. There is also a reduced mineral oil tax rate for fisheries less than 250 nautical miles from the coast. A reduced carbon tax rate applies to domestic aviation and the use of natural gas in manufacturing and mining. Emissions from domestic shipping and a proportion of domestic aviation are non-ETS emissions.

It is reasonable to assume that a proportion of the emission reduction potential of the measures to reduce emissions that are not subject to the carbon tax will be realised through the introduction of a standard tax rate, although the estimated

costs are uncertain. However, of the measures that the Norwegian Environment Agency has estimated will cost less than NOK 500 per tonne CO₂, a substantial proportion target emissions that are already taxed. In some cases it can be difficult to impose a tax on emissions, for example if they are difficult to measure or calculate. There may also be cases where the carbon tax will not function as an incentive to introduce cost-effective measures because of barriers such as a lack of expertise or information. If the carbon tax is not considered to be an adequate or appropriate instrument, other instruments that provide equally strong incentives to reduce emissions will be considered.

For the agricultural sector and the fisheries, industry representatives will be invited to take part in committees appointed to consider ways of reducing greenhouse gas emissions by 2030.

The Government has initiated a process together with relevant industry organisations on the establishment of an environmental agreement and a CO₂ fund for commercial transport. Its environmental target will need to be adapted to the extent and design of the agreement and considered in conjunction with Norway's 2030 climate targets. The first steps are to commission reviews and obtain data and information as a basis for analyses.

According to calculations by the Norwegian Environment Agency, the measures described above have the overall potential to reduce domestic emissions by about 35 million tonnes in the period 2021–2030 compared with the emission trajectory in the current baseline projections. This is considerably more than the estimated need for further emission reduction (20–25 million tonnes), and shows that the Government's strategy will most probably result in sufficient emission cuts by 2030. The Government considers it appropriate to present a wider range of possible mitigation measures since there is a high level of uncertainty in the estimates, partly because they depend heavily on future technological advances, prices and the effects of different policy instruments. The Environment Agency's cost estimates are based on the assumption that the costs of zero-emission solutions will drop considerably in the years ahead. See Chapter 6 for a further discussion of this. It is uncertain how large a proportion of the emission reduction potential outlined here will be realised.

The transport sector is an important element in the green shift. It accounts for about 60 % of non-ETS emissions in Norway, and a large proportion of the reduction in domestic non-ETS emis-

sions must therefore be achieved in the transport sector. Meanwhile, the development of low- and zero-emission technology in this sector is proceeding rapidly. To support efforts to reduce emissions in the transport sector, the Government has set a working target of a cut of 35–40 % in emissions from the sector by 2030 compared with 2005. See Chapter 5.3 for further information. This target is based on the assumption that the technological maturity of zero-emission solutions in different transport segments will improve so that they become competitive with fossil-based transport solutions.

In connection with the work of the Government-appointed expert committee on green competitiveness and the Government's subsequent work, 15 branches of industry have till now chosen to draw up their own roadmaps for a low-emission path of development. This demonstrates that the Norwegian business sector intends to seize the opportunities offered by the green shift, and are interested in cooperation with knowledge institutions and the authorities to ensure success. A number of Norway's largest companies have joined the Norway 203040 coalition in order to cooperate on the business contribution to achieving Norway's climate targets for 2030, see Box 3.2. The same trend is apparent internationally – leading global businesses in various sectors are advocating an ambitious climate policy and calling for clear political signals on this. Previous transformation processes have shown that those who lead the way in the development and deployment of new technologies and create markets for them can build up expertise and competitive advantages for the future. This will be at least as important in the transformation to a low-emission society. The Government is drawing up an overall strategy for green competitiveness.

3.3 Building up the knowledge base

The Government considers it important for Norway's efforts to meet its 2030 commitment and continue the transition to a low-emission society in 2050 that knowledge about possible mitigation measures, their costs and the effects of policy

instruments is strengthened. This knowledge-building process is important and will be given priority. Further analyses will also be necessary as a basis for reporting to the UN and the EU and for the reporting required under the Climate Change Act adopted by the Government in June 2017. The Government will follow up the Storting's request for the appointment of a technical committee responsible for calculations in the field of climate change mitigation, chaired by the Norwegian Environment Agency.

The Government will continue its work on building up data and developing analytical tools. This will include further development of mitigation analyses, including estimates of emission reduction potentials and the costs of implementing different measures. It will also be necessary to develop methodology so that it is possible to provide better estimates of the effects of policy instruments as part of an effective climate policy.

The Government intends to achieve its 2030 target mainly through domestic emission reductions, and with the use of EU flexibility mechanisms as necessary. The Government will:

- promote the use of cost-effective mitigation measures to meet the 2030 commitment;
- consider the introduction of a standard carbon tax rate for all non-ETS emissions. If the carbon tax is not an adequate or appropriate instrument, other instruments that provide equally strong incentives to reduce emissions will be considered;
- follow up political ambitions and goals for the transport sector, including zero growth in passenger transport by car in urban areas, the decision to increase the biofuel quota obligation to 20 % in 2020 and the quantitative targets for zero-emission vehicles set out in the National Transport Plan 2018–2029;
- make full use of the flexibility Norway can achieve by using emission allowances from the EU ETS;
- if it is necessary and proves to be cost-effective, plan for Norway to be able to make use of flexibility in the form of direct purchases of emission allowances from other countries;
- further develop the knowledge base for Norway's climate policy.

Box 3.1 Binding emission budget

Under the Effort Sharing Regulation, the EU's 2030 target is converted into an emission budget for the whole period 2021–2030. Instead of assessing emissions only in 2030, a binding emission budget is being established that will regulate emissions over a ten-year period.

A similar approach was used for the second commitment period under the Kyoto Protocol, where Norway's emission reduction target of reducing emissions by 30 % by 2020 was expressed as an emission budget for the period 2013–2020. Under the Protocol, Norway has undertaken to ensure that annual greenhouse gas emissions for the period 2013–2020 are on average 16 % lower than in 1990.

The end point of the emission budget is given by the emission reduction target, but before the period starts, the starting point for the emission budget must also be determined. This means that the size of the emission budget

for the period 2013–2020 does not follow automatically from the level of ambition for 2030. Several different emission budgets could be considered to be consistent with achieving the 2030 target.

Because the emission budget is dynamic, it will not be possible to say exactly how high emissions will be in the target year 2030. If countries make deep cuts in emissions early in the ten-year period, they can save unlimited amounts of unused emission units for later years.

In the context of climate change, it is primarily the total number of emission units available for the period 2021–2030 that is of interest. The way emissions are distributed within the period is less important. Chapter 4 describes in more detail how the EU's emission budget for the period 2021–2030 will be determined.

Box 3.2 The Norway 203040 coalition – Norwegian business for a green transformation

A number of leading Norwegian businesses have established the Norway 203040 coalition, a long-term initiative with the aim of identifying business opportunities and contributing to solutions to the problems of climate change in the transition to a low-emission society. The coalition is playing a leading role in efforts to ensure that Norway achieves its target of a 40 % cut in emissions by 2030. Its members believe that Norway is in a good position to achieve a green transformation and can play a leading role in showing the way towards a low-emission society. By joining forces across different sectors, the members believe that they can achieve far more collectively than the sum of their individual efforts.

In 2016, the coalition worked together to identify the most important opportunity areas, and on the basis of this, it is now developing four pilot projects focusing on the following themes:

- electrification of companies' own transport fleets on land and at sea;
- building low-carbon neighbourhoods
- financing low-carbon growth;
- enhancing consumer awareness and encouraging green choices.

The members of the coalition are Agder Energi, Coca-Cola European Partners, DNV GL, Hurtigruten, Hydro, IKEA Norge, Kongsberg Gruppen, Marine Harvest, Ruter, Snøhetta Oslo, SpareBank 1 Forsikring, Statkraft, Statnett, Statoil, Storebrand, Telenor Norge, TINE, Umoe, Veidekke, Elektroforeningen and Finance Norway, in partnership with Xynteo and the environmental organisations WWF-Norway and ZERO. The coalition published its first report, Norway 203040 – The Business Opportunity, in 2015.

4 EU climate policy and its implications for Norway

4.1 Introduction

Norway is already part of the EU Emissions Trading System (EU ETS) through the Agreement on the European Economic Area (EEA). Given an agreement on joint fulfilment of the 2030 climate target, Norway and the EU will from 1 January 2021 also cooperate on reduction of non-ETS emissions. This would also mean that the proposed EU regulations on effort sharing and on land use, land-use change and forestry become relevant to Norway. Cooperation on emission reductions between EU countries is an important part of the EU legislation for achieving the 2030 target.

4.2 The EU Emissions Trading System

The EU ETS provides flexibility for participating installations and companies, brings about cost-effective emission reductions under an overall cap on emissions, and reduces the risk of companies moving production to other countries to avoid regulation and taxation of greenhouse gas emissions. About half of all Norway's emissions are included in the EU ETS. ETS emissions are to be reduced by 43 % by 2030 relative to the 2005 level. Norwegian installations in sectors covered by the system are playing their part in achieving this target in the same way as installations in other European countries. Norway's participation in the EU ETS is an important element of Norwegian climate policy and strategy for achieving the 2030 emission reduction commitment.

The EU ETS applies to emissions from more than 11 000 installations, which account for a little under half of the EU's total emissions. Emissions from the energy supply sector, manufacturing and the oil and gas sector are largely included in the ETS. In addition, emissions from aviation within the European Economic Area are regulated by the ETS. About half of all Norway's emissions are included in the system.

Within the EU ETS, a rise in emissions in Norway must over time be offset by a corresponding

reduction somewhere else in Europe. Similarly, a reduction in emissions in Norway will allow for emissions to rise elsewhere in the system over time.

The European Commission's proposal for a directive for the period 2021–2030 further develops the existing rules for the period 2013–2020. It does not involve any major changes in the structure of the system, and its scope (the sectors and gases covered) is unchanged in the proposal.

A key mechanism of the ETS is the annual tightening of the cap, in other words the annual reduction in the number of emission allowances issued. The annual reduction is a fixed number of emission allowances, which for the current period is 1.74 % of the calculated total quantity of allowances for 2010. The linear reduction factor of 1.74 % means that the number of emission allowances issued each year will be reduced by just under 40 million from the year before. In 2013, about 2 billion emission allowances were issued and could be used by installations in the system to meet their obligations. By 2020, the number of emission allowances issued will have been reduced to about 1.8 billion.

In the Commission's proposal for rules for the period after 2020, the reduction factor has been increased to 2.2% per year. This will mean that the number of emission allowances issued per year is reduced by about 50 million, which is roughly equivalent to Norway's total emissions. As a result of the annual tightening of the cap, the number of allowances issued in 2030 will be 43 % lower than emissions in 2005 from the sectors covered by the ETS. If the annual reduction in the number of allowances is continued unchanged after 2030, the number of allowances available for the installations in the system will have been reduced to 365 million by 2050. This is about 86 % lower than the volume of emissions in 1990 from the sectors covered by the ETS.

The Commission's proposal has been discussed by the Council and the European Parliament, and the three EU bodies are now seeking agreement on the final wording of the legislation in tripartite negotiations (known as trilogue meet-

ings). It is expected that the legislation will be adopted in autumn 2017.

4.3 The Effort Sharing Regulation

4.3.1 Introduction

In the EU, greenhouse gas emissions that are not covered by the EU ETS are currently regulated through the Effort Sharing Decision. A proposal for an Effort Sharing Regulation for the period 2021–2030 has been put forward. Effort sharing applies mainly to emissions from transport and agriculture, but also includes buildings, waste, parts of the oil and gas industry and some manufacturing sectors. The effort needed to reduce these emissions is to be shared between all the EU countries. On 20 July 2016, the European Commission put forward a proposal for rules for the period 2021–2030, including proposed emission reduction targets for each country, ranging from 0 to 40 % from 2005 levels. The Commission's proposal for the period 2021–2030 includes several forms of flexibility to ensure that national emission targets for 2030 can be achieved more cost effectively. All emission reductions will take place within the framework of the EU Effort Sharing Regulation and will count towards the common target of an EU-wide reduction of 30 % in non-ETS emissions. The rules ensure that there is a common EU ceiling for emissions under the Regulation for the entire period 2021–2030. The Commission's proposal is being considered by the European Parliament and the Council, and the regulation is expected to be adopted towards the end of 2017 at the earliest.

4.3.2 National targets

The national targets for each country are differentiated according to gross domestic product (GDP) per capita. The countries with the highest GDP per capita must also make the largest cuts in greenhouse gas emissions. No country can be required to reduce emissions by more than 40 %. To take cost effectiveness into account to some degree, the targets have been adjusted among the countries with the highest GDP per capita. In order to be able to adjust the targets for the highest-cost countries downwards, the Commission has proposed that the targets for Germany, France and the UK should all be increased by one percentage point.

The Commission's proposal estimates that Norway would be attributed a target of 40 % for

Table 4.1 Proposed effort-sharing targets

Selected countries	Proposed 2030 target
Luxembourg	-40 %
Sweden	-40 %
Finland	-39 %
Denmark	-39 %
Germany	-38 %
France	-37 %
UK	-37 %
Netherlands	-36 %
Austria	-36 %
Belgium	-35 %
Ireland	-30 %
EU 28	-30 %
<i>Norway</i>	<i>-40 %</i>

Source: European Commission's Impact Assessment for the proposed Effort Sharing Regulation for the period 2021–2030, see SWD (2016)247final, dated 20 July 2016.

reduction of emissions covered by the Effort Sharing Regulation.

4.3.3 New rules and annual targets from 2021 onwards

According to EU climate policy, it is not sufficient for countries to achieve their emission targets for 2030; they must also meet their annual targets throughout the period 2021–2030. Countries' emission targets are therefore to be converted into emission budgets for the period 2021–2030. Under the proposed Effort Sharing Regulation, each country will receive an annual emission allocation (AEA) free of charge for each year of the period 2021–2030. For each year, a country must transfer an emission allowance to its compliance account in the registry corresponding to each tonne of emissions in the relevant sectors. The size of a country's AEA depends on its emission target.

Norway is likely to receive an emission allocation for the target year 2030 corresponding to 60 % of its 2005 emissions from sources to which the Effort Sharing Regulation applies. According to the Commission's proposal, 2020 is the starting

point for calculating an emission budget, and the starting level is a country's average annual emissions in the period 2016–2018. There is to be a linear reduction trajectory from the starting point in 2020 to the end point in 2030. Thus, the annual emission allocations for the period 2021–2030 will be steadily reduced from 2021 to 2030, so that the number of emission allowances a country has available is gradually reduced year by year during the period. Since the calculated reductions begin in 2020, Norway's allocation in 2021 would be a number of emission allowances corresponding to a little less than the country's average annual emissions in the period 2016–2018.

To meet its obligations, a country must ensure that its emissions are matched by the number of emission allowances held in its compliance account in the registry. Countries can choose themselves whether to achieve their targets by reducing domestic emissions or to acquire a larger emission allowance by making use of the flexibility offered by the legislation. Options for using the flexibility mechanisms are further discussed in Chapters 4.3.4 and 4.5.1.

Each country is responsible for ensuring that it has enough emission allowances to meet its annual obligations. According to the Commission's proposal, this will be followed up through two formal compliance checks, when countries must ensure that the number of emission allowances in their compliance accounts corresponds to their emissions. The first compliance check will be in 2027, and will be for emissions in each of the years 2021–2025. The second compliance check will be in 2032 and will be for each of the years 2026–2030.

Given an agreement on joint fulfilment of the emission reduction target for 2030 with the EU, the EU's reporting requirements will also apply to Norway. In accordance with its commitments under the UNFCCC and the Kyoto Protocol, Norway reports annually to the UNFCCC secretariat, among other things on emission trends, in the same way as EU member states. To meet the EU's reporting requirements, Norway will need to establish a formal national reporting framework. A review is in progress of whether parts of the proposed Regulation on the Governance of the Energy Union may also be applicable to Norway if an agreement on joint fulfilment of the 2030 target is reached. In this case, Norway must not automatically be bound by other targets and legislation in the climate and energy field beyond what follows from the EEA Agreement and the agreement on joint fulfilment with the EU.

4.3.4 Flexibility rules

To enable more cost effective achievement of targets, the Commission has proposed five forms of flexibility under the Effort Sharing Regulation, which to a large extent involve the continuation of existing rules:

a. *Flexibility to access allowances from the EU ETS*

Nine EU countries, and probably also Norway, will be eligible for a new form of flexibility, under which they will be able to cover some emissions using an EU-wide total of up to 100 million EU ETS allowances within the effort sharing system. The total quantity will be shared between the eligible countries. Countries where costs are highest will be able to make most use of this flexibility. According to the Commission's proposal, Luxembourg and Ireland will be able to cancel a number of EU ETS emission allowances each year that corresponds to 4 % of their non-ETS emissions in 2005. The other eligible countries, including Sweden, Denmark and Finland, will be able to cancel EU ETS allowances corresponding to 2 % per year of their non-ETS emissions in 2005. Countries will be required to notify the Commission by the end of 2019 of whether and to what extent they wish to make use of the flexibility to access allowances from the EU ETS.

b. *Buying and selling*

Countries may buy and sell parts of their emission allocations to each other. These transfers will take place within an overall framework that ensures an overall cut of 30 % in emissions to which the Effort Sharing Regulation applies, and that provides for cost-effective achievement of the targets.

There are limits to how much of its allocation a member state may transfer to other member states before the compliance checks. A country may only transfer up to 5 % of its emission allocation for each of the years in the five-year period before one of the compliance checks. However, countries are free to enter into agreements on future transfers. Under the current Effort Sharing Decision, there is a four-month interval between the date when a country's emissions are established and the deadline for the compliance check. This means that countries will know exactly how well the number of units in their compliance accounts corresponds to their actual emissions four months before the compliance date. This is the period when it is intended that countries will

able to trade in emission units. EU countries can also do this under the Effort Sharing Decision, which applies to the period 2013–2020. So far, this option has only been used once, when Bulgaria transferred allocations to Malta in 2013. The Commission will present a proposal for supplementary rules for the period 2021–2030 at a later date.

c. *Banking*

Countries can bank unlimited amounts of surplus emissions during the period 2021–2030 for use later in the period. Thus, a country can use parts of its emission allocation from a specific year during this period to comply with its target in the same year or in any later year during the period. The Commission's proposal does not include an option for banking unused emission units for use in a later period after 2030.

d. *Borrowing*

The Commission has proposed that countries should be able to borrow from their emission allocation for the following year of the period, limited to 5 % of their allocation for that year. This means that if for example a country's emissions in 2021 are higher than its allocation for that year, it can use up to 5 % of its allocation for 2022 to comply with its 2021 target.

e. *Credits from the land use sector*

The Commission's proposal permits countries to make use of CO₂ removals in forest and other land categories (credits from the land use sector, or LULUCF credits) corresponding to a total of up to 280 million tonnes CO₂-eq over the entire period to comply with their national targets under the Effort Sharing Regulation. The flexibility to access credits from the land use sector is shared between countries on the basis of their share of the emissions from agriculture that are included under the Effort Sharing Regulation. To use this form of flexibility, countries must be able to document net removals from LULUCF in line with the Commission's proposed accounting rules. The use of LULUCF credits under the Effort Sharing Regulation is further discussed in Chapter 4.4.3.

up to one third of the solution to this problem, particularly through reduced deforestation and increased afforestation. Active, sustainable forest management is therefore a key element of climate policy globally, at European level and in Norway. The European Commission has proposed separate legislation for the LULUCF sector. The regulation that has been proposed gives EU countries an obligation to ensure that their CO₂ emissions from the sector do not exceed the removals that may be included according to the accounting rules set out in the proposal.

The proposal includes accounting rules for determining how much of a country's actual emissions and removals from the LULUCF sector to include when assessing whether it is in compliance with its commitment. There are also rules on reporting and compliance checks.

The LULUCF sector is divided into the following land accounting categories: afforested land, deforested land, managed forest land, managed cropland and managed grassland. Countries may also choose to include managed wetland on a voluntary basis. Furthermore, there are rules for 'harvested wood products' (HWP), in other words carbon stored in long-lived wood products.

It is necessary to determine a starting point for calculating changes in emissions and removals from the LULUCF sector. It is the changes from a defined reference level that are to be included and reflected in the accounts for the sector. Different reference levels have been proposed for the different land categories.

For managed forest land, a forward-looking forest reference level for net removals by forest is to be established. Under the Commission's proposal, the reference level is to be extrapolated from forest management practice and intensity for the period 1990–2009. The reference level will also be adjusted for changes in removals resulting from the age-class structure of forests.¹ According to the accounting rules for forest management activities, only changes from 'business as usual', for example achieved through reduction of harvesting, higher planting densities or fertilisation, can be included as removals in the accounts for managed forest land. In addition, a restriction has been proposed on how much of these removals can be included to ensure compliance with the

4.4 Legislation for the land use, land use change and forestry (LULUCF) sector

4.4.1 Introduction

The LULUCF sector is very important in the context of climate change, and can potentially provide

¹ The amount of CO₂ removed by forest depends on a number of factors, including age, forest type and climatic conditions. The use of a forward-looking reference level is intended to reflect variations in age-class structure of forests from country to country, which in turn influence harvesting levels and removals.

'no-debit' rule; no more than the equivalent of 3.5 % of a country's total emissions from other sources in the base year 1990. The principle of using a forward-looking forest reference level in accounting for managed forest land is new and differs from the accounting rules Norway follows under the Kyoto Protocol, where annual net removals in managed forest are calculated in relation to net removals in the base year 1990.

The Kyoto Protocol accounting rules also restrict the proportion of removals that can be used to meet Norway's emission reduction commitment; the ceiling is the equivalent of 3.5 % of total Norwegian emissions in the base year. Under this rule, Norway can include annual removals of about 1.8 million tonnes CO₂ in the forest management category under the Kyoto Protocol. According to the European Commission's proposed accounting rules, if removals are lower than calculated using the forward-looking forest reference level, the difference will be accounted for as emissions, even if there are net removals from the category 'managed forest land'. The EU countries have already started to use a forward-looking forest reference level during the second commitment period under the Kyoto Protocol. One of the differences for Norway is that under Kyoto rules, harvesting can be increased considerably without this having to be accounted for as emissions.

Preliminary calculations show that under the accounting rules proposed by the European Commission for the LULUCF sector, Norway is likely to have to record net emissions of 15 million tonnes over the period 2021–2030 before the category managed forest land is included, despite the large net uptake of CO₂ by forest in Norway. However, the calculations are very uncertain, and the final accounting rules may influence this figure. The reason for this situation is that the high removals in managed forest land in Norway will largely be accounted for relative to a forward-looking forest reference level. If the harvest rate turns out to be the same as assumed in this reference level, the value of this category will be set at zero. This means that the large CO₂ removals in Norwegian forest (provided they are not a result of introducing new measures)² cannot be used to offset emissions from other LULUCF accounting

categories, especially deforestation. It will be possible to include removals from afforestation for a period of 30 years. Since Norwegian forests grow slowly, the contribution from afforestation will be limited in the period up to 2030.

It should be anticipated that Norway may have to record net emissions when accounting for the category 'managed forest land' according to the Commission's proposal. These emissions would be additional to the preliminary figure of 15 million tonnes mentioned above. However, this is uncertain. If the harvest rate increases beyond the historical level (for 1990–2009) used in calculating the forest reference level, reduced net removals will be accounted for as emissions. According to the Commission's proposal, the change in the carbon stock in harvested wood products (HWP) is also to be included in the reference level for managed forest land. In the reference period proposed by the Commission (1990–2009), production in the Norwegian pulp and paper industry was largely in Norway. This resulted in an increase in the HWP carbon stock, which is counted as carbon removals. Since 2009, the industry has been restructured and a larger proportion of the timber is now processed abroad. Processing abroad will not count as removals in the accounts. Using the reference period 1990–2009, Norway's results will be measured against a period when the carbon stock in HWP was increasing, giving net removals. This means that Norway's annual removals in the period 2021–2030 must be higher than the reference level for the change to be accounted for as net removals. However, the carbon stock in harvested wood products produced in Norway has been reduced since 2009, and this counts as emissions.

The Commission's proposals are being discussed in the European Parliament and the Council (June 2017), and a number of forest countries, including Norway, have advocated alternative models. Norway will work together with other European countries that have large areas of forest to promote an alternative model for the EU. The rules that are finally adopted may differ in several ways from the Commission's proposal, and this will also influence the calculations of the consequences for Norway.

4.4.2 The 'no-debit' rule

The 'no-debit' rule applies to the sum of all accounting categories in the LULUCF sector. This obligation can be met through national measures to reduce emissions or increase removals beyond

² For managed forest, removals count as zero if actual changes in net removals are consistent with the reference level. If the proportion of forest that reaches maturity is larger than in the historical reference period, a corresponding increase in harvesting can be modelled and included in the reference level.

the reference level (in other words, new climate-related measures in managed forest land). For the second five-year period (2026–2030) it will also be possible to make use of any surplus LULUCF credits from the first five-year period (2021–2025) that have been banked for later use.

A country may also use LULUCF credits from other countries to meet its obligations. They may only be used to meet its obligations for the LULUCF sector, not to achieve its emission target under the Effort Sharing Regulation (see 4.4.3 below for further information).

The proposed legislation is addressed to national authorities and not to individual forest owners.

If a country fails to comply with the ‘no-debit’ rule for the LULUCF sector, it will have to compensate for the excess emissions through further measures under the Effort Sharing Regulation, which will be additional to the reductions in non-ETS emissions required under the latter.

A restriction has been proposed on the proportion of removals from managed forest land that can be included towards compliance with the ‘no-debit’ rule if net removals are higher than the reference level. The proposed limit is the equivalent of 3.5 % of a country's total emissions in 1990, which for Norway is roughly 1.8 million tonnes CO₂. If removals in managed forest land turn out to be lower than the reference level, for example as a result of increased harvesting, the whole of the reduction in net removals will under the Commission's proposal have to be accounted for as emissions.

4.4.3 Use of LULUCF credits under the Effort Sharing Regulation

If countries have a surplus of removals in the LULUCF sector, they will on certain conditions be able to use these removals to comply with their national targets under the Effort Sharing Regulation. According to the Commission's proposal, the EU countries will be able to use a maximum quantity of 280 million tonnes CO₂-eq of removals in the LULUCF sector towards their commitments under the Effort Sharing Regulation during the period 2021–2030. This amount will be divided between the member states on the basis of their shares of the emissions from agriculture that are included under the Effort Sharing Regulation.

The European Commission has proposed criteria that must be met before LULUCF removals can be credited against a country's own emissions under the Effort Sharing Regulation:

- Compliance with the ‘no-debit’ rule. This rule applies to all accounting categories in the LULUCF sector, including managed forest land.
- Only net removals from the accounting categories afforested land, deforested land, managed cropland and managed grassland may be used towards compliance with obligations under the Effort Sharing Regulation. This means that removals as a result of measures in addition to those included in the reference level for managed forest, for example increased CO₂ removals from fertilisation or higher planting densities, may not be used to compensate for emissions under the Effort Sharing Regulation.

Since Norway according to preliminary calculations may have to record net emissions when accounting for the LULUCF sector, it should be anticipated that the Commission's proposal may mean that it is not possible to access this form of flexibility.³ The reasons why Norway may end up with net emissions from the sector are further explained in Chapter 4.4.1. The rules for calculating a reference level for managed forest land and for the use of LULUCF credits under the Effort Sharing Regulation are being discussed by the EU in connection with consideration of the Commission's proposals by the European Parliament and the Council.

4.5 Flexibility in order to ensure that targets are achieved

4.5.1 Flexibility available to Norway under the Effort Sharing Regulation

4.5.1.1 Introduction

The flexibility mechanisms under the Effort Sharing Regulation provide assurance that Norway can meet its binding emission budget, and will make it possible to achieve Norway's emission target for 2030 cost effectively. As shown in Chapter 4.3.4, these mechanisms make it possible for countries to cooperate on emission reductions.

³ According to preliminary calculations by the Norwegian Environment Agency, Norway will have to record net emissions of about 3.3 million tonnes CO₂-eq over the whole ten-year period (2021–2030). This figure is uncertain, and will for example depend on whether the ceiling of 280 million tonnes in LULUCF credits is increased when Norway is included in the system, or whether the available credits are redistributed among the countries. This has not yet been decided. The ceiling is also being discussed within the EU.

According to the Commission's proposal, Norway will be able to access flexibility mechanisms on the same terms as EU member states. The most important of these for Norway are the flexibility to access a limited number of allowances from the EU ETS, and the opportunity to trade emission units with other countries.

4.5.1.2 *Flexibility to access allowances from the EU ETS*

Given an agreement with the EU on joint fulfilment, Norway will probably be placed on an equal footing with the nine EU countries⁴ that will be eligible to use the flexibility to access allowances from the EU ETS to cover some of their emissions. The countries in question will be able to use EU ETS emission allowances corresponding to between 2 and 4 % of their non-ETS emissions in 2005. Assuming that Norway will be eligible for a similar level of flexibility, it will probably be able to use emission allowances corresponding to between 5.5 and 11 million tonnes CO₂ over the whole period 2021–2030. To ensure that Norway complies with its emission budget, the Government will make full use of the flexibility Norway can achieve by using emission allowances from the EU ETS.

Any flexibility Norway is given to access EU ETS allowances will be independent of agreements with other countries under the Effort Sharing Regulation. These allowances will be taken from a country's auctioning volume, which will be reduced each year by a number of allowances equivalent to one tenth of the total volume of allowances the country has chosen to access from the EU ETS. Thus, the cost of utilising this form of flexibility will in practice be a loss of potential auctioning income throughout the period 2021–2030. The cost will therefore depend on developments in the price of emission allowances in the ETS. Projections of the prices of emission allowances vary widely. The projected price of allowances to be cancelled in December 2020 has recently fluctuated around EUR 5.

4.5.1.3 *Buying and selling*

Preliminary and very uncertain calculations by the Norwegian Environment Agency indicate that

⁴ Belgium, Denmark, Ireland, Luxembourg, Malta, Netherlands, Austria, Finland and Sweden.

a group of about 15 EU countries are likely to have a total surplus of about 420 million emission units for the period 2021–2030. These calculations are based on the Commission's reference scenario. The projections differ somewhat from the countries' own projections of their emissions. It is to be expected that most of these countries will wish to sell their emission units. There is also reason to believe that these countries will take steps to reduce their emissions further if they can sell emission units at a price that is higher than the cost of the measures they introduce. On the other hand, there will be about 13 EU countries that have an overall deficit of about 608 million emission units. These countries will have to obtain emission units from other EU countries and/or carry out measures to reduce their emissions. The Environment Agency's calculations are based on policy measures that had been adopted by summer 2016. The effects of policy adopted or under consideration by the EU after July 2016 have not been incorporated into the analysis, and the effects of the unilateral measures that some countries have announced have not been analysed. Price trends for purchases of emission allowances from other countries are very uncertain.

Even if national policy instruments are strengthened there may be a need for more flexibility than will be offered by the expected maximum quantity of allowances that may be accessed from the EU ETS. If it is necessary and proves to be cost-effective, the Government therefore also plans for Norway to be able to make use of flexibility in the form of direct purchases of emission allowances from other countries. It is anticipated that Norway will be able to meet its need for flexibility even if the process in the EU results in stricter rules for effort sharing than those proposed by the Commission and Norway turns out to need flexibility corresponding to more than 11 million tonnes.

4.5.1.4 *Banking and borrowing*

As described in Chapter 4.3.4, there are restrictions on transfers of emission allowance between years within the period 2021–2030. According to the Commission's proposal, Norway will be eligible to bank and borrow emission units on the same terms as EU member states. This provides greater flexibility in implementing the Norwegian emission target.

4.5.1.5 Credits from the land use sector

The number of LULUCF credits that can be used towards commitments under the Effort Sharing Regulation is limited to a total of 280 million at EU level. This total will be divided between the EU countries on the basis of their agricultural emissions. According to preliminary calculations by the Norwegian Environment Agency, Norway will, on the basis of its agricultural emissions, be eligible to use credits corresponding to about 3.3 million tonnes CO₂-eq over the whole ten-year period (2021–2030). This figure is uncertain. It will depend among other things on whether the ceiling of 280 million tonnes in LULUCF credits is increased when Norway is included in the system, or whether the available credits are simply redistributed. To use LULUCF credits in this way, countries must be able to document net removals in the LULUCF sector when removals in managed forest are excluded. Since Norway according to preliminary calculations may have to record emissions when accounting for this sector, it should be anticipated that it may not be possible to use this form of flexibility.

4.5.2 Norway's eligibility for flexibility mechanisms for the LULUCF sector

Preliminary calculations for the LULUCF sector

It is possible to comply with the requirement for the LULUCF sector that emissions must not

exceed removals (the 'no-debit' rule) either through national measures or by compensating for emissions by buying LULUCF credits from other countries. Alternatively, a country's emission allocation under the Effort Sharing Regulation will be reduced by an amount corresponding to its recorded emissions from the LULUCF sector. In this case, its obligation under the Effort Sharing Regulation will be increased by the same amount as its net LULUCF emissions. If Norway ends up recording net emissions from the LULUCF sector, this will mean that without any purchases of LULUCF credits from other countries, Norway will have to reduce non-ETS emissions by more than the proposed 40 % target. It will only be possible to buy LULUCF credits if other countries have a surplus of credits that they wish to sell. According to the Commission's impact assessment of the proposed LULUCF regulation, there will be a surplus of credits in Europe as a whole, even after countries have made full use of the flexibility to access LULUCF credits to meet their obligations under the Effort Sharing Regulation. However, these calculations are uncertain. The final design of the accounting rules is also very uncertain, and this may influence the size of the surplus and the proportion of the surplus that is available for other countries to buy. A surplus of LULUCF credits that has been acquired through the purchase of credits from another country may not be used to compensate for emissions under the Effort Sharing Regulation.

5 Reducing non-ETS emissions in Norway

5.1 Emission trends

5.1.1 Norwegian emissions

In 2015, Norway's greenhouse gas emissions totalled 53.9 million CO₂ equivalents (CO₂-eq).¹ This included 27.3 million tonnes from non-ETS sources, i.e. emissions that fall outside the scope of the EU Emissions Trading System.² These

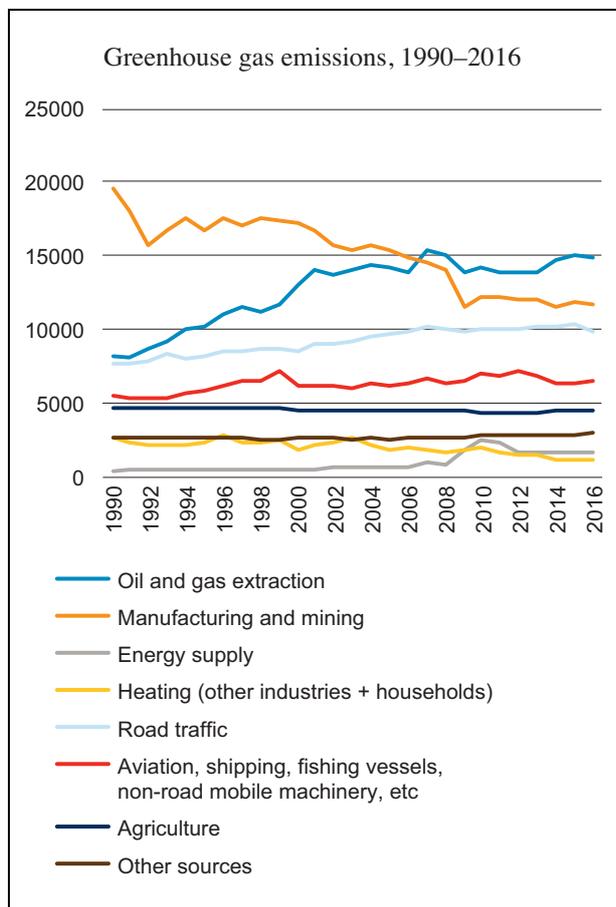


Figure 5.1

Source: Statistics Norway

¹ According to preliminary figures for the greenhouse gas emission inventory from Statistics Norway, emissions totalled 53.4 million tonnes CO₂-eq in 2016. Uncertain estimates indicate that this included 27.4 million tonnes CO₂-eq in non-ETS emissions.

² Not including land use, land-use change and forestry (LULUCF).

emissions were 0.8 % lower than in 2005, which is the reference year for the EU's emission reduction targets. Transport³ and agriculture made up the largest proportion of non-ETS emissions, 57 % and 17 % respectively (see Figures 5.1 and 5.2.) There are also substantial non-ETS emissions from waste incineration, manufacturing, the petroleum industry and various other sources, which together make up 24 % of the total.

Emissions from road traffic rose by over 30 % from 1990 to 2007, but have remained stable since then, despite a rise in the volume of both goods and passenger transport. This is partly explained by improvements in vehicle efficiency. According to preliminary figures from Statistics Norway for 2016, emissions from road traffic dropped by 4 % from 2015 to 2016, partly as a result of an increase in biofuel use.

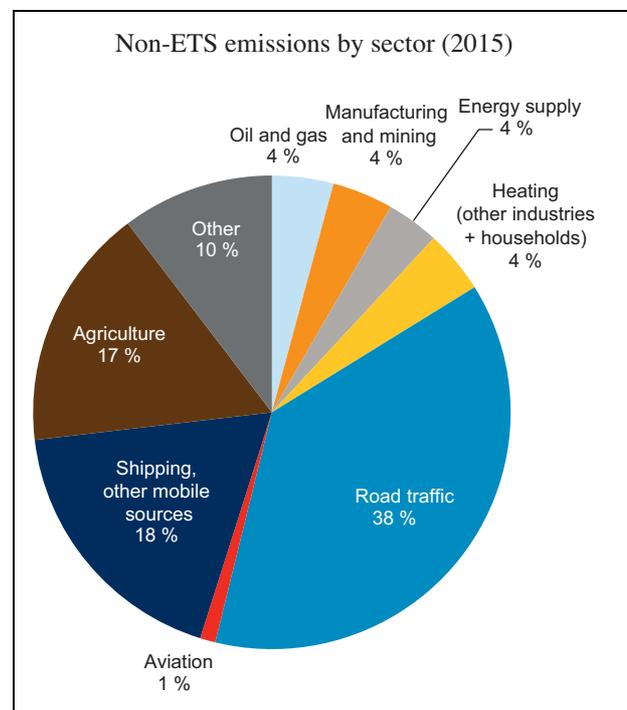


Figure 5.2

Source: Statistics Norway

³ Road traffic, domestic shipping and fishing vessels, domestic aviation and non-road mobile machinery.

Box 5.1 Norway's emission inventory and reporting to the UN

A comprehensive system has been developed for calculating and reporting greenhouse gas emissions and progress towards international climate commitments and submitting reports under the UN Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol.

Norway has an extensive national system for collection, quality assurance and regular updating of emission data.

Under the UNFCCC, Norway is required to submit the following reports:

- Every four years: Norway must prepare a national communication and submit it to the UNFCCC secretariat. The report includes a broad-based description of Norway's climate policy, its international commitments, national policy instruments, and climate-related activities in which Norway is involved internationally. Norway's most recent national communication was submitted in March 2014.
- Every two years: a biennial report, which includes information on new policy instruments introduced since the previous report and Norway's progress towards its target for the second commitment period under the Kyoto Protocol (2013–2020). Norway's most recent biennial report was submitted in December 2015.
- Every year: National Inventory Report, which includes reporting of the national greenhouse gas inventory to the Kyoto Protocol based on time series from 1990, and a comprehensive documentation of how the figures in the inventory report are calculated. Norway needs to submit a report that fulfils the Kyoto Protocol's eligibility requirements to use the flexibility mechanisms under the protocol.

All reports go through a thorough review process in the UN system. The Norwegian Environment Agency is responsible for annual reporting on Norway's official greenhouse gas inventory

to the UNFCCC and the Kyoto Protocol, while the Ministry of Climate and Environment submits national communications and biennial reports.

Norway's greenhouse gas inventory is an important element of reporting to the UN, and is compiled by Statistics Norway, the Norwegian Institute of Bioeconomy Research and the Norwegian Environment Agency in cooperation. Statistics Norway compiles and publishes statistics on greenhouse gas emissions to air, while the Institute of Bioeconomy Research compiles statistics for emissions and removals in forest and other land categories. The Environment Agency is responsible for preparing and submitting reports on Norway's complete greenhouse gas emission inventory in accordance with international commitments. Norway has maintained emission inventories for many years, and there are currently consistent time series for the period 1990–2015 and statistics for some individual years before this. Statistics Norway also reports emission data to Eurostat, while the Norwegian Environment Agency reports to the European Environment Agency.

Joint fulfilment of the emission reduction target for 2030 by Norway and the EU would entail additional reporting requirements to the European Environment Agency. The EU requires countries to submit inventory reports every year, and to provide information on emission projections and the policy instruments and measures they are using every other year. The Paris Agreement also involves reporting requirements relating to emission reductions, climate change adaptation and climate finance.

Norway's emission statistics are published online (www.ssb.no) and are thus made available to all users at the same time. The emission statistics are also available on the website www.miljostatus.no. The information reported internationally, including Norway's emission inventory, is available in the publications submitted to the UNFCCC, which can be downloaded from the UN website.

Overall, there has been a rise of 11 % in non-ETS emissions from transport excluding road transport (domestic aviation and shipping, fishing vessels, non-road mobile machinery, etc.) since 1990. Emissions from domestic shipping and fishing vessels have declined, but emissions from other mobile sources such as non-road mobile machinery have risen. Since 1990, emissions from the agricultural sector have been reduced by 5 %. Non-ETS emissions from manufacturing and the petroleum industry combined were 2.3 million tonnes in 2015, and have been reduced by 58 % since 1990.

5.1.2 New emission projections

New baseline projections for greenhouse gas emissions for 2020 and 2030 were presented in the white paper Long-term Perspectives on the Norwegian Economy 2017 (Meld. St. 29 (2016–2017)). It is estimated that Norway's greenhouse gas emissions will decline by about 0.75 % per year from 2015 up to 2030, when they are projected to be roughly 5.5 million tonnes CO₂-eq lower than in 2015. Non-ETS emissions are expected to account for most of the reduction in emissions, declining by an estimated 4.25 million tonnes from 2015 to 2030 (see Table 5.1).

In line with international guidelines, the projections are based on currently adopted climate policy. Thus, the projections show likely trends in Norwegian greenhouse gas emissions if current policy instruments and measures are continued. The projections are uncertain, partly because new solutions may be developed that influence the effects on emissions of continuing to apply current policy instruments and measures.

The projections do not describe the Government's targets, nor do they reflect the effects of new policy or policy instruments introduced in the future. Targets that have been adopted but where no proposals for changes in policy instruments or measures have been put forward, and measures that have been reviewed but have not yet resulted in regulations, decisions on taxes, agreements or the like, are not incorporated into the baseline projections. An exception to this exclusion is the ban on the use of fossil oil for heating residential and commercial buildings from 2020, since a public consultation has already been held on the draft regulations. It should be noted that the calculations of how current policy will affect emissions in future are uncertain, and the level of uncertainty increases

Table 5.1 Greenhouse gas emissions in Norway by sector. Million tonnes CO₂-eq.

	1990	2005	2015	2020	2030
Greenhouse gas emissions, total	51.7	55.1	53.9	51.8	48.3
ETS emissions		27.5	26.6	26.3	25.2
– Oil and gas production		12.9	14.0	13.9	12.8
– Manufacturing and mining		13.6	10.8	11.1	11.0
– Other sources ¹		1.0	1.8	1.3	1.4
Non-ETS emissions		27.6	27.3	25.5	23.1
– Transport ²		14.9	15.6	14.9	13.5
– Of which road traffic		9.7	10.3	9.7	8.4
– Agriculture		4.6	4.5	4.3	4.4
– Other sources ³		8.1	7.2	6.2	5.2
Land Use, Land-Use Change and Forestry (LULUCF)	-10.5	-24.7	-24.3	-23.4	-21.2
Greenhouse gas emissions including removals by the LULUCF sector	41.3	30.4	29.6	28.4	27.1

¹ Including ETS emissions from the energy supply sector and aviation.

² Including road traffic, shipping, fishing vessels, non-ETS aviation emissions and non-road mobile machinery.

³ Including non-ETS emissions from manufacturing, oil and gas production, energy supply and heating.

Box 5.2 Assumptions underlying Norway's projections of greenhouse gas emissions to air

The projections described below are based on Norway's emission inventory and the national accounts published by Statistics Norway, which are the basis for its general equilibrium model SNOW. In certain areas, the model is supplemented with more detailed analyses.

The assumptions underlying the emissions projections can be briefly summarised as follows:

- The current design of Norway's climate policy will be maintained, including the tax base and tax rates for the carbon tax.
- Within the EU Emissions Trading System (EU ETS), the price of emission allowances is estimated to rise to NOK 60 per tonne CO₂ in 2020, in line with prices quoted on the futures market for these allowances. It is assumed that after 2020, the carbon price within the EU ETS will rise by 4 % per year in real terms.
- Long-term prices for crude oil and natural gas are the same as those used as a basis in Chapter 5 of the white paper Long-term Perspectives on the Norwegian Economy 2017 (Meld. St. 29 (2016–2017)).
- The Norwegian Petroleum Directorate has drawn up projections of emissions from oil and gas production, based on reporting by the oil companies. These projections use the same definition of petroleum industry as the Petroleum Taxation Act, but onshore facilities involved in onward transport of petroleum products are also included, to ensure that the projections are in line with the emission inventory.¹ The projections take into account changes in the production mix and longer estimated lifetimes for a number of fields. Emissions of CO₂ are largely related to energy production on oil and gas installations. Emissions from the construction and installation phase, maritime support services and helicopter traffic are reported as emissions from other industries.
- Information from the model that Statistics Norway uses to calculate national emissions to air from road traffic is used for projections of road traffic emissions. It is assumed that

the proportion of electric passenger cars will rise to 50 % of new car sales in 2030. Sales of rechargeable hybrid cars are assumed to make up about 20 % of new car sales. These assumptions mean that sales of new diesel and petrol cars as a percentage of passenger car sales will decline from about 70 % in 2016 to 30 % in 2030. The volume of traffic is assumed to follow the population trend. Emissions per kilometre driven from new vehicles that run on fossil energy carriers are assumed to decline by about 1 % per year. The proportion of biofuel is assumed to remain constant at the real current level of 6.25 %.

- It is assumed that electricity consumption in energy-intensive manufacturing will remain unchanged.
- The Norwegian Environment Agency draws up projections for emissions from agriculture on the basis of activity data from the Norwegian Institute of Bioeconomy Research. The activity data are based on the assumption that current agricultural subsidies and tariff protection will be continued, but that support for cheese exports will be withdrawn from 2020. Some improvement in efficiency is included in the assumptions, so that emissions per unit of production will decline.
- Projections of net carbon uptake by forest and other land categories were drawn up in 2014. It was estimated that net uptake would decline from the current level of about 25 million tonnes CO₂-eq per year to just over 20 million tonnes CO₂-eq per year by 2030. These figures are based partly on the assumptions that the current level of afforestation will be maintained and that roundwood removals rise from the current level of 10 million m³ to 12.6 million m³ in 2030.

¹ According to this definition, the petroleum sector includes all offshore petroleum installations, the onshore facilities at Kollsnes, Sture, Nyhamna (for the Ormen Lange field), the Hammerfest LNG plant (for the Snøhvit field), Mongstad (indirect emissions from the crude oil terminal) and Kårstø (the entire gas processing plant), and some smaller LNG plants.

over time. Both future economic trends and the future population trend are uncertain. Historically, economic growth and population growth have had a strong influence on greenhouse gas emissions. There is also substantial uncertainty concerning the development and availability of low- and zero-emission technologies and the costs of deploying such technologies.

The estimated figure for non-ETS emissions in 2030 has been reduced by 3 million tonnes CO₂-eq since the previous update of the projections (in the 2015 budget). This clear reduction is particularly linked to the assumptions underlying projections of emissions from transport. Emissions from road transport are estimated to decline from 10.3 million tonnes in 2015 to 9.7 million tonnes in 2020 and further to 8.4 million tonnes in 2030. This is mainly because it is assumed that phase-in of low- and zero-emission vehicles will increase further in the coming years. The projections are based on maintenance of the current level of the biofuel quota obligation. The isolated effect of an increase in the biofuel quota obligation in line with the decision made by the Storting (Norwegian parliament) in connection with the 2017 budget would be to reduce emissions by about 1 million tonnes in 2020. However, continued growth in the number of zero- and low-emission vehicles means that this effect is projected to be smaller by 2030.

Emissions from domestic shipping and fishing vessels have declined markedly in recent years. This is probably related to a switch to less emission-intensive fuel and the use of new technologies. However, it is possible that the statistics do not fully incorporate these emissions if vessels refuel in other countries. Emissions from these sectors fluctuate a good deal from year to year. The projections are based on the assumptions that the drop in emissions is permanent and that more effective policy instruments introduced in recent years will contribute to a continued reduction in emissions after 2020.

Emissions from consumption of fossil oils for heating of buildings have declined by almost 60 % since 1990. If this trend continues, emissions will be reduced to about 0.75 million tonnes CO₂-eq by 2030. The future ban on the use of mineral oils will speed up this trend and will mean that household emissions from the use of mineral oils will be eliminated as soon as 2020, although there will still be emissions from gas and fuelwood use. The ban will also speed up the decline in the use of oil for heating in the service industries. The projections are based on the assumption that there will

still be residual emissions, since certain exemptions from the prohibition are likely to be allowed, for example in areas where considerations of security of supply warrant this. Emissions from this source in 2030 are estimated at about 0.5 million tonnes CO₂-eq.

Non-ETS emissions from the energy supply sector are generated by the incineration of waste containing fossil carbon and the use of fossil energy carriers in small-scale combustion installations. In the projections, non-ETS emissions from the energy supply sector are expected to remain at about the current level, an estimated 1 million tonnes.

As in the earlier projections, emissions from landfills are expected to be further reduced as a result of the prohibition against landfilling of wet organic waste. Emissions from agriculture are expected to remain relatively stable in the years ahead.

5.1.3 Uncertainties in emission estimates

Norway's greenhouse gas emissions are influenced by the actions of several hundred thousand companies and millions of people. The updated projections presented in the white paper Long-term Perspectives on the Norwegian Economy 2017 seek to incorporate the trends and tendencies underlying these aggregated actions, based partly on economic, technological and demographic factors.

The emission projections are based on the assumption that Norway maintains its current climate policy. This means that the tax base and tax rates for the carbon tax are kept unchanged. Support for technology development, for example through Enova, will be maintained. Norway's climate policy has been considerably strengthened in recent years. Calculations of how current policy will influence emissions in the future are uncertain, and the level of uncertainty increases over time. Factors that determine the effects of current policy include the development and availability of low- and zero-emission technologies and the costs of deploying such technologies. Most of the technological development in this field is taking place outside Norway.

The emission projections are also based on assumptions relating to future economic growth, population trends, productivity growth and international developments. These factors will have a considerable influence on emission trends in Norway, and a strategy for 2030 also needs to take into account the possibility that actual developments

may differ from the assumptions on which the projections are based.

5.1.4 Reporting required under the Climate Change Act

Under Norway's new Climate Change Act, the Government is required to give an account to the Storting each year of changes in emissions and removals of greenhouse gas emissions, projections of emissions and removals, progress towards the statutory climate targets for 2030 and 2050, and how Norway is preparing for and adapting to climate change. The Government must also provide an overview showing sectoral emission trajectories for non-ETS emissions and the types of measures that will be necessary to achieve them, and a status report on Norway's carbon budget taking into account relevant arrangements within the framework of joint fulfilment with the EU, if agreed. In its annual budget proposal, the Government is required to give an account of how Norway can achieve the climate targets and the expected effect of the proposed budget on greenhouse gas emissions. The form and content of the reports will need to be adjusted over time.

5.2 Policy instruments at national level

The Government will:

- use the carbon tax and other taxes on greenhouse gas emissions as the main instrument for reducing non-ETS emissions;
- follow up the decision by the Storting to request the Government to introduce a standard carbon tax rate for non-ETS emissions by considering the introduction of this system, or alternatively other instruments if the tax is not considered to be adequate or appropriate;
- assess the taxation level for non-ETS emissions regularly as a way of ensuring that the 2030 target is achieved cost-effectively;
- if the carbon tax is not considered to be an adequate or appropriate instrument, consider other instruments that provide equally strong incentives to reduce emissions, including direct regulation under the Pollution Control Act and voluntary agreements. The use of policy instruments in the years ahead will need to be adjusted in the light of new knowledge;
- take steps to ensure that the policy instruments used continue to be effective and well-coordinated;

- continue to focus on research and development and the deployment and dissemination of low-emission technology;
- ensure that the public sector as a customer supports the adoption and development of new environmentally friendly technologies and solutions;
- support the development of new environmentally friendly technologies and solutions, for example through Innovation Norway's new initiative for public-private innovation;
- using the recommendations of the Financial Stability Board as a basis, promote greater transparency by companies and financial-sector organisations as regards their contribution to greenhouse gas emissions.

5.2.1 Effective and coordinated use of policy instruments

All major international analyses of the problem of climate change show that establishing a carbon price, or price on emissions, is essential if we are to reduce emissions sufficiently and cost-effectively. Ensuring that the polluter pays encourages changes in production and consumption patterns that reduce emissions and promotes the development and deployment of climate-friendly technology. Taxes and emissions trading provide incentives to reduce emissions at the lowest possible cost to society and are important in creating markets for zero- and low-emission technology. To minimise the global costs of achieving ambitious climate targets, it is important to introduce a sufficiently high carbon price that applies to as many sources and areas as possible. If some emission sources are not charged for their emissions, receive subsidies or pay a reduced price for emissions, the general carbon price will have to be higher to achieve a given reduction in emissions. The principle that policies and measures to deal with climate change should be cost-effective in order to ensure global benefits is set out in the UNFCCC. Other key principles of climate policy that are set out in the Convention are the precautionary principle and the principle of common but differentiated responsibilities. The precautionary principle is also important in Norwegian environmental policy.

At present there is wide variation in carbon prices between countries and sectors. This applies both to the scope of direct pricing and to the implicit costs of regulatory measures.

The climate policy instruments that are used should be based on a set of principles that are

transparent and provide predictability, and that make it possible to achieve climate policy targets effectively and as reliably as possible. To minimise conflict between climate policy targets and goals in other areas, the use of policy instruments needs to be closely coordinated. The Norwegian Government's climate policy is based on the following:

- *The polluter-pays principle.* Policy instruments should be chosen on the principle that anyone who causes pollution or environmental damage must pay for the damage they cause.
- *Policy instruments must be effective.* Policy instruments should be designed so that environmental targets can be achieved as reliably as possible and at the lowest possible cost for society. Environmental taxes, emissions trading, direct regulation, agreements, information and subsidies must be combined as effectively as possible.
- *Support for technology development.* The development and deployment of climate and environmentally friendly technology is important in addressing climate and environmental problems, and can also open up new market opportunities for Norwegian business and industry.
- *Global effects are of crucial importance.* Norway's climate policy instruments must play a part in reducing global emissions.
- *A low-emission society, not a low-income society.* We must make full use of the opportunities offered by a green shift in the economy.

The criteria for choosing policy instruments are that they are consistent with the polluter-pays principle, and that the costs to society are as low as possible (cost effectiveness) and that they can reliably achieve climate and environmental targets (environmental effectiveness). The potential for emission reductions and the associated costs are determined by which policy instruments are chosen.

Norway's position is that further regulation should as a general rule be avoided in areas that are already regulated by means of general policy instruments. However, in some cases it is difficult to put a price on environmental damage through taxes or emission allowances. One example is greenhouse gas emissions from peat extraction, which can be difficult to measure. There may also be cases where the carbon tax will not function as an incentive to introduce cost-effective measures because of barriers such as a lack of expertise or information. If the tax is not considered to be an adequate or appropriate instrument, other instru-

ments that provide equally strong incentives to reduce emissions will be considered, including direct regulation under the Pollution Control Act and agreements. Policy instruments to support the development of new technology may also be appropriate. This approach is in line with the two cross-party agreements on climate policy, in which it was agreed that it should be possible to use other policy instruments in addition to taxes and emissions trading.

Climate policy instruments influence the behaviour of both companies and households, and may have effects in addition to reducing emissions. Such additional effects may be either positive or negative. Examples of positive additional effects of measures to reduce CO₂ emissions are abatement of local air pollution or reductions in emissions of short-lived climate pollutants (see Chapter 5.11 for further information). An example of a negative additional effect could be longer journey times for bus passengers if bus lanes are opened to other categories of vehicles.

In developing its climate policy, the Government also gives weight to positive effects other than reductions in greenhouse gas emissions. By designing policy instruments so that they also reduce emissions of short-lived climate pollutants, for example methane from sources in the agricultural and petroleum sectors or black carbon from the transport sector, it is possible to reduce the rate of global warming. A number of policy instruments will also play a part in reducing local emissions to air, and thus have health benefits. This applies for example to some measures to reduce emissions from the transport sector. Measures to limit traffic will also tend to reduce the number of accidents and result in less congestion and less wear on roads. Win-win measures for the climate and biodiversity include peatland restoration. Instruments designed to reduce greenhouse gas emissions from the agricultural sector can also have positive effects by reducing runoff, improving water quality in nearby river systems and reducing emissions of ammonia to air. These are the types of positive effects that should be given weight in policy development. At the same time, policy instruments should be designed to limit potential negative effects of measures to reduce greenhouse gas emissions, for example on the cultural landscape, biodiversity, water quality or health.

The Government's long-term target is for Norway to be a low-emission society by 2050. This will be particularly important in relation to decisions with a major impact on emissions and a very long

time horizon. However, the level of uncertainty also increases with a longer time horizon, and it can in practice be difficult to determine which specific measures will result in cost-effective emission reductions in the long term. Assessments of the measures and instruments Norway should implement nationally up to 2030 must also take into account the 2050 target of being a low-emission society. Measures implemented to achieve Norway's national emission commitment for 2030 must also play a part in cost-effective emission reductions in the longer term. Participation in the EU ETS, joint fulfilment of the 2030 targets with the EU and the principles for the choice of policy instruments also send signals to the business sector and individuals about the long-term policy approach.

To reduce the costs associated with emission reductions, it is important to develop an integrated policy and ensure good coordination of policy instruments. Policy instruments must be adjusted to the emission budget over time. This approach will also facilitate the transformation process that will be required in the years up to 2050.

5.2.2 Pricing emissions is the basis of an effective climate policy

The main policy instruments of Norwegian climate policy are taxes and emissions trading, which are cross-sectoral economic instruments. These instruments put a price on greenhouse gas emissions, thus promoting changes in production and consumption patterns over time. Such economic instruments provide incentives to achieve emission cuts at the lowest possible cost to society. They can also encourage the development and deployment of new technology. Current and anticipated future prices of emissions will influence how individuals and companies adapt and the decisions they make.

The negative impacts of greenhouse gas emissions are the same regardless of where emissions occur. This indicates that all emissions should be priced equally. Wide variations between countries and sectors might result in inappropriate use of resources and distortion of competition. Joint fulfilment of climate targets with the EU would allow Norway to cooperate with the EU, but would restrict opportunities for cooperation with non-EU

Box 5.3 Environmental pricing – Report from the Green Tax Commission

The Norwegian Government appointed the Green Tax Commission on 15 August 2014. The Commission was tasked with assessing whether and how greater use of climate and environmental taxes, in conjunction with reductions in other direct and indirect taxes, can bring about reductions in greenhouse gas emissions, improvements in environmental conditions and sound economic growth. The Commission submitted its report on 9 December 2015: Environmental pricing – Report from the Green Tax Commission (Official Norwegian Report (NOU) 2015: 15).

The Green Tax Commission pointed out that to deal with environmental problems effectively, polluters must take into account the damage they inflict on society. Taxes on environmentally harmful inputs, products or activities mean that polluters must pay for the damage they cause. This will provide incentives to reduce emissions, and at the same time make it more profitable to develop and use new, more environmentally friendly technology. Taxes are the most cost-effective instruments for reducing environmental impacts if the tax rate either reflects the marginal environmental damage or helps to ensure

that Norway meets its international commitments.

For greenhouse gas emissions, the principle that policy instruments should be cost-effective indicates that all non-ETS emissions should be subject to the same tax rate per tonne CO₂-eq. The Commission therefore proposed that exemptions from the tax and reduced rates should be abolished, and that the carbon tax rate should be set at NOK 420 per tonne in 2016. The Commission also recommended that after 2020, the general tax rate for non-ETS emissions should be set at the level necessary to achieve the national emission target for these emissions cost-effectively. This would mean setting the carbon tax rate at the same level as the carbon price under the EU's flexibility mechanisms, or the level necessary to achieve a national target for non-ETS emissions. The Commission concluded that it is uncertain whether it will be the carbon price under the EU's flexibility mechanisms or the cost of emission reductions in Norway that is binding, and that this will depend on whether there is a large enough market for the EU flexibility mechanisms.

Box 5.3 (cont.)

Since there is already a price on emissions covered by the EU ETS, the Commission's view was that in principle, they should not also be subject to the carbon tax. The Commission nevertheless proposed retaining the carbon tax for these emissions, but reducing the tax rate in line with increases in the price of emission allowances. The Commission also proposed measures to reduce non-ETS emissions that are not currently priced, for example the introduction of new climate-related taxes.

Current prices and anticipated future prices of emissions have implications for the decisions that companies make. The Commission pointed out that because investment decisions are influenced by expectations about future policy developments, providing signals about planned policy instruments can have a positive influence on investments even before implementation of these instruments. The Commission therefore concluded that giving signals about the goals and principles to be used in developing environmental policy, both now and in the future, can have benefits. The costs of adaptation for consumers and the business sector can be reduced, and people and businesses can be encouraged to make the right investments immediately. The Commission also pointed out that in recent years, some countries have introduced rules for their climate policy. However, there will always be some doubt about whether politically determined rules will be binding in the long term. New knowledge, for example about the costs of releases of pollutants, may require changes in policy over time.

The motor vehicle registration tax is also partly climate-related. The Commission pointed out that the CO₂ component of this tax results in a much higher overall carbon price for road transport than for other sectors. This makes it reasonable to question whether Norway's climate policy is structured cost-effectively. The Commission views emissions trading and the carbon tax as the primary instruments for achieving a cost-effective climate policy across

sectors. The Commission considered that the CO₂ component of the motor vehicle registration tax should be smaller than it is at present, but that arguments relating to present bias and network externalities suggest that a significant level of differentiation by CO₂ emissions should be retained. The Commission pointed out that this component has resulted in a substantial decrease in average CO₂ emissions from new passenger cars.

The Commission also pointed out that direct regulation does not normally result in cost-effective reductions across companies or sectors. This is because the authorities do not know how much it costs individual entities to achieve specified reductions in emissions or to use alternative abatement measures. Moreover, direct regulation is not in accordance with the polluter-pays principle, since the polluter is not required to pay the costs of damage caused by any remaining emissions.

The Commission identified economic instruments such as taxes and emissions trading as important in providing incentives for the development of environmental technology through all phases from research to technology dissemination. Such instruments create a constant demand for new technology with lower emissions, cleaner production from existing technology, and emission abatement measures. Direct regulation, for example emission standards and technology requirements, also gives incentives to develop environmental technology, and can be effective in cases where it is not possible to use taxes. Other non-economic instruments such as information campaigns can also raise awareness of price signals and contribute to dissemination of new technologies in the market. Environmental technology in particular needs support during its development, especially in the research phase, to correct for positive knowledge externalities. Positive learning effects and network externalities can be arguments for providing short-term support for environmental technologies in the dissemination phase.

countries to fulfil emission commitments. The EU's provision for the use of flexibility mechanisms internally can contribute to more uniform carbon prices within the geographical area to which the joint commitment applies.

Norway is using various cooperation forums to work towards carbon pricing and the development of market-based solutions. Through the Partnership for Market Readiness, the International Carbon Action Partnership and the Transformative Carbon Asset Facility (mentioned in Chapter 2.4), new forms of cooperation are being developed in which carbon pricing and market-based solutions are key features. If many countries implement measures requiring the polluter to pay for greenhouse gas emissions, the world will benefit from deeper cuts in emissions for the same effort. At the same time, this will reduce the risk of carbon leakage and enhance the integrity of the global climate regime.

More than 80 % of Norwegian greenhouse gas emissions are currently subject to the carbon tax, included in the EU ETS, or both. Norway introduced its carbon tax in 1991. Its purpose is to bring about cost-effective reductions in CO₂ emissions. In the non-ETS sector, an estimated 60–70 % of greenhouse gas emissions are subject to the carbon tax. The carbon tax on mineral products applies to petrol, mineral oil, natural gas and LPG. Non-ETS CO₂ emissions are largely from combustion of these products. Hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) are also taxed since they are greenhouse gases. A special tax rate is applied to a proportion of emissions to air of natural gas (largely methane) from petroleum activities, so that the price per CO₂-eq is the same as for combustion.

The Government uses taxation (the carbon tax and other taxes on greenhouse gas emissions) as the main instrument for reducing non-ETS emissions. Some non-ETS emissions are not taxed. This applies particularly to process emissions and emissions of greenhouse gases other than CO₂. There is no tax on non-ETS emissions of other greenhouse gases, i.e. methane (with the exception of some emissions in the petroleum sector), nitrous oxide and SF₆. Agriculture and landfills account for about 70 % of methane emissions, and agriculture accounts for about 70 % of nitrous oxide emissions. Other sources of CO₂ emissions include incineration of waste and land-use conversion. These emissions are generally neither taxed nor included in the ETS. Emissions from land-use conversion are recorded in the LULUCF sector, see Chapter 4.4.

As a result of the budget agreement for 2017 between the Government parties, the Christian Democratic Party and the Liberal Party, the carbon tax was increased to NOK 450 per tonne CO₂ from 1 January 2017 for most areas of use to which it applies. The tax on HFCs and PFCs was also raised to the same level. Almost 60 % of non-ETS greenhouse gas emissions are now subject to this standard tax rate. This was one step in following up the recommendation of the Green Tax Commission that a standard carbon tax rate should be introduced for all non-ETS emissions. However, certain industries and uses are exempted from the carbon tax or are taxed at a reduced rate. In non-ETS sectors, these include the use of natural gas in greenhouse nurseries; domestic maritime transport (goods and passengers); fisheries less than 250 nautical miles from the coast; and offshore vessels. There is also a reduced mineral oil tax rate for fisheries less than 250 nautical miles from the coast. A reduced carbon tax rate applies to domestic aviation and the use of natural gas in manufacturing and mining. Some emissions from these sources are non-ETS emissions. As mentioned earlier, there are also emissions from sectors including agriculture, manufacturing and the petroleum industry that are not subject to the carbon tax.

The Storting has adopted a decision requesting the Government to introduce a standard carbon tax rate for non-ETS sectors in 2018, for the time being with the exception of the agricultural and fisheries sectors. For these two sectors, industry representatives will be invited to take part in committees appointed to consider the possibility of introducing a carbon tax at a gradually increasing rate and to propose other climate-related measures. This must be seen in the context of the Storting's position that emissions from biological processes in the agricultural sector should not be taxed as recommended by the Green Tax Commission, which was the conclusion it arrived at during its consideration of a white paper on agricultural policy published at the end of 2016 (Meld. St. 11 (2016–2017)). The Government will follow up the Storting's request to introduce a standard carbon tax rate for non-ETS sectors by considering the introduction of this system, or alternatively other solutions if the tax is not considered to be an adequate or appropriate instrument.

The Government will regularly assess tax rates for non-ETS emissions with a view to achieving the 2030 target cost-effectively. Changes in tax rates are considered in connection with the

annual budgets. If the carbon tax is not considered to be an adequate or appropriate instrument, other instruments that provide equally strong incentives will be considered.

Other taxes also influence non-ETS greenhouse gas emissions. For example, the CO₂ component of the motor vehicle registration tax results in a much higher overall carbon price for road transport than for other sectors, see Box 5.3. The tax advantages and other preferential treatment given to zero-emission vehicles, combined with the introduction of many new car models with a longer range in recent years, go a long way towards explaining the growth in sales of electric vehicles in Norway.

Petrol, mineral oil (diesel) and LPG are subject to the road use duty on fuels in addition to the carbon tax. The duty is only payable on mineral oil and LPG when they are used in road vehicles. The road use duty is levied in order to put a price on external costs other than greenhouse gas emissions, for example congestion, accidents, noise,

wear and tear on roads and local air pollution. Mineral oil that is not subject to the road use duty is instead subject to the basic tax on mineral oil in addition to the carbon tax. However, there are various exemptions, as a result of which the basic tax primarily applies to mineral oil used for heating and fuel for non-road mobile machinery. One of the grounds for levying the basic tax is to prevent fuel oil from being used as a substitute for electricity for heating purposes or for district heating to avoid paying the electricity tax. Although the road use duty and the basic tax on fuel oil are not directly climate-related, these taxes also influence consumption of fossil fuels and thus greenhouse gas emissions.

5.2.3 Direct regulation as a supplement to economic instruments

A number of general and sector-specific acts are used to regulate greenhouse gas emissions in Norway today. They vary in purpose, and often

Box 5.4 The Pollution Control Act

The Pollution Control Act is Norway's key legislation for limiting pollution. The act lays down a general prohibition against pollution. However, unless otherwise provided by regulations, ordinary pollution from certain sources is permitted. These are fisheries, agriculture and forestry; housing, holiday homes, offices, business premises and assembly rooms, schools, hotels and warehouses, and the like; and temporary construction activity.

Permits and regulations under the Act may include conditions designed to reduce pollution. Typical examples are requirements to limit releases of pollutants and keep them below specified limits, or to make use of the best available techniques (BAT). When a company applies for a permit under the Pollution Control Act, it must provide any information necessary to evaluate whether the permit should be granted and which conditions should be laid down. The pollution control authority may by regulations or in individual cases lay down which information or investigations must be provided by the applicant.

The general prohibition on pollution includes greenhouse gas emissions, which are therefore illegal unless they are permitted by

the exceptions set out in the Act, by regulations or in permits. However, it follows from the Pollution Control Act that no emission limits are to be set for emissions that are regulated by the emissions trading system under the Greenhouse Gas Emission Trading Act. Nevertheless, requirements relating to energy efficiency and the use of BAT may be laid down for installations in the ETS sector.

Little use has been made of the Pollution Control Act to regulate greenhouse gas emissions. They have largely been regulated using other instruments such as emissions trading and the carbon tax. However, the Act has been applied to industrial emissions of certain greenhouse gases and methane emissions from waste treatment. Further, regulations relating to fertiliser products of organic origin have been adopted under the Act, which include provisions on the use and storage of manure. In these areas, regulatory measures under the Pollution Control Act have reduced emissions considerably.

Under the Pollution Control Act, applicants for permits may be required to look into ways of minimising greenhouse gas emissions from their activities.

Box 5.5 The Planning and Building Act

The purpose of the Planning and Building Act is to promote sustainable development, with an emphasis on long-term solutions. Land-use planning is a cross-sectoral activity, and land use and development patterns have a strong influence on transport needs and the choice of modes of transport. Thus, planning processes under the Act may influence greenhouse gas emissions for a long time to come, including emissions from important sources such as transport, stationary energy use, and land use, land-use change and forestry (the LULUCF sector).

Under the Act, decision makers have the primary responsibility for weighing up the importance to be given to various relevant considerations and interests. The part the Act plays in reducing greenhouse gas emissions will there-

fore depend on how much weight climate change considerations are given compared with other and quite possibly conflicting interests. To ensure that planning processes give sufficient weight to climate change concerns, the Government has adopted central government planning guidelines for housing, land-use and transport planning by municipalities and counties. There are also central government planning guidelines on municipal and county climate and energy planning. These set out requirements for planning in these fields in order to reduce greenhouse gas emissions and ensure more efficient energy use and a shift towards more environmentally friendly energy use in municipalities and counties.

interact with and supplement other instruments. The most important general acts are the Pollution Control Act, the Greenhouse Gas Emission Trading Act and the Planning and Building Act. The Roads Act, the Road Traffic Act, the Ship Safety and Security Act, the Petroleum Act and the Land Act are examples of sectoral acts in which the reduction of greenhouse gas emissions is a relevant consideration.

The environmental impacts of greenhouse gas emissions are independent of where emissions take place. Putting a price on emissions is therefore generally more cost effective than direct regulation.

As mentioned in Chapter 5.2.1, Norway's position is that further regulation should as a general rule be avoided in areas that are already regulated by means of general policy instruments. However, if the carbon tax is not considered to be an adequate or appropriate instrument, other instruments that provide equally strong incentives to reduce emissions will be considered, including direct regulation under the Pollution Control Act and voluntary agreements.

However, in some cases it may be difficult to put a price on environmental damage through taxes or emission allowances. For example, greenhouse gas emissions from the extraction of peat and diffuse industrial emissions may in some cases be difficult to measure. In such cases, direct regulation may be a more appropriate instrument

than pricing. In addition, general instruments such as taxes do not always provide strong enough incentives for the development and deployment of new technology. Barriers to these processes may include a lack of expertise and awareness in businesses. Application of the Pollution Control Act can be adapted to different industries, and in combination with funding instruments for the research and innovation sector and any other general policy instruments, this can encourage technology development and cuts in emissions.

5.2.4 Need for other types of policy instruments

5.2.4.1 Funding instruments and other support

A range of public-sector funding instruments and other support schemes have been established to promote zero- and low-emission solutions. Examples at central government level include Enova, 'Klimasats' (a grant scheme under the Norwegian Environment Agency for climate-related projects by counties and municipalities) and several schemes run by Innovation Norway.

This support can be divided into two main categories – funding instruments designed to promote research, innovation and technology development focusing on low-emission solutions, and support to promote the market deployment of low-

Box 5.6 Enova

Enova's primary objective is to contribute to reductions in greenhouse gas emissions, improved security of energy supply, and the development of technology that will bring about reductions in greenhouse gas emissions in the longer term.

Enova and the Ministry of Petroleum and Energy have entered into a new agreement for the period 2017–2020. With this, Enova's focus has been shifted more towards climate-related activities and innovation. This means that there will be a greater emphasis on reducing emissions from the transport sector and other non-ETS emissions, and on innovative solutions adapted to a low-emission society. The new agreement between Enova and the Ministry gives higher priority to reducing and eliminating barriers to new technologies and to promoting permanent market change. This means that in the long term, energy-efficient and climate-friendly solutions should succeed in the market without government support.

Enova provides support both to help technology initiatives to make the transition from the pilot phase to market introduction, and to promote permanent market change. Market intro-

duction is a critical phase, when projects must be able to demonstrate to the market that their technology functions under normal operating conditions. This is also a capital-intensive phase.

Enova offers a broad range of funding instruments that focus on technology development and non-ETS emissions, and projects that have received support in the last few years include fast-charging infrastructure for electric vehicles along Norway's main transport corridors, greater maritime use of batteries, and charging facilities for zero- and low-emission ferries. Enova has also supported a number of innovative industrial technology projects, for example dealing with aluminium production, copper production and new smelting technology that will make it possible to use hydrogen instead of coal.

Enova's activities are intended to influence the markets in which it operates. Enova itself sets its goals for market change and decides which funding instruments to use to promote this change.

Market change is normally a long-term process, and it is uncertain how long it will take to overcome specific market barriers and achieve permanent change.

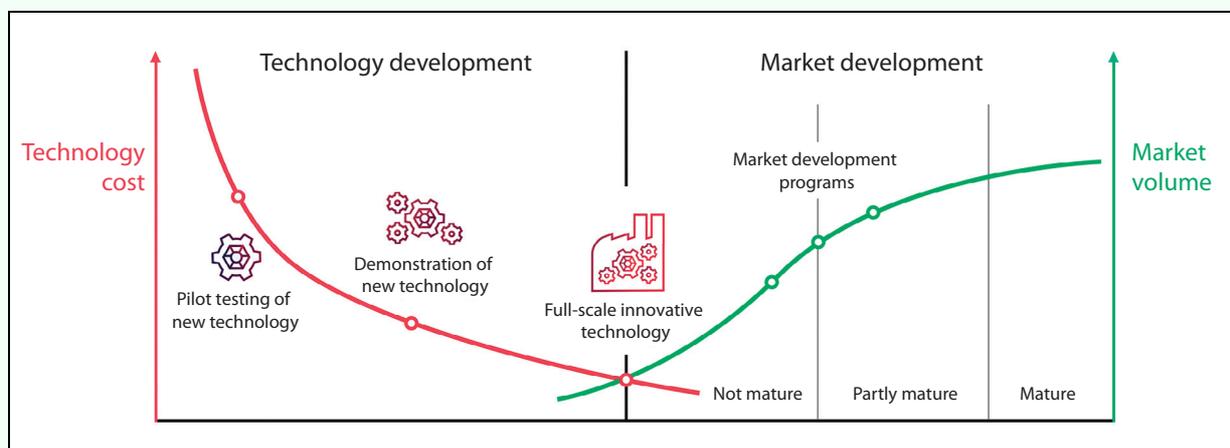


Figure 5.3

Source: Enova Annual Report 2016

emission solutions. Funding for research, innovation and technology development can be justified on the grounds that it will have positive effects beyond the companies that develop the technology. These are known as positive knowledge

externalities. Support for research and development can supplement other instruments that are important in providing incentives for the development of environmental technology.

Support to promote the deployment of low-emission solutions

Economic support in the form of subsidies can be used to steer businesses in a particular direction by reducing the price of goods and services that result in lower greenhouse gas emissions. This can shift production and consumption towards products and activities with lower emissions, and thus play a part in reducing overall emissions. Support can also be tied to investments, so that barriers to using goods or services are reduced.

The Green Tax Commission emphasises that subsidising environmentally friendly activities, as an alternative to using taxation, can result in too high a level of production or consumption of the goods in question. And while putting a price on goods or services that cause pollution will tend to reduce their consumption and increase consumption of all alternatives, subsidising a specific alternative entails the risk that there will be a shift for example from other climate-friendly alternatives to the one that is being subsidised. Furthermore, subsidies must be funded, for example through taxation, and this has an economic cost.

The Norwegian Government makes use of combinations of support schemes and other types of policy instruments, for example voluntary

agreements with branches of industry. The NOx fund is one example of a voluntary agreement, and combines emission commitments with a grant scheme for projects to bring about cuts in emissions and promote the development of technology. Funding for projects to reduce greenhouse gas emissions should primarily target technologies that will contribute to Norway's transformation to a low-emission society.

Funding instruments for research and development on new technology

The development and deployment of climate- and environmentally-friendly energy technologies is an essential part of efforts to address the challenge of climate change, and can provide new market opportunities for the Norwegian business sector. Knowledge is a public good that can benefit society, but in general one actor alone pays the investment costs for research and development in a specific project. As a result, knowledge development may be lower than the optimal level in economic terms. Research and development has positive external effects, and there can therefore be good reason for society to encourage more activity in these fields, for example through funding instruments. A cross-disciplinary approach is

Box 5.7 Funding for research, development and innovation in the field of zero- and low-emission technologies

- *The PILOT-E scheme* is a collaboration between the Research Council of Norway, Innovation Norway and Enova. Its objective is to develop and utilise novel products and services in the field of environment-friendly energy technology. It is seeking to do this through greater predictability of funding, closer follow-up and better coordination between funding agencies. Under the PILOT-E scheme, actors are followed up throughout the entire technology development pathway – from concept to market. The May 2017 call for proposals focused on commercial land transport and future digitalisation of the energy system.
- *The programme for User-driven Research-based Innovation (BIA) and the Centres for Research-based Innovation (SFI)* are examples of general, industry-neutral funding instruments run by the Research Council of Norway. The BIA programme is one of the largest Research Council programmes, and funds R&D projects which are based on companies' own strategies. Within the scope of its responsibility, the BIA programme seeks to promote the greatest possible value creation in Norwegian trade and industry through research-based innovation in companies and the R&D groups with which they cooperate. In 2017, almost NOK 647 million is being allocated to the programme.
- *The MAROFF programme and the SkatteFUNN tax incentive scheme* are playing a part in the Government's initiative to promote value creation in the maritime industry within a sustainable framework. Environmental issues are being given high priority in the MAROFF programme. In 2015, a total of NOK 83.7 million was allocated to environmental projects through these two schemes.

Box 5.7 (cont.)

- *The ENERGIK programme* is a Research Council programme designed to generate new knowledge to promote long-term, sustainable restructuring of the energy system, including more use of renewable energy, more energy-efficient solutions, environment-friendly energy for transport and greater integration with the rest of Europe, and that can accommodate a growing need for flexibility. In 2014, more than NOK 500 million was allocated to new projects through the ENERGIK programme.
- *The Centres for Environment-friendly Energy Research (FME scheme)* conduct long-term research in the fields of renewable energy, energy efficiency and carbon capture and storage (CCS) involving cooperation between leading research institutions, business and industry and the public administration. Each centre receives NOK 10–20 million per year for up to eight years.
- *The CLIMIT programme* provides support for projects in all stages of the development chain for CCS technologies, from long-term basic research to demonstration projects for new technologies.
- *The KLIMAFORSK programme* is the Research Council's large-scale programme for climate research. Its objectives are to increase knowledge about natural and anthropogenic climate change, the impacts of climate change on the natural environment and society, the transition to a low-carbon economy, and adaptation to climate change.
- Under the *BIONÆR programme*, the Research Council issued a call for proposals in May 2017 for innovation projects to reduce greenhouse gas emissions from the agricultural sector with a ceiling of NOK 45 million. For more information, see Box 5.18.
- *International cooperation on energy research* includes Norway's participation in the EU Framework Programme for Research and Innovation (Horizon 2020), cooperation through the International Energy Agency (IEA) and bilateral research cooperation in selected areas.
- Enova's primary objective is to fund projects to reduce greenhouse gas emissions and strengthen security of energy supply, and to support the development of technology that in the longer term will yield further cuts in greenhouse gas emissions. Enova is to establish instruments with the aim of bringing about lasting changes in the market. When designing instruments to promote the development of new energy and climate technology, Enova is also expected to give weight to the potential for global deployment and subsequent worldwide emission cuts.
- *Innovation Norway's environmental technology scheme* reduces the risk involved in pilot and demonstration projects for environmental technology by providing investment grants. The scheme is intended to improve the competitive position of Norwegian industry in the long term, and play a part in achieving Norway's environmental targets. In 2017, the allocation to the scheme in the national budget has been increased to more than NOK 530 million.
- *Innovation Norway's grant scheme for green shipping*. In 2016, a total of NOK 65 million was allocated for the construction of environmentally friendly ships and ferries. This scheme is intended to promote the development and deployment of low- and zero-emission technology in domestic shipping. The target groups are municipalities, counties and the private sector, including shipping companies, shipyards and suppliers of maritime equipment.
- *Innovation Norway supports the production and use of bioenergy from the agricultural and forest sector through its bioenergy programme.*
- *Since 2015, Innovation Norway has also provided grants for pilot biogas plants. The purpose of this scheme is to test biogas production using new resources, for example livestock manure and residual raw materials from the aquaculture industry that have not been used to any great extent for biogas production. In addition, funding is available through the Agricultural Agreement between the state and the farmers for the delivery of manure to biogas plants.*

Box 5.8 Bioeconomy strategy

The Government published its bioeconomy strategy on 19 November 2016. The strategy provides a basis for a national bioeconomy initiative to promote an increase in value creation and employment, cuts in greenhouse gas emissions, and more effective and sustainable use of renewable biological resources. Allocations to bioeconomy projects and programmes under the Research Council of Norway and Innovation Norway have been increased by NOK 100 million for 2017. The Research Council, Innovation Norway and Siva are to draw up a joint action plan to implement the recommendations of the bioeconomy strategy.

needed that includes the social sciences and the humanities.

Research and development on zero- and low-emission technologies will be important in the context of both the 2030 and the 2050 targets. The Government will continue to support technology development. Without support, there will be underinvestment in knowledge development and technology development. Technology that can play a part in reducing emissions is at a particular disadvantage if the price of emissions is lower than it should be given the damage they cause. Putting a price on emissions also creates markets for new technology, but if the price is too low, market development will be hampered. Thus, this kind of technology needs special support.

The Green Tax Commission emphasised that environmental technology in particular needs support during its development, particularly during the research phase. Learning effects and network externalities (the fact that a network of users is needed for a technology to become profitable) may mean that a technology is far more expensive in an early phase of development than when it has been commercialised and disseminated. The support Norway has provided for zero-emission technology for road transport is a good example. In 2015, Norway accounted for 6 % of global sales of electric cars and rechargeable hybrid vehicles, although less than 0.1 % of the world population lives in Norway. By adapting the tax system to the introduction of electric vehicles, Norway has become an important market for manufacturers of electric vehicles and thus made it a more attrac-

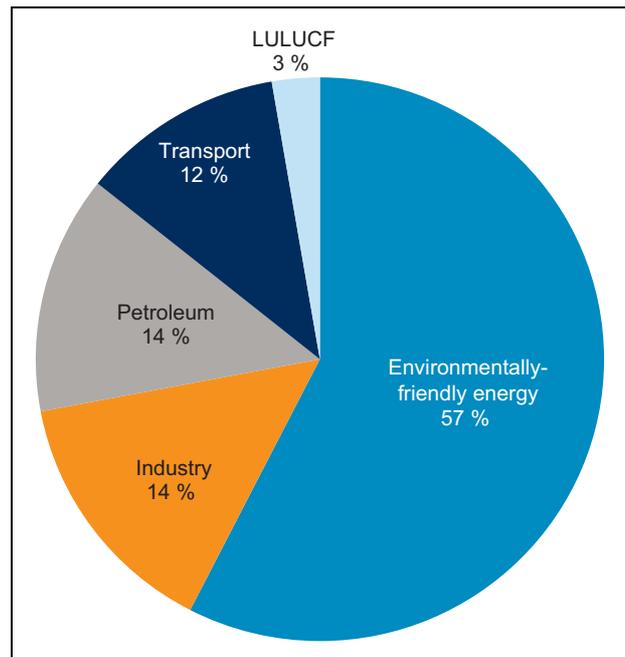


Figure 5.4 Funding through the Research Council of Norway in 2016 for research related to Norway's transformation to a low-emission society, split by sector¹. Research on carbon capture and storage is split between the energy and industry sectors.

¹ The figure shows the percentage distribution of the Research Council's portfolio by sector. Allocations for research infrastructure and basic funding for research institutes are not split by sector and are not included here. The portfolio on which the figure is based totals approximately NOK 1 billion.

Source: Research Council of Norway

tive proposition for vehicle manufacturers to develop electric vehicle models.

Norwegian research groups and education programmes are at the forefront of research in several areas of climate and environmental research and in important fields relating to environmentally friendly energy. Norway's business sector is also well developed in many of the areas where stepping up research and higher education efforts offers great potential for value creation. Education programmes in disciplines such as the natural and social sciences, technology and humaniora also play an important role. Long-term efforts to build up knowledge and expertise can play a part in the transition to a low-emission society.

For a small country like Norway, international technology development will be important for the prospects of substantial domestic cuts. Norway is also playing a part in technology development. The adoption of technology and international cooperation are therefore of key importance. The

Government has allocated NOK 71.5 million in 2017 to reinforce the Research Council's portfolio of research that can play a part in reducing greenhouse gas emissions. This research effort is intended to support efforts to achieve Norway's climate targets in the period up to 2030, and will focus particularly on transport and agriculture. Heavy freight transport is a high priority topic in 2017, and some of the funding has been channelled through the PILOT-E scheme (see Box 5.7).

5.2.4.2 Public procurement

The Government will ensure that the public sector as a customer supports the adoption and development of new environmentally friendly technologies and solutions. The objective of Norway's public procurement legislation is to make sure that society's resources are put to good use and that there is real competition. In addition, the legislation promotes public sector integrity, so that the general public can be confident that procurement is organised in a way that benefits society as a whole. Public procurement can also be used as a tool for reducing greenhouse gas emissions and other pollution if public purchasers choose solutions with less climate or environmental impact. There is a potential for emission reductions in the transport, construction and waste management sectors. One example in the transport sector is contracts for ferries, where a number of contracting authorities have included requirements to use zero- or low-emission ferries in tender documents.

New, simpler and more flexible Norwegian public procurement legislation has recently been introduced. The new act and regulations entered into force on 1 January 2017, and implement the EU's revised procurement directives in Norwegian law. One purpose of the directives is to provide more flexibility in the use of public procurement as a strategic tool in implementing the ten-year Europe 2020 strategy. This is the EU's ten-year strategy for smart, sustainable and inclusive growth, including achieving the EU's climate targets. The new Norwegian public procurement legislation sets out requirements to include environmental and climate-related considerations in procurement processes, and the Government expects public-sector consumption and investment to be supportive of Norway's climate and environmental policy objectives, in line with these provisions. The Public Procurement Act states that public agencies must carry out public procurement in a

way that reduces harmful environmental impacts and promotes climate-friendly solutions where relevant. This means that contracting authorities must consider which contracts may involve significant environmental impacts, making it relevant to include environmental requirements, and must have routines for dealing with the procurement process in such cases.

Effective public procurement requires technical procurement skills. To promote effective use of procurement processes and promote more climate and environmentally friendly solutions, it will therefore be important to make use of the expertise available from the Agency for Public Management and eGovernment and the National Programme for Supplier Development. The Agency is the Government's executive body responsible for providing public entities with the necessary information and assistance to build up expertise and organise procurement appropriately and effectively. In 2017, the Agency is taking steps to improve its expertise in climate- and environment-related aspects of public procurement so that it can help contracting authorities to reduce the environmental impacts of their activities and promote climate-friendly procurement solutions. In the budget agreement for 2017, NOK 15 million was allocated to the Agency, to be used to build up capacity and develop guidance on green public procurement at national, county and municipal level.

The National Programme for Supplier Development has been set up to promote innovative procurement by contracting authorities at central and local government level. The aim is to help selected contracting authorities at central and local level to carry out innovative procurement and at the same time enhance suppliers' opportunities for development and value creation. By assisting pioneers among public-sector buyers, the intention is to encourage wider use of innovative procurement processes. The Government has increased allocations to the programme. In 2017, more than NOK 10 million is being allocated through the budget of the Ministry of Trade, Industry and Fisheries, as compared with NOK 750 000 in 2015. The programme is working on initiatives in three areas: climate and environment, health and digitalisation.

The new Norwegian public procurement legislation introduced a new type of procedure called innovation partnerships. Its purpose is to ensure more innovation in public procurement. In one innovation partnership under the new rules, the National Programme for Supplier Development,

the Agency for Public Management and eGovernment and Innovation Norway are providing assistance to the City of Stavanger. The innovation contract scheme run by Innovation Norway can be a useful tool in this process. In its white paper on industrial policy, A greener, smarter and more innovative industry (Meld. St. 27 (2016–2017)), the Government announced that it would develop an initiative for public-private innovation in Innovation Norway. This new initiative will be able to play a part in the development of environmentally and climate friendly technologies and solutions. Several other countries also run public-private innovation schemes that give special priority to addressing key challenges such as climate change and environmental problems. In line with a request from the Storting, the Government will assess the introduction of a target for the proportion of governmental funding for public procurement to be used for innovative, climate friendly solutions⁴.

In 2017 and 2018, the Government will also seek to develop a more integrated procurement policy and identify measures to improve public procurement practices. A white paper is also planned for spring 2018.

5.2.4.3 Information activities

Information can be used as a climate policy tool, and Norwegian examples include the information provided on the website State of the Environment Norway (miljostatus.no/environment.no), which is administered by the Norwegian Environment Agency, information from Enova on energy efficiency in buildings, information from municipalities on recycling and waste separation, and a project to develop advisory services on climate change issues at individual farm level. Information can be used as a tool for influencing the behaviour of both companies and individuals. The report Environmental pricing – Report from the Green Tax Commission (NOU 2015: 15) points out that price signals through the taxation system may be less effective in certain circumstances, for example:

- if decisions require specialised insight;

- if the type of decision only arises infrequently, so that there is a high cost involved in acquainting oneself with the alternatives;
- if insufficient information is available;
- if insufficient information is available to determine one's own preferences.

Information can be used as a supplement to economic instruments to overcome such barriers, ensure that price signals are effective and that new technologies are deployed in the market. However, the sheer volume of information to which consumers may result in information overload, making it ineffective as an instrument. The use of information as a climate policy instrument should therefore be assessed in the light of insight from research into behavioural economics. Research in this field has identified tools that can be used to encourage consumers and companies to make better choices when they are purchasing or investing, without limiting their freedom of action. These include information campaigns, better labelling, advice, certification, budgeting tools, management and placement of goods in shops. Tools of this kind can be used to 'nudge' consumers in the right direction in cases where habit, inertia in the decision-making process or a tendency to copy the choices made by others in the same situation are barriers to the deployment of effective solutions.

One example is the environmental information on cars provided at the point of sale, which is used as a tool for enhancing the effect of the incentives provided by the vehicle taxation regime. There are statutory requirements to make information on fuel economy and CO₂ emissions available when new passenger cars are marketed. In addition, the Directorate of Public Roads, in cooperation with car dealers, has developed a system for providing additional environmental information when new cars are sold. This includes information on fuel costs and the tax disadvantages of owning a car with high emissions. Improvements in food labelling provide another example of the use of information as a tool. Date marking of food has been improved to reduce waste, and there have been information campaigns to promote food products that are healthier and have less climate impact. One example is the successful international information campaign run by NGOs about the use of palm oil in food products, which has resulted in both health benefits and climate benefits internationally. The Directorate for Cultural Heritage is giving priority to developing courses and information material on how to upgrade older

⁴ Based on an item in the budget agreement between the Government and the parties with which it is cooperating in the Storting and a recommendation to the Storting (Innst. 2 S (2016–2017)), where the Storting asked the Government to consider introducing the target that 10 % of government funding for public procurement should be for innovative, climate friendly procurement, and provide the Storting with a proposal for achieving this at a later date.

buildings without negative effects on their architectural or historical qualities. Its publications include guidelines on energy saving in historical buildings.

5.2.4.4 *Public investment and instruments to promote green financial investments*

The public sector invests in roads, public transport systems, power plants, water and sewerage systems and buildings. Such investments can potentially have major implications for future emission levels. A review by the consultancy firm Vista Analysis (2016)⁵ showed that Norway to a large extent has a framework in place for the inclusion of climate change considerations during planning for infrastructure investments at central and local level, in the form of legislation and other rules and guidelines. However, the report pointed out that such aims are not always followed up in practice, and suggested that it may be necessary to introduce more binding requirements that will make it easier to incorporate climate concerns and long-term climate targets more appropriately into planning processes.

In order to factor in long-term climate considerations, it is necessary to incorporate the prices of future emissions into investment calculations, using anticipated future carbon prices. Pricing should be consistent across sectors and emission sources. Sensitivity calculations should be made using both lower and higher carbon prices than the price trajectory used as a basis for the calculations. In addition, other environmental and social effects must be taken into account, for example environmental impacts that are not priced.

Article 2.1.c of the Paris Agreement states that finance flows need to be made consistent with a pathway towards low greenhouse gas emissions and climate-resilient development, in line with the purpose of the agreement. This has important implications for both public and private finance flows. Governor Mark Carney of the Bank of England has on several occasions pointed out that climate change is a real and growing threat to the financial system as a whole. In December 2016, the Financial Stability Board published a set of recommendations for how public- and private-sector companies can manage climate risk better, pri-

marily by systematically collecting and disclosing more complete and relevant information on their exposure to climate-related risks, and how they are managing these risks. According to Mr Carney, better disclosure of climate-related risks will reduce the risk of a sudden drop in the value of fossil resources and technologies in future, which is known as transition risk. A final report from the Financial Stability Board is expected in June 2017.

The Government has established a new company called Fornybar AS, an investment company that is intended to bring about reductions in greenhouse gas emissions through investments in renewable energy. The company is to invest in companies that are not listed on the stock market and through 'fund of funds' structures, mainly targeting new technology at the transition stage from development to commercialisation.

5.2.4.5 *Voluntary agreements*

In some cases, voluntary agreements have also been used to reduce greenhouse gas emissions. In 1997, an agreement on reduction of greenhouse gas emissions was negotiated between the Ministry of Climate and Environment (then the Ministry of the Environment) and the aluminium industry, and in 2005 agreement was reached on an agreement to reduce nitrous oxide emissions from mineral fertiliser production. In 2009, the Federation of Norwegian Industries and the Ministry concluded an agreement on reductions in greenhouse gas emissions for process industries that were not included in the emissions trading system in the period 2008–2012. The agreement fixed a ceiling for emissions from branches of industry that were neither in the ETS sector nor subject to the carbon tax. These agreements have helped to reduce emissions from Norwegian industry. Representatives of the agricultural organisations are to be invited to take part in a committee appointed to concluding a political agreement on how much emissions from the agricultural sector are to be reduced by 2030. See Chapter 5.4 for more information.

The Government has initiated a process together with relevant industry organisations on the establishment of an environmental agreement and a CO₂ fund for commercial transport. Its environmental target will need to be adapted to the extent and design of the agreement and considered in conjunction with Norway's 2030 climate targets. The first steps are to commission reviews and obtain data and information as a basis for analyses.

⁵ Vista Analysis (2016). *Investeringer i klimasmart infrastruktur i Norge - insentiver og barrierer* [Investments in climate-smart infrastructure in Norway – incentives and barriers], Report 2016/39. http://vista-analyse.no/site/assets/files/6267/va-rapport_2016-39_klimasmartinfrastruktur.pdf

5.2.5 Policy instruments in different sectors

The sectors responsible for non-ETS emissions differ from each other and are regulated in different ways. In addition to policy instruments that apply generally, there are already policy instruments for specific sectors. In the period up to 2030, the use of policy instruments will need to be assessed and adjusted. It is not possible at present to say exactly which combination of policy instruments will achieve the targets that have been set, but adjustments are likely to be needed over time. In addition, there is considerable uncertainty as regards emission trajectories, the effect of policy instruments on emissions and the costs of domestic emission reductions in each sector.

The Government intends to achieve its 2030 target mainly through domestic emission reductions, and with the use of EU flexibility mechanisms as necessary, see Chapter 3. The Government's strategy for 2030 is intended to facilitate substantial domestic emission reductions. In the strategy presented here, the Government shows that the estimated emissions gap of 20–25 million tonnes CO₂-eq can be closed by means of domestic emission reductions. The Government considers it appropriate to consider a broad range of mitigation measures because estimates of the emission reduction potential and costs of measures are highly uncertain. This strategy takes into account the possibility that some of the emission reduction potential may not be realised. The strategy does not present a final list of mitigation measures or policy instruments to achieve emission reductions by 2030. The Government has already implemented a range of mitigation measures and strengthened national climate policy together with the parties with which it is cooperating in the Storting. In addition, decisions made by the Storting and ambitions and goals that have been formulated will play a part in bringing about emission reductions in the years ahead. The Norwegian Environment Agency estimates that action to

achieve political goals and ambitions, combined with measures with an economic cost of less than NOK 500 per tonne CO₂-eq, has the overall potential to reduce domestic emissions by approximately 35 million tonnes CO₂-eq in the period 2021–2030 compared with the emission trajectory in the current baseline projections, see Table 5.2. The estimated emission reduction potential and costs are uncertain and sensitive to the underlying assumptions. The effects of different policy instruments are also uncertain. Technological advances will be of crucial importance for the costs of emission reductions.

Norway's National Transport Plan for 2018–2020 presents various quantitative targets for new zero-emission vehicles for 2025 and 2030. The targets are based on the assumption that the technological maturity of zero-emission vehicles in different segments will improve so that they become competitive with fossil-based transport solutions. According to the Norwegian Environment Agency's estimates, the targets for zero-emission vehicles for 2025 and 2030 could result in emission reductions of about 8 million tonnes CO₂-eq in the period 2021–2030. Analyses show that ambitious targets for emission cuts in the road transport sector will not be achieved without the use of incentives. Policy instruments already adopted by the Government are expected to contribute significantly to achievement of the quantitative targets.

It is estimated that increasing the biofuel quota obligation in line with the 2016 budget agreement can reduce emissions by about 5 million tonnes CO₂-eq in the period 2021–2030. However, if biofuels are produced in Norway, emissions from their production may be included in Norway's emission inventory, primarily in the ETS sector (manufacturing) and/or the LULUCF sector.

According to analyses by the Norwegian Environment Agency, achieving zero growth in vehicle-kilometres for passenger cars in Norway's larger towns could reduce emissions in the period

Table 5.2 Estimated aggregate emission reduction potential of action additional to that included in the current baseline projections.¹ Total potential for the period 2021–2030 (million tonnes CO₂-eq)

Emission reduction potential of achieving political goals and ambitions	16
Emission reduction potential of measures with an economic cost of less than NOK 500 per tonne CO ₂ -eq	18
Total ²	35

¹ Long-term Perspectives on the Norwegian Economy 2017, Meld. St. 29 (2016–2017)..

² The estimates are uncertain, but the figures as calculated give a total of 35 million tonnes after rounding off.

Source: Norwegian Environment Agency

Box 5.9 The committee on green competitiveness

In October 2016, a Government-appointed expert committee submitted its proposal for a national strategy on green competitiveness. The terms of reference for the committee state that 'green competitiveness' is understood to mean the ability of the business sector to compete at global level at a time when more effective instruments are being taken into use as part of climate and environmental policy. The committee was asked to discuss what constitutes a proactive, growth-oriented policy to strengthen green competitiveness within a framework of effective resource use. In line with its terms of reference, the committee invited views and input from important industries, companies, organisations and academia in different parts of Norway. The committee concluded that on the basis of the input it received, it will be possible to reduce Norway's non-ETS emissions by 40 % by 2030, and that Norway can become a competitive low-emission society by 2050. To achieve this, technology development and implementation of new technologies will need to be accelerated. According to the committee, this will require

wide-ranging measures in both the private and the public sector. The committee recommended that research should focus more on the problems that need to be solved, funding instruments should be used to promote green innovation, and the public sector should play its part as regulator, facilitator, owner and purchaser, and make use of its risk-bearing capacity. The committee also pointed out that Norwegian businesses must be competitive to maintain value creation and employment, and that policy instruments and tools must promote their competitiveness.

Part of the input to the committee's work consisted of roadmaps developed by 11 different sectors, including transport, coastal shipping and the process industries. In these, a wide range of different businesses have reviewed what needs to be done to reduce Norway's emissions and how the competitiveness of Norwegian businesses can be ensured as Norway makes a transition to a low-emission society. More industries have since developed their own roadmaps.

2021–2030 by roughly 1.5 million tonnes CO₂-eq compared with the baseline projections. To ensure judicious use of policy instruments and cuts in emissions in urban areas, Norway has established arrangements for urban environment and urban development agreements for the larger urban areas. These are now to be coordinated in a single system of integrated urban land-use and transport agreements. These agreements are intended to be instrumental in achieving the target of using public transport, cycling and walking to meet the growth in the volume of passenger transport (giving zero-growth in passenger car traffic) in the larger urban areas that are included in these arrangements.

The Government will ensure that the prohibition on the use of mineral oil for heating buildings from 2020 also includes the use of mineral oil to provide peak-load capacity. This can result in some additional reduction in emissions compared with the baseline projections. The Government has also started a consultation on a prohibition on the use of mineral oil for heating farm buildings and temporary buildings. Furthermore, the Gov-

ernment will review possibilities for reducing emissions from the use of natural gas to heat buildings, and for reducing emissions from the use of mineral oil to produce district heating to heat buildings. Another goal must be to ensure that construction sites are as fossil-free as possible in future. In the course of 2017, the Government will therefore review ways of reducing the use of mineral oil for heating and drying buildings during construction. In addition, the Government is working on an action plan for fossil-free construction sites in the transport sector.

The Storting has adopted a decision requesting the Government to introduce a standard carbon tax rate for non-ETS emissions. The Government intends to follow this up in the 2018 budget. A standard carbon tax rate for all sectors may result in emission reductions in addition to those already included in the baseline projections. Almost 60 % of non-ETS greenhouse gas emissions are currently subject to the standard tax rate of NOK 450 per tonne CO₂. However, certain industries and uses are exempted from the carbon tax or are taxed at a reduced rate. It is reasonable

to assume that a proportion of the emission reduction potential of the measures to reduce emissions that are not subject to the carbon tax will be realised through the introduction of a standard tax rate, although the estimated costs are uncertain. However, of the measures that the Norwegian Environment Agency has estimated will cost less than NOK 500 per tonne CO₂, a substantial proportion target emissions that are already taxed. In some cases it can be difficult to impose a tax on emissions, for example if they are difficult to measure or calculate. There may also be cases where the carbon tax will not function as an incentive to introduce cost-effective measures because of barriers such as a lack of expertise or information. If the carbon tax is not considered to be an adequate or appropriate instrument, other instruments that provide equally strong incentives to reduce emissions will be considered.

In its analyses, the Norwegian Environment Agency has estimated that the potential for reduction of non-ETS emissions from the petroleum sector and manufacturing is a little less than 5 million tonnes CO₂-eq at an economic cost of less than NOK 500 per tonne CO₂-eq. The estimates are uncertain.

Furthermore, the Agency estimates that there is an emission reduction potential of 5 million tonnes CO₂-eq in the agricultural sector for the period 2021–2030 at an economic cost of less than NOK 500 per tonne CO₂-eq. Changes in diet and food production account for more than half of this potential. The estimates are uncertain, and the degree of uncertainty for some of the assumptions underlying the calculations is unknown. No assessment has been made of policy instruments that can be used to trigger these reductions.

For the agricultural sector and the fisheries, industry representatives will be invited to take part in committees appointed to consider ways of reducing greenhouse gas emissions by 2030.

The Government has initiated a process together with relevant industry organisations on the establishment of an environmental agreement and a CO₂ fund for commercial transport. Its environmental target will need to be adapted to the extent and design of the agreement and considered in conjunction with Norway's 2030 climate targets. The first steps are to commission reviews and obtain data and information as a basis for analyses.

In Chapter 5.3–5.10, emission reduction potentials and possible mitigation measures and policy instruments to reduce emissions in different sectors are presented. The text is based partly on the

Norwegian Environment Agency's reports on the knowledge base for low-carbon transition in Norway, in which a range of different measures, their emission reduction potentials and their economic costs were assessed. The Agency's analyses were based on detailed information on different technologies and types of action that can be used to reduce emissions, and presented calculations of the effects of different measures in isolation. The Agency has divided measures into different cost categories. The cost categories are for the average economic costs of measures over the period covered by the analyses, 2016–2030.⁶ The mitigation analyses do not include assessments of which policy instruments will be needed, or how they would need to be applied, to ensure that the measures are implemented. However, the cost estimates are based on the assumption that policy instruments are used cost-effectively. If the policy instruments chosen are not optimal in terms of cost effectiveness, for example if subsidies are used where taxation would be preferable, the costs will be higher than estimated. The analyses do not include estimates of how much higher costs would be. The mitigation analyses are based on information from a wide variety of sources, contact with other agencies and dialogue with the business sector. Chapter 5.11 discusses measures specifically designed to reduce emissions of black carbon and other short-lived climate pollutants, while Chapter 5.12 deals with measures to increase removals and reduce emissions in the LULUCF sector.

5.3 Transport

5.3.1 Climate policy for the transport sector

The transport sector accounts for almost 60 % of Norway's non-ETS emissions. This sector includes road traffic, railways, non-road mobile machinery, maritime transport and fishing vessels, and aviation. Most of the transport sector is outside the scope of the Emissions Trading System (EU ETS), but commercial aviation is largely included in the ETS.

In the white paper Norwegian National Transport Plan 2018–2029 (Meld. St. 33 (2016–2017)),

⁶ The Norwegian Environment Agency assessed the economic costs of mitigation measures by dividing an annuity of the costs by the average annual emission reductions. This type of calculation is suitable when setting priorities for projects/measures, but is not an adequate basis for assessing the level of a tax or corresponding economic instrument needed to trigger implementation of a measure.

the Government has put forward a range of policy proposals designed to reduce greenhouse gas emissions from the transport sector in the years up to 2030 (see Box 5.10).

The Government will:

- Set a working target of cutting emissions from the transport sector by 35–40 % by 2030 compared with 2005. This target will support efforts to reduce emissions in the transport sector.
- Seek to ensure that the transport sector is virtually emission-free/climate-neutral by 2050.
- Develop a national plan for infrastructure for alternative transport fuels. This will include sufficient charging infrastructure for electric modes of transport and filling stations for hydrogen and biogas given the quantitative targets for zero-emission vehicles that apply up to 2030, and climate-friendly fuels for domestic shipping. The intention is for the development of infrastructure for zero-emission fuels to become market-driven and independent of public-sector support as quickly as possible. Public agencies in the research and innovation system, including Enova, will support market developments at an early stage.
- Consider how the anticipated demand for alternative fuels should be taken into account in planning for the power grid, roads and other infrastructure.
- Start work on an environmental agreement and a CO₂ fund for commercial transport.

Road traffic

The Government will:

- Contribute to the achievement of the targets for zero-emission vehicles through:
 - Continued development of current policy instruments so that they promote the achievement of the targets in the National Transport Plan for 2018–2029.
 - The presentation of an annual overview of progress in phasing in zero-emission technology in the vehicle segments to which the targets apply. The Government will assess the need for changes in policy instruments in the light of emission trends.
 - A predictable long-term policy of giving preferential treatment to zero-emission transport solutions and adapting policy instruments to market developments.

- The assessment of various policy instruments that can encourage greater use of zero-emission solutions for taxis, motorcycles and mopeds, vans and heavy vehicles.
- Provide a suitable framework so that it always pays to choose zero-emission vehicles. Policy instruments will be designed with this in mind.

Maritime transport and fishing vessels

The Government will:

- Support the further development and commercialisation of solutions for more climate-friendly vessels.
- Evaluate the grant scheme for building up environmental expertise at the county-level that is needed to improve the procurement of ferry and high-speed vessel services, and continue and if appropriate expand the scheme if the results are considered to be satisfactory.
- Encourage ports to levy differential rates of charges and fees on environmental grounds.

Biofuels

The Government will:

- Promote the use of advanced biofuels.
- Not propose any further increase in the biofuel quota obligation for road traffic fuels after 2020. The use of biofuels after 2020 must be considered in conjunction with the costs of alternative ways of reducing non-ETS emissions
- In the period up to 2030, seek to increase the proportion of biofuels used in the aviation industry and consider the introduction of a biofuel quota obligation for shipping.
- Play a part in further developing the EU's sustainability criteria for biofuels to ensure global climate benefits and take into account other important environmental objectives such as conservation of biodiversity globally and nationally.
- Monitor market prices and volumes for biofuels while the plan for increasing the biofuel quota obligation for road transport is being implemented.

The Government will ensure that a sufficiently large share of emission reductions takes place in the transport sector, so that Norway meets its obligations under the Paris Agreement and achieves its national climate target for 2030. The Government's ambition is for the transport sector to be virtually emission-free/climate-neutral by 2050. The Government presented a range of new

Box 5.10 Climate policy in the Norwegian National Transport Plan for 2018–2029

The Government will:

- Ensure that a sufficiently large share of emission reductions takes place in the transport sector, so that Norway meets its obligations under the Paris Agreement and achieves its national climate target for 2030.
 - Adopt the following targets for zero-emission vehicles for 2025:
 - All new passenger cars and light vans are to be zero-emission vehicles.
 - All new local buses are to be zero-emission vehicles or run on biogas.
 - Adopt the target that by 2030, all new heavy vans, 75 % of new long-distance coaches and 50 % of new lorries are to be zero-emission vehicles.
 - Adopt the target that by 2030, goods distribution in the largest urban centres is to be virtually emission-free.
 - Provide a suitable framework so that it always pays to choose a zero-emission solution when purchasing a vehicle.
 - Aim for 40 % of the short shipping fleet to run on biofuel or be low- or zero-emission vessels by 2030.
 - Provide support for the county authorities so that they can offer climate-friendly public transport.
 - Ensure that all new car ferries that are part of the national road system use low- or zero-emission systems and encourage the use of such systems in car ferries and high-speed vessels that are part of the county road system.
 - Set a biofuel quota obligation of 1 % sustainable biofuels for aviation from 2019, with the aim of reaching 30 % by 2030.
 - Require the use of zero-emission solutions in all future public procurement of railway equipment. For procurement of rolling stock, this is to be done to the extent possible given technological developments.
 - Prepare an action plan for fossil-free construction sites in the transport sector.
- Aim to use public transport, cycling and walking to meet the growth in the volume of passenger transport in urban areas
 - Provide a framework that will enable cycling and walking to meet a substantial proportion of the growth in transport. Initiatives for cyclists and pedestrians in urban areas as part of the urban environment agreements and integrated urban land-use and transport agreements will be strengthened.
 - Expand train services in and around the largest urban areas and facilitate an increase in freight transport by rail.
 - Facilitate greater use of rail and sea for long-distance freight transport.
 - Facilitate the development of Norwegian freight transport so that it can contribute to the green shift.
 - Contribute to the reduction of greenhouse gas emissions from freight transport by encouraging the use of environmentally friendly transport technology and alternative fuels and action to make transport and logistics more efficient. High priority will be given to promoting more rapid phase-in of new technology.

In the context of transport, the term zero-emission technology includes the use of electricity and hydrogen as an energy source in batteries and fuel cells, which do not emit greenhouse gases during use. Battery electric and hydrogen technology are both electric propulsion systems. Low-emission technologies are hybrid solutions that combine combustion engines with electric motors.

Analyses show that ambitious targets for emission cuts in the road transport sector will not be achieved without the use of incentives. Policy instruments already adopted by the Government are expected to contribute significantly to achievement of the quantitative targets. The targets are based on the assumption that the technological maturity of zero-emission vehicles in different segments will improve so that they become competitive with conventional solutions.

goals and ambitions in the Norwegian National Transport Plan for 2018–2029 that are intended to promote this (see Box 5.10). Policy instruments for the transport sector must be designed to support the achievement of the goals and ambitions presented in the transport plan.

The Government's view is that emission reductions should as a general rule be made where they will be most cost effective. A separate sectoral target for the transport sector could make Norway's climate policy more expensive and/or less effective than it could be. At the same time, we know that a large proportion of Norway's emission cuts must be made in the transport sector and that low- and zero-emission technology in the sector is being developed rapidly. To support efforts to reduce emissions in the transport sector, the Government has set a working target of a cut of 35–40 % in emissions from the sector by 2030 compared with 2005. This target is based on the assumption that the technological maturity of zero-emission solutions in different transport segments will improve so that they become competitive with fossil-based transport solutions. All sectors will need to contribute to reductions in emissions. Contributions from the transport sector are not a replacement for contributions from other sectors.

There are three main types of measures that can be used to reduce greenhouse gas emissions from transport:

1. the volume of transport can be reduced;
2. steps can be taken to encourage a switch to more environmentally sound forms of transport (rail, sea, public transport, cycling or walking);
3. emissions from specific means of transport can be eliminated or reduced, for example through greater use of zero- and low-emission technology.

The Government has introduced effective policy instruments to reduce greenhouse gas emissions, including a passenger car registration tax with a progressive CO₂ component, preferential tax treatment of electric and hydrogen cars, the carbon tax, Enova's grant schemes, requirements in public procurement processes, urban environment agreements, the 'Klimasats' grant scheme and so on. These policy instruments have been important for the reductions Norway has already made in emissions from the transport sector.

The Government will continue the development of current policy instruments so that they promote the achievement of the targets set out in

the National Transport Plan for 2018–2029. The Government will present an annual overview of progress in phasing in zero-emission technology in the vehicle segments to which the targets apply. The Government will monitor emissions in the transport sector and assess the need for changes in policy instruments in the light of emission trends. The Government will in the time ahead assess various policy instruments that can encourage greater use of zero-emission solutions for taxis, motorcycles and mopeds, vans and heavy vehicles.

5.3.2 Development of zero- and low-emission technology in the transport sector

The transport sector is undergoing a technological shift, both in terms of zero- and low-emission technology and in terms of digitalisation. In the context of transport, the term zero-emission technology includes the use of electricity and hydrogen as an energy source in batteries and fuel cells, which do not emit greenhouse gases during use. Low-emission technologies are hybrid solutions that combine combustion engines with electric motors.

The Government anticipates that technological developments both in zero- and low-emission technologies and in intelligent transport systems (ITS) will have major implications for greenhouse gas emission reductions and thus for the costs of achieving such reductions.

One of the key determinants of the future of climate- and environmentally friendly transport will be developments in battery electric technology. The reduction of battery costs is of crucial importance for battery electric transport in the future. Battery costs have been falling steeply in recent years, and many stakeholders are expecting a continued steep decline in costs in the years ahead. According to Bloomberg New Energy Finance, the price of lithium-ion batteries has dropped by more than 70 % since the Nissan Leaf was launched in 2010, from about USD 1000 per kWh to around USD 270 per kWh in 2016. The International Energy Agency (IEA) estimates that it is realistic to expect the cost of electric vehicle batteries to drop by 10 % per year between 2016 and 2022.⁷ On the basis of existing analyses, the Norwegian Environment Agency has estimated a similar annual reduction in battery prices, to about USD 150 per kWh in 2030.

⁷ IEA (2016). Global EV Outlook 2016.

Bloomberg has recently made a comparative analysis of production costs for electric and fossil cars in all size segments. They estimate that the production costs for electric cars will reach parity with those for corresponding fossil vehicles between 2025 and 2029, depending on car size and which market is being considered. By 2030, Bloomberg estimates that electric cars may be 15 % cheaper than corresponding fossil vehicles.⁸ These estimates are based on pre-tax prices and do not take into account potential savings on fuel and maintenance costs. Bloomberg has previously estimated that small and medium-sized electric cars may be competitive in price with similar fossil vehicles in 2022. This estimate is based on both purchase and running costs, and assumes oil prices of USD 50–70 per barrel.⁹

The passenger car market is an important driver of battery technology and associated costs. The development of battery technology, together with anticipated reductions in costs and improvements in battery power, will have consequences for emission reductions in all segments of the transport sector. A new generation of electric cars will be on the market in the next few years. There are already some electric models of motorcycles, mopeds and vans, but the development of battery technology for trucks is not as advanced. However, there are promising developments in this segment too, for example the concept of electrified motorways, where trucks can drive on electrified stretches of road. In Norway, the Public Roads Administration is heading a research and development programme called ElinGO on electric infrastructure for freight transport. This is a conceptual study on the electrification of long-distance transport by 2030.

For the bus segment, there are signs that a substantial phase-in of battery technology is beginning. There are already several electric bus fleets around the world. China stands out in this field, and produced several thousand electric buses in 2016. In December 2016, 43 new electric articulated buses were put into operation in Eindhoven in the Netherlands. Electric buses are also being introduced by public transport companies in several parts of Norway. In Oslo, Ruter will be testing electric buses in 2017, Sør-Trøndelag county is purchasing 40 electric buses to be put into operation in Trondheim from August 2019,

and Brakar (Buskerud county) has ordered electric buses that will be used on routes between the towns of Drammen and Mjøndalen.

Several maritime battery technology companies are now established in Norway, and are aiming to supply batteries for several shipping segments. Maritime battery technology for the ferry segment is particularly advanced. As a result, the Norwegian Public Roads Administration can now as a general rule require all new car ferries that are part of the national road system to use zero- or low-emission solutions. From 1 January 2018, two new battery-powered ferries will be introduced on the route Anda-Lote in Sogn og Fjordane (see Box 5.16 on low-emission ferries). The Hurtigruten shipping company is to build two new hybrid cruise ships that will be able to sail for half an hour on battery power alone. Color Line is building the world's largest hybrid passenger ferry, which will sail the route between Sandefjord and Strømstad from 2020. It will be able to run on battery power only in and out of the narrow arm of the fjord to Sandefjord, thus reducing emissions in this area. Vessels using battery technology have also been built for other maritime transport segments, for example a fully electric work boat for the fish farming industry and a hybrid electric fishing vessel.

Electric aircraft are at a much earlier stage of development than electric vehicles and vessels. However, there is growing interest in developing electric aircraft, and the level of activity is increasing. A number of companies and agencies, including Siemens, NASA and Airbus, are working on electric plane projects. The Airbus E-Fan, an all-electric, rechargeable plane, flew across the English Channel in summer 2015. Avinor has together with Norges Luftsportforbund (Norway's federation for air sports) established a long-term project to phase in electric plans in Norwegian aviation. Avinor, which operates Norway's state-owned airports, considers that Norway is particularly well-suited for analyses and testing of electric aviation. The Government is supporting Avinor's work in this field.

There is considerable research and development activity in many countries on new hydrogen-based technological solutions. Norway is considered to be a pioneering nation in this field, having been involved in these activities at an early stage. Several of the world's leading car manufacturers are now working on hydrogen and fuel-cell solutions for their vehicles, and have plans for market introduction. Several of these companies have used Norway for demonstration of their hydrogen

⁸ Bloomberg New Energy Finance (2017). When will electric vehicles be cheaper than conventional vehicles?, 12 April.

⁹ Bloomberg New Energy Finance (2016). Global EV sales outlook to 2040. Research Note.

vehicles. Hydrogen vehicles may have a potential in the future, for example where long distances or heavy loads mean that battery-powered vehicles are less suitable. The Norwegian Public Roads Administration has established a development project for a partly hydrogen-powered ferry which it plans to put into operation in 2021. Hydrogen-powered passenger trains are being tested in Germany, and the Norwegian Government will follow developments in this area. The results will form an important part of the basis for evaluating the possibility of testing and using hydrogen-powered trains in Norway.

Biogas is another area where there have been significant advances in recent years, after the Norwegian Government presented its biogas strategy in 2014. Counties including Oslo, Østfold and Vestfold have begun to use biogas widely in bus transport, and biogas is also being used for other purposes in a number of places, for example for refuse collection vehicles. Large production plants for biogas have received support from Enova, and support has also been available for pilot plants through Innovation Norway (grant scheme funded by the Ministry of Climate and Environment). The 'Klimasats' grant scheme has provided support for biogas filling stations. In recent years several large production plants have been opened, for example near Tønsberg (Vestfold), and a plant is being built at Skogn (Nord-Trøndelag). New cost assessments show that the cost of introducing biogas use as a mitigation measure may be lower than previously estimated.

Developments in zero- and low-emission technology are not the only factor of decisive importance for the future of the transport sector. As in most sectors, digitalisation is transforming the transport industry. The International Transport Forum has published several reports on the potential of shared self-driving vehicles. One recent report, *Shared Mobility – Innovation for Liveable Cities* (2016) is a case study of what might happen if all car and bus trips in a medium-sized European city (Lisbon) were to be replaced by automatically dispatched door-to-door services (minibuses). The result of the simulation was that congestion was eliminated, greenhouse gas emissions were cut by 1/3, the vehicle fleet needed required only 5 % of the parking space currently needed and the car fleet needed was only 3 % of the present fleet size. Total vehicle-kilometres driven were calculated to be 37 % below the current level, and each vehicle was found to be running about ten times more kilometres than at present. The report points out that this implies

shorter life cycles for the vehicles, enabling faster uptake of newer, cleaner technologies. This is only an example, but it illustrates the possibilities offered by digitalisation of transport. The Government will give considerable weight to strengthening the knowledge base on how technological advances will affect the need to increase the capacity of transport infrastructure.

It is not only land transport that is likely to be transformed by digitalisation. Autonomous vessels¹⁰ can be important for the efficiency of maritime transport. They can make it more profitable to transport goods by sea than by road, and thus have positive climate and environmental effects. Emissions can also be reduced because it is not necessary to use space and weight for crew facilities on autonomous vessels. A switch to autonomous vessels may be possible in only a few years, and Norway is at the forefront of developments, with testing under way in Norwegian fjords. The Norwegian Coastal Administration and the Norwegian Maritime Directorate, in cooperation with the maritime technology sector and research groups, all played a role in the designation of part of the Trondheimsfjord as the world's first test bed for autonomous shipping technology. The authorities will use experience gained from trials in the area in the further development of legislation, services and infrastructure.

The development of autonomous solutions is of interest for segments such as short sea shipping, ferries and offshore vessels. Yara International and the Kongsberg Group have announced that they plan to have a fully electric and autonomous container ship in operation from 2020. The ship is to sail between Yara's fertiliser plant on Herøya and Brevik and Larvik, which are the ports of shipment, and will replace about 40 000 truck journeys per year.

Zero- and low-emission technology can only be phased in on a large scale if the necessary infrastructure is in place. The Government will therefore develop a national plan for infrastructure for alternative transport fuels, for both sea and land transport. This will include sufficient charging infrastructure for electric modes of transport and filling stations for hydrogen and biogas given the quantitative targets for zero-emission vehicles that apply up to 2030, and climate-friendly fuels for domestic shipping. The intention is for the development of infrastructure

¹⁰ The term autonomous vessels is used both of self-driving vessels and of vessels with a certain degree of automation of functions.

Box 5.11 Enova's programmes for the transport sector

A number of the programmes in Enova's current portfolio are particularly relevant to the transport sector.

Support for introduction of energy management in transport – support through this scheme helps more companies to qualify for certification under the international standard for energy management. To do this, companies must put in place routines for monitoring energy use and identify measures to improve energy efficiency. In transport companies, this may for example involve focusing on driving patterns that reduce fuel consumption and thus greenhouse gas emissions.

Support for energy measures in ships – may include support for everything from simple energy efficiency measures such as optimising heating and lighting management to more efficient propellers and the installation of batteries to reduce fuel consumption.

Support for energy measures in land transport – through this scheme, Enova is supporting purchases of zero-emission commercial vehicles. Support may be granted for purchases of electric vans, lorries and non-road mobile machinery, and all types of hydrogen vehicles used in commercial transport.

Support for new energy and climate technology in transport – Enova supports such technology in all sectors through its programmes for demonstration of new energy and climate technology and for full-scale innovative energy and

climate technology. In the transport sector, this may for example include particularly innovative solutions for electrification and other solutions that reduce emissions or energy use.

Support for municipal and county transport services – this scheme assists public authorities that need to procure transport services. Enova can for example provide support for charging facilities for ferries and buses, which will make it easier for municipalities and counties to include stricter climate-related requirements in their calls for tenders.

Support for biogas and biofuels – through this scheme, Enova supports projects for the production of biogas and sustainable second-generation biofuels.

Support for charging infrastructure – Enova is supporting the development of a network of fast-charging stations, which will allow more people to use electric vehicles for longer journeys and help to make electric vehicles a real alternative to fossil vehicles.

Support for shore power – Enova is supporting the development of shore power in Norwegian ports with the aim of bringing about lasting changes in the market so that ships at berth in Norway can use shoreside electric power.

Support for hydrogen fuelling infrastructure – Enova has recently launched a support scheme for hydrogen filling stations to facilitate faster growth in the use of hydrogen vehicles.

for zero-emission fuels to become market-driven and independent of public support as quickly as possible. Public agencies in the research and innovation system, including Enova, will support market developments at an early stage. The national infrastructure plan is also intended to satisfy the requirements of the EU directive on the deployment of alternative fuels infrastructure.¹¹ The directive has not yet been incorporated into the EEA Agreement, but Norway considers it to be EEA-relevant and acceptable. The Government will also consider how the anticipated demand for alternative fuels should be

taken into account in planning for the power grid, roads and other infrastructure.

Norway has chosen to make a stronger contribution than many other countries in the global campaign to support the development of technology, and the Government will continue this line. Electric vehicle manufacturers are now interested in Norway because the Government's initiative has resulted in the creation of a market and the development of infrastructure. This is one reason why a number of electric vehicle manufacturers are giving priority to the Norwegian market. The Government's focus on low- and zero-emission technology for the maritime industry has also made Norway an interesting market for technology suppliers. Several battery manufacturers have

¹¹ Directive 2014/94/EU.

now established or have plans to establish production in Norway. These developments are also a result of the long-term political signals that the Government intends to cut emissions by taking into use new technology all along the coast.

5.3.3 Road traffic

In 2015, road traffic accounted for about 19 % of Norway's greenhouse gas emissions, and these emissions have risen by about 33 % since 1990. Most of the rise took place in the years up to 2007, after which emissions have remained relatively stable. According to preliminary figures from Statistics Norway, emissions in 2016 were 3.6 % lower than the year before, largely because of greater use of biofuels. The largest share of emissions from road traffic is from passenger cars and other light vehicles, which accounted for 69 % of the total in 2015. Emissions from passenger cars and other light vehicles rose by 21 % in the period 1990–2015, while emissions from heavy vehicles rose by 70 %. However, CO₂ emissions from light vehicles have risen less than would be expected given the increase in traffic. This is because the energy efficiency of car engines has been improved, more people are using zero- and low-emission cars, and the proportion of biofuel used has increased. Heavy vans and other heavy vehicles, i.e. lorries and buses, account for around 30 % of emissions from road traffic.

According to the emission projections in the white paper Long-term Perspectives on the Norwegian Economy 2017 (Meld. St. 29 (2016–2017)), greenhouse gas emissions from road traffic will be reduced from 10.3 million tonnes CO₂-eq in 2015 to 8.4 million tonnes CO₂-eq in 2030. This estimate is based on the assumption that the proportion of electric passenger cars will rise to 50 % of new car sales in 2030. In the projections, sales of plug-in hybrids are assumed to make up about 20 % of new car sales by the mid 2020s, and to remain at this level. Correspondingly, sales of new diesel and petrol cars as a percentage of new passenger car sales are estimated to decline from about 60 % in 2016 to less than 30 % in 2030. The

projections do not take into account the effects of the targets for zero-emission vehicles in the National Transport Plan for 2018–2028. The volume of transport is expected to grow at the same rate as the population. The energy efficiency of new cars using fossil fuels is expected to improve by about 1 % per year. The projections are also based on the assumption that the proportion of biofuel will remain constant at the real current level of 6.25 %. Thus, the projections do not take into account the planned increase in the proportion of biofuel to 20 %.

To illustrate the possible implications of a future technology shift for greenhouse gas emissions from light and heavy vehicles, Norway's National Transport Plan for 2018–2020 presents a 'disruptive' scenario. In this scenario, it is assumed that conventional vehicles will be out-competed earlier, from 2025. Existing conventional vehicles will become relatively expensive to run, and will be used less than today. The scenario also uses the following assumptions:

- Passenger cars:
 - 100 % of all new cars sold in 2025 are zero-emission vehicles;
 - distance driven by conventional cars is halved from the same year;
- Vans:
 - 100 % of all new light vans sold in 2025 are zero-emission vehicles (electric/hydrogen);
 - 50 % of all new heavy vans sold in 2025 are zero-emission vehicles (electric/hydrogen), rising to 100 % in 2030;
- Heavy vehicles:
 - emission factors are reduced by 25 % in 2025 and 50 % in 2030 compared with 2020.

In this disruptive scenario, Norway has 1.5 million electric vehicles in 2030, and emissions from road traffic are 3.8 million tonnes CO₂, or half the level in the reference scenario. For this scenario, technology developments in road traffic only were considered.

The Government uses taxation (the carbon tax and other taxes on greenhouse gas emissions) as

Table 5.3 Greenhouse gas emissions from road traffic in 2015 and projections for 2030 and the period 2021–2030. Million tonnes CO₂-eq

	Emissions 2015	Projected emissions 2030	Projected emissions 2021–2030 (for the whole period)
Total emissions	10.3	8.4	90

Source: Statistics Norway, Ministry of Finance and Norwegian Environment Agency.

Box 5.12 Emissions from electric and conventional vehicles

Electric vehicles have many of the same disadvantages as conventional ones. Regardless of which fuel it uses, a car causes local pollution, noise and wear and tear on the roads, occupies space when parked and competes with public transport, cyclists and pedestrians. Since fuel prices for electric vehicles are lower than for conventional vehicles, it is possible that people who own electric cars drive more than those who own conventional vehicles. Nevertheless, there is a considerable difference between emissions from electric and conventional vehicles, both during use and in a life-cycle perspective.

It requires more energy to manufacture an electric car than a conventional vehicle. This is largely because battery production is energy intensive, but the smaller scale of production may also be a contributory factor. Emissions from the manufacture of both electric and conventional vehicles can be reduced by using renewable energy during the production process. If production uses emission-free energy, the difference between production-related emissions from electric and conventional vehicles may be eliminated, even though more energy is needed to produce an electric vehicle.

The switch from a combustion engine to an electric motor in itself gives a considerable improvement in energy efficiency. 'Tank to

wheel' efficiency for an electric vehicle, in other words the efficiency of converting electric energy to motion, is about 81 %, as compared with about 30 % for a vehicle with an internal combustion engine.

Although research results vary, there is a clear tendency: electric vehicles are more climate and environmentally friendly than vehicles with internal combustion engines in a life-cycle perspective. The main factors determining the difference are the type of energy used in the manufacturing phase and for recharging electric vehicles during use, and how far electric vehicles are driven.

Transferring emissions from the individual vehicle to electricity production also brings them within the scope of the EU Emissions Trading System (EU ETS). The ETS sets an overall ceiling for emissions from electricity and heat production, manufacturing and civil aviation. If more electricity is used by electric vehicles, it will therefore be necessary to reduce emissions in other sectors over time, and perhaps to use more electricity from renewable sources. Under the European Commission's proposal for annual tightening of the emissions cap, the emission ceiling in 2050 will be 86 % lower than the volume of emissions in 1990 from installations within the scope of the system.

the main instrument for pricing non-ETS emissions. The carbon tax rate for petrol, diesel and gas for road traffic is about NOK 450 per tonne CO₂. There are also several other instruments that contribute to reductions in greenhouse gas emissions.

Passenger cars

There are three main barriers to the introduction of zero-emission vehicles in the passenger car segment in Norway: range, price, and the small number of models available. Norway is using lower tax rates to compensate for price, while both the number of models and their range have increased and are expected to increase further in the coming years. A lack of charging infrastructure is also a barrier in some parts of the country, and can be a barrier for housing units that do not

have their own parking spaces with charging points.

There has been a rapid increase in sales of electric passenger cars in Norway in recent years, and at the end of 2016 there were about 100 000 registered electric cars on the roads. In the first five months of 2017, zero-emission vehicles accounted for 17 % of new car sales. According to Bloomberg New Energy Finance, a little more than 1 million electric vehicles were sold worldwide in the period 2011–2016. Norway accounted for 7.7 % of these sales, and was the world's fourth largest electric vehicle market during this period.¹²

The tax advantages and other preferential treatment given to zero-emission vehicles, combined with the introduction of many new car mod-

¹² Bloomberg New Energy Finance (2017). Electric Vehicle Data Hub.

els with a longer range in recent years, go a long way towards explaining the growth in sales of electric vehicles in Norway. In 2016, tax advantages and other preferential treatment for zero-emission vehicles corresponded to a total of about NOK 2.9 billion, consisting of NOK 135 million in a lower tax rate for the benefits of private use of company vehicles for electric cars, NOK 1 700 million in zero VAT-rating, NOK 800 million in exemption from motor vehicle registration tax and NOK 250 million in lower annual motor vehicle tax. There is an additional unquantified benefit because electricity used to power electric vehicles is not subject to the road use duty that applies to other fuels. Electric vehicles are exempted from payment for toll roads, and the total reduction in toll revenues was about NOK 370 million in 2015. The corresponding figures for 2016 and 2017 have been estimated at NOK 500–600 million and NOK 600–900 million respectively. Electric vehicles also pay lower prices on car ferries, and the reductions are estimated to total NOK 12 million in 2015 and NOK 16 million in 2017.

There are several other advantages of electric vehicles in addition to the absence of direct greenhouse gas emissions in exhaust. For example, they do not emit NO_x or particulate matter in exhaust and they are less noisy than conventional vehicles at low speeds. However, they do produce emissions of particulate matter from brakes and as road dust in the same way as conventional vehicles, and contribute to road wear and tear and congestion. At high speeds, they are as noisy as conventional vehicles, because tyre noise is the dominant factor. For individual consumers, using an electric car will result in lower fuel costs and also lower maintenance costs; the latter are estimated to be 30–35 % lower for an electric car than for a fossil-fuel vehicle. However, electric cars may have an inconvenience cost for the individual consumer, related to factors including their range and the limited number of models on the market. The inconvenience cost is expected to be reduced as charging infrastructure is further developed and more models are introduced.

In connection with the revised national budget for 2015 (presented in the white paper Meld. St. 2 (2014–2015)), the Government and the parties with which it is cooperating in the Storting reached agreement on principles for promoting a newer, safer and more environmentally friendly vehicle fleet in Norway. This agreement is based on a review of all vehicle and fuel taxation. Vehicle taxes will be used as a tool for achieving the strengthened targets of the cross-party agree-

ment on climate policy and Norway's emission reduction target for 2030.

The budget agreement includes changes to the passenger car registration tax over time. The component relating to engine power is to be phased out and the weight-related component reduced. The CO₂ component is to be increased and made progressive, and will be considered in conjunction with the changes in the components related to vehicle weight and engine power. The budgets for 2016 and 2017 have included changes in the registration tax to follow up the agreement.

The current exemption from VAT for zero-emission cars will be maintained up to 2020. When considering the 2017 national budget, the Storting asked the Government to put forward a proposal to exempt zero-emission cars from the re-registration fee payable on change of ownership and from the annual motor vehicle tax, with effect from 2018. The annual motor vehicle tax is being replaced by a new system known as the road traffic insurance tax, and the Storting's request will be followed up in connection with this. Changes to both the tax and the re-registration fee must be notified to the EFTA Surveillance Authority, which must approve them before they can enter into force.

Preferential taxation of zero-emission cars will need to be phased out over time, partly in order to maintain state revenue from vehicle taxation.

During its consideration of the national budget for 2017, the Storting requested the Government as soon as possible, and preferably in the revised national budget for 2017, to put forward a proposal for changes in the vehicle registration tax to give more favourable treatment to plug-in hybrids with a long all-electric range than to those with a shorter all-electric range.

The vehicle registration tax for plug-in hybrids is lower than for other similar cars. This is both because the registration tax favours cars with low CO₂ emissions and because there is a special deduction from the weight component of the registration tax for plug-in hybrids (26 % of the weight used to calculate this component). The deduction is applied because plug-in hybrids have both an electric motor and an internal combustion engine, and are therefore heavier than other cars. The deduction was intended to correspond to the weight of the battery and electric motor. The deduction rate was increased from 15 to 26 % during discussions on the 2015 budget.

Under the current system, data on a vehicle's all-electric range is not recorded in the vehicle registry maintained by the Norwegian Public

Box 5.13 Costs of phasing in zero- and low-emission passenger cars

The costs of phasing in zero- and low-emission vehicles will depend on various factors, including technological developments and the feasibility of large-scale production. At present, manufacturing costs are higher for electric vehicles than for comparable petrol and diesel vehicles, mainly because of the battery costs. At the same time, fuel costs are lower for electric cars, and maintenance costs are also lower over the lifetime of a car. These costs and savings apply to individual owners. Changing to an electric car may also involve an inconvenience cost for the owner, related mainly to the limited range of such vehicles and the limited number of models compared with petrol and diesel cars. Society as a whole will also incur costs in developing the necessary charging infrastructure. On the other hand, electric vehicles provide health benefits in the form of less air pollution and noise.

The Norwegian Environment Agency¹ has estimated the costs of phasing in electric vehicles for the passenger car segment. The costs of battery packs in this segment are expected to decline in the period up to 2030.

The Environment Agency estimates that the economic cost of phasing in electric/hydrogen cars so that they account for 100 % of new passenger car sales in 2025 would be NOK 500–1500 per tonne CO₂-eq (i.e. the cost per tonne reduction in emissions) averaged over the period 2016–2030. The costs are considerably higher early in the period used for the analysis (estimated at NOK 7 000 per tonne CO₂-eq for small passenger cars and NOK 15 000 per tonne CO₂-eq for large cars), but are expected to fall steeply towards the end of the period. The cost of phasing in small passenger cars is expected to be negative (in other words, economically beneficial) from 2025 onwards.

The THEMA² Consulting Group has also estimated the costs of phasing in zero-emission vehicles in the passenger car market. This report estimates the costs for the individual consumer of buying and owning a zero-emission car rather than a petrol or diesel car. For a small car, the level of costs is estimated to be high at present, corresponding to about NOK 11 000 per tonne CO₂-eq. However, these costs are expected to fall quickly, so that by 2025 it will pay to buy and own a zero-emission vehicle, even if publicly-funded support and other preferential treatment is phased out after 2020. For larger cars, the estimated costs are higher, and zero-emission cars in this size segment will not be competitive by 2030 without public support schemes or tax reductions. The report dis-

cusses possible policy instruments for achieving emission reductions in the road transport sector if the only measure introduced is phasing in low- and zero-emission technology. It includes a qualitative evaluation of possible instruments based on factors including cost effectiveness and emission reduction potential.

In an article by Bjertnæs³, the economic cost to Norway of a changeover to electric cars is estimated at NOK 5 600 per tonne CO₂-eq, based on the loss of revenue to the state as a result of the current preferential tax treatment of electric vehicles. The estimate is based on the following estimates of total tax payable over the lifetime of a car: NOK 308 000 for petrol/diesel cars and NOK 28 000 for electric cars. The difference, NOK 280 000, can be considered as implicit compensation from the state to individuals who switch to an electric car. Bjertnæs argues that at the margin (where an individual has no preference for one type of car over another), the difference in taxation levels will be the same as the compensation required to switch to an electric vehicle and can thus be used to estimate the economic cost.

An analysis by Bloomberg New Energy Finance⁴ compares the manufacturing costs for electric cars and petrol/diesel cars for all size segments. It estimates that in the EU, the manufacturing cost of a medium-sized passenger car will reach price parity with a corresponding petrol/diesel car in 2025 at the earliest. This will happen somewhat later for large electric cars, at the earliest in 2027–2028 in the EU. For small electric cars, it is estimated that manufacturing costs in the EU will be the same as for comparable petrol/diesel cars at the earliest in 2029. The estimates are based on various assumptions on factors including developments in technology and scaling up production, and also on steadily stricter emission standards, which are raising the costs of conventional vehicles.

¹ Norwegian Environment Agency (2016). Tiltakskostnader for elbil [Costs of phasing in electric vehicles]. Report M-620.

² THEMA (2016). Potensialet for null- og lavutslippskjøretøy i den norske kjøretøyparken [The potential for zero- and low-emission vehicles in the Norwegian vehicle stock], THEMA Report 2016–26.

³ Geir H. M. Bjertnæs (2016). Hva koster egentlig elbilpolitikken? [What are the real costs of Norway's electric vehicle policy?], Aktuell analyse, Samfunnsøkonomen no. 2 2016.

⁴ Bloomberg New Energy Finance (2017). When will electric vehicles be cheaper than conventional vehicles?

Roads Administration or by the Norwegian Tax Administration. Because of the changes needed in these systems, it was not possible to introduce differentiation of the vehicle registration tax by all-electric range from 1 July 2017. The Government will present a proposal on this in connection with the national budget for 2018.

Even if substantial technological advances are made and costs are reduced in the future, it may be necessary to maintain or adjust current policy instruments after 2020 to ensure that the targets for the passenger car segment are met (see the discussion of the THEMA report in Box 5.13).¹³

Vans

In 2016, only 1.8 % of new vans sold (excluding camper vans) used zero-emission technology. There are several reasons why there has been less take-up of such technology in this segment than in the passenger car segment. The barriers are much the same as for passenger cars, the main factors being the number of models, range, charging infrastructure and costs/incentives. Until now there have been few types of light vans available, and their battery capacity has been low. Some commercial users of vans have ad-hoc travel patterns, which means it can be difficult to plan their vehicle use, and they may cater for customers over a large geographical area.¹⁴ This means that battery capacity and adequate charging infrastructure will be important factors in determining whether a firm chooses an electric van. Substantial incentives are in place to stimulate demand for zero-emission vans, but they are not as strong as for cars, partly because vans are not as heavily taxed as cars in the first place.

An article by Julsrud et al (2016) estimates that the additional cost of purchasing an electric van (light van) in Norway is between NOK 0 and 20 000 when all taxes are included.¹⁵ Savings on fuel costs provide one incentive to choose an electric van, and fuel taxes make this incentive stronger. For heavy vans, the situation is rather differ-

ent, since the technology is not as advanced, the costs are higher and the small number of models is a barrier. According to the THEMA report mentioned in Box 5.13, electric vans will not be competitive with diesel vans by 2030 even assuming that current policy instruments are maintained, and it is estimated that price support of about NOK 90 000 is currently needed for an average heavy electric van to make it competitive with a conventional van for the buyer. The Norwegian Environment Agency has estimated that the economic cost of phasing in electric/hydrogen vehicles so that they account for 100 % of all light vans sold in 2025 would be NOK 500–1500 per tonne CO₂-eq, while phasing in electric/hydrogen heavy vans so that they account for 100 % of sales in 2030 would be more than NOK 1500 per tonne CO₂-eq. However, costs, areas of use and van size all vary considerably.

Enova provides support for purchases of heavy vans through a programme for battery electric and hydrogen-powered commercial vehicles. The purpose of the programme is to increase the availability of such vehicles in the market and to encourage more rapid and larger-scale diffusion of the technologies than would otherwise have been the case.

In 2016, the Storting asked the Government to introduce a new rate of refund payment for end-of-life vans, justified on environmental grounds. This would involve an extra refund of NOK 13 000 when an end-of-life van is delivered for collection and recovery, provided that the owner purchases a zero-emission van at the same time. The Government will report back to the Storting on this in an appropriate way.

To achieve the targets of phasing in zero-emission vehicles so that all new light and heavy vans are zero-emission in 2025 and 2030 respectively, and to ensure that goods distribution in the largest urban centres is virtually emission-free in 2030, it will be necessary to eliminate the barriers discussed above. This will require technological development, which was assumed as part of the basis for developing the targets set out in Norway's National Transport Plan for 2018–2029.

Trucks

There are currently very few zero-emission trucks in Norway, and it will probably take some time before much commercial headway is made in this vehicle segment. However, there are already some developments. ASKO (distributor of groceries) has started using electric trucks and has

¹³ THEMA (2016). Potensialet for null- og lavutslippskjøretøy i den norske kjøretøyparken [The potential for zero- and low-emission vehicles in the Norwegian vehicle stock], THEMA Report 2016–26.

¹⁴ Julsrud, TE., Figenbaum, E., Nordbakke, S., Denstadli, JM., Tilset, H., and Schiefloe, M. (2016). Pathways to Sustainable Transport among Norwegian Crafts and Service Workers, TØI Report 1503/2016.

¹⁵ Julsrud, TE., Figenbaum, E., Nordbakke, S., Denstadli, JM., Tilset, H., and Schiefloe, M. (2016). Pathways to Sustainable Transport among Norwegian Crafts and Service Workers, TØI Report 1503/2016.

ordered hydrogen-powered vehicles. TINE (Norway's largest producer and distributor of dairy products) has reserved a new hydrogen truck model for which plans were launched in 2016. There are a few models of low- and zero-emission trucks, which is a major barrier, and there is considerable uncertainty about developments in the next few years. Other barriers are the lack of infrastructure and the high costs at the time of purchase. Developments will be dependent on cross-border cooperation on charging infrastructure to a much greater degree than for other vehicle categories.

The Norwegian Environment Agency estimates that the economic cost of phasing in zero-emission trucks so that they account for 50 % of new sales in 2030 would be in the range NOK 500–1000 per tonne CO₂-eq. Since technological developments are at a very early stage in this segment, it is difficult to predict future developments in costs. It will probably be possible to gain a better picture of current costs through Enova's support scheme for commercial vehicles.

The Government has decided to allow differentiated road toll rates based on environmental criteria. For heavy vehicles there are to be four classes: zero-emission vehicles, plug-in hybrids, vehicles that meet Euro VI standards, and pre-Euro VI vehicles.

There is no registration tax for vehicles with a maximum total weight of more than 7 500 kg, which means that the taxation system does not give the same incentive to buy zero- or low-emission vehicles as it does for passenger cars. As a general rule, there is little incentive in the taxation system to buy cleaner trucks, other than fuel taxes and the environmental component of the weight-based annual motor vehicle tax. The Government is working on the establishment of a CO₂ fund for commercial transport, which was originally discussed in the revised national budget for 2017, see Chapter 5.2.4.

Local buses and long-distance coaches

In the Norwegian National Transport Plan for 2018–2029, zero-emission technology for buses and coaches is defined as technology based on electricity, hydrogen and biogas. There are two main remaining barriers for zero-emission local buses: uncertainty about the technologies and the lack of charging/filling infrastructure. Purchase and operating costs may also be a barrier, depending on local conditions and driving patterns. The technology has been developing rapidly, and mar-

ket actors are cooperating on the establishment of a common charging standard. There are fewer barriers for biogas buses; the dominant barrier is considered to be the high investment costs for new vehicles. The inclusion of requirements in public procurement processes and support from Enova have been used as instruments to promote the use of zero-emission solutions for local bus transport. The Norwegian Environment Agency estimates the economic cost of phasing in electric/hydrogen vehicles so they account for 100 % of all new local buses in 2025 is less than NOK 500 per tonne CO₂-eq. The barriers are much the same for coaches, but it is expected to take longer before zero-emission technology can be used for long journeys. The Environment Agency estimates that the economic cost of phasing in electric/hydrogen vehicles so they account for 75 % of new coaches in 2030 is NOK 500–1500 per tonne CO₂-eq.

The extent to which the counties include environmental requirements in calls for tenders for bus transport varies. Some counties have therefore made much more progress than others in phasing in zero-emission technology. In Østfold, 80 % of the buses have been running on biogas since summer 2017, and there is also a growing proportion of biogas buses in Vestfold.

Motorcycles and mopeds

There is now a global market with a wide selection of models of electric motorcycles and mopeds, some of which are also sold in Norway. Overall emissions from motorcycles and mopeds are relatively limited, but emissions from large motorcycles are similar to those from passenger cars. The vehicle registration tax for motorcycles is currently based on engine power and cylinder volume, in addition to a fixed charge. The Storting has requested the Government to put forward a proposal for differentiation of the registration tax for motorcycles along the same lines as for passenger cars. In the revised national budget for 2017, the Government proposed changes to the structure of the vehicle registration tax for motorcycles from 1 July 2017, introducing a progressive CO₂ component to replace the engine power component and the fixed charge. The Norwegian Environment Agency estimates that the economic cost of phasing in electric motorcycles and mopeds so that they account for 30 % of new sales in 2030 would be less than NOK 500 per tonne CO₂-eq.

5.3.4 Reducing transport needs and switching to more environmentally friendly forms of transport

The white paper New emission commitment for Norway for 2030 – towards joint fulfilment with the EU (Meld. St. 13 (2014–2015)) highlights the importance of giving climate change considerations considerable weight in land-use and transport planning, so that development patterns and transport systems promote the development of compact towns and urban areas, reduce transport needs and promote green forms of transport.

There are close links between the design of towns and urban areas, greenhouse gas emissions and the modes of transport chosen by individual people. People who live or work in densely built-up areas where this is a wide range of economic activities travel shorter distances on a day-to-day basis, are more likely to use public transport, cycle or walk, and are responsible for a smaller proportion of greenhouse gas emissions in the transport sector than people who live in less densely-populated areas. It is therefore essential to ensure coordinated land-use and transport planning that reduces transport needs and encourages the use of green forms of transport such as public transport, cycling and walking.

In the white paper Urban sustainability and rural strength (Meld. St. 18 (2016–2017)), the Government highlighted the importance of ensuring growth throughout Norway on the basis of a sustainable land-use and transport policy, making it possible to reduce travel needs, land use and greenhouse gas emissions. The central government planning guidelines for coordinated housing, land-use and transport planning are to be used as a basis for this work.

The population in and around Norway's towns is expected to grow rapidly in the years ahead. For urban areas, the Norwegian National Transport Plan for 2018–2029 sets out the target of using public transport, cycling and walking to meet the growth in the volume of passenger transport (giving zero growth in passenger car traffic). It is estimated that zero growth in Norway's nine largest urban areas will result in a reduction in emissions of about 200 000 tonnes CO₂-eq in 2030 and about 1.4 million tonnes over the period 2021–2030 compared with the baseline projections. As one way of achieving the zero-growth target, arrangements have been made for urban environment and urban development agreements for the nine largest urban areas, which are now to be coordinated in a single system of integrated urban land-use and transport agreements, as described in the National Transport Plan for 2018–029. According to the transport authorities, the cost of achieving

Box 5.14 Municipalities play an important part in the response to climate change

The municipalities play a key role in the local response to climate change, and their responsibilities and the policy instruments they can use give them an influence on sources of substantial greenhouse gas emissions. The municipal authorities have a political role, provide services, exercise authority, are purchasers and owners, and are responsible for planning and organisation to make their municipalities attractive places to live.

Through climate and energy planning, the municipalities and counties are expected to encourage and contribute to reductions in greenhouse gas emissions and the shift towards environmentally friendly energy use.

Municipal responsibility for land-use planning is particularly important. All decisions on the siting and planning of commercial activities, residential buildings and other infrastructure

will have a long-term influence on emissions from transport. It is therefore vital that the municipalities use their authority in this field to ensure climate-smart planning for the future.

The municipal sector is also a major purchaser. Municipalities can for example choose to buy zero- and low-emission vehicles, and facilitate their use by establishing charging infrastructure.

Many municipalities in Norway are now taking action both to reduce their greenhouse gas emissions and to adapt to climate change. One good example is the City of Oslo, which has adopted its own climate and energy strategy. This includes the ambitious targets of reducing greenhouse gas emissions in Oslo by 36 % by 2020 and 95 % by 2030. This was one of the reasons why the EU has awarded Oslo the title of European Green Capital 2019.

the zero-growth target in the largest urban areas may be substantial. The Government has proposed a considerable increase in the budget framework for integrated land-use and transport agreements during the planning period for the national transport plan.

Both urban environment and urban development agreements and the new integrated urban land-use and transport agreements are long-term, binding agreements between the central government, county authorities and the municipalities in the largest urban areas. They are intended to ensure good coordination of land-use development and investments in transport systems. Municipalities and counties are expected to ensure that their land use planning is harmonised with central government investments in public transport and cycling and walking infrastructure in the relevant urban areas. Densification in urban centres and around public transport nodes is an important element of the necessary changes. Action by local authorities to promote public transport, cycling and walking and the parking restrictions they introduce will also be important, as will the introduction of road toll systems. The central government on its part will undertake to pay up to 50 % of the investment costs of five major public transport infrastructure projects in the four largest urban areas. Central government funding will also be available for projects relating to public transport and cycling and walking infrastructure along trunk roads, the development of station areas and transport nodes along the railways, and for the incentive scheme for urban areas to improve public transport. In addition, the central government will play a part in achieving the goals of the agreements by action within its own areas of responsibility and when considering where to site central government agencies that have large numbers of employees and/or visitors (this was discussed in the white paper *Urban sustainability and rural strength* (Meld. St. 18 (2016–2017))).

Agreements have been negotiated for the four largest urban areas in Norway. Trondheim (September 2016) and Oslo/Akershus (June 2017) have adopted urban environment agreements. Integrated urban land-use and transport agreements have been negotiated for Bergen and the Nord-Jæren region (including Stavanger and Sandnes); these still have to be considered at political level both locally and nationally before they can be formally adopted. Experience gained from the preparation of these four agreements will be used in negotiations on land-use and transport

agreements for the remaining five urban areas involved in these arrangements.

It is important to ensure that green public spaces are maintained and developed during densification and expansion of towns and urban areas. Green public spaces include everything from parks and footpaths/cycle tracks to streams and smaller green spaces. The Government wishes everyone, including people who live in towns, to have access to green spaces for outdoor activities and recreation near their homes. The conservation and development of the blue-green structure is also a sound climate change adaptation measure. The blue-green structure plays a vital role in stormwater management, which will become even more important in the future when higher and more intense precipitation is expected. In addition, green spaces, trees and other vegetation play a part in improving air quality, reducing noise levels and increasing biodiversity in towns.

Population growth is expected in a number of Norway's small and medium-sized urban areas, and they may also experience transport and environmental problems. Coordinated, integrated initiatives to develop effective and environmentally sound transport systems and land use will therefore be useful in these areas as well. The Government welcomes initiatives by local authorities to introduce coordinated land-use and transport measures based on a target of zero growth in passenger car traffic. This is further discussed in the *Norwegian National Transport Plan 2018–2029*. The Government also welcomes the individual targets set by some of the largest towns. For example, the City of Oslo has included targets of reducing car traffic by 20 % by 2020 and 33 % by 2030 in its climate and energy strategy.

In 2014, a grant scheme was established to promote more rapid implementation of measures to improve conditions for pedestrians and cyclists. Grants are available to fund cycling infrastructure along municipal and county roads in smaller urban areas, provided that the recipient pays at least 50 % of the costs of the measure. Municipalities can also apply for funding towards projects on climate-friendly land-use and transport planning through the 'Klimasats' grant scheme, which is administered by the Norwegian Environment Agency.

Moreover, the Ministry of Local Government and Modernisation has initiated a review of how policy instruments under the Planning and Building Act can be developed to stimulate the long-term transition to a low-emission society by 2050.

5.3.5 Promoting a shift in freight transport from road to rail and sea

A shift in freight transport from road to rail and sea will play a part in reducing congestion on the roads, improving safety, reducing pressure on the environment and reducing greenhouse gas emissions from the transport sector. An analysis of the freight sector was carried out in connection with the preparation of Norwegian National Transport Plan for 2018–2029, and showed that the quantity of freight transported by road is expected to increase from 270 million tonnes in 2013 to 400 million tonnes in 2030. Thus, shifting freight from road to rail and sea can be a good way of reducing greenhouse gas emissions. Norway's freight transport policy is both to strengthen the comparative advantages of each mode of transport and to facilitate a shift from road to rail and sea where this is economically beneficial. To reduce greenhouse gas emissions from goods transport, it will be crucial to deploy environmentally friendly technology and alternative fuels and to improve the efficiency of transport and logistics. The Government is strongly encouraging more rapid phase-in of new technology. Another important step measures will be to encourage more use of rail and sea for long-distance freight transport, in line with the Government's ambition.

In 2016, the Storting adopted a decision requesting the Government to set the target of transferring a minimum of 30 % of the volume of transport by road over distances of more than 300 km to rail or sea by 2030, and to increase this to 50 % by 2050. In the National Transport Plan for 2018–2029, the Government stated that its ambition is for 30 % of goods transported over distances of more than 300 km to be transferred from road to rail and sea by the end of the planning period. Important proposals included in the National Transport Plan include a package of measures for rail freight transport (further discussed in Chapter 5.3.6), a grant scheme for the transfer of freight from road to rail and sea, and other measures relating to ports and transport terminals (further discussed in Chapter 5.3.8).

Achieving such a large-scale shift of transport mode as 30 % of goods transported more than 300 km by road, which is the Government's ambition, will require effective economic instruments and larger investments than those included as part of the National Transport Plan for 2018–2029. The Government will therefore review other incentives that can increase the use of rail and sea transport.

5.3.6 The railways

Greenhouse gas emissions from railway operations are largely from diesel combustion on lines that have not been electrified. In 2015, these emissions were around 51 000 tonnes CO₂-eq. Up to 2030, a moderate reduction in emissions is projected, to about 49 000 tonnes CO₂-eq.

About 80 % of rail transport in Norway (measured in train-kilometres) is electrified. Otherwise diesel is used as the energy carrier. In the National Transport Plan for 2018–2029, the Government has given priority to electrification of Trønderbanen and Meråkerbanen in Trøndelag, the stretch Kongsvinger-Elverum-Hamar in Hedmark, and Hønefoss-Follum in Buskerud, which is used for timber transport. Electrification eliminates the direct greenhouse gas emissions from rail transport and can also reduce emissions of particulate matter and NO_x, but the investment costs are relatively high. The Norwegian Environment Agency has estimated that the economic cost of electrifying the remaining stretches of rail will be between NOK 500 and 1 500 per tonne CO₂-eq. The cost estimates are uncertain.

According to the National Transport Plan for 2018–2029, using hydrogen, battery power or bio-fuel/biogas are alternative ways of further reducing greenhouse gas emissions from the remaining non-electrified stretches of railway. The Government also established in the National Transport Plan that zero-emission solutions are to be required in all future public procurement of railway equipment and infrastructure. When new rolling stock is purchased, zero-emission solutions are to be required whenever technology develop-

Table 5.4 Greenhouse gas emissions from the railways in 2015 and projections for 2030 and the period 2021–2030. Million tonnes CO₂-eq.

	Emissions 2015	Projected emissions 2030	Projected emissions 2021–2030 (for the whole period)
Total emissions	0.05	0.05	0.5

Source: Statistics Norway, Ministry of Finance and Norwegian Environment Agency.

ment is sufficiently advanced to permit this. A separate strategy will be drawn up for Nordlandsbanen (from Trondheim to Bodø).

The effect on greenhouse gas emissions of electrifying the remaining stretches of railway where diesel locomotives are used will be related as much to the improved potential for shifting freight from road to rail as to direct cuts in greenhouse gas emissions from railway operations. In the National Transport Plan for 2018–2029, the Government has proposed an allocation of NOK 18 billion for infrastructure measures on the railways during this period. These measures are intended to improve the competitive position of freight transport by rail. The transport authorities estimate that they will reduce greenhouse gas emissions by 123 000 tonnes CO₂-eq per year once all the measures have been completed (after 2029). The net economic benefit of these measures is estimated at zero. The Norwegian Environment Agency estimates that transferring 5 % of all freight (measured in tonne-kilometres) from road to rail and sea will have an economic cost of NOK 500–1 500 per tonne CO₂-eq.

5.3.7 Non-road mobile machinery

Greenhouse gas emissions from non-road mobile machinery (including tractors, construction machinery including excavators and wheel loaders, and other diesel-powered machinery and equipment) have doubled since 1990, and totalled 1.9 million tonnes CO₂-eq in 2015. According to the projections, these emissions are expected to remain stable up to 2030.

Electric versions of smaller machinery, including wheel loaders, mini excavators and small site dumpers, are already commercially available. When it comes to larger machinery, the choice is generally limited to diesel-powered machines, but several suppliers are starting to market other options. Some municipalities are leading the way. The City of Oslo has received a grant of NOK 3 million through the Government's 'Klimasats' scheme to make sure that the construction sites for three construction projects are climate

friendly. Priority is being given to developing and testing electric machinery and to providing mains electricity for machinery at an early stage of the construction work. One of Enova's grant programmes provides support for energy and climate measures for land transport, and it is possible to apply for grants towards purchases of commercially available construction machinery and other non-road mobile machinery from this programme. Innovative, non-commercial solutions are eligible for support through the programme for full-scale innovative energy and climate technology. The Norwegian Environment Agency has estimated that the economic cost of phasing in electric/hydrogen non-road mobile machinery so that these types account for 15 % of all such machinery in 2030, and increasing the proportion of hybrid machinery (plug-in and conventional) would be less than NOK 500 per tonne CO₂-eq.

The Storting has asked the Government to prepare an action plan for fossil-free construction sites in the transport sector. The National Transport Plan 2018–2029 announced that the Ministry of Transport and Communications will prepare an action plan together with subordinate agencies. The Government will report back to the Storting in an appropriate manner, using experience from pilot projects that are under way as a basis. The authorities are cooperating with the business sector to identify possible measures and suitable goals for making construction sites in the transport sector fossil-free. This work will be coordinated with efforts to reduce emissions from the use of fossil fuels to heat and dry buildings during construction, which are further discussed in Chapter 5.8.

Overall diesel consumption in the agricultural sector, including diesel used by tractors and other agricultural machinery, has dropped by 16 % since 1990.¹⁶ Reducing emissions from tractors will involve other difficulties than reducing emissions from other non-road mobile machinery. Tractors have a long lifetime, and their operating hours and

¹⁶ From figures for the agricultural sector as a whole compiled by the governmental budget committee for agriculture.

Table 5.5 Greenhouse gas emissions from non-road mobile machinery in 2015 and projections for 2030 and the period 2021–2030. Million tonnes CO₂-eq.

	Emissions 2015	Projected emissions 2030	Projected emissions 2021–2030 (for the whole period)
Total emissions	1.9	1.9	19

Source: Statistics Norway, Ministry of Finance and Norwegian Environment Agency.

workload vary widely. At times, a large proportion of the tractors used on farms will be operating for many hours a day more or less at full engine capacity while being used for activities such as ploughing and harrowing. There are few zero-emission solutions for tractors at present, and in the short term biogas, biofuels and hybrid solutions seem to be most realistic. In the longer term, zero-emission solutions will probably become more feasible. The economic costs of phasing in zero-emission technology for tractors are very uncertain, and have not been estimated.

Diesel for tractors is subject to the carbon tax. Since tractors are not used much on roads, road use duty is not levied on tractor diesel, but it is subject to the basic tax on mineral oil. There is no registration tax on tractors, and they are exempt from the weight-based annual motor vehicle tax. A lower rate of the ordinary annual motor vehicle tax is payable for tractors with a permitted total weight of less than 7 500 kg. These taxes will have a bearing on incentives for the deployment of zero- and low-emission technologies. Through the programme for full-scale innovative energy and climate technology, Enova can provide support for the development of zero-emission technologies in various transport segments where such technologies are not yet commercially available. Innovative zero-emission tractors could be supported through this programme, while the programme for energy and climate measures for land transport provides support for commercially available solutions.

5.3.8 Domestic shipping and fishing vessels

Emissions from domestic shipping and fishing vessels peaked in 1999 at almost 4.2 million CO₂-eq. The sector still accounts for a substantial proportion of Norwegian greenhouse gas emissions, 2.8 million tonnes CO₂-eq in 2015. However, activity data show that the volume of traffic has increased without this necessarily being reflected in the emission statistics. One reason for this may be that many ships refuel in other countries. At

the same time, it must be assumed that vessel efficiency has been improved. Nevertheless, there is some uncertainty about the real trend in these emissions. According to the projections, emissions from domestic shipping and fishing vessels recorded in Norway's greenhouse gas inventory will be reduced by about 6 % to 2.6 million tonnes CO₂-eq.

The climate and environmental requirements that must be met by Norwegian vessels and vessels operating in Norwegian waters are primarily governed by Chapter 5 of the Ship Safety and Security Act, which is the responsibility of the Ministry of Climate and Environment. The same legislation provides the main legal basis for Norwegian implementation of international environmental requirements for ships established by the International Maritime Organization (IMO). The extensive environmental legislation for ships includes requirements relating to air pollution, greenhouse gas emissions, oil, chemicals, waste, waste water, ballast water, fuel and hazardous substances in anti-fouling systems.

There are four main segments in this sector: passenger ships (ferries, high-speed vessels, cruise ships), fishing vessels (including service vessels for the aquaculture industry), offshore vessels and cargo ships. Ships in the different segments have quite different characteristics and operating patterns, and the solutions for reducing emissions therefore also vary. Statistics Norway does not split the official emission figures by ship segment, but only provides aggregated figures for each of the two sectors shipping and fisheries.¹⁷

The Ministry of Climate and Environment commissioned an analysis of the emission reduction potential for Norwegian domestic shipping up to 2040.¹⁸ DNV GL found that by pursuing an active emission reduction policy, it would be possi-

¹⁷ DNV GL has figures for the different ship segments based on activity data from the Norwegian Coastal Administration. The figures are uncertain, especially for nearshore areas, but give an indication of the split of emissions.

Table 5.6 Greenhouse gas emissions from domestic shipping and fishing vessels in 2015 and projections for 2030 and the period 2021–2030. Million tonnes CO₂-eq

	Emissions 2015	Projected emissions 2030	Projected emissions 2021–2030 (for the whole period)
Total emissions	2.8	2.6	27

Source: Statistics Norway, Ministry of Finance and Norwegian Environment Agency.

Box 5.15 The Norwegian Government's initiatives for green shipping

In the white paper New emission commitment for Norway for 2030 – towards joint fulfilment with the EU (Meld. St. 13 (2014–2015)), environmentally sound shipping was identified as one of the priority areas of the Government's climate policy. The Government has therefore already taken several initiatives to further reduce emissions from international shipping and has introduced a number of policy instruments to reduce emissions from domestic shipping.

Emissions from domestic shipping are included in Norway's commitments under the Paris Agreement. This is why the Government is providing incentives for shipping to use emission-free energy. From 1 January 2017, the electricity tax for commercial shipping was reduced to NOK 0.0048 per kWh (the standard rate is NOK 0.1632 per kWh). The lower tax rate encourages a switch from mineral oil to electricity for ships at berth (shoreside electrical power) and to battery propulsion. The Government has also reduced the costs associated with maritime transport by cutting pilotage readiness fees from about NOK 300 million to about NOK 215 million in 2016. In addition, the reduction in fees included an environmental element, since vessels that have a high score on the Environmental Ship Index (ESI) are exempted from paying a pilotage readiness fee.

In 2016, the Government introduced a grant scheme for counties and municipalities to assist them to carry out procurement processes with a climate and environmental profile.

The Government has introduced grants for scrapping vessels and innovation loans, which are intended to promote green renewal of the short sea shipping fleet. However, the schemes have not worked as intended, and no grants were awarded in 2016. The Ministry of Trade, Industry and Fisheries is reviewing the criteria for the schemes to target them more clearly.

The Government has also established a grant scheme for transferring freight transport from road to sea, and in the National Transport Plan for 2018–2029 proposed to expand and extend the scheme. The National Transport Plan also contained a proposal for the establish-

ment of a grant scheme for environmentally friendly, effective ports.

The Ministry of Climate and Environment has signed a new environmental agreement with 15 business organisations on reduction of nitrogen oxide (NO_x) emissions. The new agreement lasts for eight years from 2018, and is the third in a series of agreements where businesses have undertaken to reduce their NO_x emissions. The steps that have been taken to reduce NO_x emissions under the agreement have also resulted in substantial climate benefits. According to the 2016 annual report on the NO_x Fund DNV GL estimates that in the previous period (2008–2017), the annual emission reduction potential was 670 000 tonnes CO₂-eq (excluding the petroleum sector) at the end of the agreement period, provided that the actual emission reductions achieved by projects that were awarded grants were the same as the amounts quoted in the grant decision documents. Many of the NO_x Fund projects have been in the domestic shipping sector.

Through the expansion of Enova's terms of reference to include the transport sector, the Government has opened the way for more large allocations to the maritime sector. Enova has for example granted funding for 35 projects for shoreside electrical power and more than NOK 480 million for charging facilities, which will make it possible to organise ambitious county procurement processes for ferry services.

The MAROFF programme and the SkatteFUNN tax incentive scheme are playing a part in the Government's initiative to promote value creation in the maritime industry within a sustainable framework. Environmental issues are being given high priority in the MAROFF programme. In 2015, a total of NOK 83.7 million was allocated to environmental projects through these two schemes.

The first call for proposals under the PILOT-E scheme focused on climate-friendly maritime transport. Under this scheme, the Research Council of Norway, Innovation Norway and Enova cooperate on joint calls for proposals to speed up the process from concept to market.

Box 5.16 Low-emission ferries

Climate-related requirements are now being included in procurement processes for ferry services that are part of the national road system. For example, from 1 January 2018, two new battery-powered ferries and one plug-in hybrid ferry will be introduced on the route Anda-Lote in Sogn og Fjordane. This is the result of the first ordinary commercial procurement process that included a requirement to use zero-emission technology. The Norwegian Public Roads Administration has published a call for tenders for two ferry services in Møre og Romsdal (E 39 Festøya-Solvågen and Volda-Folkestad), requiring three zero-emission ferries and one low- or zero-emission ferry. In future procurement processes for ferry services that are part of the national road system, requirements to use zero- and low-emission solutions will be included if this is technologically possible.

More than 85 % of all Norwegian ferry services are run by the county authorities, which are also responsible for high-speed vessels. County ferry services are funded by a combination of ticket sales and non-earmarked allocations to the counties (block grants and tax reve-

nues). One of the main principles of the county revenue system is that the non-earmarked allocations that make up the bulk of their revenues should not give incentives or guidelines for county priorities. Other instruments such as legislation or earmarked allocations must be used to provide incentives or give guidelines. If the statutory requirements the counties must meet are changed, the block grants are increased or reduced by an amount equivalent to the estimated extra expenditure or savings.

Several county authorities have received support from Enova in connection with procurement processes for ferry services. This has made it possible for them to include stricter criteria for energy use and greenhouse gas emissions in their tender documents. Enova has granted a total of more than NOK 480 million for this purpose since 2015. Grants have been used to build charging infrastructure so that more battery electric and plug-in hybrid ferries can be purchased, which will result in emission reductions. Support from Enova may also result in innovation and valuable experience that can be used in future procurement processes.

ble to cut emissions from Norwegian domestic shipping by 40 % in 2040 relative to the 2015 level.

Small modifications to the existing domestic shipping and fishing fleets can result in substantial reductions in emissions. This is in contrast to road vehicles, which already have efficient combustion engines. This is both because ships have a long lifetime (up to 40 years), and because there are several factors, including sailing patterns and weather and wind, that influence fuel consumption. A number of fossil-fuel ferries have already been retrofitted with batteries to transform them into hybrid ferries.

Some experience of the costs of emission reduction measures has been gained in the ferry segment, and the extra costs of low- and zero-emission technology for ferries that are part of the national road system are estimated at 15–20 % in

the period covered by the first round of tenders, including infrastructure. No further additional costs are expected in later periods, since investments in infrastructure will already have been made, and battery costs will be lower.

Reports from DNV GL show that there are a good many measures that would be commercially profitable for shipping companies and reduce greenhouse gas emissions, but that have not been implemented. More knowledge is needed about the barriers to the implementation of commercially profitable measures, and what the Government might be able to do to promote their implementation.

On the basis of data from DNV GL, the Norwegian Environment Agency has estimated that measures to reduce greenhouse gas emissions from domestic shipping and fishing vessels by about 3.9 million tonnes CO₂-eq over the period 2021–2030 would have an economic cost of less than NOK 500 per tonne CO₂. The measure estimated to have the greatest effect on emissions is the electrification of ferries and passenger ships, so

¹⁸ Reduksjon av klimagassutslipp fra norsk innenriks skipsfart [Reduction of greenhouse gas emissions from domestic shipping in Norway]. Report No.: 2016-0150 DNV GL.

that 51 % of the fleet is all-electric in 2030. At the same time, more knowledge is needed about emission reductions, new measures and technology costs. The Environment Agency will therefore commission an updated mitigation analysis for the shipping sector in 2017.

Although there is a potential for emission reductions through efficiency measures, further large-scale emission reductions will require extensive changes in the fleet and in fuel infrastructure. The average age of Norwegian vessels is about 30 years, so that many of them are likely to be replaced in the near future. The Government will in the years ahead support the further development and commercialisation of solutions for more climate-friendly vessels, and will design policy instruments with this in mind.

International shipping is regulated by IMO, which has established mandatory global energy efficiency measures that entered into force in 2013. As part of IMO's work on further emission reductions, international shipping will from 2018 be required to report on fuel consumption and other data that can be used as a basis for deciding on future climate-related requirements. In 2018, IMO is to adopt a new climate change strategy setting out steps towards the next generation of climate-related rules. Norway is seeking an approach to the negotiations that will give the best possible result in the form of rapid emission cuts.

Pricing of emissions is the most important instrument for achieving the 2030 climate targets for non-ETS emissions. There is a reduced carbon tax rate for mineral oil used in fisheries less than 250 nautical miles from the coast, while natural gas and LPG used for domestic maritime transport (goods and passengers) is exempt from the carbon tax. There is also a reduced mineral oil tax rate for fisheries less than 250 nautical miles from the coast. The Storting has adopted a decision requesting the Government to introduce a standard carbon tax rate for non-ETS sectors in 2018, for the time being with the exception of the agricultural and fisheries sectors. For the fisheries sector, industry representatives will be invited to take part in a committee appointed to consider the possibility of introducing a carbon tax at a gradually increasing rate and to propose other climate-related measures. The 2018 budget will include a status report on this work. The carbon tax is further discussed in Chapter 5.2.2. The Government will regularly assess tax rates for non-ETS emissions with a view to achieving the 2030 target cost-effectively.

The issue of carbon leakage¹⁹ may be relevant when evaluating the carbon tax in the shipping sector. Vessels engaged in international trade and fuel sold in international waters are globally exempt from carbon taxes. The risk of carbon leakage applies to several shipping segments including tankers and bulk carriers and fishing vessels. This issue is less relevant to certain other segments such as scheduled passenger ferries and service vessels for the aquaculture industry. Carbon leakage is a problem that often needs to be considered in connection with climate policy. Wide policy variations between countries may result in inappropriate use of resources and distortion of competition.

The development of infrastructure for alternative transport fuels for shipping is essential for large-scale deployment of zero- and low-emission solutions. The Government is supporting the development of shoreside electric power through Enova. Enova's first two calls for proposals for shoreside electric power resulted in the award of grants totalling NOK 222 million to 35 projects. A third call for proposals was published in 2017. Because infrastructure for zero- and low-emission solutions in the shipping sector is so important, the Government will develop a national plan for infrastructure for alternative transport fuels, including climate-friendly fuels for domestic shipping. The intention is for the development of infrastructure for zero-emission fuels to become market-driven and independent of public support as quickly as possible. Public agencies in the research and innovation system, including Enova, will support market developments at an early stage.

Norway has a great deal of expertise in all parts of the maritime sector, including shipbuilding and shipping. Enova can therefore contribute to market development all along the value chain. This is an international industry, and solutions that are tested in Norway may be deployed elsewhere and play a part in reducing greenhouse gas emissions globally as well. Enova has for example granted NOK 45.1 million to the Hurtigruten shipping company for two exploration ships using hybrid technology, which will be able to sail for half an hour at a time on battery power alone. This is the first time such large ships have been built

¹⁹ Carbon leakage occurs if one country, or a group of countries, pursues a climate policy that reduces emissions, and this results in a rise in emissions in countries that do not have a similar climate policy. The degree of carbon leakage will depend among other things on how many countries follow the same strict climate policy.

with the option of battery-powered propulsion. In addition to the batteries, Enova is providing support for the ships' highly effective propulsion systems, including energy-efficient motors and propellers. Together, these measures mean that diesel consumption will be 15 % lower than on similar conventional vessels. Enova has also granted NOK 7.4 million to Eidesvik Offshore for the conversion of a supply vessel to battery hybrid operation. This has made it possible to reduce annual CO₂ emissions from the Viking Energy by 1 000 tonnes.

To improve the regulatory framework for short sea shipping, fees payable to the Norwegian Coastal Administration were reduced in the 2016 budget. Vessels of up to 8 000 gross tonnage were exempted from the pilotage readiness fee, as were vessels that have a high score on the Environmental Ship Index (ESI). In all, the fees were reduced by about NOK 90 million.

In 2017, the Government introduced a three-year pilot scheme of grants to encourage a modal shift of freight from road to sea. The scheme was designed in accordance with the guidelines on state aid to maritime transport under the EEA Agreement, and has been approved by the EFTA Surveillance Authority. The scheme is designed to ensure that there is a real modal shift from road to sea and that the positive effects of the aid are greater than the negative effects on competition. To receive support, projects must meet all the compatibility requirements, including that the service involved must be commercially viable after the period in which it is eligible for public funding. The Norwegian National Transport Plan for 2018–2029 proposes that the scheme should be continued with an annual average budget framework of NOK 100 million for the first six years of the planning period and a total framework of NOK 1.7 billion for the whole planning period.

Another important measure in the National Transport Plan for 2018–2029 is a grant scheme for investments in ports to promote the development of environmentally friendly, effective ports. This is part of an integrated approach to logistic nodes, in which investments in fairways, ports, and road and railway systems are considered together. This may help to reduce transport costs for the business sector, make better use of the advantages of maritime transport and encourage a shift of freight transport from road to sea. In addition, the grant scheme may result in a general reduction in the environmental impact of freight transport.

The public sector as a customer can support the adoption and development of new environmentally friendly technologies and solutions in maritime transport as in other sectors. Developments in the ferry sector in recent years show that this approach can have a substantial effect.

In 2016, the Government offered grants to build up local government expertise and make it possible for municipalities and counties to include ambitious climate-related requirements in procurement processes. The projects that received support will give the municipalities and counties involved a good basis for including requirements for the use of zero- and low-emission solutions in calls for tenders for ferry services in the years ahead.

It can be difficult for local authorities to specify climate-related requirements that are adapted to individual ferry services, since this requires feasibility studies. Counties and municipalities that only need to organise procurement processes occasionally may find it difficult to maintain adequate environmental expertise for such complex purchases. This is particularly true if several procurement processes are needed over a relatively short period of time. The Government will evaluate the 2016 grant scheme and will continue and if appropriate expand the scheme if the results are considered to be satisfactory.

The Government will in the years ahead support the further development and commercialisation of solutions for more climate-friendly vessels.

5.3.9 Domestic aviation

In 2015, emissions from domestic aviation in Norway totalled almost 1.4 million tonnes CO₂-eq. This is a rise of more than 43 % compared with 1990. In addition, there are emissions from international aviation (i.e. flights from Norwegian airports to the first destination abroad), which in 2014 totalled 1.56 million tonnes CO₂-eq. The EU Emissions Trading System (EU ETS) covers 80 % of emissions from domestic aviation. The rise in the volume of air traffic is expected to continue in the years ahead. Growth is expected to be stronger for international flights than for domestic flights, and intercontinental traffic is expected to rise particularly sharply. Avinor expects that by 2040, as many passengers will be carried on international flights as on domestic flights.²⁰ From

²⁰ Avinor, 2015. Nasjonal transportplan 2018-2027. Perspektiv-analyse mot 2050 [National Transport Plan 2018–2029. Analysis of trends up to 2050].

Box 5.17 The true impact of aviation on the climate

Emissions from aviation include the greenhouse gases CO₂ and water vapour. The latter is important in the formation of vapour trails and contrail cirrus clouds. Moreover, NO_x emissions from this sector result in the formation of ozone in the troposphere and lower stratosphere. Ozone is a significant greenhouse gas. Aircraft also emit a number of other substances – sulphur oxides, carbon monoxide, hydrocarbons, particulate matter such as organic carbon and soot – that have minor, variable impacts on

the climate. Several research groups have therefore proposed that an emission weighting factor of 1.2–2.0 should be used for emissions from aviation, to reflect their true impact on the climate. This means that one tonne of emissions would be multiplied by a factor of between 1.2 and 2. However, this proposal has not been included in the guidelines for emission inventories and is therefore not used when countries report on their emissions.

2010 to 2035, fuel efficiency is expected to improve by 1.04 % per year.²¹ Nevertheless, projections indicate that greenhouse gas emissions from domestic aviation will rise by more than 10 % by 2030.

Policy instruments to reduce emissions from aviation

Greenhouse gas emissions from flights within the European Economic Area (EEA), including domestic flights in Norway, are largely covered by the EU ETS. Mineral oil used in domestic aviation is also subject to the carbon tax. These are the two key instruments for reducing greenhouse gas emissions in the aviation sector. Neither the carbon tax nor the EU ETS applies to flights from Norway to countries outside the EEA. There is also an air passenger tax for each passenger flying from a Norwegian airport. This is a fiscal tax, but may also influence the volume of air transport.

²¹ Ministry of Transport and Communications (2016). ICAO State Action Plan on CO₂ emissions reduction activities – Norway.

There are currently few policy instruments for reducing greenhouse gas emissions from international aviation, outside Europe. It is important to have a high level of ambition for regulation of international aviation. The International Civil Aviation Organization (ICAO) has adopted the target of achieving carbon-neutral growth from 2020 for the international aviation sector.

At its Assembly in October 2016, ICAO adopted a resolution to introduce a global market-based measure involving purchases of emission allowances from other sectors (carbon offsetting). Together with other measures such as phasing in low-emission technology and pricing to the extent possible, this is intended to ensure progress towards the carbon neutrality target. The first phase of the measure, which will last six years from 2021, is voluntary for member states. Norway has announced that it will participate on a voluntary basis during this phase.

Airlines should use the most modern aircraft engine technology possible for their fleets, to give low emissions. Norway will continue to work internationally for the reduction of emissions from aviation.

Table 5.7 Greenhouse gas emissions from domestic aviation in 2015 and projections for 2030 and the period 2021–2030. Million tonnes CO₂-eq

	Emissions 2015	Projected emissions 2030	Projected emissions 2021–2030 (for the whole period)
Total emissions	1.4	1.5	15
ETS emissions	1.1	1.2	12
Non-ETS emissions	0.3	0.3	3

Source: Statistics Norway, Ministry of Finance and Norwegian Environment Agency.

Table 5.8 Public transport mode share for Norway's four largest airports

Airport	Public transport mode share 2009	Public transport mode share 2014	Public transport target for 2020
Oslo	64 %	66 %	70 %
Stavanger	14 %	17 %	30 %
Bergen	27 %	34 %	40 %
Trondheim	42 %	45 %	50 %

Source: Meld. St. 30 (2016–2017), white paper on Avinor's activities

In the National Transport Plan for 2018–2029, the Government announced its intention of introducing a biofuel quota obligation of 1 % sustainable biofuels for aviation from 2019, with the aim of reaching 30 % by 2030, in line with the availability of certified biojet fuel and given the technical options available. The Government's initiative relies on the availability of sustainable biofuels with reliable global climate benefits. Introducing a biofuel quota obligation for aviation will also reduce non-ETS emissions from aviation in the Norwegian emission inventory.

Avinor is of the opinion that there is the potential for a larger-scale project to assess the possibility of using all-electric or hybrid planes in commercial aviation. Avinor and other stakeholders are to assess the situation with the aim of introducing planes of these types for use on domestic routes in Norway over a period of 10–15 years. Together with Norges Luftsportforbund (Norway's federation for air sports), Avinor will invite airlines and industrial companies to take part in the project. The Government is supporting Avinor's work in this field.

To improve services for passengers, reduce greenhouse gas emissions and improve local air quality, Avinor will take steps to maximise the public transport mode share for travel to and from Norway's airports. The Ministry of Transport and Communications expects Avinor to set new and more ambitious targets for the public transport mode share for 2030, as set out in a recent white paper on Avinor's activities.

According to Avinor and the transport authorities, a third runway may be needed at Oslo Airport (OSL) in 2030. If it is decided to build a third runway, it will be necessary to take into account the growth in air traffic and emissions that will result from increasing the airport's capacity. Avinor and the transport authorities expect greenhouse gas emissions associated with Oslo Airport

to rise by 28 % from the current level by 2030. If a third runway is built in 2030, it is estimated that emissions will rise by a further 6 % by 2050, whereas in a scenario without a third runway, emissions will decline by 2 % in the same period. These estimates are based on the assumption that energy efficiency will increase by 1.5 % per year.²² However, it is uncertain when and whether the need for a third runway will arise, and the Government has not yet taken a decision on this matter.

5.3.10 Use of biofuels

5.3.10.1 Current policy and policy instruments relating to biofuels

Biofuel use can play a part in reducing greenhouse gas emissions from the transport sector. However, it is important to use sustainably produced biofuels. Biofuels are fuels manufactured from biological material. Oil crops such as rapeseed and soybean can be used to produce biodiesel, while sugar and starch crops such as sugar beet and maize can be converted to ethanol. Biofuels that are produced from food crops are known generically as conventional biofuels. Biofuels can also be produced from waste, various residues, and forest biomass. Such biofuels are often called advanced biofuels, and they generally have a more reliable climate change mitigation effect than conventional biofuels.

The Government is encouraging biofuel use through the biofuel quota obligation for road traffic. All fuel suppliers are required to ensure that biofuels make up at least 7.0 % by volume of the total annual volume of fuel sold for road traffic. The biofuel quota obligation was increased from

²² Avinor and the transport authorities (2016). Fremtidig kapasitet på Oslo lufthavn [Future capacity at Oslo Airport].

5.5 to 7 % from 1 January 2017. The increase of 1.5 percentage points is to be met using advanced biofuels. Advanced biofuels count double under the Renewable Energy Directive and for compliance with the biofuel quota obligation. This means that the actual increase in volume required is 0.75 %.

In the 2017 budget, the Government proposed a plan for further stepwise increases in the biofuel quota obligation up to 2020. When the Storting considered the budget, it requested the Government to step up the increases in the biofuel quota obligation and the obligation to use advanced biofuels for 207–2020. The Storting asked for the obligation to use advanced biofuels to be set at 2.5 % from 1 October 2017, rising to 3.5 % in 2018, 4.5 % in 2019 and 8 % in 2020, and for stepwise increases in the general biofuel quota obligation in line with this, to 20 %. The Storting also asked for regulations to be adopted to make these obligations statutory. The Ministry of Climate and Environment intends to hold a public consultation on the amendments shortly.

Biofuels are exempt from the carbon tax, and any biofuel sold in excess of the biofuel quota obligation is also exempt from road use duty. This means that taxes on biodiesel sold in excess of the biofuel quota obligation are NOK 5.00 per litre lower than for ordinary diesel (road use duty and carbon tax). The corresponding difference for bioethanol is NOK 6.23 per litre. These figures are not adjusted to reflect energy content.

There are also support schemes for the production of liquid biofuels and biogas.

5.3.10.2 *Biofuels and their effect on emissions*

Emissions of CO₂ from combustion of biofuels form part of the natural carbon cycle. Provided that land is managed sustainably, CO₂ released through harvesting and combustion will be reabsorbed in new trees and other plants through photosynthesis. On the other hand, emissions from fossil fuels such as petrol and diesel are not part of the natural carbon cycle, and add new carbon to the atmosphere. Fossil emissions increase the CO₂ content of the atmosphere, resulting in global warming. The overall climate-related impacts of biofuels differ from one type to another, and the Government's goal is to ensure steady improvement of their performance.

Emissions from harvesting of biomass are included in the land-use, land-use change and forestry sector (LULUCF) according to the reporting and accounting rules for the UN Framework Convention on Climate Change (UNFCCC). Emis-

sions from biomass harvested for use as wood or biofuel are recorded in the LULUCF sector in the year when harvesting takes place, but zero emissions are recorded in the energy or transport sector when the biomass product (for example wood or biofuel) is used. This is to avoid double counting. The use of imported wood or biofuel also gives zero CO₂ emissions in the Norwegian emission inventory. The way in which production of biofuel from Norwegian forest biomass affects Norway's emission reduction commitments for 2030 will depend on the accounting rules for emissions and removals by forest (see the account of the EU Commission's proposed regulation in Chapter 4.4). Emissions from production and processing may count as emissions from Norwegian companies if the biofuel is produced in Norway. If biofuels are imported, zero emissions will be recorded in the transport sector, and emissions from cultivation/harvesting of raw materials, production and processing will not be included in the Norwegian emission inventory.

The EU's sustainability criteria for biofuels set requirements for direct greenhouse gas savings in comparison to fossil fuels and state that biofuel must not be grown in areas of high biodiversity value or with a high carbon stock. This means for example that raw materials must not be obtained from agricultural areas recently established by clearing rainforest. Biofuels that meet the EU's sustainability criteria thus result in lower direct greenhouse gas emissions globally than fossil fuels.

However, the possibility of indirect land-use change (ILUC) means that it is uncertain exactly how the use of certain types of liquid biofuels will affect emissions globally. The sustainability criteria do not include emissions associated with ILUC. ILUC describes the process that may occur if food and fodder crops are used to produce biofuels, thus displacing food and fodder production to new areas, and in turn putting greater pressure on undisturbed areas of natural habitat and causing deforestation, resulting in higher CO₂ emissions. These changes may also cause irreversible losses of biodiversity. ILUC emissions associated with biofuel types may negate part or all of the reduction in greenhouse gas emissions achieved by replacing fossil fuels with biofuels, or even result in an overall rise in emissions.

The extent to which different types of biofuels cause indirect land-use change varies widely. ILUC emissions have to be modelled, and estimates of the impact of different biofuels vary. According to estimates in the ILUC Directive, production of bioethanol from cereals and other

starch-rich crops and from sugars is expected to result in relatively low ILUC emissions, while emissions from production of biodiesel from oil crops are expected to be substantially higher. Advanced biofuels are considered not to cause significant ILUC emissions. The EU is seeking to mitigate ILUC impacts by setting a ceiling for the share of conventional biofuels that can be used to meet the target of the Renewable Energy Directive and at the same time promoting the use of advanced biofuels.

5.3.10.3 Use of biofuels in Norway today

Biofuels can be used in all parts of the transport sector. So far, they have mainly been taken into use in the road traffic sector, but there are also examples of the use of biofuels as substitutes for fossil fuels in both shipping and aviation.

Preliminary figures from the Norwegian Environment Agency show that sales of biofuels rose from 188 million litres in 2015 to 450 million litres in 2016. Biofuels made up 11 % of total fuel sales in 2016 (14.5 % when advanced biofuels are counted double). In 2016 the average blend ratio for biodiesel/(hydrogenated vegetable oil (HVO) in autodiesel was 14 % (20 % using double counting), while the blend ratio for bioethanol/other biocomponents in petrol was 6 % (6.4 % using double counting). About 85 % of the biofuel sold was biodiesel/HVO and about 15 % was bioethanol/other biocomponents. The Environment Agency estimates that the rise in biofuel consumption from 2015 to 2016 corresponds to a reduction of about 600 000 tonnes in Norwegian greenhouse gas emissions. Most of the biofuel sold was conventional biofuels produced from food crops. The largest proportion was biofuel produced from rapeseed. The proportion produced from palm oil and palm fatty acid distillate (PFAD) rose from 1 to 39 % from 2015 to 2016. In 2016, PFAD was classified as a residue of palm oil production, but after a new evaluation it was reclassified as a byproduct in 2017. Biofuel produced from tall oil (a residual product of the pulp and paper industry) made up 5 % of sales of biofuel, and forest waste made up 1 % of the total. Almost all the biofuel sold in Norway in 2016 (99 %) was imported. The figures for 2016 are being revised.

Biogas is produced largely from sewage sludge, food waste and manure. Biogas may not be used to meet the biofuel quota obligation for road traffic fuels. A comprehensive investigation of biogas use in Norway was carried out for 2015. It was found that total biogas consumption in Nor-

way was 308 GWh, of which about 105 GWh was used for transport. Biogas is mainly used to run buses and other fleet vehicles that operate near biogas production plants. Biogas production and consumption in Norway is rising.

5.3.10.4 Use of biofuels up to 2030

EEA legislation including the Renewable Energy Directive and the Fuel Quality Directive forms an important basis for the Norwegian legislation. In July 2016, the EU Commission presented a strategy for low-emission mobility giving signals about renewable energy that were incorporated into the proposal for a revised Renewable Energy Directive in November 2016. The strategy indicated that food-based biofuels will only have a limited role, and that they should not receive public support after 2020. The EU is considering the proposed revision of the directive, but is likely to give priority to advanced biofuels in the future.

To ensure global climate benefits, the Norwegian Government will also give priority to the use of advanced biofuels. The effect of using forest biomass as a substitute for fossil products such as petrol and diesel is optimised if the biomass is used for materials with a long lifetime while residual material and forest waste is used to produce bioenergy or biofuels. It is essential to obtain forest biomass from sustainably managed forest. Norway has considerable potential for production of advanced biofuels from forest biomass. Several companies have already presented plans for establishing biofuel production in Norway.

The economic costs of using biofuels are high compared with those of other mitigation measures. For road traffic, the Norwegian Environment Agency has estimated that the costs are of the order of NOK 1500 per tonne CO₂-eq. The cost estimate is uncertain. It is also uncertain how the costs will develop in future. This will depend partly on price developments for fossil fuels and the development of biofuel production technology. The Government does not intend to propose any further increase in the biofuel quota obligation for road traffic fuels after 2020. The use of biofuels after 2020 must be considered in conjunction with alternative ways of reducing non-ETS emissions.

In the Norwegian National Transport Plan for 2018–2029, the Government announced its intention of introducing a biofuel quota obligation of 1 % sustainable biofuels for aviation from 2019, with the aim of reaching 30 % by 2030, in line with the availability of certified biojet fuel and given the

technical options available. A biofuel quota obligation of 1 % will create a demand for about 1 million litres per year, assuming that sales of aviation fuel remain stable at the current level.

In 2016, the Storting asked the Government to propose a biofuel quota obligation for shipping. The Government will follow up the Storting's request in an appropriate way.

5.4 Agriculture

5.4.1 Agriculture and climate change

In the white paper on agricultural policy published at the end of 2016 (Meld. St. 11 (2016–2017)), the Government proposed specific measures and instruments for an ambitious climate policy in the agricultural sector. The main points of this are listed in Box 5.20. In addition to following up these points, the Government will appoint a working group to review existing support schemes for climate-related measures at individual farm level before the negotiations on the 2018 Agricultural Agreement, with a view to strengthening and targeting efforts to reduce emissions. The Government will also negotiate with the agricultural sector on a voluntary agreement, including a plan for reducing greenhouse gas emissions, which quantifies the level of ambition for emission reductions in the agricultural sector up to 2030.

Greenhouse gas emissions from agriculture make up about 15 % of Norway's non-ETS emissions. The main sources are livestock husbandry and meat production (methane from ruminants and storage of livestock manure), and nitrous oxide formed from nitrogen in manure and mineral fertiliser. Few agricultural policy instruments are designed primarily to reduce emissions of these greenhouse gases, but over the years, instruments relating to feed development and breeding, or that have other environmental objectives have played a part in reducing emissions. Emissions of methane and nitrous oxide from agriculture are not currently taxed, partly for practical reasons. Much of Norway's farmland is most suitable for grass production. This is an

Box 5.18 Research and innovation to reduce greenhouse gas emissions from the agricultural sector

Under the BIONÆR programme, the Research Council issued a call for proposals in May 2017 for innovation projects to reduce greenhouse gas emissions from the agricultural sector with a ceiling of NOK 45 million. The aim is for business and industry to play a part in developing systems and technologies that can bring about rapid reductions in greenhouse gas emissions from the agricultural sector. The programme has also issued calls for proposals for researcher projects on ways of reducing greenhouse gas emissions from the agricultural sector, with an overall budget framework of up to NOK 60 million.

important reason why the overall design of the agricultural support schemes results in most support being given to the type of production that results in the highest greenhouse gas emissions per unit of production, i.e. the production of red meat (largely cattle and sheep farming). This illustrates the contradictions that can arise between agricultural and climate policy goals.

When it considered the white paper on agricultural policy, the Storting pointed out that the purpose of increasing food production is to make Norway more self-sufficient, improve the level of preparedness and meet demand (in a recommendation from the Standing Committee on Business and Industry). The Committee noted that the white paper lists four overall goals for Norway's agricultural policy:

- safeguarding food security;
- maintaining agricultural production throughout Norway;
- increasing value creation;
- ensuring sustainable agriculture and lower greenhouse gas emissions.

Table 5.9 Greenhouse gas emissions from the agricultural sector in 2015 and projections for 2030 and the period 2021–2030. Million tonnes CO₂-eq.

	Emissions 2015	Projected emissions 2030	Projected emissions 2021–2030 (total for period)
Total emissions	4.5	4.4	44

Source: Statistics Norway, Ministry of Finance and Norwegian Environment Agency.

The Standing Committee agreed that the four overall goals of Norway's agricultural policy should be retained, but pointed out the importance of including a preparedness element in the goal on food security. The Committee also noted that the Government had highlighted the reduction of greenhouse gas emissions in the goal on sustainable agriculture, and endorsed this. The Standing Committee unanimously agreed that priority must be given to reducing greenhouse gas emissions from Norwegian food production, while at the same time following up the goal of increasing food production with a view to making Norway more self-sufficient. In addition, a majority of the Standing Committee made a number of comments on agriculture and climate change. Two important points are that in their view, the most important climate-related task of the agricultural sector is to reduce emissions per unit of production, and that it is not sound environmental policy to introduce measures that will result in carbon leakage, in other words relocation of production to other countries. The Committee also emphasised that measures to reduce agricultural emissions must be knowledge-based and that it must be possible to measure their effects using reasonably reliable methods.

The Fifth Assessment Report from the Intergovernmental Panel on Climate Change (IPCC) shows that there is a considerable global potential for emission reductions in the agricultural sector up to 2050, related to a transition to a less emission-intensive diet. At the same time, the purpose clause of the UN Framework Convention on Climate Change emphasises that greenhouse gas concentrations in the atmosphere are to be stabilised without threatening food production. The IPCC has estimated that climate change may reduce global food production by up to 2 % per decade, while food demand will rise by 14 %. Resources and land must be taken into use and exploited in ways that ensure adequate food production that is adapted to natural conditions.

In future, food production must be much more sustainable and less emission-intensive than is the case today. Greenhouse gas emissions from the production of red meat are five to ten times higher than from other food production. Scenarios presented in the IPCC's Fifth Assessment Report that are in line with the two-degree target show a halving of global methane emissions in 2100 compared with the 2010 level. The design of a policy for increasing food production has important implications for the prospects of achieving the

Box 5.19 Breeding programmes can improve efficiency and reduce greenhouse gas emissions

Breeding programmes have improved efficiency, product quality and sustainability in the Norwegian agricultural sector. New technology has considerably increased the effects of breeding programmes, and Norwegian agriculture is very well placed to make use of these advances. Both in Norway and internationally, cattle production will have to meet requirements relating to:

- a reduced climate footprint, with a special focus on methane emissions (from cattle and other ruminants);
- good animal health and welfare and low antibiotic use;
- effective production through better use of resources (better feed-use efficiency).

Animal health and fertility have a considerable influence on greenhouse gas emissions from cattle production. There are several reasons for this. Continuing to focus closely on health and fertility in breeding programmes will therefore also be an important climate-related measure in Norwegian milk and beef production.

During the negotiations on the 2017 Agricultural Agreement, it was decided to allocate NOK 15.5 million to the Geno group's breeding programme. Targeted breeding programmes can play an important role in the context of climate change through reductions in emissions per unit of production. Using new technology such as large-scale genotyping and collecting new, precise data could potentially double the effect of Geno's breeding programme for Norwegian Red cattle. Further progress in breeding is expected to give positive effects in a number of areas that are important for Norwegian agriculture, including lower methane emissions as a result of improvements in animal health and feed efficiency.

two-degree target. It is vital to produce sufficient quantities of safe food for a growing population, and at the same time produce more of the less emission-intensive food types and less of food types that result in high greenhouse gas emissions.

It is not possible to produce food entirely without greenhouse gas emissions, but emission levels vary from one type of production to another. Norway's agricultural policy has improved the efficiency of milk production, and as a result there are now fewer cattle, and greenhouse gas emissions from the sector were reduced by 5.3 % from 1990 to 2015. Total Norwegian emissions rose in the same period. Important factors behind this have been long-term, systematic breeding programmes, good animal health, feed development and more precisely targeted fertilisation.

The 2016 white paper on agricultural policy announced that given Norway's 2030 commitment, the Government will seek to reduce greenhouse gas emissions from the agricultural sector and gradually shift to a more climate-friendly agricultural policy. Climate change considerations will be given greater weight in the negotiations on the annual Agricultural Agreement.

The white paper also gave an account of the main problems and dilemmas associated with greenhouse gas emissions from the agricultural sector. It is a complex task to find effective ways of reducing these emissions that are not in conflict with agricultural policy objectives.

Agricultural activities also influence the land use, land-use change and forestry (LULUCF) sector, the transport sector and the building sector. The use of mineral products by the agricultural sector, for example for transport and in buildings, is subject to the carbon tax in the same way as their use in other industries, with the exception of natural gas and LPG used in greenhouse nurseries. Possible measures to reduce emissions from non-road mobile machinery are further discussed in Chapter 5.3 on the transport sector.

CO₂ emissions from new cultivation of peatland are not priced. In connection with the 2017 budget, the Storting asked the Government to put forward a proposal to prohibit new cultivation of peatland areas. New cultivation of peatland areas is further discussed in the white paper on agricultural policy. When the Storting considered the white paper, a majority of the Standing Committee on Business and Industry emphasised the need for a thorough review of this issue and for a consultation process to delimit the scope of the proposal. The Ministry of Agriculture and Food will put forward a proposal to prohibit new cultivation of peatland in the course of 2017. The proposal will be drawn up in such a way that it covers both shallow and deep peat deposits.

Beef production in Norway is currently lower than consumption, and imported beef is estimated

to account for 19 % of beef consumption in 2017. If the production support schemes are altered to reduce emissions in Norway, this could result in an increase in beef imports. In this case, Norwegian emission reductions would be partly cancelled out by increased production and higher emissions in other countries. Most imported beef is from Germany, which is bound by EU climate policy and climate targets. Given that the EU countries have undertaken to achieve these targets, there is little risk of carbon leakage within Europe. Nevertheless, there will always be a risk that higher imports from the EU to Norway indirectly result in higher imports to the EU from third countries. If priority is to be given to the risk of carbon leakage and the importance of maximising global effects, beef consumption must be reduced. Reducing beef consumption may in turn result in lower beef production in Norway, thus reducing greenhouse gas emissions. It is therefore important to make use of instruments such as consumer information to encourage a reduction in consumption.

If emissions from agriculture are not reduced by the sector's cost-effective share of Norway's total emission reductions, it will be more difficult to achieve the climate targets. In 2014 and 2015, emissions from agriculture rose for the first time for many years. These emissions rose by 1.0 % from 2014 to 2015, mainly because of an increase in sheep numbers and a rise in mineral fertiliser consumption. Preliminary calculations indicate that emissions continued to rise in 2016.

5.4.2 Measures and instruments to reduce greenhouse gas emissions from agriculture

At the request of the Storting, the Ministry of Agriculture and Food appointed a working group in March 2015 consisting of representatives of the agricultural industry, the public administration and environmental organisations. Its mandate included assessing Norwegian climate policy as it relates to agriculture in the light of new knowledge published in the IPCC's Fifth Assessment Report. The working group submitted its report on agriculture and climate change on 19 February 2016.

The working group concluded that there is a considerable potential for further cuts in emissions from the agricultural sector from 2016 to 2030, perhaps 10–20 % in total, assuming that the current production level is maintained. This would include emissions that are recorded in

Box 5.20 A more climate-friendly agricultural policy

The 2015 white paper on agricultural policy included an account of the challenges posed by climate change. The Government's view was that climate change considerations should be given greater weight when developing agricultural policy, so that the agricultural sector can play a greater part in achieving Norway's climate targets in future. Where changes in production patterns and methods may have an influence on the climate footprint of agriculture, policy instruments under the Agricultural Agreement should be designed with an emphasis on minimising greenhouse gas emissions from Norwegian agriculture, taking into account both agricultural policy goals and climate policy targets.

The white paper announced that the Government will:

- in view of Norway's 2030 emission reduction commitment, seek to reduce greenhouse gas emissions from agriculture and gradually shift to a more climate-friendly agricultural policy;
- give greater weight to climate change considerations in the negotiations on the annual Agricultural Agreement;
- in dialogue with the agricultural sector, develop a plan containing specific measures and policy instruments for reducing greenhouse gas emissions from the sector, which quantifies the level of ambition for emission reductions. The plan must be consistent with Norway's emission reduction commitments;
- during spring 2017, put forward specific measures for reducing greenhouse gas emissions from agriculture and propose measures to compensate for the negative impacts on the sector. This work will be based among other things on the 2016 report on agriculture and climate change and the report of the Green Tax Commission;
- facilitate increased production of biogas based on animal manure and agricultural waste;
- give priority to knowledge building and research on ways of reducing emissions from agriculture, the potential for carbon sequestration in soil, and how the agricultural sector can adapt to a changing climate;
- establish effective advisory services on climate change issues at individual farm level to encourage farmers to make practical use of knowledge about climate measures as quickly as possible;
- incorporate climate measures at individual farm level into the official quality system for Norwegian agriculture;
- when processing applications for investment grants, ensure that the use of energy-efficient, environmentally sound and climate-friendly technology is one of the criteria considered;
- work towards the conclusion of an agreement with the food products industry to reduce food waste;
- ensure that the introduction of climate measures does not result in an increase in subsidies to the agricultural sector.

other sectors in the emission inventory (transport, buildings and LULUCF). The working group identified 15 relevant measures that could be used to reduce emissions and increase removals from the agricultural sector. The 2016 white paper on agricultural policy discusses climate-related measures in the agricultural sector further.

Since the working group's report was published, the Norwegian Environment Agency has commissioned further analyses of the costs and effects of selected climate-related measures, for example from the Norwegian Institute of Bioeconomy Research, which published a report on climate-related measures in the Norwegian agricul-

tural and food sector. The report assessed several measures, including reducing food waste, making more use of animal manure for biogas production and reducing production and consumption of beef. According to the report, emission cuts corresponding to more than 0.5 million tonnes CO₂ a year could be achieved in 2030 at a low social cost. More than half of this potential depends on a combination of dietary changes and changes in food production. No further analysis has been made of how this potential could be realised, but it would probably require stronger incentives, for example through regulation or changes in support schemes. Analyses by the Norwegian Environ-

Box 5.21 Dietary recommendations from the Directorate of Health

1. Enjoy a varied diet with lots of vegetables, fruit and berries, whole-grain foods and fish, and limited amounts of processed meat, red meat, salt and sugar.
2. Maintain a good balance between the amount of energy you obtain through food and drink and the amount of energy you expend through physical activity.
3. Eat at least five portions of vegetables, fruit and berries every day.
4. Eat whole-grain foods every day.
5. Eat fish two to three times a week. You can also use fish as a spread on bread.
6. Choose lean meat and meat products. Limit the amount of processed meat and red meat.
7. Include low-fat dairy products in your daily diet.
8. Choose edible oils, liquid margarine and soft margarine spreads instead of hard margarines and butter.
9. Choose foods that are low in salt and limit the use of salt when preparing food and at the table.
10. Avoid foods and drinks that are high in sugar.
11. Choose water as a thirst-quencher.
12. Be physically active for at least 30 minutes every day.

ment Agency also show that several of the measures in the agricultural sector have near-term climate benefits in addition to their long-term effects (as discussed in the 2015 report Climate mitigation measures up to 2030 – short-term climate effects and health effects), see also Chapter 5.11.

A climate-friendly diet containing less meat and more fish, vegetables, fruit and berries will also have a positive effect on public health. The Government has published the Norwegian National Action Plan for a Healthier Diet for the period 2017–2021, which highlights the links between sustainability and health in food policy. Promoting a healthier, more sustainable diet is important both for public health and in the context of climate change. If people in Norway follow the dietary recommendations of the action plan, it

is estimated that the social benefits could be as much as NOK 154 billion per year. This includes an estimated reduction of NOK 12 billion in the cost of health services.

A project on climate-smart agriculture is being run by the Norwegian Farmers' Union, the Norwegian Agricultural Extension Service, the TINE Group, Nortura and Felleskjøpet Agri (a farmers' cooperative). Its purpose is to reduce the climate footprint of Norwegian agriculture by providing better information and good tools for climate-smart operations on Norwegian farms. The project was allocated NOK 20 million in the 2017 budget. The plan is to start advisory services in selected pilot areas towards the end of 2017, and a nationwide climate advisory service for individual farms in 2018.

Innovation Norway's bioenergy programme for the agricultural sector can provide investment grants for the production of bioenergy and biogas. The programme is primarily industry-oriented, but can be adjusted to contribute more effectively to the reduction of greenhouse gas emissions. From 2017, Innovation Norway has made it possible to apply for investment support for plants that combine heat production from bioenergy with solar electricity production. There is also interest in establishing electricity/heat plants based on biofuels (combined heat and power, or CHP plants), and it is now also possible to apply for support for such plants. The requirements relating to profitability are the same as for plants that produce bioenergy only. These combinations can make it possible for a farm to be self-sufficient in energy. Another area of interest is the production of biochar as a byproduct of bioenergy. It is particularly valuable to gain experience of projects of these kinds, since this will improve the prospects of using the bioenergy programme in climate-related initiatives in the agricultural sector.

Biogas can provide one important solution to the problem of climate change, and both production and use are increasing. The use of biogas is also in line with the principles of a circular economy. Innovation Norway is responsible for administering a pilot scheme for biogas plants, which is testing technology for producing biogas from raw materials other than waste, for example manure. Farmers are eligible for support (NOK 60 per tonne) for deliveries of manure to biogas plants. Enova offers grants for companies that wish to establish biogas production plants.

According to the report from the Norwegian Institute of Bioeconomy Research on climate-related measures, using biogas produced from

manure has considerable potential as a sustainable replacement for fossil energy. Some of this can be realised by building small-scale farm plants where biogas is produced and used locally for heating. However, the largest potential is linked to larger plants for co-digestion of manure and food waste. Both the potential uses of biogas and cost profiles differ between farm-scale plants and co-digestion plants. The overall economic cost of this measure is estimated to be equivalent to about NOK 500 per tonne CO₂-eq of emission reductions. This is lower than previously estimated, partly because it has been assumed that the value of biogas plants will continue to be positive after 2030. By way of comparison, the standard carbon tax rate in 2017 is NOK 450 per tonne CO₂. The potential reduction in emissions is estimated to be 58 000 tonnes CO₂-eq in 2030 if 20 % of all manure is used for biogas production. About one third of the emission-reduction potential that has been identified is linked to farm-scale plants. In addition, emissions are reduced when biogas replaces fossil fuels. However, there are currently few biogas plants in operation, partly because the investment costs are high.

Other technologies that can reduce emissions on individual farms include equipment for climate-friendly manure storage and application, and low-emission technologies for non-road mobile machinery such as tractors. Non-road mobile machinery currently accounts for greenhouse gas emissions of about 350 000 tonnes a year. The Norwegian Farmers' Union has set a target of making Norwegian agriculture fossil-free by 2030. A recent report on various low-emission solutions for tractors indicates an emission reduction potential of about 76 000 tonnes CO₂ up to 2030 relative to the baseline projections. The largest potential is related to a switch to biogas or other biofuels for new sales of tractors of large engine capacity.

Investments in equipment to reduce emissions from agriculture or to increase carbon uptake in soils are also relevant. Such investments may also help to achieve other environmental targets. For example, measures relating to fertiliser application will often also play a role in achieving the goals of river basin management plans.

Stricter requirements for the storage and application of fertiliser will be considered as part of the process of revising the regulations relating to fertiliser products. The Norwegian Institute of Bioeconomy Research and the Norwegian University of Life Sciences were commissioned by the Norwegian Environment Agency to evaluate various proposals for requirements to be included in

the regulations in order to reduce greenhouse gas emissions, losses of ammonia and nitrogen runoff from agriculture, and published their report in 2016.

The focus on climate-related measures at individual farm level is a new development, and there are few analyses or other information on which practical solutions can most effectively be used to reduce emissions. A working group will therefore be appointed to review existing support schemes for climate-related measures at individual farm level before the negotiations on the 2018 Agricultural Agreement, with a view to strengthening and targeting efforts to reduce emissions.

Methane from the digestive system of ruminants accounts for almost half of greenhouse gas emissions from agriculture. Feed quality has a strong influence on emission levels, and several studies show that better feed quality can play a part in reducing methane emissions from livestock. Here, it is for example relevant to consider measures under the Agricultural Agreement to ensure that quality is made a higher priority in coarse fodder production. Under the current accounting rules, it will not be possible to record the effects of such measures directly and report them in the official Norwegian emission inventory. However, climate-related effects of more efficient food production such as reductions in the number of livestock will be reflected in the emission inventory.

There is a high level of uncertainty in the emission inventory for the agricultural sector, and a considerable need for knowledge about overall emissions from the sector, options for reducing emissions, and the costs and consequences of possible measures. The Storting also noted these points during its consideration of the 2016 white paper on agricultural policy. Emissions from the agricultural sector are difficult to measure, since there is considerable uncertainty associated with emission figures for biological processes. Substantial progress is needed in knowledge development in this field. The Government will therefore appoint a technical committee to look into methods for further development of the overall emission inventory for the agricultural sector. The committee will consist of experts proposed by the parties to the Agricultural Agreement.

In connection with the budget agreement for 2017, the Storting requested the Government to introduce a standard carbon tax rate for non-ETS sectors in 2018, for the time being with the exception of the agricultural and fisheries sectors. For agriculture and the fisheries, industry representa-

tives will be invited to take part in committees appointed to consider the possibility of introducing a carbon tax at a gradually increasing rate and to propose other climate-related measures, taking regional, agricultural and fisheries policy goals into account. The committees will be expected to report on the status of their work in connection with the 2018 budget.

Development of the knowledge base and of instruments and measures for reducing greenhouse gas emissions from agriculture will be continued. Measures must be knowledge-based, and it must be possible to measure their effects using reasonably reliable methods. Representatives of the agricultural organisations are to be invited to take part in a committee appointed to conclude a political agreement on how much emissions from the agricultural sector are to be reduced by 2030. The work of the committee will include following up the Storting's decision to consider the possibility of introducing a carbon tax at a gradually increasing rate for the agricultural sector and proposals for other climate-related measures. If it is not possible to reach agreement with the agricultural sector on how it can achieve its cost-effective share of Norway's total emission reductions, the Government will take the initiative to put in place the necessary measures.

5.5 Manufacturing industries

The Government will:

- consider the introduction of a standard carbon tax rate for all non-ETS emissions. If the carbon tax is not considered to be an adequate or appropriate instrument, other instruments that provide equally strong incentives to reduce emissions will be considered.

Emissions from manufacturing and mining are largely included in the EU emissions trading sys-

tem. In 2015, emissions from these sectors totalled 11.9 million tonnes CO₂-eq, only 1.1 million tonnes of which was not in the ETS sector. According to the projections, ETS emissions from these sectors in 2030 are expected to be 11 million tonnes, while non-ETS emissions are expected to remain stable at 1.1 million tonnes.

Most of the manufacturing enterprises that are not obliged to take part in the emissions trading scheme are relatively small, in branches including food and beverage manufacturing, manufacturing of various products, asphalt plants and the like. Emissions from these enterprises are largely from stationary combustion or from the production processes (process emissions). However, non-ETS emissions in the manufacturing sector may also be from installations that are included in the ETS but that also have non-ETS emissions from certain activities (for example diffuse emissions of nmVOCs and methane from refineries and of nitrous oxide from fertiliser production).

Emissions from manufacturing have been reduced by 40 % since 1990. There are currently few commercially available technologies that can give further substantial reductions in process emissions from manufacturing. Developing new low-emission industrial technologies is therefore one of the priorities of the Government's climate policy. In the 2017 white paper on industrial policy, the Government announced that a strategic forum, Prosess21, was to be established for the Norwegian process industries, and that it would include participants from manufacturing industries, academia, the public administration and funding agencies. Prosess21 will provide input on how best to combine the reduction of emissions from the process industries to a minimum by 2050 with sustainable growth in the sector.

At most installations that are sources of emissions from stationary combustion, there are options for improving energy efficiency, electrification and/or for conversion to alternative fuels.

Table 5.10 Greenhouse gas emissions from manufacturing in 2015 and projections for 2030 and the period 2021–2030. Million tonnes CO₂-eq

	Emissions 2015	Projected emissions 2030	Projected emissions 2021–2030 (for the whole period)
Total emissions	11.9	12.1	120
ETS emissions	10.8	11	110
Non-ETS emissions	1.1	1.1	11

Source: Statistics Norway, Ministry of Finance and Norwegian Environment Agency.

According to calculations by the Norwegian Environment Agency, such steps will in many cases also be profitable for the company. The Environment Agency has reviewed measures that in all, could result in a reduction of 3.6 million tonnes CO₂-eq in non-ETS emissions from manufacturing in the period 2021–2030, and concluded that most of these measures would have an economic cost of less than NOK 500 per tonne CO₂-eq. The estimates are uncertain and sensitive to the underlying assumptions.

Emissions from stationary combustion are generally priced through the carbon tax on mineral products. Mineral oil is subject to the standard tax rate of NOK 450 per tonne CO₂, with the exception of the pulp and paper, fish meal and herring meal industries, which are taxed at a reduced rate. A reduced tax rate also applies to natural gas and LPG delivered to manufacturing and mining industries and used in the actual industrial processes. Certain industrial emissions are neither subject to the carbon tax nor included in the ETS. The volume of these emissions must be further assessed.

The Government will consider the introduction of a standard carbon tax rate for all non-ETS emissions. This will ensure that cost-effective measures for reducing emissions are adopted across sectors. See Chapter 5.2.2 for a discussion of the carbon tax.

If the carbon tax is not considered to be an adequate or appropriate instrument, other instruments that provide equally strong incentives to reduce emissions will be considered, including direct regulation under the Pollution Control Act and voluntary agreements.

Application of the Pollution Control Act can be adapted to different industries, and in combination with funding instruments for the research and innovation sector and any other general policy instruments, this can encourage technology development and cuts in emissions. In some

cases, it may be appropriate for the pollution control authorities to ensure that firms applying for discharge permits under the Pollution Control Act look into ways of minimising greenhouse gas emissions from their activities. Requirements relating to energy efficiency and the use of emission abatement technology may also be laid down for installations in the ETS sector.

Enova provides support for projects to reduce non-ETS greenhouse gas emissions in the manufacturing sector. Through its programmes for new technology, energy and climate-related measures and energy management, Enova is supporting innovative, energy-efficient and environmentally sound solutions that also have a potential for diffusion outside Norway.

In addition to reducing their own emissions, manufacturing industries have an important part to play in the transition to a low-emission future. For example, they are important as suppliers of climate-friendly solutions to other industries and sectors, both in Norway and internationally. The transition to a low-emission society will require the development of new products, services and solutions that can replace activities that result in greenhouse gas emissions. Manufacturing industries possess a great deal of expertise in technology, materials and energy use, and the rest of society therefore depends heavily on their success in developing environmentally sound solutions for other sectors.

5.6 Petroleum

The Government will:

- consider the introduction of a standard carbon tax rate for all non-ETS emissions. If the carbon tax is not considered to be an adequate or appropriate instrument, other instruments that provide equally strong incentives to reduce emissions will be considered.

Table 5.11 Greenhouse gas emissions from petroleum activities in 2015 and projections for 2030 and the period 2021–2030. Million tonnes CO₂-eq

	Emissions 2015	Projected emissions 2030	Projected emissions 2021–2030 (for the whole period)
Total emissions	15.1	13.9	147
ETS emissions	14	12.8	136
Non-ETS emissions	1.1	1.0	11

Source: Statistics Norway, Ministry of Finance and Norwegian Environment Agency.

Box 5.22 Shuttle tankers to use VOC fuel with support from Enova

When a shuttle tanker loads crude oil at a platform, greenhouse gases with a high energy content are released. Many of the shuttle tankers operating on the Norwegian shelf have effective systems for capturing and condensing these gases, and some of them make use of the condensate for various purposes on board. In 2017, Enova awarded NOK 133 million to the company Teekay for the construction of four new shuttle tankers that will use VOCs as fuel. In this new technological solution, VOCs are mixed with LNG, and the mixture is used directly in the ships' main engines. In addition, on-board battery packs will be used to reduce the need for engine power. Together, these measures will

reduce LNG consumption by 34 %. This is a climate-related project where Teekay is also addressing a waste problem by converting the waste into a resource. This may set a new standard for oil transport from platforms and there may be considerable potential for diffusion of the technology both in Norway and internationally.

Projects of this kind are important because they verify the performance of new technology and play a part in reducing risk-related, development, testing and production costs. This means that more companies will consider building ships using the same technology.



Figure 5.5

Photo: Teekay

In 2015, emissions from oil and gas extraction totalled 15.1 million tonnes CO₂-eq. These emissions are largely included in the EU ETS, and are also subject to the carbon tax. As a result of these and other policy instruments²³, average emissions per unit produced on the Norwegian shelf are low by international standards. In all, policy instruments in this sector have reduced annual emis-

sions from petroleum activities by an estimated 5 million tonnes CO₂-eq.

²³ Both ETS and non-ETS emissions on the continental shelf are also regulated directly, for example by prohibiting flaring and requiring the option of supplying installations with power from land to be considered for all new field developments.

In 2015, non-ETS emissions from the oil and gas industry totalled about 1.1 million tonnes CO₂-eq, and according to the projections they will remain stable at about this level up to 2030 if current policy instruments and measures are continued. This is equivalent to 11.4 million tonnes CO₂-eq in accumulated emissions over the period 2021–2030. Emission figures for the onshore facilities are mainly based on measurements, whereas figures for emissions from the continental shelf are largely estimates. There is considerable uncertainty associated with the estimated emission figures that are available at present. The methods for calculating emissions from cold venting and fugitive emissions from the continental shelf are to be updated in the course of 2017, and from 2018 onwards, reported figures will be based on new calculation methods. It is considered likely that the new methods will result in lower estimates for emissions from the continental shelf. Projections of non-ETS emissions from this sector will probably also be changed, since cold venting and fugitive emissions are important sources of these emissions.

The main sources of non-ETS emissions from the petroleum sector are:

- cold venting offshore and at onshore facilities (planned operational releases for safety reasons);
- fugitive emissions offshore and at onshore facilities (for example leaks from flanges and valves);
- vapour released during loading and storage of crude oil and other petroleum products;
- energy use during exploration drilling outside existing fields;
- energy use during production drilling using mobile rigs with a rated power output of less than 20 MW.

The emissions consist largely of methane and nmVOCs²⁴, and cold venting and fugitive emissions are the major sources.

Existing policy instruments

General economic instruments such as emissions trading and the carbon tax form the basis for decentralised, cost-effective and well-informed measures to ensure that the polluter pays. Instruments of this kind are suitable if emissions can be measured or estimated with a satisfactory degree of precision. The carbon tax is levied on measured and estimated non-ETS emissions from cold vent-

ing, and on certain other minor sources of non-ETS emissions. As one step in following up the proposals from the Green Tax Commission, the carbon tax rate on natural gas released to air on the continental shelf was increased from NOK 1.02 to NOK 7.16 per Sm³ natural gas from 1 January 2017. This means that the tax rate per tonne CO₂-eq is the same for these emissions as for combustion of natural gas. Cold venting, fugitive emissions and emissions from storage and loading of crude oil and other petroleum products are directly regulated in permits issued under the Pollution Control Act. These regulatory measures apply regardless of whether or not the emissions are taxed. As a general rule, requirements in the permits should be based on use of the best available techniques (BAT).

An emission limit in permits issued under the Pollution Control Act is used to regulate emissions of nmVOCs from loading of crude oil. The rules allow operators to cooperate on emission reductions, and they are considered to have complied with the emission limit if average emissions from all loading points on the continental shelf are below the specified limit. Since the early 2000s, these nmVOC emissions have been reduced from more than 200 000 tonnes to less than 50 000 tonnes as a result of new technology and requirements from the authorities, combined with a drop in oil production. Regulation of nmVOC emissions also indirectly limits methane emissions.

Under the Pollution Control Act, the Norwegian Environment Agency also requires operators to carry out investigations to develop knowledge and expertise on options for reducing emissions and possible measures that can be introduced. For example, in 2016 the Environment Agency required all operators on the Norwegian shelf to report on possible ways of reducing methane emissions and the costs of these measures.

Enova provides grants for projects in the petroleum sector designed to reduce non-ETS greenhouse gas emissions. Through its programmes on new technology, transport and energy management, Enova supports innovative, energy-efficient and environmentally sound solutions that also have a potential for diffusion beyond the petroleum sector.

Mitigation analyses

The Norwegian Environment Agency estimates that there is a potential for reducing non-ETS emissions from the petroleum sector by a total of

²⁴ Non-methane volatile organic compounds.

Boks 5.23 Cooperation between operators on nmVOC emissions

Since 2002, nmVOC emissions from loading of crude oil on the Norwegian continental shelf have been regulated by means of requirements in permits issued to operators under the Pollution Control Act. The provisions of these permits allow operators to cooperate to meet the emission requirements (a form of joint implementation); they are considered to have complied with the emission limit on each field provided that the average emissions from all loading points on the continental shelf are below the specified limit. To ensure compliance with the requirements relating to nmVOC emissions during loading, the operators established a cooperation forum in 2002. This finances the emission reduction measures that are considered to be most cost-effective, and sends annual emission reports to the Norwegian Environment Agency. This reduces the overall costs for the industry as a whole.

around 900 000 tonnes CO₂-eq over the whole period 2021–2030, using measures with an economic cost of less than NOK 500 per tonne CO₂-eq. This estimate includes measures to reduce emissions from loading and storage of crude oil offshore and from cold venting. There is considerable uncertainty associated with the estimates of costs and emission reductions, partly because new calculation methods are being introduced. Work is in progress to assess options for reducing emissions from onshore facilities, which would be additional to the estimate above.

According to the Environment Agency, increasing the recovery rate for methane and nmVOCs during offshore loading of crude oil could result in emission reductions of up to 365 000 tonnes CO₂-eq in the period 2021–2030, at an estimated economic cost of less than NOK 500 per tonne CO₂-eq. This estimate is based on the assumption that all shuttle tankers on the Norwegian shelf install VOC capture/recovery technology by 2030. This would increase the recovery rates from just over 60 % to 95 % for nmVOCs and to 75 % for methane.

The Environment Agency estimates that emission from cold venting and fugitive emissions can

be reduced by about 500 000 tonnes CO₂-eq over the period 2021–2030 at an estimated economic cost of less than NOK 500 per tonne CO₂-eq, for example by installing recovery equipment that returns waste gas to the process or by flaring the gas. These measures require alterations to pipelines systems and other elements of the production system, which for safety reasons can only be carried out when plants are not operating. There is therefore some uncertainty about the costs of these measures on existing installations, and the costs will probably vary considerably from project to project. New installations including processing plants can be designed to reduce methane emissions at low cost, but there may be exceptions in certain cases.

The Government uses taxation (the carbon tax and other taxes on greenhouse gas emissions) as the main instrument for reducing non-ETS emissions. The tax rate for emissions of natural gas to air was increased from 1 January 2017, so that operators now have to pay a substantial price for their emissions. This is expected to result in emission reductions. The Government will consider the introduction of a standard carbon tax rate for all non-ETS emissions. The Government will also assess whether it is appropriate to seek to include more of the emission sources in the petroleum sector in the emissions trading system. If economic instruments are not considered to be adequate or appropriate, other instruments that provide equally strong incentives to reduce emissions will be considered.

5.7 Energy supplies

The Government will:

- introduce pricing of greenhouse gas emissions from waste incineration plants;
- consider introducing the standard carbon tax rate for greenhouse gas emissions from waste incineration from 1 January 2018 and/or including emissions from waste incineration plants in the EU ETS;
- initiate an external review of future energy supplies in Svalbard, in line with the description in the revised national budget for 2017.

In 2015, non-ETS CO₂ emissions from the energy supply sector totalled 1.0 million tonnes, and according to the projections are expected to be 1.0 million tonnes in 2030 as well. The main source of these emissions is waste incineration, which accounted for almost 0.9 million tonnes in 2015. In

Table 5.12 Greenhouse gas emissions from the energy supply sector in 2015, and projections for 2030 and the period 2021–2030. Million tonnes CO₂-eq.

	Emissions 2015	Projected emissions 2030	Projected emissions 2021–2030 (for the whole period)
Total emissions	1.7	1.1	12
ETS emissions	0.7	0.2	2
Non-ETS emissions	1.0	1.0	10

Source: Statistics Norway, Ministry of Finance and Norwegian Environment Agency.

addition, there are non-ETS emissions from heating with fuel oil and the use of natural gas in district heating plants, and from electricity and heat production in Svalbard.

The legislation on the EU ETS distinguishes between waste incineration plants and co-incineration plants. The EU ETS directive makes it clear that waste incineration plants are not included in the emissions trading system. The reason for this appears to have been to ensure that threshold for proper disposal of waste is as low as possible. Co-incineration plants, on the other hand are included in the EU ETS. These plants also incinerate waste, but their main purpose is energy production, for example for industrial use, rather than waste disposal. This distinction skews the Norwegian waste market, since some plants where waste is incinerated are included in the EU ETS while others are not. The incineration plants that are not part of the EU ETS currently pay nothing for their greenhouse gas emissions. The Government intends to introduce pricing of greenhouse gas emissions from waste incineration plants.

In connection with the budget agreement for 2017, the Storting requested the Government to introduce a standard carbon tax rate for non-ETS sectors in 2018, for the time being with the exception of the agricultural and fisheries sectors. One result of steps to follow up this request may be that waste incineration plants that are not included in the EU ETS are taxed at the standard rate from 2018. An alternative way of pricing these emissions would be to include the installations in the EU ETS. Including all waste incineration in the EU ETS would also help to eliminate discriminatory treatment within the waste market. At present, only three of the 15 incineration plants in Norway are included in the EU ETS. The Government will consider introducing the standard carbon tax rate for greenhouse gas emissions from waste incineration from 1 January 2018 and/or including emissions from waste incineration

plants in the EU ETS. Norway's carbon tax is further discussed in Chapter 5.2.2.

In addition to emissions from waste incineration, non-ETS installations produce emissions from other forms of stationary combustion. As a general rule, these emissions are priced through the carbon tax on mineral products. Mineral oil is subject to the standard tax rate of NOK 450 per tonne CO₂. A reduced tax rate applies to natural gas and LPG delivered to manufacturing and mining industries and used in the actual industrial processes.

In 2015, the Storting asked the Government for a proposal for instruments to phase out the use of fossil oil in district heating systems and maximise the resource efficiency of district heating as possible. The Government will present its proposal to the Storting in the 2018 budget.

No carbon tax is payable on production in or the import of goods to Svalbard. As a general rule, when goods are exported from Norway to Svalbard no carbon tax is levied, and any tax already paid can be reimbursed. Thus, the use of mineral products in electricity and heat production in Svalbard is not subject to the carbon tax. Emissions from Svalbard are regulated by the Norwegian Environment Agency under the Svalbard Environmental Protection Act, and permits have been granted for emissions from coal-fired power production in Longyearbyen and Barentsburg. The permit for the coal-fired power plant in Longyearbyen includes specific limits for emissions to air of CO, CO₂, NO_x, SO₂ and particulate matter. New emission abatement systems were put into operation at the combined heat and power plant in 2016. At the same time, the power plant has been upgraded, and this is expected to prolong its lifetime by 20–25 years from the start of the upgrade in 2013.

During its consideration of the latest white paper on Svalbard (Meld. St. 32 (2015–2016)), the Storting asked the Government to initiate a broad-

based review of future options for energy supplies in Svalbard based on sustainable and renewable solutions.

5.8 Buildings

The Government will:

- from 2020, introduce a prohibition on the use of mineral oil to provide base-load capacity for heating buildings, and peak-load capacity for heating commercial buildings;
- hold a consultation on an additional proposal to prohibit the use of mineral oil for heating farm buildings and temporary buildings;
- review possibilities for reducing emissions from the use of mineral oil to produce district heating to heat buildings;
- review ways of reducing the use of mineral oil for heating and drying buildings during construction;
- review possibilities for reducing emissions from the use of natural gas to heat buildings.

In 2015, non-ETS emissions from heating of buildings totalled 1.2 million tonnes CO₂-eq. The projection for 2030 is 0.5 million tonnes. Mineral oil and natural gas used to heat buildings are subject to the carbon tax on mineral products. In 2017, the tax rate is equivalent to NOK 450 per tonne CO₂. In addition, mineral oil is subject to the basic tax on mineral oil. These taxes provide incentives to reduce the use of mineral oil and natural gas for heating buildings. Enova and Innovation Norway run grant schemes to promote a switch from fossil to renewable heating solutions in buildings.

A proposal to prohibit the use of mineral oil to heat buildings has been published and notified to the EFTA Surveillance Authority. The prohibition will formally enter into force once the notification process has been completed. This will be at least three months after the notification date. The proposal applies to the use of mineral oil to provide both base-load and peak-load capacity.

There will still be emissions from heating using fossil fuels that are not covered by the proposal. The Government has started a consultation on an additional proposal to prohibit the use of mineral oil for heating farm buildings and temporary buildings.

In addition, the Government will review possibilities for reducing emissions from the use of natural gas to heat buildings and from the use of mineral oil to produce district heating to heat buildings (this is further discussed in Chapter 5.7 on the energy supply sector). Emissions from the use of fuelwood for heating are discussed in Chapter 5.11.

Emissions from the use of fossil fuels to heat and dry buildings during construction are quite substantial. In 2015, emissions from the use of mineral oil and natural gas for this purpose made up 73 000 tonnes and 62 000 tonnes CO₂ respectively. Transport and the use of machinery during construction also generate emissions. For the future, it must be a goal to ensure that construction sites are as fossil-free as possible. More knowledge is needed about the availability of non-fossil alternatives for heating and drying buildings during construction and the cost of using them. In the course of 2017, the Government will review ways of reducing the use of mineral oil for heating and drying buildings during construction. Fossil fuels are currently used for a variety of purposes at construction sites, and the review should provide information on the emission reduction potential of phasing out different uses, including their climate effect, the economic cost and the costs for individual stakeholders. The review will also look at the availability of alternative sources of energy, any geographical variations in their availability, and the investments/costs involved in phasing out fossil fuels in relation to the emission reductions that can be achieved. The Government will seek a dialogue with the construction industry during this process. The review will be coordinated with the preparation of an action plan for fossil-free construction sites in the transport sector, see Chapter 5.3.7.

Table 5.13 Greenhouse gas emissions from buildings in 2015 and projections for 2030 and the period 2021–2030. Million tonnes CO₂-eq

	Emissions 2015	Projected emissions 2030	Projected emissions 2021–2030 (for the whole period)
Total emissions	1.2	0.5	5

Source: Statistics Norway, Ministry of Finance and Norwegian Environment Agency.

Box 5.24 More efficient energy use in buildings

Efficient energy use can play a part in the transition to a sustainable energy supply system. New buildings are intended to stand for many years, and the choices we make today will influence energy use and the degree of flexibility in the energy system for many years to come.

Energy prices and technological advances influence energy efficiency in buildings, and another important factor is active use of policy instruments by the authorities. These include building regulations, energy taxes and requirements relating to the energy efficiency of appliances. When designing instruments to influence energy use in buildings, it is important to take into account construction and running costs, building quality and interactions between the building and energy supply sectors.

Enova offers a broad range of funding instruments for both existing and new buildings, ranging from support for conceptual studies and new technology in the buildings of the future to sup-

port for surveys and energy efficiency measures in existing buildings. Enova has also developed a rights-based grant scheme for energy efficiency measures in residential buildings, which has an annual budget framework of NOK 250 million. This scheme provides support for energy efficiency measures that reduce energy use in existing buildings.

The Government has introduced stricter energy use requirements, corresponding to passive house standard, in the regulations on technical requirements for buildings. This is in line with the cross-party agreement on climate policy. The new requirements entered into force on 1 January 2016, and are expected to improve energy efficiency in new buildings by about 20–25 %.

In 2016, the Storting asked the Government to set a target of reducing energy use in existing buildings by 10 TWh by 2030. The Government will follow up this request in the budget for 2018.

At present, buildings currently account for about 40 % of net domestic energy consumption in Norway, but only about 2 % of total greenhouse gas emissions. In 2030, this figure is expected to be reduced to 0.7 % of total greenhouse gas emissions. Norway's situation is in strong contrast to that of countries where fossil energy carriers still dominate heating and energy supplies. Increasing energy efficiency in buildings will have little effect on greenhouse gas emissions in Norway, since most stationary energy consumption is derived from renewable sources. However, efficient and climate-friendly energy use is a key element of Norway's energy policy for the period up to 2030, as described in the white paper on Norway's energy policy (Meld. St. 25 (2015–2016)).

5.9 Fluorinated gases in products

The Government will:

- Revise the Product Regulations to implement the Kigali Amendment to the Montreal Protocol on HFC phase-down and evaluate measures, including stricter inspection and enforcement, to improve compliance with existing instruments that are designed to bring about further reductions in emissions of HFCs and other fluorinated gases.

Fluorinated greenhouse gases, or F-gases, include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆). Except for PFCs emitted during aluminium manufactur-

Table 5.14 Greenhouse gas emissions from fluorinated gases in products in 2015 and projections for 2030 and the period 2021–2030. Million tonnes CO₂-eq

	Emissions 2015	Projected emissions 2030	Projected emissions 2021–2030 (for the whole period)
Total emissions	1.3	0.7	8

Source: Statistics Norway, Ministry of Finance and Norwegian Environment Agency.

ing, these are industrially manufactured gases with high GWP100 values²⁵ that are used in technical equipment, consumer products and some processes. F-gases in products belong to the non-ETS sector. In 2015, emissions of F-gases from products made up 2.4 % of Norway's total greenhouse gas emissions.

HFCs

Norway's emissions of F-gases consist largely of HFCs. HFC emissions have risen steeply in Norway since the 1990s, and totalled 1.23 million tonnes CO₂-eq in 2015. This is equivalent to 2.3 % of Norway's greenhouse gas emissions. Projections indicate that HFC emissions will decrease in the years ahead as a result of existing and planned regulatory measures and decline to only 0.6 million tonnes CO₂-eq in 2030. HFCs are used mainly as refrigerants in cooling and freezing equipment, air conditioning and heat pumps, and have increasingly been taken into use as substitutes for ozone-depleting substances.

A tax on HFCs was introduced in 2003. It is levied on imports and domestic production of these gases. The tax applies to all mixtures of HFCs, both mixtures of different types of HFCs and mixtures with other substances, including HFCs as a constituent of other goods. There is no production of HFCs in Norway, so that in practice, the tax is levied on imports only. The tax rate has been raised considerably in the last few years from about NOK 230 per tonne CO₂-eq in 2013 to NOK 450 per tonne CO₂-eq in 2017. Thus, the tax rate for HFCs is now the same as the general tax rate for non-ETS emissions, expressed as NOK per tonne CO₂-eq (this is further explained in Chapter 5.2.2).

HFCs are also regulated under the Pollution Control Act, the Road Traffic Act and the Product Control Act. HFCs are defined as hazardous waste in the Waste Regulations. The intentional release of these gases is therefore prohibited, and there are requirements for proper handling of HFCs when products containing them reach the end of their life. When HFCs are delivered for destruction, a refund is payable corresponding to the tax rate. The use of HFCs in air conditioning systems in vehicles is governed by the Motor Vehicle Regulations. The Product Regulations, which implement the 2006 EU regulation on fluorinated green-

house gases, include provisions on proper handling of HFCs, checking for leakages, certification of personnel and companies that handle HFCs, and prohibition of their use in certain products.

The policy instruments described above have slowed the rise in HFC emissions, which have now levelled off at about 2 % of Norway's total greenhouse gas emissions. In 2015, HFC emissions declined for the first time since these gases were taken into use. However, preliminary figures indicate that emissions rose again in 2016. The taxation and refund scheme has given strong incentives to choose solutions for new investments that use gases with low GWP100 values, and to give priority to maintenance of existing systems. As mentioned earlier, projections indicate that Norway's HFC emissions will decline in the period up to 2030. The EU's new F-gas Regulation from 2014 has been taken into account in the projections, and will contribute strongly to the reduction in emissions. The Regulation includes a prohibition on using HFCs with a high GWP100 value. The new Regulation has not yet been incorporated into the EEA Agreement, but a public consultation on revision of the Product Regulations was held in autumn 2016 in preparation for incorporating the EU Regulation into Norwegian law.

Norway is to implement the Kigali Amendment to the Montreal Protocol. In 2016, the parties to the Protocol adopted amendments to bring about global phase-down of the production and consumption of HFCs. Since there is no production of HFCs in Norway, the Kigali Amendment will only have implications for imports of these substances. The Storting gave its consent to ratification of the Kigali Amendment in spring 2017.

There is a potential for greater reductions of HFC emissions than the projections indicate. Improving compliance with the elements of the legislation that are designed to minimise leakages from equipment is one way of reducing emissions. This means improving compliance with the requirements of the F-gas Regulation for regular checks of larger equipment for leakages, and enforcing the requirement for proper certification of personnel and companies that carry out work on such equipment. Estimates by the Norwegian Environment Agency show that if the industry complies more closely with the legislation, the accumulated emissions from 2021 to 2030 can be reduced by 500 000 tonnes CO₂-eq. The Government will facilitate stricter inspection and enforcement and the provision of more information on leak checks for equipment containing large quantities of HFCs.

²⁵ A GWP100 value is a measure of the cumulative radiative forcing (or warming effect) of a particular greenhouse gas relative to CO₂ over a period of 100 years. GWP values make it possible to express the impact of greenhouse gases on the climate in CO₂-equivalents.

Box 5.25 Global phase-down of HFCs: regulation under the Montreal Protocol

At the 28th meeting of the parties to the Montreal Protocol in Kigali, Rwanda, the parties reached agreement on regulation of HFCs. Norway played an active part in the negotiations. According to UN Environment (UNEP), the agreement, known as the Kigali Amendment, will help to avoid up to 0.5 degrees Celsius of global temperature rise by 2100.

For a long time, Norway and a number of other countries have considered that regulation of HFCs under the Montreal Protocol would be the most effective way of halting the rapid growth in the use of these gases. Since the mid-1990s, global consumption of HFCs has risen rapidly because they have been taken into use as substitutes for ozone-depleting substances, and as a result of a general rise in prosperity. Projections by the Technology and Economic

Assessment Panel under the Protocol show that if no measures were to be implemented, consumption would rise to the equivalent of 6 billion tonnes CO₂-eq by 2050. Consumption of HFCs is already higher in developing than in developed countries, and most of the growth in consumption is expected to be in developing countries.

The Montreal Protocol has been universally ratified, and every country in the world has taken on commitments under it. Under the Kigali Amendment, the parties have committed themselves to gradual phase-down of their production and consumption of HFCs. The phase-down schedules are different for developing and developed countries, and some countries have been granted exemptions, for example a delay in the phase-down schedule.

The quantity of HFCs imported to Norway every year is about ten times the quantity collected. Very little is exported. HFCs are used to charge equipment and appliances and are not emitted directly, but some leakages are inevitable. Recovery of HFCs is mandatory, and for larger equipment, the tax refund system is a strong incentive for collection. However, there is reason to believe that the quantities of HFCs collected could be considerably increased. This applies particularly to HFCs from small units such as vehicles and private heat pumps; in such cases, the tax refund system alone does not give a strong enough incentive to ensure correct handling of the gases. The Government will consider further how the system for collection and destruction of HFCs can be improved.

The atmospheric lifetime of HFCs varies, but is generally short compared with CO₂. Measures to reduce emissions of these short-lived climate pollutants have near-term climate benefits in addition to their long-term effects, thus slowing global warming. Calculations of the effects of these measures are presented in a report published by the Norwegian Environment Agency in 2015, Climate mitigation measures up to 2030 – short-term climate effects and health effects.

SF₆

In 2015, SF₆ accounted for 0.1 % of Norway's greenhouse gas emissions. Leakages from gas-insulated switchgear are currently the dominant source of these emissions. From 2002 to 2010, a voluntary agreement on reductions in emissions was in effect between the Ministry of Climate and Environment (then the Ministry of the Environment) and the electric and electronic equipment sector. Its effects are still believed to persist, and the agreement together with regulatory measures as set out in the EU's F-gas Regulation have resulted in a 75 % reduction in SF₆ emissions since 2002.

There is not believed to be any further potential for reducing leakages in this sector, and the focus should therefore be on reducing the growth in the volume of SF₆ in use in equipment. This can be achieved by using alternative insulating gases (only available for smaller types of switchgear) or by using air-insulated systems, which require more space (of interest for larger types of switchgear). Particular attention should be focused on the large-scale expansion that is being planned for Norway's high-voltage transmission grid. The Government will consider instruments and measures to reduce SF₆ emissions from high-voltage installations.

PFCs

Emissions of PFCs from products are currently insignificant, and this is not expected to change. The same taxation and refund scheme applies to PFCs as to HFCs.

5.10 Other sources

There are also non-ETS emissions from other sources than those described so far in this chapter. Landfilling is much the most important of these, accounting for 1.1 million tonnes CO₂-eq in 2015. These emissions are expected to decrease to about 500 000 tonnes CO₂-eq by 2030 as a result of restrictions on landfilling. Emissions from waste water and waste water treatment were over 100 000 tonnes CO₂-eq in 2015. In addition, there are emissions from nitrous oxide use by hospitals, aerosols, CO₂ emissions from the use of lubricating oils in engines, and CO₂ emissions from liming of farmland, solvents, distribution of natural gas and petrol, liming of industrial waste, composting and so on. At present, we know little about many of these sources and how emissions can be reduced.

5.11 Measures specifically designed to reduce emissions of black carbon and other short-lived climate pollutants

Short-lived climate pollutants are gases and particulates whose impact on climate occurs primarily within the first 10 years after their emission. They may have either a warming or a cooling effect on the climate. Those with a warming effect include methane (CH₄), black carbon, tropospheric ozone (ground-level ozone) and some hydrofluorocarbons (HFCs), and those with a cooling effect include organic carbon and sulphur dioxide (SO₂). Since short-lived climate pollutants have a short atmospheric lifetime, a reduction in emissions has a rapid effect and can slow the rate

of global warming. According to UNEP, measures to reduce emissions of short-lived climate pollutants could reduce global warming by about 0.5°C by 2050.²⁶ However, emission reduction measures targeting short-lived climate pollutants must be additional to efforts to reduce emissions of long-lived greenhouse gases like CO₂, and not a replacement for them. In addition to being complementary to emission reduction measures for the long-lived gases, measures to reduce short-lived climate pollutants will have other benefits including better air quality, improvements in health and higher agricultural productivity.

Black carbon is not a greenhouse gas but a particulate. It is not included in the greenhouse gas inventory nor in the 2030 emission reduction commitment. Nevertheless, emissions of black carbon may have an effect on the climate. Black carbon is a component of particulate matter, and is formed largely by incomplete combustion of fossil fuels, biofuels and biomass, and through wear and tear on roads and tyres. Black carbon is often referred to as soot, although soot in fact contains more than just carbon. The atmospheric lifetime of black carbon is only a few days to a few weeks, so that there is not enough time for it to be transported over long distances. Black carbon has a particularly large warming effect when it is released near the polar regions. In addition to absorbing solar radiation in the atmosphere, the black particles absorb heat when they are deposited on ice and snow. This speeds up melting of snow and ice, reducing the reflectivity of the earth's surface (known as its albedo) and increasing the absorption of heat. There is no generally agreed method for calculating the global warming potential of black carbon. However, Norway's proximity to the Arctic indicates that Norwegian emissions of black carbon will have a greater effect per tonne on the climate than emissions in

²⁶ UNEP/WMO (2011). Integrated Assessment of Black Carbon and Tropospheric Ozone. Summary for Decision Makers. Nairobi, Kenya: United Nations Environment Programme.

Table 5.15 Greenhouse gas emissions from other sources in 2015 and projections for 2030 and the period 2021–2030. Million tonnes CO₂-eq

	Emissions 2015	Projected emissions 2030	Projected emissions 2021–2030 (for the whole period)
Total emissions	1.5	1.0	11

Source: Statistics Norway, Ministry of Finance and Norwegian Environment Agency.

other parts of the world (Norwegian Environment Agency 2013).²⁷

In 2013, Norwegian emissions of black carbon made up about 3.8 ktonnes, a reduction of 20 % from 1990. The largest sources are fuelwood use, domestic shipping and fishing vessels, and road traffic (diesel vehicles). Emissions of particulate matter consist of varying proportions of black carbon and organic carbon (OC) depending on the source. When designing mitigation measures, it is important to focus on emission sources with a high proportion of black carbon. Measures targeting sources with a high proportion of organic carbon, such as fuelwood use, will have a much smaller climate benefit, which may even potentially be negative for a 100-year time horizon (because organic carbon has a cooling effect). The implication is that measures targeting fuelwood use can have positive climate and health effects in the short term, but are primarily health-related measures in the long term. At the Arctic Council ministerial meeting on 11 May 2017, a collective goal for reduction of black carbon emissions was agreed. The Arctic countries collectively are to reduce their emissions of black carbon by between 25 and 33 % below 2013 levels by 2025.

Emissions of black carbon are not currently taxed in Norway. The report from the Green Tax Commission (NOU 2015: 15) stated that in principle, soot emissions should be taxed. The commission noted that soot is not included in Norway's emission reduction commitment, and that it is only relevant to introduce a climate-related tax on soot if Norway wishes to reduce emissions by more than its commitment. However, the commission also pointed out that Norway has a responsibility for emissions that take place on its territory. Further, the commission noted that the global warming potential of black carbon is uncertain, and that it can be queried whether a tax would target black carbon accurately enough. Nevertheless, the commission recommended the addition of a black carbon element to the carbon tax on mineral oil. The tax rate would have to be further assessed. There may be arguments for considering the commission's recommendation. This should be done when further knowledge of the impact of black carbon on the climate is available.

²⁷ Norwegian Environment Agency (2013). Forslag til handlingsplan for norske utslipp av kortlevde klimadrivere. Rapport M-89. [Summary translated into English: Summary of proposed action plan for Norwegian emissions of short-lived climate forcers, Report M135/2014]

A mitigation analysis commissioned by the Norwegian Environment Agency shows that measures to reduce emissions from older wood-burning stoves where combustion is incomplete will have considerable health benefits and may therefore be cost-effective. Introducing such measures can also help to achieve both the limit values set out in the Pollution Regulations and the national targets for local air quality (PM₁₀ and PM_{2.5}). The report describes some existing instruments for reducing emissions from fuelwood use. There are grant schemes that provide support for replacing old stoves in some municipalities, and the report states that these could be expanded. In addition, grants are available for measures such as improved maintenance of wood-burning stoves, electrostatic precipitation of particulates, and better regulation of airflow. Municipalities may regulate emissions from fuelwood use if there is a risk that the limit values for PM₁₀ and PM_{2.5} set out in the Pollution Regulations will be exceeded. The report points out that a ban on using older wood-burning stoves with high emissions can be considered, either permanently or in periods and/or areas where concentrations of particulate matter are high. Given that these measures are very cost-effective, national grant schemes or incentives could be considered to back up municipal efforts to reduce emissions from fuelwood use, with special priority being given to areas where substantial health benefits could be achieved.

5.12 Land use, land-use change and forestry (LULUCF)

The Government will:

- continue and consider expanding programmes for forest fertilisation, forest tree breeding and using higher seedling densities;
- continue the improvement of follow-up routines to ensure that forest owners comply with their obligations relating to forest regeneration after harvesting;
- promote more use of wood in buildings and consider measures that can play a part in increasing the carbon stock in long-lived wood products;
- review the impacts and costs of various ways of designing a ban on felling of juvenile forest stands. The review is to consider the optimal timing of felling on the basis climate change considerations and the timber value respectively.

5.12.1 Emissions and removals

According to Norway's reports to the UN Climate Change Convention (UNFCCC), total net removals from the land use, land-use change and forestry (LULUCF) sector as a whole in 2015 were 24.3 million tonnes CO₂-eq, while net removals from forest land alone were 29 million tonnes CO₂-eq. The high rate of carbon sequestration in Norwegian forests is a result of extensive planting and active management during the second half of the 20th century, combined with a logging rate that has been considerably smaller than the annual increment. In the years ahead, forest that was planted in the 1950s and 1960s will be reaching maturity, and the annual increment and CO₂ removals will therefore decline. In addition, less investment has been made in forests after the 1960s. Projections therefore show a downward trend for carbon sequestration in Norwegian forests.

Norway's emissions from the LULUCF sector totalled about 4.5 million tonnes CO₂-eq in 2015. There are emissions from all land-use categories except forest, and the largest source is land-use change from forest and wetlands to settlements and cropland/grassland. Emissions from deforestation made up 2.3 million tonnes CO₂-eq in 2015. The European Commission has proposed a new EU regulation for the LULUCF sector, which would be the third pillar of the EU's 2030 climate and energy framework. The proposed regulation is further discussed in Chapter 4 of this white paper.

5.12.2 Climate-related measures in the LULUCF sector

5.12.2.1 Introduction

The IPCC has highlighted the importance of the LULUCF sector in climate policy. Forests absorb CO₂ and store large quantities of carbon, and are also an important source of renewable energy and wooden materials that can be used to replace materials with a larger carbon footprint. Other terrestrial ecosystems and organic soils are also large carbon sinks. On the other hand, human activity can cause large greenhouse gas emissions through land use and conversion of areas and ecosystems to other forms of use. To achieve a balance between anthropogenic greenhouse gas

emissions and removals by sinks in the second half of this century, which is one of the aims of the Paris Agreement, it will be vital to reduce emissions and increase removals by the LULUCF sector.

The Government intends to introduce measures designed to maintain or increase the carbon stock in forest and facilitate greater use of biomass as a substitute for fossil energy sources and fossil-intensive building materials, thus ensuring that forests can continue to play their crucial role in the context of climate change. After the adoption of the 2012 cross-party agreement on climate policy, several measures have been initiated with a view to increasing carbon uptake by forest. These measures also encourage commercial activity and help to maintain a good resource base for the forest and wood industry. As a way of strengthening the cross-party agreement on climate policy, the Government has taken steps to reduce greenhouse gas emissions from previously drained peatland. The Government will further develop and consider whether to strengthen these measures, and will also review and further develop other measures for reducing emissions and increasing removals in the LULUCF sector. Furthermore, the Government will promote more use of wood in buildings and will consider other measures that can play a part in increasing the carbon stock in long-lived wood products. More use of wood in buildings also results in substitution effects in other sectors. Most measures in the LULUCF sector will primarily have long-term effects, after 2030. However, measures should also be implemented in the LULUCF sector in the period up to 2030 in order to facilitate emission reductions and increases in removals in the longer term.

Certain measures in this sector may result in more intensive land use and thus have environmental impacts, for example impacts on biodiversity. Steps must therefore be taken to improve the knowledge base on the overall environmental impacts of climate-related measures. Such measures must be designed to take into consideration areas that are particularly important for biodiversity. It is vital to find a good balance between climate-related measures and environmental considerations. Where possible, the emphasis will be on win-win measures, i.e. those that have a positive impact as regards both climate and biodiversity. Restoration of peatlands is one example.

5.12.2.2 *Measures relating to deforested land and afforested land*

Deforested land

In the period 1990 to 2013, about 140 000 hectares of forest land has been deforested in Norway, i.e. converted to other forms of land use such as roads and settlements, cropland and grassland. This corresponds to an average of 6 000 hectares a year. Unlike emissions from ordinary logging, which in the long term are counterbalanced by carbon uptake as forest regenerates and trees grow again, emissions from deforestation and construction of infrastructure and buildings are permanent, and land conversion reduces future greenhouse gas removals. Forest that is converted to cropland or grassland can in principle be replanted.

Emissions from deforestation correspond to about 4–5 % of Norway's greenhouse gas emissions as reported to the UNFCCC.²⁸ Emissions from deforestation vary from year to year, and according to Norway's reports to the UNFCCC, were of the order of 2.3–2.5 million tonnes CO₂ in the period 2010–2015. Land use changes over time. Deforestation must therefore be considered in conjunction with deliberate afforestation and natural development of forest in new areas. Emissions from deforestation are one of the main reasons why Norway may have to report net emissions from the LULUCF sector if the legislation proposed by the European Commission is adopted, see Chapter 4. In addition to cuts in emissions, a reduction in deforestation can be a means of preventing the loss of biodiversity, provided that reducing deforestation does not cause degradation of other habitat types.

Possible measures and policy instruments for reducing deforestation should be considered in the light of the causes and drivers of deforestation. Deforestation often takes place because areas are needed for other purposes. Public and private infrastructure development accounts for 55 % of the conversion of forest land (33 % for roads, railways and settlements, 11 % for power lines and skiing infrastructure and 11 % for other purposes (gravel pits, golf courses, etc)). Within the agricultural sector, conversion to grassland and cropland accounts for about 31 % of deforestation, and forest roads and farm tracks for 14 %. If it is not possible to meet the need for land for these purposes by densification in existing built-up

areas or by building more on land that is not suitable for agricultural or forestry production, measures to reduce deforestation may have negative impacts on other valuable types of land or habitat types (for example wetlands, cultivated land or other types of cultural landscape). This means that measures to reduce deforestation may result in conflicts of interest. The Government has initiated a study to learn more about the causes of deforestation in Norway. The review will also describe possible measures and policy instruments for reducing deforestation.

Afforested land

In the long term, establishing forest in new areas will increase the carbon stock in forest, increase CO₂ removals in forest and boost supplies of environmentally friendly raw materials, thus partly or entirely compensating for emissions from deforestation. The 2012 cross-party agreement on climate policy includes afforestation of new areas as a climate mitigation measure, and development of the necessary environmental criteria, as one of the points that the Government will follow up. In 2013, as part of this work, the Norwegian Environment Agency, the Norwegian Agriculture Agency and the Norwegian Institute of Bioeconomy Research (NIBIO) published a report²⁹ on afforestation of new areas, which concluded that a total area of at least 100 000 hectares could be planted over a 20-year period with an acceptable impact on biodiversity and the environment otherwise. The report estimated that this scale of afforestation would result in additional removals of about 1.8 million tonnes CO₂ in 2050 and almost 1 million tonnes CO₂ in 2100. In a 2010 report on measures and instruments for achieving Norway's climate targets by 2020 (Climate Cure 2020), it was estimated that this measure would cost NOK 50/tonne CO₂.³⁰

Afforestation of new areas must be based on thorough assessments to find a balance between climate, environmental and commercial interests. The Government is therefore organising a three-year pilot project to provide experience of the climate effect that can be achieved, environmental criteria and practical implementation before full-scale implementation of this measure. To ensure

²⁸ In 2015 Norway's greenhouse gas emissions totalled 53.9 million CO₂-eq. This does not include emissions and removals in the LULUCF sector.

²⁹ Miljødirektoratet, Statens landbruksforvaltning og NIBIO (2013) *Planting av skog på nye arealer som klimatiltak [Afforestation of new areas as a climate mitigation measure]*, M26-2013

³⁰ This is the actual cost of tree planting, and does not include other costs that will accrue.

that the climate effect is satisfactory, that environmental considerations are taken into account and that the conflict level is low, the pilot phase only involves (i) planting Norwegian tree species, (ii) planting on open areas and areas where natural regrowth of forest is at an early stage, (iii) planting in highly productive areas where the reduction in albedo³¹ is expected to be small, and (iv) planting in areas that are not of special importance for biodiversity (i.e. no planting in threatened habitat types, where important habitat types have been mapped, or in habitats for red-listed species), are not historically valuable and do not contain valuable cultural landscapes.

After the pilot phase has been completed, there will be a thorough evaluation of whether the objectives have been achieved. The evaluation is expected to be available in 2018, and will show whether or not the environmental criteria used in the pilot phase are adequate and whether they ensure that afforestation has acceptable impacts on biodiversity and the environment otherwise (including when Norway spruce is planted in Western Norway and north of the Saltfjellet mountains in Nordland). The final stage of the process will be the development of guidelines for scaling up and expanding afforestation.

The results of the pilot evaluation phase will be used as a basis for further decisions on the use of afforestation as a climate mitigation measure.

5.12.2.3 Measures in existing areas of forest land and carbon storage in harvested wood products

Higher seedling densities in existing areas of forest land

Using higher seedling densities for forest regeneration increases the growing stock and CO₂ removals by forest. In 2016, a grant scheme was launched to increase the seedling density used for regeneration after harvesting. This measure forms part of normal planting after harvesting, and thus does not involve any change in land use. Higher seedling densities have only a modest effect in the short term, the accumulated effect for 2021–2030 being estimated at just over 100 000 tonnes CO₂. In the longer term, however, it has greater potential. Extra CO₂ removals from this measure are estimated at nearly 700 000 CO₂ in

2050, and the maximum increase in CO₂ removals in one year at just under 2 million tonnes CO₂. This would require optimal seedling densities throughout the area planted. In Climate Cure 2020, this measure was calculated to cost NOK 190 per tonne CO₂.³²

This measure meets the statutory requirements for sustainable forestry under the Forestry Act and regulations on sustainable forestry and the requirements of the Norwegian PEFC Forest Standard. It therefore ensures for example that there is a minimum proportion of broad-leaved trees in coniferous forests. Valuable species and habitats that are registered in connection with harvesting be safeguarded during forest regeneration. Areas planted at higher densities are mapped to document the climate and environmental effects. The grant scheme currently has an annual budget of around NOK 18 million, which is used to provide support for higher seedling densities on about 1/3 of the area planted annually. The Government will continue the scheme and consider whether it should be expanded. If it is to be expanded, sufficient numbers of seedling must be available, and planting must take place within sustainable limits.

Forest tree breeding

Tree breeding involves making use of the genetic variation in forest trees to produce seeds that are more robust and give higher yields than non-improved seed from ordinary forest stands. Norway spruce is the main species for which there are breeding programmes in Norway. High-quality seeds have been produced in seed orchards, making it possible to develop forest where tree survival rate is high, timber quality is better and growth in volume is 10–15 % faster. If more effective tree breeding techniques are used, it may be possible to speed up the growth in volume by 20 % or more. Thus, tree breeding is a way of increasing CO₂ removals by forests. In addition, it is possible to ensure that forest reproductive material is resilient to future climate change.

Today, 75% of the Norway spruce used for forest regeneration in Norway is from improved seed, and the aim is to establish seed orchards in new areas to provide nationwide access to improved seed. In Climate Cure 2020, it was calcu-

³¹ The albedo of a surface is a measure of how much of the incoming sunlight it reflects. A forested landscape will generally reflect less of the sunlight (have a lower albedo) than an open landscape, especially in areas with prolonged periods of snow cover.

³² The average cost of the measure was estimated at NOK 240 per tonne CO₂-eq (extra income from timber excluded from the calculations). When extra income from timber is included, the cost of the measure is estimated at NOK 190 per tonne CO₂-eq.

lated that this measure would only result in a modest increase in CO₂ removals up to 2030. In the longer term, there is much greater potential for increasing CO₂ removals if the proportion of improved seed that speeds up growth in volume by 15 % is increased to 100 %. Given these assumptions, it is estimated that the increase in CO₂ removals would be 232 000 tonnes per year by 2050 and almost 1.5 million tonnes by 2100. The need to ensure that forests are adapted to climate change and to increase CO₂ removals by forest means it is important to maintain the emphasis on tree breeding. This measure is estimated to cost NOK 2-4 per tonne increase in CO₂ removals. The Government has increased allocations to plant breeding in line with the cross-party agreement on climate policy. The Government will continue and consider increasing funding for plant breeding programmes, and will seek to ensure that most forest reproductive material used for regeneration is improved.

Fertilisation of forest as a climate mitigation measure

On forest land where growth is limited by the availability of nitrogen, using nitrogen fertiliser will increase both diameter and height growth and boost annual CO₂ removals over a ten-year period. A grant scheme for fertilisation of forest as a climate mitigation measure was started in 2016. It is designed to meet recommended environmental criteria and avoid unacceptable effects on biodiversity and the environment otherwise.³³

In 2017, NOK 15 million was allocated to the grant scheme for fertilisation of forest. It is estimated that this will result in fertilisation of 10 000 hectares of forest, and in additional CO₂ removals of 27 000 tonnes a year up to 2026. Assuming that 10 000 hectares is fertilised every year from 2018 onwards, the additional CO₂ removals will be 270 000 tonnes a year from 2027 onwards. Over the period 2021–2030, the accumulated effect of fertilisation of forest is estimated to be additional CO₂ removals of about 2.3 million tonnes.³⁴ The cost of the measure is estimated at NOK 36 per

tonne CO₂.³⁵ The Government will maintain the scale of forest fertilisation within the framework of the recommended environmental criteria.

On drained peatland, forest growth is limited by nutrients other than nitrogen. However, fertilisation with wood ash from biofuel plants can increase growth considerably. This is a common technique in Finland and Sweden, but is not permitted in Norway at present. The report on fertilisation of forest as a climate mitigation measure concludes that applying 3–6 tonnes of ash per hectare and harvesting cycle would have a good effect on growth and limited environmental impact. This is also in line with recommendations in Finland and Sweden. According to the report, production of uncontaminated wood ash is estimated at 6 000 tonnes per year, and if applied at the rate of 3 tonnes per hectare, this could be used to fertilise about 2 000 hectares a year. The regulations relating to fertiliser products are under revision, and the Government will consider whether to permit fertilisation of productive forest on drained peatland with wood ash from biofuel plants. If this is permitted, environmental criteria specifically for fertilisation with wood ash must be developed.

Following up obligations relating to regeneration after harvesting

Regeneration after harvesting is important to maintain or increase the carbon stock in forest and to ensure the availability of environmentally friendly raw materials and building materials in the future. After harvesting, forest owners are required to ensure satisfactory regeneration within three years. This must be carried out in a way that is not in conflict with other environmental considerations, and any use of foreign tree species must be in accordance with the Regulations relating to the planting or sowing of foreign tree species for forestry purposes. The Ministry of Agriculture and Food has in recent years given priority to establishing systems for management, monitoring and inspection of regeneration.

According to a report from the Norwegian Institute of Bioeconomy Research³⁶, result moni-

³³ The environmental criteria are set out in a report published in 2014 by the Norwegian Environment Agency, the Norwegian Agriculture Agency and the Norwegian Institute of Bioeconomy Research (NIBIO) (*Måltrettet gjødsling av skog som klimatiltak*, M174-2014). When these criteria are taken into account, the area that could be fertilised is estimated to be of the order of 5 000–10 000 hectares per year for the next 10 years.

³⁴ However, it is uncertain whether the entire increase in CO₂ removals can be credited as part of Norway's emission reduction commitment.

³⁵ The total cost of the measure is estimated at NOK 109 per tonne CO₂ removals, excluding extra income for forest owners from timber sales. The publicly funded share of the costs is just over NOK 36 per tonne CO₂.

³⁶ *En vurdering av utvalgte skogtiltak [An assessment of selected mitigation measures in forest]*, Skog og landskap, report 02/2015. The report used figures for the National Forest Inventory from 2009–2012, i.e. before the Norwegian Agriculture Agency started closer monitoring of forest regeneration.

toring for 2013 showed that plant density in 14 % of the total regeneration area was under the minimum legal density, and in 29 % of the area it was below the level recommended for optimal production in the sustainable forestry regulations. This means that CO₂ removals in forest are lower than they might have been. According to the estimates in the report, this will result in CO₂ removals over the whole period 2015–2100 that are 28 million tonnes lower than if plant densities had been at the minimum legal levels and 83.5 million tonnes lower than if they had been at the recommended levels.

The extent to which forest owners are failing to carry out regeneration after harvesting varies considerably between regions, and the problems are generally greatest in Western and Northern Norway where there is little tradition of forestry. Since 2014, the Norwegian Agriculture Agency has strengthened inspection routines to check compliance with regeneration obligations, and has developed a description of the process and guidelines for people responsible for inspection. Guidelines have also been drawn up for the conversion of forest land to pasture to ensure that areas are not removed from the scope of the forestry legislation in order to evade regeneration obligations. This has probably resulted in an increase in tree density in the last few years, but it takes time for such changes to become apparent in the monitoring figures, since these are based on regeneration areas that are three years old. The Government will continue to improve routines for following up forest owners' obligations to regenerate areas after harvesting, to ensure that a high level of CO₂ removals is maintained in Norwegian forests.

Harvesting of juvenile forest stands

In the context of climate change, 'sustainable forestry' means forestry operations that do not reduce the productivity of forest or its capacity to store carbon, and that do not reduce the carbon stock permanently. Result monitoring shows that from 2009 to 2013, 21 % of felled timber was felled before the trees reached maturity (i.e. they were in developmental stage I–IV).³⁷ Most of this timber (17 %) was from trees in late developmental

stage IV, and only 4 % from early developmental stage IV and 1 % from younger developmental stage (stage III and below), which were defined as 'juvenile forest' in earlier legislation. Since boreal forest grows rapidly towards the end of the harvesting cycle, it is possible to boost CO₂ removals by forest considerably by not harvesting stands too early. For forest owners, it is important to optimise the commercial value of forest, and therefore to avoid harvesting either too early or too late.

In the 2012 cross-party agreement on climate policy, the Storting agreed to the reintroduction of a ban on harvesting juvenile forest stands, which was first introduced in 1965 and repealed when the Forestry Act was revised in 2006. Since then, the Norwegian PEFC Forest Standard has been revised, and now includes a clause stating that clear cutting and seed tree felling should not normally take place in juvenile stands with an appropriate seedling density in forests dominated by coniferous trees. The Norwegian Environment Agency and the Norwegian Institute of Bioeconomy Research have reviewed the likely impacts of reintroducing the ban on harvesting juvenile forest stands for the Ministry of Climate and Environment and the Ministry of Agriculture and Food. They concluded that the impacts could vary considerably depending on how the ban is interpreted and practised. A ban that goes further than the requirements for PEFC certification could prevent a considerable loss of CO₂ removals in forest areas in the period 2020–2030. However, a ban on harvesting juvenile forest stands must be weighed against other considerations of the public interest, for example the price of timber and the industry's needs, and the best way of designing a ban today is not clear.

Since the original ban on harvesting juvenile forest stands was introduced, Norway's forest resources have increased considerably, and the market for Norwegian timber has undergone major changes. In addition, climate change has become an important consideration. This influences the optimal timing of harvesting, and makes it more important to ensure a high level of CO₂ removals and satisfactory forest growth for production of wooden materials and renewable energy that can be used to replace materials with more environmental impact.

The Government therefore wishes to postpone a decision on reintroducing the ban on harvesting juvenile forest stands until the impacts and costs (including administrative costs) have been assessed. The assessment should include a ban designed in various different ways and should

³⁷ Norway divides productive forest into five developmental stages, stage V being mature trees that are ready for harvesting. There may be sound reasons for harvesting trees before they reach maturity, for example if they are in poor health or tree density is unsatisfactory. In such cases, it may be appropriate to harvest a stand at an earlier stage. Areas of this type were not taken into account in the study.

consider the optimal timing for harvesting stands both on the basis of climate change considerations and on the basis of the value of the timber.

Carbon storage in wood products

Wooden building materials and paper and cardboard products store carbon throughout their lifetime. This is taken into account in the greenhouse gas inventory under the UNFCCC by using a separate category called 'harvested wood products', or HWP. In the inventory, the production of wood products, both for domestic use and for export, results in an increase in the HWP pool, and is reported as CO₂ removals, while products are reported as emissions at the end of their lifetime. Norway's reporting to the UNFCCC has for many years shown net removals in this sector. However, in the last few years the situation has changed, with closures in the Norwegian pulp and paper industry and increasing exports of raw timber. As Chapter 4 shows, it is likely that if the European Commission's proposal is adopted, Norway will have to report net emissions from HWP for the period 2021–2030.

If the production of wood products in Norway rises, this will have a positive effect in the greenhouse gas inventory, even if the products are exported. At present, the largest contribution to carbon storage in long-lived wood products in Norway is from the use of timber in the construction industry. Based on calculations and assumptions from the report *Climate Cure 2020*, building materials made from 0.75 million m³ of timber can theoretically store up to 0.5 million tonnes CO₂ a year until the products and the carbon in them are no longer in use. In addition, substitution effects³⁸ and the effects of using by-products and residual products can reduce emissions in other sectors.

Norway has a long tradition of using wood in single-family homes and other smaller buildings, for example smaller commercial buildings and farm buildings. In recent years, the development of new technology has also made it possible to use timber in larger buildings and other structures. Using laminated and cross-laminated timber, it is possible to build higher structures, even in urban areas. Problems relating to fire safety, durability and load-bearing capacity, which have previously limited the use of wood, have now largely been

solved. Nevertheless, studies show that factors such as a lack of standardisation and industrialisation, a lack of expertise in the industry and a lack of pre-approved solutions are acting as barriers to greater use of wood in larger, urban buildings and other structures. These barriers were also identified in Norway's strategy for the forestry and wood industry and by the expert committee on green competitiveness.

Although it is often no more expensive to use wood than alternative materials, traditional and more emission-intensive construction materials are often chosen. The Government will promote more use of wood in buildings and will consider measures that can play a part in increasing the carbon stock in long-lived wood products as reported to the UNFCCC.

5.12.2.4 Measures relating to other land categories

Reducing emissions from agricultural areas

Large quantities of carbon are stored in soils and vegetation, and the carbon content is influenced by soil management. Ploughing and other working of the soil releases carbon, while growing plants absorb and store carbon. Reducing tillage intensity can reduce emissions, and adding organic material or biocarbon can increase the size of the carbon pool in soils. Too little is known about the potential for enhancing removals and reducing emissions and about suitable measures for boosting carbon storage in agricultural areas (managed cropland and grassland). It is generally difficult to identify the effects of measures targeting these land categories. In the time ahead, the Government will give high priority to reviewing options for enhancing removals and reducing emissions of carbon from soils, and build up knowledge about relevant measures and policy instruments. A project will also be started to improve the model for calculating and reporting emissions, with a view to including actual changes in emissions and removals.

Reducing peat extraction

Intact peatlands store large quantities of carbon, are important for biodiversity and play an important role in moderating flooding. Measures to halt the extraction of peat from intact peatlands will therefore have many other positive effects in addition to preventing CO₂ emissions. In the period 1990–2015, average annual emissions associated with peat extraction in Norway were about 63 000

³⁸ In *Climate Cure 2020*, it was also estimated that 0.75 million m³ timber could substitute for construction materials made of steel and concrete that would correspond to annual emissions of 0.6 million tonnes CO₂-eq.

tonnes CO₂-eq. These emissions include both emissions from the peat extracted, and emissions from the areas where extraction has taken place. Average annual emissions from extracted peat were 40 000 tonnes CO₂-eq, and average annual emissions from the areas affected by extraction were on average 23 000 tonnes CO₂-eq.

The largest area of use for peat in Norway today is in various types of growth media and soil mixtures. By using alternatives to peat, for example compost based on park and garden waste, it is possible to reduce peat extraction. Reducing or halting extraction of peat from areas currently used for this purpose will reduce or halt emissions from extracted peat. Restoration of areas that have been used for peat extraction will reduce emissions from these areas, but not eliminate them entirely.

The Ministry of Climate and Environment has commissioned an impact assessment of completely or partly phasing out the use of peat in Norway from the Norwegian Environment Agency in 2017.

Halting new cultivation of peatland

Halting new cultivation of peatland will reduce emissions below the current baseline projections, which use assumptions about the area of peatland that will be taken into cultivation if no restrictions are introduced. Assuming that about 400 hectares is taken into cultivation every year at present, it is estimated, on an uncertain basis, that if a prohibition was introduced in 2018, the accumulated reduction in emissions would be about 0.9 million tonnes CO₂ in the LULUCF sector for the period 2021–2030. In the same period, this measure would also reduce nitrous oxide emissions by 192 000 tonnes CO₂-eq. This reduction would be reported in the agricultural sector. New estimates made by the Norwegian Institute of Bioeconomy Research in May 2017 indicate that only about 200 hectares a year of peatland is taken into cultivation, in which case the estimated emission reductions would also have to be halved. Draining and cultivation of peatland has been one of the most important pressures on threatened biodiversity in peatland habitats.

In the budget agreement for 2017 between the Government and the parties with which it is cooperating in the Storting, the Storting asked the Government to put forward a proposal to prohibit new cultivation of peatland areas. When the Storting considered the white paper on agricultural policy, a majority of the Standing Committee on

Business and Industry emphasised the need for a thorough review of this issue and for a consultation process to delimit the scope of the proposal. The majority of the committee also considered it important to distinguish between shallow and deep peat deposits. The Government will submit a proposal to the Storting on a prohibition against new cultivation of peatland.

Restoration of peatland and other wetlands

Intact peatland in Norway holds a large carbon pool and supports rich biodiversity. Other types of wetlands, such as river deltas, can protect against destructive flooding and be important in climate change adaptation. There are large emissions from organic soils (peat deposits) that have been drained in Norway, and peatland restoration can be an appropriate step in areas that are no longer being used for agriculture or peat extraction, or where draining areas for forest production has been unsuccessful. As a general rule, peatland restoration reduces net emissions (of CO₂, nitrous oxide and methane) below the levels in drained areas, but more knowledge is needed to make any estimate of the size of the emission reductions, since there are various different peatland types and their condition before restoration varies considerably. In the very long term, it may be possible to achieve net removals of carbon in restored peatlands.

The Government is implementing a plan for peatland restoration for the period 2016–2020. NOK 26 million was allocated to this work in 2017. The goals are to reduce greenhouse gas emissions, enhance adaptation to climate change and improve the ecological status of wetlands. Restoration includes blocking drainage ditches in peatland that is no longer being used for agricultural purposes or where drainage has not resulted in the growth of productive forest, in such a way that no conflict arises with agricultural or forestry interests. Whether it is possible to achieve the aim of reducing greenhouse gas emissions will depend on the properties of the area being restored. Cost-effective projects are being given priority, and restoration is carried out in agreement with landowners and rights holders. The emission reduction potential and costs of this measure will need to be updated on the basis of experience gained during the period covered by the restoration plan.

At least one third of Norway's peatlands below the treeline have been drained during the last 100 years. Areas suitable for restoration will therefore

be available both within and outside protected areas, and this will still be the case after 2020. After 2020, the Government will ask the Norwegian Environment Agency and the Norwegian Agricultural Agency for an assessment of pro-

gress towards the goals of the plan and for recommendations on whether to peatland restoration should be continued and expanded in the period 2021–2030.

6 Economic and administrative consequences

Achieving the 2030 and 2050 climate targets is bound to entail costs. The costs of reaching the 2030 target have previously been discussed in the white paper *New emission commitment for Norway for 2030 – towards joint fulfilment with the EU* (Meld. St. 13 (2014–2015)) and in a recent bill proposing a new Act relating to Norway's climate targets (Prop. 77 L (2016–2017)).

Norway will have to go through the impending transformation process in the face of great uncertainty, both as regards the costs and social impacts, and as regards the speed of technological developments in different areas. Norway can play a part in technological advances, but is at the same time dependent on technology that is developed in the rest of the world. Unilateral action by Norway cannot be an option for Norway, since this would mean that there was no concerted global effort, which would be damaging at both national and global level.

The 2030 target is a conditional commitment for Norway to reduce its emissions by at least 40 % by 2030 compared with the 1990 level. The Government is working towards joint fulfilment of this commitment together with the EU. The EU's climate policy is based on three pieces of legislation: the Emissions Trading System (EU ETS) and the proposed Effort Sharing Regulation and Land Use, Land-Use Change and Forestry (LULUCF) Regulation. The principle of equal treatment is important for the Government in its dialogue with the EU, not least in connection with determining national targets and the flexibility and forms of cooperation available when the legislation is implemented.

If an agreement with the EU is not reached, the Government will maintain the ambition of reducing emissions by at least 40 % by 2030 compared with 1990. This target will be conditional on the availability of flexible mechanisms under the new climate agreement and on Norway being credited for participation in the EU ETS, so that this counts towards fulfilment of the commitment.

According to projections presented in the white paper *Long-term Perspectives on the Norwegian Economy 2017*, Norway's non-ETS emis-

sions will decline from 27.3 million tonnes CO₂-eq in 2015 to 23.1 million tonnes CO₂-eq in 2030. The projections are based on the assumption that the current design of Norway's climate policy is maintained. This means among other things that the tax base and tax rates for the carbon tax are kept unchanged and that support for technology development, for example through Enova, is maintained. Calculations of how current policy will influence emissions in the future are uncertain, and the level of uncertainty increases over time. The uncertainty applies not only to the economic outlook and the population trend, but also the development and availability of low- and zero-emission technologies and the costs of deploying such technologies.

The Norwegian Environment Agency has carried out technical analyses of the emission reduction potential using the emission projections in the white paper *Long-term Perspectives on the Norwegian Economy 2017* as a basis, and has also estimated the economic costs of each of the measures assessed. The cost estimates are uncertain and will depend among other things on technological and economic developments. The analyses are based on a range of possible measures and do not include an evaluation of which policy instruments could be introduced to ensure that the measures are implemented.

Chapter 3 shows how the estimated emissions gap of 20–25 million tonnes can be closed by means of domestic emission reductions. If the European Commission's legislative proposals are adopted, joint fulfilment by Norway and the EU would mean that Norway too would be assigned the target of ensuring that recorded emissions from the LULUCF sector (land use, land-use change and forestry) do not exceed the recorded removals of CO₂. This means that Norway's emission commitment may increase above the level that follows from the Effort Sharing Regulation.

The Norwegian Environment Agency has estimated that action to achieve the political goals and ambitions discussed in Chapter 3 can result in emission reductions of the order of 16 million tonnes CO₂-eq over the period 2021–2030. The

cost estimates for the different measures vary widely. In its analyses, the Environment Agency has divided mitigation measures into several cost categories, and has estimated that there is an emission reduction potential of about 18 million tonnes at an economic cost of less than NOK 500 per tonne CO₂-eq in addition to the potential mentioned above. See Chapter 5 for more information on cost estimates.

The estimated emission reduction potentials and costs are uncertain and sensitive to the underlying assumptions. The Environment Agency's analyses show that many of the measures that could play a part in closing the estimated emissions gap of 20–25 million tonnes CO₂-eq have an estimated economic cost of less than NOK 500 per tonne CO₂-eq (average annual cost up to 2030). The economic costs of the remaining measures vary: some are in the category NOK 500–1500 per tonne and others are estimated to cost more than NOK 1 500 per tonne. The estimated costs of a number of measures are considerably higher early in the period used for analysis. For example, the current cost of using advanced biofuels is estimated to be from NOK 2 000 per tonne and upwards. For 2016, the cost of phasing in electric cars is estimated at around NOK 7 000 per tonne CO₂-eq for small cars and NOK 15 000 for large cars. The development of zero-emission solutions for heavy vehicles is still at an early stage, and the costs are high. The Environment Agency expects the costs of zero-emission vehicles to fall steeply towards 2030. The cost of phasing in small passenger cars is expected to be negative (in other words, economically beneficial) from 2025 onwards. In addition, there are certain non-ETS emissions that are not currently taxed or subject to other climate policy instruments, where it would be possible to achieve emission reductions by introducing economic instruments at a level equivalent to the standard carbon tax rate.

The bill proposing an Act relating to Norway's climate targets (Prop. 77 L (2016–2017)) includes a discussion of the costs of achieving the 2030 target. According to this, the greater the emission reductions Norway makes in the domestic non-ETS sector, the higher would be the expected average cost per tonne of fulfilling the emission reduction commitment. The white paper New emission commitment for Norway for 2030 – towards joint fulfilment with the EU includes an account of analyses carried out by Statistics Norway¹ based on macroeconomic modelling. These suggest emission reductions of the order of 1½–4½ million tonnes, given a carbon price that is con-

sistent with the two-degree target. Norway's 2017 national budget also discusses the costs of reducing non-ETS emissions. This account is based on an analysis by Statistics Norway of the economic cost for Norway of reducing non-ETS emissions by about 40 % from 2005 levels given different degrees of flexibility in the system. The economic cost is modelled through an increase in the carbon tax rate, and the calculations show that the rate may have to be increased by up to NOK 4800 per tonne CO₂-eq in order to reduce non-ETS emissions by about 10 million tonnes in 2030, corresponding to a reduction of around 40 % from 2005 levels. Statistics Norway carried out the analysis before the European Commission presented its proposal for an Effort Sharing Regulation on 20 July 2016.

Estimates of the emission reduction potentials and costs of measures are highly uncertain, and will depend to a large extent on further developments in low- and zero-emission technology for the transport sector. The assumptions used about international climate policy and the development of climate-friendly technology are of crucial importance. As regards non-ETS emissions, where transport is the dominant source of emissions, Norway is dependent on technology development in other countries, and the costs of such technology where it is developed will determine the cost level in Norway as well. It is possible for example that it will take longer to phase in new zero-emission vehicles or that it is more difficult to realise the potential for reduction of non-ETS emissions from the petroleum sector than the Environment Agency has assumed. The Environment Agency has not assessed the policy instruments that would be needed or how they should be applied, and this is another source of uncertainty.

The potential for emission reductions and the associated costs may depend on which policy instruments are chosen. The most effective policy instruments are considered to be either a standard carbon tax applied across sectors or emissions trading, because they provide incentives to reduce emissions where the costs are lowest. In addition to reducing emissions, a carbon tax generates state revenue that can be used for other purposes. Certain policy instruments may cause unintentional distortion of production and con-

¹ Statistics Norway (2013). Kostnadseffektive tilpasninger til togradersmålet i Norge og EU fram mot 2050 [Cost-effective adaptation to the two-degree target in Norway and the EU up to 2050], Reports 39/2013.

Box 6.1 Projected emission trends in Norway and the EU up to 2030

The 2030 targets for individual countries under the Effort Sharing Regulation are determined partly since simulations that provide information on projected emission levels in 2030. The simulations show that in a business-as-usual scenario, the overall non-ETS emissions of the EU countries will be about 24 % lower than in 2005. There are wide variations between the EU countries. The European Commission has not so far calculated figures for Norway, but the projections in the white paper Long-term Perspectives on the Norwegian Economy 2017 indicate that Norway's emissions will decline by about 16 % in the same period.

The sectors of the economy that will be most important for trends in non-ETS emissions are different in Norway and the EU. Many EU countries use fossil fuels to heat buildings, whereas Norway mainly uses electricity and biofuels. Reducing emissions from buildings will continue to be important for most EU countries up to 2030. On the other hand, a high proportion of emissions in Norway are from transport. Per capita emissions from transport are also higher in Norway than in the EU as a whole. This is explained partly by the scattered pattern of population, the large fishing fleet and the substantial transport needs of the petroleum industry. However, there are also large variations between countries within the EU.

These differences between Norway and the EU must also be considered in the context of higher economic growth and population growth in Norway than in the EU as a whole. Since 2005, growth in GDP has been about 7 percentage points higher in the Norwegian mainland economy than the overall EU figure. In the same period, population growth has been about 9 percentage points higher in Norway than in the EU. As a result of these trends, non-ETS emissions have remained more or less unchanged in Norway since 2005, whereas they have been reduced by about 12 % in the EU. However, there are wide variations between countries in the EU.

sumption that is not to the benefit of society as a whole. For example, a support scheme or subsidy for a specific technological solution may result in excessive production and consumption of these goods. This involves costs to society, and in addition, any support scheme must be funded. The Ministry of Finance currently assumes that an increase in the tax level in Norway results in an economic loss of NOK 0.2 per NOK levied. Furthermore, support schemes and subsidies may have different distributional effects from taxation and emissions trading. The effects of specific policy instruments are also uncertain. The emission reduction potential may be lower than estimated if it is found that there are no appropriate policy instruments that can be used to ensure that a measure is fully implemented.

According to the polluter-pays principle, the costs of the necessary emission reductions will largely have to be met by businesses that generate non-ETS emissions and by individuals. The way the costs are split between individuals, the private sector and the public sector will depend on the policy instruments chosen to achieve the emission targets.

The policy instruments that are chosen will also have implications for the level of administrative costs. These costs will largely be paid by the state, or in some cases by the municipalities and counties, depending on which instruments are chosen. The proposals in this white paper will have limited administrative consequences. The use of policy instruments is considered in connection with the annual budgetary processes.

A number of measures and policy instruments will also have other benefits in addition to reducing greenhouse gas emissions. This applies for example to instruments that play a part in reducing local emissions to air and thus have health benefits. Measures to limit traffic will reduce the number of accidents and result in less congestion and less wear on roads. Win-win measures for the climate and biodiversity include restoration of peatland and other ecosystem-based measures. Instruments designed to reduce greenhouse gas emissions from the agricultural sector can also reduce runoff, improve water quality in nearby river systems and reduce emissions of ammonia to air. In addition, if the authorities' dietary recommendations are followed, there will be health benefits for society as a whole.

However, even if a cost-effective approach is taken to achieving the 2030 target, the necessary action to reduce emissions will entail costs for the state, local authorities and the private sector.

For the world as a whole, the costs of not pursuing a climate policy in line with the goals of the Paris Agreement are potentially very high. For example, further global warming will increase the risk of irreversible damage such as loss of biodiversity and rising sea levels. Costs of this kind will probably be far greater than the costs of the necessary action to achieve the long-term objective set out in the Paris Agreement.

The Ministry of Climate and Environment

r e c o m m e n d s :

that the Recommendation of 16 June 2017 from the Ministry of Climate and Environment concerning Norway's Climate Strategy for 2030: a transformational approach within a European cooperation framework, approved in the Council of State the same day (white paper from the Solberg Government) should be sent to the Storting

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