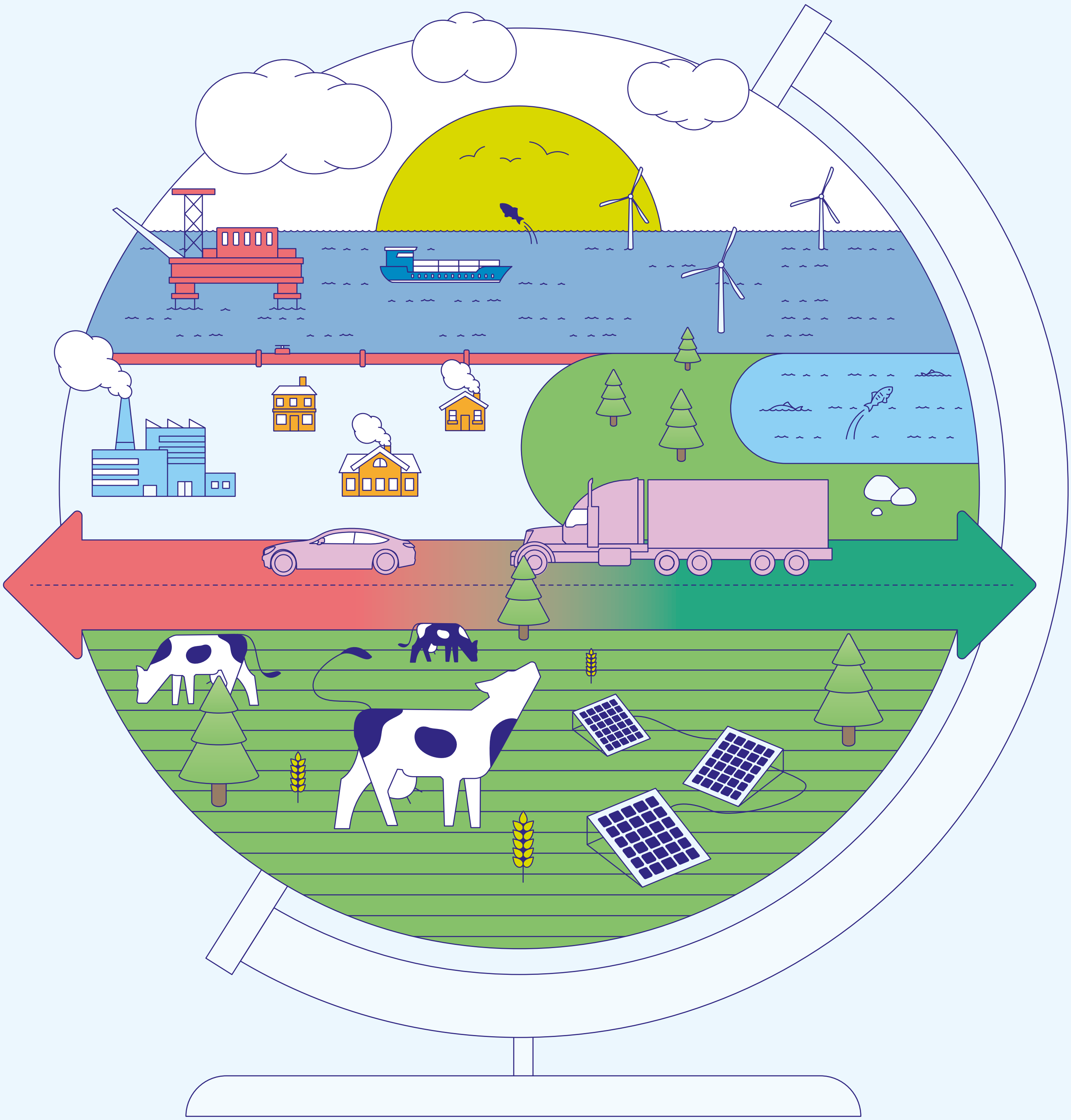
The 2050 Climate Change Committee



The transition to low emissions

Climate policy choices towards 2050

Norwegian Official Report (NOU) 2023: 25 – English Edition

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Climate policy choices towards 2050

Official report by a committee appointed by Royal Decree on 13 August 2021

Submitted to the Ministry of Climate and Environment on 27 October 2023

Norwegian Official Report (NOU) 2023: 25

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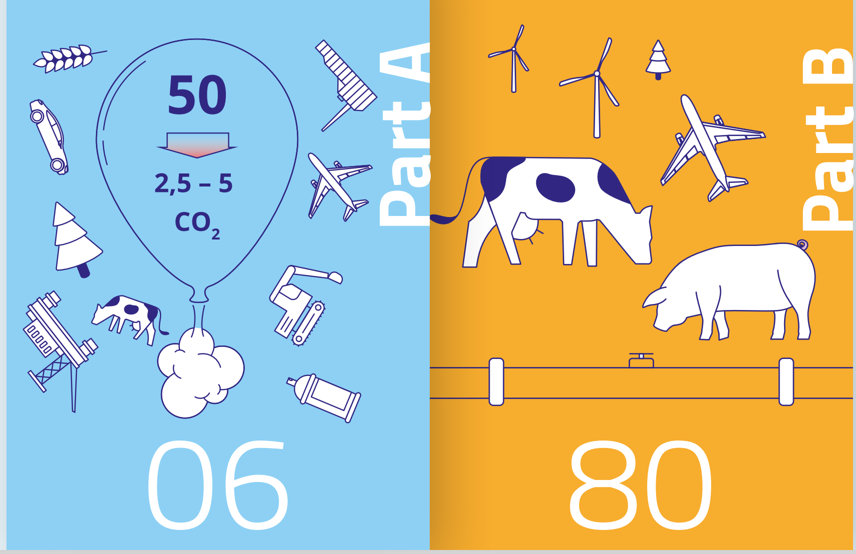

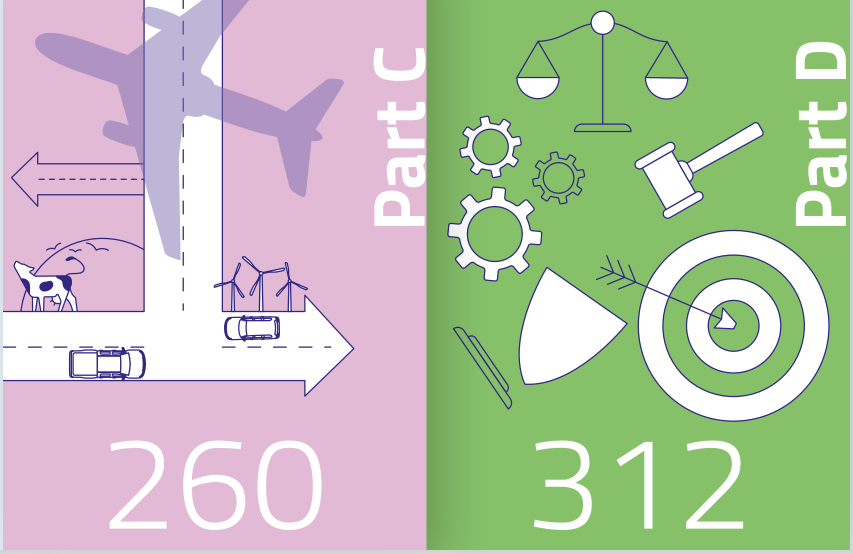
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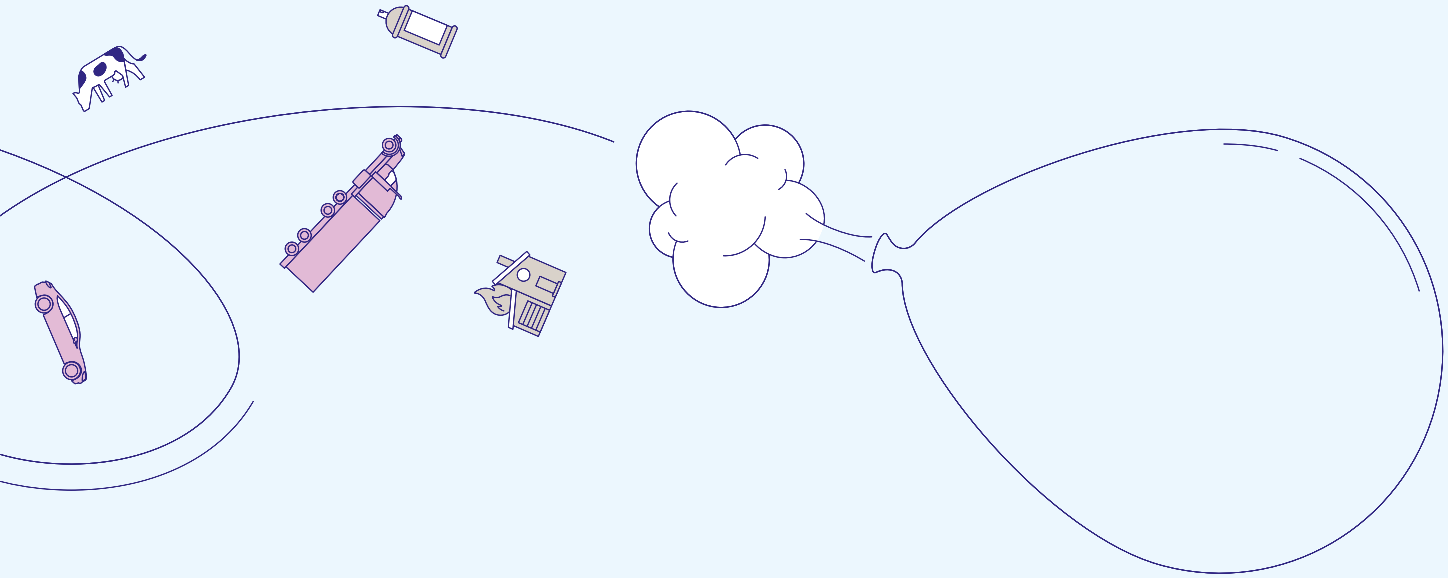


To the Ministry of Climate and Environment

The 2050 Climate Change Committee was appointed by Royal Decree on 13 August 2021 to review Norway's choices for its pathway towards a low-emission society in 2050. A unanimous committee hereby submits its report.

Oslo, 27 October 2023

Martin Skancke
Chair

Camilla Skjelsbæk Gramstad

Kristin Halvorsen

Marianne Hansen

Gro Sandkjær Hanssen

Audun Korsæth

Ola Kvaløy

Astrid Lilliestråle

Klaus Mohn

Lars Petter Maltby

Eirik Newth

Signe Nybø

Erik Trømborg

Elen Richter Alstadheim *Head of the secretariat*

Ellen Bruzelius Backer

Frid Fjose Berg

Thomas Ekeli
(from April 2023)

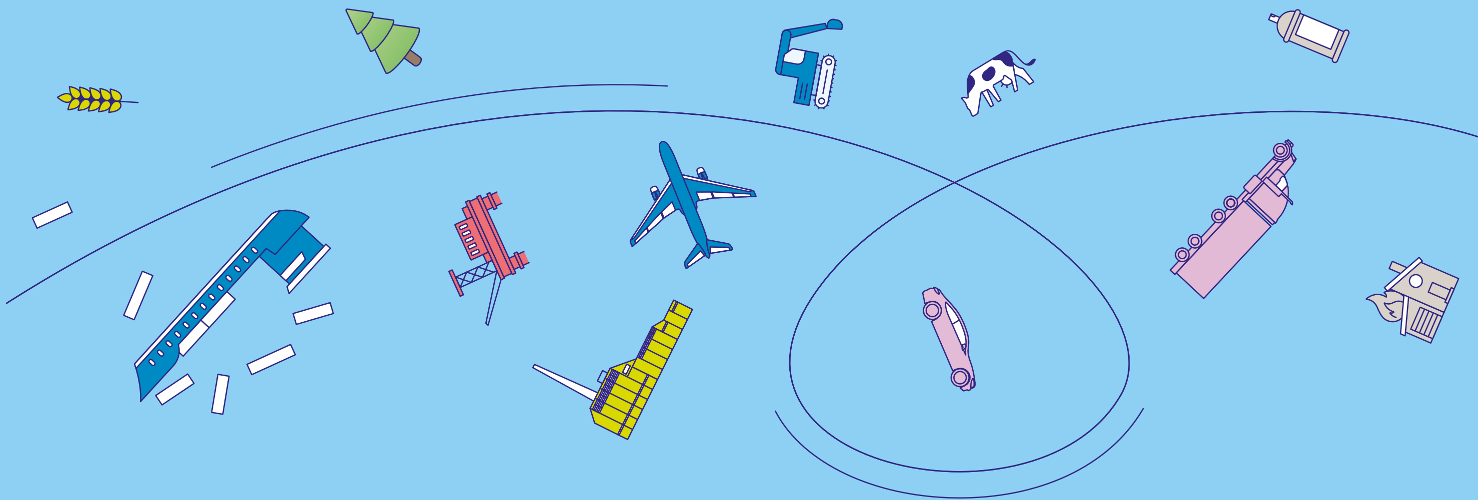
Siri Eritsland

Ane Rostrup Gabrielsen
(from October 2022)

Steffen Kallbekken

Bård Lahn

Arent Skjæveland
(until August 2022)



Part A

Starting point for the transition

In this section, the Committee describes its work on the report and the starting point for this process. The Committee also looks at Norway's emissions, climate goals and climate policy, and assesses the national climate targets.

1 The Committee's work and main assessments

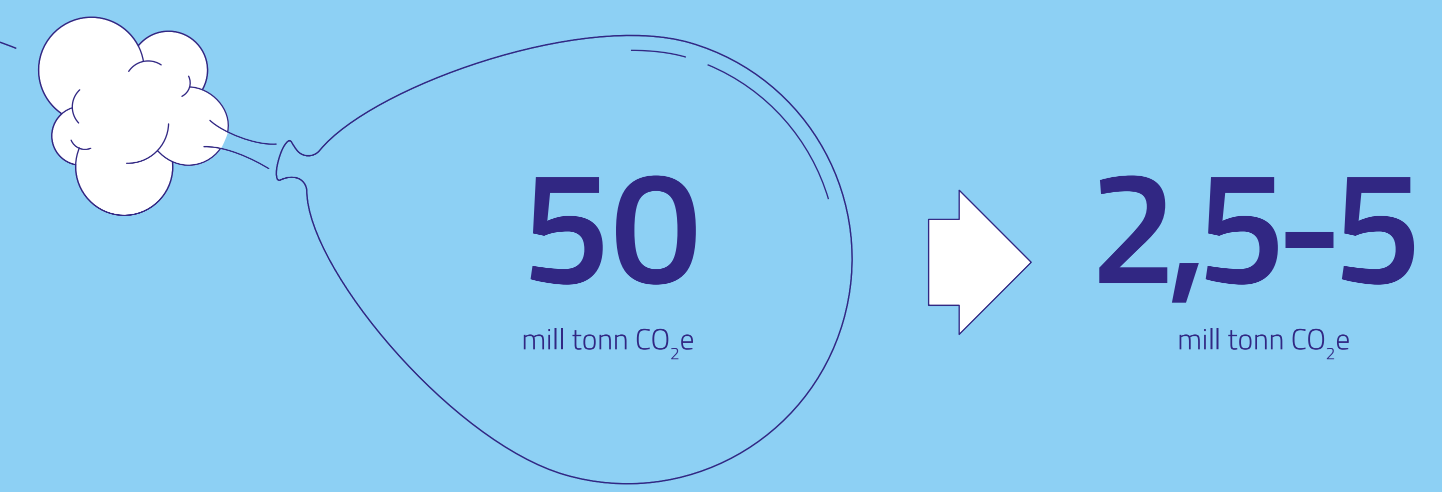
In this chapter, the Committee describes its mandate and the work that has been carried out. The Committee also goes through its main recommendations and provides a reader's guide to the rest of the report.

1.1 Mandate and members of the Committee

A committee was appointed by Royal Decree on 13 August 2021 to review Norway's choices for its pathway towards a low-emission society in 2050.

1.1.1 Mandate

The Committee was appointed by the Solberg Government. The Støre Government made some additions to the Committee's mandate:



Background

The Climate Change Act sets out a statutory target for Norway to be a low-emission society by 2050. In quantitative terms, the Act specifies that the target is to achieve reductions of greenhouse gas emissions of the order of 90–95 % from the level in the reference year 1990.

The Paris Agreement calls on all countries to formulate long-term low-emission strategies. The Government presented Norway's long-term low-emission strategy for 2050 in the budget proposal for 2020 from the Ministry of Climate and Environment (Prop. 1 S (2019-2020)). In the strategy, the Government sets out general priorities and important considerations for the pathway towards a low-emission society in 2050.

The strategy outlines four general characteristics of Norway as a low emission society in 2050:

- Emissions are low in all sectors.
- Forest and other land categories and natural resources are managed sustainably and
- in a way that promotes removals and minimises emissions of greenhouse gases. Norway's land and water act as carbon sinks and supply the population with
- materials, food and energy.
- The business sector is green, with low greenhouse gas emissions.
- Cities and communities are designed to minimise greenhouse gas emissions and
- provide good living conditions for their inhabitants.

The low-emission strategy describes how Norway's climate policy is based on the following principles and ideas: *the polluter-pays principle, policy instruments must be* *effective, support for technology development, global effects are of crucial importance, and our aim is a low emission society, not a low-income society.*

Norway's target of reducing greenhouse gas emissions by at least 50 per cent and towards 55 per cent by 2030 compared to 1990, and the Government's Climate Action Plan for 2021–2030 (set out in the white paper Meld. St. 13 (2020-2021)) are crucial steps on the path towards the target that Norway will be a low-emission society by 2050. As a party to the Paris Agreement, Norway is required to communicate a new or updated nationally determined contribution (NDC) every five years setting out its emission reduction target. To promote the transformation of Norway into a low-emission society, the Government is also required under the Climate Change Act to submit updated climate targets to the Storting (Norwegian parliament) every five years. The review of Norway's choices for its pathway towards a low-emission society in 2050 will provide important input for these processes.

A low-emission development pathway in line with the international targets of the Paris Agreement will entail both opportunities and challenges for all countries, including Norway. Norway's climate policy is closely intertwined with EU climate policy through the EEA Agreement and the agreement on cooperation with the EU to fulfil the 2030 climate target (including participation in the EU Emissions Trading System), and because the EU is Norway's most important trade partner. Implementation of the European Green Deal – the EU strategy for green growth – will influence Norway's green transition. Ongoing legislative developments in the EU will also affect the framework for Norway's climate policy.

Norwegian greenhouse gas emissions originate largely from oil and gas extraction and manufacturing, followed by road traffic and other transport, agriculture and waste. Norway is in a strong position for the transition to a low-emission pathway. Participation in the labour market is high, and there are abundant natural resources, a skilled workforce and sound state revenues. One of the main challenges in the time ahead will be to adjust to a new situation where Norway is more similar to Western economies that do not have oil and gas resources. Fulfilling Norway's commitments under the Paris Agreement is likely to result in lower demand for fossil energy and thus reduce the value of the remaining oil and gas on the Norwegian continental shelf.

However, this may also increase demand for renewable resources that can replace non-renewable alternatives associated with higher emissions, and thus increase their value. Even if large cuts are made in global anthropogenic emissions in the next few decades, it will take time for the warming trend to be reversed. It is therefore vital to prepare for change and to adapt to a changing climate at the same time as transforming Norway into a low-emission society. The climate is already changing, and the impacts are becoming apparent in Norway.

A satisfactory general framework for the business sector is a vital basis for building long-term capacity for growth and adaptation. A competitive environment and predictability are particularly important for the development of green technology. The framework for transformation to a low-emission society must be based on the best available scientific knowledge. This knowledge is constantly developing. A sound knowledge base is important not only as a basis for implementing policy as effectively as possible, but also because it helps to reduce uncertainty and puts us in a better position to manage the transition to a low emission society and deal with climate risk. The IPCC's reports, including the special reports Global Warming of 1.5 °C and Climate Change and Land, and the forthcoming Sixth Assessment Report, are considered to provide the best available knowledge base for developing climate policy. The Committee will also draw on the expertise of relevant government agencies and on key public documents, relevant analyses and expertise both in Norway and in other countries, and on the work of the technical committee responsible for calculations in the field of climate change mitigation. Both quantitative and qualitative methods will be required to conduct analyses of climate change and wider social development up to 2050. It may be necessary to supplement the currently available knowledge base.

The distributional effects of different emission reduction tools and measures will vary in relation to income, between labour and capital, and between central and less central areas. A skewed distribution of the advantages and disadvantages of climate policy could contribute to dissatisfaction in public opinion and polarisation, and delay the necessary transition.

Guidelines

The main tasks of the Committee are to conduct an overall review of Norway's choices for achieving its 2050 climate target, and to describe a pathway for the transformation to a low-emission society by 2050 that is as cost-effective as possible, resulting in a society where resource use is efficient and business and industry is competitive. This process must also ensure a development pathway that safeguards biodiversity and maintains a welfare-based society. The Committee will evaluate progress towards the targets and assess the benefits obtained against economic costs.

The review must identify cross-sectoral issues. This is particularly important in areas such as sustainable, integrated spatial management and energy, which involve various sectors. The review must also include emissions and removals in all sectors, and consider key issues relevant to achieving the 2050 target.

In reviewing different pathways Norway can choose to reach its target of being a low emission society by 2050, the Committee should consider:

- policy coherence in the short, middle and long term, including cost-benefit analyses
- climate risk (transition risk)
- issues relating to a just transition and geographical disparities on the path towards a low emission society, including distributional effects relating to income, distribution between labour and capital in the production of goods

and services, and geographical distributional effects between central and less central areas
- the influence of technology development on costs, prices and market structure
- Norway's relations with the EU and the development of EU legislation
- links between behavioural patterns, sustainable lifestyles and a low-emission
- development pathway
- issues relating to local and national decision-making processes and governance systems

The Committee will analyse the roles of different stakeholders in the transition to a low emission society. These include the central government, counties and municipalities, business and industry, the financial industry, civil society, and the general public where relevant. The Committee will invite input and involve relevant stakeholders in the work, including the business sector, civil society and the social partners. The Committee will ensure that the process is inclusive and will encourage broad-based public debate.

The Committee will provide the Ministry of Climate and Environment with a status report midway through its work. The Committee will submit an overall review and recommendations in the form of an Official Norwegian Report (NOU) by 1 November 2023.

1.1.2 Members of the Committee and the Secretariat

The Committee has consisted of the following members:

- Martin Skancke (self-employed), Oslo (chair)
- Mari Hasle Einang (student), Oslo (until August 2023)
- Tonje Foss (Strategy Director), Trondheim (until January 2022)
- Camilla Skjelsbæk Gramstad (Head of Sustainability), Nordre Follo
- Kristin Halvorsen (Director), Oslo
- Marianne Hansen (Senior Advisor), Steigen
- Gro Sandkjær Hanssen (Senior researcher), Oslo
- Audun Korsæth (Division Director), Ringsaker
- Ola Kvaløy (Professor), Stavanger
- Astrid Lilliestråle (Director of Market Development), Trondheim (from February 2022)
- Klaus Mohn (Professor), Stavanger
- Lars Petter Maltby (Director), Arendal
- Eirik Newth (Science Communicator), Oslo
- Signe Nybø (Head of Research), Trondheim
- Erik Trømborg (Professor), Kongsberg

Tonje Foss resigned from the Committee in January 2022 after a change of employers. She was replaced by Astrid Lilliestråle from and including February 2022. Mari Hasle Einang resigned from the Committee in August 2023 for health reasons.

The Secretariat has consisted of the following members:
- Elen Richter Alstadheim (Head of the Secretariat)
- Ellen Bruzelius Backer
- Frid Fjose Berg
- Thomas Ekeli (from April 2023)
- Siri Eritsland
- Ane Rostrup Gabrielsen (from October 2022)
- Steffen Kallbekken
- Bård Lahn
- Arent Skjæveland (until August 2022)

The Committee submitted its unanimous report to the Ministry of Climate and Environment on 27 October 2023.

1.2 The Committee's main assessments

The transition to a low-emission society requires stronger climate policy. As described in the Committee's interim report from June 2022, the Committee has based its work on the following:

- There is a large gap between the ambitions set out in climate policy and adopted measures and policy instruments. The implementation of climate policy must therefore be more *credible*. Measures to reduce emissions must not be eroded, the implementation of measures must not be postponed, and low-emission development must be incorporated to a greater extent into the development of society in general.
- Climate policy must be *broader.* Reducing emissions from Norwegian territory is not enough. Norway's efforts to reduce emissions elsewhere, including in connection with Norwegian exports, imports, aid and technology development, must be coordinated and intensified. It is also essential that climate policy is seen in the context of the nature crisis and policy for sustainable use of terrestrial and marine areas.
- Climate policy must place *more emphasis on long-term considerations*. Norway's climate policy must, to a greater extent, emphasise a lasting transition to zero emissions. All climate policy measures should be assessed on the basis of their overall effects on emissions over time.
- Climate policy must be *supported by a decision-making system* that is more aligned with the goal of a comprehensive transformation of society.

A targeted transition to a low-emission society must start now. Planning, decisions and goals must be revised now to bring them in line with where Norwegian society should be in 2050. The year 2050 is 27 years away. The more wrong decisions that are made now and the more investments pull in the wrong direction, the more difficult and abrupt the transition will be. The extreme weather in the summer of 2023, both in Norway and the rest of the world, serves as a reminder of the urgency of implementing more effective climate policy.

The transition to a low-emission society requires political leadership. Many measures will require change and restructuring. This can create resistance from groups interested in avoiding certain changes. Political leadership is required to balance cross-cutting considerations and interests and ensure inclusive processes that give legitimacy to decisions, while accelerating the pace of transition. Not least, leadership is required to inspire action and to show that the transition to low emissions is a transition to something better. The Committee has endeavoured to shed light on the key aspects of the transition society must undergo and to identify the most important choices we are facing. However, only political leadership can translate long-term emission targets into policy decisions today.

Table 1.1 The Committee's main recommendations

The Committee is of the opinion that…	… and has the following recommendations:
…all decisions made today must be based on the objective that virtually all greenhouse gas emissions in Norway must be eliminated for good by 2050. Norwegian climate policy must emphasise a permanent transition to zero emissions, and the pace of the transition must be increased.	• Specify Norway's climate goals for 2050 to include a reduction in emissions from Norwegian territory by 90–95 per cent compared with 1990, without including emissions and uptake from the forestry sector and other land use. • set separate climate targets for carbon emissions, uptake and sequestration in the forestry and land use sectors. The targets should be seen in the context of national biodiversity goals and international nature commitments. • base the transition to a low-emission society on existing emissions being eliminated or substantially reduced through reduced activity levels, changed behaviour and the use of zero-emission technology. • the development and implementation of direct air capture technology is important, but must not be relied upon as an alternative to reducing emissions. • develop a transition policy for the agricultural sector beyond the current level of ambition. • prepare a strategy for the final phase of Norwegian petroleum activities, and present it to the Storting as soon as possible. The Committee recommends not granting any further licences for development and operation (PDO) or installation and operation (PIO) until such a strategy has been completed.

The Committee is of the opinion that...	... and has the following recommendations:
... all policies and decisions must be based on the fact that all resources are scarce.	• all economic activity must take place within planetary boundaries, and the economy must become more circular. • give priority to solutions that reduce the use of scarce resources such as power, land and minerals and metals. • introduce stronger energy efficiency measures at the same time as the production of renewable energy is increased to ensure access to sufficient energy as a replacement for fossil energy. • not set low energy prices as the main objective of energy policy. Energy prices must reflect the costs to society of facilitating new forms of power. • give priority to measures that reduce demand for transport, both of goods and of people. • prioritise biomass, which is a scarce resource, for purposes other than energy. • reduce the level of activity in the petroleum industry beyond the expected level towards 2050, in order to prevent the sector from laying claim to scarce resources such as power and expertise, thereby making the transition to a low-emission society more difficult. The Committee recommends permanent cessation of exploration activities without a direct connection to existing infrastructure, and that no decisions are made to build new infrastructure that locks us to emissions towards and beyond 2050. • as a general rule, avoid using power from shore as an emission reduction measure for offshore installations.
... land use policy must limit loss of nature and contribute to the conservation of natural carbon sinks	• significantly limit the degradation of natural areas, and ensure that a more comprehensible and binding national framework is established for the use of land. • increase the national protection of ecosystems. • develop binding, comprehensive plans for marine areas.
...the cost of emissions must be increased	• apply carbon pricing as far as possible, and draw up a binding plan for a gradual increase of the carbon tax that is applicable also after 2030. • use other means such as regulatory and educational instruments when carbon pricing is not sufficient, possible or effective. • consider using revenues from emissions trading and funds allocated to the CO_2 compensation scheme towards net zero transitions in industries that have an obligation to surrender allowances. • manage undesirable distributional effects through the tax system and welfare schemes as a general rule.

The Committee is of the opinion that…	… and has the following recommendations:
… a broad approach must be taken to the use of policy instruments, including the use of legal, economic and educational measures.	• place emphasis on ensuring that climate policy instruments are predictable and reduce undesirable path dependence. • combine policy instruments to enable rapid transition and increased support for climate policy. • use legal instruments such as requirements, obligations and bans to a greater extent, and consider on a continuous basis whether it is useful to announce future bans on emissions from various sources. • climate considerations are prioritised in legislation through requirements for assessing climate impacts or placing emphasis on climate considerations. • always consider whether other policy instruments, such as public procurement and educational instruments, can be effective.
…plans and decision-making systems must be based on the premise that Norway will be a low-emission society by 2050.	• establish an enhanced climate governance system in Norway that contributes to the fulfilment of climate goals. • base all key governance and policy documents, such as the annual budget documents, the National Transport Plan and the white paper on long-term perspectives on the Norwegian economy, on the climate goals. • submit comprehensive climate and energy plans to the Storting every other year, and work to achieve broad and ambitious climate agreements in the Storting. • involve the Sami population more effectively in official climate policy decisions. • establish a climate panel tasked with contributing to a scientific basis for climate policy and identifying opportunities and challenges. • the municipalities are given a clear statutory responsibility to contribute to Norway's transition to a low-emission society, and the Government must take steps to enable municipalities to pursue an ambitious climate policy. • through cooperation and dialogue between employers, employees, the education sector and political authorities, pursue a structured approach to continuing and further education in order to meet the skills needs of the low-emission society.
…how Norwegian policy affects other countries' ability to transition to a greener economy must be taken into account in a more systematic way.	• step up efforts in Norway to reduce emissions in other countries. This effort must come in addition to meeting Norway's climate goals. • establish a national goal to reduce greenhouse gas emissions in other countries from consumption in Norway in accordance with the goals of the Paris Agreement. • consider how Norway can include emissions from foreign aviation and shipping relating to Norway in our own territorial climate goals. • develop trade policy as an instrument in the transition to a low-emission society and a circular economy.
…Norway is reliant on continued close cooperation with the EU on climate policy.	• continue Norway's climate cooperation with the EU and implement the EU's climate regulations leading up to 2050. • implement EU transition regulations at a faster pace.

The Committee has a broad remit. Norway must become a low-emission society and at the same time be a good society to live in for everyone, with a competitive business sector and where biodiversity is safeguarded.

The starting point for the work is the ambition to cut emissions codified in the Climate Change Act. The Committee's remit is based on the premise that greenhouse gas (GHG) emissions in Norway must be reduced by 90–95 per cent by 2050 compared with the 1990 level. This means that emissions must be reduced from about 50 million tonnes per year in 1990 to 2.5–5 million tonnes in 2050. Given that some emissions are difficult to avoid, this means in practice that virtually all other GHG emissions must be eliminated for good before 2050.

This report is not a detailed roadmap to 2050. The Committee's main objective has been to consider how good principles and decision-making systems at all levels can make the road to a low-emission society easier, faster and more efficient. There are many factors we do not know the full extent of today that will affect how easy the transition will be and which choices are wise. It is therefore neither possible nor desirable to create a detailed plan now for the entire transition society must undergo, but it is important to regularly prepare updated, continuous plans for transition and emission cuts that reflect new information. However, there are many measures that make sense no matter how the world develops.

We have more than 25 years until 2050, but many important decisions and choices must be made before 2030. The year 2050 may seem a long time off, but transformation takes time and decisions made today result in path dependency (see Box 3.3) that can either facilitate a gradual, effective transition or make the transition more difficult at a later date. The Committee emphasises that all decisions, made by public authorities and private actors alike, must be assessed against whether or not they are in line with a low-emission society in 2050. This will entail many both minor and major changes in how we plan, implement and evaluate decisions and investments in virtually all areas of society.

The Committee has emphasised the importance of highlighting key contexts and considerations in climate policy. The transition affects society as a whole and requires access to resources that will become scarce, such as electric power, land and expertise. Measures in one sector may as such affect the opportunities and constraints other sectors face in the transition. A good transition policy must take this into account.

There are many ways in which to perceive and analyse the comprehensive transition needed to fulfil the climate targets. Economic, legal, social, administrative and psychological perspectives can all be useful for understanding both the challenges and opportunities associated with the transition. This means that many different disciplines can contribute useful approaches to how the transition can best be implemented. The composition of the Committee is broad, and insights and principles from several disciplines have been incorporated into the work on this report.

1.3 The Committee's work

The Committee has had 18 committee meetings, as well as a number of digital subject-specific meetings. The first committee meeting was held in October 2021, and the last took place in September 2023. Three of the meetings were combined with various study trips to Trondheim, Stavanger, and Troms and Finnmark, respectively. On the visit to Troms and Finnmark, the Committee visited the Sami Parliament in Karasjok and attended meetings in Hammerfest and Tromsø. Presentations from the subject-related introductions at committee meetings and subject-specific meetings have routinely been posted on the Committee's website www.klimautvalg2050.no.

The Committee has based its assessments on a broad range of official studies and reports, input, meetings with various stakeholders and written documentation prepared during the process. The Committee's knowledge acquisition process has been broad, and this came in addition to the existing substantial national and international knowledge base in the climate field on which the Committee has based its assessments. The Committee has obtained knowledge and experience from experts in the field as well as important stakeholders in the transition process. Other sources are reports, articles, podcasts, external reports and supporting material produced by the secretariat.

In its work, the Committee has emphasised the importance of public involvement. It has held two open online meetings where it has been possible to submit written input afterwards. The first online meeting was about interpretation of the mandate and was held during the initial phase of the work. The second online meeting presented the Committee's interim report from June 2022. The report is available as a digital appendix to this report. Here, the Committee asked for input on a number of specific issues. This input has been important to the Committee's work on the main report. All input received has been posted on the Committee's website and is available as a digital appendix to the report. The Committee has also participated in a meeting with the Council for a Just Transition for Workers. It has also organised a public event on petroleum policy in Stavanger, and a public event on power in Norwegian climate policy in Oslo. Both events were well-attended. Recordings are available on the Committee's website. The Committee also organised four input meetings on land, power, biomass and the food system in a low-emission society, respectively. The introductory talks at these meetings were given by experts in the respective fields, followed by plenary discussion. Participation was by invitation, and a wide range of representatives from the business sector, civil society and other relevant stakeholders attended. Minutes of the discussion meetings have been published on the Committee's website. In addition, the chair of the Committee has given several introductory talks about the Committee's work to various stakeholders. See also the appendices for an overview of introductory speakers at Committee meetings.

In parallel with the work of the 2050 Climate Change Committee, other committees have worked on related topics. A number of government-appointed committees have been established whose remits are relevant to the 2050 Climate Change Committee. The most relevant of these are the Energy Commission, the Natural Risk Committee, the Truth and Reconciliation Commission, the EEA Review Committee, the Food Waste Committee, the Procurement Committee, the Skills Needs Committee, the Tax Committee and the technical committee responsible for calculations in the field of climate change mitigation (TBU Climate). The secretariat and chair of the Committee have engaged in dialogue with several of these committees and exchanged information and background knowledge for mutual benefit.

It has been important for the Committee to hear the voice of children and young people. To ensure that the Committee received input from these groups, the Norwegian Children and Youth Council (LNU) was commissioned to prepare a written report on views and recommendations from children and youth organisations. The assignment was to gather input from children and young people engaged in voluntary organisations, and to base the work on the Committee's interim report. The report of the *Climate Committee Young* was presented to the Committee and is available as a digital appendix to the report.

In collaboration with the United Nations Association of Norway, the Committee has asked lower and upper secondary school pupils to contribute texts about life in the future Norwegian low-emission society. The Committee received many helpful and varied contributions, several of which are reproduced in this report; an illustration by Linda Kronberga (Figure 1.2), a text by Annabelle Gil Widerøe (Figure 3.17), a text by Aurora Snekkermoen Nydahl (figures 5.9 and 5.10), a text and illustration by Theodor Strøm Thrane (figures 12.14 and 12.15), a text by Karine Morseth Hallerud (Figure 14.2), and a text by Eden Kidane Fanta (Figure 16.1). The contributors will be in their early 40s in 2050. This serves as a useful reminder that many of the frameworks outlined in Norwegian policy today will help shape the society in which today's young people will live in adulthood.

The Committee has commissioned several official studies and reports conducted by external expert environments. The purpose of these has in particular been to provide information and a background for the Committee's discussions. The reports also provide relevant information about Norway's transition to a low-emission society that is now available to the public. The reports have been continuously published on the Committee's website.

The Committee entered into a framework agreement with a group of consultancy firms and expert environments for technical assistance. The group was led by Menon Economics, and otherwise consisted of representatives of NIBIO (Norwegian Institute of Bioeconomy Research), Holth & Winge, Multiconsult, Thema Consulting Group, FNI (Fridtjof Nansen Institute) and Ruralis (Institute for Rural and Regional Research). These have either carried out or organised the studies.

The following official studies (in Norwegian only) were commissioned by the Committee:

- Time use from the exploration and production permit is granted to the start of production on the Norwegian Continental Shelf.
- Acceptability and behavioural responses to climate policies
- International trade agreements and the Norwegian transition to a low-emission society
- Who has power in Norwegian climate policy?
- Overview of roadmaps for emission cuts in various sectors in Norway
- Legislation on the use of coastal and marine areas
- Production potential in agriculture and national food self-sufficiency
- The ocean as a carbon store
- Legislation in support or as an obstacle to reaching a low-emission society
- Climate and work with emission reductions in the award letters to state directorates
- Greenhouse gas emissions distributed by population segment
- Norwegian emissions in other countries
- Compilation of scenarios for power production and demand

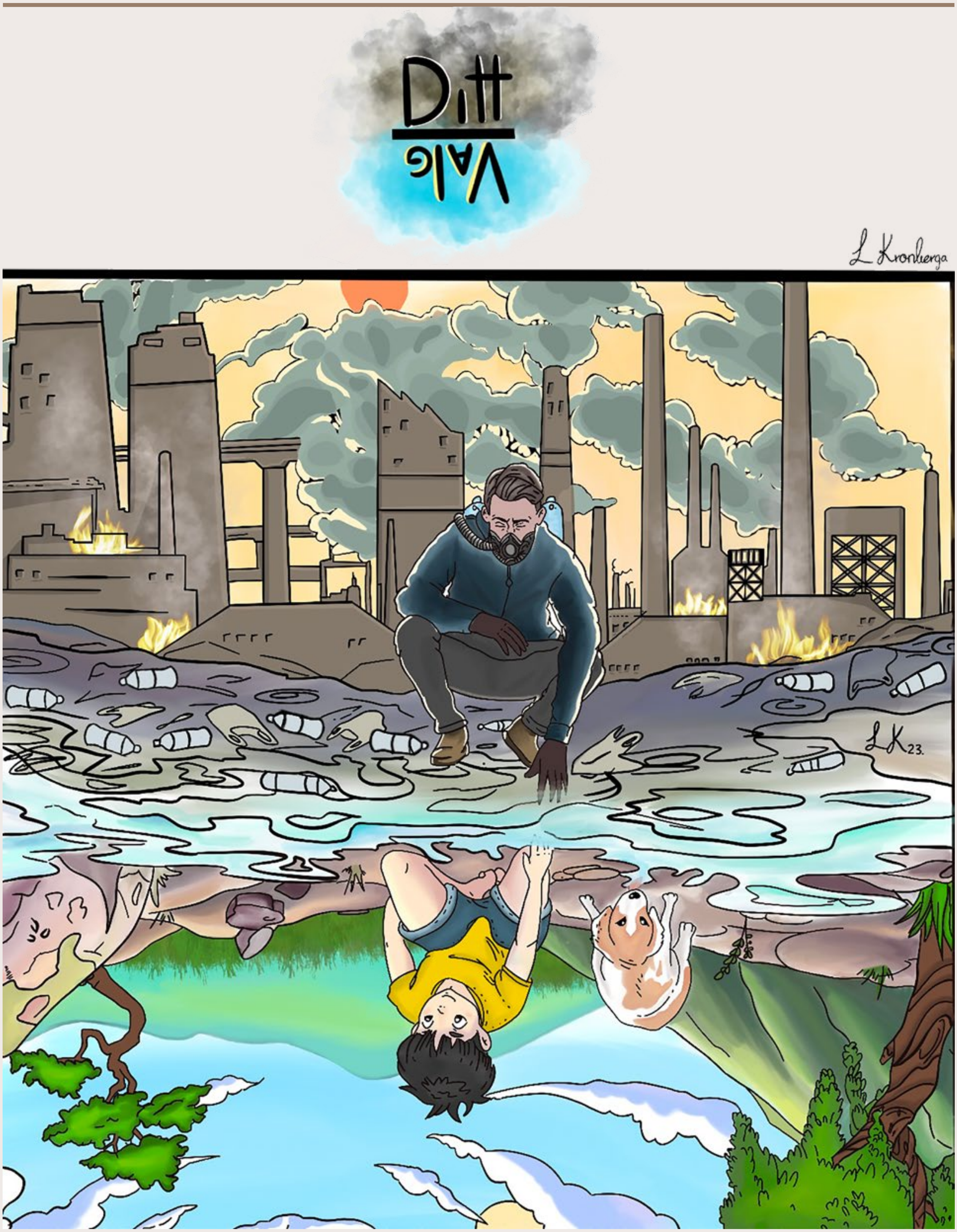
The reports are available as a digital appendix to the Committee's report.

Thematic background texts have been prepared during the Committee's work on the interim report and final report. In addition to a comprehensive basis in the form of official studies, reports and articles, the Committee's secretariat has prepared various thematic reports as a basis for the Committee's discussions and assessments. These have been prepared during different periods of the Committee's work and are not necessarily updated. Nor do they represent the entire basis on which the Committee has based its assessments on a given topic. The texts are available as a digital appendix to the report.

In addition to the report in NOU format, the Committee has created a special printed version with a more accessible layout. This is available as a digital appendix. The content of the special printed version and the NOU report are the same. The Committee concluded its work on 15 September 2023. The texts have not been updated after this.

The Committee would like to thank everyone who has contributed to the work, both with subject matter and administrative work. The Committee has received excellent help with organising trips and visits. Many experts and representatives from academia, the business sector, civil society and the public administration have attended meetings, shared their experiences and knowledge, and provided insight into challenging issues. This has enriched the Committee's knowledge material and discussions.

Contribution from **Linda Kronberga**



1.4 Reader's guide

The report is structured as follows, as shown in Figure 1.1:

- **Part A provides the framework for the challenge Norway is facing: that virtually all greenhouse gas emissions must be eliminated for good.** Based on this, the Committee describes what Norway's overall climate policy ambitious should be and how the goal of a low-emission society should be understood.

- **Part B reviews a number of topics that provide guidance on how Norway can implement the comprehensive transition the targets require.** This includes the energy system, the use of land and other resources, nature, the food system, mobility, economic activity and circularity, innovation and industry structure, the petroleum sector and footprints. In other words, this section of the report reviews how the goal of a low-emission society is related to other important societal goals and policy areas, and what issues this raises. It shows that there is a notable difference between how to assess individual measures to reduce a given GHG emission and an overall transformation of society where practically all emissions are to be eliminated. This supports the reasoning that climate policy cannot be chiselled out sector by sector, but instead must be based on a comprehensive development of society. Climate policy cannot be narrowly focused on emissions in the Norwegian emission accounts and the short-term development of these emissions, but must be designed based on a more comprehensive, long-term perspective.

Emission accounts: an overview that includes all emissions and removals of greenhouse gases within a country's borders. The main gases are CO_2, methane (CH4) and nitrous oxide (N_2O), but also other gases such as fluorinated gases are considered greenhouse gases and included in Norway's emission accounts

- **Part C discusses choices on the path to a low-emission society, and discusses principles for the use of policy instruments and political priorities in climate policy.**

- **Part D examines the framework for policy implementation and what governance tools Norway should adopt to achieve the goal of a low-emission society by 2050.** It discusses what a comprehensive transition to low emissions should mean for the planning, implementation and evaluation of climate policy.

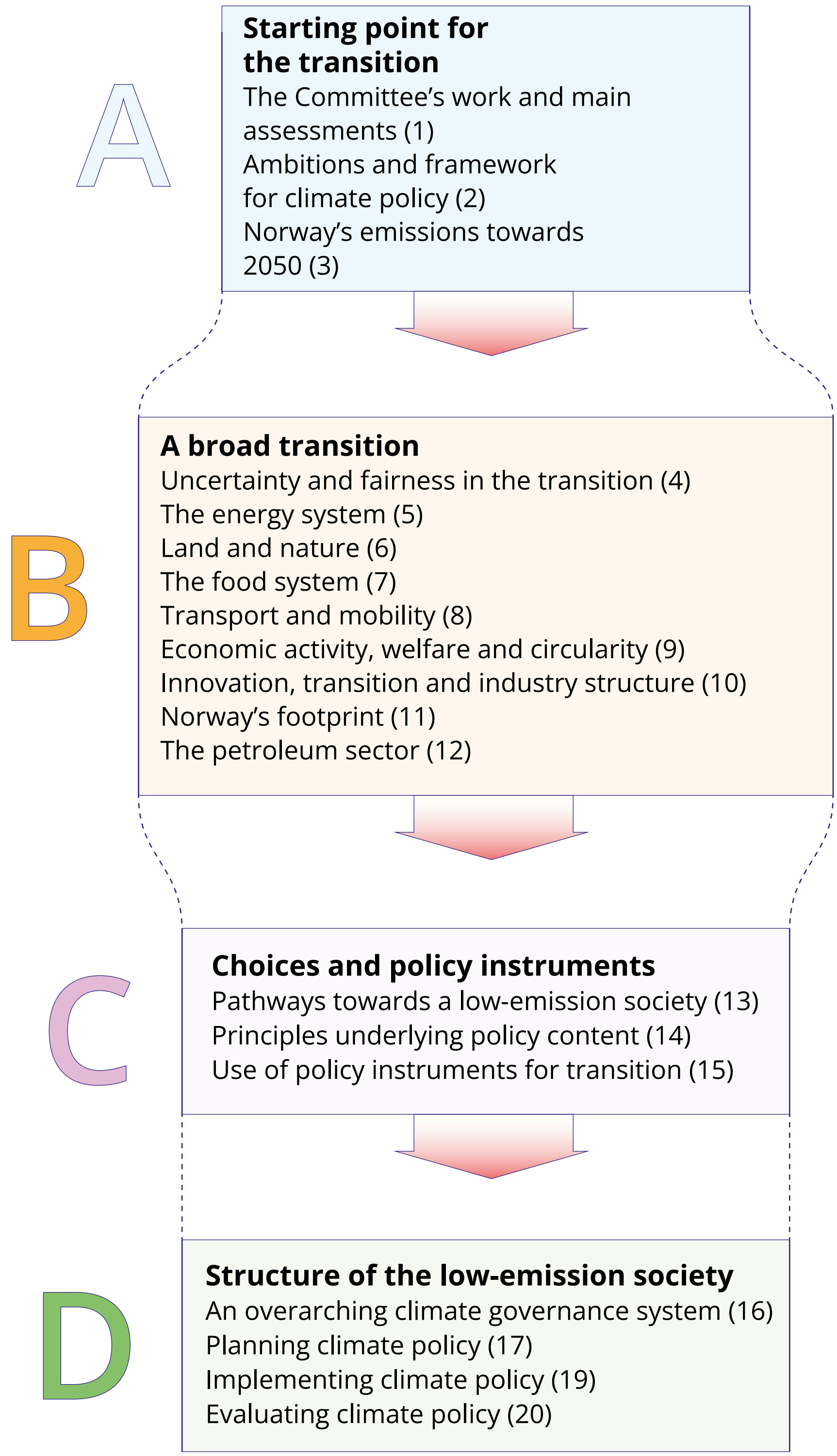
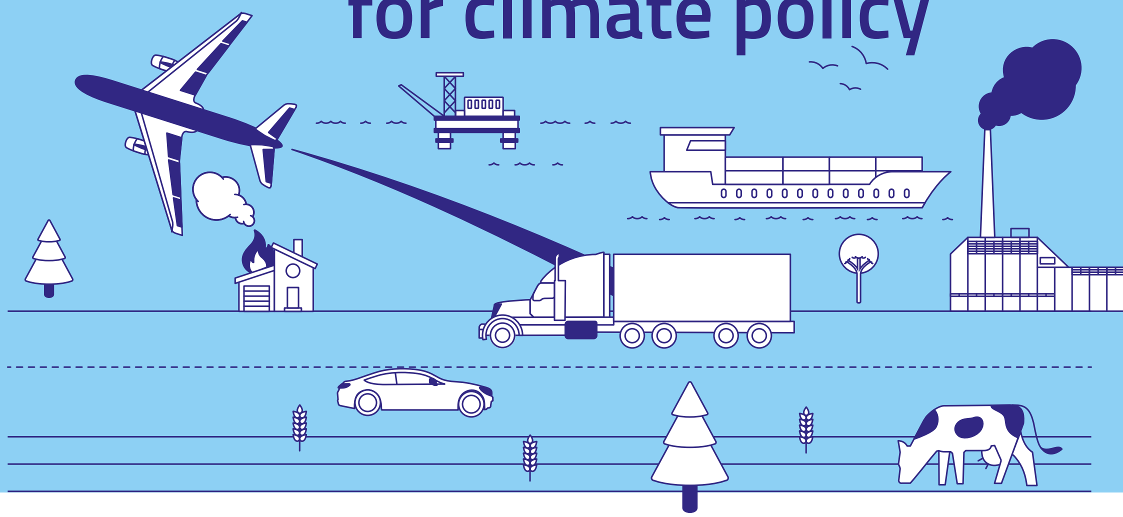


Figure 1.1 **Structure of the report.**

Source: The 2050 Climate Change Committee

2 Ambitions and framework for climate policy



This chapter describes the overarching goal of climate policy: to mitigate climate change in line with internationally adopted targets. It describes the magnitude of the necessary emission cuts at the global level and the international framework for Norway's contribution to climate action, primarily in relation to the Paris Agreement and EU cooperation.

2.1 The impact of climate change is severe

Natural diversity: biodiversity, landscape diversity and geological diversity, which are not essentially the result of human influence.

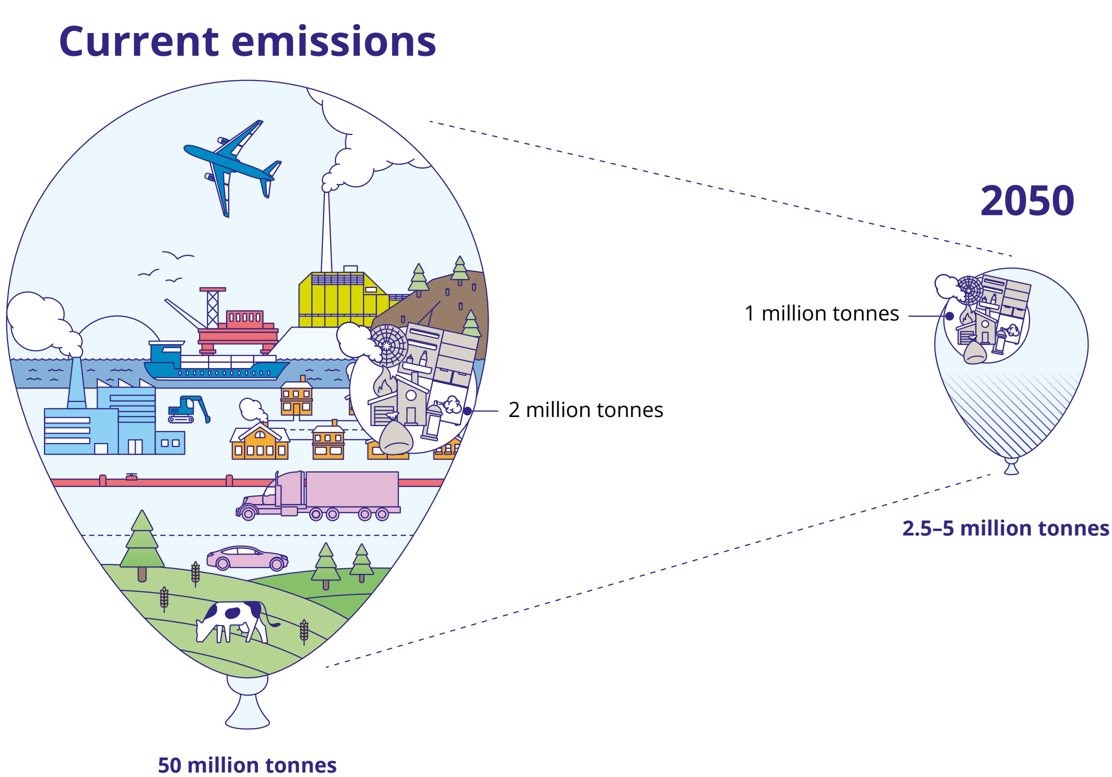
If the world does not reduce greenhouse gas emissions, it will lead to poorer access to food and water, poorer physical and mental health, humanitarian disasters, loss of natural diversity and species extinction, damage to nature, infrastructure and buildings, and loss of life (IPCC, 2022a). It will amplify existing problems such as social inequality, poverty and conflict and result in displacement. Some of these consequences are already clearly visible and can be linked with high confidence to anthropogenic climate change. Examples are the heat waves and floods seen in Europe and Asia in 2022 and 2023. The most visible direct effects for Norway are probably linked to changes in precipitation that cause surface water runoff, landslides and floods, which we saw many examples of in 2023. The last few years have also shown how extreme weather events can have unpredictable and far-reaching consequences for society, such as when coal power plants in Germany and nuclear power plants in France were forced to reduce production due to drought and high temperatures, thus affecting the entire European power market, or when the transport of goods through the Panama Canal had to be restricted due to drought. The most important consequences of climate change for Norway will probably be how we, as a small country with close ties to the rest of the world, will be affected by changes and isolated events in countries that are more vulnerable to climate change.

A global transition to a low-emission society is therefore necessary. A successful transition is a prerequisite for giving current and future generations the opportunity to lead good lives, and for society to have the best possible basis for tackling existing and future challenges. As such, climate policy is a means to ensuring a good society in the future.

The Paris Agreement forms the basis for global efforts to combat climate change. The agreement established a common global target of keeping the temperature increase to well below two degrees and to pursue efforts to limit the increase to 1.5 degrees. The global target is to be achieved through nationally determined contributions (NDC), which should be stepped up over time. All countries must submit new contributions every five years. Each new contribution must be more ambitious than the previous one, and reflect the highest possible level of ambition. The Paris Agreement also includes global targets for climate adaptation and for making financial flows consistent with a pathway towards low emissions.

Almost all CO_2 emissions in Norway should be eliminated for good by 2050 in order for Norway to contribute enough to achieving the goals of the Paris Agreement. According to the Intergovernmental Panel on Climate Change (IPCC), global CO_2 emissions must be cut to net zero by around 2050 in order to halt global warming in line with the temperature targets of the Paris Agreement. CO_2 remains in the atmosphere for a long time, and every tonne on the road to 2050 counts. Global emissions have continued to rise, and the window for achieving the temperature target in the Paris Agreement is closing quickly. Figure 2.1 illustrates how much Norway's emissions must be reduced by 2050.

Figure 2.1 Necessary emission reductions to achieve the goal of a low-emission society.
The figure illustrates how much Norway's emissions need to be reduced by 2050, from the current level of around 50 million tonnes of CO_2e to 2.5–5 million tonnes in 2050. Emissions of 2 million tonnes of CO_2e and 1 million tonnes of CO_2e now and in 2050, respectively, indicate the magnitude of emissions that are particularly difficult to remove, such as emissions from fires.
Source: The 2050 Climate Change Committee



Emissions of GHGs other than CO2 must also be greatly reduced. Certain biological processes, especially relating to food production, cause emissions of, e.g., methane and nitrous oxide, which are currently not possible to remove without ceasing the activity. These emissions are affected by what we produce, and how. At the global level, warming will stabilise if emissions of short-lived gases such as methane are slightly decreasing, but to achieve the target set in the Paris Agreement, emissions must be stabilised at a significantly lower level than today (IPCC, 2022b).

Net zero emissions: a state in which the amount of CO_2 emitted into the atmosphere from human activity is equal to the amount removed from the atmosphere through human activity over a given period of time

The fact that the world has to achieve net-zero GHG emissions by 2050 does not mean that all countries must reach net zero at the same time. There are major differences between countries in terms of welfare, prosperity and historical responsibility, as well as their possibility of achieving emission cuts or geological carbon storage and uptake in natural systems such as forests and soils. To reach net zero GHG emissions globally, the countries that *can* must contribute with storage and increased removal (Lee et al., 2021). Several analyses point out that rich countries and countries with good carbon removal possibilities should also contribute with removals before 2050.

Prosperity and welfare: prosperity is linked to the amount of material goods in society, while welfare is linked to the population's opportunities and rights, such as the possibility of education, access to social safety nets and access to health services.

The climate debate has often revolved around which emissions should be cut, but in a 2050 perspective, the question is rather which minor emissions should remain. This means that all sectors must undergo extensive changes to remove their emissions. This, in turn, will have consequences for the need for labour, power, land and other resources, meaning that the transition will affect all parts of society. The transition will involve difficult trade-offs concerning which sectors can account for the minor remaining emissions and gain access to limited resources such as electric power, land and expertise. Petroleum, agriculture and aviation are examples of sectors where it can be particularly demanding to eliminate emissions completely by 2050 while also maintaining activities. The Committee's climate policy recommendations have been based on the question of what minor emissions should remain.

If some sectors are to have emissions in 2050, other sectors will have to cut more, and CO_2 uptake and sequestration must be increased. Removal of atmospheric CO_2 can be done either through uptake in natural systems or industrially using various technologies (see Figure 2.2). These forms of CO_2 removal reduce the amount of CO_2 that has already been emitted, unlike capture and storage of fossil CO_2 (CCS) from, for example, coal power generation or industry, which only prevents new emissions from occurring. The potential for both natural and industrial CO_2 removal is limited. Uptake in forests and other natural ecosystems must take place while taking into account biodiversity and ecosystem functions. Industrial capture and storage is both energy and land intensive. In a long-term perspective, the potential for geological storage is not infinite either.

Ecosystem: a more or less well-defined, uniform natural system in which communities of plants, animals, fungi and microorganisms function in interaction with each other and with the non-living environment.

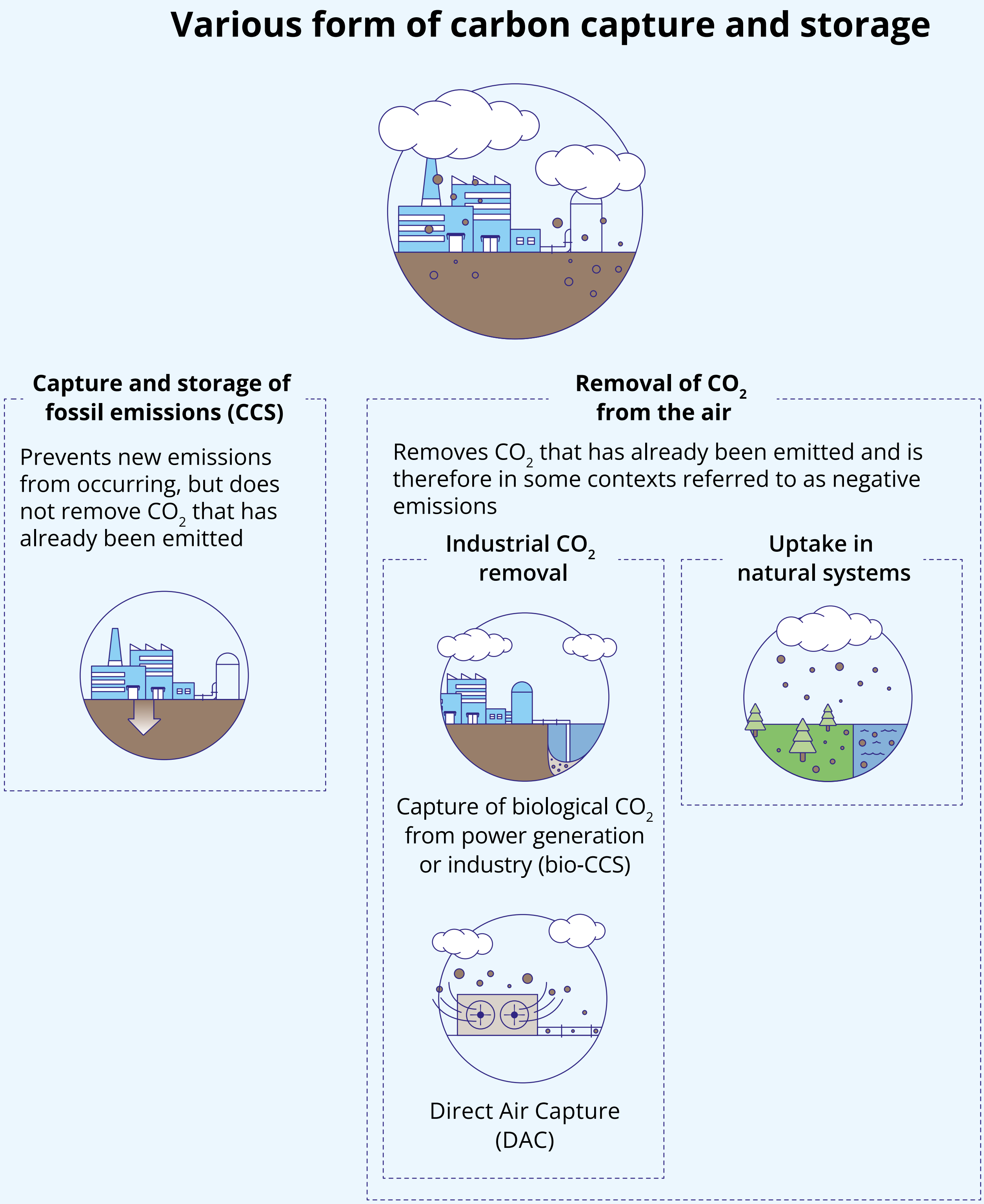


Figure 2.2 Various form of CCS.
The figure explains the difference between the form of CCS that prevents new emissions and the forms that remove CO_2 that has already been emitted.
Source: The 2050 Climate Change Committee

Ecological condition: an assessment of the state and development of the functions, structure and productivity of a habitat in light of current impact factors. A good ecological condition contributes to ecosystem services and the preservation of natural diversity.

Norway is particularly well suited for geological storage, but storage and increased removal cannot replace reduced emissions. Norway has natural advantages and technological expertise in geological storage. As a nation, we therefore have both greater responsibility and greater opportunities to contribute than many others. It is also possible to increase the removal of CO_2 in Norway, both by industrial means and by natural uptake through, for example, adjusting our land use and marine spatial management. However, there are limits to how much carbon removal can be increased while maintaining a good ecological condition. In its report, the European Scientific Advisory Board on Climate Change has assessed environmentally acceptable limits for removal of atmospheric CO_2 as well as the use of bioenergy (European Scientific Advisory Board on Climate Change, 2023). For many emission sources, CCS will be costly and require land, materials and energy, and for some sources it is technically difficult or impossible. Technologies for extracting CO_2 directly from the ambient air, known as direct air capture (DAC), are being tested. Such technologies can be important contributions in the transition to zero emissions, but will also require energy, land and materials. There are limits to how much CO_2 can be absorbed and stored from an eternal perspective. Nor does the high carbon uptake in Norwegian forests mean that Norway can cut less of its emissions. This is discussed in more detail in Chapter 3.

See the Committee's assessment of CO_2 uptake and storage in Norwegian climate policy in Chapter 3.

Many decisions made today will affect emissions and removals towards, but also after, 2050. This applies in particular to emissions relating to land use, land degradation and large, long-term investments in, among other things, infrastructure, industry and petroleum activities. Today's decisions on infrastructure investments, development and land use will affect future energy use, transport patterns and land use trends. Today's decisions will also set the pathway for emissions beyond the lifespan of buildings and infrastructure. This applies, for example, through permanent land use changes or other investments resulting from existing infrastructure. Decisions with far-reaching consequences must therefore take into account that they will form part of and contribute to a low-emission society.

Implementing emission cuts as early as possible will lead to significant climate gains. Climate change is determined by total emissions over time, and not the level of emissions in a given year. Early transition also means that Norway will be able to contribute more to technology development and gain experience of low-emission solutions, which other countries can benefit from. In some sectors, the costs of early emission cuts may be high in the short term since the costs of new climate technologies are expected to fall over time. At the same time, the expected cost reduction is based precisely on someone making these initial investments and scaling up the technology. Norway will also benefit greatly from global climate change being limited.

Zero-emission solutions: solutions that generate no direct greenhouse gas and exhaust emissions during use. This means, for example, the use of an electric motor in combination with a battery, or direct use of electricity or a fuel cell that utilises a carbon-free energy carrier such as hydrogen.

Decisions that result in emission cuts in the short term, but not in the longer term, must be avoided. In some cases, measures that bring about rapid emission cuts can at the same time make it more difficult to achieve larger emission cuts in the longer term. This is especially true if the measure establishes infrastructure of long duration or channels resources into temporary solutions rather than permanent zero-emission solutions. Examples are investments in petroleum infrastructure, biofuels used in internal combustion engines and carbon credit purchases by both companies and the central government, rather than cutting emissions in Norway. It can also apply to measures that promote emission-free technologies, such as electric cars, if they also contribute to maintaining high consumption and emissions through land use. The electric vehicle policy has accelerated the transition to zero-emission cars, which is positive, but may also have led to greater use of private cars than would otherwise have been the case. Increased use of cars gives rise to the desire to build more roads, which in turn lays claim to scarce land resources. It has been important for the Committee to consider how such long-term considerations can be better incorporated into current climate policy.

Cost-effectiveness must remain a key consideration when formulating climate policy. The transition to a low-emission society will be demanding, and potential conflicts between climate policy and other societal considerations will be exacerbated if the transition is made more expensive than necessary. This increases the risk of not meeting the climate targets.

However, the assessment of what is cost-effective must be based on a broader perspective than just looking at the cost of individual measures in the short term. In climate policy, measures and policy instruments have often been assessed individually, based on which emissions are easiest or cheapest to remove at this point in time. This will, in principle, be a cost-effective approach if the goal is to reduce a limited share of emissions. However, such an approach does not necessarily provide a cost-effective transition to a low-emission society seen as a whole. A strategy that postpones all emission cuts in Norway until other, cheaper cuts have been implemented in other countries can result in a late and abrupt transition in Norway as we approach 2050. Such a transition can have societal costs in the form of, for example, unemployment that are not taken into account when only considering the cost of individual cuts.

When the vast majority of emissions are to be eliminated for good, it must be considered how each individual emission can be removed in the best possible way as part of a long-term transition. Many emission cuts will take a long time to implement because they depend on long-term technology developments or they need to be implemented alongside the replacement of existing infrastructure and equipment. This will often apply to the processing industry in Norway, for example.

The Committee is therefore of the opinion that we must pursue a broader and longer-term perspective than before when designing climate policy. It is not sufficient that a given measure reduces emissions in the short term. It must also stand the test of time and be appropriate in a world that is to achieve permanently low emissions within a framework where all the UN SDGs are to be achieved. The goal of an overall transition of society to permanent zero emissions will affect what we consider to be 'cheap' and 'expensive' climate policy. Climate policy must be set in a

Biofuel: liquid or gaseous fuel produced from biological material, often called biomass. In Norwegian legislation, the application of the terms conventional and advanced biofuels are based on what raw material the fuel is produced from. Conventional biofuels are produced from raw materials that can also be used to produce food or animal feed (agricultural crops). Also known as first-generation biofuels. Advanced biofuels are mainly produced from waste products from the food industry, agriculture or forestry, and not from raw materials that can be used as food or animal feed (non-food biomass). Also known as second-generation biofuels.

framework where it is possible to determine which overall strategy provides the best and cheapest transition as a whole.

Emission accounts: an overview that includes all emissions and removals of greenhouse gases within a country's borders. The main gases are CO_2, methane (CH4) and nitrous oxide (N2O), but also other gases such as fluorinated gases are considered greenhouse gases and included in Norway's emission accounts.

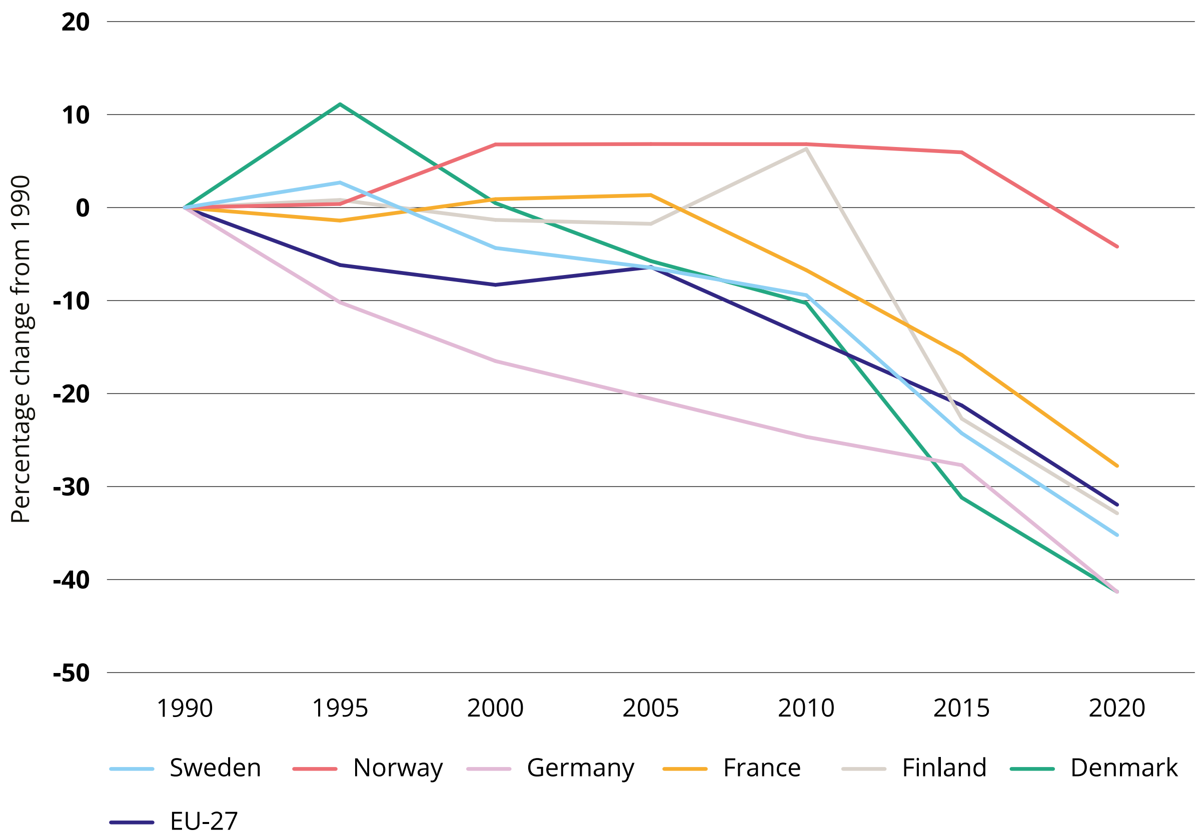
A broader approach to climate policy means that emphasis should also be placed on Norway's impact on carbon emissions and removals in other countries. Norway affects global emissions in a number of ways. We have a very high level of consumption that contributes to ///production and emissions in other countries, as well as an extensive petroleum sector where emissions from using the products it produces are not included in our own emission accounts. At the same time, Norwegian climate policy also seeks to directly influence emissions and removals in other countries, for example through rainforest conservation measures and renewable energy investments in developing countries.

European Green Deal: a green growth strategy to help Europe become the world's first climate-neutral continent. The goal is to transform the EU into a sustainable, circular and climate-neutral economy by 2050. Climate and environmental policy must be incorporated into all policy areas, and a broad range of policy instruments must be used.

The EU is at the forefront of global climate action and provides a crucial framework for Norway's transition to a low-emission society. Through the European Green Deal, the EU has developed a climate policy that encompasses virtually all parts of the economy, and all policies must be designed to advance the EU towards the goal of climate neutrality by 2050. As Figure 2.3 shows, the 27 EU member states have on average reduced their emissions by 31 per cent between 1990 and 2020 (European Environment Agency, 2022). Between 2019 and 2020, emissions fell by close to 10 per cent. In comparison, in the period between 1990 and 2022, Norway's emission reduction was 4.7 per cent (Statistics Norway, 2023).

Norway is affected both directly and indirectly by developments in the EU. We are closely linked to the EU through the EEA Agreement, committed to the EU's climate policy framework and the EU is our most important export market.

Climate change forms an important part of the issue of justice between generations, between countries and between different groups in society. In the international context, the countries that historically have contributed the least to global emissions are generally the countries that will be hit the hardest by climate change. If today's leaders postpone the transition, future generations will have to deal with both a rapid transition to a low-emission society and the consequences of a changing climate. This could be extremely demanding. A just climate policy is about how the benefits and burdens resulting from the transition are distributed between groups in society, but also about different groups' opportunities for participation and recognition.



In the Committee's opinion, Norway has a special moral obligation to contribute to fulfilling the global climate goals. Norway has a high level of income and consumption, which is financed, among other things, by high revenues from the petroleum sector. Our climate challenges and our oil wealth have the same origin: the production and consumption of fossil fuels. Norway has high GHG emissions per capita, approximately 70 per cent higher than the global average and 33 per cent higher than the EU average (Friedlingstein et al. 2022). Historically, Norway has emitted more than most other countries in the world in relation to the size of our population. In addition, Norway has far more resources available than most other countries. With this in mind, it is not right to shift the challenges of the transition to a low-emission society to other countries. The Committee also believes that the current generation has a moral obligation to contribute to fulfilling global climate goals for future generations.

Figure 2.3 Changes in greenhouse gas emissions since 1990 in EU 27 and selected countries.
The figure shows that many northern European countries have reduced their emissions significantly over the last 30 years, while Norway has only recently achieved some reduction.

Source: European Environment Agency, 2022

In Norway, consideration for Sami interests must weigh heavily in the transition to a low-emission society. Sami society has historical rights to land and stewards a culture that has been dependent on nature for thousands of years. Climate change is also a threat to traditional Sami cultural practices. Everyone must contribute to the climate transition, but society at large has a particular responsibility to ensure that the necessary transition takes into account Sami culture and rights.

Climate policy affects most areas through interventions, distribution effects, resource use, land use and in other ways. The goals of climate policy must be achieved in parallel with a number of other societal goals. A comprehensive policy to become a low-emission society must systematically exploit the opportunities offered by the transition to strengthen other goals and avert negative impacts, for example relating to fair distribution, welfare benefits, conservation of biodiversity and sustainable value creation. Where conflicts of objectives cannot be avoided, clear trade-offs and choices must be made to gain the necessary acceptance. To be able to see different goals in context in this manner, climate policy should be designed using a comprehensive approach where measures and policy instruments are considered together, not individually. Climate policy goals must also form the basis for all policies that affect emissions. This is in line with the EU's approach to climate policy under the European Green Deal.

Public finances also set the framework for the implementation of climate policy. With the phasing-in of oil revenues, Norway has experienced a greater growth in budgets and fiscal policy leeway over the past two decades than most other countries. As in many other countries, spending on pensions and healthcare in Norway will continue to rise going forward. At the same time, the revenue side of the national budget is likely to grow less. In a few years, petroleum production will decline and the Government Pension Fund Global will grow more slowly. In the long term, revenues from environmental and climate-based taxes will also decline as emissions are reduced. This could put additional pressure on public finances, and it is not a given that there will be leeway for high spending on climate-related expenses.

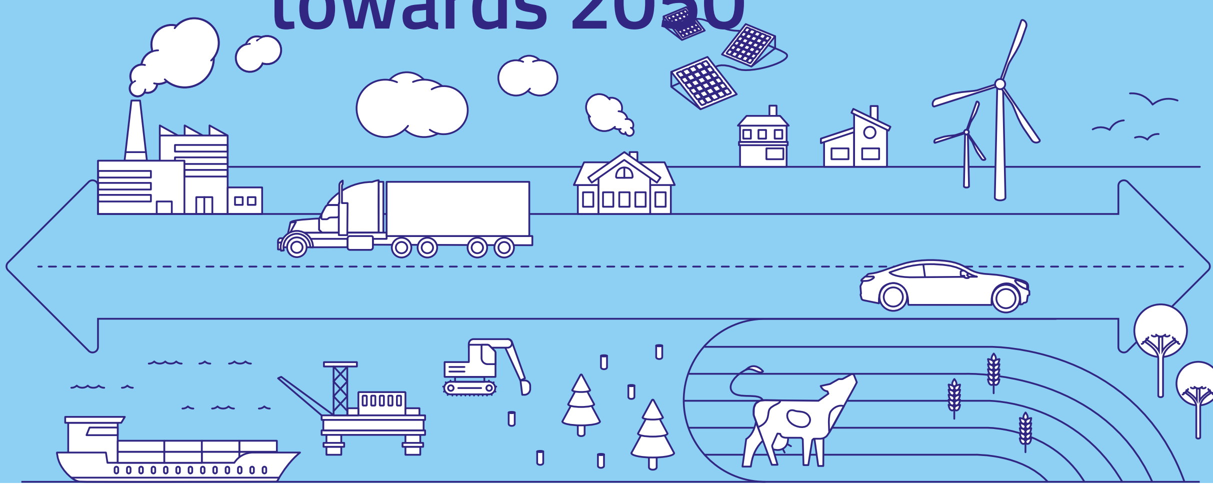
Increased climate-related expenditure will mean lower spending in other areas, necessitating difficult prioritisation. If climate-related investments increase, it may, for example, mean that a relatively smaller share of society's resources can go to other investments or public or private consumption. The more of the expenses for necessary climate transition investments are financed by the public sector, the less there will be left for other purposes financed under the same budgets. Cost-effective solutions are therefore crucial.

To facilitate a rapid and just transition, it is important to ensure flexibility and adaptability in the economy, welfare systems and society at large. A robust society with a high degree of trust, low inequality, sustainable welfare systems and a secure public economy will be more capable of and willing to transition to a greener economy. A well-functioning labour market with high participation is a key aspect of meeting the prerequisites for economic transition. Tripartite cooperation between employers, employees and the State therefore has an essential role to play.

Transitioning to low emissions will also provide new opportunities for value creation, development of society and a better everyday life. Climate action is often discussed primarily in terms of costs or dilemmas, yet the major societal changes that will be required to eliminate virtually all emissions for good also provide great opportunities. Norwegian society has undergone many sweeping changes over the past 30 years that may have been demanding or costly for some, but that overall have resulted in increased welfare, quality of life and new economic opportunities. Similarly, the changes needed to achieve a low-emission society over the next 30 years will provide new opportunities in many areas. An important aspect of comprehensive climate policy is to strengthen and highlight the positive effects of the transition.

3

Norway's emissions towards 2050



This chapter describes the historical development of Norwegian greenhouse gas emissions and explains Norway's myriad different climate goals. The chapter describes Norway's climate cooperation with the EU, before addressing the potential distribution between different emission sources in 2050. Finally, the Committee gives its assessment of Norway's climate goals up to and beyond 2050.

3.1 Minor changes in overall emissions, but major changes in sectoral emissions

Norway's emissions have only slightly decreased since 1990, and the pace of the transition must be significantly increased. In the 31 years from 1990 to 2021, Norwegian emissions were reduced by less than 5 per cent, from 51.3 to 49.2 million tonnes of CO_2e; cf. Figure 3.1. In less than 30 years, Norway must reduce its emissions by at least a further 85–90 per cent to 2.5–5 million tonnes of CO_2e. Although emissions have been relatively stable overall since 1990, there have been major changes in the various sectors; cf. figures 3.2 and 3.3. While emissions from industry and heating have been greatly reduced since 1990, emissions from the petroleum industry and transport have increased.

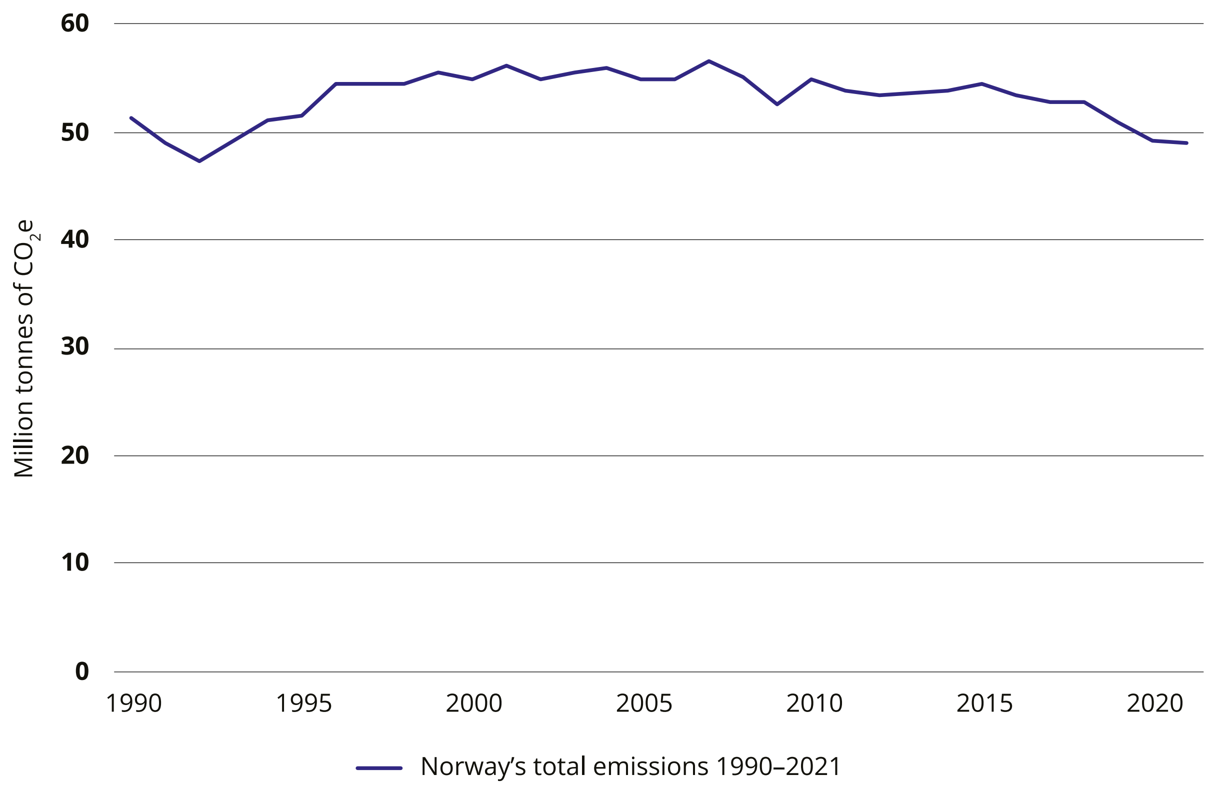


Figure 3.1 **Norwegian emissions 1990–2021.**

Source: Statistics Norway

Emissions and removals in the forestry and land use sector are often omitted when talking about Norwegian GHG emissions. There are several reasons for this. The forestry and land use sector represents a high net CO_2 removal. In 2021, this amounted to around 15 million tonnes of CO_2e. This can be divided into a gross removal in forest areas of approximately 20 million tonnes of CO_2e, and gross emissions from other land use categories of approximately 5 million tonnes. Had the overall net removal in the forestry and land use sector been included in the overall sum of Norwegian emissions, this total would not have been an adequate expression of the magnitude of Norway's GHG emissions. The emission accounts for forestry and land use are calculated by NIBIO and are not part of Statistics Norway's emission statistics. In the sections below, the discussion of emissions on Norwegian territory does not include emissions and removals in the forestry and land use sector. These are discussed in separate sections at the end of the chapter.

Emission accounts: an overview that includes all emissions and removals of greenhouse gases within a country's borders. The main gases are CO_2, methane (CH4) and nitrous oxide (N_2O), but also other gases such as fluorinated gases are considered greenhouse gases and included in Norway's emission accounts.

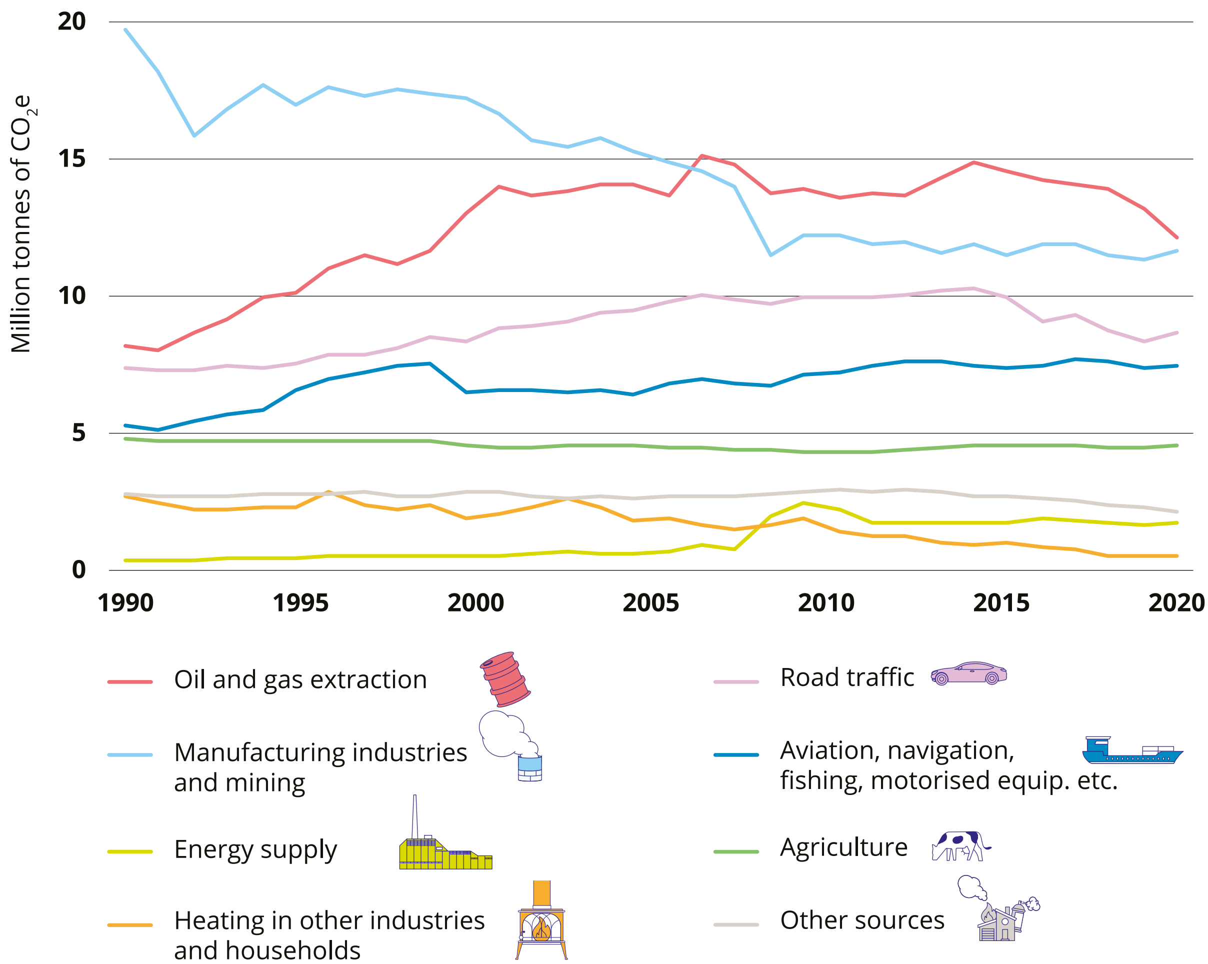


Figure 3.2 **Norwegian emissions 1990–2021 by sector.** Emissions and removals in the forestry and land use sector are not included in the figure.

Sources: Statistics Norway and the Norwegian Environment Agency

More than half of Norway's emissions are due to fossil fuel combustion. This is shown in Table 3.1. Of the emissions of 49.2 million tonnes of CO_2e in 2021, about 33 million tonnes, or more than 65 per cent, came from fossil fuel combustion in transport, offshore turbines and industry.

More than a third of Norwegian emissions are emissions other than CO2 from fossil fuel combustion. Process emissions from industry and oil and gas production amounted to just over 9 million tonnes of CO_2e, or just under 20 per cent of total emissions. GHG emissions other than CO_2 amounted to just under 8 million tonnes of CO_2e, or just over 15 per cent. See Box 3.1 on the different greenhouse gases, Table 3.1 and figures 3.4 and 3.5.

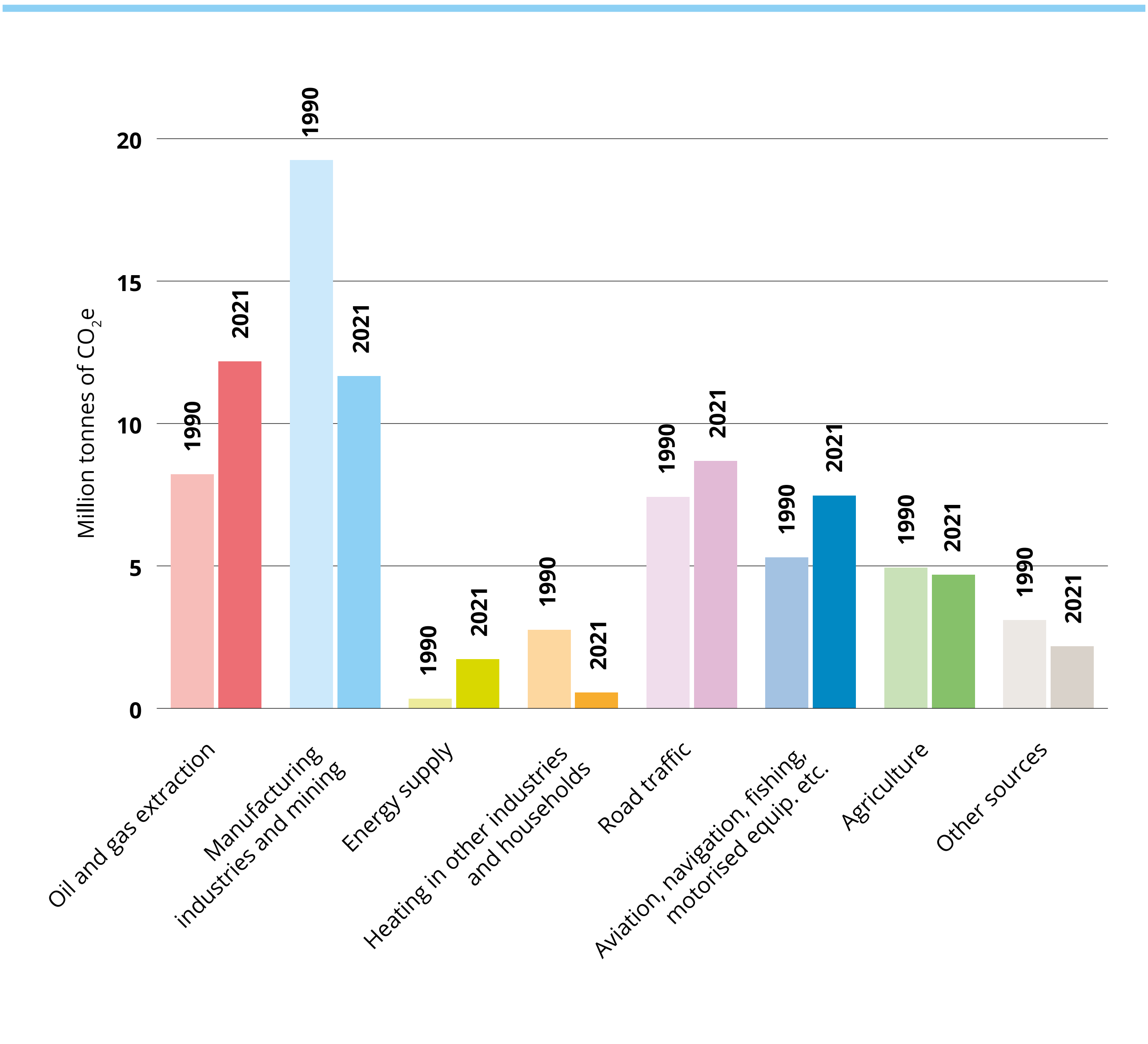


Figure 3.3 **Emissions in 1990 and 2021 by sector.**

Source: Statistics Norway and the Norwegian Environment Agency

Figure 3.4 Breakdown between process emissions and other emissions by sector.

Source: Statistics Norway and the Norwegian Environment Agency

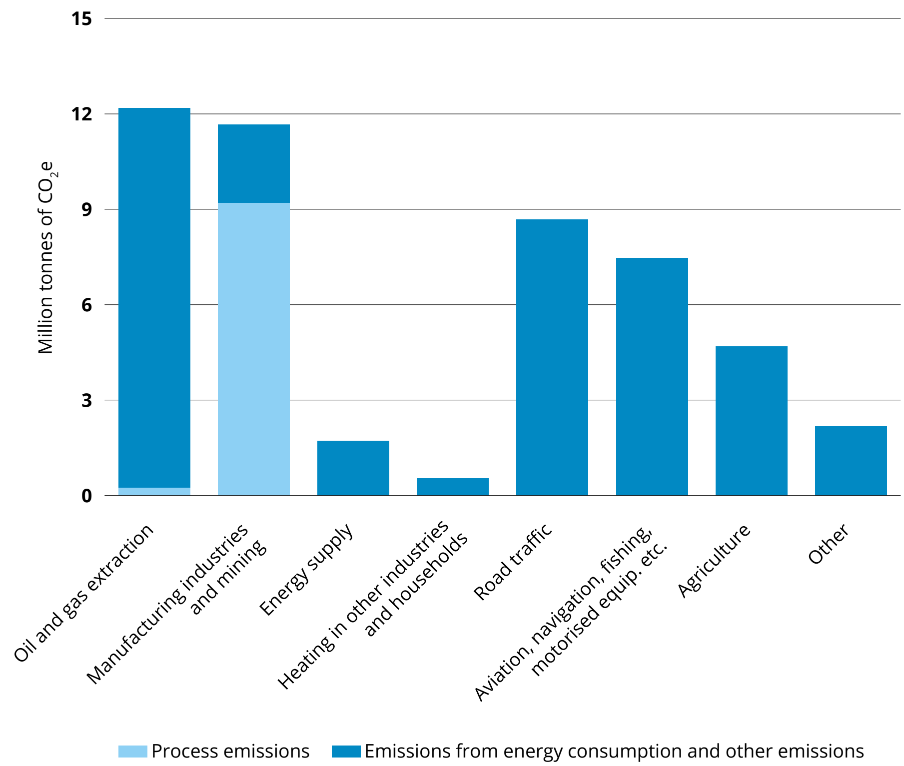
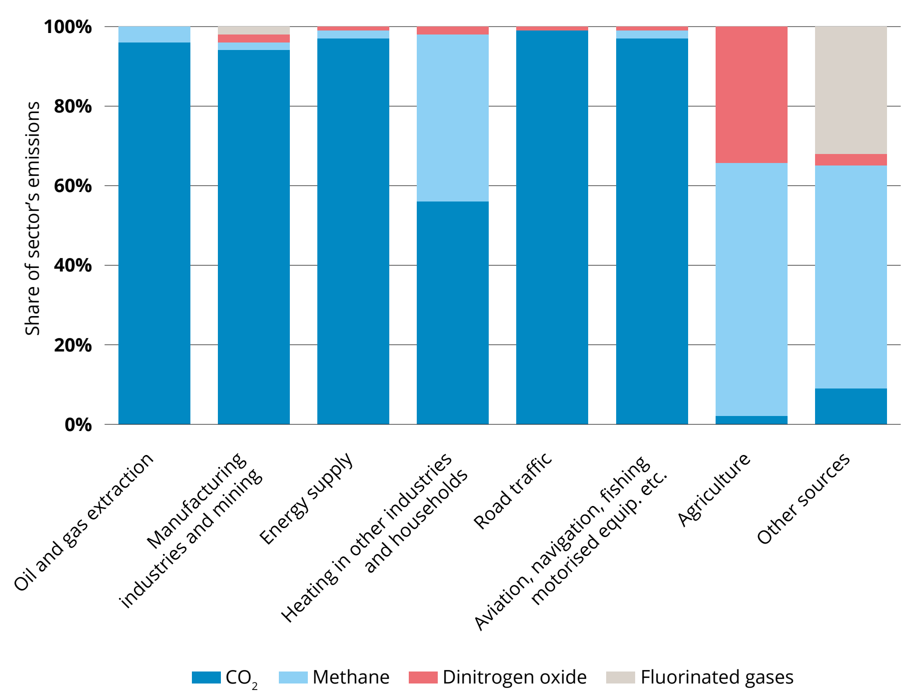


Figure 3.5 Breakdown between emissions of CO_2, methane (CH_4), nitrous oxide (N_2O) and other gases by sector.

Source: Statistics Norway and the Norwegian Environment Agency



Box 3.1 Different greenhouse gases and their warming effect

A comprehensive climate policy must be able to take into account all GHG emissions, which means weighing GHGs with very different properties, such as lifetime, against each other. Weighting factors are used to facilitate comparison between emissions of different GHGs in terms of their impact on climate change.

Many different weighting factors have been discussed in the literature. The two best known are Global Warming Potential (GWP) and Global Temperature Change Potential (GTP). GWP100 (warming potential with a 100-year time horizon) is used in the official emission accounts.

Weighting factors should not define climate goals. They are tools that make it possible to assess and implement policies aimed at several GHGs at the same time, such as emissions trading with several GHGs. The weighting factor that should be used depends on a number of value choices and which aspects of climate change are most important. Different climate goals can lead to different conclusions about the most suitable weighting factor.

Figure 3.6 shows the weighting factors GWP and GTP for the three main greenhouse gases (CO_2, methane and nitrous oxide) over 10, 20, 50 and 100 years, respectively. Note that the weighting factor for CO_2 is 1 regardless of the time horizon, since it is used as a reference.

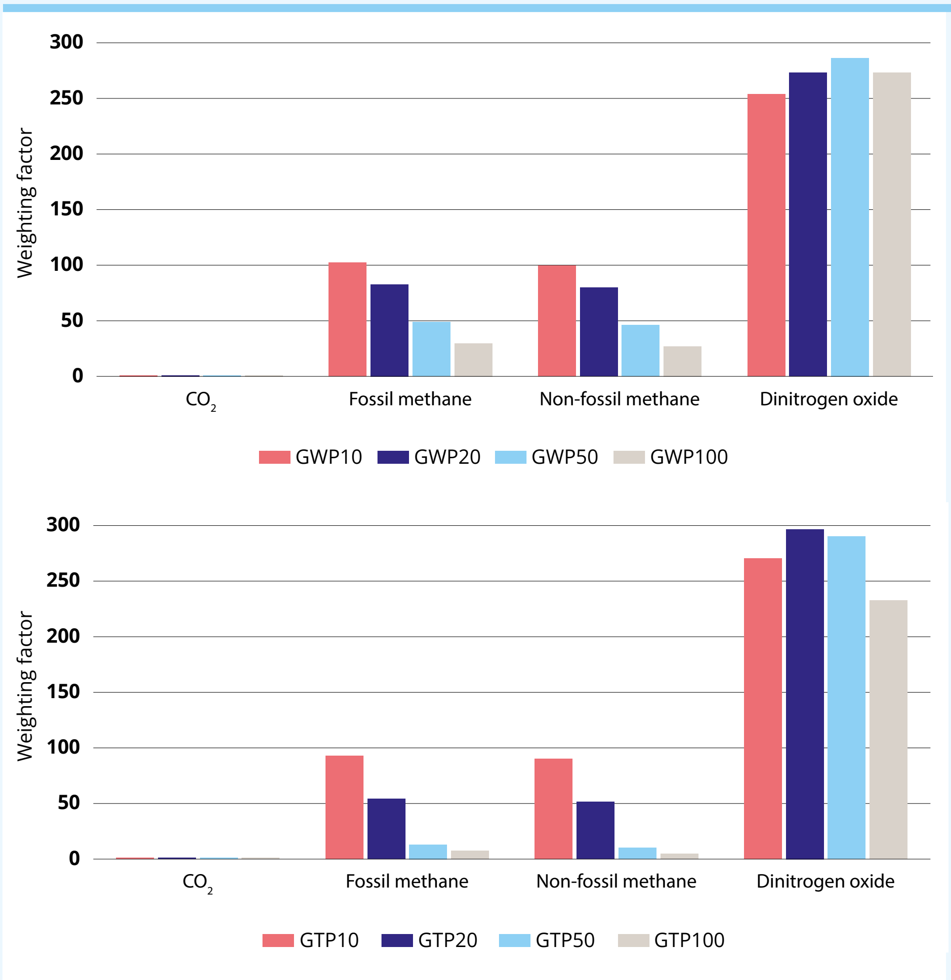


Figure 3.6 Weighting factors (GWP and GTP) for different time horizons.

Source: Based on data from the IPCC (2021)

Table 3.1 The table shows the change in emissions from 1990 to 2021 by sector, the breakdown between process emissions and other emissions and the breakdown between emissions of CO_2, methane (CH_4), nitrous oxide (N_2O) and fluorinated gases.

	1990 (mill. tonnes of CO_2e)	***Percentage of total*** (1990)	**2021** (mill. tonnes of CO_2e)	**Process emissions** (mill. tonnes of CO_2e)	**Percentage of total** (2021)	***Percentage CO_2*** (2021)	***Percentage methane*** (2021)	***Percentage nitrous oxide*** (2021)	***Percentage fluori-nated gases*** (2021)
Oil and gas production	8,2	*16*	12,2	0,2	*25*	96	*3,9*	0,1	0,0
Industry and mining	19,2	*38*	11,7	9,2	*24*	95	*1,6*	1,7	1,9
Energy supply	0,3	*1*	1,7		*4*	97	*1,9*	1,3	0,0
Heating in other industries and households	2,8	*5*	0,6		*1*	56	*42,4*	1,8	0,0
Road traffic	7,4	*14*	8,7		*18*	99	*0,3*	1,0	0,0
Aviation, navigation, fishing, motorised equip. etc.	5,3	*10*	7,5		*15*	98	*1,5*	0,8	0,0
Agriculture	4,9	*10*	4,7		*10*	2	*63,2*	34,4	0,0
Other	3,1	*6*	2,2		*4*	9	*56,3*	3,4	31,7
Total	51,3	*100*	49,2	9,4	*100*	83	*10,7*	4,2	1,9

Source: Statistics Norway and the Norwegian Environment Agency

3.2 Norway's climate targets

Norway has set many climate targets for different years and different emissions. Norway has former and current internationally binding targets under the Kyoto Protocol and the Paris Agreement for 2012, 2020 and 2030. Table 3.2 provides an overview of the current Norwegian climate targets. The 2008 Climate Policy Agreement set a quantified target for national emission reductions in 2020. This target was not achieved. In addition to these targets, a number of targets and ambitions have been set for national emissions, individual sectors and emission segments, including several targets for transport. A goal has also been adopted to halve emissions from petroleum linked to the tax package adopted by the Storting in 2020, and an agreement has been reached between the Government and the agricultural industry on emission reductions by 2030.

The status and scope of the climate targets varies. Table 3.2 compares the targets in current climate policy, and shows the target year, the year of reference, and when the target was set. The different targets have different statuses. Under the Paris Agreement, Norway is obliged to set a target for the most important GHGs and all sectors, meaning an economy-wide emission reduction target. Through the climate agreement with the EU, Norway is subject to climate targets and annual emission budgets for emissions not covered by the EU ETS, in addition to a separate target for the forestry and land use sector. These are legally binding through the EEA Agreement. The Climate Change Act stipulates Norway's climate targets for 2030 and 2050, which means that Norway also has targets that are legally binding under Norwegian law. In addition, Norway has national goals that are not legally binding, but that are politically adopted goals, for example through a government platform. The different targets can be met in different ways. The targets Norway is legally bound by through agreements and legislation allow for the financing of emission reductions in other countries through credit purchases, while the Government's politically adopted transition goals must be achieved through emission reductions in Norway and not through the purchase of carbon credits from other countries. As such, the targets are ambitious in different ways. This results in a complex structure of goals and targets that it can be demanding to understand and interpret. The Committee is of the opinion that clearer targets should be set for emission reductions that must take place in Norway going forward.

Table 3.2 Norway's targets and commitments.

	Scope	Target year	Reference year	Submitted under the Paris Agreement	Year target was set	Commitment level for the target	Provides for country-level purchases of approved credits?
At least 55% reduction[1]	All emissions	2030	1990	Yes	2022	The target is enshrined in the Climate Change Act and internationally binding (submitted under the Paris Agreement)	Yes
Transition target (55% reduction)	All emissions	2030	1990	No	2022	Government target (national) that are is internationally or legally binding.	No
50% reduction in emissions not covered by EU ETS	Only emissions not covered by EU ETS	2030	2005	No	2019	Legally binding through climate agreement with the EU	Yes
Net-zero commitment for forestry and land use	Emissions and removals from forestry and land use	2025	Varies between accounting categories		2019	Legally binding through climate agreement with the EU	Yes
Climate neutrality by 2030	Not clarified	2030	1990	No	2016	Policy target adopted by the Storting that is not internationally or legally binding	Yes
90–95% reduction	All emissions	2050	1990	No	2021[1]	The target is enshrined in the Climate Change Act, but not internationally binding	[2]

1 (Norway's first climate target for 2050 became statutory in 2017)
2 The effect of Norway's participation in the EU Emissions Trading System (EU ETS) is to be taken into account when assessing progress towards achieving the targets.

Source: Ministry of Climate and Environment

Norway has largely met its international commitments through emission cuts in other countries, and has to a limited extent cut emissions in Norway. In the last three decades, climate policy has aimed to reduce emissions by a given percentage in the short term. The targets have been set in a way that enables reductions to take place in other countries through the purchase of carbon credits or the use of flexibility. This has allowed Norway to choose to reduce, maintain or even increase emissions in each sector, while at the same time achieving internationally binding climate targets. Norwegian emissions have only been reduced by 4.7 per cent from 1990 to 2021. Without national climate policy, however, the level would have been significantly higher (Norwegian Government, 2018). See Box 3.2 for a description of the various emission trading schemes and the use of flexibility. Box 15.1 provides a detailed description of the EU Emissions Trading System (EU ETS).

Box 15.1 provides a detailed description of the EU Emissions Trading System (EU ETS).

3.3 The importance of the climate agreement with the EU

Norway's climate agreement with the EU provides a binding framework for Norway's climate goals. Through the agreement, Norway becomes part of the EU 2030 climate and energy framework, the purpose of which is to ensure sufficient emission reductions in the EU/EEA to achieve the climate goals.

EU Emissions Trading System (EU ETS): covers emissions from industry, oil and gas extraction, energy supply and aviation in Europe, in Norway this accounts for approximately half of the total emissions.

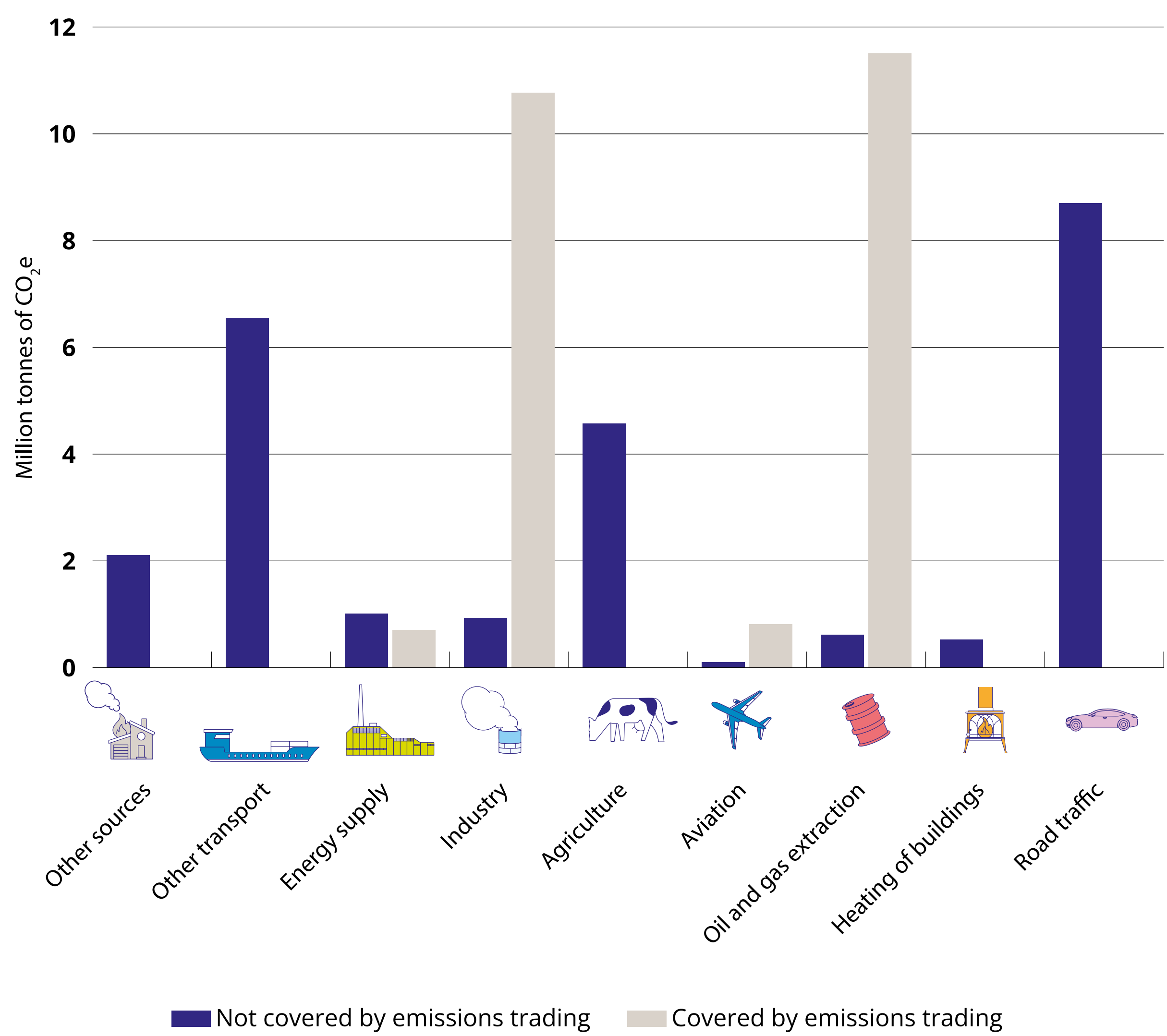
The EU regulatory framework covers all emissions. Norway's compliance with the regulations ensures a framework that covers all emissions in the Norwegian emission accounts. The EU ETS covers emissions from industry, oil and gas production, energy supply and aviation in Europe. This represents about half of Norway's overall emissions. The regulations for emissions not covered by the EU ETS (the Effort Sharing Regulation – ESR) cover emissions from transport, agriculture, waste and construction, but also some emissions from industry and petroleum activities. Figure 3.7 shows the breakdown by sector of emissions covered and not covered by the EU ETS. Emissions and removals in LULUCF are not included in the figure.

Overall, the EU climate regulations aim to ensure that the EU reduces emissions by 55 per cent by 2030 compared with 1990 levels. Emissions covered by the EU ETS must be reduced by 62 per cent in 2030, compared with 2005 levels. Emissions not covered by the EU ETS must be reduced by 40 per cent in 2030 compared with 2005. This overall target is broken down to one target per country. In accordance with the current climate agreement with the EU, Norway must reduce emissions not covered by the EU ETS by 40 per cent. This is expected to increase to 50 per cent after the EU stepped up its climate ambitions. For the LULUCF sector, there are different targets for the periods 2021–2025 and 2026–2030. The goal for the first phase is for accounted emissions from land use to be compensated by at least an equivalent amount of accounted removals, according to a 'no debit' rule. The second phase will employ a different method of calculating emissions and removals from the sector and the target is adjusted accordingly.

Norwegian climate policy and targets have distinguished between emissions covered and not covered by the EU ETS, and policy instruments have varied accordingly. Participation in the EU ETS has been a particularly important instrument for emissions covered by this system. However, a carbon tax has also been introduced for some EU ETS emissions, and installations covered by the system have been granted funding for technology development. EU policy also distinguishes between emissions covered and not covered by the EU ETS, but has strong policy instruments in place in addition to the ETS for emissions covered by the system.

Figure 3.7 **Breakdown of Norwegian emissions covered and not covered by the EU ETS in 2021.**

Sources: Statistics Norway and the Norwegian Environment Agency



Box 3.2 Emissions trading schemes

There are many different emissions trading and carbon offsetting schemes of different geographical scope. There are national schemes, company schemes and also voluntary emissions trading markets that everyone can take part in. The schemes have different rules, some stricter than others.

One carbon credit corresponds to one tonne of GHG measured in CO_2e.

National emissions trading schemes

When countries purchase carbon credits or emission reductions to achieve their own climate targets and finance emission reductions in other countries, as Norway has done, this is often called the use of *flexible mechanisms* or *flexibility.* The UN Framework Convention on Climate Change provides for this, and more detailed regulations have been developed under the Kyoto Protocol and the Paris Agreement. The Paris Agreement regulates the purchase and sale of carbon credits for the years from and including 2021. Under the Kyoto Protocol, there were various types of UN-approved credits that could be used as settlement of a country's commitments. Countries do not surrender carbon credits for all their emissions under the Paris Agreement, but they can still use credits from other countries towards their nationally determined contributions (NDC). The UN administers schemes under both the Kyoto Protocol and the Paris Agreement that, with the host country's approval, issue credits on the basis of emission reduction activities towards emission targets in the buyer countries.

Carbon offsetting for companies

Globally, there are a number of different carbon offsetting schemes for companies. Norway is part of the EU Emissions Trading System (EU ETS), which covers emissions from industry, oil and gas production, energy supply and aviation in Europe. There is also a carbon credit system for companies in other regions and countries, including the USA and China. The EU ETS ensures that emissions remain within a certain limit by setting a cap on the number of credits (known as allowances) made available at any given time. Companies in the system must surrender allowances that correspond to their emissions. These allowances can be bought and sold, and the fact that an allowance has a value gives companies an incentive to reduce emissions. The allowances can then be sold to other companies that emit more than their allowances permit. In this way, Norwegian companies contribute to emission reductions throughout the EU/EEA, either by paying for allowances that reduce emissions in other EU/EEA states or by reducing their own emissions and thereby freeing up allowances for others.

In order for an emissions trading system to reduce GHG emissions over time, it is necessary to have:

- carbon offset registries to keep track of the credits
- a system for measuring or calculating emissions
- a system that covers both buyer and seller to avoid multiple counting of credits, emissions or emission reductions
- a cap on total emissions that decreases over time

Volume of allowances in the EU ETS

The volume of allowances in the EU ETS has been gradually reduced over time in line with EU climate targets. A fixed reduction in volume is determined for each emissions trading period. There has been a large surplus of allowances for a long period and thus low allowance prices. As a result, a market stability reserve (MSR) was introduced, with fixed rules for the transfer and deletion of allowances in the event of large surpluses.

The EU 2030 climate and energy framework

The 2030 climate and energy framework, which applies to the period 2021–2030, divides emissions into three categories, each with its own regulations: emissions covered by the EU ETS as described above, emissions not covered by the EU ETS, which are regulated by the Effort Sharing Regulation (ESR), and emissions and removals that fall under Land Use, Land-use Change and Forestry (LULUCF). All emissions included in the member states' emission accounts are covered by one of these three regulations. The EU has its own emissions trading system at national level for emissions and removals that fall under ESR and LULUCF, providing various links and the possibility of flexibility between the different systems and over years. The EU system is complex, but ensures control of emissions while avoiding multiple counting of emissions and emission reductions.

Voluntary carbon credit market

Anyone can buy carbon credits in the voluntary market, both private individuals and companies. It can be misleading to refer to the voluntary carbon market as *one* market, as it comprises many types of actors and different types and qualities of credits, which are offered through different channels to those who wish to use them. There is no regulation of the voluntary market, and carbon credits in this market have different degrees of credibility. One credit in the voluntary market does not confer the right to emit one tonne of carbon, as in the EU ETS, but is a certificate showing that you have paid for reduced emissions or higher removals elsewhere.

Carbon leakage means that businesses move to other countries due to increased costs as a result of climate policy.

EEA relevant: EU legislation that is defined as falling within the policy areas covered by the EEA Agreement.

It will not be natural in future policy to distinguish as sharply between emissions covered and not covered by the EU ETS. The EU is moving towards all emissions, except from land use, forestry and agriculture, being covered by an emissions trading system. The EU 2030 Climate Target Plan expands the EU ETS to include shipping. A separate emissions trading system is being developed for emissions from construction and transport. However, the Effort Sharing Regulation for emissions not covered by the EU ETS, where all countries set a national emissions target, will also be continued. This means that these regulations will in future also apply to some emissions covered by the EU ETS. The EU is proposing to adjust policy instruments aimed at preventing carbon leakage,. Direct compensation to companies covered by the EU ETS through free allocation of allowances and the CO_2 price compensation scheme will be phased out and replaced by other policy instruments, including the Carbon Border Adjustment Mechanism (CBAM), which is a mechanism for adjusting for different carbon prices between countries. This can provide greater scope for introducing policy instruments aimed at emissions covered by the EU ETS, but without increasing the risk of carbon leakage. Much of this legislation will also apply to Norway through the EEA Agreement. The relevance of the CBAM to the EEA has not yet been clarified.

3.4 Emissions development towards 2030

Biofuel: liquid or gaseous fuel produced from biological material, often called biomass. In Norwegian legislation, the application of the terms conventional and advanced biofuels are based on what raw material the fuel is produced from. Conventional biofuels are produced from raw materials that can also be used to produce food or animal feed (agricultural crops). Also known as first-generation biofuels. Advanced biofuels are mainly produced from waste products from the food industry, agriculture or forestry, and not from raw materials that can be used as food or animal feed (non-food biomass). Also known as second-generation biofuels.

The Government has set a transition target for the entire economy for 2030. In the Government's platform, this is formulated as a target to cut Norwegian emissions by 55 per cent compared with 1990 levels, i.e. reducing emissions to 23 million tonnes by 2030. This means that the Government has a national transition target for both sectors covered and not covered by the EU ETS.

A large part of the Government's planned emission cuts for 2030 that are not covered by the EU ETS are from the biofuel sales requirement and higher carbon taxes. The Government's Climate Action Plan from 2022 sets out quantified contributions from various proposals and policies under development. The biggest impact on emissions not covered by the EU ETS comes from the sales requirement for biofuels for transport and machinery. Significantly reduced emissions are also expected from higher carbon taxes, reduced emissions from agriculture, and requirements and funding for zero and low-emission technologies.

The Government's Climate Action Plan (2022) refers to emission reductions that have been assessed from, among other things, CCS, electrification of the petroleum sector and the transition from fossil to renewable technology for sectors covered by the EU ETS. According to emissions projections, the electrification of petroleum installations with power from shore will constitute a large part of the reduction of emissions covered by the EU ETS towards 2030. Emission cuts in industry, for example through CCS, have also been assessed. Figure 3.8 shows historical and projected emissions until 2035 along with (dotted) trajectories for reduced emissions towards 2030 and 2050.

Updated analyses of measures for 2030 show that comprehensive policies are needed for Norway to achieve the 2030 climate target. In June 2023, the Norwegian Environment Agency, in collaboration with other sector agencies, presented an analysis of 85 emission reductions measures in all sectors by 2030 (Norwegian Environment Agency, 2023c). The analysis shows that it is possible to both meet Norway's commitment under the cooperation agreement with the EU and achieve the transition target of a 55 per cent reduction in national emissions by 2030.

According to the Norwegian Environment Agency, areas with great potential for reducing emissions are to introduce policy measures in industry, the transport sector and petroleum industry, encourage a diet in line with current dietary guidelines and implement CCS. Many of the measures concern electrification, and if all of them are implemented, demand for electric power will increase by up to 34 TWh in 2030 compared with 2021. The Agency emphasises access to electric power as a prerequisite for achieving the goals. It also stresses that land is a limited resource and that the transition must take this into account.

Biomass: the total mass of living organisms in contexts where numbers of individuals are impractical, for example the number of trees in a forest. Biomass can also be used as a term for bioenergy; fuels derived from trees and plants, fertilisers, forest waste, peat etc.

It will be necessary to use policy instruments such as requirements and bans, as well as support schemes and the use of purchasing power in public procurement. The Norwegian Environment Agency's analysis shows that the added costs of a transition are a significant barrier to emission reduction measures, but that there are also many other barriers that must be overcome. These include technological immaturity, regulations and institutions, access to scarce resources such as biomass, land and expertise, as well as barriers relating to behaviour. A higher carbon tax will help pull in the right direction, but will not be enough.

The Committee emphasises the importance of ensuring that short-term emission cuts are aligned with the transition to a low-emission society in 2050. The fact that the resources needed for the transition, such as renewable power, land and biomass resources, are scarce both nationally and globally must also be taken into account. It is difficult to gain an overview of both the total costs of the various measures and how these will be distributed between the public sector, companies and households. The use of advanced biofuels is expensive, but it is also easy to predict the effect of a sales requirement on Norway's emission accounts. It is more demanding to determine the effect of tax changes and funding with certainty. Dietary changes are a premise for achieving the emission reductions in agriculture that the Government refers to in its plan, and for the potential for reduced emissions in agriculture that the Norwegian Environment Agency refers to in its analysis.

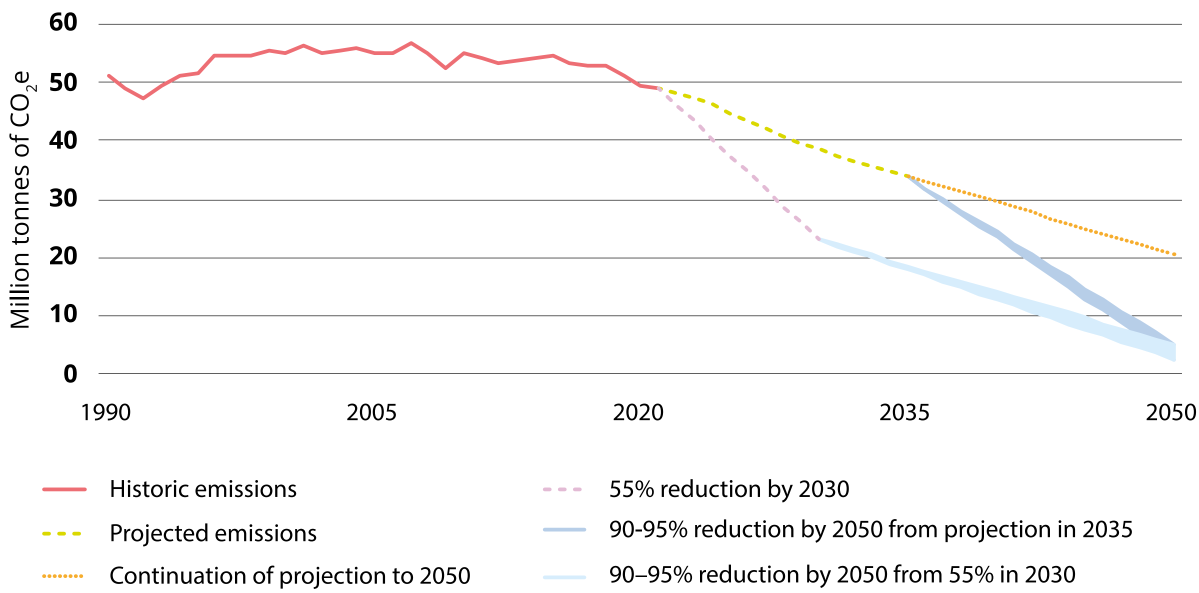


Figure 3.8 Historical emissions, projected emissions and pathways for reduced emissions until 2050.
Emissions and removals in the forestry and land use sector are not included in the figure. The light blue and sky-blue lines show the range between a 90 and 95 per cent reduction in 2050.

Sources: The Ministry of Finance, the 2050 Climate Change Committee, the Norwegian Environment Agency, NIBIO and Statistics Norway.

There may be good reason to plan for a more powerful reduction rate during some periods than others, and to make big cuts at an early stage. Early emission cuts are valuable since, over time, they contribute more than to reducing global warming that cuts made at a later stage. This is important from a climate justice perspective. Climate justice also entails reducing as much as possible as quickly as possible to limit the challenges for future generations. Key technologies may have reached a maturity and cost level that makes it prudent to rapidly implement high emission cuts. This applies, for example, to several transport segments. In addition, many remaining minor emissions may prove demanding to reduce in the medium and long term. On the other hand, many demanding technology development projects can have unpredictable time spans, for example the development of new technology in the processing industry. This means that a steady reduction in emissions cannot be expected.

Zero-emission solutions: solutions that generate no direct greenhouse gas and exhaust emissions during use. This means, for example, the use of an electric motor in combination with a battery, or direct use of electricity or a fuel cell that utilises a carbon-free energy carrier such as hydrogen.

The Committee does not consider all measures outlined in the Government's climate action plan to be permanent solutions for 2050. Biofuels, for example, are not a long-term solution for road transport because biomass resources are scarce and the use of such resources potentially threatens food security, biodiversity and other environmental assets. Use of biofuel may also delay the transition from internal combustion engines to electric motors. Bioresources should be reserved for areas where there are no good alternative zero-emission solutions and where it is not desirable to cease the activities that generate emissions. However, the use of biofuels can be a good contribution in the short term to reducing emissions quickly and staying within the emissions budget Norway has committed to through the EU climate agreement. The cuts in transport based on biofuels are cuts Norway will have to make in other ways in the long term, for example through zero-emission vehicles, changed modes of transport and reduced demand. Electrification of the continental shelf is also a choice that has long-term consequences, not only for petroleum activities but also through increased pressure on nature and on other stakeholders who will face more expensive electric power, power shortages and fewer available workers. See Chapter 8 on transport and mobility, Chapter 12 on the petroleum sector, and Chapter 13 on pathways to the low-emission society.

See discussion of transport and mobility in Chapter 8, the petroleum sector in Chapter 12 and important policy choices in Chapter 13.

Climate policy must therefore take account of the fact that the choices Norway makes today also affect the options available in the future, known as path dependency (see Box 3.3). It is important that temporary solutions do not create barriers to Norway's transition to a low-emission society. This means, among other things, that temporary solutions must not stimulate the development of value chains or industries that are not conducive to a low-emission society. For example, transport policy should not be based on an equal share of privately owned passenger cars as previously. Decisions about long-term investments, such as transport planning, must be based on their suitability in a low-emission society. Choosing the right pathway early on for society's development towards low emissions will reduce costs and make the transition easier, but major uncertainties about where the world is headed mean that we must be prepared for the eventuality that some of the choices prove to be wrong. See Chapter 13 on pathways to the low-emission society.

See discussion of policy choices towards a low-emission society in Chapter 13.

3.5 The potential for emission cuts by 2050

This section is based on a technical analysis of emission reductions in Norway towards 2050. The analysis is not a plan for how the cuts should actually be implemented, nor is it a recommendation on how emissions should be reduced. Developing a low-emission society requires sweeping changes in Norwegian society. Activities in the various sectors affect each other, and the changes must take place in a coordinated manner if Norway is to achieve its goals. There are many pathways to a low-emission society in which changes in behaviour, technology and activity levels all play a role. A reduction in emissions of 90–95 per cent compared with 1990 levels, as prescribed by the Climate Change Act, means that total emissions in Norway will be at 2.5–5 million tonnes of CO_2e in 2050.

According to the analysis, it is difficult to envisage emissions below 5 million tonnes of CO_2e in 2050 without changing the level of activity in some sectors. The analysis is based on a number of assumptions, including an unlimited supply of resources such as expertise and labour, power, land, biomass, minerals and metals. These assumptions are not realistic because such resources are limited. More realistic modelling that takes into account such scarcity factors would show that it is even more demanding to achieve the targets by 2050.

The analysis is a review of all emissions in the Norwegian emission accounts, in order to assess how far down towards zero emissions it is possible to get by 2050 without changing the level of activity. The Norwegian Environment Agency has assisted the Committee in this work. The exercise is based on the premise that emissions must be reduced to as close to zero as possible in 2050, with the use of known, but not necessarily mature, technology. The exercise does not entail a forecast of a likely development nor a backcast from a set target, but is rather a review of the emission cuts that currently appear plausible towards 2050 without changing the current level of activity and given unlimited resources. The analysis is based on the current industry structure and activity level, and these are unlikely to be the same in 2050 as at present.

In the Committee's opinion, the review is useful to highlight the challenges Norway faces in reducing emissions to close to zero by 2050, but the analysis is not a recommendation. It provides a basis for assessing the wide-reaching changes Norway is facing, and the challenges that need to be addressed today. The review does not include emissions from forestry and land use.

Many emissions can be reduced if an activity is reduced. Emissions from the petroleum industry, for example, will be reduced if the level of activity is reduced, and emissions from agriculture will be reduced with lower production of red meat. The technical assumption of an unchanged level of activity in the analysis makes it possible to illustrate how far it is possible to envisage reducing emissions by using alternative technology, and which remaining emissions will require other emission reduction measures, such as lower activity.

The most essential assumptions and delimitations in the analysis are as follows:

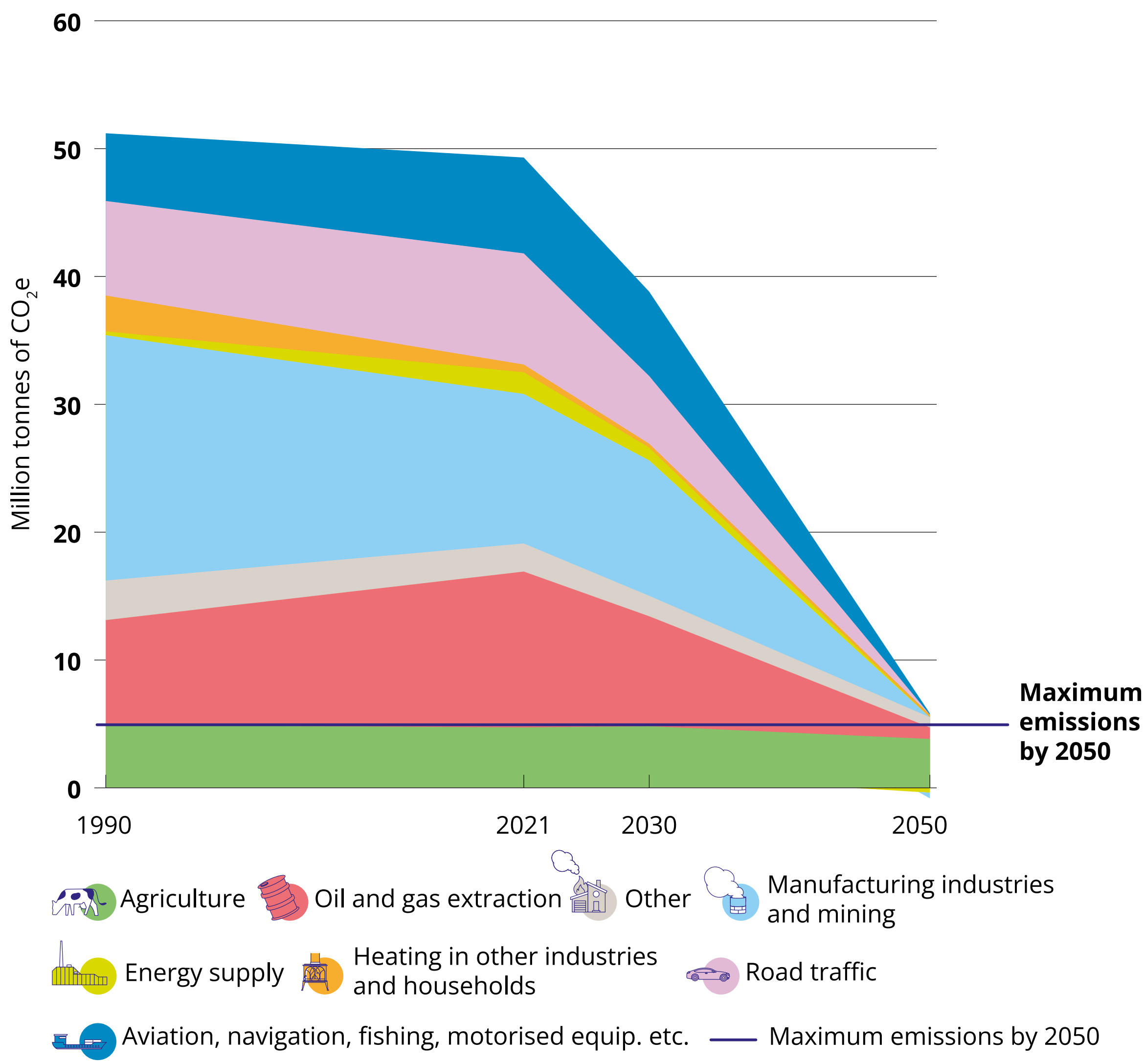
- The analysis has looked at GHG emissions included in the Norwegian emission accounts, excluding emissions from forestry and land use.
- The costs have not been assessed.
- The extent of the changes such a scenario will entail for individual stakeholders and individuals has not been assessed.
- No restrictions have been made on access to electric power, biomass, metals, minerals or other raw materials, land, labour or expertise.
- Similarly, there are no restrictions on the resources of central, regional or local authorities or the private sector to implement measures.
- It has not been taken into account whether it is possible to implement all of the measures in parallel, as the analysis assumes.
- Nor has account been taken of the fact that some of the measures will be technically demanding to implement before 2050.
- It is assumed that the emission accounts will not be expanded to include additional emissions sources as a result of new methods or new knowledge.
- The assessments are based on existing technology and new technology that could plausibly be available by 2050, but it assumes the success of technology development in many areas.

- It is assumed that CCS can be used where desired. It is also assumed that a CCS facility can capture and store 95 per cent of exhaust gases. By comparison, most facilities today are built for 90 per cent capture. A 95 per cent capture rate is still likely to be technically demanding and costly in 2050.
- For stationary use of fossil energy (combustion), it has been assumed that this has been replaced by renewable electricity or bioenergy, or a combination, possibly also in combination with CCS.
  - The combustion of bioenergy emits methane and nitrous oxide, as does the combustion of fossil energy. It is assumed that methane and nitrous oxide emissions are the same for bioenergy and fossil energy. Emissions of CO_2 from biomass combustion are counted as zero in line with current emission accounting rules.
  - In some applications, it is possible to envisage partial electrification and partial use of bioenergy as a solution, for example in aviation and some areas of shipping. This has been taken into account when calculating residual emissions of nitrous oxide and methane.
  - As regards the heating of buildings, it is assumed that about half of gas and bioenergy-powered heating is replaced by electric heating, but that wood-burning stoves are maintained at the current level. Wood burning emits methane and nitrous oxide. CO_2 emissions from wood burning are counted as zero in line with current emission accounting rules.
- Road traffic is assumed to be fully electrified. The use of biofuels or bioenergy, which gives residual emissions of methane and nitrous oxide, has not been included. Among other things, this means that the analysis has not taken into account that vintage cars that run on liquid fuel may still be in use.
- It has been assumed that 30 per cent of aviation and shipping can be electrified. The remainder will be covered by biofuel or other alternative fuels.
- Small craft, snowmobiles, tractors, construction equipment and other motorised equipment such as chainsaws and lawnmowers are assumed to be fully electrified. Among other things, this means that there is no construction equipment, agricultural machinery or recreational craft that run on liquid fuel.
- In the agricultural sector, the analysis assumes reduced emissions as a result of changes in feed and fertilisation practices, and how the soil is cultivated. However, the potential for emission reductions through such changes is limited. There is assumed to be no change in what is produced.
- A large proportion of the biological waste that is incinerated is assumed to go to plants with CCS capabilities. This is considered removal of atmospheric CO_2 and thus offsets other emissions. The analysis is sensitive to assumptions about the amount of waste and what the biological waste is used for.
- For fluorinated gases, a reduction in emissions has been assumed in line with the EU's long-term plans. Many products with fluorinated gases are already in use and will still be in use in 2050, and these may continue to leak gas.
- To assess the possible emissions level in the petroleum industry in 2050, the Committee has requested an assessment from the Ministry of Petroleum and Energy, which has also been supported by material from the Norwegian Petroleum

Directorate. The Ministry of Petroleum and Energy emphasises the uncertainty associated with estimating emissions in 2050, and points out that emissions in 2050 are likely to be limited because production levels are expected to fall significantly by that time, and that the remaining infrastructure in 2050 will largely run on power from shore or possibly other low-emission solutions. If it is assumed that all offshore installations and onshore facilities in operation in 2050 are powered by renewable energy, and that emissions from other emission sources are reduced, the Ministry of Petroleum and Energy believes that it will be possible to have an emissions level in 2050 of less than 1 million tonnes of CO_2e. Based on this, the Committee has assumed emissions of 0.9 million tonnes of CO_2e from the oil and gas industry as the technical basis for the analysis. This level of emissions presupposes extensive use of renewable energy to replace fossil energy sources on the installations.
- Emissions from the petroleum industry include emissions from new fields in operation that are included in the Norwegian Petroleum Directorate's resource report, for example in Lofoten, Vesterålen and Senja, and the Barents Sea.
- Emissions relating to the decommissioning of installations on the continental shelf are not included in the analysis. This could be emissions from flaring in connection with the emptying of wells, or energy consumption by vessels.

The technical analysis shows that it is very demanding to reduce emissions by 90–95 per cent compared with 1990 while maintaining an unchanged level of activity. Even with the optimistic assumptions that have been made, emissions are only just reduced to the extent necessary. The outcome is right at the upper end of the emissions range of between 2.5 and 5 million tonnes of CO_2e. This means that, to achieve the goal, the level of activities that produce emissions needs to change. The result of the analysis is shown in Table 3.3. Figure 3.9 shows historical emissions in 1990 and 2021, emissions in line with the emissions projection for 2030, and reduced emissions in 2050 according to the technical analysis. Figure 3.10 shows the change from 2021 to 2050 sector by sector.

The review illustrates that there are several sources of emissions that are difficult to significantly reduce or eliminate without doing less of what produces the emissions, changing behaviour or finding completely new ways of doing things. This applies, for example, to emissions from meat production in agriculture, and the petroleum sector. The size of the remaining emissions here is largely due to the scale of activity in the agriculture and petroleum sectors.



In general, CO_2 emissions from the combustion of fossil energy are the easiest to remove, while emissions from industrial and biological processes and emissions of other GHGs are often more demanding. Much of what is currently based on the combustion of fossil energy can, with relatively low intervention costs and without major technical obstacles, switch to using renewable energy. It is more demanding to remove emissions from industrial processes where fossil energy carriers are involved in chemical processes or processes that generate emissions of other GHGs. These emissions are more demanding technologically and often more expensive to remove. The combustion of biomass, such as wood burning, emits methane and nitrous oxide. It is difficult to reduce this without reducing the use of wood-burning stoves. Where fossil energy carriers are replaced by biomass, there will still be residual emissions

Figure 3.9 Historical emissions in 1990 and 2021, the projection for 2030 and the technical analysis for 2050.
The development between the different years is shown as straight lines. Emissions in 2030 are based on the projections as presented in the National Budget for 2022. Emissions and removals in the forestry and land use sector are not included in the figure.
Sources: Statistics Norway, the Norwegian Environment Agency, the 2050 Climate Change Committee.

of methane and nitrous oxide. Methane emissions from ruminants can be reduced somewhat, for example by making changes to feed and breeding, but cannot be significantly removed or reduced without reducing the number of livestock. Emissions from fires and biological processes such as decay in landfills or wastewater are difficult to avoid. Many fluorinated gases are very powerful GHGs, while also having unique properties that lead to their popularity in many existing products, some of which have long service lives. These range from refrigeration and freezing systems, heat pumps and spray cans to insulation applications in both electrical switches and double-glazed windows.

It is not possible to remove all emissions associated with oil and gas production as long as such activities are maintained. Even if all energy consumption on offshore and onshore installations is based on renewable energy, there would be significant emissions from oil and gas production relating to leaks, flaring, loading and unloading of petroleum and processing plants. In its resource report for 2022, the Norwegian Petroleum Directorate has illustrated three possible pathways for production on the Norwegian continental shelf going forward, all of which show a significant decline in production towards 2050. The difference in the production levels lies, among other things, in the level of exploration activity and the discovery rate. Lower production levels will mean lower emissions as long as less production also means less infrastructure in operation, since emissions are more related to the infrastructure and the number of turbines in operation than to the production level.

Table 3.3 Emissions in 1990, 2021 and 2050. Negative figures are negative emissions, i.e. net removal of atmospheric CO_2.

	1990 (mill. tonnes of CO_2e)	***Percentage of total*** (1990)	**2021** (mill. tonnes of CO_2e)	***Percentage of total*** (2021)	**2050** (mill. tonnes of CO_2e)	***Percentage of total*** (2050)
Oil and gas production	8,2	*16*	12,2	*25*	0,9	*18*
Manufacturing industries and mining	19,2	*38*	11,7	*24*	-0,5	*-9*
Energy supply	0,3	*1*	1,7	*4*	-0,4	*-8*
Heating in other industries and households	2,8	*5*	0,6	*1*	0,2	*5*
Road traffic	7,4	*14*	8,7	*18*	0,0	*0*
Aviation, navigation, fishing, motorised equip. etc.	5,3	*10*	7,5	*15*	0,1	*2*
Agriculture	4,9	*10*	4,7	*10*	3,8	*76*
Other	3,1	*6*	2,2	*4*	0,8	*17*
Total	51,3	*100*	49,2	*100*	5,0	*100*

Source: The 2050 Climate Change Committee

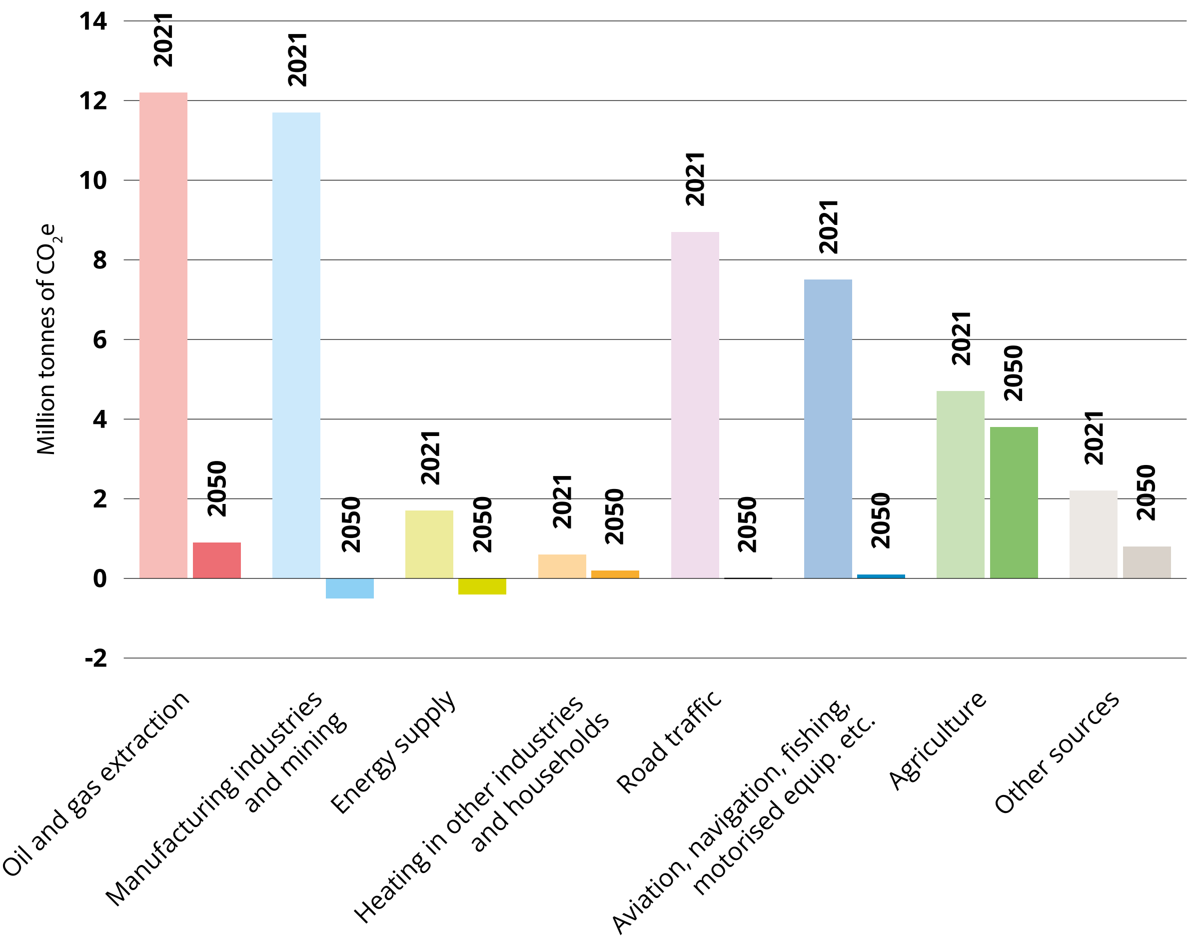


Figure 3.10 **Historical emissions in 2021 and the results of the technical analysis for 2050.**
Emissions are broken down by the different emission sectors. Emissions and removals in the forestry and land use sector are not included in the figure.
Sources: Statistics Norway, the Norwegian Environment Agency, the 2050 Climate Change Committee.

Emissions from oil and gas production will be higher than the analysis shows if fewer installations on the continental shelf are electrified. It is assumed that the remaining infrastructure in 2050 will largely run on power from shore or other low-emission solutions. This will lay claim to electrical power, which is a scarce resource in the transition. If installations on the continental shelf are not electrified, emissions from oil and gas production in 2050 will be higher than assumed for the purpose of this analysis. See the discussion in Chapter 12 on the petroleum sector and Chapter 13 on pathways to the low-emission society.

The industrial sector has high emissions from processing that cannot be cut without technology that has not yet been developed and which may also depend on the availability of resources such as land, biomass, electric power and storage of captured CO_2. It is therefore demanding to estimate how far towards zero emissions many of the industrial emissions could reach. At the same time, there is potential for removing atmospheric CO_2 using bio-based raw materials such as wood chips and charcoal combined with CCS. Prosess21 has conducted an analysis of the reduction potential by 2050 on which the assessments here are based, although

See discussion of the petroleum sector in Chapter 12 and policy choices towards a low-emission society in Chapter 13.

the assumptions used for Prosess21's analysis differ from those used in this analysis (Prosess21, 2021). Prosess21 has, among other things, assumed increased industrial activity and also included emission reductions relating to new production of renewable energy with capture and storage of biogenic CO_2 emissions, i.e. removal of atmospheric CO_2. The Committee's analysis therefore shows a smaller reduction potential than Prosess21, with just 0.5 million tonnes of CO_2e removed from the atmosphere (negative emissions). The main potential for removal of atmospheric CO_2 using biomass combined with CCS is in the wood processing and ferrous metals industries.

Waste management can help remove more CO2 from the atmosphere than it emits by employing CCS in waste incineration where part of the waste is biological. If the biological waste is used as a bio-resource instead of being incinerated, this will change. There will still be some emissions from both electricity production and district heating if biogas is used.

Emissions of methane and nitrous oxide from wood-burning stoves account for almost half of the emissions from heating in buildings. CO_2 emissions from biomass combustion (e.g. wood) count as zero in the greenhouse gas accounts. With biogas and more clean-burning wood stoves, emissions of methane and nitrous oxide from wood burning can be reduced, but not completely removed. In addition to emissions from wood burning, it is mainly the use of natural gas and LPG (liquefied petroleum gas, such as propane and butane) that generate emissions from the heating of buildings at present. There are also some emissions from mineral oil and diesel. These emissions can be completely eliminated by electrification, or significantly reduced with the use of bioenergy.

In agriculture, it is demanding to envisage emission reductions beyond what has been assumed in this analysis without reducing the number of livestock, particularly ruminants. This is because agricultural emissions are a consequence of biological processes, although the level of emissions results from decisions on activity levels. The analysis shows that, by 2050, agriculture could account for about three-quarters of the remaining emissions, with emissions of close to 4 million tonnes of CO_2e.

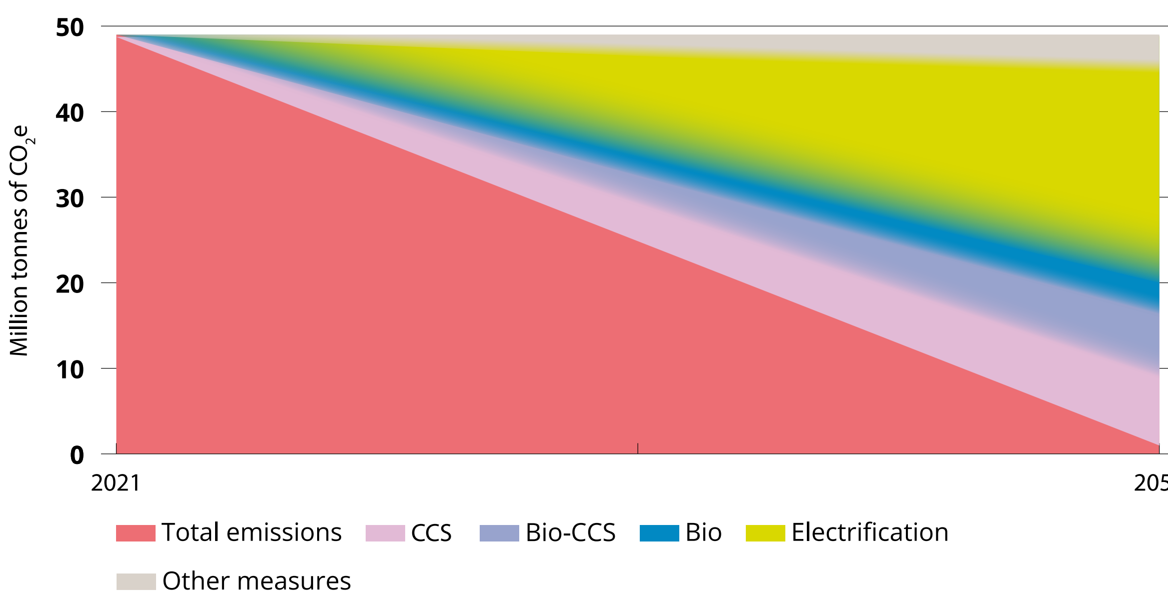
The category 'other emissions' does not include combustion emissions, and more than 90 per cent of the emissions are GHGs other than CO2. The largest source in this category is emissions of fluorinated gases from products. It is difficult to envisage zero emissions of fluorinated gases in 2050. Other emission sources in this category are liming, gas distribution, fires (not forest fires) and cremations, composting and methane from old landfills and wastewater treatment. It is difficult to see how many of these sources can be removed, and with plans for more use of biogas, some of the emissions could increase towards 2050. It is also difficult to envisage changes in what generates some of these emissions, not due to lack of willingness, but because it is not physically possible. In total, emissions in the 'other sources' category amount to just under 1 million tonnes of CO_2e in 2050. This means that, in an emissions budget of 2.5–5 million tonnes of CO_2e, there will be 1.5–4 million tonnes remaining for emissions in other sectors.

There is no explicit distribution between measures such as electrification, use of biomass or CCS in the analysis. Further analyses are necessary to be able to give a more specific estimate of the resources required for an emission reduction of this magnitude to be achieved without changing the level of activity. However, the Committee has made some rough estimates of how the different reductions could be distributed among different resources and technologies, as also shown in Figure 3.11.

In the analysis, more than half of the emissions in 2021 will be reduced or removed by 2050 with the use of electric power. Power is therefore a resource that will be in high demand. It will be necessary to prioritise the use of power and make it more efficient, and it must be expected that power will be a scarce resource. The production and distribution of power requires other resources that are scarce, and this must be carefully considered in the transition. It is not certain that power will be available to the extent assumed in the analysis, at a price and cost level that is acceptable to society.

Figure 3.11 Breakdown of measures including electrification, use of biomass, CCS and other measures to reduce emissions towards 2050. The figure is based on the results of the technical analysis and assumes, among other things, that there are no limitations on the available resources.

Source: The 2050 Climate Change Committee



In the analysis, biomass contributes to reducing almost 25 per cent of emissions by 2050. Biomass is used to replace fossil energy and fossil raw materials. Using biomass combined with CCS (known as BECCS), more than 10 million tonnes of CO_2 emitted in 2021 – particularly from industry and mining, energy supply, heating in industry and households, and aviation, fishing and shipping – can instead lead to the removal of up to 0.3 million tonnes of CO_2 from the atmosphere by 2050. The analysis has not assumed any restrictions on access to biomass. Prosess21 estimates increased demand of between 7.5 and 20 million solid cubic metres (sm^3) compared with current levels. This also includes somewhat increased activity in industry (Prosess21, 2021; Prosess21 Expert group report, 2020). By comparison, annual felling of industrial timber in Norway has comprised just over 10 million sm^3 in recent years. In addition to increased demand in industry, the 2050 analysis assumes that biomass will be used for energy supply, heating in industry and households, and aviation, fishing and shipping. Sustainably produced biomass is unlikely to be available to such an extent if all countries plan for a similar level of use.

CCS from exhaust gas is key to eliminating close to 25 per cent of emissions. This applies to emissions from industry and mining and waste incineration. In the analysis, the use of BECCS will reduce emissions from industry and mining and waste incineration by 11 million tonnes of CO_2 in 2021 and instead lead to the removal of more than 1 million tonnes of CO_2 from the atmosphere by 2050.

Using CCS will not completely eliminate emissions. The analysis is based on an assumed capture rate of 95 per cent. By comparison, most facilities today are built for 90 per cent capture. A carbon capture facility requires energy, and energy consumption increases significantly with increasing amounts of captured CO_2. Capture rates above 95 per cent of the CO_2 content of exhaust gas are technically demanding and energy intensive. This in turn makes the facilities considerably more expensive to operate than those with a lower capture rate. At the overall level, the scope of CCS is therefore a trade-off between the use of scarce resources that are also of high value for other uses and the need to reduce emissions from these particular emission sources, weighed against opportunities for changes in activity levels and reduced activity.

CO_2 can be removed from the atmosphere by using a combination of biomass and CCS. The analysis assumes that this will collectively remove just over 1.5 million tonnes of atmospheric CO_2 by 2050. Without this, total emissions would increase to over 6.5 million tonnes of CO_2e. Given the assumptions in the analysis regarding the unchanged level of activities that generate emissions, we are dependent on large amounts of biomass and on extensive resources being allocated to CCS in order to achieve the target of reducing emissions to between 2.5 and 5 million tonnes of CO_2e by 2050. Greater use of BECSS than assumed in the analysis is technically conceivable, but in such case with even greater challenges relating to the availability of scarce resources such as sustainable biomass. This suggests a need to adjust the activity level to reduce emissions.Dette indikerer at det er behov for å justere aktivitetsnivået for å redusere utslippene.

See section 3.8 for a description of emission projections for the forestry and land use sector.

A similar analysis that also included emissions from the forestry and land use sector could show that the transition is even more demanding than indicated here. The Committee has not carried out a similar analysis of emissions from the forestry and land use sector. Projections in this sector are based on a continuation of the historical trend, as discussed in section 3.8. This means that the projection shows the development without changes in the activity level. Further into this century, the projection shows a net annual removal in the land use category 'forest' of between 10 and 20 million tonnes of CO_2e, and net emissions in the categories cultivated land, pasture, lakes and peatland and built-up areas of approximately 5 million tonnes of CO_2e. Higher removals or reduced emissions assumes a change in activity level compared with current levels. At the same time, the analysis for the other sectors shows significantly increased demand for biomass. If this demand is met in whole or in part by significantly increased felling in Norway, carbon uptake and sequestration in forests will decrease, at least in the next few decades, compared with the existing projection. The nature of the development in the longer term depends on how the forest is managed and whether the requirement for forest regeneration after felling is met. Other assumptions in the analysis that apply to other sectors will also change the development in the forestry and land use sector. For example, the development of renewable energy or many CCS facilities could lead to more built-up areas than assumed in the projections.

See discussion of climate and energy action plans in Part D.

The Committee believes that such technical analyses are useful as part of the assessments that must be made in connection with the transition to 2050. The analysis should be further developed and improved in the authorities' further work, and include assessments of resource availability. In the Committee's view, the further development of this type of analysis should include the forestry and land use sector. The analyses can be included in the work on climate and energy plans; see Part D of the report.

3.6 Remaining emissions in 2050

In the analysis, around three-quarters of the emissions in 2050 come from food production in the agricultural sector, as well as from petroleum production and from what are currently minor, other sources. The target for 2050 is to reduce emissions by 90–95 per cent compared with 1990, i.e. that emissions in 2050 should be about 2.5–5 million tonnes of CO_2e. With the assumptions made in the review, emissions in 2050 are at the upper end of this range, with remaining emissions of 5 million tonnes of CO_2e. It is difficult to envisage how emissions could be lower than this without reducing the level of activity, for example through reduced oil and gas production and/or a reduced number of ruminant livestock. Alternatively, remaining emissions can be compensated through new technologies, such as extensive use of DAC.

DAC could provide an opportunity to reduce the atmospheric concentration of CO2 to compensate for remaining emissions. In a report, the Norwegian Environment Agency assessed the potential and costs of industrial carbon removal (Norwegian Environment Agency, 2023b). Assessments include BECSS, processes using biological material and DAC. The Agency refers to DAC projects with a potential for annual emission reductions of 1–3 million tonnes of CO_2 in 2030, and the potential for 2050 could be even greater. This could offset some of the emissions that have not been reduced by 2050.

DAC is both land and energy intensive. There are currently 18 DAC plants in operation in the world, primarily pilot and demonstration plants. The overall capacity of these plants is approximately 9,000 tonnes of CO_2 per year, and the largest of the facilities, located in Iceland, captures up to 4,000 tonnes of CO_2 a year. This plant opened in September 2021. A plant with a capacity to capture one million tonnes of CO_2 per year would be the size of a large chemical processing plant and may need several TWh of energy. In a report commissioned by the Norwegian Environment Agency, SINTEF and Vista Analyse show that capturing 15 million tonnes of CO_2 per year could require power consumption of up to 22–63 TWh, i.e. between 14 and 40 per cent of Norway's annual power production (Bisotti et al., 2023). Such a facility may require 6–22.5 square km of land. In the same report, reference is made to the fact that an area equivalent to around 20 football fields is needed to remove 0.5 million tonnes of CO_2. This indicates that avoiding emissions entails more efficient use of resources than first emitting CO_2 and then investing energy, land, minerals, metals and expertise to capture and store it.

DAC technology is immature and is therefore costly at present. The cost of the facility in operation in Iceland is USD 600 per tonne of CO_2 removed, but this is expected to become more affordable over time. Since the technology is so immature and there is little experience of using it, it is difficult to estimate the future cost development, but it is estimated to be between USD 100 and 800 per tonne of CO_2 removed, without including transport and storage costs. The estimates are uncertain, however, and will depend heavily on energy costs, as well as technology, location and available infrastructure. A cost of USD 100 per tonne of CO_2 can only realistically be achieved with low energy prices below USD 0.05/kWh (Bisotti et al., 2023).

Carbon sequestration in nature on sustainable terms should also be considered. In Chapter 6, the Committee gives its assessments of the importance of preserving existing natural carbon sinks. It is also possible to increase carbon uptake and sequestration in nature. Examples of possible measures are the re-establishment of kelp forests, and wider buffer zones of trees and shrubs around watercourses and between agricultural areas. This will result in increased uptake and larger carbon sinks in various ecosystems. Certain other nature-based measures, such as peatland restoration, will primarily help to reduce emissions and prevent existing carbon sinks from being further reduced. There is uncertainty about the overall climate effect of afforestation on new land, partly due to the effect on carbon stored in the soil. Measures to increase natural carbon sinks over time should be seen in light of the goals of the Global Biodiversity Framework to restore degraded ecosystems. Such measures should first and foremost be implemented where they contribute to improving the ecological condition of natural ecosystems. See Chapter 6 for the Committee's assessments relating to nature and land.

See the Committee's assessments relating to nature and land use in Chapter 6.

A time perspective is central to assessing the usefulness of DAC. Relying on DAC at a later stage rather than reducing emissions today will lead to a temporarily higher atmospheric concentration of CO_2. This increases the risk of exceeding physical tipping points, which in turn increases the risk of adverse consequences of climate change. Norway's contribution to a balanced global climate system will be less if DAC technology development is used to replace emission cuts now. Any investment in such technology must therefore come in addition to emission cuts. At the same time, using DAC technology to offset minor remaining emissions that cannot otherwise be eliminated could help limit dangerous effects of climate change.

The development and implementation of DAC technology and measures must not be seen as an alternative to reducing emissions by adopting zero-emission technology and adjusting behaviour to zero-emission activity. In the Committee's opinion, DAC is potentially an important technology to offset the last, difficult emissions since some emissions cannot be removed through technology or changed behaviour. DAC can also reduce the likelihood of temporarily exceeding global carbon budgets if emissions are not reduced quickly enough. It is important to be aware that there are several uncertainties relating to whether and how well this technology will work in Norway, partly because the technology works less well in temperatures below zero degrees, and in humid air. If such technology is to be developed for use in Norway, it will be crucial to weigh the use of the resources it requires against other possible measures, to avoid laying claim to expertise, power or other resources that may be more beneficial in other areas. There are many benefits associated with direct emissions cuts, and risks associated with both DAC and other types of carbon storage. The European Scientific Advisory Board on Climate Change shows in its report that reducing emissions has several advantages that DAC does not offer. Nevertheless, DAC may be a necessary supplement to emission cuts.

Norway has experience that can be useful in the development of DAC technology. There is likely to be demand for such technology in a number of countries. Several countries are developing the technology, and companies in Iceland, Canada and the USA appear to have come particularly far. Norwegian funding for DAC development could constitute a national contribution towards fulfilment of the global climate targets. Norwegian companies and institutions have already built up more CCS expertise and infrastructure than most other countries. There is great potential on the Norwegian continental shelf for storing CO_2 from both Norwegian and international sources. Solutions for capturing, transporting and storing CO_2 from industrial activities and other appropriate emissions sources in Norway and other countries should be scaled up. Norway's experience so far relates in particular to CO_2 capture from gas streams, where the CO_2 concentration in the gas is higher than in the atmosphere and the gas itself may already be wholly or partly contained in a closed system. Skills development is thus also essential for Norway to be able to develop DAC technology.

Future technologies that reduce the atmospheric concentration of CO2 will increase the carbon budget, but involve significant risks. The potential of future technologies can make it tempting to delay the transition and demanding emissions cuts. Such technologies will lay claim to scarce resources. Many of the solutions are both energy and land-intensive and can have negative consequences for biodiversity and ecosystems. Some of the technologies and measures that have been proposed are nature-based, such as growing large quantities of kelp and sinking it to the ocean floor to sequester carbon. Such solutions can negatively affect ecosystems and biodiversity. There are also solutions that do not reduce the CO_2 concentration, but that are intended to reduce the global temperature increase in other ways, such as setting up large sails or mirrors in the atmosphere to reflect solar radiation, or chemical manipulation of the atmosphere to reduce solar radiation. Most of these suggestions or technologies are experimental and their consequences unknown and many have not been tested on a large scale. Whether the projects will gain access to all the necessary resources to implement such measures on a large scale is highly uncertain, and they could have unforeseen negative consequences.

Norwegian climate policy has so far placed great emphasis on the development and implementation of technology and less emphasis on transformation and lower resource use. Emissions have not been reduced to the extent necessary to become a low-emission society. At the same time, both the problem and the understanding of what is required to limit climate change have shifted in recent decades. Our approach to climate change in the early 2000s does not address the challenge as it stands today. In Norway, the climate debate is characterised by technology optimism (Gulbrandsen & Handberg, 2023). There is a danger that support for new technologies such as DAC will undermine the message about the need for a rapid transition. This must be a key aspect of how we prioritise different policy measures and our communication around the need for transition.

For some emissions, it will take time from when a measure is introduced until emissions are removed. This is because some emissions require large investment or changes to value chains and major structures in society. It is therefore important to implement policies to reduce emissions as quickly as possible. This will give the policy time to take effect, and at the same time build credibility when it comes to achieving the climate targets. When other stakeholders in society align themselves with these signals, the policy will receive important support towards implementation.

The Committee believes that an analysis should be conducted of when it is realistic to expect different emissions sources to achieve net zero, in order to provide predictability during the transition. This will vary between different sectors of society, and the scientific basis must therefore be broken down into sectors. This must also be seen in the context of further developing and updating the analysis for 2050, as recommended by the Committee; see section 3.5. For example, it can realistically be envisaged that road transport will be emission-free by 2040. For other emissions, it may be more demanding to reach net zero, such as the processing industry, which is dependent on the development of new technology in long-term technology cycles. Such an analysis should be based on a robust knowledge base provided by the sectoral authorities on measures and policy instruments for emission reductions, and be updated regularly. Considerations relating to the acceptance of climate action, motivation for change and barriers other than economic barriers should also be included. It should build on existing inter-agency cooperation, which, among other things, has provided an updated knowledge base on the emission reduction potential, barriers and possible policy instruments towards 2030. The analyses should be updated in connection with the comprehensive climate and energy plans the Committee recommends presenting to the Storting; see recommendations in Chapter 18. An example of such an analysis conducted by the UK Committee on Climate Change is shown in Figure 3.12.

See selected recommendations on climate and energy plans in Chapter 18.

<table>
<tr><th></th><th>2020s</th><th>2030s</th><th>2040s</th></tr>
<tr><td>Electricity</td><td>Largely decarbonise electricity: renewables, flexibility, coal phase-out</td><td colspan="2">Expand electricity system, decarbonise mid-merit/peak generation (e.g. using hydrogen), deploy bioenergy with CCS</td></tr>
<tr><td>Hydrogen</td><td>Start large-scale hydrogen production with CCS</td><td colspan="2">Widespread deployment in industry, use in back-up electicity generation, heavier vehicles (e.g. HGVs, trains) and potentially heating on the coldest days</td></tr>
<tr><td>Buildings</td><td>Efficiency, heat networks, heat pumps (new-build, off-gas, hybrids)</td><td colspan="2">Widespread electrification, expand heat networks, gas grids, potentially switch to hydrogen</td></tr>
<tr><td>Road Transport</td><td>Ramp up EV market, decisions on HGVs</td><td colspan="2">Turn over fleets to Zero-emission cehicles, cars & vans before HGVs</td></tr>
<tr><td>Industry</td><td>Initial CCS clusters, energy & resource efficiency</td><td colspan="2">Further CCS, widespread use of hydrogen, some electrification</td></tr>
<tr><td>Land Use</td><td colspan="3">Afforestation, peatland restoration</td></tr>
<tr><td>Agriculture</td><td colspan="3">Healthier diets, reduce food waste, tree growing and efficiency on farms</td></tr>
<tr><td>Aviation</td><td colspan="3">Operational measures, new plance efficiency, constrained demand growth, limited sustainable biofules</td></tr>
<tr><td>Shipping</td><td colspan="3">Operational measures, new ship fuel efficiency, use of ammonia</td></tr>
<tr><td>Waste</td><td>Reduce waste, increase recycling rates, landfill ban for biodegradable waste</td><td colspan="2">Limit emissions from combustion of non-bio wastes (e.g Deploy measures to reduceemissions from waste water)</td></tr>
<tr><td>F-gases</td><td colspan="3">Move almost completely away from F-gases</td></tr>
<tr><td>Greenhouse Gas removals</td><td>Develop options & policy framework</td><td colspan="2">Deployment of BECCS in various forms, demonstrate direct air capture of CO_2, other removals depending on progress</td></tr>
<tr><td>Infra-structure</td><td>Industrial CCS clusters, decisions on gas grid & HGV infrastructure, expand vehicle charging & electricy grids</td><td colspan="2">Limit emissions from combustion of non-bio wastes (e.g Deploy measures to reduce emissions from waste water)</td></tr>
<tr><td>Co-benefits</td><td colspan="3">Health benefits due to improved air quality, healthier diets and more walking & cycling
Clean growth and industrial opportunities</td></tr>
</table>

Figure 3.12 **Example of an analysis of when emission reductions should be implemented, from the UK.**
The figure is a simplified summary.
Source: UK Committee on Climate Change (Stark et al., 2019)

3.7 Avoid-Shift-Improve

The *Avoid-Shift-Improve (ASI)* framework is key to developing policy for the transition to a low-emission society. The IPCC points out that such a framework provides a classification of socio-cultural changes, technological development and infrastructure measures, also on the demand side (IPCC, 2022b). The framework is based on *avoiding*, as far as possible, the activity or action that causes emissions, for example to travel less by air and avoid land degradation. If this is not possible, *shift* the activity, i.e. change the way it is carried out. One example of this could be to travel by train instead of by air. If it is not possible to *avoid* or *shift*, we should *improve*. This often involves technology improvements or more efficient use of resources, and could, for example, be using an electric rather than a fossil-fuel car. The framework is illustrated in Figure 3.13.

Measures to avoid emissions are given the highest priority, and should be the starting point for all assessments. It will be necessary to implement all types of measures, but the framework specifies an order or priority and direction for the design of both more general policies and individual measures. The framework will be designed differently or mean slightly different things in different areas of society, but can be adapted to all sectors.

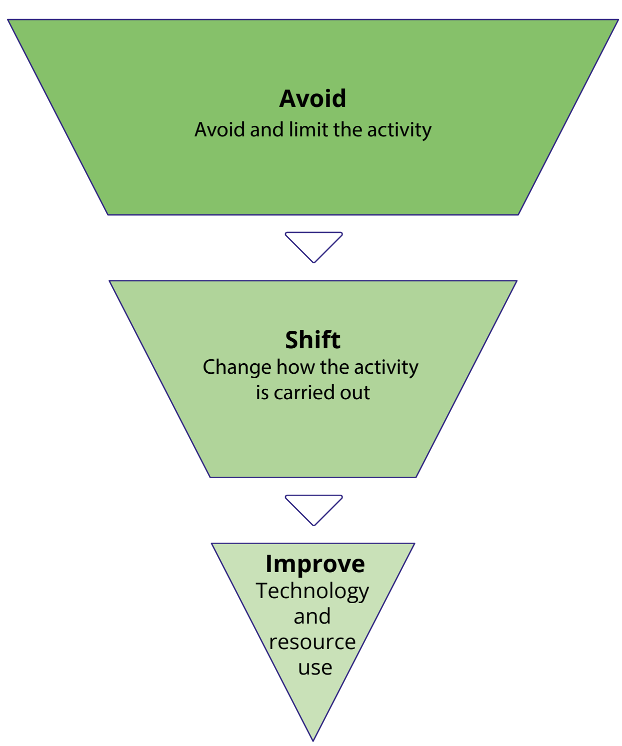


Figure 3.13 **Framework for policy measures – *Avoid-Shift-Improve.***

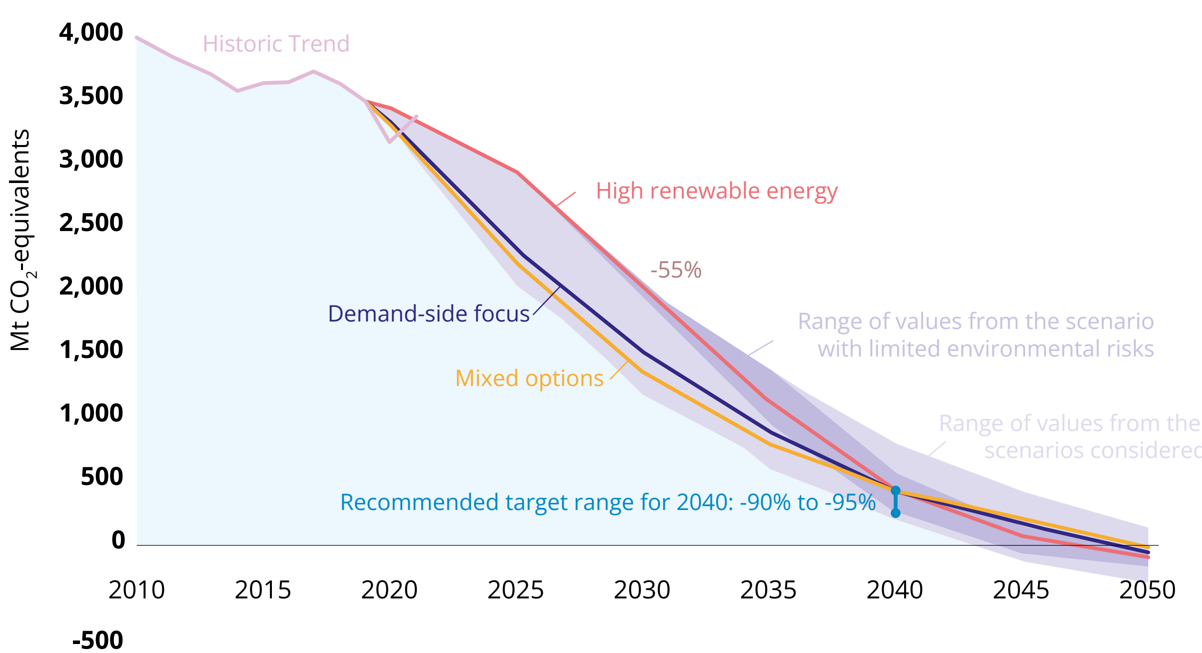
Source: The 2050 Climate Change Committee

Measures that contribute to avoiding emissions through reduced demand for resources will make it easier to ensure the achievement of other important goals. As the European Scientific Advisory Board on Climate Change points out in its scientific advice for the determination of an EU-wide 2040 climate target and a greenhouse gas budget for 2030–2050, scenarios based on lower energy and natural resource use promote greater achievement of all SDGs and enhanced energy security (European Scientific Advisory Board on Climate Change, 2023). The Advisory Board points to benefits such as better health, cleaner air, improved water safety and protection of nature. In addition, scenarios based on lower resource consumption reduce the need for large-scale investment in supply-side measures with relatively high transition risks, such as nuclear power, CCS and bioenergy.

Demand-side measures are also more conducive to rapid emission reductions. The Advisory Board has also looked at three different main scenarios: the demand-side focus pathway, the high renewable energy pathway and the mixed options pathway All the scenarios provide the same level of emissions in 2040, but the trend towards 2040 is very different. Figure 3.14 illustrates that simultaneous investment in demand-side measures and the development of more renewable energy results in the fastest emission reduction and significantly lower emissions over time than simply investing in more renewables. The figure also shows the Advisory Board's recommended target range for 2040 of 90–95 per cent.

Figure 3.14 **Various scenarios for 2050, developed by the European Scientific Advisory Board on Climate Change**

Source: European Scientific Advisory Board on Climate Change (2023)



3.8 Future climate goals

3.8.1 Using flexibility to meet Norway's climate targets

So far, Norway has largely met its climate targets through emission cuts in other countries. UN-approved carbon credits are often referred to as flexible mechanisms and the use of such credits is called flexibility. The Paris Agreement sets out rules for flexibility, and it should not be confused with emission allowances under the EU ETS. See Box 3.2 on carbon offsetting and emissions trading schemes. The possibility of using flexibility in international climate agreements has allowed Norway to set ambitious goals and also contribute to the development and spread of technology and reduced emissions in other countries.

The climate agreement with the EU means that Norway is part of the EU's climate framework, with separate rules for flexibility used to achieve the target under this agreement. The current EU framework allows for flexibility between the various emission pillars in one country: emissions covered by the EU ETS, emissions not covered by the EU ETS (ESR), and land use, land-use change and forestry (LULUCF), between different years in the period 2021–2030, and between countries. For example, Norway may use a limited amount of EU ETS allowances at business level to meet its emissions budget for sectors not covered by the EU ETS (ESR), or purchase allowances from EU/EEA member states that exceed their commitment. The European Climate Law does not permit the use of carbon credits from non-EU countries to achieve the 2030 climate target, and the EU plans to be climate neutral by 2050 without the use of credits from non-European countries.

The kind of flexibility available to Norway after 2030 will, among other things, depend on whether the climate agreement with the EU is continued after 2030. Continuation means that EU rules for the use of flexibility will also apply to Norway after 2030, in addition to the rules under the Paris Agreement. If such an agreement is not continued, only the rules under the Paris Agreement will apply. Countries do not surrender allowances for all their emissions under the Paris Agreement, but they can still use credits from other countries towards their NDCs. The UN administers schemes under both the Kyoto Protocol and the Paris Agreement that, with the host country's approval, issue carbon credits on the basis of emission reduction activities towards emission targets in the buyer countries.

No marketplace for the purchase and sale of carbon credits between countries has been established within the EU's climate framework. Given that credits are available, this will therefore most likely be done through bilateral agreements in the period 2021–2030, as was the case in the period 2012–2020 for EU member states. For Norway, such purchases of carbon credits from EU member states were not an option until 2021, since Norway only became subject to the regulations from that year.

For Norway to be able to purchase carbon credits, such credits must be available. In order to buy credits to meet its commitments, there must be other countries that have exceeded their commitment and wish to sell these credits. Preliminary indications suggest that it is not given that many countries will exceed their targets or have allowances to sell within the EU system towards 2030, either in the form of emissions under the ESR or the LULUCF sector. Several countries are so far looking to fall short of their emission reduction plans.

Information about the availability and price of allowances from EU/EEA member states may be available so late that it will be demanding to consider it as an alternative to emission reductions. Measures to reduce emissions take time to implement and take effect. The countries in the EU system that are to sell allowances will only know with certainty how many they have to sell after their emissions have been calculated and audited. Similarly, Norway will only know with certainty how much emissions need to be covered by allowances after the emissions have occurred, and have been calculated and audited. It will often be too late for a country to reduce its own emissions if it turns out, at the time of purchase, that there are insufficient allowances available from other EU/EEA member states, or if the price of allowances is very high. This means that, if Norway's plan is to buy allowances from other countries, we become locked into this choice. To the extent a country chooses to buy allowances rather than reducing its own emissions, it will also commit to paying a price for the allowances that is unknown when the decision is made.

The situation when purchasing carbon credits on the global market is largely the same. The market mechanisms under the Paris Agreement have recently been established and are not yet fully operational. We do not therefore know what the market for these mechanisms will be like. Norway may have to make purchases in an unpredictable market, where there are potentially few sellers and more buyers, and it is unclear what magnitude of carbon credits are available. It is not certain that the price of such credits will be set in a transparent market with a good flow of information about the participants and their interests. In a world with increased geopolitical tension, there is a higher risk that the price of credits will be affected by far more factors than just the cost of reducing emissions. The future price of carbon credits is unknown and could be high.

By using flexibility under the Paris Agreement, we could reduce the actual climate impact of Norway's goal achievement. The environmental integrity of flexibility mechanisms depends on the emission reduction involved representing actual emissions cuts. Environmental integrity is also affected by how the buyer uses it. If Norway uses previously purchased carbon credits to achieve climate goals at a later point in time, this will reduce the environmental integrity of Norway's goal achievement. Environmental integrity also depends on the system around it. See Box 3.2 on carbon offsetting and emissions trading schemes for an overview of the characteristics that can lead to reduced GHG emissions over time. If Norway chooses to rely on the purchase of carbon credits in the future to achieve its climate goals, and it turns out that there are no credits available, or the price is higher than we are willing to pay, Norway risks not being able to meet its climate commitments.

It is not certain that the environmental integrity of carbon credits under the Paris Agreement will be sufficient to enable Norway to use them to meet its own obligations. If the world does not transition towards low emissions, or only parts of the world do, it is difficult to see how there will be credits of sufficient quality for a country like Norway to have an interest in paying for them. It will be difficult for Norway to claim that we have achieved our national climate targets if they have been achieved through the use of flexibility with questionable environmental integrity.

Purchasing carbon credits with acceptable environmental integrity requires resources. Experience gained from the purchase of certified emission reduction (CER) credits under the Clean Development Mechanism suggests that it requires relatively large administrative resources in Norway to ensure that the credits purchased have sufficient environmental integrity. Continuously purchasing credits to meet Norway's obligations will therefore lay claim to administrative resources in the central government, with associated costs.

Norway reaching its climate goals by purchasing emission reductions rather than making the transition to a low-emission society could potentially represent a political burden. Norway has wanted to come across as a pioneer in the green transition. It is difficult to see how this can be reconciled with achieving our climate goals through purchasing carbon credits. Achieving Norway's climate goals by purchasing emissions reductions could negatively affect the country's reputation.

Carbon credits can have benefits in the short term, but in a 2050 perspective, Norway cannot rely on emissions trading to achieve the goals. There is consensus under the Paris Agreement that a balance should be struck between emissions and removals of GHGs towards the second half of the century. To achieve this, emissions must be reduced as quickly as possible. The Paris Agreement also encourages countries to pursue national emission reductions. The global carbon budget is limited, and developed countries have a particular responsibility to take the lead in reducing emissions. In the long term, all emissions must therefore be eliminated and those that are not must be compensated for in other ways. To avoid exceeding the global carbon budget, it is necessary not only to eliminate existing emissions, but also to ensure that emissions do not increase again, or that emissions arise from new sources. This means that, in Norway as well, virtually all emissions must be eliminated in the long term.

Emissions trading and carbon offsetting is thus more a question of *when* an emission should be cut than *whether* it should be cut. The purchase of carbon credits can be seen as payment for temporarily postponing the emissions cut. Seen in isolation, waiting to reduce some types of emissions may carry a value since technology development can make it easier and cheaper to cut the emissions at a later date. Emissions trading offers an opportunity to postpone emission reductions until they are potentially cheaper and easier, but at the same time incurs the cost of the carbon credit today. In many ways, emissions trading means paying for an emission reduction twice: first purchasing credits in order to postpone the transition and then paying for the transition itself at a later date. Postponing emission reductions also increases the risk of a late, abrupt transition, and can lead to path dependency that makes the transition more expensive at a later date. Delaying emission cuts also means that Norway drains more of the overall carbon budget than would be the case with early emission cuts. See Box 3.3 on path dependency.

With some types of emissions, there is not necessarily a value in waiting for technology development, and the transition may also bring about benefits that are additional to the actual emission reduction. For example, it would be unwise to postpone the transition to more sustainable land use. Nor are there any benefits to be gained from delaying a shift in behaviour towards greater sustainability when it comes to diet, reuse and recycling of resources and materials, and transport. Postponing this transition could reinforce path dependency and necessitate a more abrupt transition at a later date, with high costs to society and individual stakeholders. The need for research, development, piloting and testing of solutions, and uncertainty about which solutions will be developed in other countries, make it essential to get started with the transition at an early stage.

A later transition can lead to undesirable path dependency. This makes it demanding to move from one way of doing something to another. An established way of doing something rests on established frameworks such as infrastructure, workplaces and norms in society. This makes investments in established industries and activities less risky. Individuals will, on a general basis, prefer an existing situation to a new situation (Samuelson & Zeckhauser, 1988). Even if emissions are priced, investments in established sectors can be repaid faster because existing infrastructure and established knowledge environments make innovation less expensive. Established industries and systems are maintained by the fact that established interest groups hold power in society. This power can be used to uphold norms and define what is perceived as possible and not possible. If, in principle, there is majority support for a given change in the population, but the preferences for change are weak, a group that is well organised can mobilise effective resistance to change despite representing a small minority (Olson, 1971). Path dependency in innovation and norms therefore leads to institutional inertia that makes transformation more difficult. There are also a number of risks and uncertainties associated with investments in new solutions that can slow down the pace of innovation and roll-out of solutions. These include factors such as higher costs, energy availability, willingness to pay among key customers, unknown costs and access to expertise, as well as more industry-specific risks.

The purchase of carbon credits from other countries will also make expectations for Norway's transition to low emissions more ambiguous. It will send an unclear message to businesses, municipalities and other stakeholders about the need for a transition, making the process slower and more difficult.

Box 3.3 Path dependency

Path dependency is about choices. Choices made at one point in time can chart a course of development in society that affects the choices available later. Once a given way of doing something has been established, this practice often rests on established parameters such as infrastructure, workplaces and norms in society. This often makes it demanding to move from one way of doing something to another. Being locked to a course of development can be both positive and negative for the transition towards a low-emission society. At the same time, the common use of the term is often linked to the fact that modern society is built around the use of fossil energy resources. Transport systems based on private cars are a clear example of path dependency in urban development: The growing prevalence of private cars in the mid-20th century made it possible for people to settle further away from expensive and often polluted city centres. This led to a need for road construction, which in turn facilitated further car use. Today, we are in a situation where dependence on private cars is reinforced by a development pattern where homes are often far from workplaces, there is a well-developed road network, and there are strong social and cultural preferences for individual mobility. Previous choices on the development of cities and towns make it more difficult today to achieve a transition from private mobility to public transport and active transport that would save emissions, resources and land.

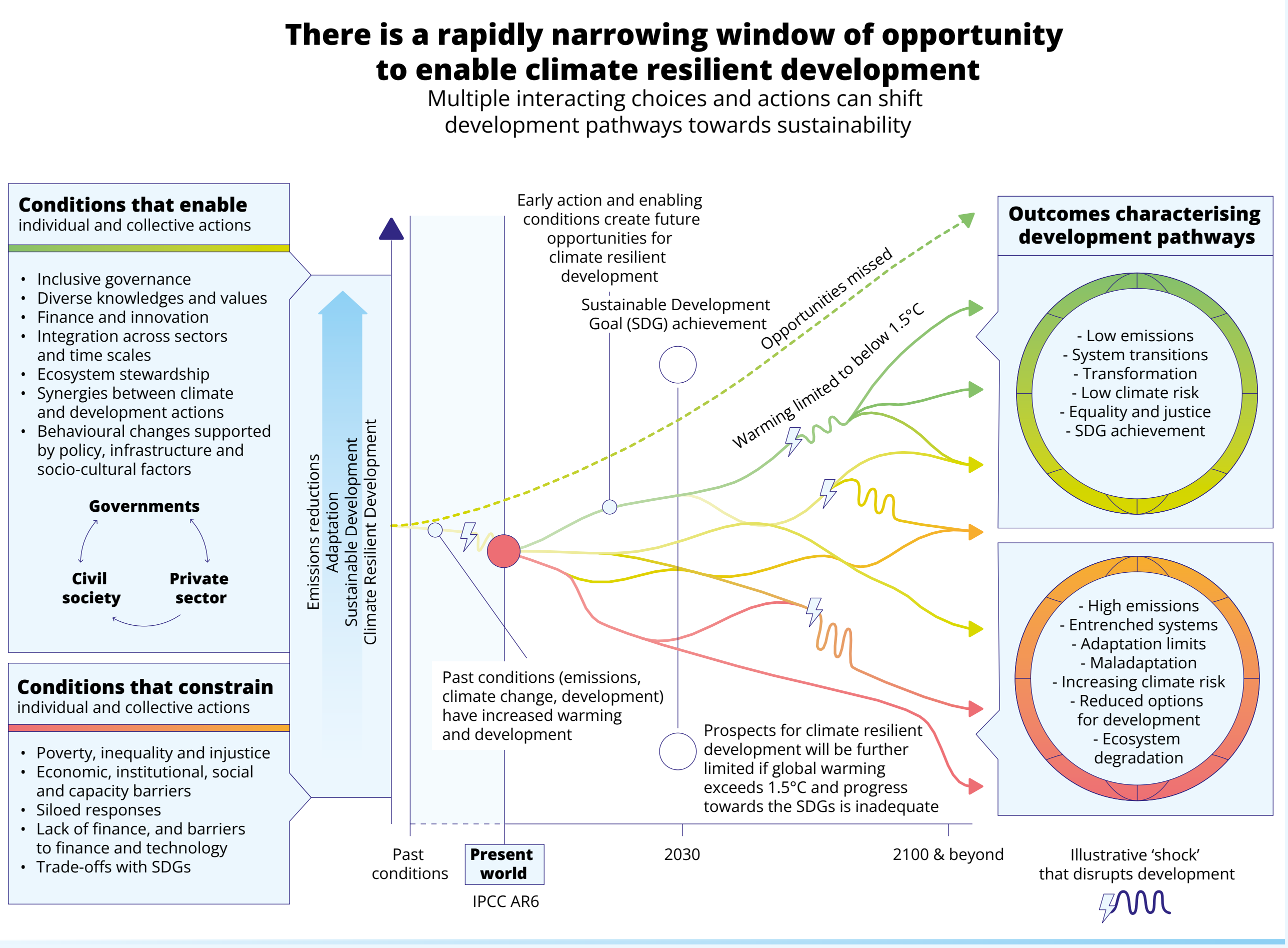


Figure 3.15 Path dependency

Source: (IPCC, 2022a), edited by the Norwegian Environment Agency.

The political system forms a key part of this path dependency. Well-established institutions will often resist change because it challenges established power structures, both out of self-interest and due to pressure from powerful stakeholders who do not want change. There are institutional feedback loops whereby the stakeholders who benefit most from the existing structures advocate framework conditions that reinforce their interests. This, in turn, gives them greater resources, increasing their political and economic power (Seto et al., 2016). There are often close ties between politicians, bureaucrats and business interests within a given sector, with the same people often switching roles within a sector (Dal Bó, 2006). Policy measures and instruments can contribute to the emergence of new coalitions of stakeholders that support a different policy direction (Boasson & Tatham, 2023). This can consequently help overcome existing path dependency. Policy packages allow multiple issues to be addressed simultaneously. This can help build broad coalitions in society and maintain a new direction over time (Pahle et al., 2018; Bergquist et al., 2020)

The IPCC points out that path dependency is particularly important for emissions development in cities, with associated buildings and transport systems, but it is significant in all sectors. In relation to energy systems, the closely related term 'carbon lock-in' is often used. It often takes large investments to build an emission-free system to replace a fossil-based system, and individually, these investments will in many cases not be profitable even if emissions are priced. If existing long-lived infrastructure (such as power generation, transport systems etc.) is used for its entire service life with fossil energy sources, it will lead to emissions that exceed the 1.5-degree carbon budget (IPCC, 2022b section 2.7).

Path dependency means that early choices are important. Political choices concerning, for example, infrastructure investments and the conditions offered for different types of business activities set a direction for long-term development that can be both intentional and unintentional. The development becomes to a certain extent self-reinforcing as important investments are made. Figure 3.15 illustrates how the scope of action to ensure climate-resilient development is restricted by path dependency, and how early action is essential to create future opportunities for climate-resilient development. At the same time, it is the cumulative effect of choices made over time that shapes the outcome. The Norwegian Environment Agency states that it is crucial to remove barriers, which can be economic, institutional, social or related to capacity, to shifting away from our current path (Norwegian Environment Agency, 2022b). The figure lists factors that could enable such a change.

3.8.2 National emission reduction targets

A clear target for how much emissions should be reduced in Norway will make climate policy less ambiguous for decision-makers, business and the general public. Norway has pursued an ambitious climate policy and ambitious goals for global emission reductions, while the goals for what should happen in Norway have been less well-defined. The challenge is that climate targets that provide for the possibility of offsetting emissions through reductions in other countries make it less clear what needs to happen in Norway. In the transition to a low-emission society, the purchase of carbon credits and emission reductions must play a lesser role in achieving Norway's climate targets. Strategic choices in climate policy should be based on the long-term goal of eliminating virtually all emissions in Norway for good. Progress towards this goal will also ensure fulfilment of Norway's commitments under the Paris Agreement and the cooperation with the EU. This means clear targets for Norwegian emissions in the short, medium and long term. In Part D of this report, the Committee makes its recommendations on how this should be systemised.

There are two important dimensions to the current 2050 targets that make it unclear what Norway's emissions in 2050 will be. Firstly, as part of the formulation of Norway's targets, it is stated that account should be taken of the effect of Norway's participation in the EU ETS. This means that Norway should not necessarily measure actual emissions from Norwegian companies covered by the EU ETS when assessing goal achievement, but that the European emissions effect of Norway's participation should be calculated. Secondly, it is not clear how emissions and removals in forestry and other land use should be assessed.

The Committee believes that Norway's overarching target for 2050 must be to reduce emissions from Norwegian territory by 90–95 per cent compared with 1990, without including emissions and removals from the forestry and land use sectors. This is a clarification of the target formulated in the Climate Change Act that will help make the target clearer and somewhat more ambitious. With this clarification, the Committee stresses that emission reductions must take place in Norway. This will send a clear message to society about what the goal is and signal expectations of the transition. Furthermore, the Committee believes that emissions and removals in the forestry and land use sector should not be included, and that separate targets must be set for this sector. See section 3.8.4 for a more detailed discussion of this. Finally, the Committee believes that the phrase 'of the order of' should be removed from the wording of the target in the Climate Change Act, as it makes the target unclear.

See the Committee's recommendation on climate targets for the forestry and land use sector

The 2050 target is just one step in the right direction. In 2050, only 5–10 per cent of emissions from the 1990 level should remain. These emissions should be completely eliminated as far as possible, or reduced. Consideration must be given to how to compensate for the climate impact of emissions that cannot be completely eliminated in order for Norway's climate targets to be in line with the targets of the Paris Agreement on striking a balance between GHG emissions and removals in the second half of the century. A target should therefore also be set for the Norwegian emissions trend after 2050, and how the remaining emissions can be compensated for. The Committee has not considered which year such a target should be set for. Targets should also be set for the forestry and land use sector after 2050.

Norway has a goal of becoming climate neutral by 2030. This goal is not internationally or legally binding and has not been widely discussed in the public sphere since the Storting passed it in 2016. The goal comes in addition to Norway's other climate targets and means that Norway will, from 2030 onwards, contribute to triggering emission cuts abroad that offset our remaining emissions. Fulfilment of the goal is intended to contribute to increased emission reductions in the global context, and will therefore be an additional contribution to meeting the Paris Agreement's temperature target. How the goal is to be achieved, how much of the removals in Norway's forestry and land use sector is to be included and what carbon or emission reductions are permitted has not been clarified. The Committee recommends phasing out the goal of climate neutrality from 2030 because it creates confusion about what Norway's objectives are. The goals described in Chapter 3 are sufficient.

To achieve the temperature target of the Paris Agreement, all countries must contribute, but some must contribute more than others. Countries have different prerequisites for contributing, and the Paris Agreement makes it clear that the countries have a common but differentiated responsibility. Developed countries must take the lead. The parties to the Paris Agreement have adopted a goal on the way to achieving the temperature target: to reach global peaking of GHGs as soon as possible, and then reduce emissions quickly so as to achieve a balance between emissions and removals in the second half of the century. If the global goals of the Paris Agreement are to be achieved, some countries must become climate-neutral and move towards net negative emissions before others. Rich developed countries such as Norway have a special responsibility in this respect.

Clear goals should be set for Norway's international efforts. There are good arguments in favour of a rich country like Norway contributing to the development of technology and emission reductions in other countries, and the Committee finds it important that Norway continues its efforts to reduce emissions in other countries. In the past, UN-approved carbon credits have been purchased with climate goals in mind, while also being seen as part of Norway's international climate efforts. The European Scientific Advisory Board on Climate Change has assessed how the EU's contribution to the Paris Agreement can be both fair and in line with climate goals and science. The Advisory Board recommends that the EU should contribute to emission reductions both outside and within the EU, since the scenarios for reduced emissions that are consistent with physical and social constraints do not align with what the Board considers a fair contribution from the EU to global emission reductions. The Advisory Board does not provide advice as regards what kind of reductions these should be (European Scientific Advisory Board on Climate Change, 2023). Similarly, Norway's international efforts, for example through the International Climate and Forest Initiative, must be made in addition to fulfilment of Norway's climate goals. The same applies to Norway's efforts to develop technology that may prove important for global emission cuts, even if they do not necessarily reduce emissions significantly in Norway. These efforts should be strengthened, systematised and be better aligned with overall climate policy. Development policy, trade policy and foreign policy should support the transition to a low-emission society in other countries as well.

3.8.3 How to incorporate forestry and land use into the climate target

Around 90 per cent of global emissions are covered by climate neutrality goals, but it remains unclear what these goals covers and how to achieve them. The most common way to define the goals is that the sum of emissions and removals from a country's territory should be zero. The prerequisites for achieving net zero vary from country to country.

The magnitude of forest uptake and sequestration and how this is calculated in the climate accounts influence the level of ambition of a net-zero emissions target. Countries with abundant forests and significant GHG removals will need to reduce a smaller proportion of their emissions to achieve net zero than countries with less removal capacity. For example, Brazil, Canada and Russia will need to reduce their emissions far less than other countries if all forest carbon removal is included in the measurement of goal attainment. Norway also has substantial forest areas. In the period after 2000, Norway had a substantial net removal of emissions in the forestry and land use sector, which accounted for nearly half of emissions in other sectors during the same period. This removal is attributed, in part, to extensive afforestation in the decades following World War II and moderate felling compared with forest growth during those years. This means Norway would need to reduce a smaller proportion of its emissions to achieve net zero compared with countries where forest carbon removal is less significant in relation to total emissions. The EU is an example of this, where forest carbon removal is significantly lower than overall emissions in other sectors. The level of ambition for emission reductions in Norway's and the EU's climate goals is virtually identical in their current form.

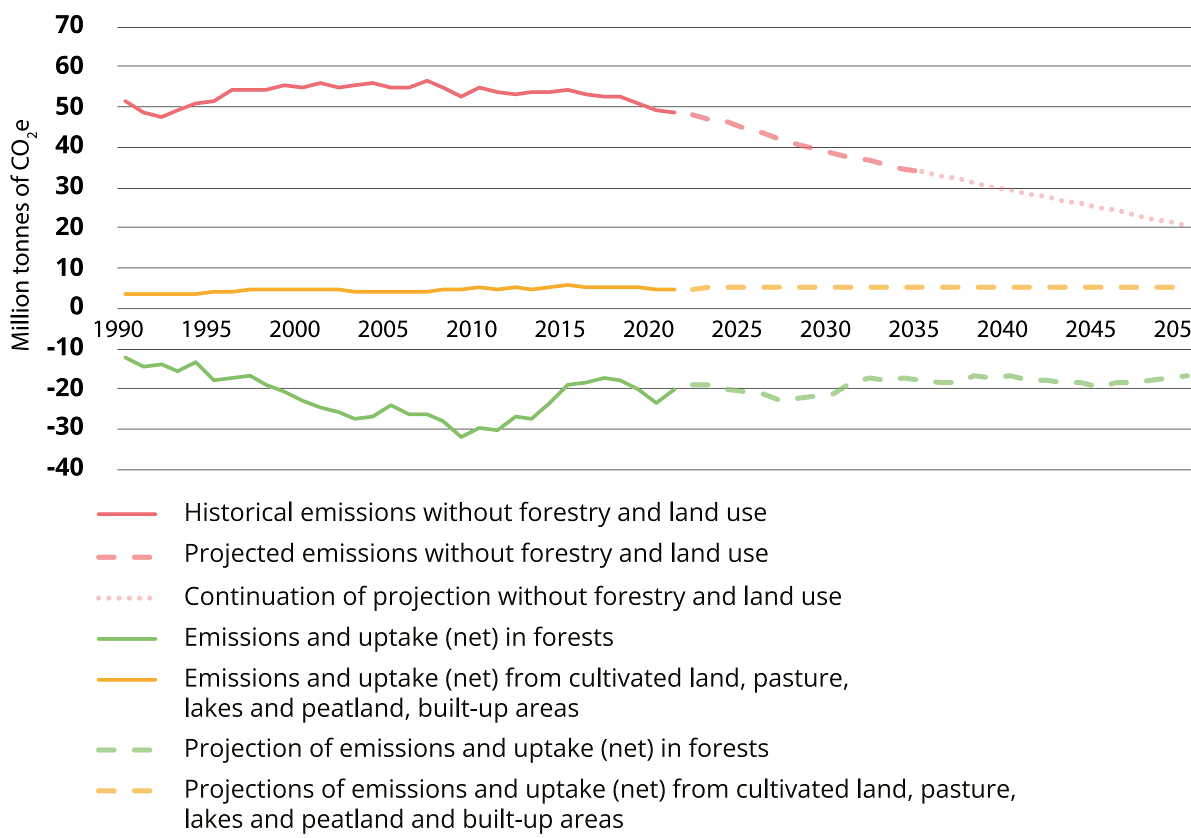


Figure 3.16 **Historical figures and projections for Norwegian emissions, net removal (emissions and removal) in the land use category forestry, and net emissions (emissions and removals) in the categories cultivated land, pasture, lakes and peatland and developed land.**

Source: Statistics Norway, the Ministry of Finance, NIBIO, the Norwegian Environment Agency, the 2050 Climate Change Committee.

Carbon uptake and sequestration in forests varies from year to year. The variation is due to several factors, including variations in temperature and precipitation during both summer and winter, the level of felling, and unforeseen events such as storm damage, forest fires and insect infestation. The variation in carbon uptake creates uncertainty about how much other emissions must be reduced to achieve a net-zero emissions target. Figure 3.16 presents historical data and projections for Norwegian emissions excluding forestry and land use, net removals in the land use category forestry, and net emissions in categories such as cultivated land, pasture, lakes and peatland and built-up areas. There is a relatively good basis for forecasting the development of forest areas. The forecasted trends in other land use, such as developed land, cultivated land and pasture, are based on a continuation of the historical trend, while actual land use will be closely linked to many other development trends in society and what policies are implemented. The technical committee responsible for calculations in the field of climate change mitigation (TBU Climate) is assessing methods for emission projections and the impact of policy instruments that affect GHG emissions and removals from forestry and land use. This will be useful for designing policy that is based on a more thorough overview and understanding of how changes in land use are linked to broader societal developments.

In the Committee's opinion, Norway's climate targets for the other emission sectors should be kept separate from emissions and removals in the forestry and land use sector. The climate goals for emissions excluding forestry and land use should be about reducing emissions. Carbon uptake from forests and removals that exceed the expected level should not be included. A net-zero emissions target that includes forest carbon removal provides an unpredictable basis for designing emission reduction policies in other sectors.

For Norway, including the entire removal capacity from forestry and land use in the current 2050 target would mean a significant weakening of the level of ambition for emission reductions. The 2050 target set out in the Climate Change Act does not explicitly clarify how carbon removals from forestry and land use should be included in the assessment of goal achievement. The preparatory works to the Act state that how the forestry and land use sector is to be managed for climate goals that will be applicable after 2030 must be considered in light of developments in international legislation in this area. Although the Act does not explicitly state how the forestry and land use sector is to be included in the target, one of the premises underlying the statutory target is that it does not include the entire amount of carbon removal from forestry and land use in Norway. In other words, the target is not a 'net goal' for 2050.

What is essential is to look at the purpose of the 2050 target, which is to promote the transition to a low-emission society and reduce emissions with a view to limiting the dangerous effects of climate change. If removals in the forestry and land use sector is included without adjusting the target, the target will be achieved by significantly lower emission reductions from the other sectors. In other words, unless the target is adjusted to take this into account, including all carbon removals from forestry and land use in the 2050 target will lead to higher atmospheric emissions. The level of ambition for emission reductions in the target will be significantly weakened. This would reduce the incentives for permanent emission cuts and weaken the signal effect of reducing emissions. The Committee considers this incompatible with the transition to a low-emission society and the overall goal of limiting dangerous climate change.

The rules for accounting and calculating how emissions and removals from the forestry and land use sector are to be included in the climate target should not guide what constitutes sensible policy and expedient policy goals in Norway. It must be clarified how emissions and removals from forestry and land use should be accounted for when setting climate targets. Separate targets for emissions and removals in the forestry and land use sector provide a better basis for policymaking in the sector. A possible continuation of climate cooperation with the EU will provide guidance on Norway's obligations in forestry and land use, with specific accounting rules within the framework of such a cooperation. It is important to take account of the rules for calculation, but at the same time to avoid allowing them to govern the targets set for Norwegian emissions trends and land use policy.

3.8.4 Targets for the forestry and land use sector

In the Committee's opinion, separate climate targets must be set for the forestry and land use sector. This will provide clearer guidelines for policy development than attempting to integrate it into the target for reduced emissions from other sectors. Under the Paris Agreement, developed countries such as Norway must have economy-wide climate targets, i.e. a target that covers all the most important greenhouse gases and all emission sectors. Separate climate targets must therefore be set and reported for the forestry and land use sector under the Paris Agreement, when emissions and removals from this sector will not be included in the target for other emissions. Targets for the forestry and land use sector should be reflected in the Climate Change Act.

A net target for the sector will result in unclear governance signals. There are both emissions and removals in the forestry and land use sector. This means that setting a target for a desired change in the net sum of emissions and removals – a net target – makes it unclear whether the goal is to stimulate reduced emissions or increased removals. This has different implications for policymaking.

The Committee notes that the EU's climate policy for the forestry and land use sector is constantly evolving. The same applies to other policies that affect land use, such as the EU's agricultural policy, biodiversity policy and forest management policy. This may affect the context for Norwegian policy development, even if these fields are not EEA-relevant or part of Norway's climate cooperation with the EU. The Committee considers it important to closely monitor EU policy developments, including in fields that are not EEA-relevant. Further cooperation with the EU must be facilitated on climate policy for the forestry and land use sector.

The goals set for the sector must provide strong incentives to reduce emissions from this sector. So far, most of the measures have focused on increasing carbon uptake and sequestration. Norway currently has significant emissions as a result of the rezoning of forests and other areas for new cultivation and development, for example in connection with the construction of roads and holiday home areas. There are also emissions associated with the management of agricultural land. Norway is not in a position to fulfil its commitments towards 2025 under the current LULUCF Regulation (which Norway is bound by under its climate agreement with the EU) on balancing emissions with removals in the sector. The situation is more unclear for the years between 2026 and 2030, where it appears more likely that Norway will meet its commitments due to changes in the EU's accounting regulations. See Chapter 6 for the Committee's assessments relating to land use.

See the Committee's assessments relating to land use in Chapter 6.

Setting one climate target for reduced emissions and one for removals in the LULUCF sector may be a suitable solution. This could result in clearer governance signals than one overall target for both emissions and removals in the sector. At the same time, it will make the climate targets more complex. Due to the natural emissions and removal processes in this sector, it will also require some delineations between what should be included in which of the two targets. One possibility is to adopt a separate climate target for forest areas and areas that become forests, and one target for all the other land use categories. Forest areas have net carbon removal. Although there are some emissions relating to felling, the emissions mainly come from other land use categories. The removal target for forest areas must take into account that measures that stimulate increased removals, such as fertilisation of forests and increased planting density, may be detrimental to biodiversity. For all land use categories other than forest, consideration should be given to whether the goal should be to reduce emissions by 90–95 per cent compared with 1990 levels, in parallel with other emissions. This will mean far less development and degradation of nature and carbon-rich areas than today, especially in forests, and placing more emphasis on safeguarding carbon sinks in, for example, the management of agricultural areas. A separate target for natural carbon sinks may also be considered, as it would help preserve them.

Climate targets for the forestry and land use sector must be considered in the context of national biodiversity targets and international nature commitments. Important elements from a climate perspective are to reduce emissions from land use, preserve natural carbon sinks and stimulate the restoration of ecosystems, while maintaining steady uptake. Biodiversity and ecosystem goals should be used as a basis to assess how a climate target for the forestry and land use sector should be specified for Norway.

3.9 The Committee's recommendations

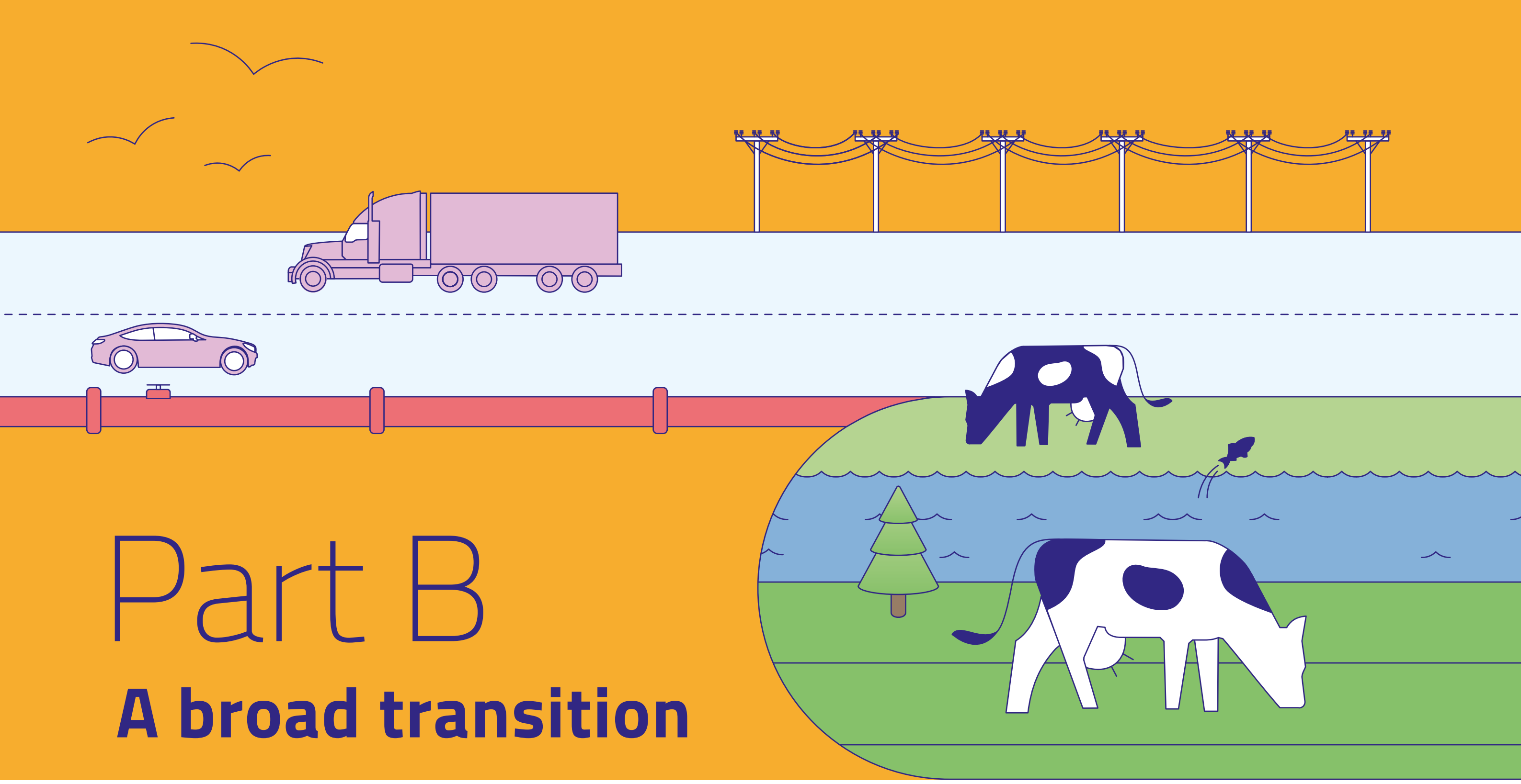
The Committee is of the opinion that clear objectives must be set for the Norwegian emissions trend towards 2050. This means clearly communicating that emissions in Norway must be reduced. In the Committee's view, various strategies that delay emission reductions in Norway, such as the purchase of emission reductions or uncertain new technologies, entail a significant risk that Norway will not become a low-emission society as well as making the consequences of climate change even more dire. The Committee therefore has the following recommendations:

- Specify Norway's climate target for 2050 as to reduce emissions from Norwegian territory by 90–95 per cent compared with the 1990 level, to between 2.5 and 5 million tonnes of CO2 equivalents, without including emissions and removals from the forestry and land use sector. Norway should not use emissions trading to achieve this target. This implies a clearer and somewhat more ambitious target, and the Climate Change Act should be updated to reflect this.
- set separate climate targets for the forestry and land use sector that are considered in the context of national biodiversity targets and international nature commitments. These targets must facilitate both reduced emissions from the redistribution of land and carbon uptake and sequestration, for example by setting separate targets for reduced emissions, uptake and sequestration.
- introduce separate targets for emissions from Norwegian consumption; see Chapter 11.

- step up efforts in Norway to reduce emissions in other countries. These efforts must come in addition to meeting Norway's climate targets, and must not be linked to Norway's own emissions.
- remove the goal of climate neutrality by 2030 because it creates confusion about what Norway's objectives are.
- set a target for the Norwegian emissions trend after 2050. A target should also be set for forestry and land use after 2050.
- prioritise early emission reductions and measures for a lasting transition over reduced emissions at a later date. Since it will take time from when a measure is introduced until emissions in some sectors are eliminated, it is important to implement transition policies to reduce emissions as quickly as possible.
- base measures on the framework Avoid–Shift–Improve (ASI). Measures to avoid emissions are given the highest priority and should be the starting point for all assessments.
- base the transition to a low-emission society on eliminating or substantially reducing existing emissions through reduced activity levels, changed behaviour and the use of zero-emission technology.
- avoid considering the development and implementation of direct air capture technology as an alternative to reducing emissions by adopting zero-emission technology and adjusting behaviour to zero-emission activity.
- weigh the use of resources for direct air capture technology against other possible measures, so that this does not lay claim to expertise, electric power or other resources that may be better applied in other measures.
- prioritise sequestering carbon in nature on sustainable terms. Measures to increase natural carbon sinks are seen in light of the Global Biodiversity Framework's goal to restore degraded ecosystems, and are primarily implemented where they contribute to improving the ecological condition of natural ecosystems.
- conduct an analysis of when it is realistic to expect different emissions sources to achieve net zero, in order to provide predictability during the transition; see the recommendations in Chapter 21.

On track

Tropical weather, tropical breeze
even though the trees have no leaves
the sun is covered, and the clouds are bleak
the weather forecast says in repeat
the streets full of electrical gear
the heavens rain their sad tears
Trying to remind us of what we did way back
we need to return to that track
the consequences are like a magnifying glass
that makes us see what we must be better at
In a heart so dark, there is a small light that shines
a star that must be kept alive
a tiny light so very clear
telling us to stand behind what we hold dear
We still have time to do what's needed
to come up with ideas that must be heeded
all of this is in the news
it seems we need a Paris review



Part B

A broad transition

This section of the report reviews how the goal of a low-emission society is related to other important societal goals and policy areas, and what issues this raises. Part A assessed the level of ambition and overall goals on the road to the low-emission society. Part B takes a closer look at the challenges these ambitions entail in terms of energy, land and resource use, economy, distribution, the business sector and other important areas of society. This part shows that a broad transition is required for Norway to become a low-emission society, and that this transition is linked to a number of other developments in the world around us.

4 Uncertainty and fairness in the transition

This chapter deals with how choices to achieve a low-emission society by 2050 will have to be made under considerable uncertainty. Although the low-emission society will be a good society, some may find the road to achieving it demanding. The transition must therefore not only be about emission cuts, but also about whether the consequences for the individual are acceptable and that society as a whole takes advantage of the opportunities the transition will bring.

4.1 Transition under uncertainty

Important choices for the transition to a low-emission society must be made under considerable uncertainty. The 2050 Climate Change Committee has been tasked with assessing the choices Norway must make to become a low-emission society by 2050. Determining the best path depends on many factors, all of which are uncertain. Norway can influence some of the factors, while many are related to circumstances over which Norway has little influence.

The Committee wishes to point out the following factors as being particularly important to Norway's transition to a low-emission society:

- The development of *climate policy globally, especially in the EU*. Norway is tied to the EU in many ways, and benefits greatly from close cooperation on climate change issues. The EU's climate policy is highly ambitious in the global context. Any changes to this will be of material significance to the Norwegian economy and policy.
- Access to *new technology* in many different areas. Norway is dependent on being able to take advantage of technology developed in other countries, and the pace of technology development in various areas will have a major impact on the costs of achieving climate goals.
- The degree of *conflict* in the world, for example in areas such as trade and international cooperation (NOU 2022: 12). A world characterised by close cooperation, low levels of conflict and stringent climate policy will make developments in the economy, prices and access to resources more predictable than in a more turbulent world. A high level of conflict will affect how much emphasis is placed on security of supply for key commodities such as food and energy, which in turn will have an impact on both policymaking and investment decisions that affect the transition to a low-emission society. A turbulent world

Blue hydrogen: hydrogen produced from fossil energy, but with carbon capture and storage.

Economic growth: increase in the production of goods and services. Economic growth can be achieved through more efficient use of input factors or if multiple input factors are used.

is not necessarily a world without ambitious climate policy, but ambitious climate policy will be more demanding to achieve and may be different than in a less turbulent world.

- Developments in *demand for petroleum products*, including demand for blue hydrogen, are of particular significance to Norway. The petroleum sector accounts for a large share of Norwegian emissions, and if demand gradually falls, this sector will also gradually be phased out. Continued high demand for oil and gas will mean greater conflicts between climate policy and other considerations.
- *Economic growth, increased energy consumption and population growth* lead to increased consumption and are among the most important drivers of greenhouse gas emissions globally, as well as affecting pressure on land and other scarce resources. This, in turn, affects the climate policy framework.
- *The time dimension* of policy measures can also be significant. A late, abrupt tightening of climate policy may affect the premises underlying different investment decisions and lead to major changes in the value of different types of assets. A predictable and smooth transition process will reduce the economic and social costs of the transition.

Several of these factors are interrelated to some degree. For example, there is a clear correlation between the level of ambition in international climate policy and the pace of development and spread of new technology. Both international climate policy and technological developments will affect the pace of the energy transition and thereby also demand for oil and gas. The geopolitical situation has also been shown to influence technological developments in recent years.

Climate policy decisions should be robust with respect to different outcomes. When there is a significant degree of uncertainty associated with key factors for the transition to a low-emission society, decision-making processes and decisions must be able to stand the test of time, even if the trajectory is not the one currently considered most likely. The decision-making basis can be strengthened by exploring plausible development pathways for relevant uncertainty factors. Various quantitative and qualitative scenarios form part of this picture. It is useful to identify which trends are particularly important for the formulation of Norwegian climate policy. A good understanding of the uncertainty associated with these trends makes it easier to design policies that are robust to different outcomes and to adapt policy to changing circumstances in step with new knowledge.

Decarbonisation: means that activities that currently involve CO_2 emissions are changed so that the activity becomes zero emission, for example switching from cars that run on petrol/diesel to electric cars.

Some decisions are wise regardless of what is happening in the world around us. Examples are efficient resource and energy consumption and nature conservation. Measures towards more circularity, more sustainable land use and better energy efficiency should therefore be part of climate policy regardless of global developments. The European Scientific Advisory Board on Climate Change points out, similarly, that there are many different pathways to climate neutrality for the EU, but that some trends are common to all scenarios. These trends include an almost complete decarbonisation of power production by 2040 through the phase-out of coal by 2030 and gas power without CCS by 2040, a sharp increase in wind, solar and hydropower, and a significant decrease in fossil energy imports. In addition, all scenarios show a decline in energy end-use and prioritisation of emission reductions, while also focusing on carbon removal through both natural and technological solutions.

Other policy choices and investment decisions should reflect the uncertainty of developments in the world around us. It is not impossible for Norway to become a low-emission society even if global efforts prove too weak in that direction, but it will be far more demanding economically, technologically, politically and socially. How easy it will be for Norway to become a low-emission society, and the wisest path there, is influenced by political decisions and technological developments in other countries that Norway can, to some extent, influence but not control. An important and imminent example for Norway relates to factors that influence the direction and pace of transition in the petroleum sector.

The Committee bases its recommendations on the premise that Norway will implement an ambitious climate policy even if the future is uncertain. Norway is committed to achieving ambitious climate policy goals at the global level. This must form the basis for our choices in the years ahead, and is even more essential in that Norway's choices can affect how other countries act and the likelihood of achieving the global climate goals. An ambitious and credible climate policy will in itself reduce some uncertainties.

4.2 Fairness in the transition

The transition to a low-emission society must be as fair as possible, both because a just society is an end in itself and because it will make the transition easier. A society characterised by small differences and relatively equal opportunities for participation in matters of great importance to people's lives is beneficial in itself. At the same time, support for climate policy is closely linked to whether the policy is perceived as fair. Lack of support can develop into resistance, which makes it difficult to implement an increasingly ambitious climate policy.

A just transition involves a number of different considerations, and there is no clear answer to what just climate policy entails. Different political ideologies have different answers to the key question of what kind of society is most fair. Whether climate policy is considered just is related to the distributional effects of policy, but also whether social debate and decision-making processes ensure genuine opportunities for participation and whether the views, interests and contributions of different groups are acknowledged. Trade unions also highlight the importance of a just transition in working life that ensures participation and good, secure jobs for workers in sectors particularly affected by the transition. See Box 4.1 for more details on these different aspects of a just transition.

Box 4.1 Climate justice and a just transition

Climate justice is a term used in many contexts to mean actions taken to address climate change should be just in terms of both processes and outcomes. The term can refer to several different levels and aspects of fairness:

- *Fairness at the international level:* The distribution of climate action between countries and groups of countries has been a key issue in international climate policy. Countries have different responsibilities and capacities to contribute to the transition. Under the Paris Agreement, all countries must justify the way in which their contribution is fair and ambitious.

- *Fairness at the level of society:* Climate policy can affect different groups within a country in different ways. In the event of major societal changes, marginalised groups will often be particularly vulnerable because they lack resources or opportunities for influence and participation. This means that extensive changes will reinforce existing economic and social inequality or come at the expense of indigenous or minority rights.

- *Fairness between generations*: How climate action is distributed over time will have consequences for the distribution of goods and burdens between generations. If today's leaders postpone the transition, future generations will have to deal with both a rapid transition to a low-emission society and the consequences of a changing climate.

Some literature makes a distinction between distributional, procedural and recognitional justice (Newell et al., 2021):

- *Distributional justice* is about the distribution of benefits and burdens, such as how the costs of emission reduction measures are distributed, or who benefits from support schemes and new income opportunities.

- *Procedural justice* is about how opportunities for participation and influence are distributed, and whether everyone has equal opportunity to participate in the processes leading up to political decisions or that in other ways affect their living conditions.

- *Recognitional justice* involves, among other things, that different groups are seen and included as relevant participants in, and contributors to, the transition, and that their perspectives and contributions are given importance.

The term *just transition* is used in some contexts to describe a transition that is just along several of the dimensions mentioned above. The term is often used more specifically to describe the effects of the transition on working life and the consideration of workers. The Paris Agreement specifically mentions the need for a just transition of the workforce and the importance of decent work.

The International Labour Organization (ILO) has prepared guidelines for a just transition that particularly concern employee participation and cooperation between the social partners to achieve this goal (ILO, 2015). Norway has well-established channels for cooperation between the social partners. The Government has also established a dedicated council for a just transition of the workforce, where the parties regularly have dialogue meetings with the Minister of Climate and Environment on how to ensure a just transition within the framework of Norway's climate goals.

Norway is in a good position to establish just climate policy. Relatively small differences, a high degree of trust in public institutions and a well-organised employment sector are important prerequisites for implementing the transition in a way that is perceived as just and legitimate by as many as possible. A comprehensive transition policy must build on these strengths. The social partners and tripartite cooperation will play an important role in safeguarding the interests of workers in industries and regions that face particular challenges from the transition, and can contribute to broader social acceptance.

Measures to reduce GHG emissions will have distributional consequences. Requirements for emission reductions, carbon pricing and other forms of regulation will entail new costs for individual stakeholders. For others, new opportunities will emerge, for example when markets for new products and services are created. Taxes generate government revenue that can benefit society, for example in the form of welfare services or infrastructure investments. Other, more structural distributional effects have also been predicted (see Box 4.2 on the distribution of income between work and capital). How the benefits and burdens associated with the transition are distributed depends on how climate policy instruments are designed, but also on general economic policy, the structure of the tax system as well as a number of other factors.

Climate action contributes to a limited extent to reinforcing economic inequality, and can also help reduce relative differences in society. Economic instruments will necessarily be perceived as more restrictive for groups with lower purchasing power, and increased taxes or other restrictions could always be seen as unfair to some individuals. This is especially true if our adaptability is unevenly distributed, for example if alternative options are very much geographically dependent or require private financial investments that are not available to everyone. In general, there is a strong correlation between income levels and emission-intensive consumption (Albertsen et al., 2022). This means that, overall, taxes and other policy instruments aimed at GHG emissions hit high-income groups harder than low-income groups. For example, transport emissions are significantly higher from high-income groups due to more use of private cars and especially air travel, while low-income groups make more use of public transport, cycling and walking. Higher taxes aimed at car and air transport can therefore balance out economic differences, particularly if the tax revenues are invested in improving public transport or reducing social inequality.

Measures to achieve fair distribution and limit economic inequality should mainly be addressed by other policy areas. Active policy to combat inequality can help facilitate the transition to a low-emission society as it will build trust and financial security in society, increase adaptability and mitigate the negative impacts of the transition for individual stakeholders during the transitional phase. However, taking distributional effects into account in each climate policy measure or compensating for all the distributional effects of the green transition will not be able to replace the effects of the tax system, economic policy and general welfare schemes when it comes to reducing inequality in society. The most important aspect of ensuring a fair distribution is therefore the governing economic distribution policy, but the distributional effects of climate action should be assessed more systematically in political processes and choice of policy instruments. To strengthen climate policy in order to achieve low emissions, we need more knowledge about how both individual measures and the transition as a whole affect the distribution between different parts of the country, different age groups, genders, income groups, and majority and minority groups. This will make it easier to consider possible compensatory measures in each case, and how to combine different policy instruments in packages that, as a whole, address the goal of fair distribution without weakening the climate effect.

Compensation for negative consequences and distributional effects must support the transition rather than cementing current solutions and infrastructure. In cases where the choice is made to compensate for the effects of climate action for individual groups, the compensation must be designed so that it does not undermine the purpose of the measure. One way of doing this could be to redistribute revenue from carbon taxes as dividends to the general population, as proposed in schemes known as carbon fee and dividend (CFD). Other ways include using dividends to make alternative choices of action more readily available, or investing them in general welfare measures. Research shows that acceptance of taxes increases when tax revenue is used for climate measures (Baranzini & Carattini, 2017; Carattini et al., 2019).

Broad participation in the planning, implementation and evaluation of climate policy is important to ensure fairness. It is essential to put effective processes in place to ensure that the public and those affected by climate policy have an opportunity to provide input and opinions. Participation can take place in several ways, including through formal consultation processes, at open input meetings, or by engaging in political or other relevant organisations. At the same time as needing faster action to increase the pace of the transition, it is important that decision-makers encourage active public involvement when developing and implementing policies. This can contribute not only to making the transition more just, but also to better decisions and greater support for policy over time. An analysis of the status of Norwegian democracy was conducted in 2023. The report concluded that the Norwegian political system scores very high on democratic quality along several dimensions, but can be improved by strengthening opportunities for direct public participation (Knutsen et al., 2023).

Particularly affected groups must be actively involved and taken into account in the policymaking process. Children and young people must live with the consequences of climate change, and the decisions adults make today will play a role in determining their future. It is therefore essential that their voice is represented in climate policy. A report written on behalf of the Nordic Council of Ministers shows that women and men are affected differently by climate policy in the Nordic countries (Svendsen et al., 2022). The report concludes that none of the Nordic countries sufficiently take into account how climate policy affects genders differently in their policymaking. Such perspectives must be taken into account when designing climate policy.

Efforts must be made to ensure that all segments of the population are well represented in the political system. Today, young voters are less represented in elections, and women and especially young people are underrepresented in formal politics. The report from the Climate Committee Young stresses that children and young people must be given a seat at the table, and that getting involved when important decisions are made about their future can make a difference; see the digital appendix to the report. To achieve this, political processes must be organised so as to give all segments of the population a genuine opportunity to participate. Political parties have a particular responsibility to ensure good representation in the political system.

The history of the Sami community in Norway makes the inclusion and safeguarding of Sami interests in the transition to a low-emission society especially important. This applies both procedurally in terms of how the Sami community is included in policy development and decision-making processes, and substantively in that Sami society and culture are taken into account in the transition.

The Sami population must be more effectively involved in official climate policy decisions. The Committee is of the view that Sami perspectives are not sufficiently heard in current practice. The Truth and Reconciliation Commission points out that Sami traditional industries and the use of natural resources are under great pressure, and that unresolved rights to land and water contribute to conflict in many cases. The Commission encourages a survey of real estate and tenure rights outside Finnmark in accordance with international law. This must include the right to reindeer herding outside the current reindeer grazing district and national minorities' right of use based on adverse possession and established custom. In addition, the Commission proposes an overall review of the land-use situation for reindeer herding and its significance for Sami culture. The Committee endorses these recommendations, and stresses that resources and expertise from official Sami bodies must form a central part of such work. In line with the Commission, the Committee also sees a need to assess the practice of advance possession provided for in the Expropriation of Real Property Act.

Early and broad public debate on EU climate policy is important to ensure legitimacy. As mentioned above, EU policy has a strong influence on Norwegian climate policy. At present, public debate in Norway on EU policy is often not initiated until the policy is set to be incorporated into Norwegian legislation. Earlier involvement and increased public debate will strengthen legitimacy nationally and improve our ability to influence EU policy. This may become increasingly important as EU climate policy is tightened and has greater implications in Norway. Broader public debate could also give the Norwegian public a better understanding of the EU's importance for the transition of the Norwegian economy. In the Committee's view, efforts should be made to determine Norway's position and ensure public involvement at an earlier stage to help align EU climate policy more rapidly.

Municipal and county authorities can serve as testing grounds for new participation processes, as a smaller scale can make policy implementation and involvement of the local community easier. Municipalities should have the capacity and opportunity to experiment with different forms of participation in their decision-making processes. The population's ability and right to complain about local decisions is an important form of participation because it helps hold political leadership accountable.

The central government should increasingly work in partnership with the social partners, civil society and private stakeholders. Trust between the social partners has been important to Norway's development in recent years. Norway must safeguard this on its way to the low-emission society. The social partners therefore play a vital

Box 4.2 Distribution of income between work and capital

The transition to a low-emission society will entail significant changes in a number of areas. As described in Chapter 10, Norway has undergone many major transitions in recent decades. Some companies have gone bankrupt and some industries have been downscaled, which has freed up labour and capital and enabled more profitable businesses to grow. In the meantime, some people have lost their jobs. If this results in prolonged exclusion from the labour market, important resources will be lost and the distribution of income will be negatively affected.

Transition is associated with costs and benefits. The impact of the transition on income distribution depends on who will ultimately bear the costs and who will reap the benefits.

A key question is how major structural changes in the economy give rise to changed opportunities and welfare, and secondly how policy measures can address undesirable distributional consequences.

Statistics on income trends for companies and households are often used to shed light on such developments, including the distribution of income between companies and employees (the functional distribution of income) or between different households.

The labour share is a measure of the share of value creation in the economy allocated to wages, while the remaining share goes to capital. The labour share of the Norwegian mainland economy has remained relatively stable in recent decades; see Figure 4.1. The OECD also points out that the labour share has declined in several member states, while the capital share of total value added has increased. For a more detailed discussion of the functional distribution of income and a presentation of different measures of income inequality between households, see the 2023 National Budget.

Internationally, a reduced labour share is seen in the context of megatrends such as globalisation and technology development, which change demand for labour and increase the market power of some producers. The lower levels of unionised workers is also highlighted as a possible explanation for the reduced labour share internationally.

Norwegian Official Report (NOU) 2022: 12 *The Fund in a changing world* shows that there has been a marked increase in listed enterprises' return on equity internationally since 1995 (which has been part of the explanation for the strong increase in the Government Pension Fund Global). Profitability developments are related to robust growth in the global economy, globalisation and more efficient operations. However, profitability has also been boosted by some companies using their market power to steeply increase shareholder value, by global business taxes having been reduced on average, and by declining interest expenses. While the companies' profitability has increased, the report points out that there has been a decline in the labour share and refers to studies that see this in the context of increasing industry concentration, increased market power, globalirole in the transition. The Norwegian model is based on tripartite cooperation, where the State and the social partners come together to find solutions to sweeping societal challenges. In a transition where entire industries will be transformed and many new jobs will be created, this should be used as a resource. The Government has established the Council for a Just Transition for Workers where issues relating to the transition of the employment sector will be discussed. The Committee believes that this platform should be maintained and further developed going forward.

sation, automation and weakening of workers' bargaining power.

There is so far little research addressing how the transition to a low-emission society could affect value creation in the Norwegian economy, and how much of the value creation will be allocated to wages and capital, respectively. Historically, Norway has undergone immense industry structure transformations without this in itself affecting the distribution of value creation between labour and capital. At the same time, it is conceivable that the choice of climate policy instruments, such as the scope and application of subsidies and taxes to stimulate green technology and business development, may have an impact on how this distribution develops. In general, there are a number of factors that will affect the distribution of income over time, including factors outside Norway's borders that are difficult to influence through national policy. More knowledge is needed about the distributional effects of climate action and the transition to a low-emission society.

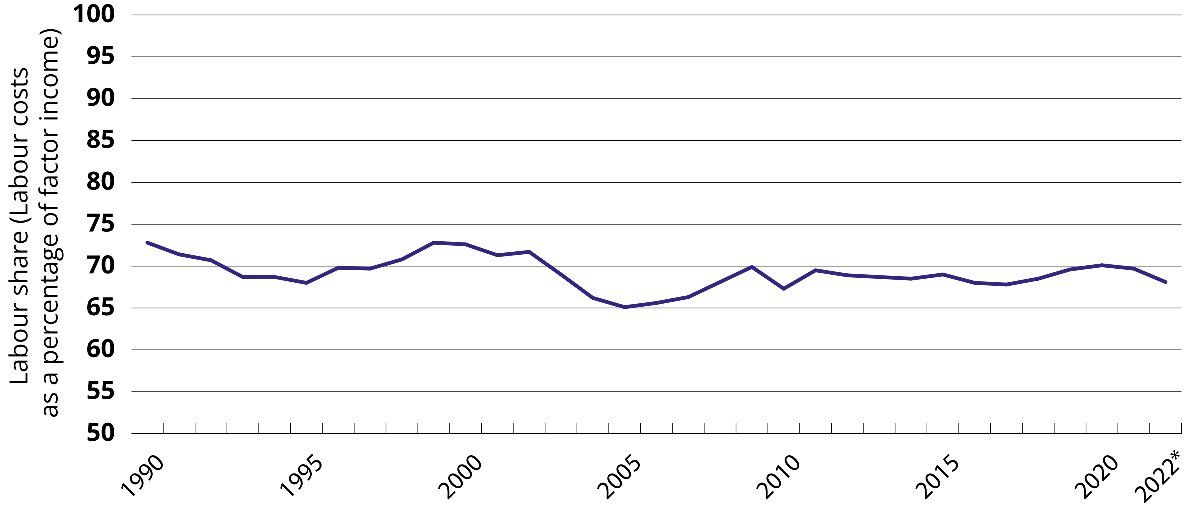


Figure 4.1 **Labour share (Labour costs as a percentage of factor income. Market-oriented enterprises in mainland Norway).**
Source: Statistics Norway

Green collective agreements: often defined as collective agreements that have included provisions aimed at reducing emissions or improving the environmental status of an organisation's activities. May also include provisions that distribute the consequences of the measures that will lead to reduced emissions from the organisation's activities.

Tripartite cooperation should be actively used in the transition. Both management and employees at each individual workplace should be involved in transition efforts. Labour market participants can exert a great influence: they can help to identify solutions and initiate change, for example by influencing the company's strategic initiatives, the application of new technology, meeting new skills needs or establishing greener procurement schemes. At present, this possibility is not sufficiently exploited. The parties themselves should come up with the specific solutions, but green collective agreements where employees can, for example, transform value growth into a reduction in working hours rather than wage growth, and cooperation on climate budgets in the workplace, have been proposed as methods that can boost more binding cooperation between the parties in the climate transition. The social partners should be encouraged to identify their own measures to reduce GHG emissions and contribute to the transition. Examples are to help identify future skills needs or relevant measures for the transformation of regions that will be particularly hard hit by climate policy measures.

It is important to further develop employees' skills. This is essential to reduce emissions, for the individual employee and to effectively facilitate the transition to a low-emission society. The Skills Needs Committee has stated that Norway lacks the skills needed to carry out the green transition. This could slow down the transition. For affected employees, the lack of skills may lead to greater inequality (Skills Needs Committee, 2023). Since the transition to a low-emission society must take place relatively quickly, the skills of graduates will not be sufficient. It will also be necessary to increase the skills of those who are already in work. A good system for further education is therefore important. The Confederation of Vocational Unions' 2023 Working Life Barometer shows that the majority of workers are unable to envision how the green transition will affect their work situation (Ingelsrud et al., 2023). The report also shows that they are less motivated to take further and continuing education.

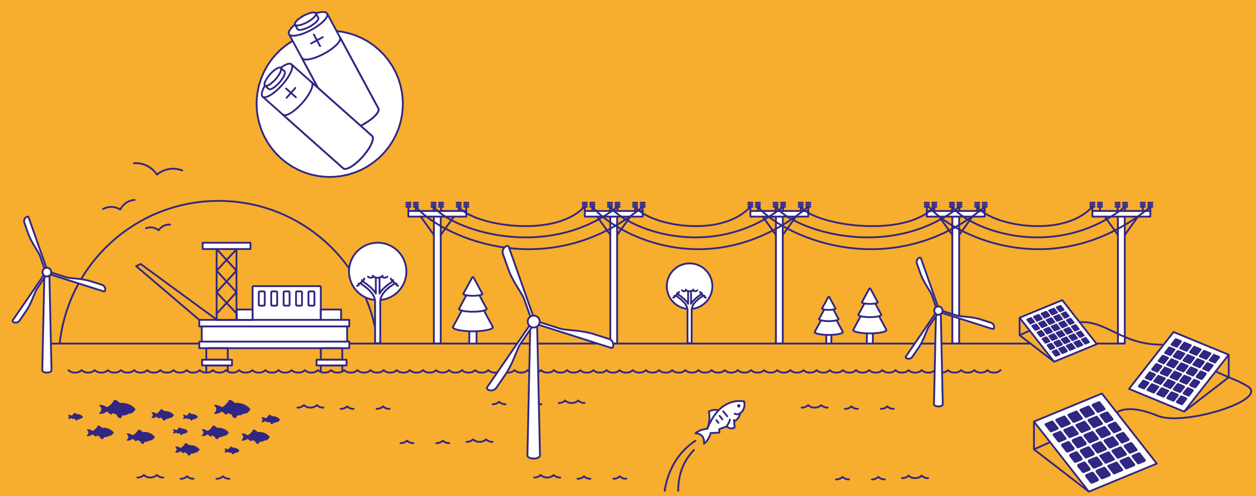
Since society needs more and new skills in the transition to a low-emission society, further and continuing education cannot be the responsibility of individual employees. A structured approach to further and continuing education is needed. This requires cooperation and dialogue between employers, employees, the education sector and political authorities. A realistic offer of continuing and further education to as many as possible should be a goal in order to develop the skills and expertise we need in the transition and in a low-emission society. This could benefit both the individual's and society's transition.ette vil kunne gagne både omstillingen for den enkelte, og samfunnets omstilling.

4.3 The Committee's recommendations

The Committee's premise is that the transition to a low-emission society will entail changes in all parts of society. It is therefore of the opinion that climate policy must have a comprehensive design, that the transition must be as just as possible and that broad participation in the design and implementation of the policy must be facilitated. The Committee therefore has the following recommendations:

- implement an ambitious climate policy in Norway, even though the future is uncertain.
- while measures to achieve fair distribution and limit economic inequality are mainly addressed by other policy areas, the distributional effects of climate policies should be assessed more systematically in political processes and choices of policy instruments.
- strengthen knowledge of the distributional effects of the transition and different policy choices in relation to income disparities, geographical differences and effects on the distribution between labour and capital.
- ensure that compensation for negative consequences supports the transition rather than cementing current solutions and infrastructure.
- provide a realistic offer of continuing and further education to as many as possible in order to raise the skills and expertise we need in the transition and in a low-emission society.
- organise decision-making processes so as to strengthen the possibility of meaningful participation by all segments of the population.
- encourage employers' and labour organisations to identify their own measures to reduce greenhouse gas emissions and contribute to the transition.
- maintain and further develop the Council for a Just Transition for Workers.
- structure the approach to continuing and further education to meet the skills needs of the low-emission society through cooperation and dialogue between employers, employees, the education sector and political authorities.
- involve the Sami population more effectively in official climate policy decisions. As urged by the Truth and Reconciliation Commission, a survey of real estate and tenure rights in the areas outside Finnmark should be carried out in accordance with international law, as well as an overall review of the land-use situation for reindeer herding and significance for Sami culture. There is also a need to assess the practice of advance possession provided for in the Expropriation of Real Property Act.

5 The energy system



This chapter describes how the energy transition is a prerequisite for the low-emission society. The chapter highlights that electric power is a scarce resource in the transition to a low-emission society and that trade-offs must be made in energy policy between power quantity, prices and encroachments on nature.

5.1 Climate policy and energy policy must pull in the same direction

We will not be able to achieve the global climate change targets without an energy transition. The consumption and production of energy is the largest source of global emissions. Renewable energy production is growing rapidly, but fossil energy consumption remains stable and still accounts for the largest share of global energy consumption. Norway has hydropower and has come further than many other countries in electrifying society. Despite this, more fossil energy is produced and consumed in Norway than renewable energy. Figure 5.1 shows that Norway has a high energy consumption per capita compared with other Western European countries. The differences in consumption reflect, among other things, differences in industry structure. Norway has a lot of energy-intensive industry, a petroleum sector and a population with a high level of income. The task of phasing out fossil energy will be demanding, also in Norway.

All energy consumed and produced in Norway must be emission-free. To achieve this, the energy system must become more efficient and flexible. An efficient, robust system will make it easier to electrify activities that are currently based on fossil energy. A zero-emission energy system will mainly be based on renewable energy. This will give rise to new types of challenges. Renewable power generation, with the exception of hydropower with reservoirs, is more variable and more difficult to store than fossil energy. The production, transmission and final consumption of energy are closely interconnected, both within and between countries. It is therefore necessary to look at how the energy system as a whole is connected.

The pace of the energy transition must be increased to achieve the climate goals. Both climate and energy policy must be planned on the basis of Norway's long-term goal to become a low-emission society by 2050. It often takes a long time to develop more power and transmission capacity. Many energy policy decisions must therefore be made in the near future. So far, too little has been done to transform the Norwegian energy system. Figure 5.2 shows how many sectors in Norway consumed approximately the same share of fossil energy in 2022 as in 1990.

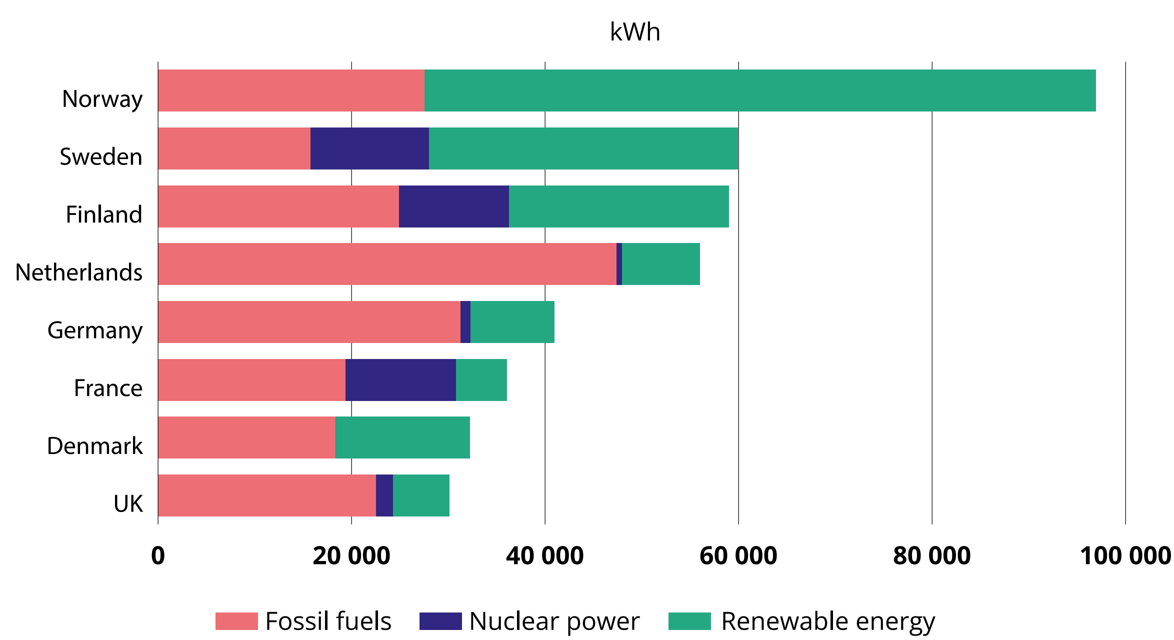


Figure 5.1 **Per capita energy consumption from fossil energy, nuclear power and renewable energy in 2022.**

Source: Our World in Data (2023)

Box 5.1 The Norwegian energy system

The energy system comprises various energy sources and the production, storage, distribution and consumption of energy. Energy can come from various non-renewable and renewable sources, such as oil, gas, biomass and solar and wind power. An energy carrier is something that can store energy, such as water reservoirs, batteries and hydrogen. Energy also comes in various usable forms, such as electrical energy and thermal energy. Electrical energy is often referred to as power, and a power plant converts energy into electrical energy. Extensive infrastructure is involved in further processing and distributing energy, including power grids, gas pipelines and refineries. The use of energy also requires infrastructure like charging networks and filling stations. Figure 5.3 shows the relationships between energy sources and consumption in the Norwegian energy system.

In 2021, the total energy consumption in Norway, including on the continental shelf, was 326 TWh. Of this, 138 TWh was electricity, 165 TWh fossil energy, 16 TWh bioenergy and around 7 TWh district heating, which is mainly fuelled by bioenergy (NOU 2023: 3, 2023).

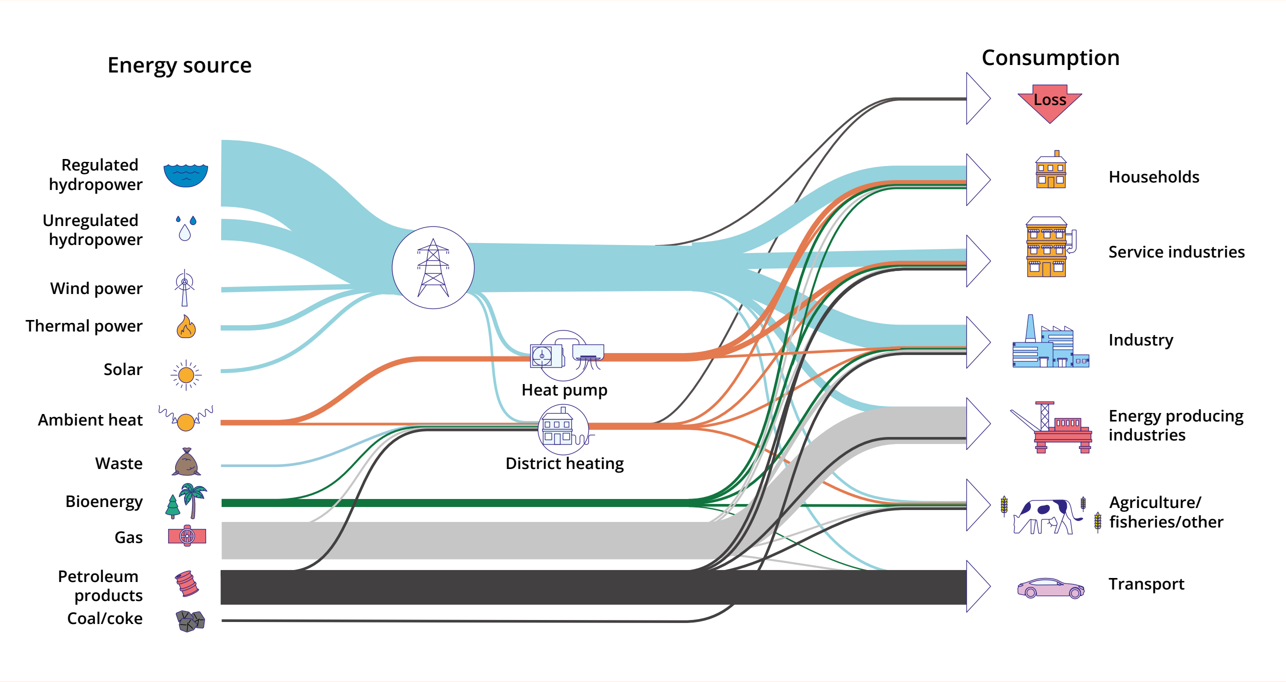
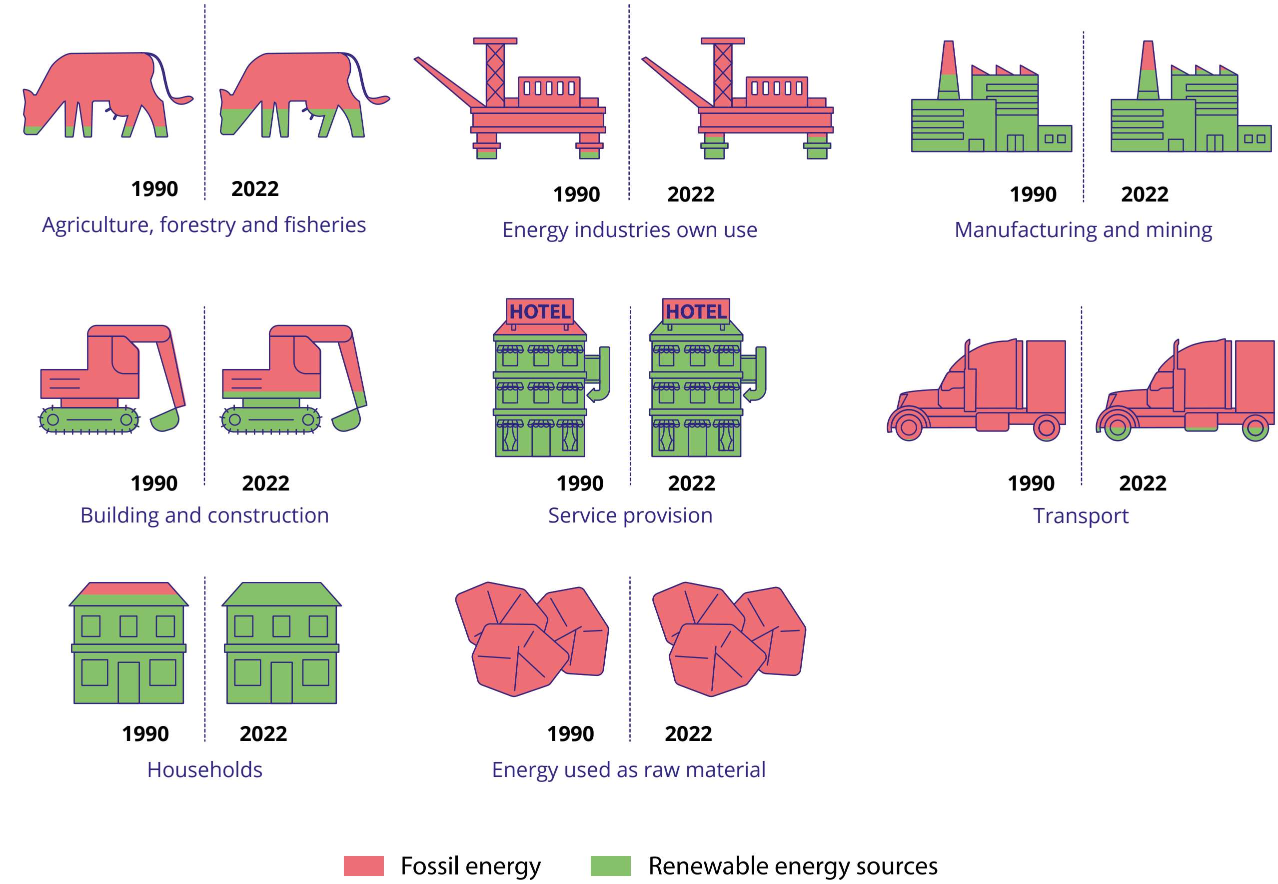


Figure 5.2 **The Norwegian energy system.**
The figure shows the energy balance for Norway as of 2020. The thickness of the lines indicates the relative share of energy consumption from each energy source.

Source: Energy Facts Norway (Energy Facts Norway, 2023). Adapted by the 2050 Climate Change Committee.



Energy is a limited resource, even though energy is renewable. Renewable energy has a significantly smaller climate and environmental footprint than fossil energy. Electrification will also in many cases reduce energy consumption because electricity can be used more efficiently than fossil energy carriers. At the same time, all energy production has a negative impact on nature and resource use. When all sectors must reduce their emissions, there will be pressure on energy resources in the form of both renewable power and biomass.

The sum of many different decisions will determine how much energy will be produced and consumed when Norway has become a low-emission society. The decisions of market participants are based on profitability assessments. At the same time, their decisions will largely be the result of political decisions made in Norway and in other countries. The starting point for all decisions must be that natural resources must be used as efficiently as possible, and that comprehensive energy efficiency measures must be implemented. At the same time, it is necessary to develop enough renewable energy and other zero-emission solutions to enable them to displace fossil energy consumption. The Energy Commission's remit included a clear goal that Norway should continue to have surplus power production, and that abundant access

Figure 5.3 Consumption of energy by sector in 1990 and 2022.
Statistics Norway's energy balance shows energy consumption in Norway by industry sector, which differs from the sectors in the Norwegian emission accounts. *Own consumption in the energy producing sector* shows energy consumption in industries that produce primary energy products, such as the recovery of crude oil and natural gas, coal extraction and hydropower plants. *Energy used as raw material* shows energy products that are used as inputs in the production of goods, for example in the production of chemical raw materials and natural gas used in methanol production.

Source: Statistics Norway energy balance, edited by Menon Economics to renewable energy should continue to be a competitive advantage for Norwegian industry. To electrify society, renewable energy must be able to compete with fossil energy. Investment in new power generation depends on price signals from the power market. At the same time, policy must provide direction for a rapid and just energy transition. A political goal of surplus production can influence important choices in the transition to a low-emission society. It is not a given that this is the right priority, or that it provides the right order in which decisions should be made.

Energy policy must be mindful of the trade-off between power quantity, prices, use of resources and encroachments on nature. Combining low energy prices with GHG emission cuts and limited encroachment on Norwegian nature is difficult. If prices are to be kept low, a power surplus is required. This can be achieved by developing new power or by lowering ambitions for electrification. Energy efficiency can also contribute to this end, but is more difficult to achieve with low energy prices.

Lack of priorities will delay the transition. The necessary democratic processes mean that it will take time to develop more power and expand the grid. Efforts to phase out fossil energy from the Norwegian energy system will require considerable effort and clear political priorities in the time ahead, and this is urgent. The authorities face important energy policy choices in the transition to a low-emission society. Both a high-energy society and a low-energy society can be compatible with a low-emission society, and there are advantages and disadvantages to both.

A high-energy society produces and demands a lot of power. A high-energy society does not assume that electric power is a scarce resource, and low energy prices are a main objective. Low energy prices to end-users combined with high demand may require government subsidies to increase power production sufficiently. Low renewable energy prices provide incentives to develop and roll out low and zero-emission solutions more rapidly. At the same time, it can also mean that operators choose energy-intensive solutions, such as ammonia and hydrogen, rather than more energy-efficient solutions that may require a major transition or investment in technology development.

Zero-emission solutions: solutions that generate no direct greenhouse gas and exhaust emissions during use. This means, for example, the use of an electric motor in combination with a battery, or direct use of electricity or a fuel cell that utilises a carbon-free energy carrier such as hydrogen.

A low-energy society is based on the premise that electric power and other energy are scarce resources, and that increased production has negative consequences. Emission-free energy must replace fossil energy in a low-energy society as well, but here, policy is geared to a greater extent towards removing barriers to energy efficiency and allowing prices to work so that consumers limit their electricity and power consumption. Prices will provide incentives for developing new renewable power without subsidies.

A zero-emission Norwegian economy requires more renewable power, but it is primarily plans for the establishment of new, green industry that can lead to a major growth in demand. Estimates of future power demand vary considerably. Forecasts that indicate increased demand are often based on the assumption that power will be cheap. In its report, the Energy Commission compiled various forecasts for power demand and recommends a goal of 40 TWh of new power production by 2030 (NOU 2023: 3). The assumptions in the various forecasts also vary, and consequently so does power consumption. Figure 5.4 shows how estimates from 185 TWh (Statnett low scenario) to 269 TWh (DNV GL) are indicated for 2050, corresponding to an increase of between 23 and 80 per cent compared with current consumption. The wide range of forecasts reflects, in particular, different assumptions regarding new activity that will be based on the availability of low-cost power.

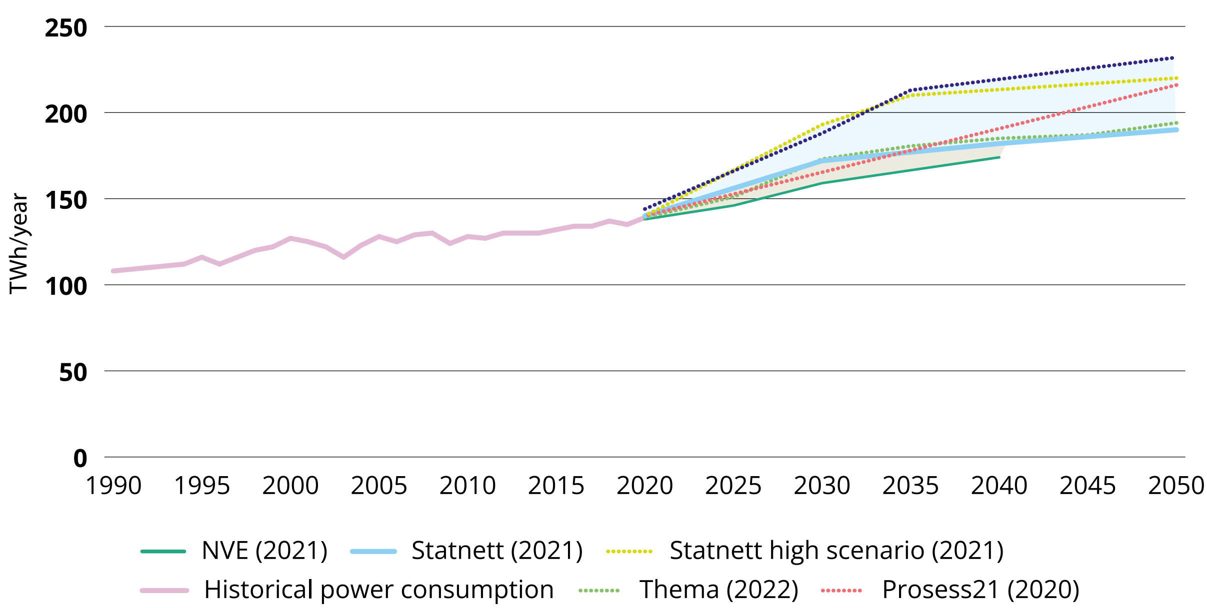


Figure 5.4 **Sample space for forecasts of power consumption in 2030, 2040 and 2050, TWh/year.**

Source: The Energy Commission (NOU 2023: 3)

New industries can contribute to global technology development, but they rely on access to clean energy. In a low-emission society, there will be needs that must be met by new business activities, such as direct air capture or hydrogen-based fuel. New businesses can help demonstrate that new technology is ready to be rolled out. This can, among other things, make it easier for a supranational player such as the EU to introduce stricter regulations, which in turn can lead to further technology development. Norway is not supposed to, and nor can it, produce everything, but it is natural to assume that new business activities will also be established in Norway. These activities will need energy, space, grid access and other resources.

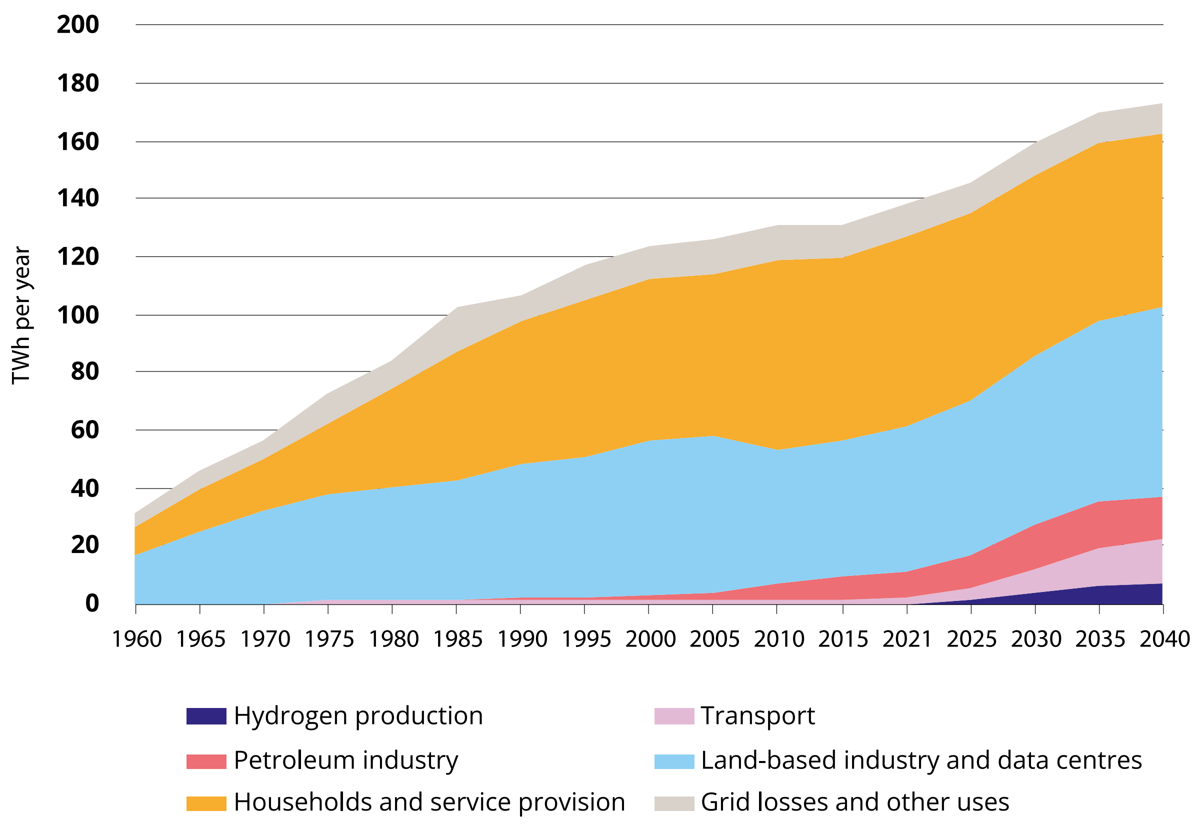


Figure 5.5 **Historical development and NVE's assessment of power demand towards 2040 by source.**

Source: NVE (2021)

Emission cuts must not be restricted by limited access to power or grid availability. Figure 5.5 illustrates that projects that do not necessarily contribute to the transition, either in Norway or globally, can constitute a significant part of the growth in demand for power towards 2040. There is limited land available for developing new power and grid capacity, and it would therefore be unfortunate if new business development displaces necessary climate mitigation measures.

There is considerable room for political control when it comes to demand for and production of energy. Many external factors affect power demand, such as prices and technology development, but also policies for business development, transmission capacity, security of supply, electrification of society, energy efficiency, circular economy and investment in the production of, for example, hydrogen and ammonia. The choices are closely related to the impact on nature. See Chapter 11 for a comprehensive review of choices in climate and energy policy.

See Chapter 13 for a comprehensive review of choices in climate and energy policy.

In the Committee's view, there are far fewer disadvantages to planning for a low-energy society than a high-energy society. Making a choice towards low energy will be consistent with the principle that land and resource efficiency must form the basis for the transition. Low energy households are less vulnerable to fluctuations in energy prices, and less development of new renewable power production will cause less pressure on land. In some cases, however, consumption of renewable energy will increase in step with the energy transition. This applies in particular to the processing industry and the transport sector. Significantly greater energy efficiency efforts will be required on the part of both companies and households.

Circular economy: value chains in which the products/materials are used in different ways for as long as possible and then reused in a cycle. In a circular economy, products must last as long as possible, be repaired, upgraded and reused to a greater extent. When the products cannot be reused, the waste can be recycled and used as raw materials in new production. In this way, we use the same resources several times and generate the least possible loss.

Low energy consumption and energy efficiency must always come first. Energy policy measures should be considered based on the framework *Avoid–Shift–Improve (ASI)*, as shown in Figure 5.6. Energy consumption involves an encroachment on nature and other negative impacts. It should therefore always be considered first whether it is possible to avoid consumption, either by avoiding activities that require energy consumption or by maximising energy efficiency. The consumption that does occur must be shifted from fossil to zero-emission sources. At the same time, efforts must be made to improve the energy system, for example, by facilitating more flexible consumption. It will be necessary to work on all of these energy policy pathways in parallel. Climate, environment and energy policy would be more coherent if energy policy were based on such a framework.

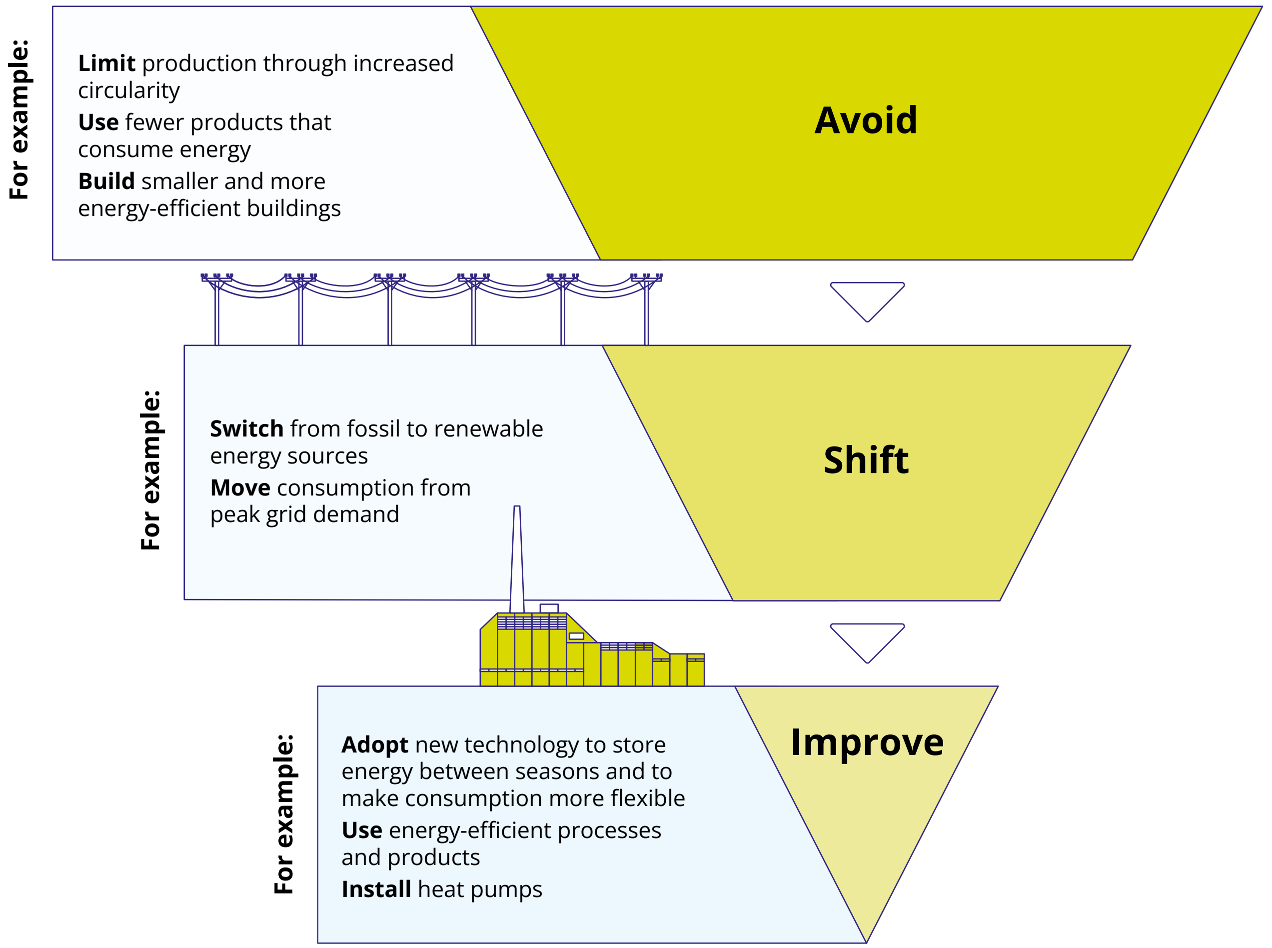


Figure 5.6 **Framework for policy measures –** ***Avoid-Shift-Improve*** **in the energy system.** The figure shows various priorities and examples of how the priorities can influence policymaking. The examples are not exhaustive.

Source: The 2050 Climate Change Committee

Energy prices must be allowed to reflect the fact that electric power is a scarce resource. The Energy Commission's conclusions highlight the need to speed up the development of renewable energy and its importance to achieving the climate goals. The Energy Commission's remit is based on the premise that access to plenty of clean, reasonable power will be maintained. The Climate Change Committee would like to emphasise that power production does not come without costs to society and nature, and that electric power, especially in the transition to a low-emission society, will be a scarce resource. It is demanding to limit energy consumption if prices are artificially low. When the price signal takes effect, it will be an important instrument for coordinating the need for new investments. This will provide an incentive for profitable investments in power production and energy efficiency. Global overconsumption is at the heart of both the climate and nature crises. Making low energy prices a key objective of energy policy is not a good response to this challenge.

At the same time, electric power is a necessity. High energy prices can hit individual households hard. Several analyses indicate that electricity prices will fluctuate more when both Norway and Europe switch to a renewable energy system (Statnett, 2023a; NVE, 2021). It is important that the welfare state provides support, but not in such a way as to reduce the incentive for efficient energy consumption. It can be difficult for low-income households to take advantage of energy efficiency subsidies, as they require the means to cover large one-off expenses. The Committee recommends organising energy efficiency grants in a way that enable the schemes to be used by all households, including those with low income. This could be done by introducing instalment schemes with long downpayment periods. This is also important to ensuring the energy transition's legitimacy in the population.

A skills boost is required on several levels. With the entire energy system undergoing change, new demands will be placed on skills in many sectors. Everyone must contribute to avoiding or rationalising their energy consumption, and many must also shift their energy consumption. This requires both professional and technical expertise, but also behavioural changes in the population. The education and employment sectors are the main contributors to this development.

5.2 Norway should contribute to the European energy transition

European leaders are advocating an emission-free but also less vulnerable energy system in Europe. The war in Ukraine has reminded European leaders that the current energy system is not only unsustainable, but also vulnerable to crises. They have responded by accelerating the development of alternative energy sources and energy carriers. In the long term, this will also lower the cost of European energy consumption. At the same time, there is increased awareness that the development of an emission-free European energy system must not give rise to other types of vulnerabilities. In 2021, 21.8 per cent of total energy consumption in the EU was based on renewable sources (Eurostat, 2023). EU member states have committed to 42.5–45 per cent of their consumption being based on renewable sources by 2030. This requires access to a large volume of raw materials, minerals and metals. The EU has developed regulations to ensure safe, robust value chains for critical raw materials and contribute to more European production. These value chains are currently dominated by China (European Commission, 2023a).

The EU also sets targets for the development of many different energy sources and carriers. The target for the share of electricity in the energy mix is to reach 75 per cent by 2050, of which 57 per cent of consumption should be based on direct use of power and 18 per cent on the use of energy carriers such as hydrogen (Council of the European Union, 2023b). Electricity, hydrogen and other low-carbon gases are intended to replace the current consumption of natural gas (Council of the European Union, 2023a).

The EU energy transition will require immense amounts of power. The ambition to produce more raw materials will require power on top of the necessary electrification.

The Commission's scenarios show that demand could increase from below 3,000 TWh today to up to 6,800 TWh by 2050 (European Commission, 2021). At the same time, climate policy will contribute to reducing energy consumption. The European Scientific Advisory Board on Climate Change has conducted a review of different scenarios. They found that, in all scenarios, energy consumption will be significantly reduced by 2040, by 20–40 per cent compared with current energy consumption. When electricity replaces fossil energy, it will in itself reduce energy consumption since less energy is lost with the use of electricity than with the combustion of fossil energy. The reduction will be greatest in the transport sector, at 30–60 per cent, and in industry, with a reduction of 20–45 per cent (European Scientific Advisory Board on Climate Change, 2023).

Norway can and should contribute to the EU's goal of an energy mix based on renewable sources and low-carbon gases. Norway's abundant renewable resources enable us to contribute to the transition in the rest of Europe, but their importance in the long term may lessen given our neighbouring countries' high ambitions for the development of renewable energy and energy storage solutions. The development of renewable energy in many countries is likely to result in lower price differences throughout Northern Europe. The Committee's view is that climate policy should look beyond the impact on our own national emissions and also take into account how Norwegian policy affects emissions in other countries. The impact of Norwegian energy policy on the transition opportunities for the European energy system should therefore also be an element in the assessment of Norway's overall climate and energy policy.

Energy exchange is also important to Norway's transition. With more weather-related fluctuations in European power production, it must be possible for countries to exchange power to stabilise supply and prices. Access to imports could be an important security factor in the face of droughts. At the same time, tensions may arise between considerations for an efficient and stable overall system and national considerations, for instance relating to security of supply. Energy exchange will therefore have to take place within a politically determined framework.

5.3 Efficient and zero-emission consumption

The potential for increased energy efficiency is considerable. Both Enova and the Norwegian Water Resources and Energy Directorate (NVE) have identified great potential for energy efficiency in Norway (Enova, 2023a). Much can be done in both Norwegian buildings and in industry. NVE and the Norwegian Building Authority have found a profitable potential for energy efficiency measures in buildings of 23.6 TWh, with an energy price of NOK 1/kWh, and a profitable potential for heat pumps of 7.5 TWh (DiBK & NVE, 2022). In 2021, the HighEFF research centre found a 20 TWh loss in the form of surplus heat from Norwegian industry (Røkke et al., 2021). Little of the energy efficiency potential previously identified by Enova has so far been realised (Enova, 2023a).

Signals from the power market are important, but it is also necessary to implement stronger energy efficiency policy measures. Enova defines several market factors that drive energy efficiency: high energy prices that vary throughout the year and day, financial market developments that make it easier for projects to access financing, digitalisation that makes it easier to manage consumption and stricter requirements for sustainability reporting (Enova, 2023b). At the same time, there are several barriers that prevent measures from being implemented, even those that are socio-economically and profitable for individuals. One example is a lack of information and skills among both people and companies to implement measures, in addition to various behavioural barriers; see Chapter 15. In rented accommodation, there are few incentives to implement measures because the owner pays for the investment, while the tenant receives the gain in the form of lower electricity bills. This barrier can be addressed, for example, by setting minimum requirements for energy standards in rental housing. Public authorities can take the lead and adopt such standards to apply to public buildings. Another barrier can be high investment costs, which can make it demanding for low-income households to implement energy efficiency measures, even with government subsidies. Policy instruments should take this into account.

See Chapter 15 for a discussion of barriers to climate transition.

Norway should make better use of energy efficiency support provided by the EU than it does today. The EU has made it easier for consumers to make informed choices, for example by improving and expanding energy labelling schemes. Work on implementing much of the regulatory framework has so far been slow in Norway. The Committee recommends speeding up government efforts to implement EU regulations in the work on energy labelling and efficiency measures.

The transition to a circular economy can lead to lower growth in energy demand and more stable value chains for renewable energy development. Both Norway's and the EU's strategies for the circular economy have previously focused primarily on products such as electronics, textiles, plastics and the building and construction sector. The value chains for the development of renewable energy production and distribution must become more circular, both to reduce resource use and to reduce reliance on unstable value chains. The EU has recently presented directives aimed at building more circular value chains to promote energy and resource-efficient production, including for battery production. Norway has established partnerships with the EU on raw materials and batteries. The Committee recommends stepping up efforts in Norway to ensure that measures for a more circular economy contribute to reduced energy and resource consumption throughout the value chain for solar and wind power production and battery production.

The work on energy efficiency in buildings is a low-hanging fruit that should be harvested as soon as possible. Buildings involve energy consumption when they are built, when they are used, when they are demolished and when managing waste. A large share of the energy is used for heating. Norwegian buildings currently use around 50 TWh of power for heating (NVE, 2020). Buildings could also account for an important part of demand flexibility in a low-emission society. Most of the buildings that will be standing in 2050 have already been built. There is a need for policy instruments that contribute to reducing emissions and energy consumption from renovation and conversion work. Renovation is a better climate mitigation measure than building new buildings. Both the Planning and Building Act and technical requirements for building quality are currently designed to a large extent with new buildings in mind. The Committee recommends considering adjustments to regulatory and economic policy instruments that shift investments from new construction to the operation and maintenance of existing buildings and infrastructure in a more energy-efficient and circular direction. This could for example be done by amending the Technical Regulations (TEK); see also Chapter 9.

See Chapter 9 for a discussion of policy instruments towards a more circular economy in the construction sector.

Energy efficiency measures will be particularly effective if they help manage peak demand. Peak demand occurs when many people use power at the same time, typically when it is cold, which means that flexible, and energy-efficient heating solutions in buildings can make a particularly positive contribution. It also gives most businesses an opportunity to adapt their consumption and reduces the need to expand the grid and other infrastructure. In order to trigger the necessary investments in such solutions, it is important that any support schemes relating to high electricity prices are not designed in a way that removes incentives to shift consumption to periods of lower grid demand.

Decarbonisation: means that activities that currently involve CO_2 emissions are changed so that the activity becomes zero emission, for example switching from cars that run on petrol/diesel to electric cars.

Mainland industry must save large amounts of energy, but industry decarbonisation will also be energy intensive. A high share of Norwegian industry is energy intensive. Many industrial companies have already implemented significant energy efficiency measures, but there is still great potential with many others. Stronger policy instruments are needed to ensure that energy efficiency measures, such as better utilisation of waste heat and more co-location of industry, are implemented. At the same time, industry and other business activity must be decarbonised. The use of fossil fuels for energy consumption in industry should be banned to ensure the necessary transition of this sector. This is an emission reduction measure that has undergone several rounds of assessment. The Norwegian Environment Agency has described how such a ban can be applied and delimited (Norwegian Environment Agency, 2023c), and it has the potential to reduce emissions by close to 800,000 tonnes of CO_2e. The Agency has also carried out analyses of measures to cut emissions towards 2030 by up to 78 per cent compared with 1990 levels in industry and the energy supply sector. These cuts include the capture of 1 million tonnes of atmospheric CO_2. The analysis estimates that the sum of these emission cuts will increase power demand by around 14 TWh (Norwegian Environment Agency, 2022b).

Policy instruments aimed at reducing carbon leakage should where possible be accompanied by a requirement that the funds contribute to emission reduction measures and energy efficiency. Norwegian mainland industry has so far been shielded from the cost of its emissions by measures that counteract carbon leakage through the free allocation of carbon credits. Carbon leakage occurs when a country introduces climate measures and emissions-intensive production is outcompeted and moves to countries with less stringent climate policies. A large share of Norwegian mainland industry supplies materials that are important in the transition to a low-emission society, and many companies are world leaders in developing and adopting zero and low-emission solutions. There may be good reasons to implement policy instruments aimed at avoiding carbon leakage. Although our future industry structure is not known, there is reason to maintain policy instruments that level the playing field to ensure global reductions. The EU has introduced the Carbon Border Adjustment Mechanism (CBAM) to address this concern. This instrument imposes a tax on iron, steel, aluminium, cement, electricity and hydrogen imported from countries outside the EU that have lower carbon taxes than the EU for the same products.

Alternative fuels such as ammonia and hydrogen must be considered in light of the resources they lay claim to. The production of ammonia and hydrogen based on both fossil and renewable energy sources requires large amounts of power and results in a large energy loss. Figure 5.7 shows the difference in power requirements for driving a large truck one kilometre, running on battery, hydrogen, ammonia and synthetic fuel, respectively. Ammonia and hydrogen based on fossil energy sources relies on the capture and storage of CO_2 emitted from the process. Hydrogen leakage also has a potentially negative climate impact in the atmosphere (Sand et al., 2023). This implies that, in a situation where energy is a scarce asset, a conscious approach must be taken to the use of such fuels. The development of production lines and measures that stimulate adoption must take into account the overall use of resources.

Green hydrogen: hydrogen produced from renewable energy.

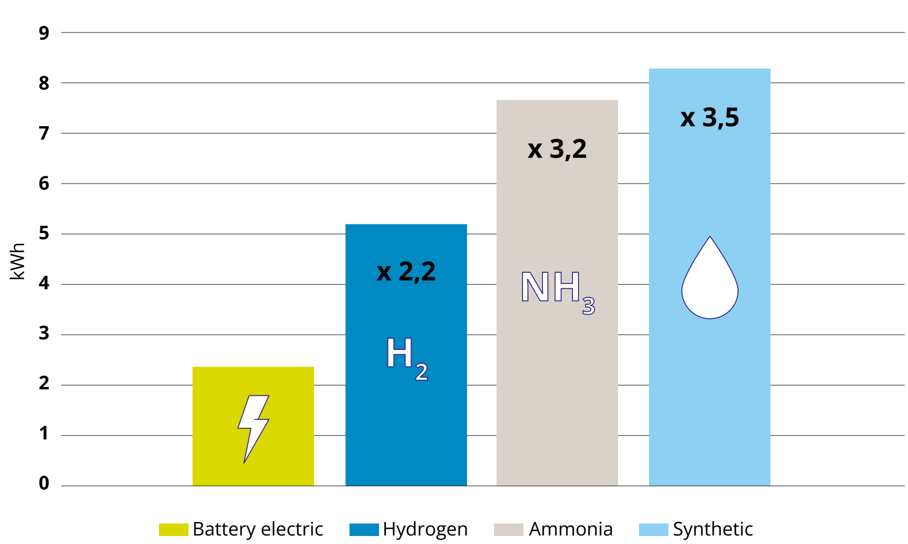


Figure 5.7 Power requirements for driving a large truck one kilometre, running on battery, hydrogen (in a fuel cell), ammonia (in an internal combustion engine) and synthetic fuel (in an internal combustion engine).
The power requirement includes the production of fuel with green hydrogen (from electrolysis).
Source: The Norwegian Environment Agency (Norwegian Environment Agency, 2022c)

Emission accounts: an overview that includes all emissions and removals of greenhouse gases within a country's borders. The main gases are CO_2, methane (CH4) and nitrous oxide (N_2O), but also other gases such as fluorinated gases are considered greenhouse gases and included in Norway's emission accounts.

Biomass is a scarce resource and should be prioritised for purposes other than energy. Bioenergy is based on biomass from plant products, fertilisers, forest waste and other biological waste, for example food waste. Bioenergy can take the form of different energy carriers such as wood, pellets, or be converted to fuel (Brænd, 2023). CO_2 from biomass combustion is not included in the emission accounts, while emissions of nitrous oxide and methane from combustion are included. Bioenergy is the largest renewable energy source in Europe, and accounts for around 6 per cent of energy consumption in Norway (NVE, 2023b). Around 4 million tonnes of biofuels are used in Norway every year (Statistics Norway, 2023a). Biofuel use in Norway is rapidly increasing and constitutes about 14 per cent of total fuel in road transport (Norwegian Environment Agency, 2022a). The biofuel is largely imported. As much as possible of the bioenergy should be waste products and by-products from forestry and agriculture that have few other uses. Over time, the vast majority of available biomass should be used in the parts of transport and industry that are difficult to electrify, and the overall use of biomass for energy should be restricted. Biomass can also replace fossil raw materials for use in various products such as plastics and chemicals, and can have greater value in such applications than for energy purposes.

Biomass: the total mass of living organisms in contexts where numbers of individuals are impractical, for example the number of trees in a forest. Biomass can also be used as a term for bioenergy; fuels derived from trees and plants, fertilisers, forest waste, peat etc.

Biomass should be used where it has the highest value. The EU Renewable Energy Directive states that biomass resources must be used in accordance with the cascading principle. This means that it should be used where it has the highest value for the climate and economy, on the grounds that biomass combustion leads to temporary GHG emissions, and biomass extraction can lead to loss of biodiversity and other natural assets. The use of bioenergy reduces emissions if it is used as a replacement for fossil sources, provided that the raw material is from sustainably managed land. In Norway, forest-based resources represent the greatest bioenergy potential. Felling of tropical forests to grow bioenergy/biofuel crops will not result in reduced emissions. Replacing the carbon lost from tree felling and soil degradation will require many years of crops before breaking even, and the vegetation will not necessarily bind more CO_2 than the tropical forest. The choice of raw material for bioenergy is important if it is to make a positive contribution to the climate accounts. Most energy scenarios, including those outlined by the IPCC, assign bioenergy an important role because it provides security of supply and flexibility. Heat from firewood or wood chips is an effective solution on calm, dark and cold days when wind or solar power cannot be produced and demand is high. Biofuel can be important for long-haul aircraft because there are few alternatives. In addition, forest raw materials can have many new applications, such as biochemicals and bioplastics.

5.4 Produce enough with zero emissions

Norway must increase its production of renewable energy enough to replace fossil fuels. Energy efficiency will not be sufficient to displace the large amounts of fossil energy currently used in the Norwegian energy system. This must be replaced by zero-emission energy.

Power generation and transmission grids must also be sufficient to secure the short-term and long-term flexibility of the system. The Norwegian power system is very flexible in the short term but weather-dependent in the longer term. Climate change will result in more variation in the weather. In a year with favourable weather conditions, the power surplus can be up to 40 TWh higher than in a year with poor weather conditions (NVE, 2022b). NVE and Statnett's forecasts indicate that our power balance will be tighter as we approach 2030. This will make Norway more dependent on imports in dry, cold years. Expanding the grid capacity for power transmission within and between countries will make Norway less vulnerable to weather variations.

Access to power need not be a material barrier to emission reductions in the medium term. The Norwegian Environment Agency has estimated that 34 TWh is needed to realise the emission cuts necessary to achieve the 2030 climate targets (Norwegian Environment Agency, 2023c). The Energy Commission proposed a goal to develop 40 TWh by 2030 to facilitate emission cuts and new industry establishment. In its consultation submission to the Energy Commission's report, NVE argues that it is unrealistic to develop 40 TWh of new renewable power production by 2030, but considers it ambitious yet realistic to secure 25–30 TWh from solar power and energy savings by 2030 (NVE, 2023a). Although the Government's offshore wind ambitions have only been partially realised, this can provide large volumes of power relatively quickly. The Government's goal of developing 30 GW of offshore wind by 2040 will generate around 150 TWh a year, i.e. about as much as current hydropower production (Statnett, 2023b). Norway is part of a common Nordic power market with Sweden, Denmark and Finland, and large volumes of new power are under development in these countries. With a change of pace in energy efficiency efforts, efficient facilitation of new power production and prioritisation of climate mitigation measures, the power situation in Norway should not be a material barrier to emission reductions in the medium term. The most important consideration is not whether 40 TWh will be developed by 2030, but to prevent the climate transition from being delayed by an inadequate energy transition.

To facilitate increased renewable energy development, Norway must be more restrictive in developing land for other purposes and, to the extent possible, utilise land that has already been developed. New renewable energy development will require land. This indicates that a more restrictive land use policy should apply to other purposes. In Chapter 6, the Committee presents assessments relating to land use on the pathway to a low-emission society.

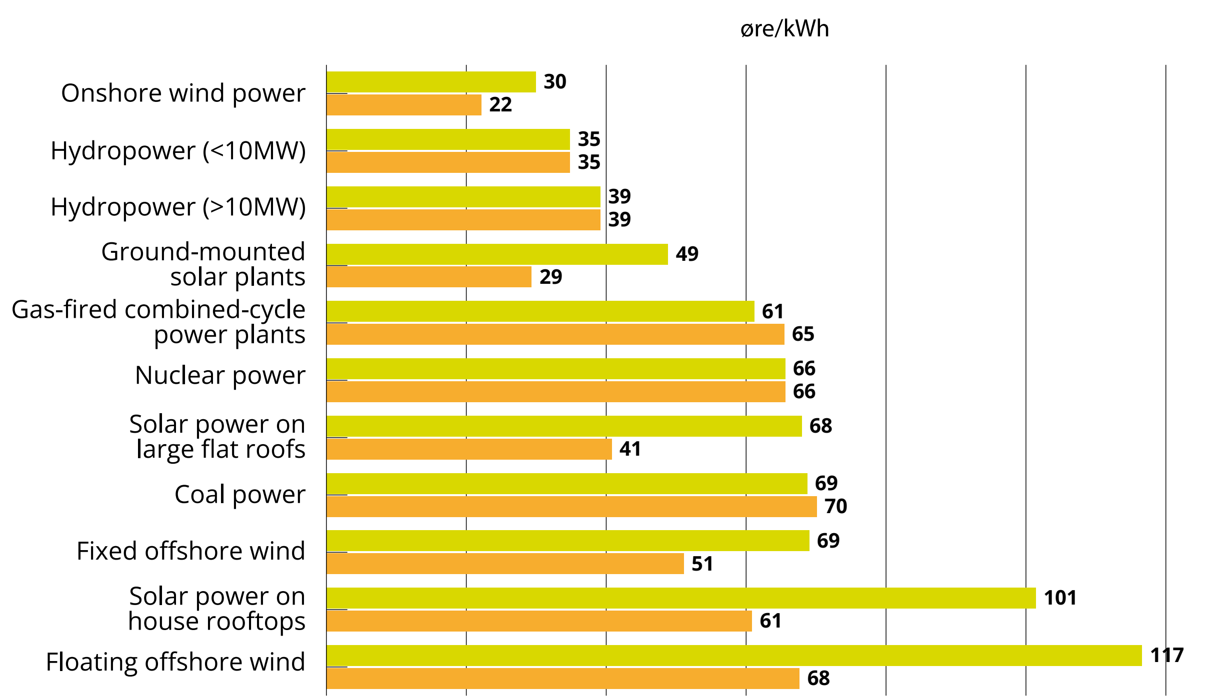
See Chapter 6 for a discussion of the Committee's assessments of land use towards the low-emission society.

It is the characteristics of the energy system that are important, not precisely which zero-emission energy sources gain ground. Norway has very favourable water and wind resources, and the cost of renewable power production has fallen sharply, especially for land-based solar and wind power. Figure 5.8 shows NVE's assessment of the cost per kWh of different energy technologies, taking into account both investment and operating costs, known as the levelised cost of energy (LCOE). The figure illustrates an expectation of further cost reductions particularly for floating wind power and solar power, while more mature technologies do not show the same reduction. The figure also shows that land-based wind and hydropower are already cheaper than fossil power production and nuclear power.

There is a substantial difference between the costs of existing and new power production, and between land-based and floating offshore wind. Energy prices must reflect the development costs associated with establishing new capacity, and not the production cost of paid-off hydropower plants, in order for such development to pay off. An energy system in which new production sets the prices will bring major gains to hydropower producers. The legitimacy of such a system will depend on mechanisms for passing on profits to consumers.

Figure 5.8 Production costs (LCOE) (NOK 0.01/kWh) for different power production technologies in 2021, and forecasts for 2030.

Source: NVE (2022) and the Energy Commission



The cost of renewable power production is central, but other considerations must also weigh heavily. The transition to a low-emission society must be cost-effective in the sense that it provides the lowest transition costs overall. These costs also include non-monetary costs, such as costs relating to public resistance and reduced or improved quality of life. Cost-effective alternatives can also challenge indigenous rights. Norway is responsible for preserving the basis for Sami culture. Power development may come into conflict with these interests. The Committee emphasises the need to respect indigenous rights in the transition to a renewable energy system.

Appropriate and thorough processes are essential to ensuring the legitimacy of energy development. It is important that affected parties are involved in such processes and that their views are heard. Independence between the assessor and the developer in impact assessments can strengthen the legitimacy of renewable energy development, making the scientific basis for decisions more robust. A mapping of social and cultural factors and natural conditions should be considered early in the licensing process.

Steps should be taken to stimulate more development of small-scale power production in Norway. Small-scale production of energy, such as rooftop solar panels and smaller wind turbines where other infrastructure has already been established, for example on industrial sites, entails less land degradation than traditional large-scale power production. Facilitation of such solutions can contribute to increased support for the energy transition (Leiren et al., 2020). A study conducted by Multiconsult on behalf of the industry organisation Solar Energy Cluster shows that the technical potential for solar power on accessible roofs and facades corresponds to an annual power production of approximately 65.6 TWh per year, i.e. about half the capacity of Norway's developed hydropower (Hjelme et al., 2022). The study points out that large-scale development of solar power requires more grid expansion, making it necessary to look at the interaction between solar power and other energy sources to ensure the power and energy balance. There are also several barriers to further growth in power production from solar cells, including lack of requirements in relevant regulations such as the Technical Regulations (TEK) and the Planning and Building Act, and lack of skills and labour. The Government has recently implemented changes to facilitate more local energy production through simplified licensing processes, and this work should continue.

There is an ongoing debate about whether nuclear power is an appropriate solution for the Norwegian energy system. Nuclear power can deliver large amounts of stable and virtually emission-free power with relatively little land use. The technology plays an important role in IPCC and IEA global scenarios. As shown in Figure 5.8, nuclear power is currently relatively expensive. Developing nuclear power takes a long time, both because of the long construction time and the need for extensive procedures to decide where a plant should be located and how spent nuclear fuel should be managed. International efforts are under way to develop small modular reactors (SMRs) that will require less space and use more standardised, prefabricated components. Such reactors are not yet in commercial operation, and it remains to be seen whether they will significantly change the view of nuclear power as a relatively expensive, complicated technology compared with relevant alternatives for Norway. The Committee refers to the Energy Commission's conclusion that nuclear power is not a viable solution for Norway at present, but that international developments should be closely monitored.

Blue hydrogen: hydrogen produced from fossil energy, but with carbon capture and storage.

In the long term, Norwegian gas exports to Europe are likely to take the form of blue hydrogen. Norway is Europe's largest supplier of gas. The EU's goal is to achieve an energy mix based on renewable sources and low-carbon gases. This means that natural gas must be converted to hydrogen. This can either take place on Norwegian installations or in the recipient country. The EU has sent a clear political message that natural gas should be emission-free in the long term, including through a decision that long-term natural gas contracts without CCS must be terminated by 2049 at the latest. At the same time, hydrogen based on natural gas with CCS will also generate emissions, and future demand for blue hydrogen will depend on technological and policy developments that are difficult to foresee. Hydrogen gas leakage also has a negative climate impact in itself (Sand et al., 2023). More research is needed on the climate impact of hydrogen gas leakage.

5.5 A robust, flexible energy system

Norway's energy system must be adapted to a shift towards more non-regulated power production and higher power consumption. An energy system must ensure that electric power is available at all times and over time. The first is referred to as output and the second as energy. With flexible consumption and flexible production, the system can deliver electric power even during peak load periods, i.e. when many people use power at the same time. The system must also ensure access to enough energy over time. Together, this provides security of supply. Hydropower installations with reservoirs in Norway are flexible and allow storage of large amounts of power. This provides us with one of the world's most flexible energy systems and a better starting point than many other European countries. However, Norway is faced with other challenges. With a large share of heating based on electricity, we experience peak demand during cold periods.

The flexibility of the power system should be strengthened. For Norway, variations between years are a greater challenge than short-term flexibility. At the same time, the NVE expects increasingly higher peak demand in the time ahead. A more weather-dependent European power system can cause power shortages in many countries at the same time (Lund, 2023). The Nordic region already has a power deficit, and this is likely to increase further towards 2030 (NVE, 2022a). The power balance depends on how much of the consumption is flexible. Flexibility can come from flexible power generation, for example by increasing the output capacity of hydropower and building pumped-storage facilities, developing various forms of energy storage and increasing consumption flexibility (Bråten, 2022).

The Energy Commission has made several suggestions on how consumer flexibility can be strengthened. They highlight that energy efficiency and lasting reductions in the use of electricity for heating also contribute to a better power balance. Otherwise, digitalisation and the use of new technology can strengthen short-term flexibility by making it easier for consumers to shift their consumption to off-peak hours when prices are lower. New solutions for seasonal heat storage and other forms of energy storage can make it easier to switch between electricity and other energy carriers and thereby provide more flexibility between seasons. In order for people and companies to invest in flexibility solutions, it is essential that prices are allowed to reflect the fact that electric power is a scarce asset. The power grid must be dimensioned to deliver power through the highest peak load periods. However, new grid development entails extensive encroachments on nature. It is therefore important that energy policy helps prevent everyone from using power at the same time, to reduce peaks loads. This means less pressure to develop the power grid and less encroachment on nature. The Climate Change Committee supports the Energy Commission's proposal to implement a requirement for an assessment of consumer flexibility before traditional upgrades are carried out.

Further development of the power grid is a prerequisite for the energy transition. Stakeholders who want grid access are currently granted access based on a first-come, first-served principle. This can delay projects that are important to Norway's climate goals. Statnett has called for a prioritisation scheme that to a greater extent reflects the benefits to society of various proposals (Statnett, 2022). The Government's action plan for faster grid development and better grid utilisation proposes that grid companies should prioritise mature projects where there is a queue for grid capacity (Ministry of Petroleum and Energy, 2023b).

The Climate Change Committee believes that a clearer prioritisation should be established that to a greater extent reflects the societal benefit of grid access on the pathway towards a low-emission society. We can relieve the power system through local solutions and exploitation of the emerging high share of electric cars in Norway. Energy production based on local resources for heating in buildings and industry can relieve the power system and contribute to security of supply. Air and ground source heat pumps help to both reduce power consumption and relieve the power grid. Electric vehicles can be used to store electricity and deliver it back to the grid during peak times. Several of these solutions are currently expensive, however, and in some cases resource intensive. District heating can contribute to heat being recovered rather than wasted. It can also free up electricity that can be used for other purposes. However, this is not a zero-emission solution at present. The authorities should facilitate solutions that help strengthen the security of supply and flexibility of the power system while making the energy system emission-free.

5.6 The Committee's recommendations

The energy transition from fossil to renewables is a prerequisite for the low-emission society and must take place as rapidly as possible. The Committee therefore has the following recommendations:

- prioritise energy efficiency while increasing the production of renewable energy to ensure access to sufficient energy to replace fossil fuels.
- ensure that electricity prices reflect that electric energy is a scarce resource, in order to provide incentives to limit energy consumption.
- the State should assist households that have difficulties handling high and unstable prices, but not in such a way as to reduce the incentive for efficient energy consumption and energy saving.
- gear measures for a more circular economy in a way that helps reduce energy consumption and build circular value chains for the production and distribution of renewable energy and other inputs necessary in the transition. See also the recommendations in Chapter 9.
- introduce stronger energy efficiency measures, for example:
  - amend the Planning and Building Act and Technical Regulations (TEK) so they contribute more to renovation and conversion, resulting in lower energy consumption.
  - stipulate requirements for increased energy saving in policy instruments designed to prevent carbon leakage, such as the CO_2 compensation scheme for installations covered by the EU ETS.
  - set requirements for the utilisation of waste heat when establishing new industry and data centres.
  - increase support for energy efficiency, in particular measures to reduce peak consumption to limit pressure on the grid and power system. The arrangement of energy efficiency subsidies should be changed so that low-income households also meet the eligibility requirements.
  - set minimum requirements for energy standards in rental housing and public buildings.
- ensure that increased development of renewable energy and new infrastructure takes place within the framework of a comprehensive land use policy.
- set as a requirement that measures for increasing consumption flexibility are always assessed before traditional network upgrades are carried out.
- remove barriers to facilitate greater development of small-scale power production that does not involve encroachments on nature, such as rooftop solar power.

- make it easier for consumers to make informed choices, for example by improving and expanding energy labelling schemes. Norwegian authorities should work towards rapid implementation of relevant EU legislation in this area.
- use the ban on the use of mineral oil for heating, which was announced well in advance, as a model for the systematic assessment of all fossil energy use with a view to announcing bans in step with the maturation of alternatives. For example, the use of fossil fuels for energy consumption in industry should be banned.
- develop energy policy in a way that takes into account how Norway can contribute to the European energy transition, while also safeguarding national considerations.
- prioritise biomass, which is a scarce resource, for purposes other than energy. As much as possible of the bioenergy should be waste products and by-products from the forestry industry that have few other uses. Over time, more of the biomass should be used in the parts of transport and industry that are difficult to electrify.

Cost effectiveness must be emphasised in the planning of energy policy, but consideration for nature and the environment must also weigh heavily, and indigenous rights are an important premise. The Committee therefore has the following recommendations:

- create a better framework for the involvement of indigenous peoples in licensing and development processes and assess how it can be ensured that procedural rules safeguard Indigenous rights while at the same time safeguarding climate objectives and security of supply. As pointed out by the Truth and Reconciliation Commission, there is also a need to assess the practice of advance possession provided for in the Expropriation of Real Property Act. See recommendations in Chapter 4.
- ensure independence between the assessor and the developer in impact assessments. A mapping of social and cultural factors and natural conditions should be considered early in the licensing process.
- determine whether it is appropriate to prioritise access to power grid capacity based on benefit to society and contribution to the transition to a low-emission society.

Power against chaos!

About 30 years ago, we were at a tipping point. The climate would either get to the point where we couldn't fix it, or we could turn around and save the Earth. Oil and gas as energy sources had to go, and greater investment was needed in hydropower, solar energy and wind power. I have always believed in nuclear power, so when we needed new sources of energy, this was something that interested me. I wanted to develop micro-nuclear power plants that could provide energy for entire city districts, and these power plants would run on thorium, not uranium. An article was published that inspired me, by a researcher at NTNU who said that Norway is the country with the third largest deposits of thorium, which could provide us with enough energy for 2,000 years! (Brembo, 2022). So why isn't this being used? Many politicians were sceptical at first, and so were large parts of the population. The fear of accidents was greater than the belief in technology, and I thought this had to be due to a lack of knowledge. I got my dad on board, who became my biggest supporter, and we started planning what is now our company, Mjølner-Energy. We chose the name because thorium is named after the Norse god Thor, and Mjølner was his weapon against the forces of chaos. Micro-nuclear power plants are our weapon against the forces of nature, and the extreme weather and chaos that will break loose if we fail to do something about the climate as soon as possible.

The UN Sustainable Development Goals (SDGs) are something we thought about when we created our company, and particularly SDG 7. Clean energy for all is difficult to achieve, especially when many refuse to let go of oil and gas. It is true that we have a lot of hydropower in Norway, but we wanted to create something that could inspire and be relevant in other countries.

A thorium reactor is fuelled by energy supplied from the outside, unlike uranium, which reacts to neutrons. A uranium core reacts to a neutron, splits and emits new neutrons that another uranium core will react to, and so on. This chain reaction could run wild if not controlled. In a power plant, the action is of course controlled, but there is a greater risk associated with uranium than with thorium. In a thorium reactor, a particle accelerator controls the process, and even if thorium is converted into uranium, there will be a much smaller chance of the reactor 'running wild' because, if you turn off the particle accelerator, the whole process stops. This involves very complicated technology, and neither I nor my dad have any expertise in the field. Therefore, we entered into a collaboration with the company Norsk

Kjernekraft AS to help us develop these micro-power plants, using thorium instead of uranium. They had already worked on power plants of a scope similar to the ones we wanted, and have a lot of knowledge in the field.

We brought more people into our company. We encountered many problems in addition to this being a relatively new technology that needed a lot of research. As mentioned earlier, many were sceptical of nuclear power, and there was a lot of fear of a possible accident. Therefore, we had to work very hard to convince people that thorium reactors are safer than uranium reactors, and as a brand new company, we also had to build a good reputation. National pride became a big part of our branding. Thorium is Norway's national element, in addition to the fact that it's named after a Norse god, which we believed many Norwegians would react kindly to. This worked surprisingly well. Many believed that, if this worked, it could become Norway's new oil, and then we could go international and make a lot of money from it.

It took many years to develop a technology that worked well, and it took almost as many years to convince the market. In 2033, ten years after we developed the idea, we had a working prototype. It was built in Søndre Nordstrand and was able to supply electricity to the city district at below normal market price. When we saw that it worked, demand increased and the projects started queuing up. We expanded into all the districts of Oslo, and eventually spread to all of Norway. We were, and still are, the electricity supplier with the cheapest and most environmentally friendly electricity.

Now, in 2050, we are working to continue supplying cheap, green electricity to all the people of Norway, in addition to going to seminars and giving lectures around Europe, to spread the technology we have used. Oil, coal and gas have not been completely abolished yet, but we are constantly working on finding new ways to use our thorium reactors, so that, eventually, we won't need fossil fuels at all. We have a long way to go, but we've already taken big steps, and I'm really proud of what my company has achieved. A micro-power plant that is cheaper to build than a big one, that provides entire city districts with green energy, but does not take up much space and runs on thorium, a resource abundant in Norway. I look forward to seeing what the future holds, and hope that other countries will follow in our footsteps.

6 Land and nature

This chapter discusses the relationship between greenhouse gas emissions, loss of nature and land use. The chapter describes how land use policy is characterised by a high degree of both path dependency and irreversibility. It also provides the Committee's assessments of the current management system for planning and use of terrestrial, coastal and marine areas, seen in light of the objectives of the Global Biodiversity Framework and the fact that land is a scarce resource in the transition to a low-emission society.

6.1 Climate change and loss of nature

The world is facing two major, interconnected crises at the same time: climate change and loss of nature. Climate change is caused by increased GHG concentrations in the atmosphere due to emissions from the combustion of fossil energy, agriculture, industrial processes and land use change. Emissions from agriculture, forestry and other land use account for approximately 22 per cent of GHG emissions. In Norway, deforestation and degradation and drainage of peatland resulted in emissions of 2.6 million and 2.2 million tonnes of CO_2e, respectively, in 2020. This amounts to more than the country's emissions from passenger cars. Neither these emissions nor carbon removals in the forestry and land use sector are included in what is commonly referred to as 'Norwegian emissions' of around 50 million tonnes of CO_2e.

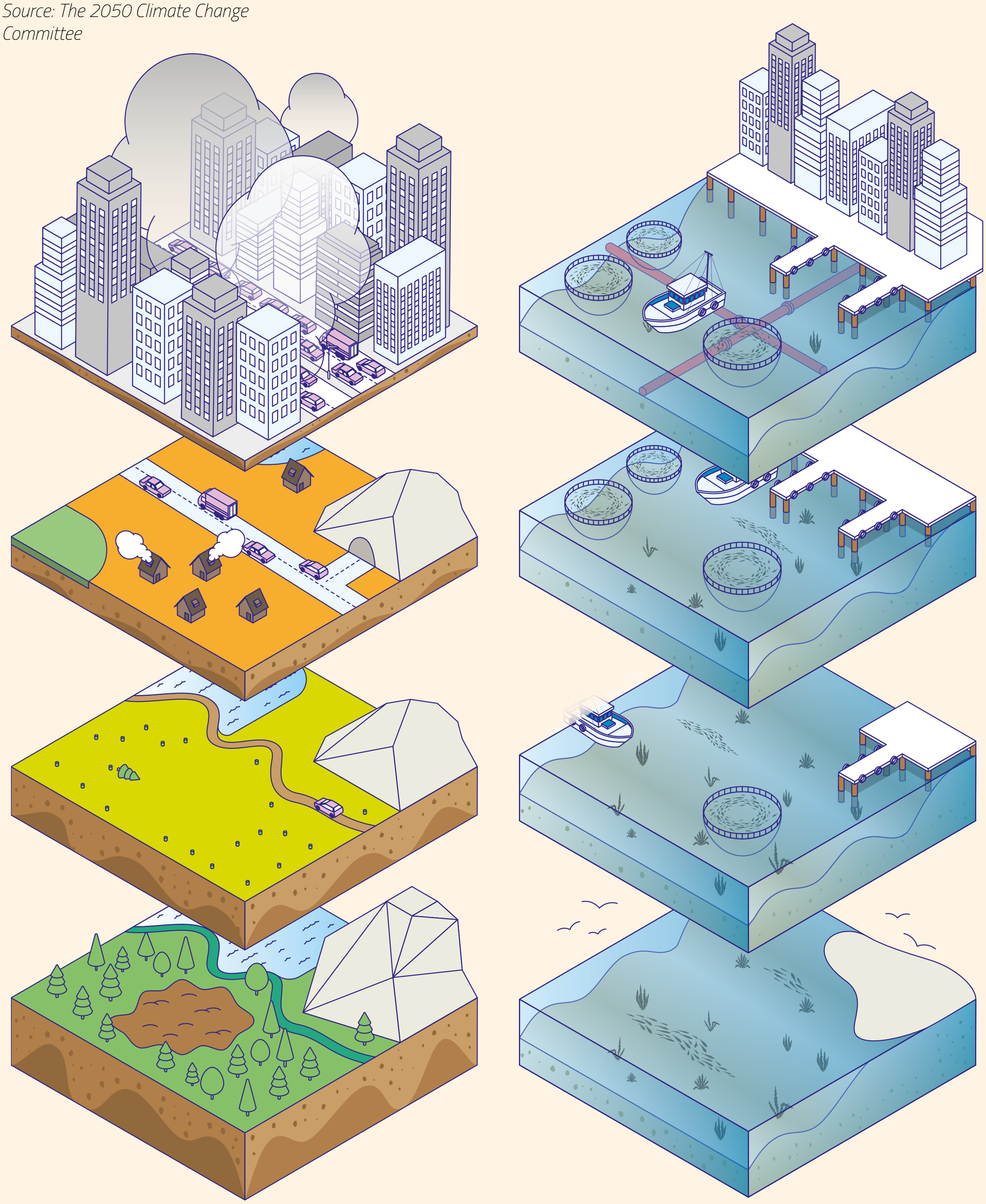
Loss of nature and biodiversity destroys the ecosystems on which humans depend and is caused by destruction and degradation of habitats through new and changed land use, pollution, over-harvesting, introduction of alien species and climate change. It is not possible to achieve the goals of the Paris Agreement without managing emissions from land and preserving the natural carbon sinks found in the sea, the soil, and in plants and trees. Preserving and restoring ecosystems is key to halting the loss of nature. At the same time, many of the climate solutions, particularly relating to energy production, require land. This will lead to greater pressure on nature and potentially emissions from natural carbon sinks.

Ecosystem: a more or less well-defined, uniform natural system in which communities of plants, animals, fungi and microorganisms function in interaction with each other and with the non-living environment.

Use of land not only produces emissions from the land itself, but also determines other emissions in the future. This is particularly related to transport structure, urban and peri-urban structures and industry structures. These structures set important premises for future demand for transport, materials, resources and energy, in turn affecting GHG emissions. Many land use policy choices are difficult to reverse. They often govern land use and transport for many decades, and in some cases more than a hundred years ahead. This applies, for example, to the location of institutions many people visit, such as schools and hospitals, the construction of quays and ports, or the establishment of shopping centres outside of towns and cities. Placing such establishments outside existing built-up areas will result in increased transport demand, urban sprawl and decline of city centres. These trends are difficult to reverse. Land use and land development therefore place structural conditions on society's ability to transition towards low emissions. In other words, land use policy can lead to a high degree of both path dependency and irreversibility; see Box 3.3 on path dependency. Figure 6.1 illustrates the relationship between the use of land and marine areas and natural carbon sinks.

Figure 6.1 Relationship between use of land and marine areas and natural carbon sinks.
Development and degradation affect nature's ability to absorb and sequester carbon.

Source: The 2050 Climate Change Committee



6.2 Land use, nature and emissions

Preserving natural carbon sinks is essential to achieving the climate targets. Many habitats sequester large amounts of carbon. In Norway, a particularly large amount of carbon is stored in the soil and on the seabed. Habitats such as peatland, areas rich in organic soil and soft-bottom marine plains will give rise to emissions if the carbon sinks are disturbed. Nature can also remove atmospheric CO_2. Norway's forests absorb high levels of carbon, which is sequestered in living and dead trees and in the soil, although some carbon will also be released into the atmosphere again throughout the life cycle of trees or in the event of felling.

The IPCC recommends the conservation of between 30 and 50 per cent of the Earth's area on land, at sea and in freshwater as part of efforts to reduce GHG emissions and adapt to climate change. Although the figures cannot be transferred on a flat-rate basis to countries, regions or municipalities, the Committee believes that the IPCC's recommendation sends a clear message about the direction and level of ambition for land use management.

In December 2022, a new global agreement on nature was adopted. The Kunming-Montreal Global Biodiversity Framework (GBF) sets out 4 global goals for 2050 and 23 targets for 2030. Some of the most important targets are the effective conservation of at least 30 per cent of all terrestrial and inland water areas, and of marine and coastal areas, the restoration of at least 30 per cent of degraded ecosystems, the inclusion of all land in participatory and integrated spatial planning to halt the loss of nature, and to eliminate, phase out or reform incentives, including subsidies, that are harmful for biodiversity.

The goals of the GBF provide an important framework for climate policy. They govern which resources, in the form of land and natural resources, will be available for addressing the climate crisis. At the same time, the goals are important for achieving the climate targets due to natural carbon uptake and sequestration, and to ecosystem services as a key part of climate change adaptation. The GBF is part of the UN Convention on Biological Diversity (CBD), which entered into force in 1993. The purpose of the Convention is the conservation of biological diversity, the sustainable use of the components of biological diversity and the fair and equitable sharing of the benefits arising from the utilisation of genetic resources. The GBF and global goals are not legally binding, but all the parties have endorsed the framework and are expected to comply with it. Norway's efforts to implement the GBF will provide an important framework for climate policy towards 2050.

Just over 17 per cent of Norway's total land area, including Svalbard, is subject to some form of protection under the Nature Diversity Act. This protection is unevenly distributed between different ecosystems. To achieve the goals of the GBF, this must be increased. For forest and marine ecosystems in particular, the area awarded traditional protection is not sufficiently large. The extent of protection must be increased considerably in order to preserve carbon sinks in these ecosystems. The protection of peatland should also be increased due to the amount of carbon it sequesters.

Land conversion, land-use change and land fragmentation are the biggest threats to biodiversity in Norway (Norwegian Biodiversity Information Centre, 2021; Jakobsson & Pedersen, 2020). Biodiversity is greatest in low-lying areas. This is also where the competition is greatest from other parts of society, for the development of urban areas, infrastructure and the establishment of industry. The best agricultural and forestry areas are also found in low-lying, nutrient-rich areas and are under pressure from land degradation. It has been a political goal for many years to limit the loss of agricultural land. Although the trend has been slowed, large areas of agricultural land are still converted for other purposes every year (Ministry of Agriculture and Food, 2023a).

It is not only the ecological condition of an individual area that matters, but also its size and connection with other areas. Fragmented development can do greater damage than more concentrated development, even if the development itself covers an area of the same size, as it disturbs habitats and migration routes. Development can also have consequences far beyond the specific area that is being developed or cultivated. The different ecosystems are interconnected. If, for example, peatland is drained and cleared, it will affect how the water flows and is stored or not stored in the surrounding areas. Urban development is also important in this context, both in terms of preserving green structures and in relation to densification, so as to limit the pressure on areas outside the cities.

Benefits of nature: everything from living nature that contributes to human welfare is referred to as benefits of nature or ecosystem services. Includes everything from mushrooms and berries, to photosynthesis and flood mitigation, and recreational experiences in nature.

Some changes are irreversible and degrade the quality of land in the foreseeable future. Some ecosystems can take a very long time to build up, as can a good ecological condition. This applies, for example, to peatland, arable land and coral reefs. Many changes are difficult to reverse in a short-term perspective, and some qualities are lost permanently when they are lost. It is nonetheless possible to restore degraded ecosystems and natural assets, at least to a certain extent. However, this is often both expensive and difficult, and the outcomes are uncertain. It is usually both cheaper and better to avoid degrading ecosystems in the first place (IPBES, 2018).

Nature restoration could also be important in the transition to a low-emission society. One of the global goals of the GBF is to ensure that, by 2030, at least 30 per cent of areas of degraded terrestrial, inland water and marine and coastal ecosystems are under effective restoration. Based on our current knowledge, peatland restoration, which stops emissions, and measures to re-establish kelp forests, which provide higher carbon uptake and increased marine carbon sequestration, will be relevant measures in Norway. Other measures that may be relevant include more edge vegetation along rivers and around fields, and measures relating to forest ecosystems. Although measures to restore natural ecosystems have beneficial climate effects, they should first and foremost be implemented to improve the ecological condition of natural ecosystems. Such measures may also be relevant for climate adaptation, such as dealing with surface water runoff, or as protection against floods or landslides.

Many climate mitigation measures will affect the possibilities of halting loss of nature. This impact can be both positive and negative; cf. Figure 6.2. The IPCC and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) show that it is in particular climate action relating to renewable energy production and planting of new forests that are negative for nature, while measures relating to agriculture, such as dietary changes, reduced food waste and use of pasture, and the safeguarding of natural marine and terrestrial carbon sinks, are positive. Although there are some exceptions, the work of the IPCC and IPBES shows that the vast majority of measures to halt loss of nature are also positive for climate change.

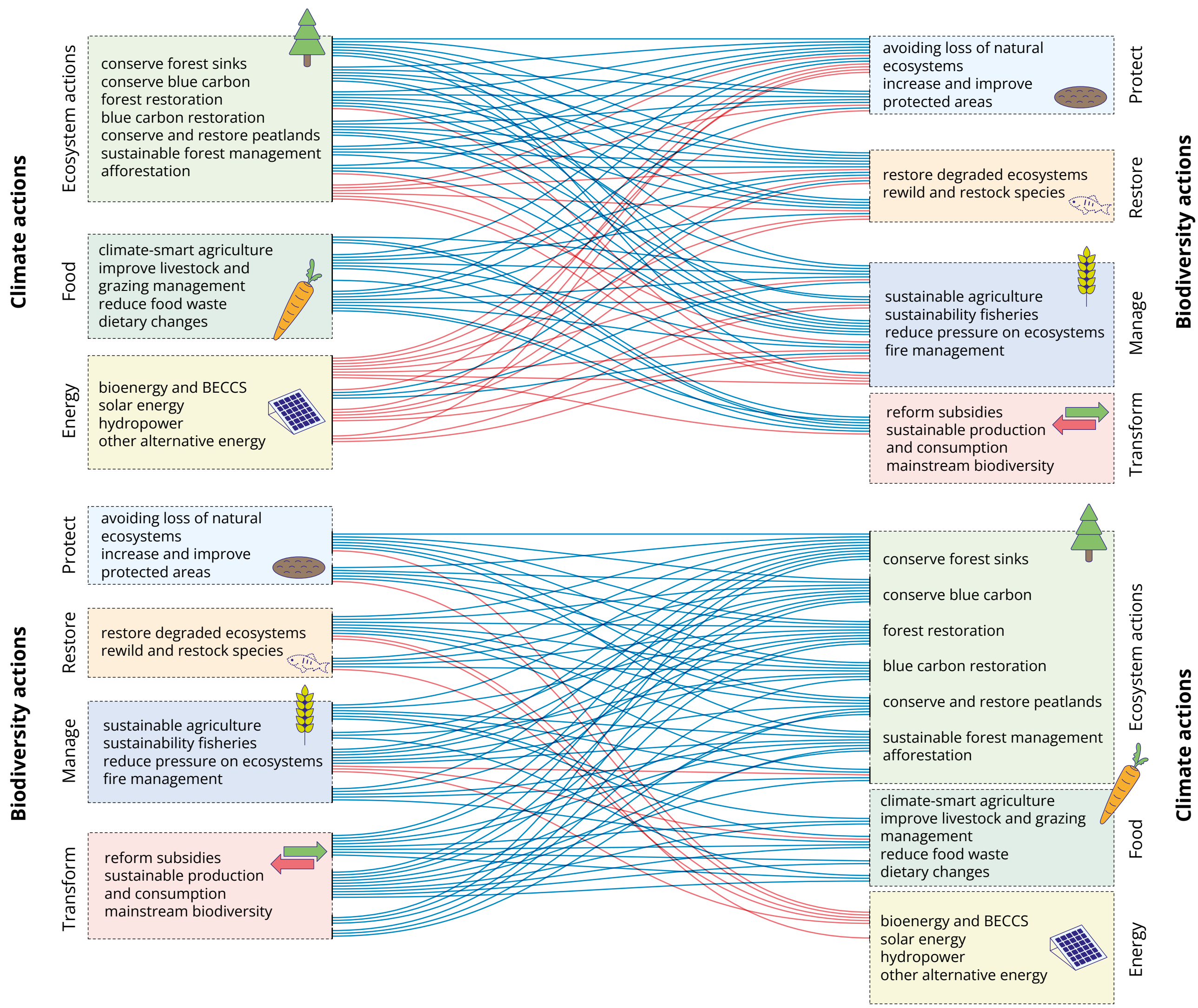


Figure 6.2 **Positive and negative correlations between climate action and nature conservation measures, and vice versa.**

Source: IPCC and IPBES (Pörtner et al., 2021)

Biomass: the total mass of living organisms in contexts where numbers of individuals are impractical, for example the number of trees in a forest. Biomass can also be used as a term for bioenergy; fuels derived from trees and plants, fertilisers, forest waste, peat etc.

In Norway, forests play an important role in the transition to a low-emission society because they produce biomass, absorb and sequester a high level of carbon, and cover large areas. In addition, forests are important for biodiversity. The Norwegian Nature Index for forests shows relatively low values for biodiversity (Norwegian Environment Agency, 2023d). Forest management in Norway has at times been characterised by a high level of conflict, with disagreement on the science of how forestry affects GHG emissions. The systems for obtaining an overview and knowledge of the natural assets of forest areas are the subject of extensive discussion. There is disagreement about how much old-growth forest there is in Norway, and on the development of these forests. The system for reporting, follow-up and control of felling has limitations. Among other things, there is no requirement for reporting the location of felling. To help limit felling in carbon-rich old-growth forests that are not formally protected, the Committee recommends introducing a reporting obligation at the national level for felling in old-growth forest areas. To ensure that forest policy is in line with the climate targets and goals of the GBF, the Committee recommends reviewing current legislation and policy instruments in the forestry sector and introducing systematic reporting of the location of felling.

6.3 Land is a limited resource

Terrestrial, coastal and marine areas fulfil many functions and are expected to meet many needs. Norway's land contributes to meeting society's needs when it comes to energy, housing, business and industry, ports, roads and railways, resources such as timber and minerals, areas for leisure and outdoor recreation. Sami cultural practice is also closely related to use of the land. Fisheries, aquaculture, forestry and agriculture are important for how terrestrial, coastal and marine areas are managed, and these areas are therefore closely linked to food production. Society relies on the natural qualities of the land and sea that ensure important ecosystem services.

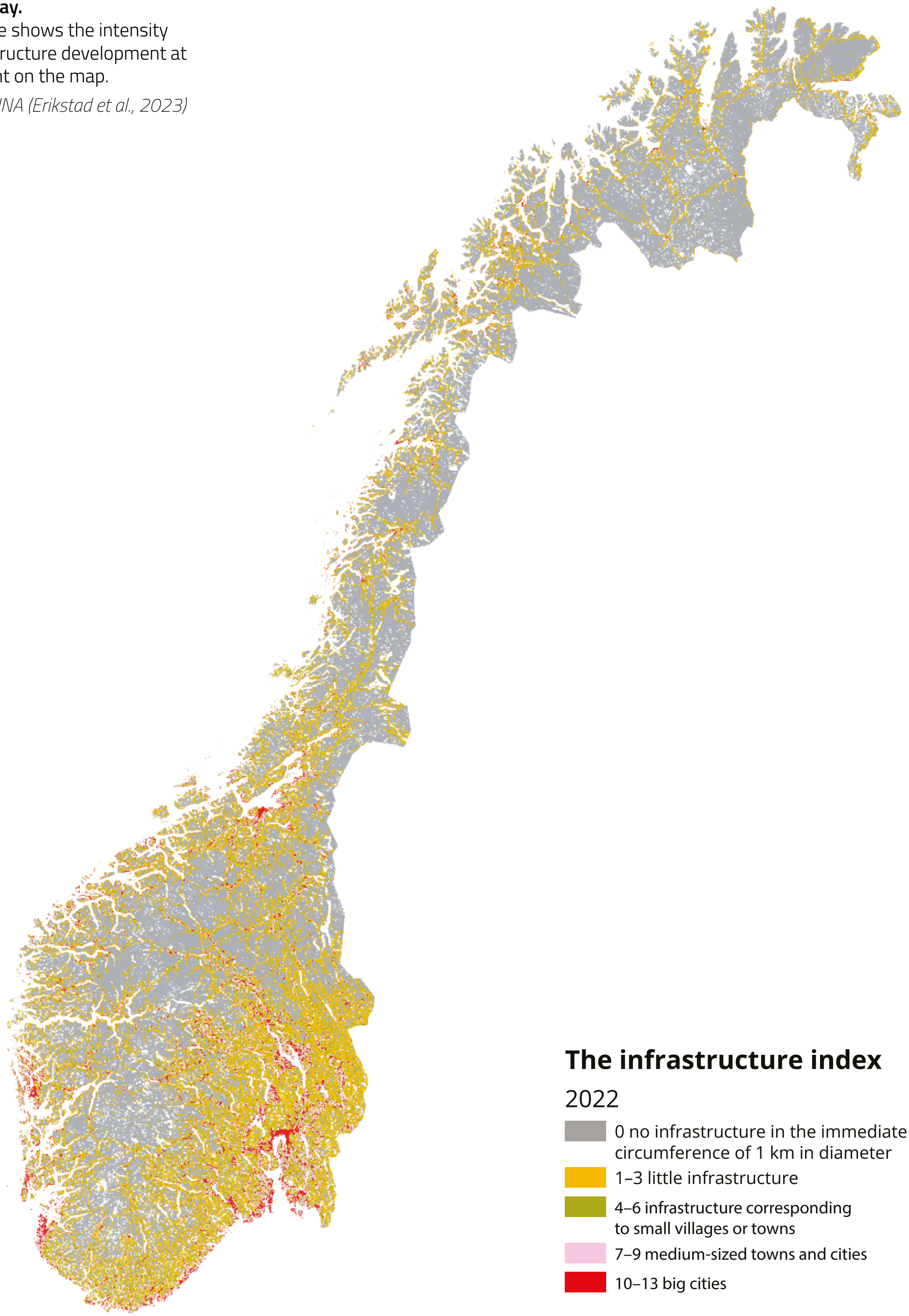
Ecosystem services: everything from living nature that contributes to human welfare is referred to as benefits of nature or ecosystem services. Includes everything from mushrooms and berries, to photosynthesis and flood mitigation, and recreational experiences in nature.

Urban development is important for emissions other than those relating to land use itself. Although towns and cities only cover a small proportion of Norway's land area, the concentration of jobs, people and buildings means that urban development is important for how other emissions and land use develop. Solutions for green mobility, circular economy in the form of reuse of buildings and materials, recreation and jobs in and between these areas must reflect the goal of Norway becoming a low-emission society.

Circular economy: value chains in which the products/materials are used in different ways for as long as possible and then reused in a cycle. In a circular economy, products must last as long as possible, be repaired, upgraded and reused to a greater extent. When the products cannot be reused, the waste can be recycled and used as raw materials in new production. In this way, we use the same resources several times and generate the least possible loss.

Land degradation in Norway has increased since 1990. From 1990 to 2019, over 1,500 square km of nature, pasture and cultivated land has been used for other purposes, corresponding to an average of about 50 square km per year. The two main drivers behind the degradation are buildings and roads (Norwegian Environment Agency et al., 2023). Figure 6.3 illustrates the intensity of infrastructure development on the Norwegian mainland.

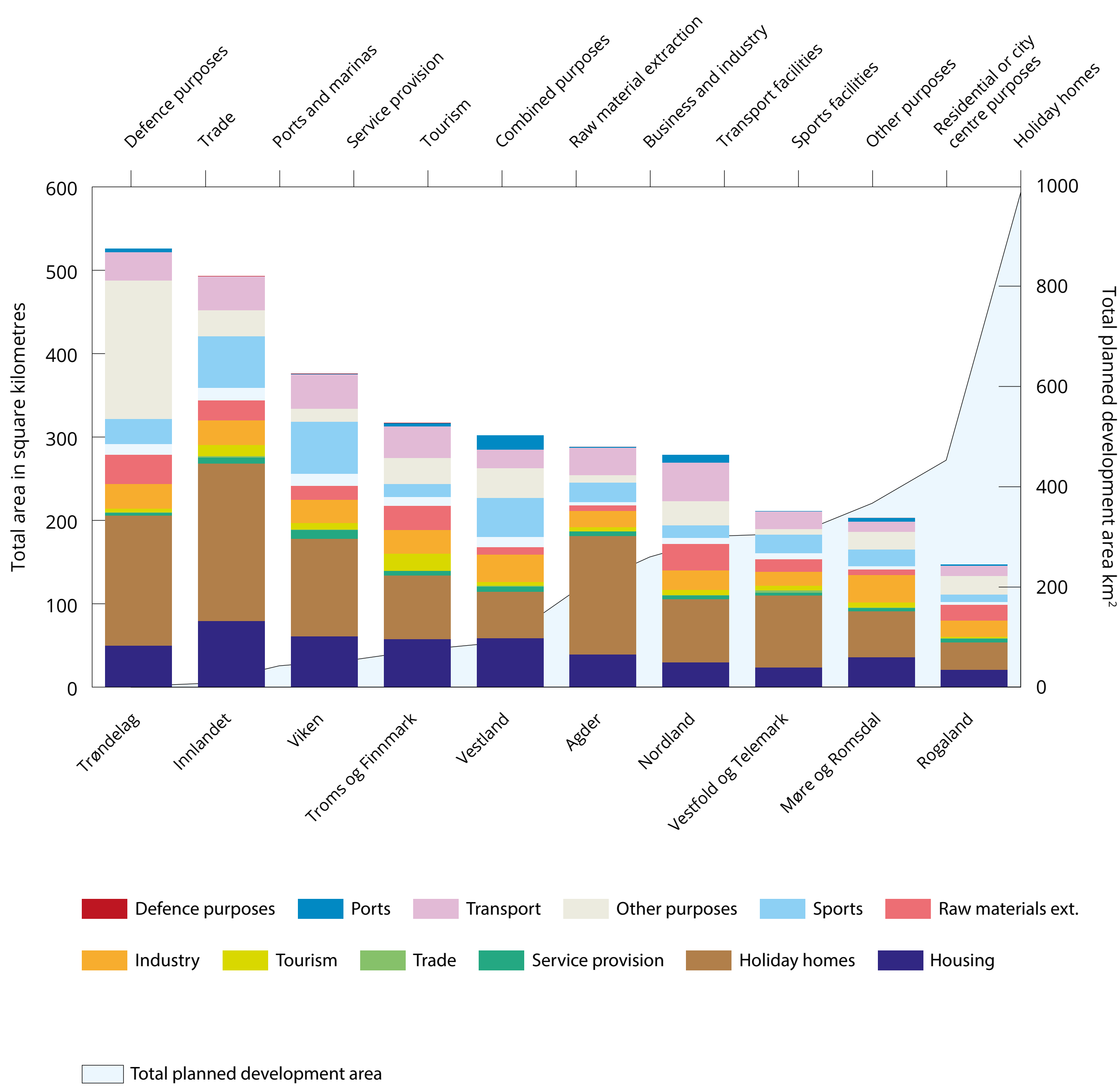
Figure 6.3 Infrastructure index for Norway.
The figure shows the intensity of infrastructure development at each point on the map.
Source: NINA (Erikstad et al., 2023)



The trend of increased degradation of nature has continued. Based on the plans currently adopted, the planned developed area in Norway for housing, holiday homes and commercial purposes is estimated to be 2,166 square km (Simensen et al., 2023). This does not include land for transport, sports facilities and 'other purposes' such as energy facilities. This planned developed area for residential, leisure and commercial purposes corresponds to an area the size of Vestfold county (2,168 sq. km), or almost 40 per cent of existing built-up areas. More than twice as much land has been set aside for holiday homes (987 sq. km) as for housing (453 sq. km). Figure 6.4 shows planned developed areas broken down by land use objective and county, and total planned developed area by land use objective at the national level.

Figure 6.4 Planned developed area in Norway. The bars show the total area covered by development plans broken down by land use objective and county. The graph behind shows the total area covered by development plans broken down by land use objective at the national level.

Source: NINA (Simensen et al., 2023).



Many areas subject to development plans are forest areas. Development is also planned on other types of land that are important for climate and nature, such as peatland; cf. Figure 6.5. This will reduce natural carbon sinks and carbon uptake going forward. It is therefore necessary to review these plans. All municipalities should revise the land use part of the municipal master plan and adopted zoning plans (older than five years), in order to remove areas allocated to various forms of development, but where the plan does not take necessary account of climate and environmental goals. Similarly, adopted transport projects that have not yet been implemented should be subject to a project review, so that the degradation of carbon-rich areas and valuable nature is significantly restricted.

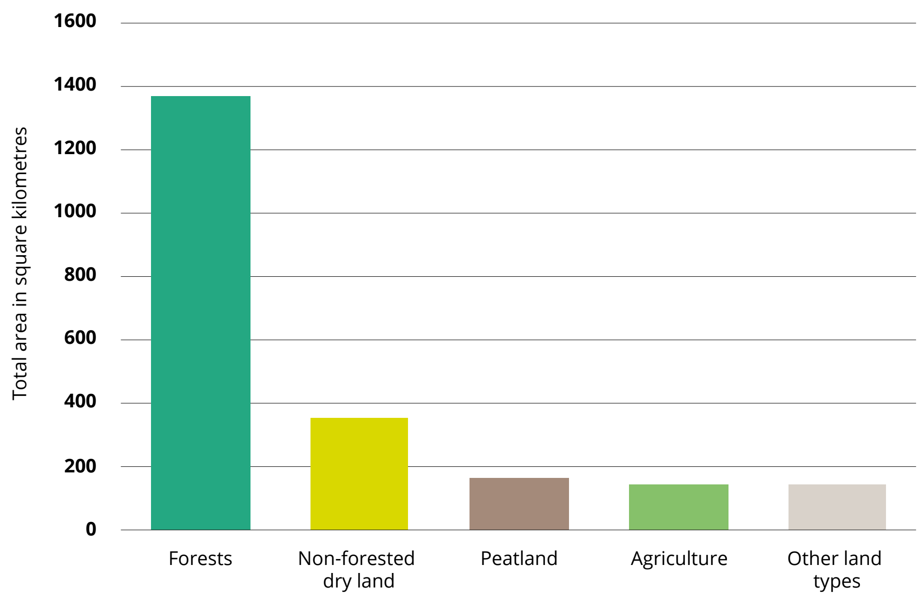


Figure 6.5 **Type of planned development areas for housing, holiday homes and industry.**

Source: NINA (Simensen et al., 2023).

Sami cultural practice is also closely linked to use of the land. This practice affects several different types of terrestrial, coastal and marine ecosystems and areas. Both reindeer herding and Sami traditions relating to fishing, harvesting and gathering in natural ecosystems are covered by Norway's international commitments on the rights of indigenous peoples. The Truth and Reconciliation Commission points out that pressure on traditional industries and the use of natural resources are a recurring challenge for Sami cultural practice, and also for Kven cultural practice. The Commission points out that a number of industrial projects in recent years have laid claim to areas used for traditional activities on land and at sea, for example in the form of mining, wind power development, power lines and aquaculture, and that the sum of these interventions has significant consequences for Sami and Kven cultural practice (Truth and Reconciliation Commission, 2023). Part of this is land use that may be linked to the transition to a low-emission society, such as renewable energy production and power grid development. The Truth and Reconciliation Commission also draws attention to the management of uncultivated land which has increasingly prioritised outdoor recreation and nature conservation interests at the expense of local custom-based use. The Commission believes that unresolved rights to land and water are an important cause of land use conflicts. It is crucial to take indigenous rights into account in the transition to a low-emission society. The Committee's assessments relating to Sami rights and the recommendations of the Truth and Reconciliation Commission are discussed in more detail in Chapter 4.

See Chapter 4 for a discussion the Committee's assessments relating to Sami rights and the recommendations of the Truth and Reconciliation Commission.

Our cultural landscape is affected by degradation and fragmented land use, including through the development of holiday homes, wind power plants, roads and other infrastructure. Many cultural landscapes, such as traditional pastures, meadows and heathlands, are important areas for biodiversity, carbon sequestration and cultural history. Avoiding development in such areas could contribute to achieving policy goals in cultural environmental protection and to preserving the agricultural resource base.

Land management requires a prioritisation between different needs. At present, the municipalities have extensive authority to make such prioritisations. Land management must, to a greater extent, be based on the fact that land is a limited resource, in order to avoid losing the assets this land represents. This could be natural assets, ecosystem services or cultural environmental values. Not all areas can be used for all purposes and different needs must be balanced against each other. Importance should also be placed on nature's intrinsic value, i.e. that nature should not only meet human needs, but also be a habitat for wildlife. Land management is thus also a moral issue.

Norway is an elongated country, and the perception of whether areas are under pressure, or that natural ecosystems are being degraded, can vary a great deal. Many areas appear to have more than enough land to cover all interests. In other places, it is more obvious that many stakeholders want to use the same areas for different activities that are not easily reconciled. The relationship between use of land locally and the global challenges of climate change and loss of nature is not always clear. Challenges will arise when local authorities have main responsibility for land use policy while being expected to take into account both global crises and local interests. It may be attractive for the individual municipality to develop non-built-up or natural areas to attract business or make it more affordable to build housing for the local population. At the same time, these areas could be important to nature. There are also several examples of land that is not used intensively but is still important for certain groups, where this use is not compatible with various forms of interventions and permanent installations. There are several examples of Sami reindeer herders having interests in the same area as companies looking to develop renewable energy, and that summer grazing for livestock such as cattle and sheep can create conflicts with holiday home development and tourism. This illustrates that land is a scarce resource and that different uses are sometimes difficult to reconcile.

In Norway, responsibility for terrestrial and coastal zone land use policy is highly decentralised. Authority is largely delegated to the municipalities, which are responsible for drawing up and adopting land use plans in accordance with the Planning and Building Act. The land use plan applies to terrestrial and coastal zone areas up to one nautical mile outside the baseline. The central government communicates expectations and guidelines for municipal and regional planning through various policy instruments, including national expectations for regional and municipal planning, central government planning guidelines, and objections under the Planning and Building Act, as well as through objectives and ambitions in specific fields, such as soil protection. Legislation for certain sectors, such as energy legislation, takes precedence or has an unclear link to the Planning and Building Act. The municipalities nevertheless have a high degree of authority to control land use development in Norway, with the exception of when the Government expropriates or applies a central government planning provision.

The decentralised responsibility for land use policy can make it more demanding to achieve national goals where land use policy is an important part of both the problem and the solution. Developments in individual municipalities are not necessarily decisive to achieving goals at the national level, but the sum of many decisions that do not pull in the right direction can make the achievement of national goals more demanding. Local self-government is enshrined in Article 49 of the Constitution, and aligning decisions with local interests is an important principle in the Norwegian public administration. The Committee considers it important that these principles form the basis for work on solutions. In the same way, there must also be recognition that the municipalities have a responsibility to contribute to achieving nationally adopted climate and nature goals. The municipalities have a responsibility to safeguard specific rights and obligations decided by national authorities in other areas, such as schools and primary health services. In the same way, national authorities can prescribe similar obligations in the areas of climate and nature. See Part D for the Committee's assessment of the role of municipalities.

See Part D for the Committee's assessment of the municipalities' role.

Part of the problem is that each municipality must meet a number of expectations both from its own residents, and from central and regional authorities, and national-level guidelines on the order of priority between these various goals are unclear. Some of the challenges in the current terrestrial and coastal zone land use situation are likely due to a diversity of governance signals from different authorities, and an unclear order of priority between these different signals, expectations and goals. To achieve a more sustainable land use policy, the national authorities must make the prioritisation between different goals and considerations more explicit for the municipalities. In this context, there is a need for a system for obtaining information about whether the municipalities' land use policy is aligned with national climate, nature and land use policy goals. A system that monitors land use changes in the municipalities over time, such as nature accounts and land use accounts, may be appropriate to this end.

Land cover accounting: an overview of what land resources are used for and changes in land use within a specific period of time.

Nature accounts: the main purpose of the accounts is to highlight the contribution of ecosystems to different parts of the national economy. The accounts can also be used to document ecosystems' contributions to human welfare, jobs and livelihoods and to report on the achievement of the UN Sustainable Development Goals.

Objections can be an important tool when municipalities need to prioritise between different interests. In recent years, the right of objection, which is intended to ensure that national climate and environmental considerations are taken into account in local land use planning, has been weakened and no longer functions in line with its intention under the Planning and Building Act. This has occurred in part due to central government guidelines stating that the number of objections should be reduced and that great importance should be placed on local self-government in assessments of whether an objection should be put forward. The guidelines on limiting the use of objections have made it more demanding to ensure that municipal plans contribute towards national climate and nature goals. Using objections more actively can provide guidance and direction to the municipalities on how their plans should contribute to achieving national climate and nature goals.

Another challenge is the relative strength of the individual municipality and development interests. Stakeholders seeking to develop an area may have more resources than a given municipality. This can make it difficult for the municipalities to resist a desire to develop land. A report by Menon shows that, in land use planning, a lack of expertise and capacity in the municipalities contributes to higher GHG emissions and more land degradation. This is particularly the case with land use changes implemented in medium-sized municipalities. The smallest municipalities have a weaker expert environment, but are not subject to as much pressure from developers, while the larger municipalities have stronger expert environments that can manage development interests (Pedersen et al., 2023). Ensuring that municipalities have sufficient resources to address such interests is therefore key. It is also important that the scientific basis for decisions is as robust as possible. More generally, the Committee is of the view that impact assessments should be commissioned by the public authorities and not by the project developer. This will help ensure independent impact assessments, but may also require resources in the municipality. Resources from the county authorities and guidance from the county governor can be very helpful in this respect. See also Part D of the report.

See also Part D.

The location of state-owned enterprises is also significant. These enterprises, such as hospitals, tend to have many employees and many visitors. Their location affects demand for transport, and sometimes also settlement patterns and land use development in general in the surrounding areas. Often, insufficient emphasis is placed on spillover effects for land use development when deciding the location of state-owned enterprises. In the transition to a low-emission society, the Committee is of the view that climate and environmental considerations must be a guiding factor in the location of state-owned enterprises.

The Committee believes that the Planning and Building Act should be strengthened so it can serve as a tool in the transition to a low-emission society. It is necessary to clarify and strengthen coordination between the Planning and Building Act and other legislation, and to strengthen the role of climate considerations in legislation, including in the regulations on impact assessments. The consultancy firm Holth & Winge conducted an assessment on behalf of the Committee that looks at the role of the Planning and Building Act on the road to a low-emission society (Holth & Winge AS, 2023). The report makes a number of proposals that could make the Act more appropriate as a policy instrument. The proposals are partly about clarifying the scope of action that already exists in the Act, and partly about strengthening climate considerations. The Committee recommends using these proposals as a basis for revising the Act. This is discussed further in Part D of the report.

The management systems for marine and terrestrial areas, respectively, are designed very differently. Since the first version of the Planning and Building Act entered into force in 1985, we have had a framework act for terrestrial and coastal zone land use planning, but there is no corresponding act that specifies a process for planning and coordinating the use of marine areas. This is perhaps due to fewer stakeholders expressing an interested in the same marine area, stronger sectoral interests, or that knowledge of the overall impacts of different uses of marine areas has been less widely discussed or less comprehensive than of terrestrial areas. Regardless of the reasons, Norway currently has a plan-based system for the coastal zone and terrestrial areas, and a measures-based system for marine areas. Figure 6.6 provides an overview of Norway's marine areas and the demarcations between the sea, coastal zone and land.

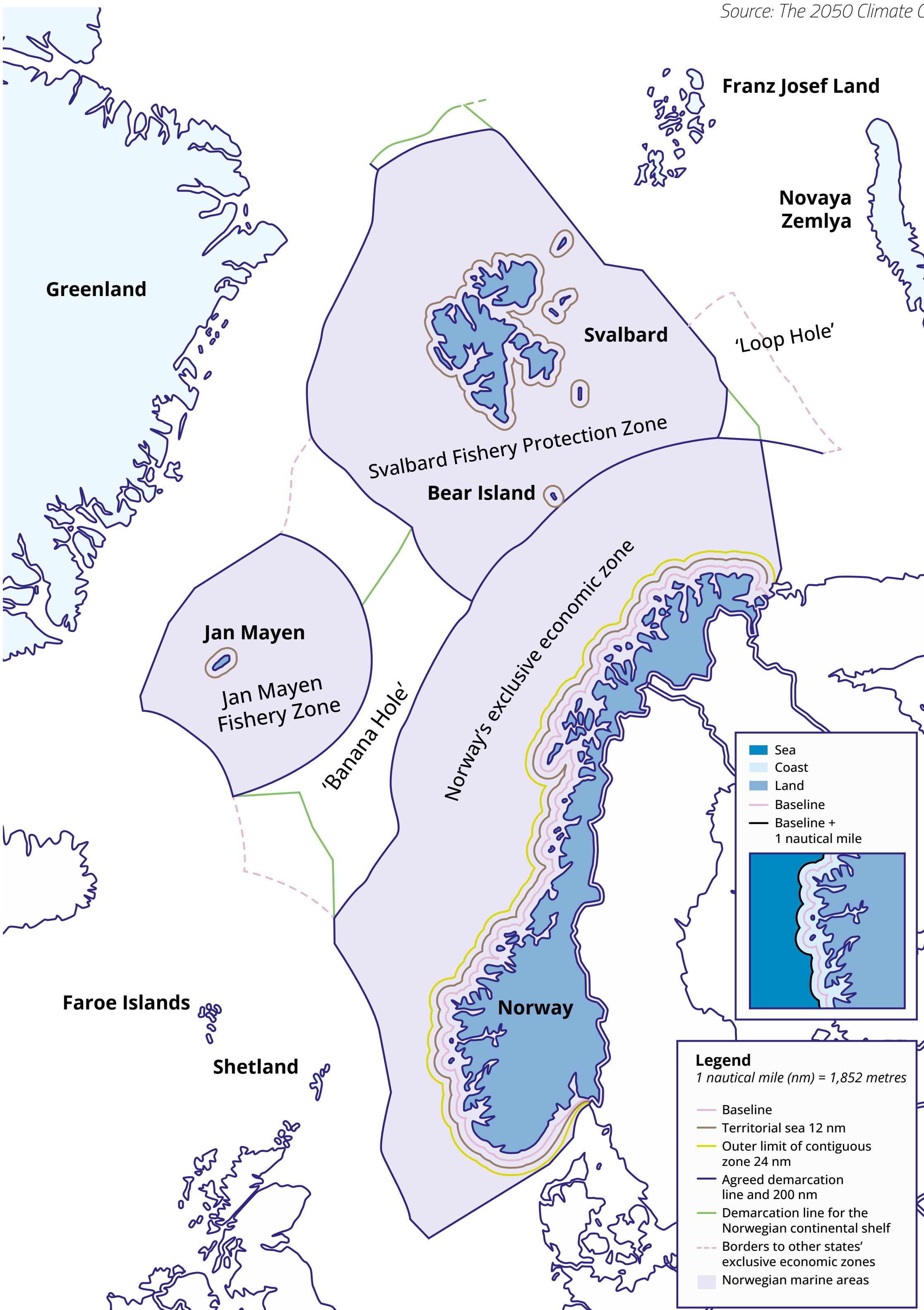
Management plans for marine areas: a tool for conducting comprehensive and ecosystem-based management of Norwegian marine areas.

The management plans for marine areas provide a common technical and political basis for marine management, but the use of marine areas is equally governed by sector-specific legislation designed based on specific interests. The management plans are an important tool towards a comprehensive, ecosystem-based management of Norwegian marine areas. Adopted management plans are to be regarded as instructions from the Storting to the Government (Fauchald, 2023a). Nevertheless, marine areas are largely managed based on individual sectors or individual measures and projects, such as fisheries and petroleum activities. Each sectoral authority is responsible for decision-making processes relating to their sector-specific legislation, meaning that different sectoral authorities are assigned responsibility and authority in their respective fields, but no one has a mandate or sufficient authority to ensure comprehensive marine management (Schütz & Johansen, 2023). Legislation that is important to safeguarding environmental considerations, such as the Nature Diversity Act and the Water Management Regulations, or to ensuring coordination, such as the Planning and Building Act, is not, or only partially, applicable to marine areas. As a result, interests other than the relevant sectoral interest are defined as 'secondary considerations' in each individual case. In many cases, the EU Environmental Impact Assessment (EIA) Directive and the Water Framework Directive have not been correctly implemented for marine areas (Fauchald, 2023a). In addition, not all the regulatory frameworks for impact assessments in individual sectors have been completed, and these are poorly coordinated with the rules on impact assessments provided under the Planning and Building Act.

See also discussion of marine carbon sinks in Chapter 11.

Knowledge of how the use of marine areas affects marine carbon sinks is inadequate. There are knowledge gaps concerning the location of the different types of carbon sinks, how carbon is absorbed and sequestered, and how different uses of marine areas affect the sinks (Hancke et al., 2022; Hjermann et al., 2023; Hobrak et al., 2023). We know, for example, little about how bottom trawling affects carbon sequestered in soft-bottom substrates (Løkkeborg et al., 2023). This knowledge should be strengthened. See also Chapter 11.

Figure 6.6 **Norwegian marine areas.**
The inset shows the demarcation between the sea, the coastal zone and the land.
Source: The 2050 Climate Change Committee



More comprehensive management of marine areas is essential in a situation with increased demand and need for conservation of marine areas. Ecosystem protection must be the guiding principle underlying marine management. The current management system is not designed to handle the increased use of marine areas Norway is heading towards. Fauchald points out that some of the regulations are unclear or not fully developed, and some parts of the regulations do not take into account that the activities to which the regulations apply may lead to disadvantages for other activities or nature (Fauchald, 2023a). The Committee is of the opinion that a more comprehensive policy and framework is needed to create well-considered plans for which marine areas can be used for what. This will help to align the different interests with one another, and stimulate good coexistence where possible. A system of binding, comprehensive marine spatial plans can facilitate this.

The EU also uses comprehensive marine spatial plans in the management of marine areas. The purpose of marine spatial planning in the EU and in other international organisations and different countries is to plan the management of human activities in marine areas within national jurisdiction outside the baselines, while protecting the marine ecosystems. The EU Marine Strategy Framework Directive from 2008 describes procedures for employing an ecosystem-based approach. The directive refers to the use of spatial protection measures as policy instruments for achieving a good environmental status of the EU's marine waters.

In 2014, the EU adopted the maritime spatial planning directive (Directive establishing a framework for maritime spatial, 2014), which provides guidelines for the development and use of marine areas through spatial plans. Its purpose is to see sectoral interests in context and contribute to achieving objectives within the EU's energy, transport and fisheries policies, good environmental condition and pollution prevention, while taking into account the climate adaptation of coastal and marine areas. The directive provides a framework for marine spatial planning with the aim of promoting maritime industries, sustainable development of marine areas and sustainable use of marine resources. The plans are designed to ensure conservation, protection and improvement of the environment, including climate resilience. It is especially important to achieve a good environmental condition, halt the loss of biodiversity and the degradation of ecosystems and reduce the risk of marine pollution. The directives are not considered to be EEA relevant and have therefore not been implemented in Norway.

EEA relevant: EU legislation that is defined as falling within the policy areas covered by the EEA Agreement.

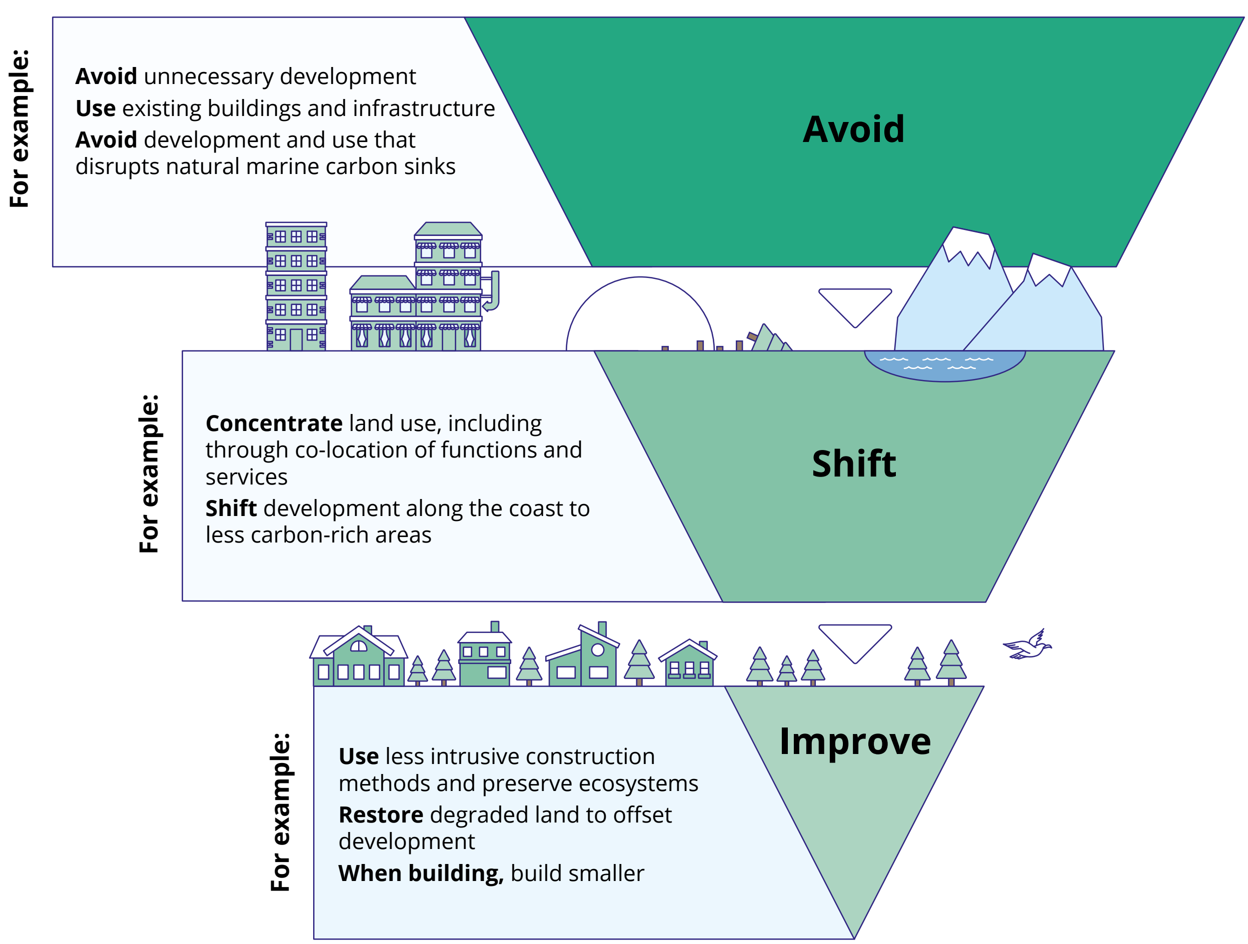
We need stronger governmental control of land use policy and marine spatial management. National authorities must provide clear guidelines for what type of use and of which areas should be prioritised, and that land degradation should be significantly restricted. There is therefore a need for changes in the management system for terrestrial, coastal zone and marine areas. These changes will apply to the central, regional and municipal authorities alike, and the cooperation and distribution of authority between them.

A national land use policy should take into account that the situation is different in different parts of the country. It must seek solutions to local, national and global problems. This means that the distribution of responsibility and authority between the different levels of governance and stakeholders is decisive to ensuring that land use policy addresses all these dimensions.

The framework *Avoid–Shift–Improve* (ASI) provides a useful order of priority that can also be applied to land use and marine spatial policy. Development in areas with natural ecosystems should be avoided. As a rule, all rezoning of land to be used for infrastructure, buildings, energy, business and so on should take place through the transformation and densification of existing built-up areas. If land degradation cannot be avoided, it must be limited as far as possible and used in areas with low carbon sequestration. A last resort is to compensate for degradation by restoring another site. Figure 6.7 illustrates how the framework can be applied to land use and marine spatial policy.

Figure 6.7 Framework for policy measures *Avoid-Shift-Improve* (UFF) in land use and marine spatial policy.
The figure shows various priorities and examples of how the priorities can guide policymaking. The examples are not exhaustive.

Source: The 2050 Climate Change Committee



The solutions for the climate crisis must be based on the resources that society has already taken into use. Lower consumption of resources, and better reuse and recycling of resources already in circulation, will ease the pressure on nature and land. The impact on nature from the extraction of minerals and metals to meet demand in the green transition will be limited if we can achieve a high degree of reuse, repurposing and recycling of such resources. A more circular economy is at the core of this development. This will help halt loss of nature and reduce GHG emissions, and must therefore form the basis for climate solutions.

Nature-based solutions: solutions inspired, copied or supported by nature to address the environmental, social and economic challenges facing society in a sustainable way. These can be measures that safeguard or restore the climate benefits of nature, and measures that use nature to increase GHG removal.

The EU has linked climate and nature policy in a way that Norway can learn from. The European Commission emphasises the importance of taking a comprehensive approach when proposing legislation and initiatives. The Commission wants to ensure that climate action is not detrimental to nature, and emphasises nature-based solutions that underpin nature's ability to sequester carbon. This is based on a clear intention to link climate and nature policy, even if this is not always easy in practice.

Policy development in the EU is relevant to Norway, including on topics that are not part of the EEA Agreement. The EU places considerable emphasis on developing policies across policy areas, and increasingly addresses the different areas in context. This means that policies in different fields affect each other. For land use policy, this applies, for example, to agriculture, forestry and nature management. Although many of the EU's policy areas are not implemented in Norway through the EEA Agreement, the political discussions and considerations, the knowledge base and developments in public opinion in the EU and member states form a backdrop for Norwegian policy development. In many ways, the format of EU policy challenges the way the EEA Agreement is structured. Norway is also more indirectly affected by the fact that the EU is Norway's most important trading partner, and that Norway is part of the single market. This means that many Norwegian companies that wish to export to the EU are dependent on aligning their activities with developments in the European market. This can also have spillover effects that affect nature and land in Norway.

Nature neutrality: net zero loss of nature by restoring as much land as is degraded. Unlike area neutrality, nature neutrality also indicates that the quality of nature and ecosystems must be sustained.

Land use neutrality: net zero loss of nature by restoring as much land as is degraded.

A goal of nature neutrality at the national or regional level can help clarify how Norwegian land use policy will contribute to reducing GHG emissions and halting the loss of nature. Such a goal will steer the location of new development projects towards already built-up areas, and towards avoiding further degradation of natural ecosystems. It will also highlight the need to compensate for the removal of natural ecosystems. Between 50 and 100 municipalities have already adopted a goal of area neutrality in one form or another for their own part. Whether, from a national perspective, such a target is most appropriate at regional or national level, and how marine areas should be included, should be considered in more detail.

6.4 Better mapping both on land and at sea

The Committee believes that better mapping of nature is needed as a basis for good spatial planning policy. This applies to both land and marine areas. A good overview of ecosystems, species and habitats is a prerequisite for a sustainable land use policy. Habitats throughout Norway that are important to natural diversity and climate resilience must be identified. Local assessments and national priorities must be based on thorough, objective data on natural assets.

There is a need for better regional and national overviews of existing and planned land use. The GHG accounts for emissions and removals from forestry and land use at the municipal level are published every five years. Municipal planning data are difficult to access, and difficult to compile at the national level. This makes it difficult to obtain an overview of the consequences for national climate and environmental targets, even though national figures for emissions and removals from forestry and land use are published each year. A national overview of planned development should therefore be prepared based on the municipalities' various plans. The overview should be updated annually. A national overview of annual actual land use changes must also be established. This should contain both mapped information and aggregated statistics, and be published each year. In general, the municipalities' tools and data sources used in land use planning should be kept up to date, for example by the municipalities submitting updated digital planning data to national databases. Strengthening nature management and climate change expertise among the municipal, county and central government authorities will help enable the municipalities to fulfil their role in the green transition.

Ecosystem accounting will be a useful tool at the national, regional and local level. Ecosystem accounts consist of both maps and accounting tables, and include land use accounts, the ecological condition of the areas and the ecosystem services they provide. The accounting must be based on the UN System of Environmental Economic Accounting, which is comprehensive and includes built-up areas, infrastructure, natural areas, agricultural areas and marine areas. Ecosystem accounts at the municipal level will contribute to comprehensive land use planning and an overview of rezoned areas where nature, climate and other societal goals are taken into account. Ecosystem accounts can identify areas for restoration, areas for ecological compensation (area banks), important biodiversity areas and areas of particular importance for carbon sequestration and nature-based solutions. Accounts that are repeated over time will show the overall effect of all land use management.

The work initiated on ecosystem and land use accounts is important, but not necessarily sufficient to ensure a sustainable land use policy. Ecosystem accounts can form a scientific basis for better land use policy, but better decision-making and reporting tools must be developed for local decision-making systems. These must be well aligned with other systems providing information about the areas and their use. The IPBES has pointed out that research relating to ecosystem valuation is not sufficiently used in policy development (IPBES, 2022). It is therefore crucial that, along with the development of the scientific basis, procedures and requirements are established for how such research should be incorporated into decision-making.

6.5 Use of a nature tax as a policy instrument

Various forms of nature taxes imposed on parties responsible for land degradation have been assessed several times. This is discussed in the Green Tax Commission's report (NOU 2015: 15), the Norwegian Environment Agency's report on a factual basis for the assessment of a tax on greenhouse gas emissions from land degradation (Norwegian Environment Agency, 2021), and most recently, in the Tax Committee's report (NOU 2022: 20). Reference is made to these reports for a description of nature taxes.

The idea behind such a tax is based on the recognition that land degradation is currently 'free', or very affordable, because the cost is not visible. It is society as a whole and stakeholders other than the developer that bear the costs of land degradation. The fact that land degradation is free therefore means that more natural areas are degraded than is beneficial to society as a whole.

A tax on land degradation will make it more expensive to degrade nature. The purpose of increasing the cost of land degradation is to limit such harmful practices, make the cost of degradation visible and ensure that the parties benefitting from the degradation also bear the cost of it in that particular area. If the tax is linked to GHG emissions from land degradation, the primary purpose is to limit emissions from the degradation by either changing the extent of the intervention or moving it to an area that will result in lower emissions. The effects will depend on how the tax is designed.

Determining the correct valuation of a natural area is very demanding. A tax on or other pricing of nature will not necessarily reflect the real cost to society of degrading an area. There are several reasons for this. Firstly, it is almost impossible to take into account the overall effects of all land use through a price per unit of land. Secondly, it is difficult to value the ecosystem services in a limited area in the context of the surrounding areas. Thirdly, it is uncertain what these services will mean in the future, and fourthly, it is not given that all user groups or functions have been identified. The same area can have different value for different people and groups. Furthermore, we do not have complete knowledge about the ecosystems and their functions. Nature also has an intrinsic value that goes beyond what is possible to put a price on. In other words, the price will have to be determined on an uncertain basis, without it being possible to assume that the price represents the actual loss caused by the degradation now and in the future. The effect of pricing will depend on the price level, and on whether it is differentiated for different types and categories of land. A price based on a discounted estimated value of an area also raises challenges relating to irreversible encroachments with permanent and unpredictable consequences in the future, and the correct discount rate in such cases.

There has been little discussion of a trading system as an instrument in land use policy. While a tax provides a predictable price, a land use trading system will ensure that the overall land use is kept within a predefined level. With credits that can be bought and sold in some form of market, different categories of land will possibly have to be divided into different markets with their own pricing to ensure that different areas are assigned different values.

The pricing of land use through credits or taxes will entail administrative costs, and these will increase in step with increasing consideration of differences in value between different categories of land. Assessing and establishing a system for pricing land will require resources in both local and central authorities, and many demanding evaluations and trade-offs will have to be made. It must, for example, be considered how the tax system should be set up, how different ownership and customary use of different areas should be dealt with, the consequences of applying the tax differently to different parties and how different land categories should be valued. Such a system will also increase the administrative costs for the parties wanting to use land.

Another approach to the cost of land degradation is to introduce a requirement that the developer must restore an equivalent area elsewhere (ecological compensation). This will increase the cost of land degradation because the developer will also have to bear the cost of restoring a similar area. It will also entail administrative costs relating to keeping track of the location of such restoration areas, determining what an 'equivalent area' would be and assessing whether the restoration has been satisfactorily carried out. It is not a given that all user groups will agree with the assessments of what constitutes an equivalent area, or that sufficient information about ecosystems is available to perform such an assessment on a sufficient basis. Nor is it a given that the restoration will achieve the desired ecosystem condition. Such an approach is based on the concept of area neutrality or nature neutrality for the individual development project. One municipality (Nordre Follo) and the construction organisation *Nye veier* have started using ecological compensation schemes. The calculation models are constantly being revised and improved. It will be possible for others to use these models and to learn from their experience.

The choice of policy instruments must support the standards that must be followed in order to reduce GHG emissions and halt the loss of nature. Introducing a tax on land degradation will signal that this is an action society accepts as long as it is paid for. A requirement to restore an equivalent area to the one being degraded signals that one area can be replaced by another. This is not sufficient to form a standard for society that will ensure the preservation of natural ecosystems.

In a low-emission society, the degradation of terrestrial, coastal and marine areas must be avoided. Limiting climate change and halting the loss of nature requires us to preserve natural carbon sinks and intact, interconnected ecosystems. Degraded areas must be restored, without this being a substitute for the degradation of other areas.

A system should be introduced whereby those who benefit from land degradation must pay for it. This can be done in several ways. Schemes such as implementing a tax on land degradation or other economic instruments, an order for compensatory measures or an obligation to pay for 'ecological compensation' can be considered. An important objective is to help ensure that land degradation to a greater extent takes place in areas other than valuable natural ecosystems. In addition, a ground rent on the use of nature and land should be further investigated, as proposed by the Tax Committee (NOU 2022: 20).

A tax on land degradation will not, on its own, ensure a sustainable land use policy in Norway. A tax or a requirement to restore an equivalent area could signal to society that land degradation should be limited, but in the Committee's opinion, it is not sufficient to achieve goals relating to climate and nature considerations in land use. Land use policy must incorporate considerations of both local and specific factors relating to the specific area, the surrounding area and for the individual ecosystem. Overall, this means that the Committee is of the view that a nature tax alone is not a suitable policy instrument to achieve sustainable land use policy.

Achieving the climate and nature goals requires an active, clear land use policy and the implementation of a number of different policy instruments. We need a comprehensive approach to land use policy and broad use of policy instruments, where a nature tax can be included as one of several elements.

6.6 The Committee's recommendations

The Committee is of the opinion that Norway's policy when to comes to land use and the use of coastal and marine areas is not adapted to the transition to a low-emission society nor the objectives of the Global Biodiversity Framework. This applies to the knowledge base, the management system and current policies. Land use has strong elements of path dependency and irreversibility, and addressing these challenges is crucial for Norway to become a low-emission society while halting the loss of nature. The Committee notes that land use policy has received more attention in recent years, but wishes to stress that it is urgent to implement measures that have an impact on land use development. Although there are still gaps in the knowledge base, it is necessary to implement new policies that change the course now, so as not to reinforce undesirable structures. The Committee therefore has the following recommendations:

- the national authorities must set a clear framework for the municipalities' responsibility in land use policy so that national climate and nature goals are achieved.
- base the national framework for local land use policy on the premise that land degradation must be substantially restricted.
- significantly increase the traditional protection for all ecosystems, especially the ocean, peatland and forests. To help limit logging in old-growth forests that are not formally protected, the Committee recommends introducing a reporting obligation at the national level for felling in old-growth forest areas.
- the Government should present an item to the Storting on a comprehensive national policy on land use and the use of coastal zone and marine areas. The item should highlight challenges and solutions relating to climate and nature, and be linked to a comprehensive approach that incorporates all interests in society. It should also assess how the goal of nature neutrality for Norway can be achieved, including the use of area banks. The Committee recommends presenting the item well in advance of the first climate and energy plan. See Chapter 21 for recommendations on climate and energy plans.
- review whether the application of current legislation and policy instruments in the forestry sector takes into account carbon uptake and sequestration and biodiversity.
- introduce a system whereby those who benefit from land degradation must pay for it.
- ensure that climate and environmental considerations, for example in relation to land use and generated transport needs, set the direction for decisions on the location of central government and county authorities.
- incorporate nature restoration as part of the transition process to achieve comprehensive, sustainable land use in a low-emission society. The Committee recommends that restoration should first and foremost be carried out to improve the ecological condition of natural ecosystems.

To achieve sustainable land use policy, it is necessary to review and revise laws and regulations. The Committee therefore has the following recommendations:

- strengthen consideration for climate and nature in the Planning and Building Act by reviewing and revising the legislation, while also considering the need to create links to other acts of law.
- establish clearer legal authority and control regimes in the Nature Diversity Act, the Planning and Building Act and the Forestry Act in order to safeguard ecosystems that are important from a climate and nature perspective.
- amend the Regulations on Impact Assessments to include a requirement that impact assessments are commissioned by the authorities and not by the project developer to ensure independent assessments.

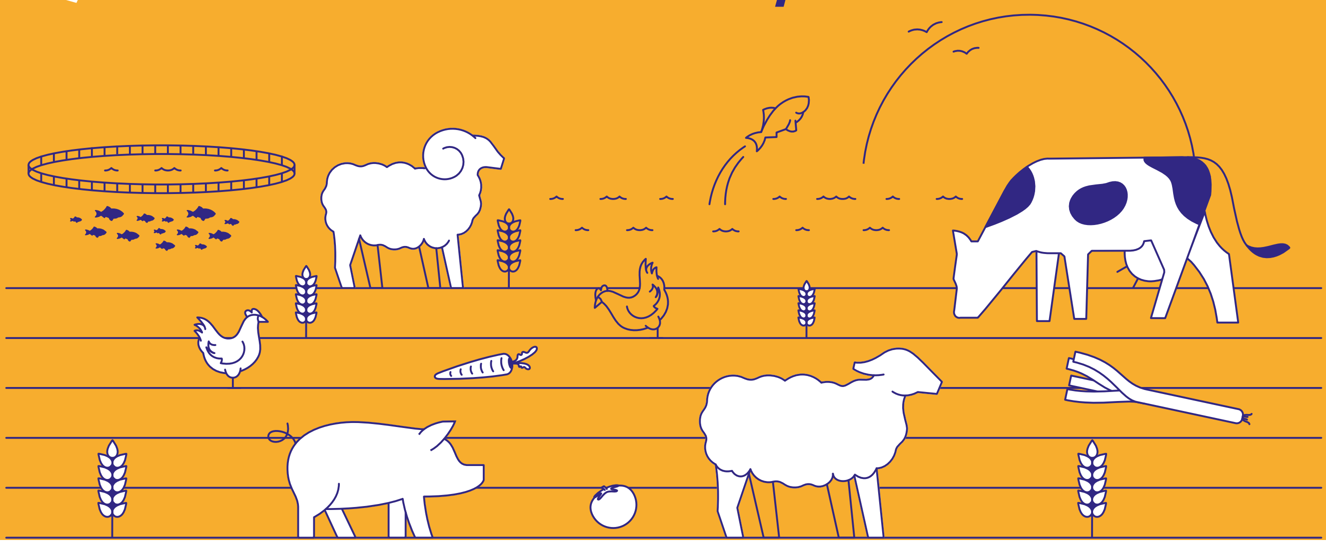
There is a need to further develop the systems for organising and monitoring land use policy in order to support good decision-making processes. The Committee therefore has the following recommendations:

- introduce a system for binding, comprehensive plans for the use of marine areas, where responsibility for the implementation and follow-up of the planning process is assigned to one competent authority. When considering new activities and initiatives, such as seabed mineral extraction and large-scale seaweed cultivation, account must be taken of knowledge gaps when it comes to the carbon emissions and removals that these activities may entail. Based on the precautionary principle, new and existing activities that could reduce marine biodiversity or the ocean's carbon sequestration potential should not be initiated until the impact of the activities has been mapped.
- national authorities should introduce a system for monitoring land use changes in the municipalities over time, and assess whether the municipalities' land use policy is in line with national climate, nature and land use policy goals. Nature and land use accounts can be useful tools to this end.
- develop the role of county authorities in land use policy and as a regional planning authority, for example by providing mobile resource teams for the municipalities. See Chapter 21 for recommendations relating to the role of country authorities.
- use objections actively to provide guidance and direction to the municipalities on how their plans should contribute to achieving national climate and nature goals.
- introduce a requirement for reviewing plans so that the municipalities revise the land use part of the municipal master plan and adopted zoning plans (older than five years), in order to remove areas allocated to various forms of development, but where the plan does not take necessary account of climate and environmental goals.
- introduce a requirement for reviewing adopted transport projects that have not been implemented, so that degradation of carbon-rich areas and valuable nature is significantly restricted. See also Chapter 8.

More knowledge and expertise is needed to ensure sustainable land management. The Committee therefore has the following recommendations:

- intensify work on mapping ecosystems and their condition, including systematic reporting of felling that has been carried out.
- conduct an analysis of overall planned land use in Norway, including land for transport and energy.
- enhance knowledge of the ocean's carbon sequestration potential.
- keep the municipalities' tools and data sources used in land use planning up to date. This applies to both planning and current land use tools. Nature accounts and area accounts should be established at the national, regional and local levels. This will form the basis for gaining an overview of annual land use changes. Both mapped information and aggregated statistics at the national level on land use changes should be published annually. The impact of land use changes on nature and ecosystem services must be identified and made public.
- strengthen expertise on nature and climate change in all municipalities, county authorities and with the county governor.

7 The food system



This chapter discusses the links between the Norwegian food system and greenhouse gas emissions, as well as the role of the food system in the low-emission society. Since the food system is varied, the measures that can bring emissions down will also vary. Overall, the food we eat produces greenhouse gas emissions and has an impact on nature.

7.1 Transformation of the food system is necessary

According to the IPCC, the global food system accounts for between 21 and 37 per cent of global GHG emissions (IPCC, 2019). The food system also affects land use, the use of freshwater and marine areas, biodiversity and other environmental parameters (van Oort et al., 2021). To achieve the goals of the Paris Agreement, changes must be made to the food system, including reducing food waste, increasing efficiency in production and dietary changes. This applies even if emissions from fossil fuels were to stop immediately (Clark et al., 2020).

The food system includes production, processing, distribution, trade, consumption and management of food waste. The food system is extensive and links factors such as the climate, the environment, infrastructure and institutions with the food value chain.

The Norwegian food system is varied, with many different forms of production, including products from aquaculture, fisheries and agricultural products such as vegetables, food grains, dairy products and meat. Very different framework conditions, regulations and government transfers apply to the different actors in the food system. For example, there is a big difference between the aquaculture sector, with high profits and the agricultural sector, with substantial government transfers, even though both sectors are heavily regulated.

For 2024, allocations for agriculture under the state budget are estimated to be close to NOK 27 billion (Ministry of Agriculture and Food, 2023b). Budget support for dairy and meat producers makes up an estimated three quarters of the allocation of NOK 27 billion, while the remainder is support for grain, vegetable, fruit and berries, potato, egg and wool producers. Market price support, i.e. trade policy support to restrict import competition or promote exports, comes in addition. In the 2023 National Budget, this was estimated at NOK 9.1 billion in 2021. Several official studies have previously recommended measures that can reduce emissions from food production, especially in the agricultural sector (NOU 2015: 15, NOU 2022: 20).

The production of different foods generates different levels of GHG emissions and has different impacts on nature. Meat from cattle and sheep, for example, generates higher GHG emissions than other types of meat such as pork and chicken. Animal-source foods, including dairy products and eggs, generally produce higher emissions than plant-based foods. Figure 7.1 provides a global representation of emissions from various types of food. The figures reflect emissions throughout the value chain, in different countries and with different production methods. All of the figures are based on published studies and provide a good overall indication of the spread in emissions. The figure also illustrates the substantial differences in emissions associated with the production of a product (Ritchie, 2020; Poore & Nemecek, 2018).

Food production also plays a large role in Norway's GHG emissions. The agricultural sector accounts for 9.5 per cent of Norway's overall GHG emissions; see Chapter 3 for more details. Emissions from energy consumption for farm buildings, tractors and other equipment come in addition, as do emissions from energy consumption for fishing fleets and energy consumption in the aquaculture sector. GHG emissions in the food system also come from the land that is cultivated and used for grazing, fisheries and aquaculture, transport, processing and distribution, and from waste.

See breakdown of Norway's GHG emissions in Chapter 3.

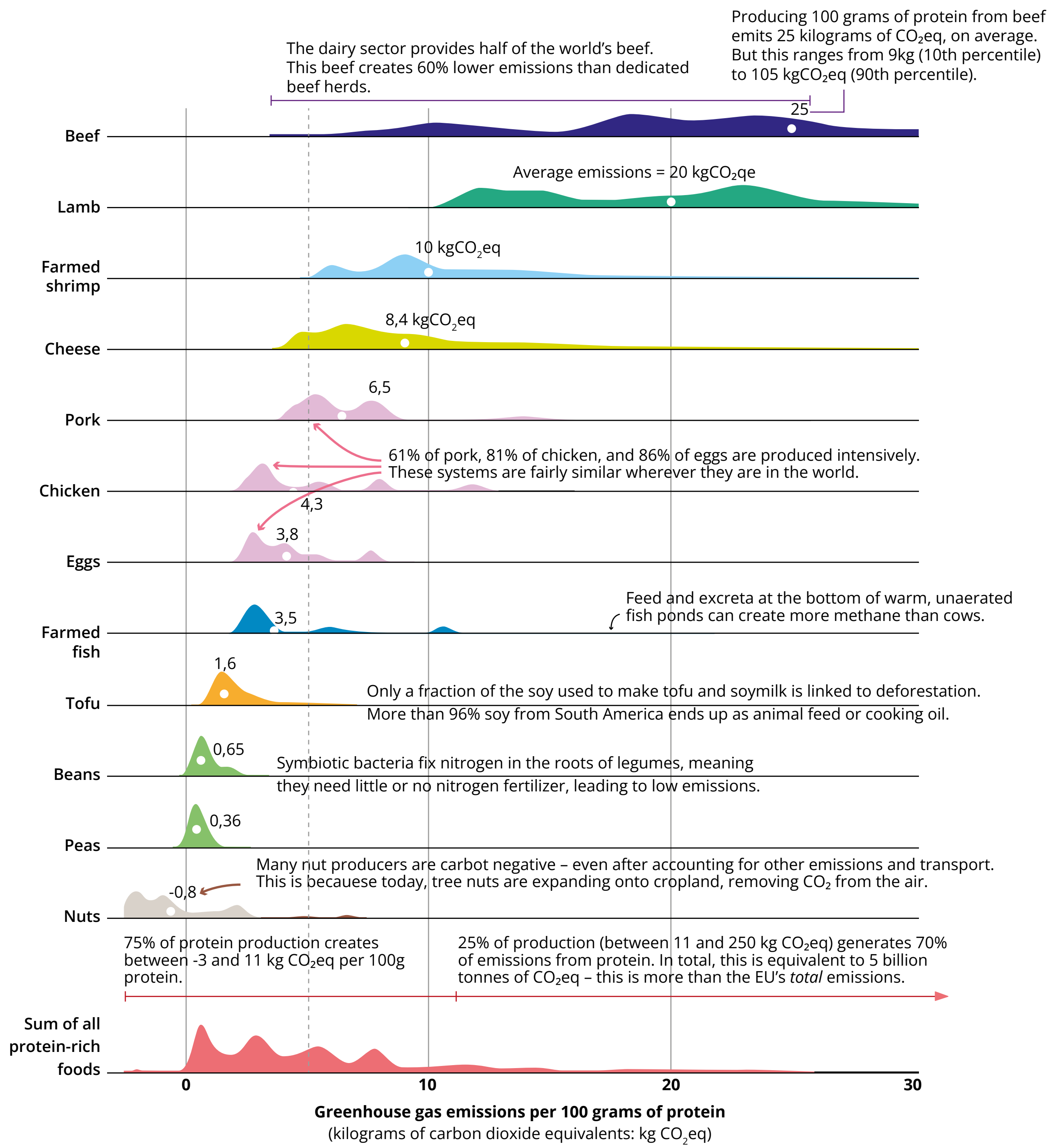


Figure 7.1 **Greenhouse gas emissions for different foods.**
Figures from 38,700 farms in 119 different countries. The entire value chain.
Source: Ritchie (2020), with figures from Poore & Nemecek (2018)

The Norwegian diet generates emissions from the food systems in Norway and in other countries. Norwegian food consumption is determined by a number of factors, including preferences, habits and traditions, availability, price, advertising and various types of dietary information. All types of food production lead to GHG emissions, but, in line with international figures, the highest emissions in Norway come from meat production from cattle and sheep, as illustrated in Figure 7.2. The figure shows GHG emissions from the production of a range of Norwegian food raw materials (Bakken et al., 2023; Johansen et al., 2022). There is uncertainty associated with such estimates, and they will depend on which delimitations and assumptions are made.

An increasing share of the Norwegian population have said they would like to eat more plant-based food, but this has had little effect on overall consumption. An overview from the Norwegian Directorate of Health shows that the consumption of cereals, fish and seafood has decreased over time. Vegetable consumption has increased in recent years, but meat consumption has increased more. Chicken accounts for a very large part of this increase. Fish consumption is significantly lower than meat consumption (Directorate of Health, 2022). Other sources also show increased meat consumption. Animalia's calculations show that, in real terms, meat consumption per capita is higher than both 10 and 20 years ago (Animalia, 2022). Although meat consumption is increasing, research suggests that more people are opting for plant-based diets. Different studies indicate slightly different trends in Norwegian food patterns. In Ipsos's Norske Spisefakta 2022 survey, about 11 per cent of the respondents state that they are vegetarians, vegans, pescatarians or flexitarians (Ipsos, 2022), and the same survey for 2018 shows a strong increase in the proportion of respondents interested in vegetarian food (Ministry of Agriculture and Food, 2021). In another survey conducted by Ipsos in 2021, 8 per cent state that they are vegetarians or vegans, an increase of four percentage points from the previous survey in 2019 (Bymag, 2021). The proportion who stated that they limit their meat intake was 23 per cent, also an increase. In a report by the Norwegian Institute of Public Health (FHI), more than 60 per cent state that they have changed their diet over the past three years towards a more sustainable and environmentally friendly diet (Abel & Totland, 2021). In the same report, 10 per cent state that they have a plant-based diet (vegan, vegetarian or flexitarian diet). It is not a goal to stop people from eating meat altogether, but emissions from food production can be reduced if it becomes easier to reduce meat consumption, enabling consumption and production to be scaled down. For some consumers, there are likely to be significant barriers to such a change. The regulation of the various industries affects the prices consumers face, and relative price differences between different foods can be a barrier to change.

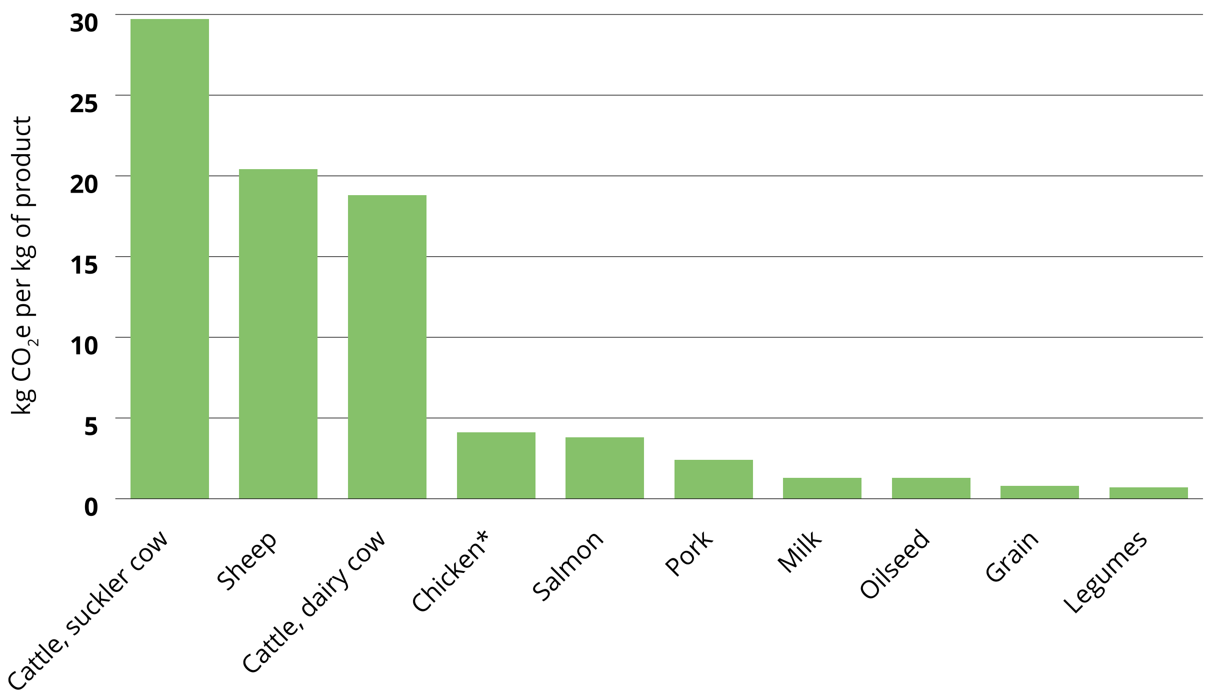


Figure 7.2 Greenhouse gas emissions from the production of Norwegian food raw materials calculated from the 'cradle' to the farm gate.
[1] Chicken: from raw material to slaughtered.
Source: Bakken (2023) and Johansen (2022)

The Nordic Nutrition Recommendations (NNR) were updated in summer 2023. The recommendations are science-based and will be used in the Nordic and Baltic countries to revise national dietary guidelines. In addition to the health effects of food, the impact of food on the environment has also been assessed for the first time. The recommended amount of red meat has been reduced, and NRR now recommend a predominantly plant-based diet with plenty of vegetables, fruits, berries, legumes, potatoes and whole grains. They recommend an abundant intake of fish and nuts and a moderate intake of low-fat dairy products. The new NNR recommendations are less concerned with saturated fat than before and more with the quality of fat and the type of food we eat. The Nordic recommendations will lay the foundation for the Norwegian recommendations, which are scheduled to be launched in spring 2024 (Norwegian Directorate of Health, 2023).

The Norwegian food system must be involved in the transition to a low-emission society. In the Committee's opinion, the food system in a low-emission society should contribute to achieving several societal goals, including relating to food security, health, settlement, regional policy and employment. Policy objectives throughout the food system must be based on Norway becoming a low-emission society. A sensible transition involves gradual changes, and decisions made today will have a major impact on the food system in 2050. To avoid the different goals undermining one another, it is important that they are adjusted and adapted in relation to how they affect the achievement of other goals. Policy measures may be aimed at influencing both the production and consumption of food. When assessing whether different national initiatives will have the intended effect, it must be considered what adaptations they give rise to, both nationally and internationally.

According to the UN, sustainable food systems must ensure food security and good nutrition for all, and safeguard the economic, social and environmental basis for food security and nutrition for future generations. The UN defines food security as existing when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food to meet dietary needs for a productive and healthy life. Food security is thus about more than being self-sufficient, and it is important that Norway contributes to global food production and food security, and that the security of supply of imported foods is ensured.

Food security is also reflected in the Paris Agreement. The preamble to the agreement recognises that ensuring food security and ending hunger is a fundamental priority. It also points out that food production systems are particularly vulnerable to the harmful effects of climate change. The message is that GHG emissions must be reduced to ensure food production globally.

Self-sufficiency is an important element of Norwegian food security. Norway has a food self-sufficiency rate of about 46 per cent in terms of energy, which means that we produce about 46 per cent of the food we eat. If corrected for feed import, the self-sufficiency rate is 40 per cent (Directorate of Health, 2022). Coverage is a measure of the amount of food a country produces as a share of energy consumption. Norway's coverage rate is about 90 per cent. The feed-corrected coverage rate is close to 86 per cent. The high coverage is due to our substantial production of fish. Norway is among the world's largest net exporters of food, primarily in the form of proteins (NOU 2015: 1, 2015).

Agriculture, the aquaculture industry and fisheries all depend on imported input factors. Key imported input factors are feed, fertiliser raw materials, pesticides, medicines and feed ingredients for both agriculture and aquaculture. Equipment, spare parts, machinery and fuel are other input factors. Norway also uses a great deal of foreign seasonal workers. We also import a high proportion of the food we consume. The Norwegian food system therefore also contributes to environmental impacts and emissions in other countries. In a potential crisis situation without well-functioning trade, problems will arise in all sectors, but these are unlikely to be greater for Norway than most other countries. In a crisis situation where imports are severely restricted, it is possible to cover large parts of Norway's food needs by making extensive changes to what we eat.

The Committee assumes that, in a low-emission society, where virtually all emissions have been eliminated for good, there will still be emissions associated with food production. It is not possible to remove all emissions associated with biological processes from food production, but they can be reduced by changing how and what is produced. Reducing emissions in the food system therefore involves both the use of low-emission technology, production changes and behavioural changes.

There is a complex relationship between GHG emissions and consumer preferences, food production and all the stages between. We need more knowledge about GHG emissions from the Norwegian food system, including information about how consumption and the organisation of distribution, wholesale, further processing and primary production affect GHG emissions at various stages.

Climate change can in itself create challenges for the food system. Climate change is expected to lead to more precipitation and more frequent and heavier rainstorms in Norway, as seen in August 2023. Precipitation patterns will become more unpredictable. Climate change poses challenges when it comes to spring farming and difficult harvest conditions in many areas. However, higher temperatures can also lead to more drought, such as in the summer of 2018. A large share of food in Norway is imported, and many countries in southern Europe have been affected by drought and crop failure. Despite these challenges, Norwegian food production may be less affected by the climate crisis than many other countries. Although higher temperatures can lead to a longer growing season, the overall precipitation pattern is likely to lead to greater challenges.

Climate change is therefore of double significance to food production. Food systems both nationally and internationally cause GHG emissions and loss of nature, thereby affecting climate change. Climate change in itself poses challenges for production. The physical climate risk of more extreme weather, such as torrential rain, higher sea levels, wind and drought, can mean changed production conditions, making robust value chains even more crucial.

See Chapter 3 for a discussion of Norway's climate goals.

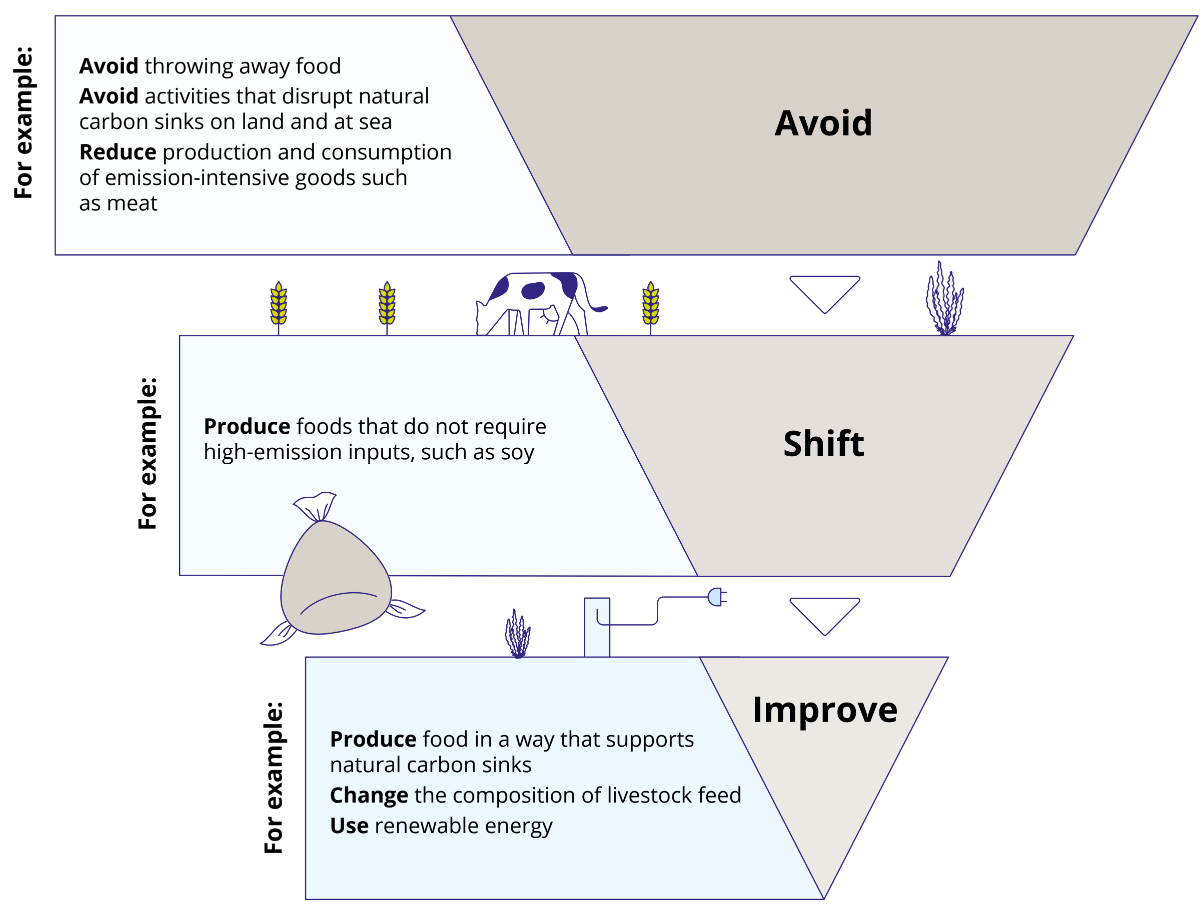
Emission accounts: an overview that includes all emissions and removals of greenhouse gases within a country's borders. The main gases are CO_2, methane (CH4) and nitrous oxide (N_2O), but also other gases such as fluorinated gases are considered greenhouse gases and included in Norway's emission accounts.

Emissions from the food system must be reduced from the current level. Although the food system in a low-emission society leads to some emissions, these emissions must also be limited. To become a low-emission society, emissions in Norway as a whole must be reduced by 90–95 per cent compared with 1990 levels, or to between 2.5 and 5 million tonnes of CO_2e; cf. Chapter 3. Overall emissions from the agricultural sector in the emission accounts, which do not include e.g. fuel, heating of buildings and land use change, amounted to 4.6 million tonnes of CO_2e in 2022. This is a decrease of about 7 per cent since 1990. During the same period, the Norwegian population has increased by 30 per cent, while agricultural production has increased by around 20 per cent. This means that emissions from production have decreased, partly due to genetic and agronomic improvements resulting in more crops per acre and higher production per animal. The central government and agricultural organisations have signed a letter of intent on an overall reduction of emissions and an increase in removals from agriculture of at least 5 million tonnes of CO_2e accumulated over the period 2021–2030, i.e. 0.5 million tonnes per year. The agreement is divided into three parts, where agriculture is responsible for reductions in emissions and removals, and the central government is responsible for work on consumption changes that may indirectly lead to reductions and for rules on how the agreement must be followed up and how measures should be recognised in the climate accounts (Ministry of Climate and Environment, 2022).

The European Scientific Advisory Board on Climate Change expects a significant reduction in emissions of GHGs other than CO_2 in the EU. Some of the trajectories the Advisory Board has looked at show a halving of demand for food from ruminants. All scenarios show significant reductions in the use of mineral fertilisers and thus in nitrous oxide emissions (European Scientific Advisory Board on Climate Change, 2023).

All parts of the food system must be adapted to a low-emission society, including production, transport, processing, consumption and waste management. In order for Norway to become a low-emission society, emissions from fisheries, aquaculture and agriculture must be reduced, along with emissions associated with the transport, storage, processing and discarding of food. The Norwegian Environment Agency's analyses show that measures on the demand side (food consumption) that, in turn, lead to changes on the production side, are the measures that can lead to the greatest emission reductions in the agricultural sector. Dietary changes and reduced food waste will make a particular contribution (Norwegian Environment Agency, 2023c). As regards fisheries and aquaculture, the Agency points out that electrification of vessels or use of emission-free fuel such as ammonia or hydrogen is a key policy measure. Figure 7.3 shows how the framework *Avoid–Shift–Improve* (ASI) can be applied to the food system. The examples are not exhaustive.

Figure 7.3 Framework for policy measures *Avoid-Shift-Improve* (ASI) in the food system.
The figure shows various priorities and examples of how the priorities can guide policymaking. The examples are not exhaustive.
Source: The 2050 Climate Change Committee



The Committee assumes that fossil emissions in the food system must be completely eliminated. This means that all processes that are currently powered by fossil energy must be restructured to become zero-emission. This includes transport, the operation of fishing vessels and agricultural machinery, and heating.

GHG emissions from biological processes must also be reduced. Scaling down high-emission production, improving production methods, developing technology, and breeding and genetic engineering will reduce emissions. Over time, emissions from biological processes in agriculture have decreased as a result of efficiency and genetic improvements, both in livestock and crop production. The reduction potential is still great, but experience shows that it takes time.

Climate footprint: a concept often used to indicate the amount of greenhouse gases emitted from an activity, an organisation or a product, including emissions from the inputs needed to perform the activity, run the organisation or make the product.

A reduction in the production of red meat must be made without increasing imports. If dairy and meat production is unilaterally reduced in Norway, without consumers reducing their consumption, it will lead to carbon leakage and increase the risk of Norway's overall climate footprint from food consumption becoming larger. This is not desirable, and a reduction in emissions in the form of restructuring of high-emission production should take place without increasing imports of the same goods. When the Norwegian authorities consider measures for lowering emissions from the food system, they must therefore consider the development among both producers and consumers.

Agricultural policy must be designed in way that exploits grass resources and rough grazing and safeguards cultural landscapes. Dairy and meat production should primarily be reduced in areas of the country that are suitable for grain and vegetable production, but the production of food plants should be encouraged wherever growth conditions allow. Furthermore, food production should be geared to local conditions so that food plants are primarily grown where possible, while ruminant production takes place where there are no alternatives to grass production.

The transition to low-emission agriculture is taking place at the same time as other major changes in the agricultural sector. From 2034, dairy production is required to take place in loose housing. The average age of Norwegian farmers is high, and many will retire in the next few decades, without there necessarily being anyone to continue running their farms. A changed climate could also give rise to challenges that affect agriculture. Together, these factors could lead to further structural changes and fewer and larger farms, regardless of the transition to a low-emission society. Such a development may make it more difficult to preserve both the biodiversity that depends on grazing and swath harvesting and dynamic rural communities in many parts of the country. In addition, arable land may be lost. At the same time, it emphasises the importance of setting a clear path for agriculture towards the low-emission society now, so as to avoid sudden policy changes in the future and help prevent inevitable changes in agriculture from being implemented in a way that makes it more difficult to achieve the climate goals.

The current agricultural management system in Norway should be further developed to better stimulate the transition to low emissions in the sector. The sector is characterised by many objectives, many support schemes and extensive regulation. Clear management is needed to ensure a good transition that also safeguards other goals for agriculture. The pathway towards low emissions can also provide many opportunities in communities across Norway relating to local food production. Seen as a whole, trade policy, tariff protection, subsidies, the Basic Agricultural Agreement and landscape protection should be aligned so that they support the transition to low-emission agriculture without the transition being cancelled out by food imports with a higher climate footprint.

There is considerable variation in GHG emissions from the production of Norwegian seafood. Different types of seafood production generate different levels of GHG emissions, affecting nature and the environment in different ways. The approach to reducing the environmental impact of the different products varies accordingly (SINTEF, 2020).

Biomass: the total mass of living organisms in contexts where numbers of individuals are impractical, for example the number of trees in a forest. Biomass can also be used as a term for bioenergy; fuels derived from trees and plants, fertilisers, forest waste, peat etc.

Ecosystem: a more or less well-defined, uniform natural system in which communities of plants, animals, fungi and microorganisms function in interaction with each other and with the non-living environment.

Recent decades have seen strong production growth in the aquaculture industry. Feed imports from abroad have increased in step with this growth. This leads to GHG emissions in other countries, while transport of the feed imported to Norway also generates emissions here. At the same time as the industry has grown, there have been problems with high mortality rates, salmon lice and diseases. These challenges have resulted in poorer feed utilisation, increased need for treatment with the use of service and well boats, and production of pharmaceuticals and cleaner fish used to treat salmon lice. This results in higher energy consumption. Increased mortality rates leads to poor feed utilisation because the feed is produced and used for more fish than are harvested. Furthermore, it is uncertain how overfeeding, waste and biomass discharged from the cages and into the sea affect ecosystems and carbon sinks in the areas around the cages.

Emissions from the aquaculture sector must be reduced. It is essential that the industry switches to feed that generates lower GHG emissions. Norway is a major exporter of farmed fish and a major importer of fish feed. The highest GHG emissions in the aquaculture industry are related to feed imports. Producing low-emission feed for the aquaculture industry and for animal husbandry will therefore bring about global climate benefits. Improved utilisation of the entire fish (including by-products), less air transport and increased use of renewable energy sources in transport and the supply chain are also potential emission reduction measures.

In the same way as in agriculture, fisheries have also become more efficient. The structure of the industry has changed, with a shift from inshore fishing to trawlers and larger boats. The number of fishermen has steadily declined, as has the number of vessels. At the same time, catches per fisherman have increased. In step with this, GHG emissions associated with wild-caught fish have also decreased. This decrease applies to all types of wild fish and is due, among other things, to the phasing out of refrigerants with a high climate impact, but also to an increase in several stocks that has led to more efficient catching. Although fisheries have a low climate footprint, there is a potential for reducing emissions. Examples include positive effects from changes in fuel, increased fuel efficiency and better use of by-products from fishing.

It is important to establish more knowledge about how fisheries and aquaculture affect marine carbon sinks, such as soft-bottom substrates and kelp forests. Bottom trawling, for example, can affect carbon that is stored in the soft substrate, but we know too little about it (Løkkeborg et al., 2023). We need more knowledge about how the ocean's different carbon sinks are affected by different catch methods such as bottom trawling, by different types of fishing gear and by the size of catch quotas. As long as the climate impacts of bottom trawling are unknown, catch methods with a possible negative effect on carbon sinks should be restricted. The Committee therefore believes that we should consider ceasing bottom trawling pending more knowledge. Kelp forests bind large amounts of carbon. We therefore need more knowledge about the effects of kelp trawling on carbon uptake and sequestration. In the aquaculture sector, we need more knowledge about how nutrients and waste from cages affect marine carbon sinks. There is also a need to gain a better overview of marine carbon sinks and sinks in tidal areas along the coast, so that this can be taken into account in low-emission spatial planning.

In the Committee's view, the management of fisheries and aquaculture must take into account that new knowledge about marine carbon sinks may entail a need for changes in these industries as well. In the same way as in agriculture, such changes must also take into account that other important societal goals must be safeguarded.

Direct emissions from the grocery trade sector are minor compared with the indirect ones, which come from the products they sell. The direct emissions are in particular related to transport. When indirect emissions are taken into account, well over 90 per cent of sector's overall emissions come from the products they sell. Since the grocery trade has a strong influence on what customers actually buy, they can contribute to lowering emissions from production by influencing customers to buy goods with a lower footprint, for example through the use of nudging (Ytreberg et al., 2023). Through various campaigns, enterprises can currently contribute to more emissions, for example by keeping the price of meat artificially low to attract customers. Inadequate access to information about the climate impact of various foods is a challenge for consumers and the grocery trade alike. Requirements for suppliers regarding product labelling could make a positive contribution to this end.

Consumer behaviour is also influenced by other channels. Information-based interventions, especially in combination with other approaches, could help consumers make greener food choices. Food labelling and dietary advice can be helpful. Information from public authorities via various food information offices should not encourage the consumption of foods with high GHG emissions. The UK Climate Change Committee also points out in a report that consumption is also influenced by access, how food is presented, for example through labelling, and by making plant-based alternatives more attractive (Climate Change Committee, 2023).

The structure of the grocery trade affects Norwegian food production. Weak competition in the market has many costs, but it is not obvious how much bearing it has on emissions from the food system. It can be difficult for manufacturers to get their products into stores, and if this affects the supply of low-emission goods, it can keep emissions at a higher level. How products are presented in stores and the approach of campaigns can also influence spending in different directions. There may also be reason to believe that more effective competition in the market could stimulate, among other things, innovation of healthier products and more sustainable packaging. Part of Norway's food waste occurs in the grocery trade, but the sector should also have a responsibility for reducing food waste in the production chain and in households.

Food waste must be reduced. In 2020, food waste from the food industry, the public sector and households amounted to 400,000 tonnes (Stensgård et al., 2021), corresponding to emissions of about 1.3 million tonnes of CO_2e. To achieve the goal of overall emissions of 2.5–5 million tonnes of CO_2 by 2050, these emissions must be significantly reduced. Food waste occurs in all parts of the food system, but by far the largest proportion occurs in households, followed by the food industry and the grocery trade. There is less waste in the hospitality industry, wholesale, and in kiosks, filling stations and the service trade. Waste is poorly documented in some parts of the production chain.

The Food Waste Committee is tasked with assessing measures to achieve a 50 per cent reduction in food waste by 2030 and proposing a comprehensive set of measures and policy instruments that will help achieve the target. It will also consider how a potential food waste act could be used as a policy instrument, and draw up a concrete proposal for such an act. The work will be presented by the end of 2023.

Efforts to limit food waste at all stages must be intensified. The measures introduced must stand the test of time in a 2050 perspective. The Climate Change Committee notes that statistics on food waste are inadequate. This applies, among other things, to figures for farmed fish that die in cages, male goats and cockerels that are killed immediately after birth, laying hens that are no longer used for egg production, and vegetables, cereals and potatoes that are not harvested but ploughed into the soil.

7.2 The Committee's recommendations

Food system policies must be aligned with climate policy, and the emissions budget for 2050 must form the starting point for policy development. Food system policies must also take into account that decisions made today lead to path dependency in the transition and could lay claim to scarce resources, such as electric power and expertise. The Committee therefore has the following recommendations:

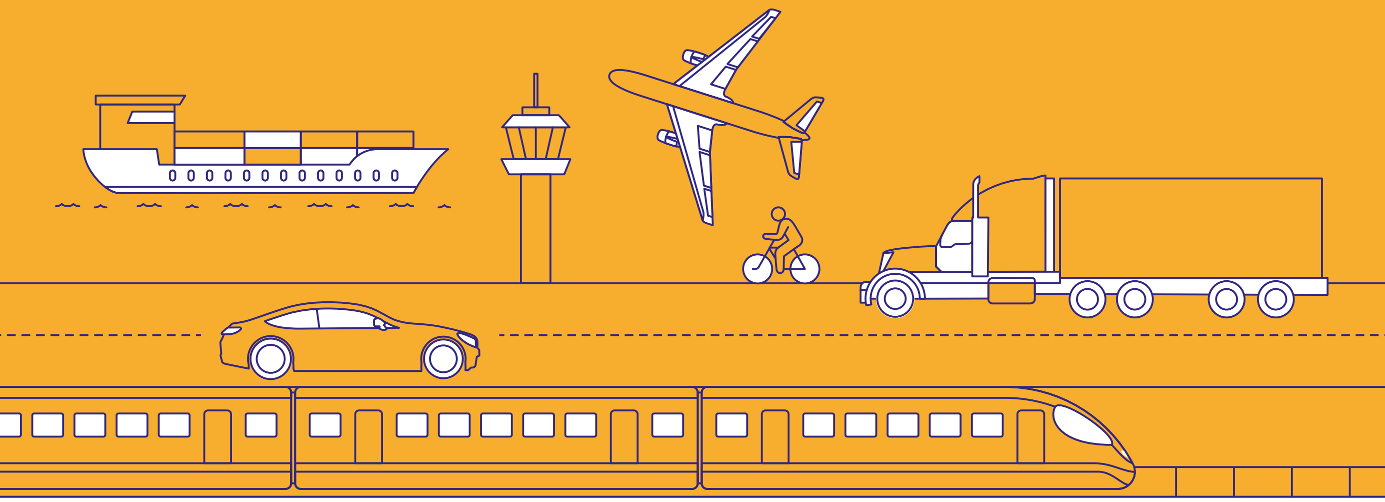
- base policy objectives throughout the food system on Norway becoming a low-emission society. This involves to:
  - remove all greenhouse gas emissions of non-biological origin in the agricultural sector
  - reduce emissions from food production through technology and production improvements and scaling down meat consumption and production.
  - adjust funding schemes under the Basic Agricultural Agreement to better support the transition of agriculture towards low emissions and safeguard cultural landscapes and biodiversity, while taking into account other agricultural objectives. This could include assessing whether parts of the Basic Agricultural Agreement should be covered by multi-year agreements.
  - avoid promoting the consumption of foods with high greenhouse gas emissions through information from public authorities via various food-related public information offices
  - review funding schemes under the Basic Agricultural Agreement to identify which schemes stimulate production with particularly high greenhouse gas emissions.
  - reduce emissions from the aquaculture sector by switching to feed that generates lower greenhouse gas emissions.
  - reduce food waste, including by following up the government-appointed Food Waste Committee.

We need more knowledge and skills to facilitate the transition of the food system. The Committee therefore has the following recommendations:

- acquire more knowledge about carbon in soil and carbon dynamics in Norwegian agroecosystems, and how changes occur over time, and incorporate this knowledge into the public administration.
- acquire more knowledge about how aquaculture affects carbon sequestration and ecosystems, and incorporate this knowledge into the public administration
- acquire more knowledge about carbon uptake and sequestration in marine carbon sinks and incorporate this knowledge into fisheries management and administration.
- stop bottom trawling until the effects of this activity on the climate are better mapped.

Transport and mobility

8



This chapter is about the transition of the transport system. The chapter highlights that how demand for transport is created is a key part of the transition of the transport system and the various transport technologies. It also shows how transport is linked to the use of resources and land.

8.1 Transport and mobility are cornerstones of society

Modern society is based on the premise that both people and goods can and should be transported between different places. Today, society is built up around us moving between home, work, school and various leisure and recreational activities. Many jobs involve travelling, going to meetings, meeting customers or carrying out inspections. Raw materials are transported from where they are produced to where they are processed, often in several stages and in different places, before being transported to stores and then on to the consumer, before finally being transported as waste. Such transport often covers long distances and crosses several countries.

This extensive mobility is of relatively recent date. A few decades ago, the volume of freight transport was significantly lower, and expectations of how often and how far you as an individual could travel, and by what means of transport, were quite different than today.

Transport is one of the largest sources of GHG emissions in Norway, with direct emissions of more than 16 million tonnes of CO_2e in 2021. One third of Norwegian GHG emissions come from transport. The vast majority of this is road transport, representing more than 8 million tonnes of CO_2e, but there are also emissions from

Biofuel: liquid or gaseous fuel produced from biological material, often called biomass. In Norwegian legislation, the application of the terms conventional and advanced biofuels are based on what raw material the fuel is produced from. Conventional biofuels are produced from raw materials that can also be used to produce food or animal feed (agricultural crops). Also known as first-generation biofuels. Advanced biofuels are mainly produced from waste products from the food industry, agriculture or forestry, and not from raw materials that can be used as food or animal feed (non-food biomass). Also known as second-generation biofuels.

See the Committee's assessments relating to land use in Chapter 6.

See Chapter 11 for a discussion of emissions in other countries relating to Norwegian consumption.

See the Committee's assessments relating to economic growth and circular economy in Chapter 9.

See the Committee's assessments relating to energy for transport in Chapter 5.

fishing boats, motorised equipment, and domestic aviation and shipping. Emissions from transport are more than 25 per cent higher than they were in 1990. This is partly due to increased freight transport, and partly due to increased emissions from other transport sources, such as domestic shipping and motorised equipment. Due to lower fuel consumption per vehicle and an increased share of diesel cars, emissions from passenger cars were relatively stable from 1990 until 2015, despite a significant increase in driving distance. Since 2015, emissions from cars have been somewhat reduced. This is particularly due to increased use of biofuels, but also an increased share of electric and hybrid vehicles.

There are also indirect emissions from transport. This comes from land that is developed to build roads, parking spaces, airports, port facilities etc., and from the materials and energy used both in the construction and maintenance of infrastructure such as roads, airports and railway lines, to the fuel and the means of transport themselves, such as cars and aircraft. Overall demand for transport is therefore important for other emissions and developments in sectors beyond the transport sector. See Chapter 6 for the Committee's assessments relating to land use.

Norwegian transport demand produces emissions and lays claim to resources in both Norway and other countries. This chapter discusses the relationship between mobility in Norway and GHG emissions, and outlines the Committee's assessments and recommendations. Emissions in other countries relating to Norwegian consumption are addressed in Chapter 11.

Transport is also linked to other environmental challenges, including local air quality and noise, and pollution from microplastics and road salts. The transport system as a whole relates to issues such as the framework conditions for business and industry, and to public health through how the transport system facilitates physical activity in everyday life.

Transport of goods and people will also be important in the low-emission society. At the same time, the transport system cannot continue to develop as it has if Norway is to achieve its low-emission target. The IPCC points out that replacing technology in the transport sector will not be sufficient on its own to achieve the goal of keeping global warming below 1.5 degrees. This is because the scope of transport is growing faster than the replacement process. Efficiency could lead to more transport, the production of materials and energy for means of transport and infrastructure generates emissions in itself, and there is a shortage of renewable energy and raw materials for alternative fuels and batteries. Emissions from land use changes for transport infrastructure come in addition. A continuation of the transport system's current trajectory will lead to the system laying claim to land, resources and energy that other sectors will need in the transition. See also the Committee's assessments relating to economic growth and circular economy in Chapter 9, and its assessments relating to the use of energy for transport in Chapter 5 on the energy system.

Policies that affect transport demand, which govern mobility in society, require a different analytical basis than policies for the transport itself. Mobility and transport are closely interlinked. Transport policy must be developed from solely concerning the specific movement of goods or people from one place to another, to also include how the desire or need to transport goods and people from one place to another is influenced by the transport system. We must consider how the organisation of cities and rural communities, the location of hospitals, schools and other public institutions, the geographical distribution and scope of production and consumption, as well as cultural and social expectations and ideals influence mobility. Mobility is about all of these elements. Mobility and transport are therefore closely interrelated, but not identical, topics.

8.2 Development of the transport system in a low-emission society

The transition of the transport system towards a low-emission society will be highly reliant on reducing the need for transport as much as possible, moving what can be moved to means of transport with lower resource and energy consumption and emissions, and finally, improving technologies. The framework *Avoid-Shift-Improve* (ASI) shown in Figure 8.1 is also a useful starting point for the transport sector. See Chapter 3 for a general description of the framework. In simple terms, measures to avoid transport are at the societal level. These are best triggered through the planning of transport systems and larger social structures. Examples include the use of digital meetings and working from home, and transport-efficient land use planning that reduces the distance between different destinations. Measures to shift transport to less energy and emission-intensive modes are more related to the journey itself, for example the transition from using a car to taking public transport or cycling. Measures to improve technology are related to the individual unit, such as the transition from a diesel car to an electric car. All measures form part of a broader, systemic approach. Although these different types of measures must be implemented simultaneously, the main lines of the policy must be about *avoiding* demand for transport. This is because the scope of transport sets the direction for the other measures.

See Chapter 3 for a general description of the ASI framework.

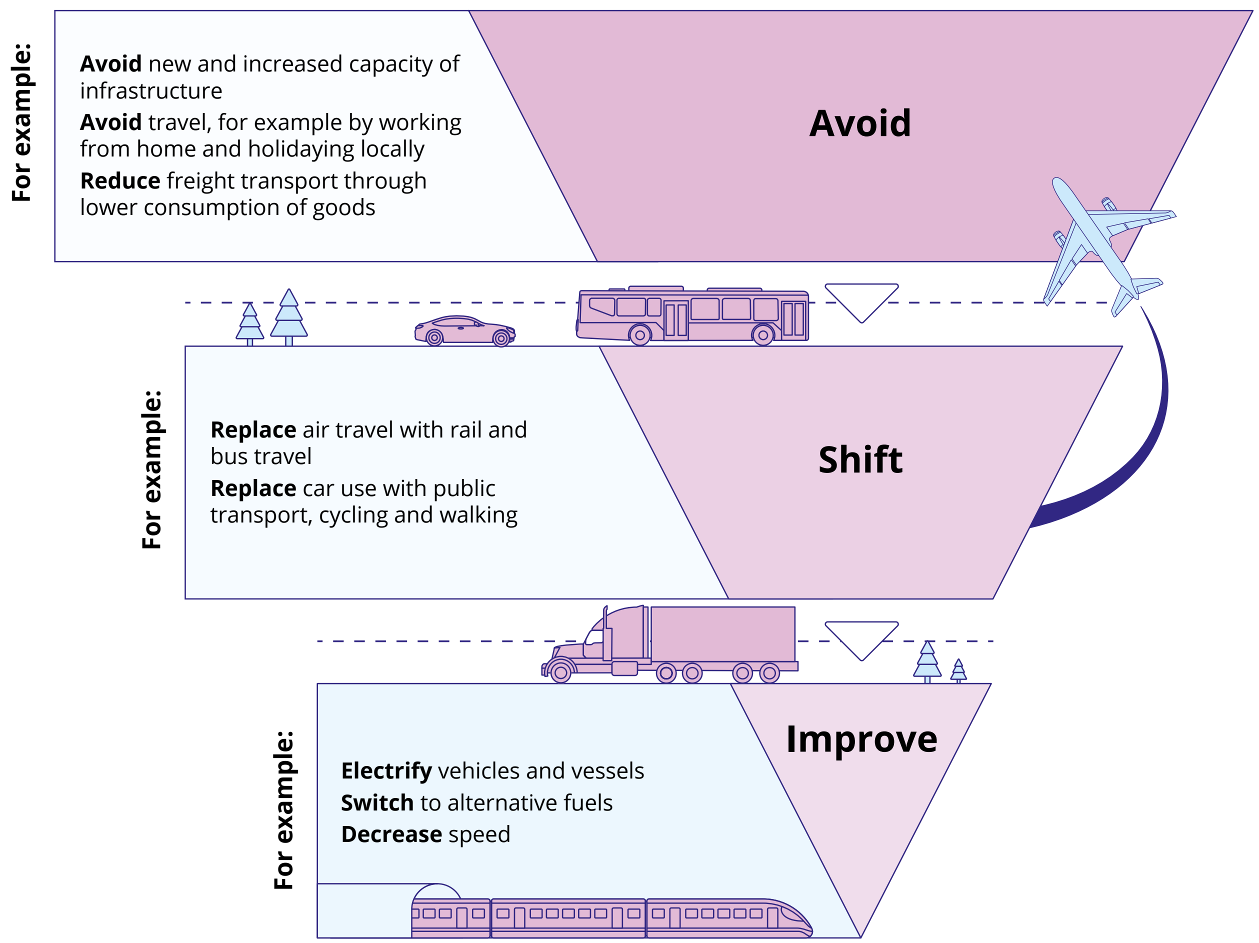


Figure 8.4 **Framework for policy measures *Avoid-Shift-Improve* (ASI) in the transport system.** The figure shows various priorities and examples of how the priorities can guide policymaking. The examples are not exhaustive.

Source: The 2050 Climate Change Committee

The low-emission society is contingent on a further development of transport policy. Part of the transition is about changing the starting point for transport policy from how transport demand should be met, to limiting how the transport system itself generates increased demand for transport. Understanding how adaptation and efficiency contribute to demand for transport and for different modes of transport is a key consideration. This applies to both passenger transport and freight transport.

There is a high degree of path dependency in the transport system, both at the societal level and for individuals. Path dependency is created through the infrastructure that exists and is used; see Box 3.3 on path dependency. Building good roads rather than railways will mean that transport will increasingly be based on the road system. Investments at the individual level can also lead to path dependency. If you have bought an e-bike, you may be more motivated to use it than to drive a car, and if you have a car, the car is always an option instead of using public transport. Path dependency is also psychological. Many journeys are habitual journeys, for example between home and work or school. Fixed patterns in transport make it more difficult to establish new habits. This means that path dependency and measures that reinforce a positive path dependency must be given importance in policymaking.

Transport policy should emphasise reducing the need for, and thereby the scope of, transport and the overall use of resources for transport. This requires change across the entire transport system. Growth in transport demand cannot continue as it is today if Norway is to become a low-emission society by 2050. Policies are needed to reduce demand for transport of both goods and people. Some countries and regions have already set a goal of limiting transport. Scotland, for example, has set a target to reduce car kilometres travelled by 20 per cent by 2030. In order to limit overall resource consumption, it will also be important that more people share some goods, such as private cars. At the same time, it must be taken into account that, in a circular economy, there will be a need to transport used materials and resources to where they will be reused. A changed transport pattern is therefore also part of the transition to a circular economy. Freight transport is closely linked to both private consumption and industry structures. A high private consumption of material goods significantly increases freight transport. See Chapter 9 for the Committee's assessments relating to economic growth.

See the Committee's assessments relating to economic growth in Chapter 9.

In its analysis of measures for 2030, the Norwegian Environment Agency emphasises the importance of reducing transport demand (Norwegian Environment Agency, 2023c). The Agency refers to the IPCC's emphasis on better and more comprehensive regulation of transport demand, and that a mere replacement of current technology is not sufficient. The Agency also shows that, if growth assumptions in the current National Transport Plan (NTP) are used as a basis, a zero-emission transport sector will need as much as 60 TWh of electric power in 2050, in addition to 750 million litres of biofuel. With zero growth in transport volume, this need will be reduced to 45 TWh of power and 550 million litres of biofuel (Norwegian Environment Agency, 2022c). Reducing the transport volume is therefore also important for the implementation of other types of measures that require resources. In addition, continued transport growth will make it more demanding to achieve Norway's commitments under the Global Biodiversity Framework.

Transport planning must, to a greater extent, take into account how transport contributes to society's overall use of resources and land. This means that, for example, the development of new roads, the need for parking spaces and charging stations, new routes and expansion of airports must be considered in light of land occupation. The early-stage planning models KVU/KS1 (choice of concept assessment and external quality assurance) must place more emphasis on climate and nature considerations, and it should be considered whether these models should be linked to the Planning and Building Act in order to safeguard such considerations. In addition, early-stage planning models should place more emphasis on non-priced consequences. See also Chapter 18. It is essential to make better use of existing infrastructure. Further development of the transport system must also consider

See the Committee's assessment of how the climate transition should be planned in Chapter 18.

the resources it will require. This applies both to the materials used by the modes of transport and to energy requirements. Both Norwegian and imported resources should be included in this assessment. A system based on public transport and carpooling is less resource-intensive than a system in which everyone has their own car. It is important to both facilitate increased use of public transport and carpooling, while reducing emissions from these modes of transport as quickly as possible. Transport planning must take account of the system's overall resource load.

Transforming the Norwegian transport system towards a low-emission society will have several positive effects. The Norwegian Environment Agency refers to how the changes will reduce the need for electric power and transport infrastructure. This, in turn, will result in less land degradation and lower emissions from land use changes. It will also lead to lower emissions from the production of raw materials and materials in Norway and globally. Reducing the transport volume contributes to reduced emissions at many levels and in many places in the world, both directly and indirectly, and through life cycles and long value chains. Conversely, increased transport causes higher emissions along all these dimensions.

See the Committee's assessments relating to land use in Chapter 6.

Good transport solutions are crucial in the development of cities and towns. The location of homes, workplaces and visitor-intensive establishments such as hospitals and shopping centres determine transport patterns and demand. This is especially the case in the areas in the immediate vicinity of the establishments, but also has spillover effects to other areas. Shopping centres and hospitals located outside city centres are examples of this. Emphasis must be placed on compact cities and towns, and on facilitating good modes of transport, including cycling, walking and public transport. Transport-efficient urban development can and should lead to increased quality of life in general. See Chapter 6 for the Committee's assessments relating to land use.

We must also ensure that the transport that does take place minimises both emissions and resources. This means using resource-efficient modes of transport with as low emissions as possible, such as public transport, cycling and walking. Restrictive policy measures may be as important as facilitation and stimulation to this end. Urban growth agreements with the four largest cities in Norway have been an important national policy instrument to limit growth in passenger car traffic and stimulate the use of public transport, cycling and walking in these cities. General arrangements for increased use of bicycles and incentives to travel by public transport are also examples of this. In this way, transport is shifted from modes of transport that have higher resource and energy consumption, such as cars, to modes with lower resource and energy consumption, such as bicycles or public transport. It has also long been a political objective to shift a larger share of freight transport from road to sea and rail in order to reduce emissions.

At the same time, it must be taken into account that different measures affect and may undermine each other. Experience from Bergen, Trondheim and Stavanger/Sandnes shows that the national EV policy largely undermines the goal of avoiding an increase in passenger car traffic (Leknes & Bayer, 2023). The expected decline in driving due to high toll rates in urban areas has not been achieved, and it appears that, although the share of fossil car journeys has fallen sharply, the share of electric car journeys has increased correspondingly. In some districts, electric cars are in the process of outcompeting public transport. Studies show that electric car owners use their car to and from work to a significantly greater extent than fossil car owners, travel less by public transport and are less concerned with reducing their car use than fossil car owners.

Measures to *avoid* and *shift* transport should be given priority. The Norwegian Environment Agency suggests considering land use planning that takes into account the need to curb transport demand in addition to combining restrictive measures with measures that make the alternatives attractive. All measures should be assessed on the basis of the overall use of resources they require and the behaviour they encourage. This applies in particular to measures to improve technology, but also planned road developments, for example in the NTP. We must take account of the fact that more efficient transport can cause setbacks and lead to increased demand.

So far, the most high-profile measures to reduce GHG emissions from transport have largely revolved around technology improvements. These include the phasing-in of electric cars and the electrification of ferries, measures primarily aimed at improving existing technology, within the same pattern and system of mobility.

There is a good knowledge base for reducing emissions in the transport sector through the use of low-emission technologies. Significant development work is taking place within the various transport technologies. The development of, among other things, electric cars, electric buses, electric construction equipment that runs on electric power, and the testing of electric aircraft and phasing-in of electric ferries demonstrate that extensive technology development and roll-outs are taking place. The Norwegian Environment Agency has assessed 25 improvement measures (Norwegian Environment Agency, 2023c). Most concern the electrification of transport, as well as measures for the use of hydrogen-based fuels, biogas and liquid biofuels. These are applied to land transport, machinery, aviation and shipping. The Agency points out that electrification is crucial, and that the main barriers are a lack of profitability and infrastructure. In addition, different forms of behavioural barriers play a role.

As many transport segments as possible should be electrified, but this may not be possible in some modes. Alternative fuels, such as hydrogen, ammonia or other fuels with lower GHG emissions than fossil fuels, should only be used where electrification is not possible, since the use of alternative fuels will be significantly more resource-intensive than direct electrification. The transition to zero-emission technology using alternative fuels can raise other dilemmas. For example, the use of bioenergy can have a negative impact on nature and the environment, and energy carriers such as hydrogen, ammonia and synthetic fuels require a lot of energy to produce. Hydrogen gas leakage also has a negative climate impact (Sand et al., 2023). Limiting transport demand will help reduce these dilemmas.

Since more and more means of transport consume electric power, the consequences for other activities that require energy and output must be considered. As for all sectors of society that demand power, there will also be a need for the transport sector to acknowledge that power is a limited resource with potentially high benefits to society from other uses. Increased electrification of the transport sector will also lead to an increased need for electric power. The development of power generation and power grids requires land. The transport sector must also take into account the need to limit overall power consumption so that increased power and grid development does not increase the pressure on nature. See Chapters 5 and 6 for the Committee's assessments relating to energy and land, respectively.

See the Committee's assessments relating to energy and land use in chapters 5 and 6.

The use of biofuels must also be carefully considered. Bioresources are a limited resource, locally, nationally and globally. The production of some forms of biofuels requires large areas of land and may put pressure on nature. The vast majority of the various raw materials used for biofuels have an alternative use, and their benefit in other applications can be high. Although biofuels can be useful in a transitional phase pending the development and roll-out of low-emission technologies, such an approach must not slow the transition to a low-emission society. This is particularly important because, at the same time as working on the transition to low emissions, Norway is also committed to achieving the goals of the Global Biodiversity Framework. Almost all of the biofuel Norway uses today is imported from other countries. Seeking low-emission development through a measure that, directly and indirectly, puts increased pressure on natural resources globally is not expedient.

Interventions beyond technology measures should also be considered to reduce emissions and the use of resources. As an example, the Netherlands has reduced the daytime motorway speed limit from 130 km/h to 100 km/h to reduce emissions and energy consumption. In general, roads built for lower speed limits will reduce the need for materials and land, and driving at lower speeds also greatly reduces energy consumption. Lower speed limits can also reduce the attractiveness of the car relative to other alternatives. Such measures should be considered as part of the transition in the transport sector.

8.3 Transport planning must be further developed

The transport system of the future needs to be planned based on an overall perspective. The transport system in a low-emission society must be based on minimising the use of resources for transport. We need to focus more on developing all forms of transport as one system, both public and private transport, road, rail, shipping and aviation, and active forms of transport such as cycling and walking. Joint improvements or new construction should, for example, always be considered when building infrastructure for roads where there are also railways, and vice versa. In Sweden, the Swedish Transport Administration is responsible for the long-term planning of infrastructure for road, rail, maritime transport and aviation. In addition, the agency is responsible for the construction and operation of national roads and railways. A similar organisation may also be appropriate in Norway and should be considered. In addition, transport demand must be considered in light of digitalisation, the transition to a circular economy, and the possibilities of meeting the need for mobility in ways other than physical travel.

As regards freight transport, cross-border cooperation is particularly important. Much freight transport takes place across national borders. This means that, in order to achieve emission-free and resource and energy-efficient transport of goods and materials, there is a particular need for countries to cooperate on the solutions. Norway should cooperate with the most important countries in the freight transport network on how the transformation of freight transport can be most effectively achieved. This applies to both imported and exported goods.

The assessments should to a greater extent take into account other aspects of transport than time. Many people consider trains more comfortable or find it easier to work on them than, for example, buses. Many people would not replace a flight from Oslo to Stockholm with a journey by bus, but more are willing to drop flights if the train service is good. The same applies to rail transport in cities. It is not certain that the Dovre Railway or the Bergen Railway would have been built today, but there are few who argue that these decisions were unfortunate for Norway. These dimensions are not usually taken into account in analyses. Such elements may be important in the development of a transport system. It will not always just be the time we spend travelling that matters, but also how we spend our time *while* travelling. Facilitating such 'multiple use' of travel time can outweigh other disadvantages.

Further development of the transport system must be based on Norway becoming a low-emission society. Transport planning must be based on the goal, not a forecast of where we will end up if current trends continue. An approach based on a forecast of current trends will not provide the desired development. The 'predict and provide' approach in mobility planning must be replaced by 'design the future'. The starting point for transport plans must be what a good transport system looks like in a low-emission society. Thereafter, consideration must be given to how the current transport system needs to be developed and adjusted to that transport system. See also the Committee's assessments relating to decision-making systems in Part D.

8.4 The Committee's recommendations

The Committee is of the opinion that transport policy must be based on a reduction in overall Norwegian emissions of 90–95 per cent by 2050, and that there is very limited scope for emissions from transport towards 2050. The Committee therefore has the following recommendations:

- prioritise transport policy measures that avoid emissions. Measures that shift transport to less emission-intensive forms should be prioritised over measures that improve existing transport.
- prioritise measures that reduce demand for transport, both of goods and of people, including by.
  - utilising and maintaining existing infrastructure rather than developing new.
  - consider and emphasise path dependency in all decisions, because transport policy and investment decisions provide important guidelines for the type of infrastructure and modes of transport that are facilitated.
  - ensure that the development of the transport system contributes to reducing overall use of resources and land, both in Norway and in other countries.
  - ensure that the development of the transport system reduces the overall energy consumption of transport. This means that direct electrification should be used as far as possible, and not energy-intensive fuels such as hydrogen or biofuels. These should be reserved for transport that cannot be easily electrified, such as long-distance sea transport.
  - place less emphasis on facilitating high speed in the road system, which will limit overall energy consumption and have positive spillover effects on land use.
- see transport policy as part of the development of a circular economy. This is particularly pertinent due to the need to transport goods and materials for reuse, repurposing and recycling.

In order for decision-making systems and the knowledge base to contribute to achieving this, the Committee has the following recommendations:

- develop the transport system collectively across different modes of transport and regions based on the transport system we want in the future rather than on the continuation of historical trends.
- ensure that the National Transport Plan is based on transport demand and the transport system in a low-emission society in 2050.
- consider whether merging the various transport agencies into one common organisation could lead to a more comprehensive development of transport policy.
- ensure that the early-stage planning models KVU/KS1 (choice of concept assessment and external quality assurance) to a greater extent highlight climate and nature considerations, and consider whether these models should be linked to the Planning and Building Act in order to safeguard such considerations.
- expand the knowledge base on transport and mobility to include what drives demand for mobility, what people want to spend their travel time doing, preferences for different modes of transport and how different modes of transport can facilitate the desired use of travel time.

9 Economic activity, welfare and circularity

This chapter discusses how the composition and extent of economic activity affects greenhouse gas emissions and the road to a low-emission society. The energy transition and a more circular economy with efficient use of all resources, such as energy, land and minerals, can break the link between economic growth and greenhouse gas emissions. The Committee's point of departure is that all economic activity must take place within planetary boundaries and be based on efficient use of all resources, and not the depletion of nature.

Economic activity: production of goods and services in the public or private sector.

Economic growth: increase in the production of goods and services. Economic growth can be achieved through more efficient use of input factors or if multiple input factors are used.

Prosperity and welfare: prosperity is linked to the amount of material goods in society, while welfare is linked to the population's opportunities and rights, such as the possibility of education, access to social safety nets and access to health services.

9.1 Economic growth and greenhouse gas emissions

Population and prosperity growth have resulted in GHG emissions and increasing pressure on nature. The global population has increased by almost tenfold since 1750, to about eight billion people, and the production of goods and services is many hundred times greater than in pre-industrial times. Developments since the Industrial Revolution have resulted in an unprecedented growth in prosperity. Seen as a whole, this has brought about improved quality of life, better health and higher life expectancy. As part of this development, large amounts of fossil resources from geological deposits have been extracted and exploited, while land use has expanded so much that only a quarter of the earth's surface is now unaffected by direct human intervention. Figure 9.1 shows how the rapid growth in GDP per capita in the world has co-occurred with a dramatic increase in the concentration of atmospheric CO_2. The production of goods and services has largely been based on unsustainable use of land and other natural resources. Various forms of natural capital have been converted into consumer goods and called 'income', but in reality, it has been withdrawn from an account that is now overdrawn. Many resources have been too cheap or free to use. Future generations will therefore take over a poorer environment and natural basis, resulting in lost opportunities, costs and consequences.

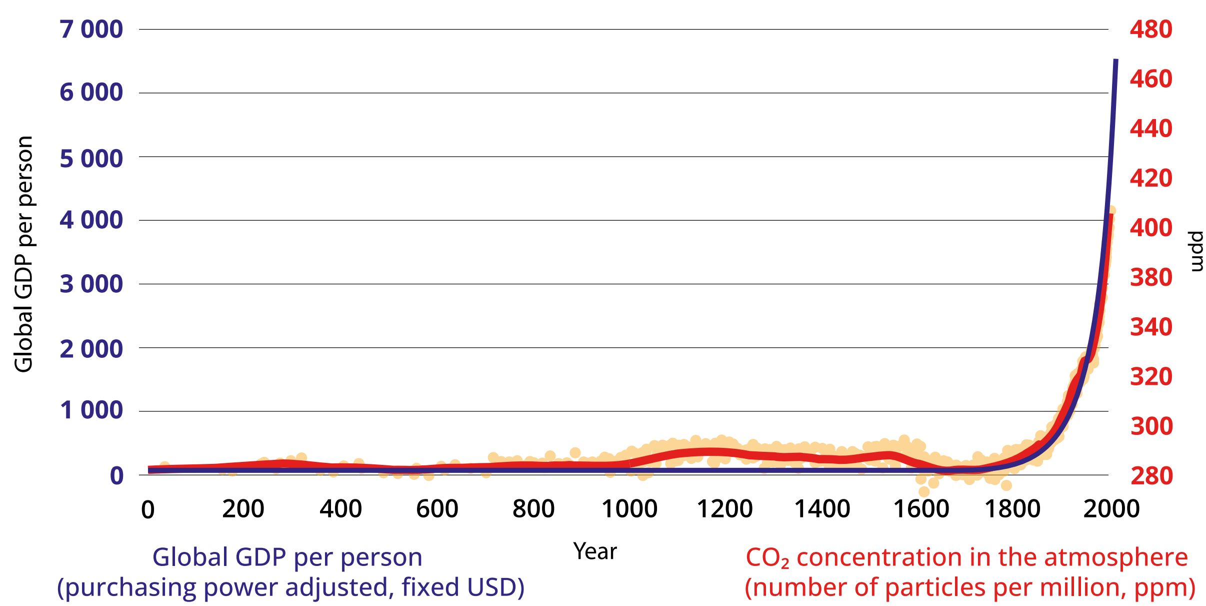


Figure 9.1 **GDP per capita and atmospheric CO_2 concentration.**
Source: Statistics on World Population, GDP and Per Capita GDP. 1–2008. Angus Maddison, and the IPCC (2021)

The distribution of economic prosperity and GHG emissions is very uneven on a global basis. Consumption patterns have a significant impact on GHG emissions. Rich countries have significantly higher GHG emissions per capita than poor countries, and within individual countries, high-income groups account for significantly higher emissions than low-income groups.

The IEA has looked at differences in emissions relating to energy consumption between income groups and regions, and shows that emissions from energy consumption is 11 times higher for an average person in the USA than an average person in an African country. However, this disparity is even clearer between different income groups across countries. Emissions from energy consumption from the one per cent of the world's population who emit the most amounted to more than 50 tonnes of CO_2 per capita in 2021, which is more than 1,000 times higher per capita than the lowest-emitting percentage in the world (IEA, 2023). This is probably due to more use of transport such as aviation and cars, and that the food they consume has higher emissions. Figure 9.2 shows how increasing income in a country is associated with higher emissions per capita (measured as carbon footprint, which takes into account the effect of imported consumer goods).

Climate footprint: a concept often used to indicate the amount of greenhouse gases emitted from an activity, an organisation or a product, including emissions from the inputs needed to perform the activity, run the organisation or make the product.

The average global CO_2 emissions per capita in the analysis is 4.7 tonnes. The existing knowledge base suggests that, in Norway as well, the richest income groups have a significantly higher climate footprint than low-income groups. According to figures from the Future in Our Hands, the one per cent richest households had a carbon footprint of more than 150 tonnes of CO_2e per household in 2019. The 10 per cent richest households measured by income and wealth had an average climate footprint of around 54 tonnes of CO_2e in 2019, while the half of the population with the lowest income and wealth emitted about 15 tonnes of CO_2e per household (Future in Our Hands, 2023). Figures from the database 'Emissions Inequality Calculator' show the same trend (Ghosh et al., 2021).

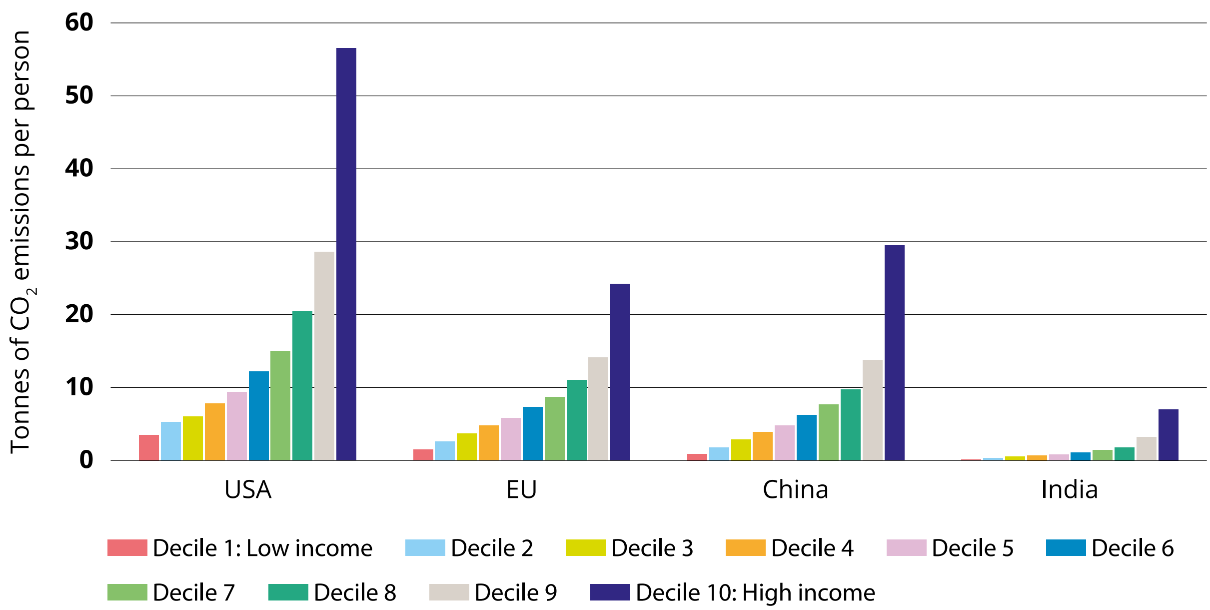


Figure 9.2 **Energy-related tonnes of CO_2 emissions per capita by income distribution, 2021.**

Source: IEA (2023)

Sustainable economic development is based on nature determining the framework for all economic activity, so as to safeguard the basis for future production and living conditions. A core question is therefore whether economic activity can be decoupled from the use of fossil energy and other natural resources, making it possible to achieve the climate goals while the economy continues to grow. These questions have led to increased attention to the circular economy and concepts such as degrowth.

Transitioning the energy system to zero emissions and renewable energy is a core challenge on the pathway to a low-emission society. At an overall level, there are three ways to resolve the close coupling between economic activity and carbon emissions from fossil energy sources:

– reduce the use of fossil fuels in favour of renewable energy, i.e. the energy transition.
– increase energy and material efficiency in economic activity.
– curb purchasing power (per capita, for a given population).

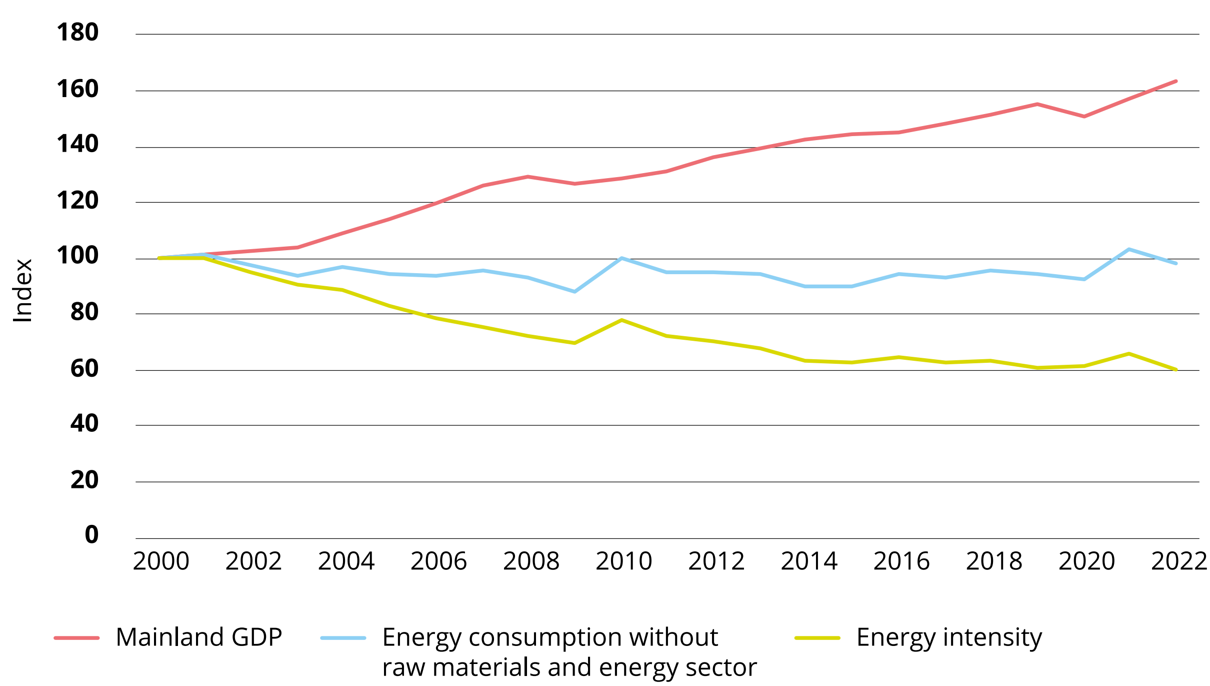
However, replacing fossil energy with renewable energy is not sufficient to solve the climate challenges. Energy production and consumption generate GHG emissions other than CO_2 from combustion, such as emissions relating to land use and physical infrastructure. Certain industrial and biological processes also generate GHG emissions, which must be reduced and removed, and other GHGs such as fluorinated greenhouse gases (F-gases) harm the environment if they are released into the atmosphere.

Many countries are seeing a trend towards a weaker correlation between economic growth and emissions. A number of countries have increased the energy efficiency of the economy, which can provide a relative decoupling of economic growth and GHG emissions, where growth in emissions is lower than the rise in economic growth. In some countries, perhaps especially in the EU, we also see a trend towards absolute decoupling, where economic growth continues while emissions decline. However, such figures must be interpreted with caution. In recent years, some Western countries have reduced their own emission-intensive industrial production and instead imported such goods from emerging markets, thereby shifting emissions associated with the value chain for individual products. Decoupling in an individual country that does not take into account emissions relating to the import and export of goods and services, or the use of materials, means that national figures conceal some important elements and may be somewhat random depending on the development of different countries' industry structures.

The Norwegian economy has become more energy efficient. Measured by mainland GDP, the Norwegian economy has grown by more than 60 per cent over the past twenty years, while domestic energy consumption has been relatively stable. Energy intensity, measured as net domestic energy consumption (without raw materials and energy consumption in the energy-producing sector) divided by mainland GDP, has been reduced by more than 35 per cent; see Figure 9.3. An important explanation is that less energy-intensive industries have accounted for much of the growth in the Norwegian economy.

Figure 9.3 **Development in energy intensity in Norway 2000–2022.**

Source: Statistics Norway



Economic activity will continue to be an important driver for energy consumption and GHG emissions. The current economic and political system is largely based on expectations of technological progress, increasing productivity and economic growth. Poor countries and emerging economies have ambitions to close the wealth gap to developed countries, and in developed countries as well, the population generally strives for a higher standard of living.

Different calculations have recently been designed to better capture a broader set of welfare indicators than GDP. These include a set of global indicators developed to measure the development of the UN SDGs. Statistics Norway has compiled Norwegian statistics and documentation for a selection of the global SDG indicators. The indicators are continuously updated. In addition to GDP per capita, the UN Human Development Index includes life expectancy, literacy and schooling, and income distribution. The UN Environment Programme (UNEP) has developed the Inclusive Wealth Index, which index includes the social value of capital assets, including human capital, produced capitals and natural capital, to indicate countries' progress on sustainability. The OECD report *How's Life?* describes the development of various factors that affect the population's well-being (OECD, 2020). The report shows that countries that score high on well-being tend to have greater equality between population groups. In countries traditionally associated with high well-being, such as the Nordic countries, the Netherlands, New Zealand and Switzerland, there is less inequality than in other countries. Distribution and inequality are related to justice, which is an important factor in assessing the climate transition. International surveys highlight a relatively close relationship between a country's GDP and indicators of living standards and welfare, but the correlation is likely to become weaker when GDP reaches high levels. However, as discussed above, high material wealth for an average of the population does not necessarily mean a high quality of life for everyone.

9.2 Economic growth prospects

Many climate scenarios include assumptions about economic growth. The IPCC has developed five Shared Socioeconomic Pathways (SSP) based on different assumptions in order to illustrate and explore possible trajectories. The main differences between the different pathways are related to assumptions about global population growth, access to education, urbanisation, economic growth, resource availability, technology development and demand drivers (such as lifestyle changes). The purpose is to clarify various choices and directions for the future, and the consequences thereof. All of the pathways include growth in the global economy, with global GDP in 2100 at between four and ten times greater than in 2010. This results in an average annual global GDP growth of between 1.8 per cent and 3.4 per cent, but in all pathways, the growth rate slows down. This growth is one of the most important drivers of future CO_2 emissions, even if the different pathways assume different levels of future decoupling of growth and emissions. In the 'most difficult' pathways, characterised by high population growth, increased nationalism and regional conflicts and/or high economic growth and energy demand, it is technically impossible in several of the models to find a solution that ensures compliance with the 1.5°C target (Rogelj et al., 2018).

In Norway, important long-term economic forecasts are published in the white paper on long-term perspectives on the Norwegian economy. This report is presented every four years, and discusses, among other things, the long-term economic sustainability of public finances and how population development affects public expenditure with the current design of publicly funded welfare schemes and their tax basis. The report also discusses how alternative assumptions affect the calculations. The long-term projections show, for example, that increased work participation and more efficient use of resources in the public sector will reduce the fiscal gap (Dyvi, 2021). The projections cannot be considered a forecast of the most likely development in the Norwegian economy, but constitute a technical analysis of continuing current welfare services, given, among other things, an ageing population. The macroeconomic framework used in these calculations is also used in the emission forecasts. Overall, the projections can be useful for assessing how the welfare society's social, climate and economic sustainability can be ensured. In the Committee's opinion, the white paper on long-term perspectives for the Norwegian economy should contain analyses that show the extent to which economic growth projections are consistent with the goal of reduced GHG emissions and a more circular economy. See Part D for the Committee's recommendations.

At the same time as tackling climate change and the transition to a low-emission society, the international community faces a number of other major challenges. Many countries have an ageing population and increased dependency burdens, public and private debt have reached high levels after the Covid 19 pandemic, and inflation is the highest it has been in decades. After the invasion of Ukraine, geopolitical unrest has increased, and progress after several years of good international cooperation is at stake; see, for example, the discussions in NOU 2022: 12.

In the years ahead, climate change and the transition to a low-emission society will affect the Norwegian and international economy in several ways. The transition will lead to changes in industry structure and infrastructure, but could also lead to changes in livelihoods and settlement. It is difficult to analyse the economic consequences of climate change. In Norwegian Official Report NOU 2018:17, the Climate Risk Commission pointed out that the knowledge base is limited, the data basis inadequate and the analyses uncertain, while many impacts are so serious that it makes little sense to quantify them. In recent years, productivity growth in both the Norwegian and the international economy has declined, and analyses point to a further decline (Dyvi, 2021). Such an overall trend will, in turn, have consequences for the welfare of individuals.

A well-functioning welfare society will also be possible in the low-emission society of the future. The Committee's remit is based on the premise that the low-emission society will not be a low-income society. The Committee points out that Norway has a very high level of income in an international context, and that we have seen a stronger growth in material consumption over the past 20–30 years than most other comparable countries. The white paper Long-term Perspectives on the Norwegian Economy 2021 assumes a growth in GDP per capita of about 70 per cent towards 2060. None of the relevant scenarios for a cost-effective climate policy presented in the report imply that Norway will become something that can reasonably be characterised as a low-income society.

It is also important to remember that there is no one-to-one relationship between income and a good, meaningful long life with high welfare and good health. It is quite possible to maintain and further develop a well-functioning welfare society with a weaker development in material wealth than Norway has become accustomed to. Policy must then to a greater extent revolve around the distribution of benefits and burdens than ensuring further economic growth for society as a whole. In the Committee's opinion, it is important to employ a broader set of indicators than GDP in policymaking. The level of a country's welfare is linked to the population's opportunities and rights. The opportunity for education, work and employment, leisure, social safety nets and access to healthcare services are important elements of a good life. Democracy, the rule of law, individuals' degree of participation in society and how income and wealth are distributed, have a major impact on the level of welfare. The same applies to access to nature and healthy food, and ensuring that our working and living environment is safe. Many of the factors included in an overall concept of welfare do not necessarily entail production or energy consumption, such as nature experiences and meaningful social relationships, which means that the link between welfare development and GHG emissions and loss of nature is not unequivocal. The level of wealth is not the same as the level of welfare, and the former is to a greater extent linked to material consumption and consumption of a number of services. A country can have a high level of prosperity for only a few, but low overall welfare. The most important factor in the development of society is how welfare develops overall.

The Committee's point of departure is that all economic activity must take place within planetary boundaries and be based on efficient use and reuse of resources. Norway's growth so far has relied too much on production and consumption based on the extraction of natural resources and land use that cannot be sustained over time. Policy must ensure that the use of resources is adapted to planetary boundaries, based on the precautionary principle. This must set the framework for growth going forward. Continued material progress is possible, but it must be based on more efficient land use, more efficient use and reuse of resources and materials through new technology, changed business models, productivity improvements and increased circularity, and not on the depletion of nature. The Committee also wishes to point out the significant long-term economic costs of not succeeding in climate policy and efforts to preserve biodiversity. High economic growth in the short and medium term that is not climate resilient or ecologically sustainable will not provide a basis for higher prosperity or welfare in the long term.

9.3 Circular economy as a contribution to solving the climate crisis

Economic activity has historically been based on the extraction of minerals and raw materials and the use of land, leading to loss of nature, loss of ecosystems, pollution and GHG emissions. The environmental and climate impacts of the extraction, processing, use and waste management of materials and land are substantial. The production of goods and services, including food, accounts for a large part of global GHG emissions. The price of many goods and services does not reflect the real costs to society of production, use and waste management, including costs to the environment. High material consumption and use of land, combined with global population growth and an ever-growing middle class, puts additional pressure on resources. The OECD estimates that, without new policy measures, global use of material resources will increase from 89 gigatons in 2017 to 167 gigatons in 2060 (OECD, 2019).

The transition to a low-emission society requires new technologies, minerals and raw materials. Many of the materials that are critical to renewable energy and some electronics are scarce. Growing demand leads to increasingly higher economic costs of extraction and greater competition for materials, leading to new global value chains and subsequent geopolitical consequences. The European Commission's proposal for a regulation on critical raw materials points to the estimated huge growth in demand for critical and strategically important raw materials, and the need for circular solutions to reduce the EU's dependence on importing such strategic materials (European Commission, 2023a). This can also affect Norwegian exports and production, as Norway is a significant European producer of several critical materials (aluminium, silicon, graphite, manganese alloys etc.).

The world's small and large ecosystems form the basis for the production of food, medicines and a variety of materials. They clean the air and water, produce food, sequester carbon, provide protection against floods, landslides, storms and erosion, and provide us with opportunities for outdoor experiences. If utilised and managed in a sustainable manner, ecosystems can continue to provide these services in the foreseeable future.

An economy that further reduces the amount of new resources consumed and keeps resources in the cycle as long as possible can contribute to solving the climate crisis. The negative effects of economic activity will be reduced and the rate of extraction of minerals, raw materials and land can be curbed if the economy becomes more circular.

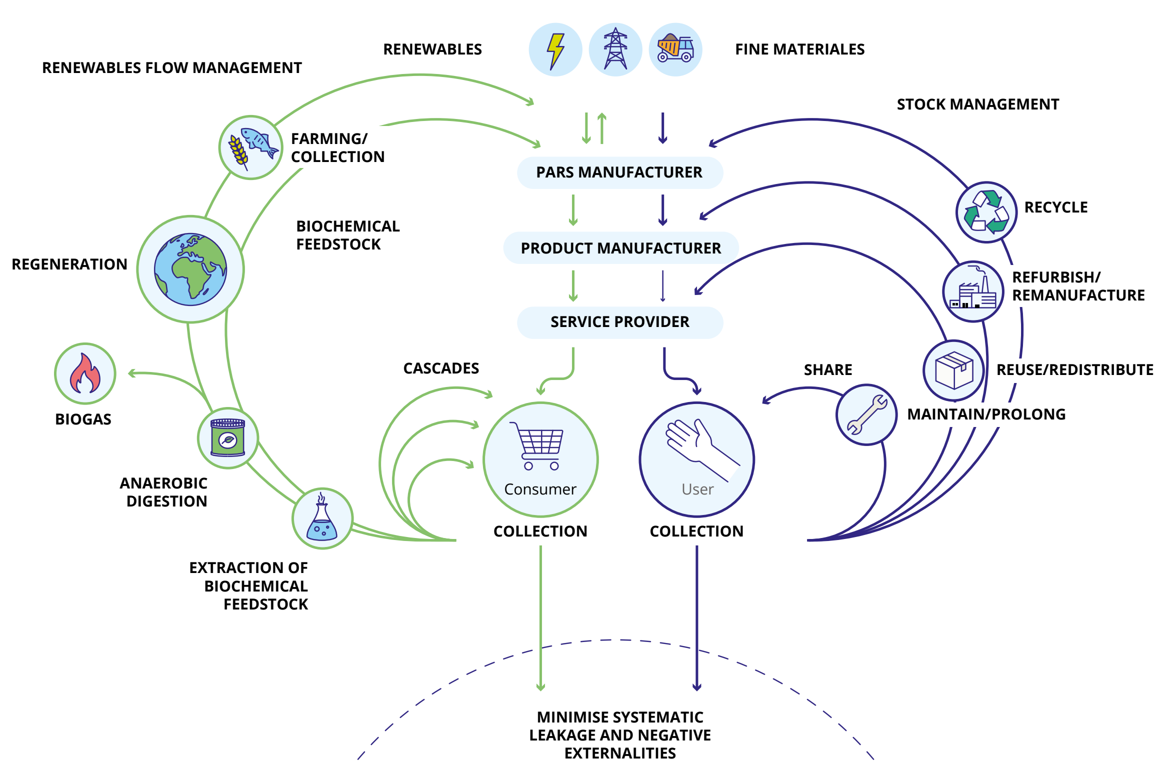
Ecosystem: a more or less well-defined, uniform natural system in which communities of plants, animals, fungi and microorganisms function in interaction with each other and with the non-living environment.

Circular economy: value chains in which the products/materials are used in different ways for as long as possible and then reused in a cycle. In a circular economy, products must last as long as possible, be repaired, upgraded and reused to a greater extent. When the products cannot be reused, the waste can be recycled and used as raw materials in new production. In this way, we use the same resources several times and generate the least possible loss.

There is not one unambiguous definition of the concept of a circular economy, and the term is understood differently. Geissdoerfer et al. define a circular economy as a regenerative system in which resource input and waste, emission and energy leakage are minimised by slowing, closing and narrowing material and energy loops (Geissdoerfer et al., 2017). This can be achieved through long-lasting design, proactive maintenance, recycling, repairing, refurbishment and remanufacturing. The Ellen MacArthur Foundation illustrates the continuous flow of materials in the circular economy in what is known as a butterfly diagram (see Figure 9.4). There are two main cycles: the technical cycle and the biological cycle. In the technical cycle, products and materials are kept in circulation through processes that ensure maximum use, such as sharing, repair, reuse, remanufacturing and recycling. In the biological cycle, the nutrients from biodegradable materials are returned to the Earth to regenerate nature.

Figure 9.4 **Circular economy illustrated in a butterfly diagram.**

Source: Based on the Ellen Macarthur Foundation, ellenmacarthurfoundation.org/circular-economy-diagram



Ensuring maximum use, repair, reuse and other measures to extend a product's life is not a new idea. However, the concept of a circular economy is relatively new. There is therefore little research on which policy instruments best support a transition to more circularity that entails less harm to nature and the climate. However, it is possible to make use of continuous experience from other countries in policymaking. The EU is developing a comprehensive regulatory framework that aims to ensure more sustainable products and value chains, which we will gain experience from in the years ahead.

In addition to benefits for the climate, environment and nature, increased circularity can be a driver for business development. Few studies have looked at the value creation and employment potential of a more circular economy, but according to the World Bank, some have suggested a positive correlation between resource efficiency and productivity benefits, mainly driven by technological innovation and reduced production costs (World Bank, 2022). The European Commission's Circular Economy Action Plan 2020 refers to a study that finds that a more circular economy can increase employment as a result of increased labour demand from activities relating to extended use, such as repair, reuse and material recycling, and stimulate repair and private consumption (the latter due to increased disposable income from more use of a sharing economy) (European Commission, 2018; European Commission, 2020). If companies fail to move towards more circular business solutions, they risk becoming less competitive or having trouble obtaining funding and access to critical or strategic materials. Competitiveness may be weakened as a result of physical risk (shortages or more expensive raw materials) and transition risk (changes to regulations, markets and reputation). The transition to a circular economy can therefore be considered to have clear positive effects also beyond climate, environmental and natural benefits.

New solutions are important to promote a circular economy. To reduce emissions and resource and land use, we need both new types of products and new business models. Many of the zero-emission solutions being developed today require the extraction of metals and minerals, and their production tends to be based on major encroachments on nature. For some metals and minerals, demand resulting from the green transition is higher than that available within the circular value chain. One example is lithium required in connection with the increasing need for batteries. For others, the need is in line with what is already available. To move from a linear to a circular economy, new business models are needed that help restructure a given industry. More innovation towards the sharing economy and sharing mobility can help consumers change their behaviour and reduce the resources used for consumption and mobility. Owning less and sharing more through a sustainable approach will reduce our footprint on nature, resources and the climate.

There is no common international method for calculating the degree of a country's circularity. The EU has developed an indicator framework to measure the degree of circularity in the EU and its member states. The indicator framework was updated in 2023 to better show the links between circularity, climate neutrality and the EU's zero-pollution vision. The framework measures production and consumption, waste management, secondary raw materials, competitiveness and innovation, and global sustainability and resilience. Together, the indicators provide an impression of the overall status of circularity in the EU and the development of individual indicators over time.

According to the World Bank, Europe has made important overall advances in material efficiency. Total use of materials in Europe has decreased from 6.6 billion to 6.0 billion tonnes, and the share of resources based on materials recovered from waste has increased by almost 50 per cent over the past 20 years. Overall resource productivity (i.e. euros per kg of domestic material consumption) increased by almost 35 per cent over the same period. However, the development can be partly explained by a change in industry structure, and according to the World Bank, much remains to be done before the European economy can be described as circular.

9.4 Circular economy in Norway

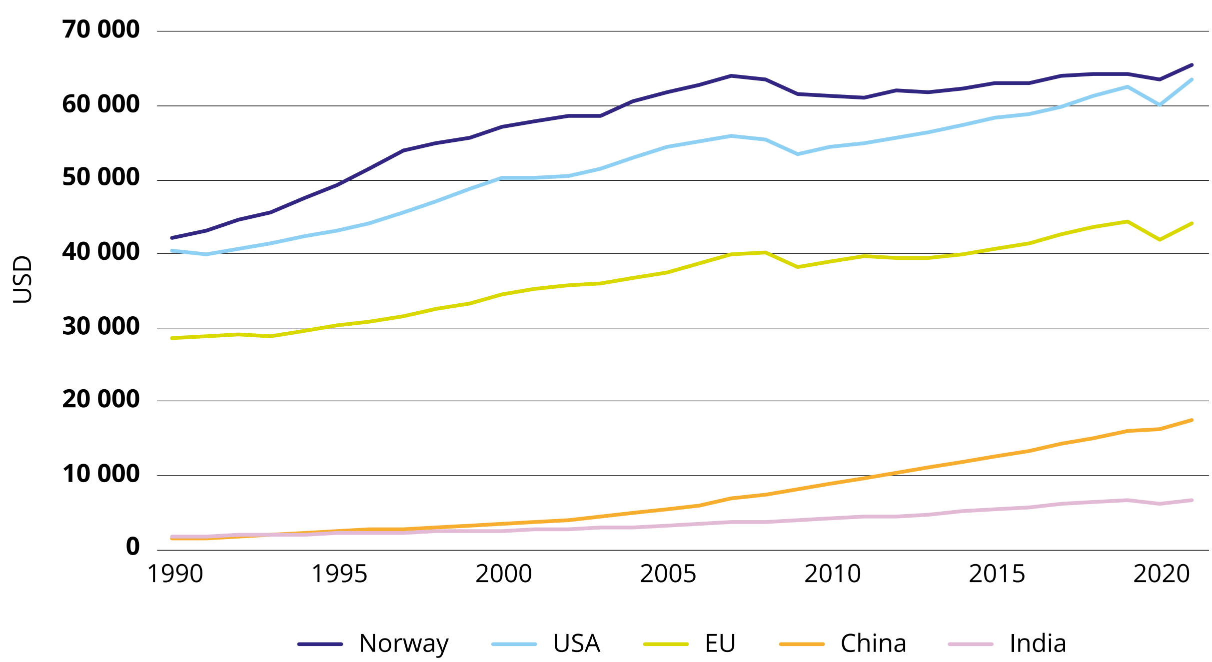
Several indicators suggest that the Norwegian economy is less circular than other economies. Norway scores low on the World Bank's circularity indicators for Europe. The OECD's environmental performance review of Norway shows that Norway has a high material footprint per capita compared with other countries (OECD, 2022). A country's material footprint refers to its actual use of raw materials to meet demand in the economy. In addition to the fact that high material consumption and an industry structure emphasising raw material production contribute to a high material footprint, the OECD points out that an important part of the material footprint is linked to imported goods and therefore also our global environmental impact. In 2021, the Norwegian Government submitted its second voluntary report to the UN reviewing Norway's efforts towards achieving the SDGs. The report shows that Norway scores well on the goals in a number of areas. However, our performance is lower on the goals relating to consumption, emissions and biodiversity, and these areas are highlighted in the report as the main challenges for Norway when it comes to meeting the SDGs. SDG 12 (Responsible consumption and production) and SDG 13 (Climate action) are the targets Norway scored lowest on.

A number of regulations are being drawn up to promote sustainable products and value chains. This applies to both Norway and the EU, and the regulations will probably affect Norway's goal achievement in the years ahead. However, there is also a need to further develop Norwegian policy to ensure benefits for the climate, environment and green business development at home.

Norway does not currently meet binding EU targets for waste. Norway failed to achieve binding EU targets for preparing for reuse and recycling of household and similar commercial waste for 2020, and is even further away from the 2025, 2030 and 2035 targets. Policy measures are being developed to increase the proportion of waste prepared for reuse and material recycling, but the measures are unlikely to be sufficient to achieve the EU targets. Major changes are needed to reach the targets. Norway has set an environmental objective that the increase in waste generation must be significantly lower than economic growth, and that material recycling of waste must increase (Norwegian Environment Agency, 2023e). However, with a few exceptions, waste volumes have grown faster than the economy in recent years. According to Statistics Norway's waste accounts, there has also been a decrease in the recovery rate of ordinary waste.

Developments in the Norwegian economy in recent years may have hindered progress towards a more circular economy. Over the last few decades, Norway has experienced high economic growth, also in an international perspective, and benefited greatly from Norwegian goods being sold at a high price to other countries while imported goods have become cheaper (see Figure 9.5). The terms-of-trade gain is due to particularly high petroleum prices and low prices for goods from, for example, China.

Figure 9.5 **GDP per capita (adjusted for purchasing power parity, fixed prices, US dollars).**
Source: World Bank (Macrobond)



Norway's economic development has enabled high investments and a high consumption of goods and services. Private consumption in Norway has risen more than in other countries. The public sector has made many and substantial investments in, for example, construction and transport. Every year, the public sector procures goods and services for over NOK 740 billion. Both investments and procurements have an impact on GHG emissions and loss of nature. Environmental impacts result in particular from procurements in construction, transport, canteens, food, ICT and EE products, plastics, batteries, furniture and textiles. Asplan Viak calculated the climate footprint of public procurements in 2019, on behalf of the Norwegian Agency for Public and Financial Management (DFØ, 2023c). In total, it was estimated that public procurement and investment have a global climate footprint of 11.2 million tonnes of CO_2e. Following a tightening of the regulations for public procurement in 2023, climate and environmental considerations must now, as a rule, be weighted by a minimum of 30 per cent in tenders.

In Norway, maintenance and repairs do not often pay off financially for the individual. This may have reinforced growth in the purchase of new goods. According to surveys conducted by the Consumer Council of Norway, many broken products are not repaired because it is too expensive (Norstat on behalf of the Consumer Council of Norway, 2021). Combined with a high and growing level of prosperity and the fact that many goods have a short service life, these developments contribute to Norway's high material consumption, low circularity and substantial waste generation. With a changing composition of consumption, Norway has also become one of the European countries with the highest number of flights per capita and the highest volume of waste per capita, and the OECD country with the third highest material consumption (Guillen-Royo, 2022; OECD, 2022).

The problem with the current economic system is that externalities arise to a large extent in the major commodity-producing economies of the world. The OECD points out that, as for many other developed economies, part of the material footprint from Norwegian consumption arises outside Norway. The OECD recommends facilitating a transition to a more circular economy in Norway, and to take account of the negative environmental impacts in other countries caused by Norwegian consumption. Many emerging economies have a limited capacity to develop an ambitious climate and industrial policy within a reasonable timeframe. Since Norwegian consumption is dependent on global value chains, changes in Norway will lead to emission reductions abroad as well. The Committee discusses a number of issues relating to Norway's overall footprint in Chapter 11.

See discussion of issues relating to Norway's overall footprint in Chapter 11.

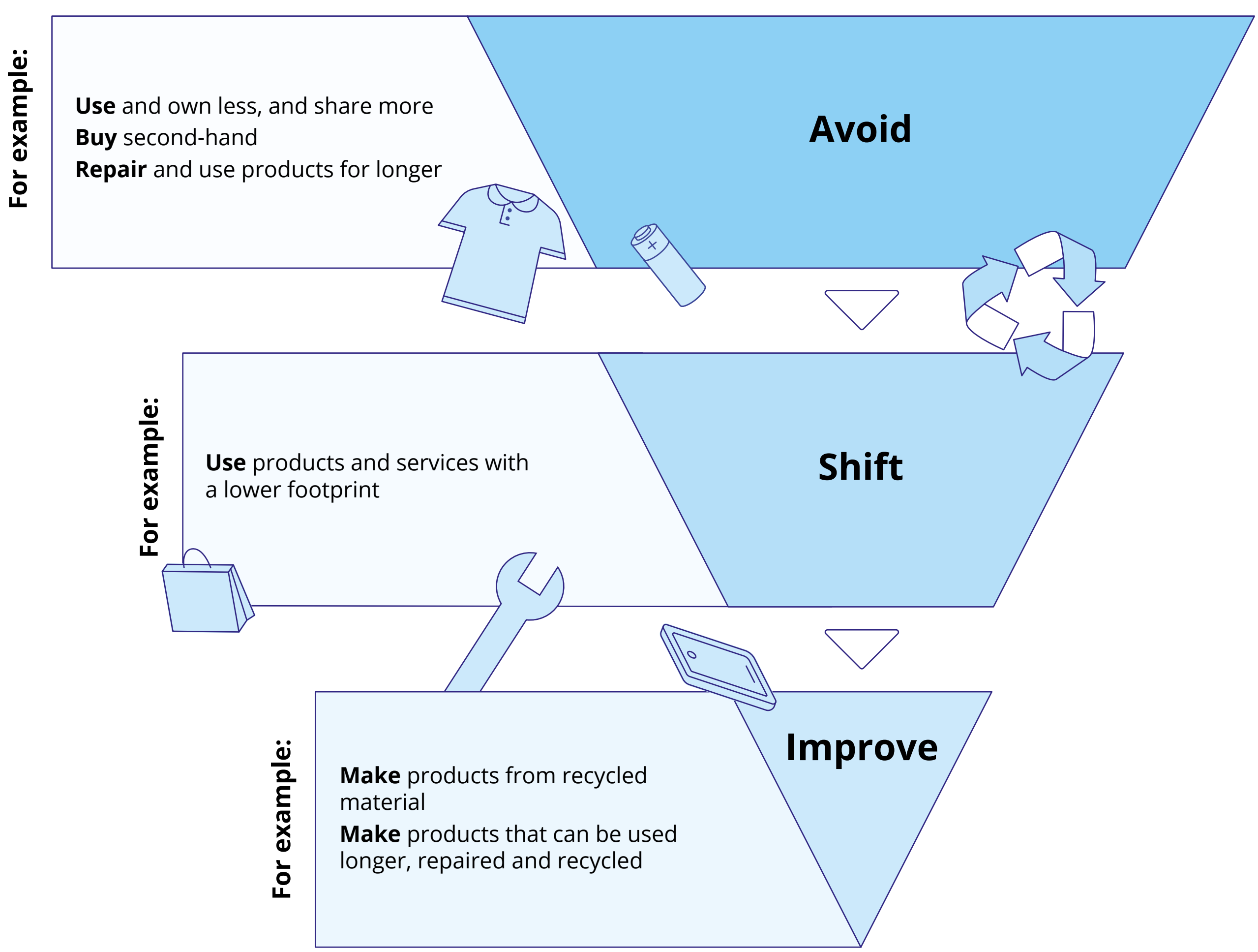
9.5 Policymaking to promote a more circular economy

Measures to promote increased circularity should primarily concern extended use, reuse and material recycling. In most cases, this will ensure the most positive effects. Figure 9.6 shows how the framework *Avoid–Shift–Improve* (ASI) can function in a more circular economy, where emphasis is also placed on avoiding activities. The examples are not exhaustive.

Most EU initiatives relating to circularity affect Norway through the EEA Agreement. The EU's action plan will therefore be key to the transition towards a more circular economy in Norway. A number of changes have already been made to the Norwegian regulatory framework in line with changes in EU regulations, and this will continue going forward.

Figure 9.6 Framework for policy measures *Avoid-Shift-Improve* (ASI) in a more circular economy. The figure shows various priorities and examples of how the priorities can guide policymaking. The examples are not exhaustive.

Source: The 2050 Climate Change Committee



The EU is working on a number of initiatives to promote a more circular economy. The European Commission's Circular Economy Action Plan from 2020 emphasises that a rapid transition towards a more circular economy is a prerequisite for the transition to a low-emission society and reduced loss of biodiversity. The action plan contains 35 initiatives, which include both new regulations and reinforcement of existing regulations and standardisation processes. Parts of the regulations have already been adopted, some parts will be considered this year and a number of proposals are expected to be negotiated and adopted by mid-2024.

The proposed Ecodesign Regulation will affect how products are made. The regulation is intended to replace the current Ecodesign Directive, which so far is deemed to have facilitated a substantial reduction in energy consumption. The same effect is now being sought for a more circular economy. The overall framework will apply to a great many products and make it possible to set requirements for the use of recycled material in different types of products, set limits on the content of hazardous substances and make more stringent requirements for products to be repairable, reusable and recyclable. It will also strengthen consumers' rights and opportunities to make sustainable choices through labelling and digital product passports, as well as criteria for public procurement. The European Commission will set out specific eco-design requirements in product-specific underlying regulations. Large companies will also be required to publish the number of unsold products they discard and how the waste is managed. A ban may also be imposed on the destruction of selected products. In the textile industry, a ban on the destruction of unsold and returned textiles is under consideration. Work on underlying legislation will continue for several years, and areas that are likely to be given priority are textiles, furniture, mattresses, tyres, cleaning products, paints, lubricants, iron, steel and aluminium. Similar requirements will be introduced to ensure sustainable products and value chains in several other regulations, such as the Batteries Regulation, the Packaging Directive and the Clean Vehicles Directive.

Consumer information affects which products are purchased, and new rules affect how they can be repaired. In addition to the Ecodesign Regulation, a strengthening of the right to repair is proposed through initiatives that will give consumers better information about the duration and reparability of products before purchase, as well as the establishment of harmonised rules that promote repair after purchase (European Commission, 2023b).

The objective of the EU's classification system for sustainable economic activity (known as the EU taxonomy) is to help financial markets channel capital to profitable sustainable activities and projects. The Taxonomy Regulation establishes the overall framework for the system. A new Sustainable Finance Act that implements the Taxonomy Regulation in Norwegian law entered into force on 1 January 2023. The regulation defines six climate and environmental goals, including the transition to a circular economy. In order to be defined as sustainable, an activity must contribute significantly to achieving at least one of the objectives and do no significant harm to the other objectives.

The European Ecodesign Regulation will also to be incorporated into Norwegian law. In June 2023, the Government submitted a new draft act on sustainable products and value chains for consultation, which will provide legal authority for introducing new, stringent rules for products on the market. The new requirements aim to reduce the climate, environmental and nature footprints of products, reduce waste and combat wasting of resources (Ministry of Climate and Environment, 2023).

The Tax Committee has conveyed a need to transition towards a more circular economy (NOU 2022: 20). The traditional view in economics has been that national environmental policy should not be used to correct externalities that arise in other countries. Although, in many cases, the external costs of Norwegian goods consumption do not arise in Norway, lack of pricing and regulations in the producer country or in connection with international transport will affect consumer choices in Norway. This will make it more attractive to continue consuming new goods rather than to reuse and repair. If, instead, appropriate taxes had been levied on all activities that create externalities, there would be less need for policy instruments to promote the circular economy. At the same time, it is difficult to envisage the possibility of pricing the externalities of resource and material consumption in all cases. The Tax Committee has discussed various policy instruments within the tax system that can help stimulate circular activities, including less extraction of raw materials in addition to more reuse, repair, return and recycling. The Tax Committee identified a great need for knowledge about the circular economy and therefore recommends a broad study of measures that can promote circular activities. Furthermore, it recommends that tax measures should be assessed against other measures, including direct regulation and information initiatives.

The Tax Committee assessed how environmental pricing and other economic instruments can contribute to increased circularity. The main emphasis of its analyses was therefore on policy instruments within the tax system. The Committee discussed tax on plastics and textiles, tax on the extraction of primary raw materials, differentiated VAT, reduced VAT on second-hand products, tax on the handling of waste and EU regulations. The Tax Committee stressed that the list is not exhaustive, but that it includes proposals that have been raised in the public debate or recently introduced in comparable countries.

The relationship between the prices of new goods, reuse and repair of second-hand items is probably an important part of the reason why a shift towards more circular consumption in Norway is so demanding. The introduction of certain taxes could help change these relative prices. For example, a tax on plastic packaging and new textiles, as well as reduced VAT on the sale of second-hand products and on services, could promote circular activities. Similarly, a tax on disposal can promote more circular solutions. Until now, low prices on a number of products in combination with high prices of repairs have been a barrier to increased circularity in Norway. Reduced VAT on repairs is often highlighted as a solution, but given the large relative differences in wage levels between Norway and the countries we import from, there is reason to believe that this will not be of decisive importance in making repairs rather than the purchase of new goods profitable.

Limited availability of spare parts and second-hand products, and little knowledge of how to assess the quality of a second-hand product, are barriers to circularity. Even with the desire to buy second-hand, the product must be available at a time and place where you need it. It may require more knowledge to assess the quality of a second-hand product if there is no information about this in the form of, for example, a digital product passport. Knowledge and skills may also be needed to repair or adapt the second-hand item to the desired use, which may not be available to the buyer or companies that receive products for repair.

The volume of public procurements suggests that they have an impact on GHG emissions and loss of nature. The regulations for public procurement allow for the purchase of second-hand goods, but this is not a requirement. It is not a given that everyone is familiar with the scope of available options under the regulations. The Norwegian Agency for Public and Financial Management (DFØ) produces a number of guides for public procurement, including more than 20 guides on climate and the environment, two of which are on circular procurement (DFØ, 2023b and DFØ, 2023d). The Government has appointed a legislative committee that, among other things, is tasked with drawing up proposals that can strengthen climate and environmental considerations in the public procurement regulations. This includes assessments of how public procurement can accelerate the transition to a green circular economy. The legislative committee will submit the first part of its assignment in November 2023, and the second in May 2024. In 2023, the Government adopted a main rule for public procurement that climate and environmental considerations must be weighted by a minimum of 30 per cent, and specific requirements will be introduced to promote green public procurement in a number of EU/EEA regulations in the years ahead. This will boost the role of public procurement in promoting the circular economy in the years ahead.

Several Norwegian business models have recently been established relating to the circular economy. One of the goals of these has been to make circularity profitable for all links in the value chain. Such private initiatives can be pivotal in the years ahead.

The potential for increased circularity appears to be particularly high in the construction and real estate industry. The sector accounts for a large share of global GHG emissions, and the most important materials used are steel, concrete, plastics and aluminium. These materials generate high emissions during the production phase and require natural resources such as sand and minerals. The most effective climate action in building and construction is to improve the efficiency of land use and the use of materials. Norwegian industry has relatively low direct emissions, but generates high indirect emissions through the import and use of building materials. The construction industry accounts for around 14 per cent of Norway's direct and indirect emissions. Almost two-thirds of this is from the production and transport of materials (Jahren et al., 2020). Materials used in industry are not reused to any degree, and reuse has largely been limited to individual projects. However, some enterprises have recently established trading in used building materials. Industry accounted for 25 per cent of Norway's total waste generation in 2021, and was the largest single source of waste. It is estimated that over 80 per cent of this waste was recycled or used as filling and covering material in 2021, but the figures are uncertain.

Important measures to reduce emissions in building and construction are to demolish fewer buildings, and to choose circular solutions and low-emission building materials based on a life-cycle perspective. This could reduce emissions from production, waste treatment and the transport of materials. A study conducted on behalf of Enova shows an average estimated potential for emissions reduction in renovated low-emission buildings of 57 per cent. In other words, there is great potential for reducing emissions by renovating buildings with climate-friendly materials rather than erecting new low-emission buildings (Fuglseth et al., 2020).

Measures have been implemented in Norway in recent years to make reuse of construction materials easier and more profitable. It is estimated that circularity measures in the Nordic construction sector can reduce the use of building materials by up to 20 per cent and lead to a reduction in GHG emissions of up to 10 million tonnes of CO_2e, when taking into account the extraction, production and transport of building materials. So far, changes have been made to the energy, climate and environmental requirements in the Technical Regulations (TEK) as well as associated changes in the Building Application Regulations. These changes entail a requirement for new buildings to be constructed in a way that enables subsequent dismantling, and that the materials must be surveyed for reuse during major work on existing buildings. The requirement for sorting waste at construction sites has been increased from 60 to 70 per cent. A requirement has also been introduced for GHG accounting for apartment buildings and commercial buildings. New documentation rules have been introduced for construction materials that will make it easier to sell used construction products.

However, construction companies that wish to become more circular still report a number of barriers. For example, it is often more profitable to erect new buildings than to renovate or incorporate used materials. The market for used materials does not function as intended, and the TEK contain few binding requirements on the reuse of materials. Nor do the current regulations require recycled raw materials to be incorporated into products or stipulate limits for emissions generated by the use of materials. One suggestion mentioned by the industry is to tighten requirements in the TEK. Another example that is mentioned is the exemption from document tax that applies to the first-time transfer of new buildings. Since the vast majority of the buildings of the future have already been built, requirements in connection with renovation are at least as important as requirements for new buildings. Requirements for the use and handling of materials should therefore be introduced to make it more attractive to reuse materials, use recycled materials, limit the use of materials and facilitate reuse through appropriate handling.

To stimulate appropriate handling of secondary materials and waste, it is important that the cost structure of fossil CO_2 emissions provides incentives for well-functioning circular value chains, thereby resulting in a high degree of recycling. There should be a cost for fossil CO_2 emissions, but this cost must be geared so that preparation for reuse and recycling is prioritised and provides incentives for the capture and storage of not only fossil, but also biological CO_2.

Barriers to increased circularity are also reported in other industries. In the clothing industry, for example, requirements for longer life, repairability and increased opportunities for material recycling can be considered. As previously mentioned, EU requirements will be introduced to this end. The food system also generates substantial amounts of waste, and even more emphasis should be placed on reducing this at all stages – in production, trade and consumption. There are regulations, classifications and incentives in the waste industry that can prevent circularity. Electronic consumer goods could be designed with a longer service life and made easier to repair, and EU regulations will contribute to this end going forward. The ongoing revision of the Second-hand Trade Act can more effectively facilitate second-hand trade, repair and lending.

Policy instruments targeting business and industry can be designed to stimulate a more circular economy. These policy instruments offer a variety of schemes and programmes such as loans, grants, guarantees and various skills initiatives to help businesses with R&D, establishment, growth, scaling and export. The goal is to support business development that increases overall value creation in Norway within a sustainable framework. Although the proportion of Norwegian companies making use of available policy instruments is relatively low, it is positive that the system is increasingly helping businesses towards low emissions. For the system to stimulate increased circularity, this could more often be made a criterion for obtaining project funding.

More sustainable land use will promote circularity. Regulations and price structures that promote more sustainable land use will increase the value of land. This will, in turn, increase the cost of using energy and materials that lay claim to land, and stimulate a more circular economy. The municipalities can also facilitate circular solutions. They have been assigned clear roles as drivers of community development, as procurers and as planning authorities. They can, for example, promote the sharing economy, repair, reuse and recycling, and facilitate business clusters by allocating land.

Municipalities should also use their purchasing power to choose circular goods and services. Asker municipality has, for example, facilitated second-hand trade through a dedicated reuse centre and through information on its website.

Developments in social norms and preferences also have an impact on progress towards circularity. The emergence of both physical and digital markets for the reuse of building materials, second-hand clothing and other consumer goods is driven by profitability, but also by trends that indicate that second-hand products are more acceptable to consumers. In the private and public sectors as well, the reuse of materials and goods is often as much driven by the commitment of individuals to reuse as by financial assessments. Such norms and preferences can be influenced by policy in both a positive and negative direction. Research into how policies can influence the behaviours and decisions of individuals and organisations is evolving rapidly. It is important that the Government builds policy on such knowledge.

A sharing economy could also contribute to more efficient use of resources, as it facilitates the use or exchange of services and expertise, assets and property, resources or capital, mainly between private individuals. This happens without the transfer of ownership rights. Exchanges take place in particular through communication on digital platforms. More frequent use of objects and property can lead to lower production overall if organised in a sustainable way. This can have a positive effect on resource extraction and GHG emissions. The sharing economy can also contribute to more efficient use of resources through increased market competition and potentially lower prices, a better selection of products and services, and innovation. At the same time, there is a certain risk that the sharing economy may have the opposite effect. Carpooling, for example, may lead to people choosing to drive rather than use public transport. It is important that the policy that regulates and facilitates sharing solutions also seeks to counter such effects and ensures that the overall effect on the climate and environment is positive.

The sharing economy has great potential. Through the use of digital solutions, the sharing economy has facilitated more extensive direct sales between private individuals than predicted. Regulatory frameworks in various areas are not sufficiently adapted to this. Examples are consumer protection rules that are designed based on the model of professional companies selling to consumers with little bargaining power, tax rules based on taxpayers engaging in economic activity continuously and over a long period, and labour market regulations based on companies with employees.

Efforts towards a more circular economy should be given higher priority. An economy that reuses resources to a greater extent can contribute to solving the climate crisis. The 2050 Climate Change Committee supports the Tax Committee's recommendation for a broad assessment of policy instruments for a more circular economy. Such an assessment should consider a broad range of policy instruments, also beyond the tax system, that can contribute to a more circular economy. National calculations and indicators should be established for the circularity of the Norwegian economy. These indicators should be comparable with EU indicators, allowing developments to be monitored over time and compared across borders. This can form the basis for setting national targets for the status of the circular economy in 2050.

Det bør settes av tilstrekkelige ressurser til å følge regelverksutviklingen i EU knyttet til sirkulærøkonomi, til å gi innspill til utformingen av regelverket, og til å forberede gjennomføring i norsk rett. Norge bør gjennom samarbeid med EU sikre at vi deltar i et fremtidig sirkulært marked. Involverte myndigheter må samarbeide tett og sikre korrekt og rask implementering. Veilederne for offentlige innkjøp som handler om sirkulære anskaffelser bør i større grad gjøres kjent, og utvides til flere typer innkjøp. Barrierer som bremser nye forretningsmodeller knyttet til sirkulær økonomi og mer sirkularitet i bygg- og anleggsbransjen bør identifiseres og bygges ned. Relevant regelverk, som Byggteknisk forskrift og Plan- og bygningsloven, må oppdateres med klare krav til ombruk av materialer, energieffektivisering og økt tilrettelegging for rehabilitering. Arbeidet for en mer sirkulær økonomi bør fortsette med full styrke i klesbransjen, i elektronikkbransjen, i matsystemene og i avfallsbransjen.

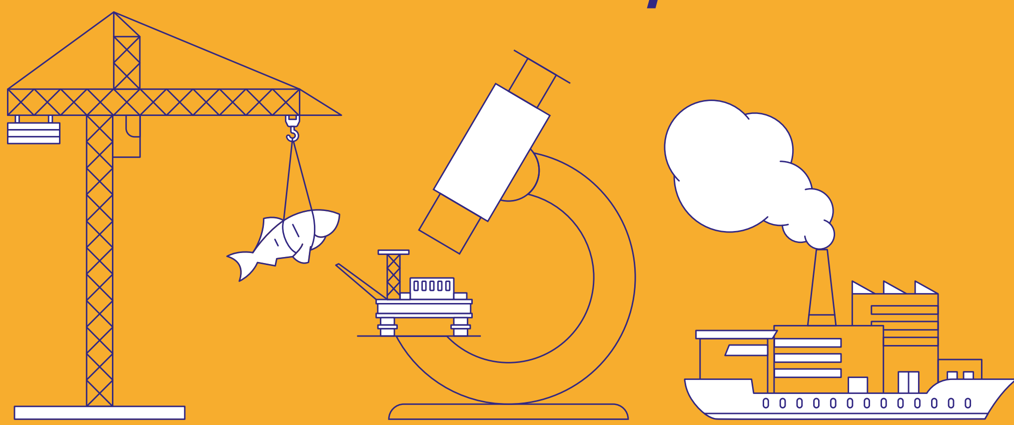
Sufficient resources should be set aside to monitor regulatory developments in the EU relating to the circular economy, to provide input for the design of the regulatory framework and prepare for implementation in Norwegian law. Through cooperation with the EU, Norway should ensure participation in a future circular market. The authorities involved must cooperate closely and ensure correct and rapid implementation. Public procurement guidelines that address circular procurement should be promoted and extended to include several types of procurement. Barriers that slow down new circular business models and more circularity in the construction industry should be identified and reduced. Relevant legislation, such as TEK and the Planning and Building Act, must be updated to include clear requirements for material reuse, energy efficiency and better arrangements for renovation. Efforts to achieve a more circular economy should continue with full force in the textile industry, the electronics industry, in food systems and in the waste industry.

9.6 The Committee's recommendations

The Committee's point of departure is that all economic activity must take place within planetary boundaries and be based on efficient use of all resources, and that all policy must be based on this objective. The Committee therefore has the following recommendations:

- emphasise welfare above material prosperity and base policy on the premise that resources are scarce and that a more circular economy is necessary.
- ensure that economic policy is consistent with the transition to a low-emission society. The Government's white paper on long-term perspectives for the Norwegian economy should contain analyses that show the extent to which economic growth projections are consistent with the goal of reduced greenhouse gas emissions and a more circular economy.
- follow up the Tax Committee's recommendation for a broad assessment of policy instruments for a more circular economy. Such an assessment should consider a broad range of policy instruments, also beyond the tax system, which can contribute to a more circular economy.
- establish national estimates and indicators on how circular the Norwegian economy is, in line with the EU's indicator work, which can form the basis for setting national targets for the status of the circular economy in 2050.
- through cooperation with the EU, ensure that Norway participates in a future circular market, including cross-border material flows.
- set aside sufficient resources to follow regulatory developments in the EU relating to the circular economy, to provide input for the design of the regulatory framework and prepare for implementation in Norwegian law. This is important, among other things, when it comes to the repairability of products and recycling of critical raw materials.
- update relevant legislation with clear requirements and incentives for the reuse of materials, energy efficiency and increased facilitation of renovation. This could include considering setting requirements in the Technical Regulations (TEK) on the reuse of materials and reviewing how stamp duty is applied.
- continue head-on efforts to achieve a more circular economy and reduce barriers that slow down new solutions relating to more efficient land use and more circularity in the construction industry, the textile industry, the electronics industry, in food systems and in the waste industry. The use and reuse of existing building stock is key to limiting the use of materials, the occupation of land for new buildings and exploiting existing infrastructure. Regulatory and economic policy instruments should contribute to shifting investments from new construction to the operation and maintenance of existing buildings and infrastructure.
- align the cost of fossil CO_2 emissions in a way that provides incentives for reducing waste and encouraging good waste management through well-functioning circular value chains, thereby leading to a high degree of material recycling and demand for recycled materials.

10 Innovation, transition and industry structure



This chapter describes a major investment need in the transition to a low-emission society, and discusses the importance of innovation and transformation to cut greenhouse gas emissions. It also discusses consequences for the industry structure and the role of business and trade policy in promoting an effective transition. An ambitious and credible climate policy that reduces uncertainty and gives private companies predictability and incentives to make green, profitable investments strengthens the capacity for innovation and transition.

10.1 Removing emissions requires major investments

Climate change and the transition to a low-emission society increase the need for both public and private investment. This applies in particular to infrastructure and other investments with a long service life. A large share of investments towards the transition to a low-emission society will be linked to the transition from fossil to renewable energy. In addition, there will be a need for significant investments in transport systems, food systems, decarbonisation of industrial processes and new industries. Much of the infrastructure investments will have to be covered by public sector budgets, but the transition will not be possible without a significant share of private capital. In order to reduce the use of fossil energy, investments in energy efficiency, new renewable energy and infrastructure for distribution, storage and supply and demand efficiency are particularly important. During the transitional period, investments must be made in the energy systems of the future while at the same time operating today's systems (Naug, 2023).

Decarbonisation: means that activities that currently involve CO_2 emissions are changed so that the activity becomes zero emission, for example switching from cars that run on petrol/diesel to electric cars.

Estimates vary considerably when it comes to the size of the global investments that will be needed going forward. Many estimates of investment needs only look at needs relating to the energy transition. The investment required in the energy transition varies significantly between countries, depending on their current fossil intensity. Countries with a large share of fossil energy production must increase their low-carbon electricity capacity the most. Figure 10.1 is based on a stylised OECD energy transition scenario towards 2050, and shows how the capacity of renewable energy sources in different countries is likely to increase compared with the 2020 level (OECD, 2023). The figure shows that solar and wind power can play a particularly important role in many countries. Although Norway has a large investment need and is likely to have to more than double its capacity by 2050, the need for increased capacity is still smaller than in other countries. The IMF refers to how global demand could vary between USD 3,000 and 6,000 billion per year (i.e. in 3–6 per cent of GDP) up until 2050 (IMF, 2022). The size of the necessary investment is uncertain, among other things because of uncertainty in factors such as climate policy and future GHG emissions, the economic consequences of climate change and the development of technology costs (Prasad et al., 2022). The potentially huge consequences of dramatic climate change mean that investment costs associated with the energy transition are small compared with the cost of inaction. In the IEA's low-emission scenario towards 2050, the value of the low-emission technology market is on a level with the current value of the global oil market. In this scenario, increased investments in renewable energy sources are largely matched by falling investments in fossil energy sources.

Although there has been an increase in climate-related investments in recent years, much remains to be done. The IEA shows that the level of investment in technology development and zero-emission technology infrastructure is still too low (IEA, 2021). According to the Climate Policy Initiative, most of the investments in renewable energy are now financed by private capital. Both the IEA and the Climate Policy Initiative point out that the increase in investments in solar and onshore wind technology reflects falling costs in the renewables sector in recent years, which has led to increased commercial profitability. Investments in zero-emission transport are also growing rapidly, building on multiple years of government subsidy policies and falling technology costs (Buchner et al., 2021).

The world needs large-scale deployment of new solutions. According to the IEA, all the technology needed to achieve the 2030 target is available, while almost half of emission cuts towards 2050 will have to be made using technology that is currently at the demonstration or prototype stage. The IEA highlights the processing industry and long-distance transport as the most demanding emissions. New technology is also essential to achieving a rapid and less turbulent energy transition (IEA, 2021). The IEA points out that behavioural change is much needed in order for new technology to be used to a greater extent.

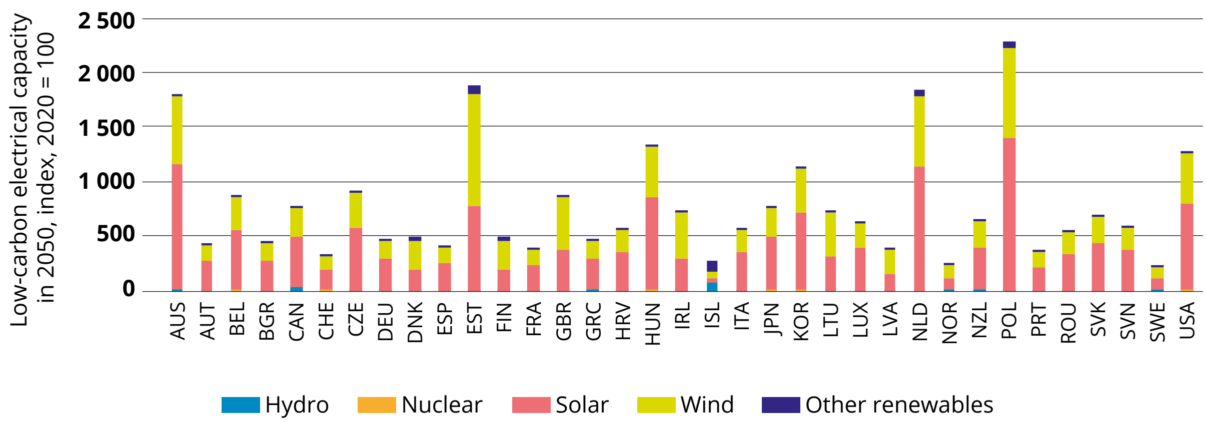


Figure 10.1 **The energy transition requires large investments in renewable energy sources. Increase in low-carbon electricity capacity towards 2050.**

Source: OECD, 2023

Both the scope and nature of the climate-related investments needed in Norway are uncertain. Although Norway already has extensive renewable energy production, there is a need for increased investment here as well. The extent of the power demand is unknown, however, and depends on many different factors, including decisions made by the authorities and private companies relating to energy efficiency and power-intensive activities. Investments must also be made in technology that can reduce emissions from the processing industry, including CCS. Solutions for capturing and storing carbon from ambient air are capital-intensive and lay claim to significant amounts of power and land. How long increased investment is needed is uncertain, as are long-term prices for energy and other input factors Norway. This depends, among other things, on different policy choices. The development of technology globally and the combination of technologies used will play a role. At the same time, a mobility shift towards less transport and less resource-intensive modes of transport, cf. Chapter 8 on mobility, can reduce the need for transport infrastructure investments. Changes in investment needs as a result of the transition to a low-emission society, in the private sector as well as at the central and local government levels, should be considered on an ongoing basis, for example in the white paper on long-term perspectives on the Norwegian economy. See also chapters 9 and 18. It is also uncertain how investments will affect economic development and employment in general in Norway. It will depend on both the scope of the investments and the profitability of the individual industry, as well as on policy action and the extent of willingness to pay (over time) for less carbon-intensive or zero-emission products. Companies in Norges Bank's Regional Network report that the climate transition will result in increased investments overall. More than 40 per cent of them have invested in climate-related projects in recent years, and more than 50 per cent will do so between 2023 and 2025 (Naug, 2023).

See Chapter 8 for a discussion of mobility in the low-emission society.

See Chapter 18 for a discussion of how the government can plan the climate transition.

It is difficult to predict which climate-related investments will be profitable from a long-term socio-economic perspective. With a high use of resources for investments in both the public and private sectors, it is important to manage the risk of funds being misused. Investment in reduced emissions is important, but it is equally necessary to prioritise between the different investment options. Investment decisions must be made in a climate of uncertainty, which requires good decision-making processes and a thorough decision-making basis. When many large projects are taking place at the same time, good governance and management is required to maintain cost control, transparency and coordination of projects that may impact each other. In such an uncertainty environment, it is important to facilitate the most efficient use of the market to allocate capital.

Private financing is necessary to cover a large part of the investment needs. An effective, credible climate policy is essential to provide incentives for private investments in new zero-emission solutions. If carbon is priced high enough (globally), it will increase incentives for private investment. This way, climate policy and the financial industry complement each other. Good policies stimulate private investment and help to achieve climate goals. The EU's classification system for sustainable economic activity (known as the taxonomy) is a key measure to help financial markets channel capital to profitable sustainable activities and projects.

Zero-emission solutions: solutions that generate no direct greenhouse gas and exhaust emissions during use. This means, for example, the use of an electric motor in combination with a battery, or direct use of electricity or a fuel cell that utilises a carbon-free energy carrier such as hydrogen.

Effective planning and implementation of public investment projects is central to the successful transition to a low-emission society. The increased need for investment in public infrastructure, for example relating to energy and transport systems, highlights the importance of high-quality planning and implementation. Both international and Norwegian analyses show that inefficient public investment processes result in large losses. The IMF has a diagnostic tool for assessing infrastructure investments (PIMA), also with a climate perspective (C-PIMA), across different countries, and finds an average efficiency loss of 1/3 globally and 15 per cent in developed countries. No such assessment has so far been conducted for Norway (IMF, 2023).

NTNU's research programme *Concept* assesses concept selection, resource utilisation and the impact of large-scale government investment projects in Norway. Cost control of large government investments in Norway does not appear to be much weaker than what is found internationally, but there nevertheless seems to be significant room for improvement (Berg et al., 2022). Keywords to strengthening the quality of public investment decisions are often related to managing unfortunate incentives, path dependency and political priorities (Samset, 2023).

See also Box 3.3 on path dependency.

In order to ensure that the transition to a low-emission society does not become more demanding than necessary, the authorities should devote more attention to efficient planning and implementation of public investment projects that incorporate the low-emission transition. Learning from, and being involved in developing, international best practices is part of this picture. Part D details how climate considerations can be better integrated into public planning.

10.2 Transition and innovation

Norway has undergone many major transition processes. The changes have been important to the development of society and have affected many people. The introduction of the National Insurance scheme in the 1960s has been of particular importance to welfare, as has compulsory primary and secondary education. One of the most important changes for business and industry has been the emergence of the petroleum sector, which shifted production and employment to an extremely profitable industry. Norway went from having a large primary sector to industrial production and later to service production.

Changes in the Norwegian industry structure over time reflect how production has shifted from industries with low to industries with high commercial profitability. In a well-functioning economy, some companies will go bankrupt and some industries will be downscaled. This frees up labour and capital that can be utilised in more competitive and profitable businesses. Within an industry, value creation can also be increased by replacing uncompetitive, unprofitable and unproductive companies with other companies. Similarly, production in a country can increase when the composition of industries changes. A particular challenge now is to facilitate a transition away from what has been a highly profitable petroleum sector, but which is unlikely to play a major role in a low-emission society; see the further discussion in Chapter 12. The climate transition is unique in that it requires a transition to industries that are not necessarily profitable in the short term, which means that climate policy is necessary to trigger private investments.

See discussion of petroleum activities in a low-emission society in Chapter 12.

Figure 10.2 shows the development in employment broken down by primary industries (which use nature to extract raw materials, such as agriculture and fishing), secondary industries (which process raw materials, such as manufacturing industry) and tertiary industries (which provide services, such as retail, transport and public administration). Figure 10.3 shows the employment trend for the secondary industries, and Figure 10.4 shows the development in value creation (gross product) within the secondary industries (where the profitability of the petroleum sector can be clearly seen).

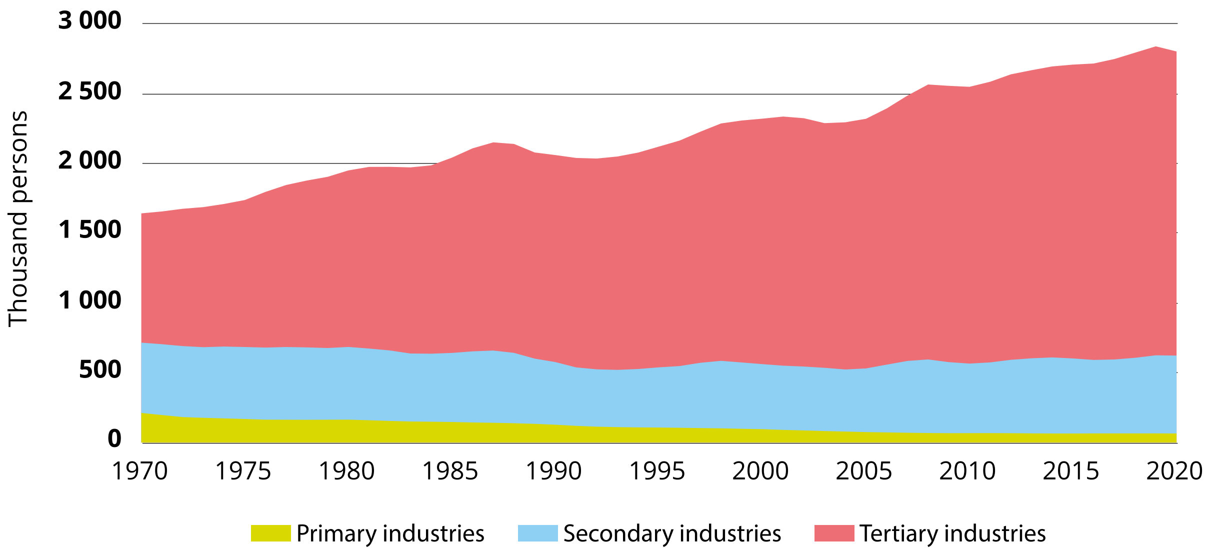


Figure 10.2 **Employment by main industry (1,000 persons).**
Source: Statistics Norway

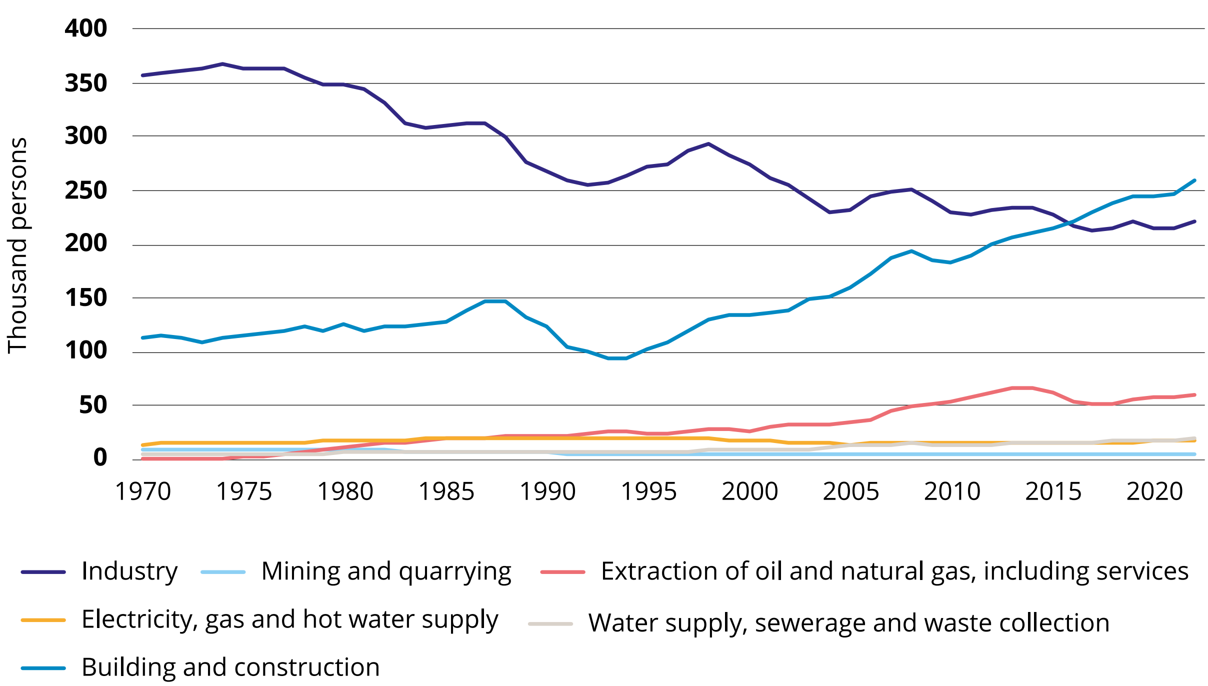


Figure 10.3 **Employment in secondary industries (1,000 people).**
Source: Statistics Norway

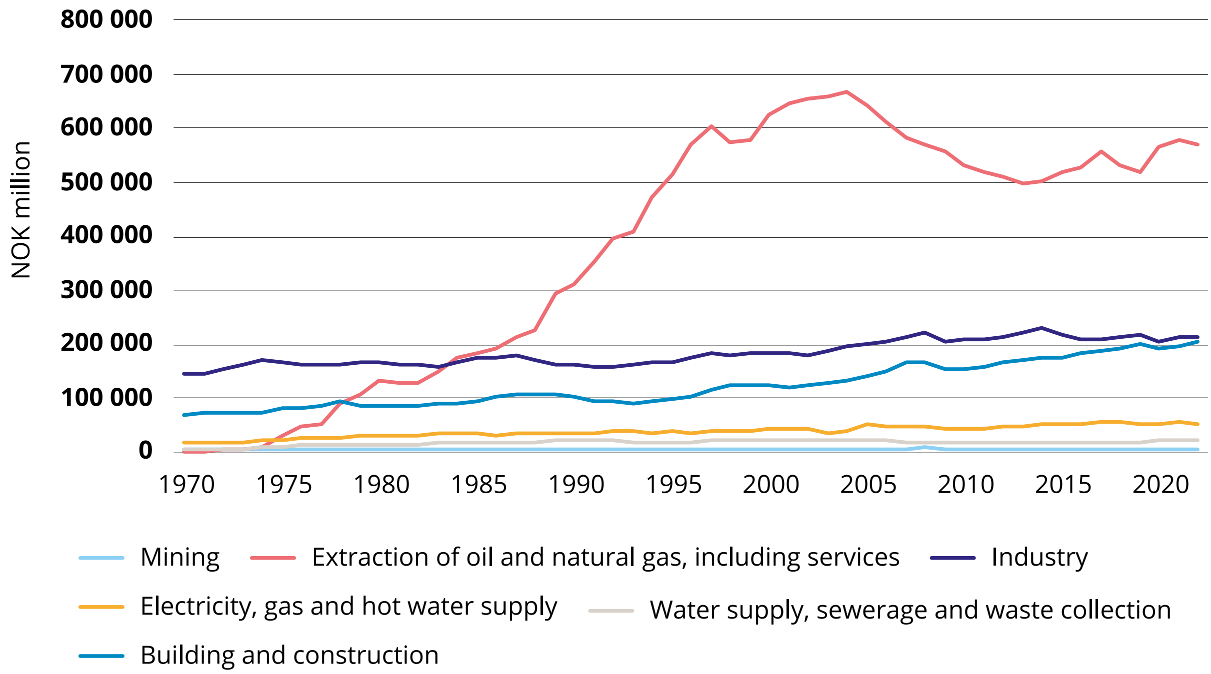


Figure 10.4 **Value creation in secondary industries (gross product, NOK million, fixed 2015 prices).**

Source: Statistics Norway

The competitiveness of individual industries and of Norway as a whole is not the same. A country's competitiveness expresses its ability to maintain a reasonable balance in the external economy over time, while at the same time making full use of labour and capital. The competitiveness of an industry depends on that industry's profitability and its ability to pay for input factors. A profitable industry must be able to compete with foreign and Norwegian companies in product markets, and with other Norwegian industries in the labour market and the capital market in particular. A growing economy with a high degree adaptability will be characterised by different developments in the competitiveness of different industries. In the competition for scarce input factors, some industries will have to scale down their operations, while others expand in line with increased profitability.

There are many drivers behind good adaptability and innovation in the business sector, and much can be influenced politically. Labour market policy, the education system, the tax system, the quality of public services and universal welfare schemes affect the adaptability of business and industry and how attractive it is to conduct business activity in Norway. The welfare state provides a safety net that increases the willingness of individuals to take risks. An economic policy that contributes to stable and predictable development reduces businesses' costs of uncertainty. Furthermore, competition policy, trade policy, tax policy and how public ownership in Norwegian business and industry is managed have an impact on the dynamics of the business sector, the competitiveness of companies and the country's industry structure over time. Transport policy and knowledge policy have an impact on the productivity of business and industry. The business sector is also dependent on well-organised structures and legislation that make it easy to start, run, develop and close down businesses. Confidence in the good functioning of these policy areas is fundamental to the dynamics of business and industry, and contributes to companies' ability to adapt in step with changing framework conditions. There are various barometers that seek to measure a country's ability to adapt. These indicate that Norway is well positioned in many areas, but that there is also room for improvement (Abelia, 2023; IMD, 2023).

Education and skills are crucial for a successful transition. A shortage of relevant expertise can slow down the necessary transition to a low-emission society. A sudden transition of industry, where labour needs are reduced in one industry without having the necessary skills to build up another industry, can give rise to unemployment and increase social inequality.

The Skills Needs Committee's thematic report on skills needs for the green transition points out that the transition to a greener economy leads to jobs arising in new industries, but that the transition mainly takes place within existing industries (Skills Needs Committee, 2023). The committee finds that the green transition in particular leads to increased demand for professionals such as engineers, ICT specialists and skilled workers in technology and crafts – as well as teachers in these areas of education. These are occupational groups that, among other things, are central to the development of new technology and renewable industries, as well as the electrification and capacity expansion of the power transmission system. The committee also points out that a wide range of businesses and organisations demand workers with an understanding of climate change and the environmental challenges the world is facing, and of what role each individual companies can play in reducing emissions and preserving nature. Different occupations and industries may require different types of sustainability skills. The need for vocational and industry-specific sustainability skills can be met by adapting the content of existing study programmes and by ensuring that employees throughout the labour market receive relevant training or further education. The Skills Needs Committee believes that there is a great need for transition skills, including social and emotional skills, both for those who will drive the changes and for those affected by the transition. SpareBank 1 SMN's Sustainability Barometer shows that medium-sized businesses lack sufficient expertise in sustainability to a greater extent than large businesses (SpareBank1, 2023).

Climate policy is important to ensuring that the development of technology responds to the climate challenge. Climate policy measures and instruments give direction to innovation, which in turn affects which technologies resources are allocated to developing and spreading. Many of the markets that the products are supplied to were created through political decisions, especially in the start-up phase. Zero and low-emission technology is in demand in the market and researchers are working to develop solutions because political goals have been set and measures taken to achieve the goal of cutting emissions, not primarily because customers demand these technologies regardless of developments in climate policy. For example, strong public policy instruments, in the form of both funding schemes and other instruments, have resulted in major cost reductions for electric vehicles, and solar energy and wind power. If climate policy supports technology development and implementation, and helps to price externalities and increase the price of limited resources, the market will drive innovation on this basis. The profitability of technology development may therefore be linked to how ambitious climate policy is. At the same time, when some are given advantages while others are not, this can affect the markets and potentially slow down other innovation processes. If the public sector is to support technology, it must be based on the long-term viability of the technology without public support, and technology neutrality is often a useful starting point.

Barriers other than costs also prevent new technology from being taken into use. Barriers such as lack of knowledge, resistance to change, social norms and accessibility also prevent the rapid spread of new zero-emission solutions. Most of the measures assessed by the Norwegian Environment Agency face more than one barrier (Norwegian Environment Agency, 2023c). As this is this case for most climate mitigation measures, the Agency points out that one policy instrument alone will rarely be sufficient.

Successful transition and innovation depends on a well-functioning interaction between many different stakeholders. Interaction between the public and private sectors and civil society will become more important when establishing cross-sectoral solutions. Tripartite cooperation, i.e. between the Government and the social partners, is also important when resolving major societal challenges. One example is the Committee for a Just Transition for Workers, which is chaired by the Minister for Climate and Environment and includes representatives of the largest employee and employer organisations. Another example is climate partnerships as an arena for structured dialogue on the green transition between the Government and various sections of business and industry, an initiative launched in 2023 by then Minister of Climate and Environment Espen Barth Eide and Minister of Trade and Industry Jan Christian Vestre, together with the main employer and employee organisations. Good cooperation between the authorities and the various sectors will be useful as they can jointly identify the barriers that need to be overcome in order for necessary changes to occur.

Interaction between technological and social innovation facilitates a rapid transition. As the technology for batteries and electric vehicles improved and various charging solutions were developed, it also became easier for consumers to switch to electric cars. Increased acceptance of electric vehicles resulted in a larger market for further developing the technology. Cross-border learning is important for technology diffusion. Norway's experience of facilitating increased use of electric vehicles has attracted a lot of international attention.

New solutions must replace the old ones. If new technology is to help reduce emissions, it must be more than just another product on the market. The effect on emissions is not immediate, but will only be fulfilled when the zero-emission technology replaces the emission-intensive technology, or when new solutions are developed that eliminate demand for the old technology.

10.3 Industry structure and industrial policy

Many industries will have a bearing on the transition going forward, but for different reasons. While some industries will be more important because they provide goods and services that are in demand in the low-emission society (for example renewable energy production), other industries play a role in the transition itself (for example the financial industry). Expectations of climate change and policies affect market pricing and business adaptation. Financial markets are forward-looking, and if something is expected to happen in the future, it will be reflected in the prices the financial markets set today.

The Norwegian industry structure in the low-emission society will depend on which industries succeed in the transition. How competitive Norwegian businesses will be in the low-emission society will be determined by a wide range of factors. At the same time as the terms and conditions of business are determined by national policies, very much depends on developments in various national and international markets. Large parts of the Norwegian business sector are engaged in international value chains and will be affected by developments in a wide range of global markets. Norway is a major producer of petroleum, seafood and metals, and has a significant maritime sector. Innovation and technology development in other countries will be of great benefit and importance.

The transition to a low-emission society may provide new opportunities for Norwegian businesses. An effective, credible climate policy could lead to new, private initiatives. Established companies can find new business models and markets, but new skills and new industries will also be valuable in the future. We do not know which industries will be competitive and profitable in the future, and it is the business sector itself that is best qualified to consider which areas it would make sense to invest in. At the same time, there is a risk that industrial policy will lead to path dependency if it is primarily aimed at safeguarding the interests of existing industry and thereby preserves the current industry structure.

Most companies in Norway are small, with few employees. There are more than 600,000 companies in Norway, and of these, around 150 are covered by the EU's emissions trading system (EU ETS). Fewer than 5,000 companies employ more than 100 people. This means that the vast majority of private companies in Norway are affected by the transition to a low-emission society in ways other than through the EU ETS. The policy must enable these companies to take advantage of the commercial opportunities the transition to a low-carbon society provides.

Companies need to invest in technology development, upscaling and industrialisation and must prepare for a market where there is willingness to pay for the investments resulting from the climate transition. To enable companies to make investment decisions, they need predictable framework conditions and an overview of the uncertainties associated with technology. The risk situation is complex and includes technology choices, changed emission limits, access to power/heat, access to skills, future carbon taxes/prices, willingness to pay for products with lower/no carbon intensity etc. It will be easier for companies to make an investment decision when the many factors that affect the decision are associated with greater predictability. The measures that companies will want to take will depend on the availability and maturity of technology, expertise, access to capital and framework conditions. To increase predictability, the Government's Expert Committee for Climate-Friendly Investments recommended, inter alia, to facilitate broad agreements between different political parties and across parliamentary periods, and that legislative decisions may be a necessary instrument, together with participation in binding international cooperation, including the EEA. The Expert Committee also pointed out that measures that contribute to the transition help increase the credibility of the goals and that the policy instruments should be predictable but dynamic, allowing them to adapt to changing needs (Expert Committee for Climate-Friendly Investments, 2022).

An ambitious, credible climate policy can potentially reduce uncertainty and give private companies incentives to make green and profitable investments. It is crucial to send credible signals about a stringent climate policy to the market, where signals about future costs, revenues, regulation, framework conditions for free establishment and competition are key. Competitive business and industry must be built on general framework conditions for the entire sector, and not on permanent government transfers. In the transition to a low-emission society, the interaction between the public and private sectors, the profitability of various industries and how the Norwegian authorities prioritise their climate-related policy instruments will be important.

Public funding is essential for technology development. Companies that invest in developing new technologies are often not left with all the profit themselves, partly because others may copy the technology. For this reason, companies often do not have incentives to invest enough in developing new technology, and part of the technology development should therefore be supported through funding schemes (see also Chapter 15).

See discussion of policy instruments for technology development in Chapter 15.

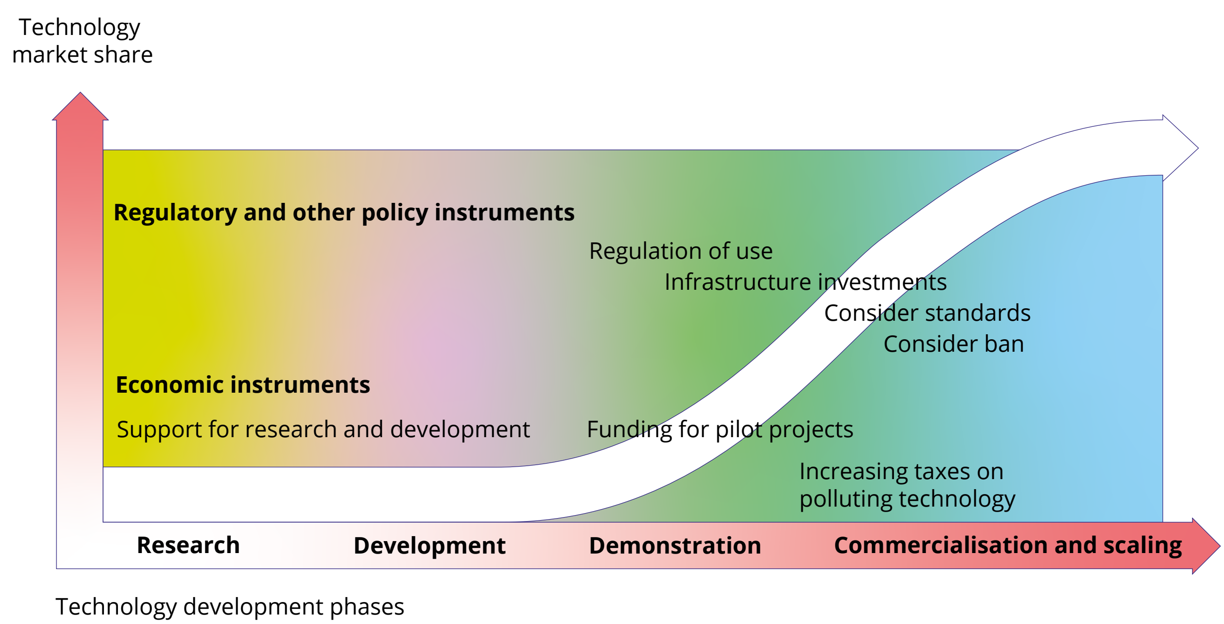
At the same time, there is scientific and political disagreement about how big the government's role should be. The debate can roughly be divided into two sides. One side points out that the government should facilitate green transition through rules of the game and ensure productive incentives in the ecosystems surrounding entrepreneurs and innovative growth companies, as well as provide support for research-based development , as that is where the market signals appear to be weakest. The government should concentrate on disseminating knowledge, while the market should primarily deal with the spread of innovation, as the market coordinates many individual decisions most effectively. The other side highlights that the government, to a greater extent than commercial players, has the possibility to think long-term and take on risk. The government should therefore also provide risk relief at various stages of the innovation process, signal the direction for private companies through funding agencies' prioritisation of important areas, while also contributing to reducing barriers to the spread of innovation.

There is a growing recognition in research that the government should both coordinate and relieve risk. High carbon prices are effective in stimulating the development of new technology, but to ensure that the necessary technology is developed in time, the price must be set higher than the socio-economic costs of emissions. There are also many barriers to behavioural change, for example in energy efficiency, which means that price alone is not enough to realise sufficient new technology that needs to be in place within a short space of time. The IEA highlights that governments must play a crucial role in technology development if the world is to achieve the required acceleration of technology development towards 2050 (IEA, 2020). This mindset is probably the background to several EU initiatives, which are based on governments helping to coordinate efforts and mitigate risk. This can provide a better division of labour between different players in that they avoid having to take responsibility for something they are not qualified for.

The use of policy instruments for technology development should be adapted to the maturity of the technology. Technologies, and other solutions such as new business models, range from those efficient and mature enough to be profitable, through solutions that are technologically mature but still cost more than their emitting alternatives, to solutions that are currently very expensive and will require a lot more development before they are able to compete in the market. It therefore makes sense to think about the choice of policy instrument for developing and adopting technology as a sequence from immature to mature technology. This is illustrated in Figure 10.5 below.

Figure 10.5 **Use of policy instruments for different phases of technology development.**

Source: 2050 Climate Change Committee



The first step for a given technology is often public funding of basic research. Thereafter, targeted subsidies may be suitable to further develop new concepts and reduce costs during the development phase. Subsidies to early adopters may be appropriate for a period before further technology development and economies of scale make it possible and socio-economically profitable to increase taxes on the polluting alternative. At some point, it may also be more appropriate to use regulations through obligations and bans than economic instruments. When the technology is commercially viable, it will often be crucial to reduce other barriers, including by introducing standards and investing in infrastructure (especially where network externalities exist).

Finding the right time for phasing out subsidies is demanding, as a premature phase-out will slow the transition, while a too late phase-out entails an unnecessary cost to the public purse. It is important that the economic and regulatory policy instruments support the desired change, in each phase of technology development. An important advantage of such a sequencing over time is that the first phase helps to develop new solutions, which makes it less demanding to introduce taxes and regulations later when interest has been sparked among businesses and other stakeholders who also welcome the transition.

Public funding for technology development should avoid known pitfalls. A key challenge of public funding for innovation is that private companies that are well-connected receive support that could be used by others for more productive purposes. Policy instruments should therefore be designed broadly with objective criteria in order to ensure competition between projects and technologies and to avoid rent-seeking behaviour and lobbying. Another challenge is that administrative costs, both for the applicants and those considering the applications, must be less than the socio-economic benefit. A third challenge is calibrating the scope of government instruments correctly, to avoid companies devoting too many resources to obtaining funding at the expense of more value-adding activities. A final challenge is that public funding can keep companies artificially alive and prevent funding from being redirected from less productive companies towards realising more productive solutions. The Expert Committee on Climate-Friendly Investments also highlights a number of these challenges.

Public funding for technology development should come as an addition to private funds. It is important that public funding for technology is based on the principle of additionality, meaning that there is reasonable assurance that the funding actually results in an additional desired effect. If the government supports a desired technology development, it should be because a given stakeholder would not have implemented it independently and that the project provides a desired development that would not otherwise have taken place. In immature markets, it is at present unlikely that companies will develop solutions for the low-emission society quickly enough and on a large enough scale to achieve national or global climate targets. The IEA stresses the need for governments to help test new technologies at this time. However, the government should only support technology and projects that are potentially sustainable in the long term, both in terms of climate change and the economy – given market conditions, regulations, direct and indirect taxes. Furthermore, industries and businesses should compete on equal terms for support, which means that public funding for innovation should be as technologically neutral as possible, as long as it displaces the use of fossil energy and promotes better use of resources. If existing commercial interests influence industrial policy, there is a risk that innovation and transition will slow down. If the Norwegian Government is excessive in singling out industries and companies that should be allowed to grow further, it may lead to unwanted behaviour, misinvestment, lack of skills development and high costs (Wennberg & Sandström, 2022).

On our way towards a low-emission society, countries should be careful not to participate in a race to subsidise their own business and industry. Since the USA introduced the *Inflation Reduction Act* (IRA), which includes extensive government support schemes relating to the establishment and development of climate-related business activities, there have been discussions about protectionism and that countries and companies outside the USA fear losing a battle over industrial development and jobs. There are unfortunate sides to IRA, but the measures are likely to help reduce global GHG emissions and develop renewable energy and zero-emission technologies, something that will benefit all countries. To achieve the global climate targets, the business sector in every country must adapt and all countries must cut emissions. It is not certain that this should be achieved by each country participating in a race to subsidise its own business and industry. In terms of emissions, it has little bearing on where the technology and new business models that reduce GHG emissions are developed. At the same time, it is crucial for achieving the climate targets that zero-emission technology is developed and deployed as quickly as possible. This may mean that it is effective for several countries to work in parallel on developing technology in the same areas. The main purpose of climate policy is not to make the world richer overall, but to solve the climate problem. When businesses in many countries compete to develop the same industries, the solutions the world needs may become cheaper to use and will be rolled out at a fast pace. The IEA refers to the fact that much of the technology has already been developed; it is just too expensive to be used on a large enough scale. A subsidised race is probably not optimal for increased global prosperity in the short term, but it can provide a rapid technology development that accelerates the climate transition.

Climate policy and industrial policy must pull in the same direction. The Roadmap for the Green Industrial Initiative identifies industries that need to succeed in order to realise the climate transition in Norway and globally, where the impact for Norway must also be a transition in the form of jobs, increased activity in rural areas and increased Norwegian exports. The selected focus areas largely overlap with EU initiatives, but if great emphasis is placed on impacts for Norway, it may lead to projects being selected that have little or an uncertain climate impact in the global context. They may as such generate good financial results for the business sector and investors without having much impact on climate change. If there are too many such examples, the road to the low-emission society can become expensive and difficult. It is important that industrial policy and climate policy instruments pull in the same direction. Transparency about goals and priorities, and a transparent cost allocation between public and private actors, can provide more effective action and limit public sector costs. In many areas, benefits can be gained from the innovation power, expertise and resources that Norwegian companies possess. Industrial policy goals can therefore also be achieved through efforts to achieve climate policy goals. The Expert Committee for Climate-Friendly Investments points out that public funding should be more oriented towards climate-friendly solutions and be given a clearer responsibility for the transition, and that it should be a prerequisite for support that the projects are in line with the climate targets and the development of a low-emission society (Expert Committee for Climate-Friendly Investments, 2022).

Sufficiently rapid deployment of new technology relies on policy instruments and policies that support and facilitate such development. The Norwegian Environment Agency points out the need for more policy instruments targeting the deployment of new technology (Norwegian Environment Agency, 2023c). For measures where the technology is ready to use, but is still expensive because it has not been deployed on a large scale, financial support will be needed during a transitional period. The Agency refers to how the current system of policy instruments does not trigger deployment of a scope that corresponds to the potential identified, and points to contracts for difference as a possible measure to give competing players the necessary predictability. Regulation through obligations and bans may also be important to ensure a transition to zero-emission solutions when the technology is mature.

Public policy can mitigate companies' transition risks. Companies face a wide range of uncertainties when devising their investment plans relating to the outlook for climate policy, technological development and market development. It is easier to make investment decisions when the pieces fall into place and uncertainty is reduced. The ability of companies to cope with the transition depends on a number of factors. In addition to the fact that credible climate policy can provide private companies with financial incentives for green, profitable investments, public policy can reduce companies' transition risk by mitigating other forms of risk. One example is to address the transition skills gap.

Successful innovation is driven by entrepreneurs, but relies on a system that underpins it. Often, individuals play an important role in bringing new technological solutions to the market or creating social or economic reorganisation. Examples are the role Elon Musk has played for electric vehicles and Mohammad Yunus for microfinance. Individuals must bear the risk associated with spearheading technologies, but they rely on a system or movement to achieve results. This applies to technical as well as social innovation.

Norwegian policy for industrial and technology development should be adapted to the European Green Deal. Norwegian companies may risk losing their competitiveness in the European market if the transition in Norway is slower than the industrial development currently taking place in Europe. Many European countries have chosen to introduce national policy instruments targeting emission sources within the scope of the EU ETS, because they see that the ETS alone does not provide sufficiently rapid emission cuts, or that other considerations indicate that development must be accelerated. A large surplus of allowances in the EU ETS historically, which may also be partly due to such additional use of policy instruments, has enabled the EU to tighten the emission trading system in various ways, both through a faster reduction of the allowance volume and through the introduction of the market stabilisation mechanism (MSR), which means that allowances are cancelled when there is a large surplus according to given rules. Technology demonstration can also contribute to the EU introducing stronger policy instruments that in turn can contribute to further technology development and cost reductions. This suggests that national policy instruments will be important for developing technology and transforming Norwegian companies, despite the fact that EU-level instruments will become more comprehensive and radical going forward.

European Green Deal: a green growth strategy to help Europe become the world's first climate-neutral continent. The goal is to transform the EU into a sustainable, circular and climate-neutral economy by 2050. Climate and environmental policy must be incorporated into all policy areas, and a broad range of policy instruments must be used.

New requirements for corporate reporting on climate and sustainability risks are key to ensuring sustainable businesses in the long term. Access to relevant information is important for financial market participants to be able to correctly assess and price return prospects and risks. If financial institutions and investors are to channel capital to the companies that are best equipped to handle the transition to a low-emission society, good information is crucial. In order to be able to assess and compare companies, financial market participants and other stakeholders need both information about how the companies are affected by and deal with climate and sustainability-related circumstances and how their operations affect society and the environment around them. The EU's Corporate Sustainability Reporting Directive (CSRD) introduces more detailed reporting requirements, as well as a requirement to prepare sustainability reporting in accordance with upcoming pan-European standards. The Norwegian Government aims for the new rules to be introduced in Norway at the same pace as in the EU, which means the rules will start to apply to the largest listed companies from the 2024 financial year (Ministry of Finance, 2023a).

Transition plans should highlight whether companies' business models are profitable in the transition to a low-emission society. In accordance with the EU's new regulations on sustainability reporting, the sustainability information must include a brief description of the company's business model and strategy, including how resilient the business model and strategy are to risks associated with sustainability. Furthermore, information must be provided about the company's plans to ensure that the business model and strategy are compatible with the transition to a sustainable economy and with limiting global warming to 1.5 degrees in line with the Paris Agreement and the EU's goal of achieving climate neutrality by 2050. Sustainability reporting requirements for large companies have been strengthened considerably in recent years.

It is important that reporting and disclosure of information are developed further in the years ahead. If the requirements are implemented in an appropriate way for small and medium-sized enterprises as well, this may, together with knowledge sharing and guidance, be a positive measure to encourage companies to think about their strategy and profitability in the transition to low emissions.

There has been strong growth in investor engagement relating to climate mitigation. Several organisations and networks have been established by investors who wish to strengthen their efforts in this area. There may be several reasons why investors work more on climate mitigation than before. Some of the most important are probably that:

- Physical impacts of climate change increasingly affect businesses' profitability and risk.
- Investors have a strong self-interest in understanding and taking into account both threats and opportunities in the transition to a low-emission society, especially if it is credible that climate policy will force a rapid transition that can have major, rapid effects on the profitability of the companies they finance.
- Many investors will also face increased expectations from customers and others affected by their activities.
- Extensive regulatory changes are made to corporate activities, particularly relating to reporting requirements (cf. above review). Development in regulations for how companies work on climate issues is very rapid and affects many Norwegian companies, and thus also their investors.
- Supervisory authorities devote more attention to climate risk. The Network for Greening the Financial System (NGFS) brings together over 100 financial supervisory authorities and central banks working on how climate risk can affect financial markets. Financial institutions must increasingly account for how they deal with climate risk in their operations in reports to the supervisory authorities.

See discussion of sustainability reporting and requirements for transition plans in Chapter 12.

The State's role as a direct owner in several companies also comes with obligations. The State must be an active, responsible and long-term owner that contributes to the companies' profitability and development. The Government's ownership policy report describes how state ownership can contribute to maximum returns and good services, at the same time as the companies demonstrate responsible business conduct and help accelerate the green transition (Ministry of Trade, Industry and Fisheries, 2022). The new direction signalled in the report, with respect to clarifying and reinforcing sustainability considerations in the State's objectives as owner, is useful in the transition to a low-emission society. In this work, transparency about goals and priorities will also be important, so that ownership actually contributes in a positive direction. New requirements for corporate reporting on climate and sustainability risks and the preparation of transition plans give both private and sovereign investors a clear responsibility to exercise their ownership with a view to ensuring profitable companies with good capital discipline on the road to a low-emission society. This is particularly important for the petroleum industry, which is facing significant restructuring; see more details in Chapter 12.

Scope 1, 2, 3: a way of classifying emissions that a given company contributes to through its own activities and through the value chain of the product the company produces. Scope 1 concerns the company's direct emissions, i.e. emissions from factories, properties or equipment owned by the company. Scope 2 concerns emissions associated with the company's energy use. Scope 3 concerns a company's indirect emissions, i.e. emissions relating to the production of goods and services the company buys or sells.

The Committee is of the opinion that companies must set their own climate targets and develop plans for how to achieve them. The targets should include the company's direct and indirect emissions (Scope 1, 2 and 3) based on a materiality assessment. Progress towards the targets should be reported on annually in publicly available reports. Companies should not rely on achieving the targets by purchasing carbon credits, but through their own emission reductions; see more details in Chapter 15. They should also assess how relevant information about emissions from goods and services can be made available to consumers.

See description of the voluntary carbon market in Chapter 15

10.4 Trade policy

The regulatory framework that governs international trade and investment is important for a small, open economy like Norway, with large foreign assets. Many companies have long international value chains and suppliers, customers, competitors and partners in other countries. A good regulatory framework that supports the transition to a low-emission society is therefore important for both Norwegian business and industry and foreign investments.

International trade is closely linked to greenhouse gas emissions. About 30 per cent of global carbon emissions are linked to exported goods and services (World Trade Organization, 2022). This shows how production, trade and consumption are coupled with emissions under current technology and production processes.

International trade regulations are important for the implementation of global climate policy. This applies both to multilateral regulations within the framework of the World Trade Organization (WTO) and bilateral trade agreements. Through international trade, a technology or product that contributes to lower emissions can be spread to more users in more countries. This can be done both by removing barriers to technology transfer and by setting requirements for the use of low-emission technology in the production of traded goods. The trade regulations are therefore an important means of helping to ensure that solutions are shared and implemented widely.

The regulations may allow for requirements to be introduced for goods with major negative environmental and climate impacts. Such impacts may be due to characteristics of the product itself that become apparent during use or disposal, or the manner in which a product is manufactured. Requirements may affect goods from different countries in different ways. The trade regulations allow for requirements and restrictions based on climate or environmental considerations to affect goods from different countries differently, but not differential treatment based on which countries the goods come from. It is unclear how wide the scope for differential treatment is. This applies in particular to differential treatment based on environmental and climate impacts from the production of goods. Such impacts from production often manifest themselves in the country where goods are manufactured or on their way to the country where they will be used. Production processes may vary from country to country due to different assumptions and choices based on these. It can be difficult to document differences in climate and environmental impacts and that the requirements or restrictions imposed are due to these impacts, and not the country in which the goods are manufactured. Environmental or climate impacts from use often manifest themselves in the country that sets requirements or restrictions and may be easier to document. It can therefore be easier to gain recognition for the fact that such differences make goods different, and, as such, that it is on this basis and not the country of manufacture that requirements and restrictions have varying impacts on the goods of different countries. The Committee believes that Norway should increasingly advocate allowing room in trade regulations for requirements and restrictions based on environmental and climate impacts from production.

Trade policy is not sufficiently elucidated in Norway's low-emission policy nationally and globally. The effects of the trade policy commitments Norway undertakes for the transition to a low-emission society are not sufficiently understood. This increases the risk of misalignment between trade policy and Norway's commitments and goals for the low-emission transition. Therefore, the new annual reports to the Storting on trade policy should also address how trade policy supports and hinders the transition. Public authorities should, to a much greater extent than at present, facilitate public discussion of trade policy and trade agreements and how they support and hinder the transition. Publishing starting positions for negotiations, as the EU does, should be part of this discussion.

How trade agreements can contribute to the transition appears to be a low priority in Norway's efforts on multilateral free trade agreements. Since 2011, most agreements have included a special chapter dealing with sustainable development. In existing agreements, this chapter is less binding and with weaker follow-up mechanisms than other parts of the free trade agreements (Fauchald, 2023b). At the same time, it does not appear that other commitments in the agreements have been assessed and adjusted in light of the need for a transition to a low-emission society. Other countries, especially in the EU, have seen a more clear development in the direction of their trade agreements and trade policy objectives. There is considerable potential for a more well-defined Norwegian policy in this field. Although Norway has special chapters on the environment in bilateral free trade agreements, and attends relevant WTO discussions, there are indications that there is still room for significant policy development. The complexity and lack of transparency in the field, together with scarce and scattered expertise, make it difficult for the authorities to draw on relevant resources and expertise in the private sector and civil society. Norwegian bilateral trade agreements should be updated to reflect international trends that stimulate low-emission development to the greatest extent, also beyond the dedicated chapter on trade and sustainable development.

Enforcement of trade regulations through international dispute resolution bodies can pose challenges when it comes to national environmental and climate mitigation measures. This may concern requirements that policies should not place greater restrictions on trade than necessary, or requirements for scientific evidence as the basis for new policies. National authorities may be challenged by other countries on what is needed to achieve other policy objectives, where this is then to be decided by an international dispute resolution body. This body will not be bound by what the country itself considers necessary. Trade agreements regulate the composition, qualification requirements and procedures of such bodies, and appoint those who will deal with each individual dispute. The qualification requirements rarely set specific requirements for climate or environmental expertise.

Similar challenges may lie in the regulatory framework relating to investment protection and investors' possibility of seeking compensation if more stringent climate policies negatively affect their profit prospect. Investment protection raises several dilemmas, among other things because there is a need for significant investments in renewable energy in the coming years. Investors may believe that investment protection agreements are necessary to reduce risk to an acceptable level. There are nonetheless challenges associated with the current regulatory framework. This is illustrated by recent developments concerning the Energy Charter Treaty, where several countries, including Germany, Spain and Poland, have announced that they will withdraw from the treaty because they do not find it compatible with the Paris Agreement and that it instead represents an obstacle to low-emission development (Politico, 2022; Szumski, 2023). The Energy Charter Treaty protects investments in fossil energy and gives international investors in energy projects an opportunity to sue governments for loss of profit as a result of changes in policy.

According to the Storting's website, Norway has not ratified the treaty, but implements it in practice (Norwegian Storting, 2022b). A better and more accessible knowledge base should be developed to assess whether existing trade and investment commitments make the transition to a low-emission society more difficult. The knowledge base should include global, regional and bilateral trade agreements, including provisions on investment protection. Considerations relating to intellectual property rights, local content requirements and the dissemination of technology should also be part of this. Consideration should also be given to how the regulatory framework promotes the transition to low emissions.

The international regulatory framework for trade and investment, including regional and multilateral trade agreements, should be further developed so that it strengthens, and not hinders, the transition. The EU places increasing emphasis on climate change in its free trade agreements, and implementation of the Paris Agreement is a prerequisite for deeper trade cooperation. An understanding of consequences and impacts is central as a basis for further development of the regulatory framework, both under WTO and in regional and multilateral trade agreements. The EU conducts impact assessments of its trade agreements (Fauchald, 2023b). Norway should establish a permanent practice of assessing the sustainability of new trade agreements, including an assessment of how the individual agreements help ensure that trade regulations, as a system, contribute towards the low-emission society. This will be an important measure to increase understanding and develop policy in this field.

Circular economy and policy instruments such as subsidies are also related to trade policy and trade regulations. The regulations under WTO set guidelines for the use of subsidies. Recently, an agreement has been negotiated on fisheries subsidies, and there are negotiations to phase out subsidies that are harmful to the climate. Trade regulations are also important to achieve a more circular economy. There is a need for policies that guide how trade regulations can promote a circular economy, for example by imposing less favourable tariffs on goods with a higher proportion of virgin material than on the same goods with a greater proportion of recycled material, through technical requirements that stimulate lower resource use, reparability and more reuse, and by imposing less favourable conditions for trading in goods with a high carbon footprint.

10.5 The Committee's recommendations

In the Committee's opinion, the most important aspect of ensuring innovation and transition is an ambitious and credible climate policy that reduces uncertainty and gives companies predictability and incentives for climate-friendly and profitable investments. The Committee therefore has the following recommendations:

- the authorities must pay greater attention to more efficient planning and implementation of public investment projects that incorporate climate considerations, so that the transition to a low-emission society does not become more demanding than necessary.
- consider changes in investment needs in more detail in the private sector and at the central and local government levels, as a result of the transition to a low-emission society, for example in the white paper on long-term perspectives on the Norwegian economy.
- ensure that climate policy and industrial policy are moving in the same direction.
- ensure that public funding for technology development triggers rather than replaces private funds.
- ensure that Norway does not participate in a race to subsidise its own industry on the way towards the low-emission society.
- adapt Norwegian policy for industrial and technology development to the EU's Green Deal.
- further develop the interaction between the State and the social partners to ensure a successful transition, for example by building on the experience of the Committee for a Just Transition for Workers and climate partnerships with the business sector.

- adapt the content of existing education programmes to meet the need for vocational and industry-specific skills relating to the transition.
- both private and sovereign investors have a clear responsibility to exercise their ownership with a view to securing profitable companies with good capital discipline on the road to a low-emission society, a responsibility that has been made clear through new requirements for corporate reporting on climate and sustainability risks and the preparation of transition plans.
- consider whether the requirements for corporate reporting on climate and sustainability risks and the preparation of transition plans should also be implemented in an appropriate way for small and medium-sized enterprises, which, together with knowledge sharing and guidance, can be a positive measure to stimulate companies to think about strategy and profitability in the transition to a low-emission society
- ensure that companies set climate targets and plan how to achieve them. The targets should include the company's direct and indirect emissions (Scope 1, 2 and 3) based on a materiality assessment.
- develop trade policy to support the transition to a low-emission society and a circular economy, by, among other things:
  - updating Norwegian bilateral trade agreements to follow international trends that stimulate low-emission development to the greatest extent, also beyond the dedicated chapter on trade and sustainable development.
  - determining whether existing trade and investment commitments are conducive to or promote the transition to a low-emission society.
  - establishing a permanent practice of assessing the sustainability of new trade agreements, including an assessment of how the individual agreements help ensure that trade regulations, as a system, contribute towards the low-emission society.
  - to a much greater extent facilitating public discussion of trade policy and trade agreements, including by publishing starting positions for negotiations, in line with EU practice.
  - considering measures for a more circular economy in trade regulations in connection with a broad assessment of the circular economy. See recommendations in Chapter 9.

11 Norway's footprint

This chapter discusses how emissions that Norway contributes to outside its own borders impact Norwegian climate policy. It also describes emissions that occur in Norway, but that are not included in the Norwegian emission accounts.

11.1 The path to a low-emission society is about more than Norway's own emissions and removals

The basis for Norway's climate targets is the greenhouse gas accounts. These accounts cover GHG emissions and removals on Norwegian territory and emissions and removals from forestry and land use, agriculture, transport, industry, energy production and waste management. The territorial delimitation and the sectors included follow from guidelines issued by the IPCC, and are used by all countries in their reporting to the UN.

Emission accounts: an overview that includes all emissions and removals of greenhouse gases within a country's borders. The main gases are CO_2, methane (CH4) and nitrous oxide (N_2O), but also other gases such as fluorinated gases are considered greenhouse gases and included in Norway's emission accounts.

However, Norwegian policy and society affect a wide range of emissions that occur elsewhere, in addition to the emissions included in the account. This concerns emissions relating to the production of goods that are manufactured elsewhere and then imported into Norway and consumed, emissions that occur in connection with the consumption of Norwegian exports (especially petroleum products), consequences resulting from the choices made by companies in which the Norwegian State has an ownership interest, investments made by the Government Pension Fund Global (GPFG), and other Norwegian policies that affect stakeholders beyond Norway's borders through, for example, aid, trade, research and technology development. Figure 11.1 illustrates global emissions and reduced emissions that Norway influences through policy, society and the economy.

The petroleum sector is in a unique position. Fossil energy is at the core of the climate challenge, and emissions from the combustion of oil and gas exported from Norway are ten times greater than Norway's territorial emissions; around 500 million tonnes of CO_2e per year. Petroleum policy is closely linked to the transition to a low-emission society. This means that Norway must make changes to align its petroleum policy with the goal of achieving the Paris Agreement's temperature target.

See discussion of the petroleum sector in Chapter 12.

Only anthropogenic emissions are included in the emission accounts, meaning that emissions from what are considered natural processes, such as emissions from unmanaged peatland or emissions resulting from thawing of permafrost, will not be included in the accounts.

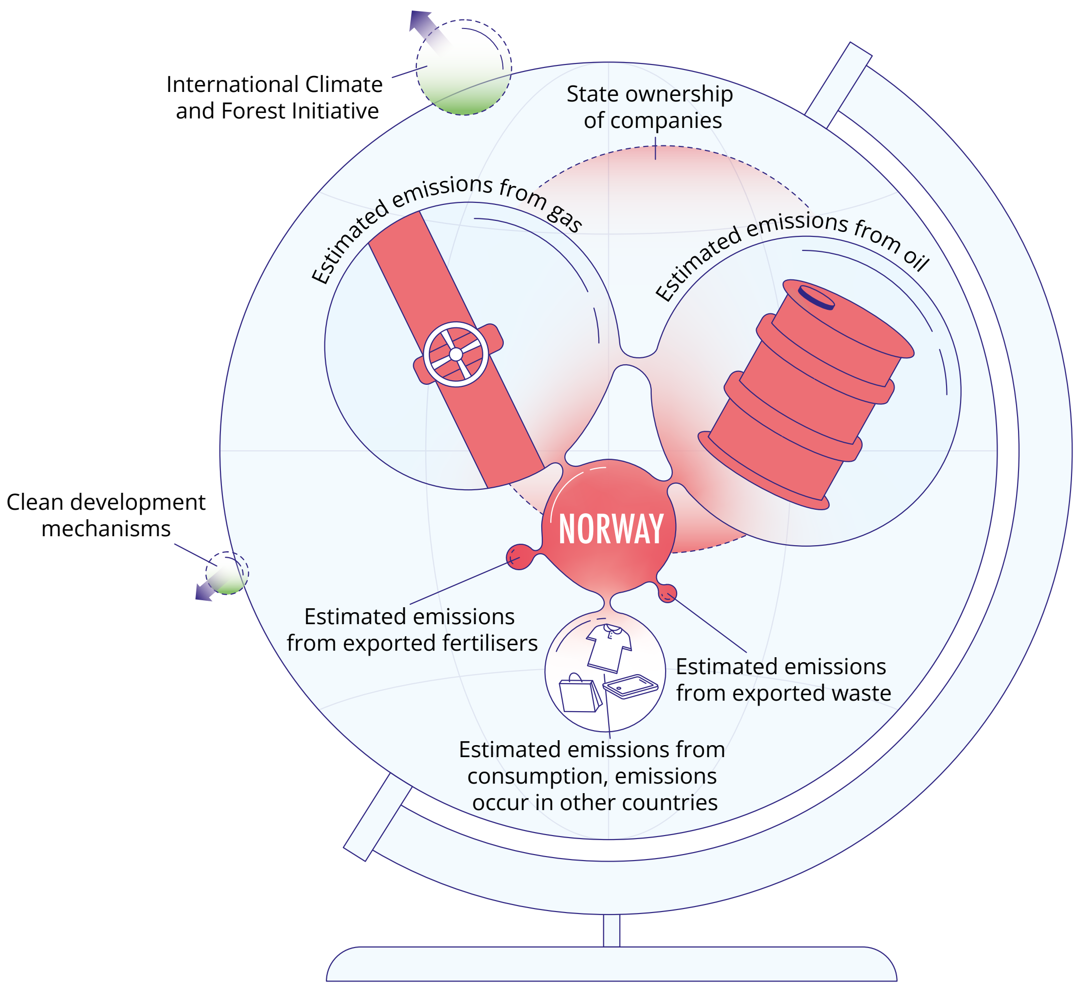


Figure 11.1 Global emissions and reduced emissions that Norway influences through policy, society and the economy. Illustration.
The size of the bubbles corresponds to estimates of annual emissions and emission reductions. The Government's investment in CCS through the Longship project will contribute to emission reductions in other countries, but the carbon storage facility under development on the Norwegian continental shelf will not be operational until 2024. Estimated emission reductions from this project are not therefore included in the illustration. So far, the operators who will be running the storage facility have signed agreements to receive 800,000 tonnes of CO_2 per year from the Netherlands and 450,000 tonnes per year from Denmark.
Source: 2050 Climate Change Committee

Biomass: the total mass of living organisms in contexts where numbers of individuals are impractical, for example the number of trees in a forest. Biomass can also be used as a term for bioenergy; fuels derived from trees and plants, fertilisers, forest waste, peat etc.

The footprint of imported biomass is not shown in the Norwegian accounts. The emission accounts are based on the principle that emissions should only be counted once, and emissions from the harvesting and use of biomass are recognised in the country where the harvest takes place. Emissions from the use of biomass belong to several categories in the emission accounts, both in the forestry and land use sector and in the energy sector, which makes transparent accounting a complex task. All countries must have good emission accounts in place in order for the system for calculating emissions from biomass consumption to provide a correct picture of the situation.

The pathway to a low-emission society is about more than Norway's own emissions and removals. In the same way as the Norwegian economy is closely linked to the rest of the world, Norway's pathway to a low-emission society is also closely linked to the pathways of other countries. Developments in the world in general will have a major impact on Norway's progress towards low emissions. Through policy, Norway can help reduce or increase emissions included in other countries' emission accounts and commitments under the Paris Agreement. This is a natural extension of Norway's close ties to the rest of the world through, for example, business value chains, Norwegian imports and exports, international cooperation, and research and technology development communities. How Norwegian policy is geared towards supporting low-emission developments elsewhere is central both to the Norwegian transition and to joint global efforts to achieve the goals of the Paris Agreement.

A parallel can be drawn to how private companies are expected to take responsibility for GHG emissions in their value chains. Private companies are now increasingly expected to both calculate and take responsibility for reducing emissions in their value chains, in addition to reducing their own direct emissions. The work on value chains applies to both input factors that companies buy and use in their production, and emissions from the use of the products the company manufactures.

By contributing to the transition to a low-emission society globally, the transition in Norway will also be strengthened. Low-emission transitions in other countries can provide useful lessons for Norway for the formulation of policies, use of policy instruments, development of technology, demand for goods and services, and knowledge and skills in general. Similarly, the lessons Norway learns from the transition could be useful for other countries. Norway's electric car policy is an example of this, where the country has become an important pioneer market for electric cars and gained useful experience of various policy instruments for the deployment of a new technology and charging infrastructure, and also how electric cars have and will increasingly affect the energy system. It is in Norway's interest to support low-emission development elsewhere, although our ability to influence other countries has its limitations. How much and what kind of influence Norway can exert will vary. For example, Norway is a key player in reducing deforestation in tropical countries, even though we do not have tropical forests of our own.

In addition, the Paris Agreement's obligations extend beyond emissions and removals on the territory of each country. There is every opportunity to define nationally determined contributions under the Paris Agreement that include more than the countries' territorial emissions. The agreement also includes commitments on, among other things, financing and technology transfer. This also plays a central role in the transition to a low-emission society at the global level, and is a field in which Norway's policy is important for the green transition both nationally and globally.

Climate considerations must weigh heavily in Norway's foreign and development policy. This has a bearing on trade policy, policy that affects consumption, policy relating to exports, research and innovation policy, climate financing and development policy, petroleum policy and energy policy. Although the development trends described in Chapter 4 will affect the framework conditions for Norwegian climate policy, Norway also has an opportunity to influence some of these framework conditions through low-emission efforts globally. This applies in particular to other countries' climate policy ambitions and technology development. The EU has developed a robust climate diplomacy toolbox. The Committee recommends that Norway cooperates more with the EU to enhance the impact of Norway's overall international climate efforts.

11.2 Emissions on Norwegian territory that are not included in the emission accounts

Ecosystem: a more or less well-defined, uniform natural system in which communities of plants, animals, fungi and microorganisms function in interaction with each other and with the non-living environment.

Some anthropogenic emissions occur on Norwegian territory that are not currently included in Norway's emission accounts. Emissions associated with the degradation of coastal areas such as tidal swamps, and emissions from marine ecosystems resulting from activities such as kelp harvesting and bottom trawling, are not currently included in Norway's emission accounts. Norway's emission accounts should be improved and further developed, especially for marine carbon sinks. Norway has well-developed emission accounts in line with the IPCC guidelines, but there is always room for improvement. There are some emissions that have so far not been included, a particularly important example of which are emissions and removals from marine carbon sinks. The Committee believes it is important to introduce effective calculations for these emissions. This will reduce the risk of replacing emissions that *are* included in the emission accounts with emissions that are not. New activities and industrial development in areas or fields where there is an insufficient basis for assessing the effect on GHG emissions must take this into consideration. This may apply, for example, to seabed mineral extraction and the management of coastal areas that affect the kelp forest. This is described in more detail in Chapter 6.

See discussion of marine carbon sequestration in Chapter 6.

The accounts for emissions from biomass harvesting must be improved. This is especially true in other countries, but better knowledge is also needed in Norway about the consequences of harvesting biomass from natural carbon sinks. Biomass combustion emits CO_2, methane and nitrous oxide. CO_2 emissions from biomass combustion in Norway are calculated in the Norwegian emission accounts, but in accordance with the rules, the emissions are not included in Norway's sum total of emissions, unlike emissions of nitrous oxide and methane. The emission accounts are set up this way because CO_2 emissions from biomass combustion are to be included in the calculation of emissions and removals in the forestry and land use sector in the country where the biomass is harvested. Biomass, such as timber and plant oils, is traded on the international market. When imported biomass is combusted in Norway, the quality of the emission accounts in the country that has harvested the biomass depends on this emission being reflected in the accounts. Many countries have inadequate estimates of emissions associated with biomass harvesting.

The emission accounting system is designed to ensure that emissions are not counted twice, but entails a risk that some emissions are not counted at all. One example of this is if a country that produces biomass has emission accounts that do not reflect emissions from biomass harvesting in line with the guidelines. As the emissions are not included in the emission accounts of the country combusting the biomass either, these emissions will not be captured by any accounts. This must be taken into consideration when developing policies that stimulate the use of biomass in Norway.

Emissions from international aviation and shipping relating to Norway are not included in the Norwegian climate targets. Like other countries, Norway reports emissions from international aviation and shipping to the UNFCCC, but these figures are not included when calculating Norway's contribution to the Paris Agreement, only emissions from aviation and ship traffic between destinations in Norway.

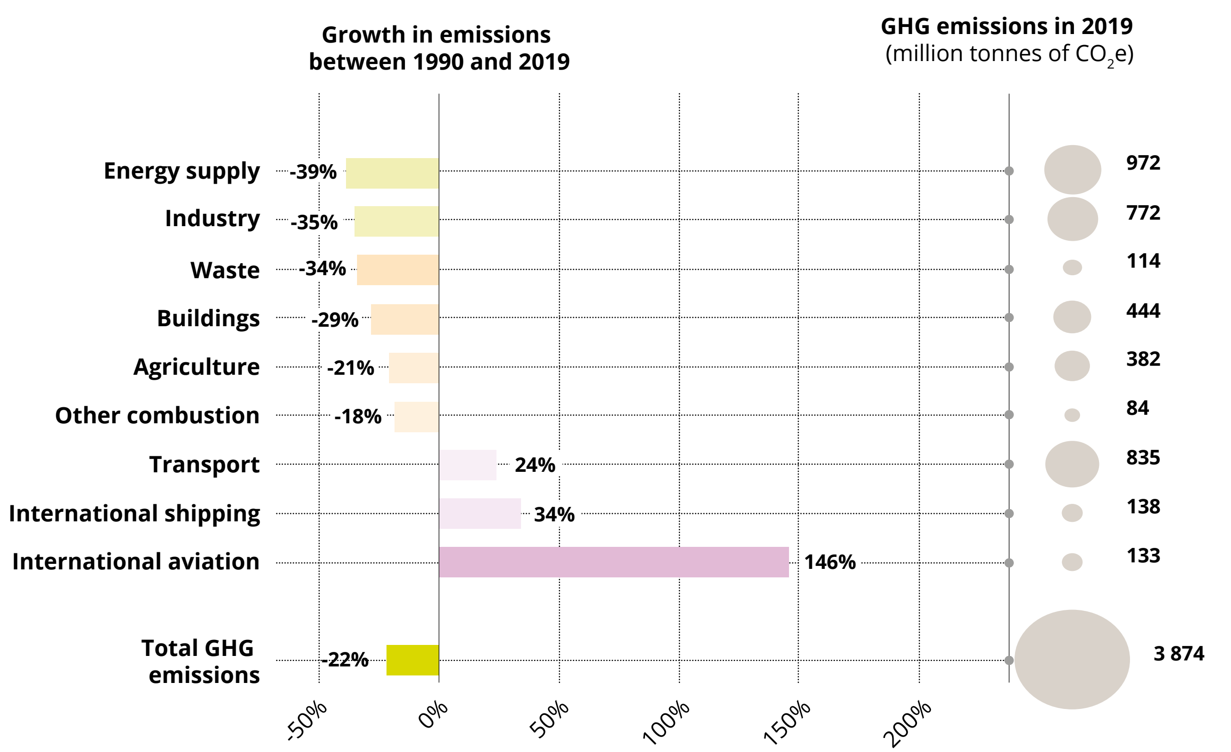
The calculations of emissions from international transport are delimited and do not necessarily show the effect of a country's aviation and shipping activity. Other delimitations in the calculations could produce different results. For example, the calculations for international aviation do not show emissions associated with all travel by Norwegians abroad.

Emissions from international aviation and shipping are linked to how much fuel is consumed. In accordance with the rules for emission accounting, Norway reports emissions based on how much fuel has been sold in Norway, and not based on where it is used. For international aviation, the calculations thus show emissions for flights from Norway to another country for all travellers, calculated on the basis of fuel sold in Norway. Similarly, the calculations for international shipping only show fuel bunkered in Norway, and not emissions from ships that are Norwegian-owned, operated or registered in Norway. In 2021, emissions from bunker oil sold in Norway for international shipping were estimated at just under 1 million tonnes of CO_2e, while emissions from fuel sold to international aviation were just over 1.7 million tonnes of CO_2e in 2019 (due to the pandemic, the figures for 2020, 2021 and 2022 are not representative of the general trend in emissions from international aviation). This represents a tripling of emissions from fuel for international aviation since 1990, but more than a halving of emissions from international shipping. This may be due to the fact that the shipping industry has implemented measures to reduce emissions, but also that bunkering increasingly takes place in other countries with lower costs. Emissions from military aircraft and vessels in military international operations are also reckoned as international aviation and shipping.

Emissions from both shipping and aviation are among the fastest growing on a global scale. Figure 11.2 shows how the development of international aviation is strikingly different to that of other emission sources in the EU. In the EU, emissions from international aviation increased by 146 per cent between 1990 and 2019, while total emissions fell by 26 per cent during the same period (EU Court of Auditors, 2023). When the EU's climate targets for 2030 were stepped up, GHG emissions from aviation and shipping within the EU were included. The regulatory changes under the 'Fit for 55' package aim to cut these emissions, including by tightening the criteria for internal aviation and by including shipping (100 per cent of internal traffic and 50 per cent of traffic between the EU and non-EU ports in the region) in the EU emissions trading market. The second directive is intended to stimulate a change in fuel consumption. The EU Court of Auditors (which has a similar function to the Office of Auditor General of Norway) has assessed the EU's progress towards the climate targets, and, among other things, recommended that both EU and non-EU aviation and shipping should also be included in the 2050 target (EU Court of Auditors, 2023).

Figure 11.2 **Emission trend in different sectors in the EU between 1990 and 2019.**

Source: EU Court of Auditors, based on data from the European Environment Agency (EU Court of Auditors, 2023).



Some countries have included emissions from international aviation and shipping in their targets. The UK has decided to include its share of emissions from international aviation and shipping in its commitments. These emissions are part of the UK's sixth carbon budget for the period 2033 to 2037. In Sweden, a proposal has also be made to include emissions from international aviation and ships bunkering in Sweden in its goal to achieve net zero emissions from Swedish territory by 2045 (SOU 2022:15, 2022). The proposal means that domestic aviation will be made fossil-free by 2030, and bunkering for both domestic and international flights by 2045. A proposition has been made to include half of the bunkering for international shipping in Sweden's climate target. The Committee believes that the Norwegian Government should consider how emissions from international aviation and shipping can be included in Norway's climate targets.

Net zero emissions: a state in which the amount of CO_2 emitted into the atmosphere from human activity is equal to the amount removed from the atmosphere through human activity over a given period of time.

11.3 Emissions relating to Norwegian exports, in particular petroleum

Some Norway exports emit GHGs during use. In an official study carried out on behalf of the 2050 Climate Change Committee, Menon has assessed which Norwegian exports emit GHGs when used, and calculated emissions from Norwegian exports of oil, gas, mineral fertilisers and waste (Menon Economics, 2022). The figures are shown in Figure 3.1.

Emissions from the combustion of exported oil and gas are in a unique position. With annual emissions of around 500 million tonnes of CO_2e, they are around ten times greater than the total annual emissions of around 50 million tonnes of CO_2e included in Norway's emission accounts. The Committee's assessments relating to the petroleum sector are set out in Chapter 12. There are also emissions relating to the use of exported mineral fertiliser and management of waste that has been sent out of Norway, but these are small compared with Norway's emissions from oil and gas exports. The Committee recommends keeping separate accounts for direct and indirect emissions relating to the use of goods and services Norway exports.

See the Committee's assessments relating to the petroleum sector in Chapter 12.

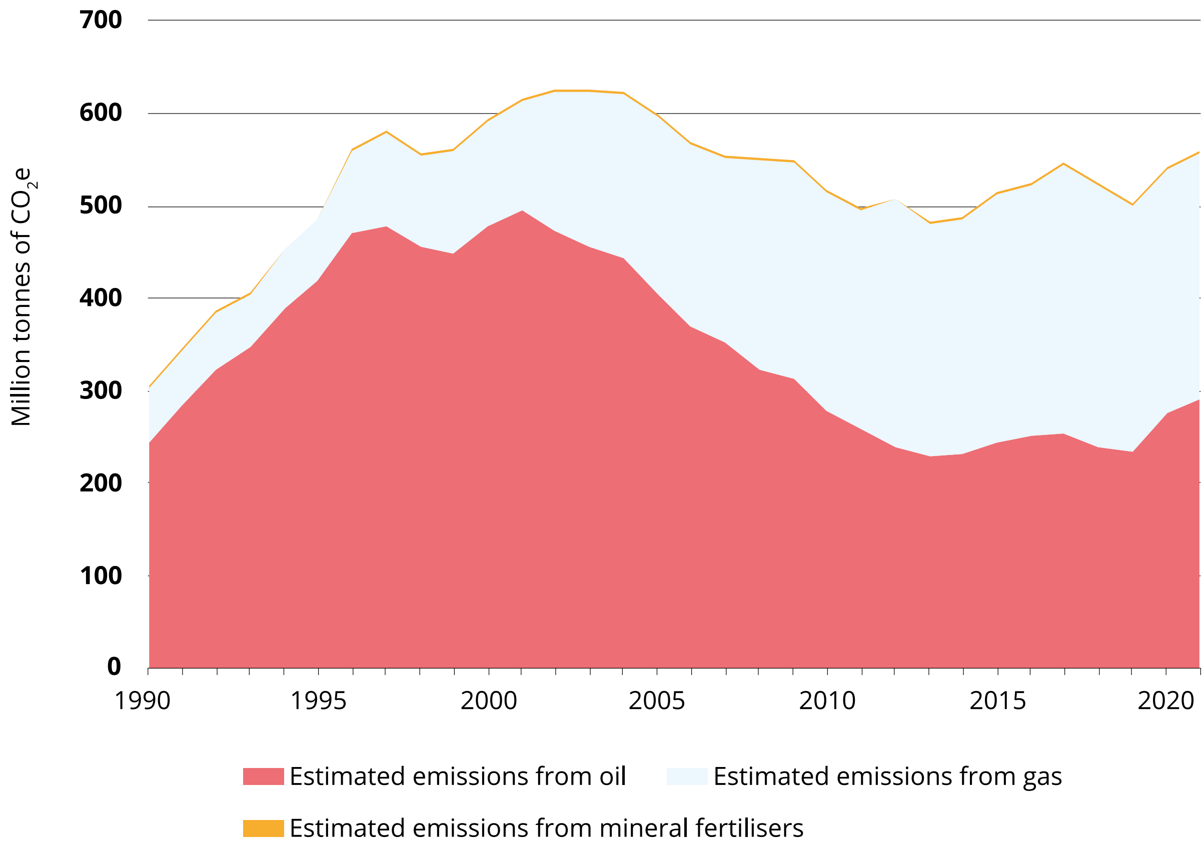
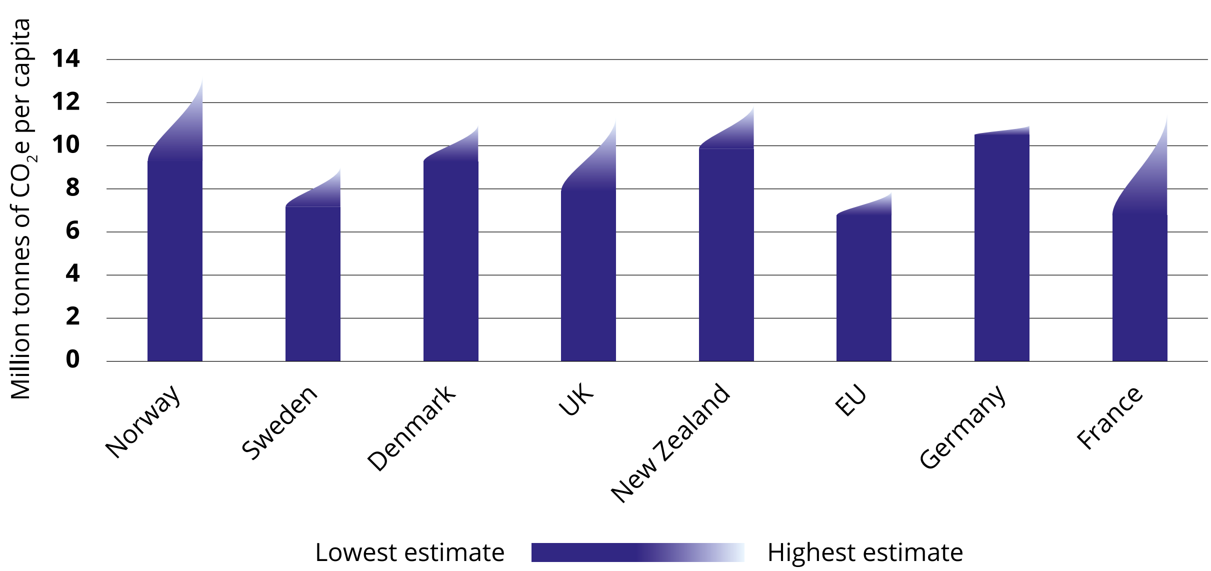


Figure 11.3 **Emissions from a range of Norwegian exports.**
Emissions from waste and mineral fertilisers exported from Norway are very small compared with emissions from oil and gas, and therefore barely represented in the figure.
Source: Menon, based on data from Statistics Norway

11.4 Emissions in other countries relating to Norwegian consumption

Norwegian consumption is very high on a global scale and has a significant environmental footprint. OECD calculations show that Norway has the third highest material consumption of the OECD member states. Norwegian consumption is linked to emissions in other countries through extraction of raw materials, production of input factors and production of finished goods. Estimates show that emissions relating to imports are about 40 million tonnes of CO_2e, which is slightly lower than Norway's territorial emissions (Menon Economics, 2022). WWF has estimated that, if everyone in the world lived like the population of Norway, we would need 3.6 Earths to produce all the natural resources consumed and manage all the waste generated (WWF, 2022). In a compilation of calculations of emissions relating to consumption, a report from Menon Economics shows that estimates of GHG emissions from consumption per capita are highest for Norway; see Figure 11.4 (Menon Economics, 2022). Such calculations are associated with considerable uncertainty and large variations depending on, for example, the choice of method and delimitation, but they nonetheless provide an indication of the level of emissions generated by Norwegian consumption. In order to give a precise picture, the quality of other countries' emission accounts is important. This quality varies, both between countries and between sources of emissions. The Committee believes that emissions relating to Norwegian material consumption must be reduced in line with the transition to a low-emission society, even if the emissions are not included in Norway's emission accounts.

Figure 11.4 Estimate of GHG emissions from consumption per capita.
Different estimates have been prepared based on different methodologies and there is therefore uncertainty associated with the estimates.
Source: Menon Economics (Menon Economics, 2022)



Knowledge of consumption-based emissions should be improved. Research and data availability for emissions relating to consumption are inadequate both in Norway and in other countries (Future in Our Hands, 2023). Research conducted in Norway is largely limited to individual studies; there is no comprehensive, systematic overview of emissions from consumption that is updated regularly. Information about how emissions relate to different characteristics in the population such as age, gender, place of residence, education and work is inadequate. The greenhouse gas accounts for municipalities published by the Norwegian Environment Agency are prepared according to the same principles as the national emission accounts, and do not include indirect emissions from, for example, the production and transport of goods and services consumed in the municipality. Figures that would make it easier to compare emissions from consumption across countries are also lacking.

Several studies suggest that higher income results in higher emissions from consumption, both in Norway and globally. Most of the studies that have been conducted clearly point to a close correlation between inequality in income and inequality in emissions from consumption. At the global level, Chancel et al. find that, contrary to the situation in 1990, the disparity between emissions per capita is now greater within than across countries (Chancel, 2022). The IEA also finds substantial differences in consumption-based emissions between different income groups (IEA, 2023). A report from Future in Our Hands has estimated emissions associated with various income groups in Norway. The report points out that emissions from transport, especially air travel, increase with increasing income (Future in Our Hands, 2023).

See discussion of the relationship between income and emissions in Chapter 9.

Norway must do more to contribute to the UN Sustainable Development Goals. Data obtained from reporting on the SDGs indicate that Norway has a more negative effect on other countries' ability to achieve the goals than, for example, Sweden, Denmark and Finland. This is due to low scores on indicators such as water consumption relating to imports, emissions of sulphur dioxide in imported products, nitrogen and CO_2, exports of plastic waste, and that imported goods represent a threat to natural diversity (Sachs et al., 2022). Norway also has a long way to go to meet the goal relating to responsible consumption and production (SDG 12). This is particularly related to the indicators for electronic waste, imported emissions of sulphur dioxide and nitrogen, inadequate recycling of municipal waste, and export of plastic waste. On the other hand, the indicators for emissions of sulphur dioxide associated with use have higher scores. Norway has been given the characteristic 'major challenges remain' also for SDG 2 relating to hunger, SDG 13 on climate action and SDG 15 relating to life on land (Sachs et al., 2022).

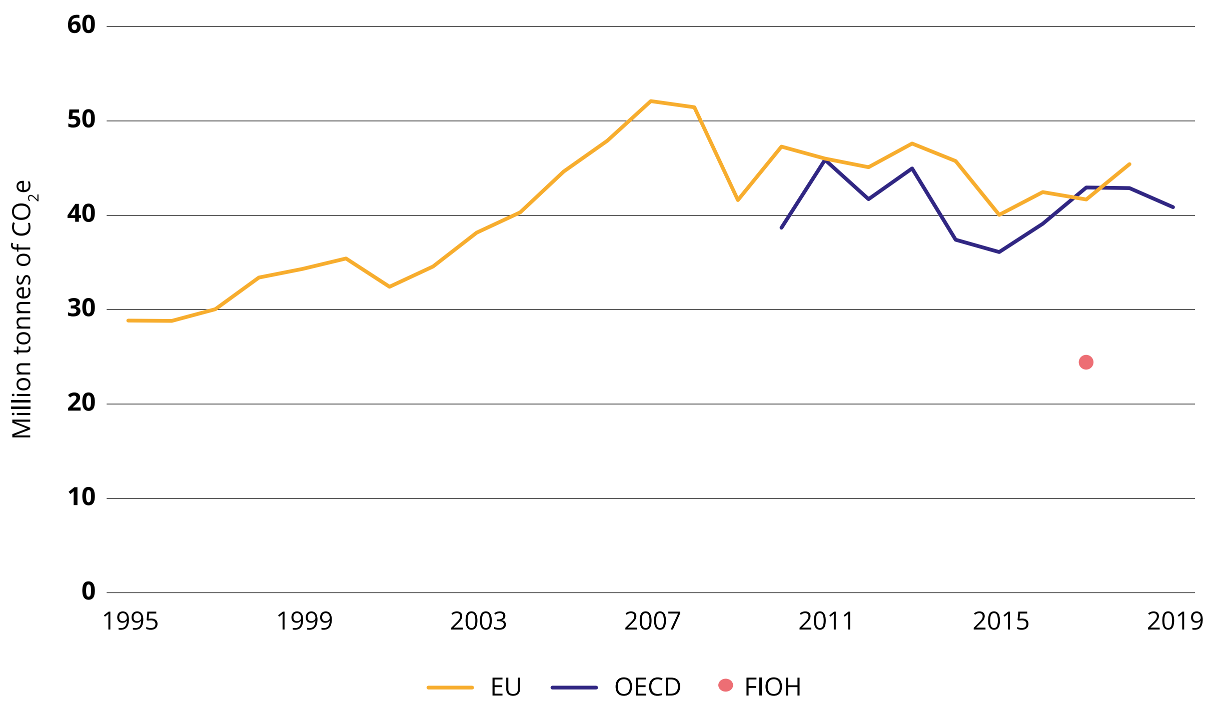


Figure 11.5 Results of various calculations of Norwegian consumption-based GHG emissions in other countries, by year.
The calculations from Future in Our Hands show CO_2e, and the OECD and the EU only show CO_2. The graph does not include emissions occurring in Norway.
Source: Menon, based on data from Future in Our Hands (2021), OECD (2021) and Eurostat (2021b) (Menon Economics, 2022).

Norway should cooperate with the EU to strengthen the impact of Norway's overall international climate efforts. The EU is Norway's most important trading partner. Now that the EU is moving towards a circular market with a low footprint, Norway must be part of this transition. Cooperation with the EU is also important for spreading climate technology developed in Norway, such as CCS solutions. The EU has also developed a comprehensive global climate diplomacy with which Norway should strengthen its cooperation.

Other countries have set targets and ambitions for climate policy that go beyond territorial emissions. Sweden has set a generation goal, which states that the overall goal of the country's environmental policy is to hand over to the next generation a society in which the major environmental problems have been solved, without increasing environmental and health problems outside Sweden's borders. It emphasises that the goal requires the government to work to ensure that patterns of consumption cause the least possible problems for the environment and human health. A parliamentary committee comprising representatives of different parties is responsible for proposing policies that will help achieve the generational goal. Its proposals include that Sweden should have a negative global climate footprint by 2045 and that a target should be set for the climate impact of Swedish exports (SOU 2022: 15). Denmark has launched a long-term strategy for global climate efforts that sets the direction for Denmark's overall international climate efforts (Danish Government, 2020). The government has committed to reporting annual figures showing Denmark's global impact on the climate. The analysis deals with how Danish consumers, Danish businesses and Danish authorities affect GHG emissions outside the country in different ways. In the 2023 report, it is estimated that Denmark's consumption-based emissions for 2021 amounted to 63 million tonnes of CO_2e, while emissions from imports totalled 103 million tonnes. Emissions from exports were estimated to 129 million tonnes of CO_2e. In comparison, total emissions from Danish territory amount to around 44 million tonnes (Danish Energy Agency, 2023).

These measurements are supported by statistics. Sweden, Denmark, the UK, New Zealand and some other countries have official statistics on GHG emissions associated with consumption, and both the OECD and the EU publish estimates of consumption-based GHG emissions for their respective member states and a handful of other states. The EU Court of Auditors has recommended that the Commission include figures for consumption-based emissions in its official emission statistics (EU Court of Auditors, 2023). When the EU establishes the Carbon Border Adjustment Mechanism (CBAM), the Commission will collect data that will simplify efforts to measure consumption-based emissions from Europe in a number of areas.

The Committee recommends that Norway establishes a national goal to reduce GHG emissions from consumption that is consistent with the goals of the Paris Agreement. The Committee believes that Norway should develop a more comprehensive climate policy that is also designed to support low-emission development elsewhere, to enable joint global efforts to achieve the goals of the Paris Agreement. A national goal to reduce consumption-based emissions will make such an ambition more concrete and ensure systematic efforts to that end.

A new goal should be supported by statistics that are made available to the public. Better statistics are needed for consumption-based emissions, and it can be favourable to base such statistics on established sources, such as the OECD. Emissions occurring in other countries should be identified separately. Norway can also benefit from cooperation with the other Nordic countries through the Nordic Council of Ministers, where efforts are being made to produce better statistics and joint solutions for reducing consumption-based emissions (Nordic Council of Ministers, 2020). The Norwegian Environment Agency has been commissioned to conduct an analysis of emissions from Norwegian economic activity, including consumption. This may in the long run form the basis for permanent statistics. At present, we have limited knowledge about the footprint of both public and private consumption in Norway. Several Norwegian municipalities are consciously working on their own footprints, but there is a need for comprehensive national accounts. A more comprehensive scientific basis will be able to provide a better understanding of how Norway affects global emissions, and what kinds of policies may be relevant to reduce them. This will also make it easier for climate-conscious consumers to make everyday choices that reduce their climate footprint. So far, the discussion relating to Norway's impact on emissions in other countries has primarily focused on certain goods, such as oil and gas exports and import of palm oil, or tropical forest conservation. This provides a fragmented approach to Norway's role in global low emission efforts. There is also a need to strengthen knowledge about how gender, age groups, place of residence and variations relating to other characteristics of the population are linked to the footprints of individuals. Better knowledge about the population's footprint and variations in emissions from consumption will enable us to consider whether it is appropriate to adapt policies to different parts of the population.

See the Committee's assessments relating to the transition to a circular economy in Chapter 9.

Transitioning to a circular economy is essential to reducing consumption-based emissions. This is vital to the transition to a low-emission society. The transition to a circular economy requires efforts and new policies both nationally and internationally if it is to help reduce the footprint from Norwegian consumption.

11.5 Development policy and climate financing

Through development policy and climate financing, Norway can influence emissions in other countries, including contributing to a low-emission society in developing countries. Under the Paris Agreement, Norway is obliged to provide climate financing to developing countries to help them achieve their emission reduction and climate adaptation targets. In 2020, climate-related Norwegian aid amounted to approximately NOK 6.2 billion, corresponding to just over 16 per cent of total aid (Norad, 2021). This includes funding for both emission reduction measures and climate change adaptation, the majority of which goes to emission reductions. Climate financing refers to funds that influence GHG emissions and the transition directly, through climate-relevant projects. Development policy and financial assistance also affect emissions and transition indirectly, through support and development of society and the economy in general. Estimating the overall effect of Norwegian aid and climate financing on emissions is very demanding, and the Norwegian Agency for Development Cooperation (Norad) points out that we do not know enough about the effect of various aid projects (Norad, 2021).

Norway's work on energy in developing countries is one of the focus areas where a change is taking place from more traditional development work to considering climate and development in context. Previously, such work was aimed at increasing access to energy, but in recent years there has been an increased focus on new, clean energy as a result of more attention to the climate challenges. The 'Oil for Development' programme will be concluded in 2024, and Norway has launched a new climate fund to invest in renewable energy in developing countries, with the aim of contributing to reduced GHG emissions.

The most high-profile climate mitigation measure financed under the aid budget is Norway's International Climate and Forest Initiative, the aim of which is to halt and reverse deforestation in tropical countries. The initiative also supports developing countries in setting ambitious goals for the conservation of forests and implementing policies to achieve these goals. The initiative works on a wide range of topics and with various stakeholders, primarily international, and can contribute to low-emission development globally. The International Climate and Forest Initiative engages in various forms of cooperation and dialogue with e.g. large private companies, the media, civil society, UN organisations and the financial industry, in addition to governments in countries with tropical forests.

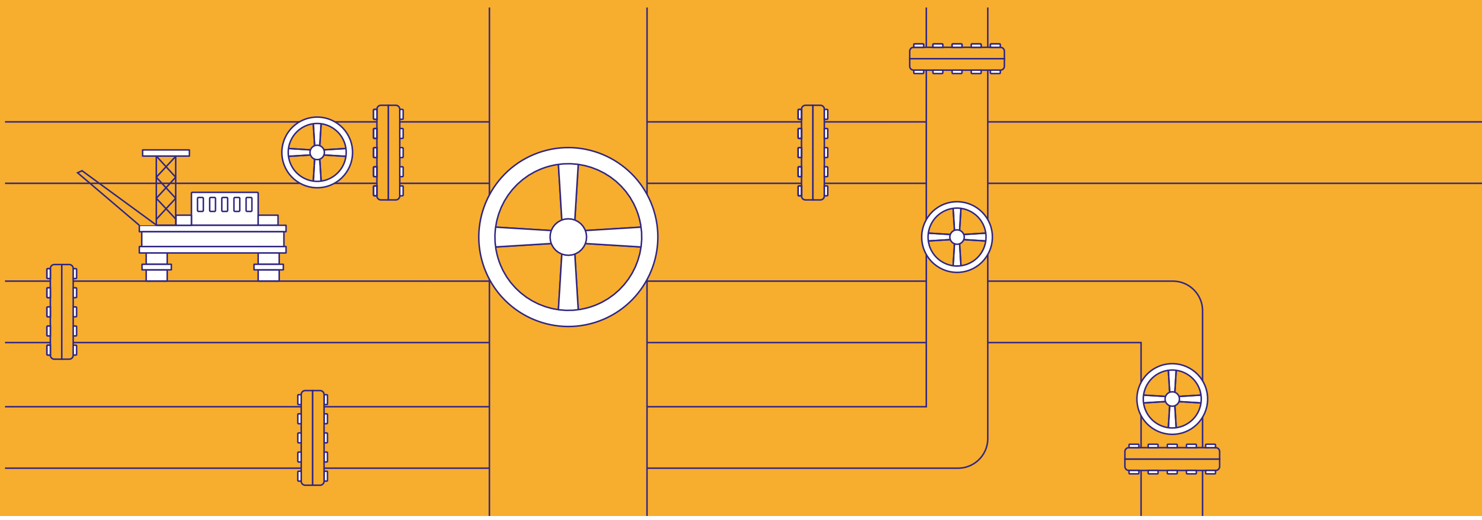
The Committee is of the opinion that Norwegian development policy still has the potential to contribute even more to the transition to low emissions internationally. It is important that Norway fulfils its obligations under the Paris Agreement on climate financing, but also crucial that development policy in general supports the transition to a low-emission society in the countries Norway has interests in. This applies in particular to aid relating to land, nature, social planning, energy, transport, biomass and agriculture. This could also help other countries pursue an ambitious climate policy, and thus reduce uncertainty in the formulation of Norwegian policy. This, in turn, could have positive spillover effects for the development and spread of technology. The Committee recommends reinforcing Norway's contribution to climate financing and drawing up an escalation plan that is communicated to the UN as Norway's climate financing contribution under the Paris Agreement.

11.6 The Committee's recommendations

Norway should work to a greater extent and more systematically to reduce emissions that fall outside the scope of the climate accounts. The Committee therefore has the following recommendations:

- pursue a more pervasive and comprehensive policy in Norway to help reduce emissions in other countries affected by interaction with Norway. Norway should cooperate more with the EU to strengthen the impact of Norway's overall international climate efforts.
- the authorities should consider how Norway can include emissions from foreign aviation and shipping with ties to Norway in our own territorial climate goals.
- establish a national target for reduction of greenhouse gas emissions from consumption that is consistent with the goals of the Paris Agreement. The target must be supported by emission accounts relating to domestic consumption, including emissions generated in other countries from the production of goods and services consumed in Norway. The accounts should be published each year.
- improve and further develop Norway's emission accounts to include sources that are not currently included in the accounts. This applies in particular to the ocean as an ecosystem, including carbon sinks on the seabed.
- keep separate accounts for direct and indirect emissions relating to the use of goods and services that Norway exports, and publish the accounts each year.
- reinforce Norway's contribution to climate financing and create an escalation plan that is communicated to the UN as Norway's climate financing contribution under the Paris Agreement.
- ensure that all aspects of Norwegian development policy, especially aspects that affect energy, land, nature and biomass, support the transition to a low-emission society, both locally and globally.

12 The petroleum sector



This chapter discusses Norwegian petroleum policy in light of the transition Norway must undergo to become a low-emission society. The chapter assesses the sector's role and future development during the transition to low emissions and presents the Committee's assessments of further developments in petroleum policy relating to exploration and production.

12.1 Petroleum policy choices are of key importance to Norway

The petroleum industry is a pivotal industry in Norway and represents by far Norway's greatest impact on climate change and on the global energy system. Oil and gas on the Norwegian continental shelf have made significant contributions to welfare development, business development and public revenues. Over the past five years, petroleum activities have accounted for about 20 per cent of Norway's gross domestic product (Ministry of Petroleum and Energy, 2023a). Norway is a significant supplier of fossil energy and a stable and reliable supplier of gas to our neighbouring areas. At the same time, petroleum activities are Norway's primary source of GHG emissions, and an important reason why we have not achieved the same emission reductions as our neighbours. Figure 12.1 shows that Norway's petroleum exports, when converted into GHG emissions, far exceed emissions from Norwegian territory. In total, petroleum generating emissions of about 18,000 million tonnes of CO_2 has been exported. If all remaining resources on the Norwegian continental shelf were to be produced, it is estimated that they would generate additional emissions of 19,000 million tonnes of CO_2 (Climate Change Commission, 2020). Undiscovered resources account for about half of this. Every year, Norway exports oil and gas that generates 10 times more emissions than Norway's total domestic GHG emissions, i.e. around

500 million tonnes of CO_2e (Menon Economics, 2022). The choices Norway makes at the intersection between petroleum policy and climate policy are therefore crucial to both Norway's GHG emissions and for Norway's overall impact on the transition to a low-emission society, both nationally and globally.

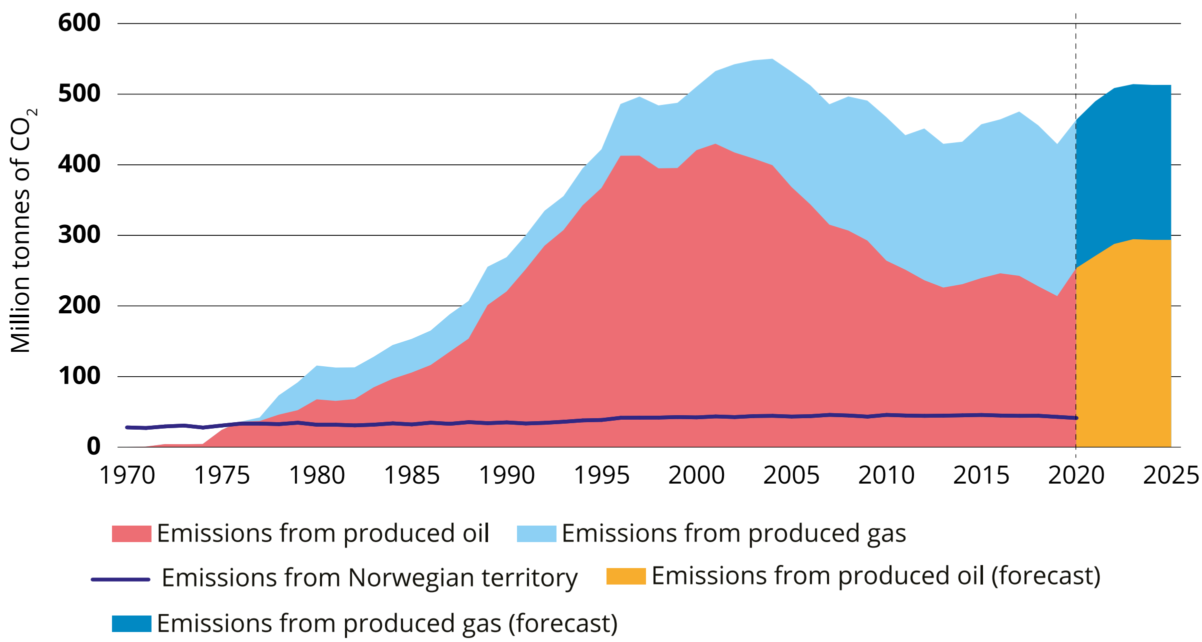


Figure 12.1 **Annual CO_2 emissions from the combustion of produced Norwegian oil and gas, compared with annual GHG emissions on Norwegian territory.**
The figure is based on the Norwegian Petroleum Directorate's historical production figures up until 2020 and production forecasts for 2021–2025.

Source: Robbie Andrew, CICERO (Andrew, 2021)

Oil and gas production on the Norwegian continental shelf impacts the climate both directly and indirectly. Direct emissions from production and emissions from oil and gas consumption in Norway are covered by the Norwegian emission accounts. Consumption of oil and gas exported to other countries is covered by the importing country's emission accounts. Oil and gas activities also affect the transition in other ways than just direct emissions, for example through the sector's use of electricity, labour and other resources. The Norwegian oil and gas industry is a significant player also outside Norway's borders, and influences the development of the European energy system. Norwegian petroleum activities are therefore of great significance for the transition to a low-emission society in many respects, in Norway and in other countries, relating to Norway's role globally.

A key question is what role climate considerations should play for the future level of production on the Norwegian continental shelf. The main issues in Norwegian and international climate policy have been to target demand for fossil energy, based on the assumption that production over time will have to adapt to consumption. The ambitious global climate goals set out in the Paris Agreement have led to increasing discussion about the need to also focus measures on supply, i.e. the production of

Emission accounts: an overview that includes all emissions and removals of greenhouse gases within a country's borders. The main gases are CO_2, methane (CH4) and nitrous oxide (N_2O), but also other gases such as fluorinated gases are considered greenhouse gases and included in Norway's emission accounts.

coal, oil and gas. There is both scientific and political disagreement about the extent to which supply-side measures in climate policy result in reduced emissions globally in the short and medium term. Uncertainty about the development of the oil and gas markets in a rapidly changing world makes these assessments demanding, as illustrated by the abrupt changes in European energy policy and in European energy markets in the wake of the war in Ukraine.

Another question is which emission reduction measures should be implemented in petroleum activities in both the short and long term. As our biggest source of emissions, the oil and gas industry is decisive to reducing Norway's own GHG emissions. If petroleum production will be reduced in the decades ahead in any case, the effect of emission reduction measures such as power from shore will be transient. Large investments in and use of resources to transport power from shore for the electrification of offshore petroleum activities may thus have little impact in the longer term. However, if the oil and gas industry is to be further developed, and the activity continues towards and beyond 2050, comprehensive emission reduction measures will be needed in the sector. Even with extensive measures, there will still be residual emissions from activities on the continental shelf; cf. Chapter 3. With Norway's target of reducing emissions to 2.5–5 million tonnes of CO_2e in 2050, policy choices relating to the development of petroleum activities will determine how much of the emissions budget the industry lays claim to. Emission reduction measures in the oil and gas industry will also lay claim to resources, such as power and labour, which will affect the resources available for transition and development in other sectors.

See Chapter 3 for a review of remaining emissions in 2050.

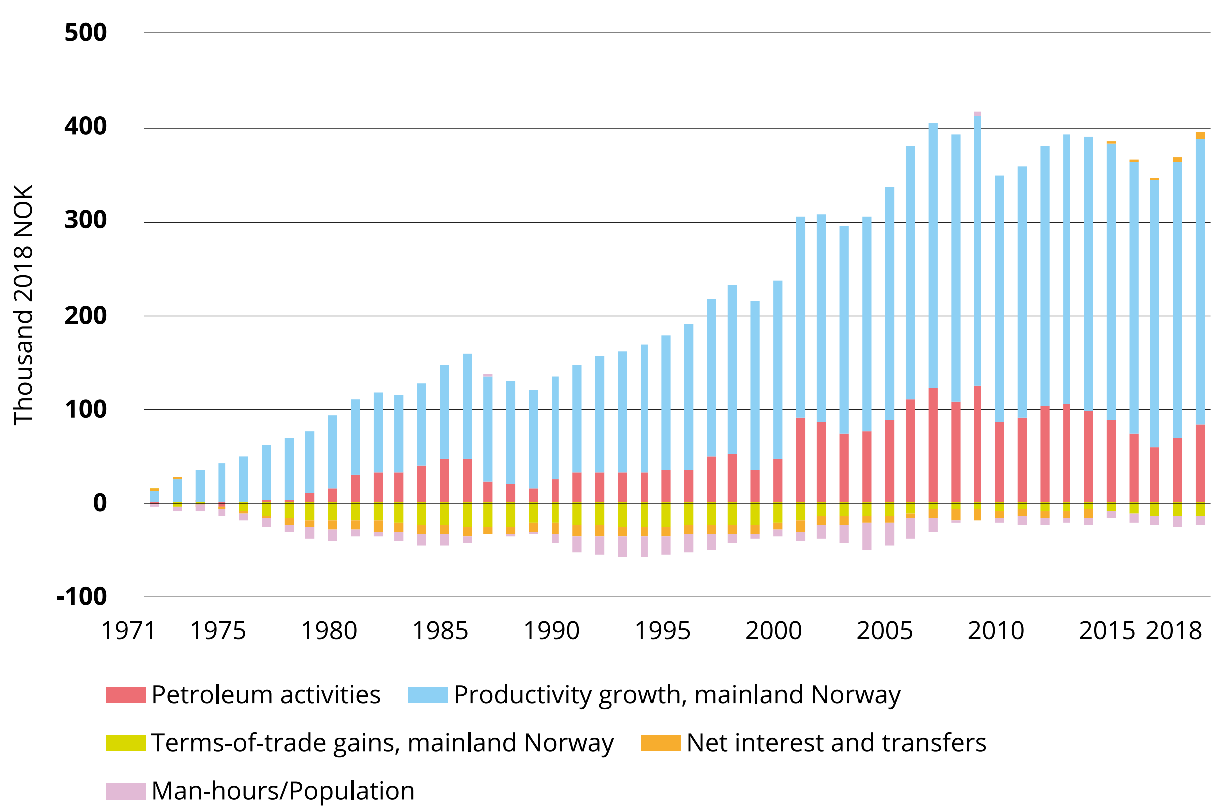
Norway must in any case manage the transition resulting from an expected decrease in oil and gas activities over the next few decades. This is a challenge Norway must face regardless of climate policy since oil and gas are non-renewable resources that are gradually being depleted. However, the pace of the decline, and thus of the necessary transition, is not given. There is a difference between a gradual decline caused by resource depletion, a decline caused by lower and more unpredictable oil and gas prices, and a policy that facilitates a controlled deceleration of oil and gas production. The pace will be influenced by national and international policy choices. The pace of the decline also affects the extent to which resources such as labour and electrical power will be available for the transition of other sectors. Although the transition to a less oil-dependent economy is not purely a climate policy issue, there are important links between the transition challenges and climate policy choices.

12.2 The petroleum sector's significance to Norway will decrease

Norway has seen a significant increase in welfare over the last 50 years, and the petroleum industry has been an important source of this development. Oil and gas production on the Norwegian continental shelf has meant increased activity and higher revenues in the Norwegian economy. Higher oil and gas prices contributed to particularly high profitability in the industry between 1998 and 2014, when oil prices peaked. Since 1970, Norway has achieved a sharp increase in real disposable income per capita. Petroleum activities have made a significant contribution to this development, while increased labour productivity in mainland industries and higher female labour force participation have been the most important factors; see Figure 12.2.

Figure 12.2 Breakdown of accumulated growth in real disposable income per capita since 1970.
Income definition from the national accounts. Measured in 1,000 2018-NOK.

Source: Long-Term Perspectives on the Norwegian Economy, 2021



In parallel with increased petroleum production, emissions from the sector have also increased, especially since 1990. In 1990, emissions from petroleum production on the Norwegian continental shelf amounted to around 8.21 million tonnes of CO_2e. Emissions increased sharply towards the turn of the millennium and stabilised at around 14 million tonnes of CO_2e. This increase is partly due to an increase in the production level, and partly due to the fact that the production becomes more energy intensive as the fields are exhausted. Since 2015, emissions have decreased and in 2022 they amounted to 12.2 million tonnes of CO_2e (Statistics Norway, 2023b). Gradually lower production and electrification will reduce emissions going forward. However, oil and gas production is still the sector that singlehandedly accounts for the highest GHG emissions in Norway, with 25 per cent of total emissions.

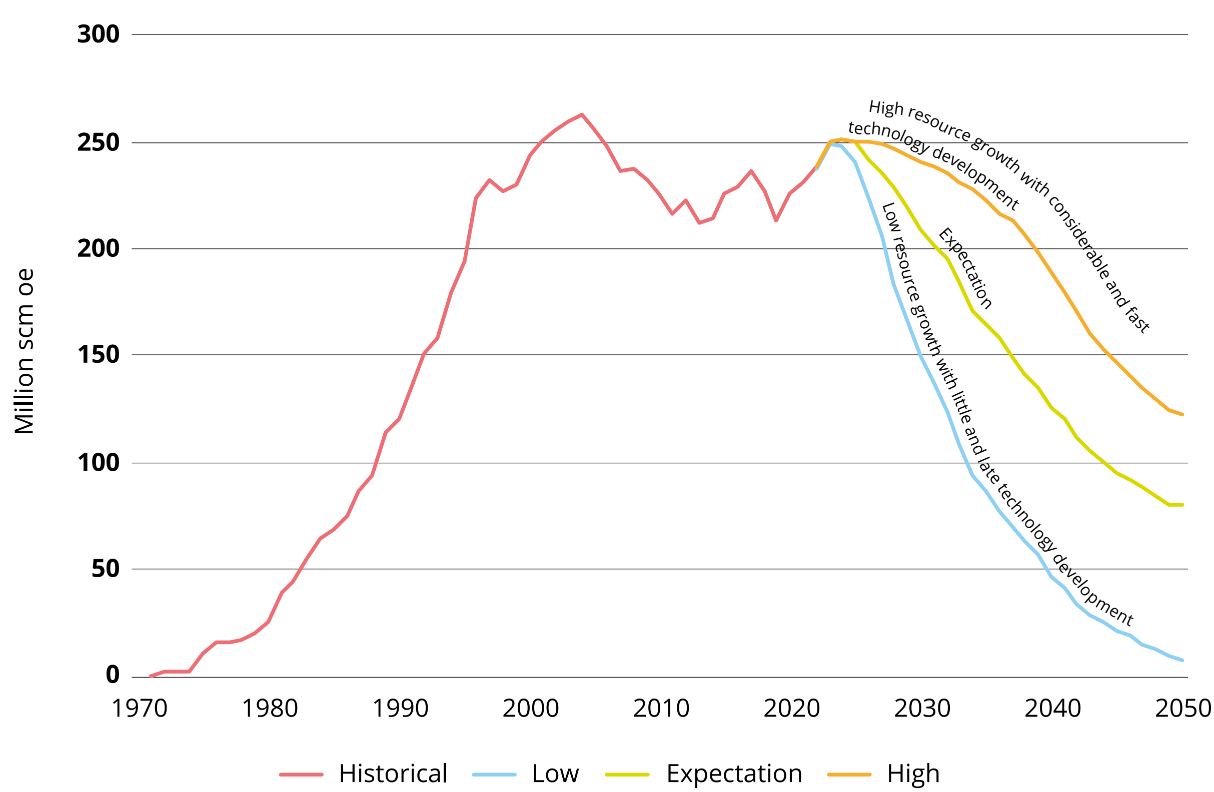
Production of gas power on the platforms is the biggest source of emissions from oil and gas production, but other parts of the process also cause emissions. Producing, separating, processing and transporting oil and gas require large amounts of energy. About 90 per cent of emissions on the Norwegian shelf come from the combustion of natural gas or diesel in turbines, engines and boilers to generate power and heat to recover oil and gas from the seabed (Gavenas et al., 2015). The gas turbines on the platforms are less efficient than modern onshore gas-fired power plants. In addition, other parts of the process generate emissions. Surplus gas is flared or vented, which may be necessary for safety reasons, but generates large emissions. Norway has introduced a general ban on flaring for safety reasons. The sector also emits uncombusted gas from equipment on the installations, and from the storage and loading of crude oil and petroleum products. These emissions are difficult to significantly reduce, although many measures are available that could help reduce these emissions as well. Possible measures are discussed in the Norwegian Environment Agency's analyses (Norwegian Environment Agency, 2022b).

It is not possible to remove all emissions associated with oil and gas production as long as such activities are maintained. Even with electrification and the use of CCS, there will, in a 2050 perspective, be significant residual emissions from oil and gas production relating to, among other things, leaks, flaring, loading and unloading of petroleum and processing plants. This will also be the case without new fields being put into operation. A significant part of these emissions are not covered by the EU ETS and are also not liable to tax. If it is assumed that all installations and onshore facilities in operation in 2050 are powered by renewable energy, and that emissions from other emission sources are reduced, the Norwegian Petroleum Directorate believes that it will be possible to achieve emissions in 2050 of less than 1 million tonnes of CO_2e (see digital appendix to the report). By comparison, 1 million tonnes of CO_2e will account for 20–40 per cent of Norway's remaining emissions in 2050 if the climate targets are achieved. The higher the level of activity in the oil and gas industry, the more emissions in other sectors will have to be reduced to keep overall emissions in 2050 within the target of 2.5–5 million tonnes.

How the level of activity on the Norwegian continental shelf will develop towards 2050 is highly uncertain. In its resource report for 2022, the Norwegian Petroleum Directorate has illustrated three possible pathways for production on the Norwegian continental shelf going forward (Norwegian Petroleum Directorate, 2022). The estimates also include areas that are not currently open for exploration and production of petroleum, such as Lofoten, Vesterålen and Senja, the Barents Sea North and the areas around Jan Mayen. Figure 12.3 shows the expectation scenario (centre) together with two alternative scenarios: one for low resource growth with little and late technology development (low scenario) for increased recovery from existing fields, and one for high resource growth with considerable and fast technology development (high scenario). All three scenarios show a significant decrease in production towards 2050, but the decrease varies from a halving of the current level in the high scenario to a reduction of 97 per cent in the low scenario. The expectation scenario entails a decrease of 65 per cent from 2020 to 2050 (Ministry of Petroleum and Energy, 2022). The differences are due to different assumptions, among other things in terms of exploration activity and discovery rate. A decrease in oil and gas production will mean lower emissions, although there is not a one-to-one relationship between production and emissions. Actual production has consistently exceeded the forecasts, and estimates of future production have been upwardly adjusted, partly because the Government has pursued an active policy for exploration and increased recovery from existing fields; see Figure 12.4. The NPD's estimates indicate that about half of the production in ten years will come from projects for which an implementation decision has not yet been made. There is thus great uncertainty associated with the estimates.

Figure 12.3 Estimates for oil and gas production towards 2050.
The production trajectories are based on the same price assumptions where the price of oil will be USD 55/barrel from 2030, and USD 5.85/Mmbtu for gas. The trajectories are not therefore based on different scenarios for climate policy or other factors that may change demand for oil or gas.

Source: The Norwegian Petroleum Directorate 2022



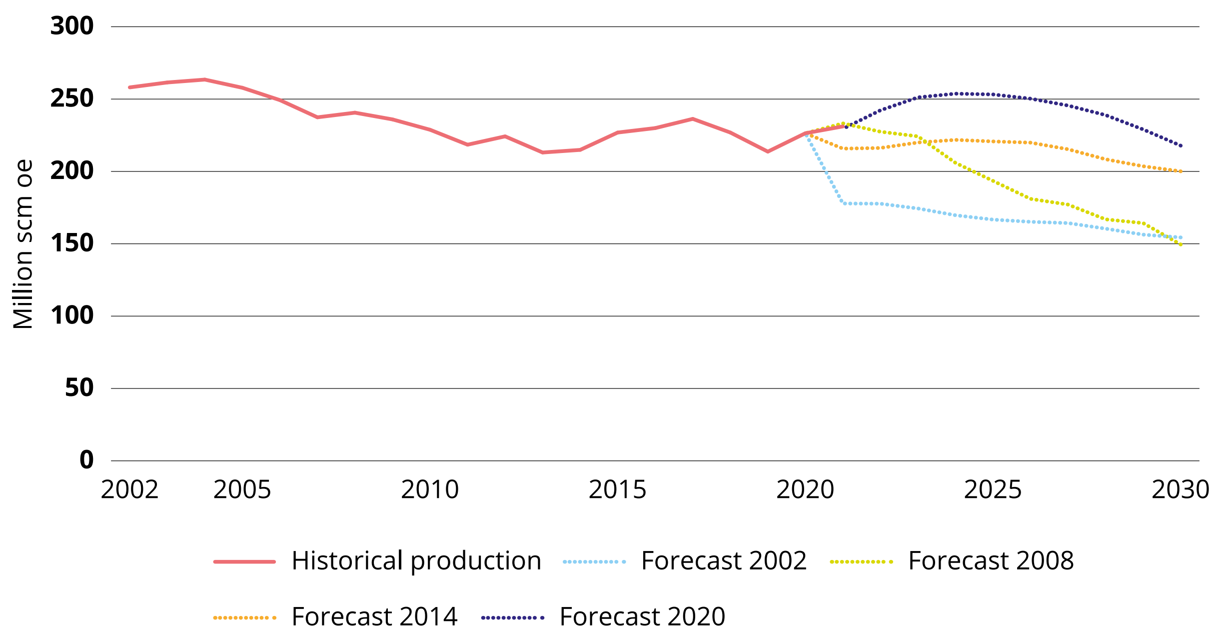


Figure 12.4 **Estimates for petroleum production in the white papers on long-term perspectives on the Norwegian economy published every four years.**
The figure shows that the estimate for production towards 2030 has been upwardly adjusted with each new white paper submitted.

Source: Long-Term Perspectives on the Norwegian Economy, 2021

The overall future level of oil and gas production is greatly influenced by policy choices, primarily through exploration policy, infrastructure development decisions and tax policy. Norwegian oil and gas production is highly politically regulated, but decisions on investments in new production are left to the petroleum companies. Exploration policy is governed by the opening of marine areas for petroleum activities under the Petroleum Activities Act, followed by the award of production licences either through ordinary licensing rounds or through the system for awarding in predefined areas (APA). It is within the predefined areas that most exploration activity takes place today. If a viable discovery is made, the development must be approved through the processing of the Plan for Development and Operation (PDO) and the Plan for Installation and Operation (PIO). The tax system for petroleum activities is designed with a view to ensuring correspondence between commercial and socio-economic profitability. The Government takes a high share of the return on oil and gas production, but also covers a correspondingly high share of the investment costs. The way the tax system and the framework in general are designed, it is the companies that assess the risk and make decisions about investments in exploration and production, within the framework established by exploration policy and resource management.

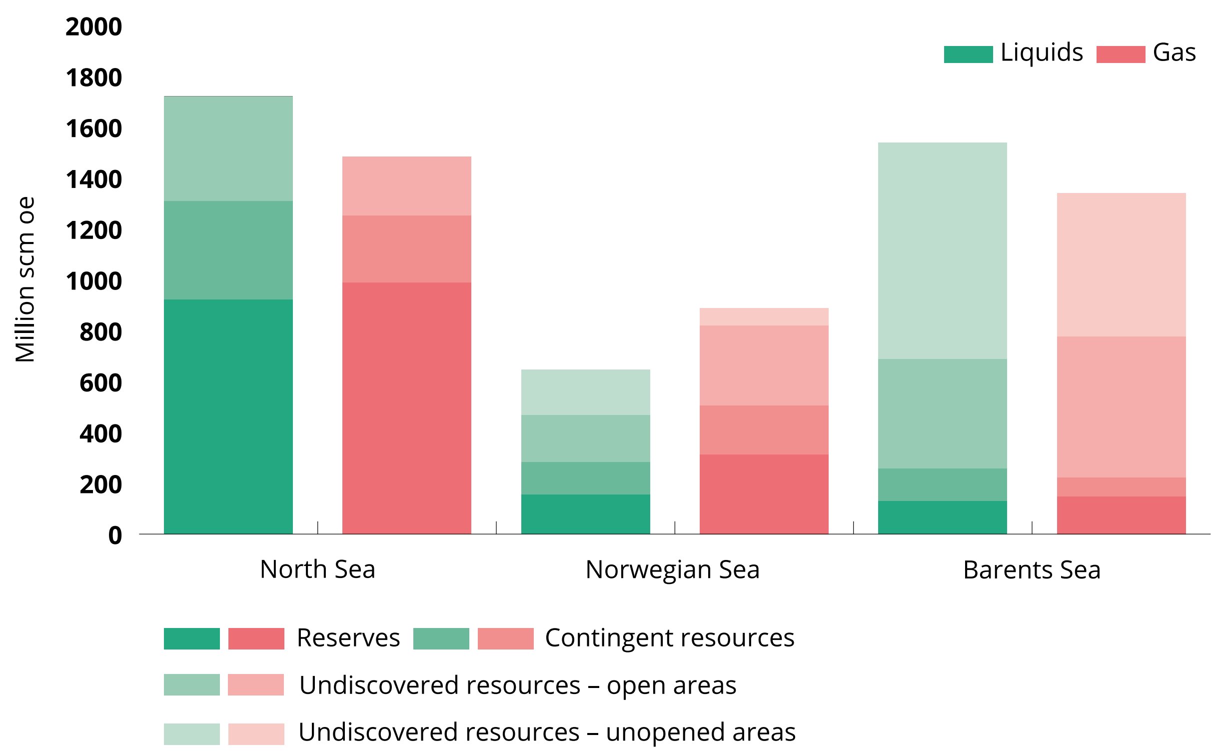


Figure 12.5 Distribution of remaining liquid and gas resources by area and resource category.
The figure shows that, while remaining resources in the North Sea and to some extent the Norwegian Sea are mainly reserves in existing fields, most of the estimated resources in the Barents Sea are still undiscovered. A large part of these resources are assumed to be in areas that have not been opened for petroleum activities.
Source: Norwegian Petroleum Directorate's Resource Report 2022

A large proportion of assumed undiscovered resources are located far from existing infrastructure. There were 93 fields in production on the Norwegian continental shelf at the turn of the year 2022/23. Most of the fields are located in the North Sea (70), followed by the Norwegian Sea (21) and the Barents Sea (2). The Norwegian Petroleum Directorate estimates that around half of the remaining resources on the continental shelf have been discovered (Ministry of Petroleum and Energy, 2022). Figure 12.5 shows that 60 per cent of the estimated undiscovered resources lie in the Barents Sea. In its resource report for 2022, the Norwegian Petroleum Directorate states that, without greater export capacity (for example in the form of pipelines), both proven and undiscovered gas resources in the Barents Sea are of less interest. Developing oil fields will also be demanding because petroleum resources under the seabed contain both oil and gas, which means there will still be a need for market opportunities for gas.

Petroleum activities have major spillover effects on the economy, but there are different views on what these effects will be in the future. In 2020, about 163,000 people were directly or indirectly employed in the petroleum industry, i.e. about 6 per cent of total employment in Norway (Hungnes et al., 2022). The industry creates jobs in many areas of the country, thus contributing to a decentralised settlement pattern. In a proposition to the Storting in 2023, the Government stated that the industry is highly productive and technically advanced and thus contributes to technology transfers and productivity impulses to other sectors at a scale that cannot be expected of other future industrial activities. In this way, the industry provides a basis for the development of new industries (Ministry of Petroleum and Energy, 2023a). The Skills Needs Committee, on the other hand, points out that high activity in the oil and gas industry can impede the transfer of skills to other industries because oil and gas employs many people in occupations that the labour market in general, including new energy industries, will need in the green transition (Skills Needs Committee, 2023).

A large part of Norway's original oil and gas assets have already been recovered and the proceeds invested in the Government Pension Fund Global (GPFG). Since the fiscal policy framework in Norway separates the use of oil revenues from earnings, the upcoming decrease in petroleum activities will not directly affect public sector budgets other than tax reductions due to lower activity in associated industrial activities. However, lower contributions to the GPFG will mean that provisions for the fund gradually become smaller and it will eventually stop growing. This will happen regardless of policy decisions, but will happen faster with a steeper decline. In 2021, the value of the GPFG was estimated to be about three times as much as the Government's expected future petroleum revenues (present value of net cash flow), and in ten years, the value of the fund is estimated to be eight times greater (see Figure 12.6) (Ministry of Finance, 2021). Therefore, central government finances are relatively robust against falls in oil and gas revenues, while they have become increasingly vulnerable to falls in the fund's value.

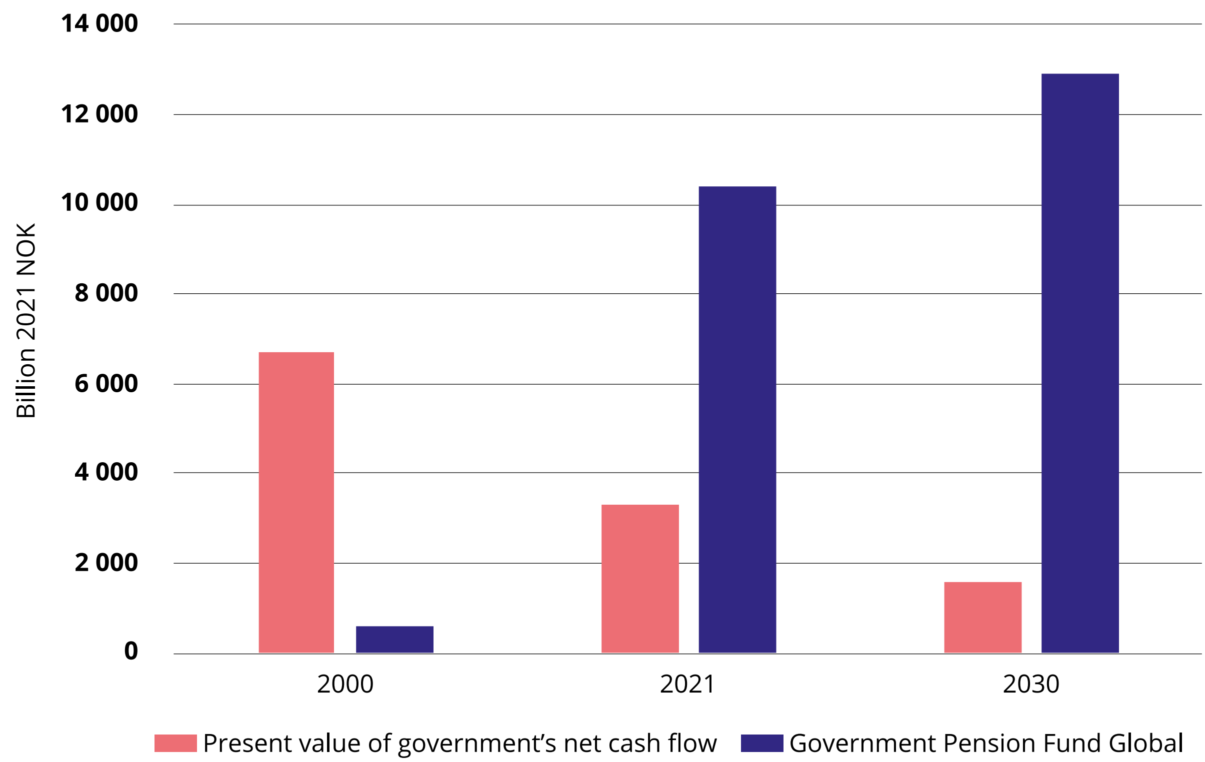


Figure 12.6 **Present value of the Government's net cash flow from petroleum activities and the value of the GPFG at different times. Billion 2021-NOK.**

Source: Long-Term Perspectives on the Norwegian Economy, 2021

Norwegian petroleum activities will play an important role in the Norwegian economy for many years to come, but the industry is no longer expected to be such a major growth engine towards and beyond 2030. Consequently, the favourable productivity and wage developments in the rest of the economy resulting from petroleum activities are also likely to slow down. A single new industry cannot be expected to take over as growth engine after the petroleum sector. The fact that the scope of petroleum activities is reduced will therefore also mean a more diverse industry structure. The profitability of future petroleum activities will be affected by cost developments, where resource scarcity and maturation of existing fields push costs up, while technology development may pull in the opposite direction. Maturation in the technological sense will normally contribute to lower costs and more efficient production, while an oil and gas field that has been producing for a long time can result in higher costs because more energy is needed to recover petroleum when the pressure in the reservoir gradually falls. Climate policy, both nationally and internationally, will also affect future profitability in the petroleum industry.

12.3 Lower demand for oil and gas

The goals of the Paris Agreement provide little or no possibility of new investments in fossil energy globally. According to the Intergovernmental Panel on Climate Change (IPCC), global CO_2 emissions must be cut to net zero by around 2050 in order to halt global warming in line with the temperature targets of the Paris Agreement. Petroleum products are still used in low-emission scenarios, but the scope varies and is heavily dependent on assumptions about technological development and costs. However, it is clear that planned production globally exceeds what the Paris targets allow. According to the IPCC, existing fossil infrastructure will generate more GHG emissions than the remaining carbon budget for the 1.5°C target, assuming operation until the end of its technical lifetime (IPCC, 2022b). Fossil energy reserves in fields already in production or under development exceed the emissions budget for a 1.5-degree temperature rise (Trout et al., 2022). In its scenario for how the 1.5°C target can be achieved, the IEA states that no oil and gas production should be initiated beyond existing or planned fields. As shown in Figure 12.7, the planned production of coal, oil and gas up until 2040 will far exceed what is compatible with the Paris Agreement's temperature target (SEI et al., 2021).

How oil and gas production develops depends both on Norwegian policy and on the situation outside Norway. An expected global climate policy with higher carbon pricing, more stringent regulations on fossil energy use and production, and increased circularity in the economy will, together with the development of new technology, lead to a transition to renewable energy sources. This in turn will reduce global demand for fossil fuels and thus also the prices oil producers can take. The future price of oil is also affected by adjustments in the supply of major oil producers, including the OPEC oil cartel. Oil and gas from the Norwegian continental shelf covered around 2 and 3 per cent of global demand, respectively, in 2019. Almost all gas produced in Norway is exported. About 95 per cent is transported via pipelines to other European countries. The policy pursued in Europe is therefore particularly important for how demand for Norwegian gas will develop.

Demand for oil will fall with an ambitious global climate policy, but it is not a given that market developments provide incentives for a gradual transition in Norway. In a world characterised by ambitious climate policies targeting fossil energy consumption, combined with well-functioning international cooperation, the profitability of new oil production will be lower than today. This will make new investments in oil production less profitable from both a commercial and socio-economic perspective. In that situation, the conflict between climate considerations and petroleum policy goals in Norway will be reduced. However, a less uniform and coordinated climate policy globally, combined with turbulent markets and international conflict, could mean that oil and gas prices are affected by sudden shifts and instability.

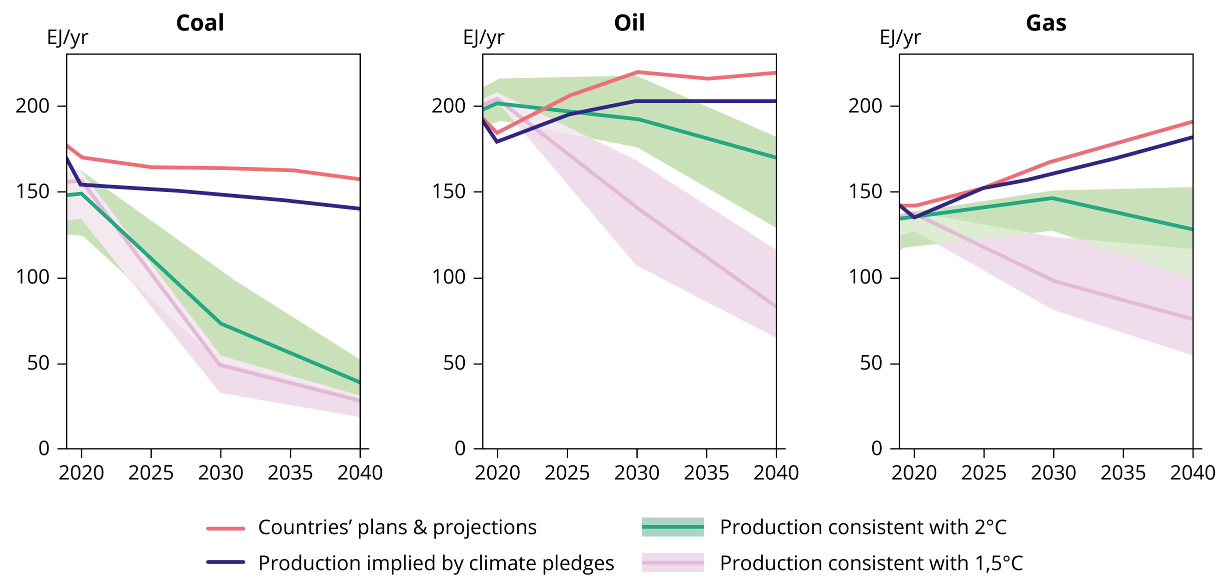


Figure 12.7 **Planned production of coal, oil and gas up until 2040 compared with production in line with a 2-degree or 1.5-degree path.**

Source: Stockholm Environment Institute et al. (SEI et al., 2021)

Abrupt shifts in oil prices can create pressure to introduce special arrangements that are unfortunate with regard to the long-term transition. Such arrangements will slow down the transition of Norwegian petroleum activities and affect access to resources for the transition of society more generally. Sudden changes can be interpreted as temporary crises, and strong pressure may arise to maintain exploration and investment through more favourable framework conditions for the oil companies. The sharp drop in oil prices in spring 2020 created pressure to introduce special arrangements that would maintain the level of activity in the sector. An oil tax package with favourable schemes for the industry was adopted by the Storting in spring 2020. These schemes have provided prospects of a very high level of investment in oil and gas production over the next few years tie up more resources in the sector. Calculations from Rystad Energy show that the development plans submitted in 2022 together constitute the highest investment amount in any single year in Norwegian petroleum history; see Figure 12.8. The oil tax package and the changes in the petroleum tax regime that were implemented simultaneously also lead to reduced tax revenues from the projects (Ministry of Finance, 2023b). New sudden price drops in the coming decades could create political pressure similar to that seen in 2020 for tax reductions. The Committee believes it is important to send political signals now that there will be no corresponding relief in similar situations in the future. An expectation of such political packages provides unfortunate incentives and makes the transition more difficult for both the petroleum industry and other industries. The Skills Needs Committee points out that uncertainty about the possibility of transferring expertise from the oil and gas sector can pose a challenge in meeting skills needs in new energy industries (Skills Needs Committee, 2023).

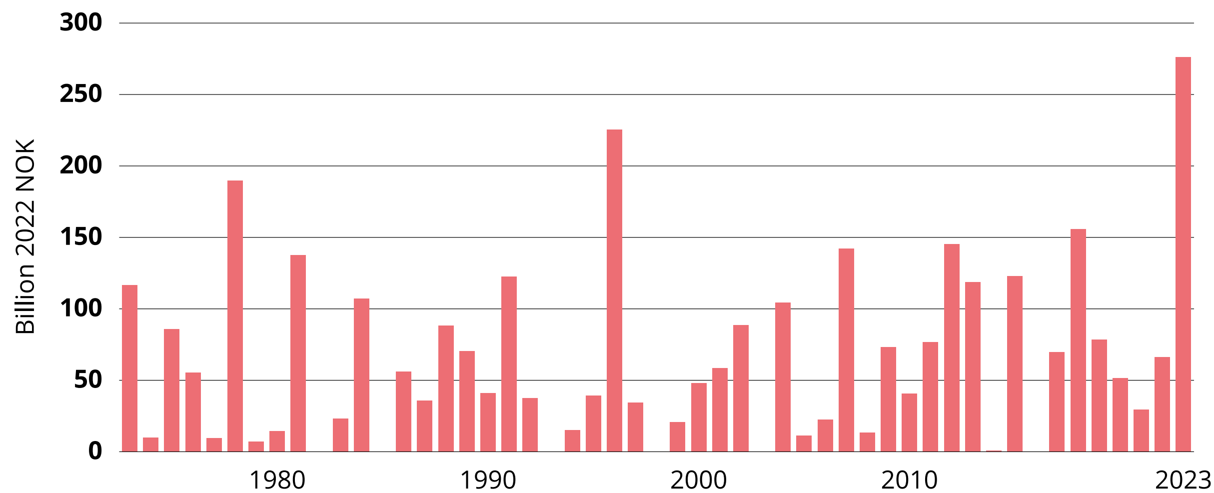


Figure 12.8 Total investments in submitted plans for development and operation. The figures show the year of approval rather than the year of submission. For fields that have had several development stages, the investments are included in the year when the PDO for the first development stage was approved.

Source: Rystad Energy.

Demand for gas will not necessarily fall as much as for oil. Global energy models differ substantially when it comes to the role of gas in the low-emission society. The results are highly dependent on assumptions about the development of renewable energy sources and CCS technology. In scenarios based on limited removal of atmospheric CO_2, gas consumption is reduced at least as much as oil, while the reduction is somewhat less if large amounts of CO_2 removal are assumed (Achakulwisut et al., 2023). Demand for Norwegian gas largely depends on the climate and energy policy pursued in the EU and European countries. In the short term, demand has risen as a result of Russia's invasion of Ukraine. However, the loss of Russian gas also increases pressure to phase out gas from the European energy system, so Norway's role in the longer term is less clear. In Europe, gas is currently used for power generation (32 per cent), heating of homes/buildings (38 per cent) and industry (26 per cent) (Norwegian Environment Agency, 2022b). To achieve the 2030 climate targets, the EU points to the need to reduce energy consumption and switch to zero-emission sources in all these sectors. Renewable electricity production will need to double from current levels, while oil and gas consumption must be reduced by 30 and 25 per cent, respectively, from 2015 to 2030. After Russia's invasion of Ukraine and the strong restrictions on Russian gas supply to Europe, the EU's goal is to accelerate this development. The invasion has also led to an increased political will to become independent of imports of essential goods such as energy, raw materials and technology. The EU's Scientific Advisory Board on Climate Change is looking at different scenarios towards a recommended 2040 target for the EU of a 90–95 per cent cut in emissions from 1990 levels. They point out that a common development feature for all scenarios is the almost complete decarbonisation of power production by 2040 through the phase-out of coal by 2030 and of gas power without CCS by 2040. In addition, a large-scale deployment of wind, solar and hydro energy as well as a substantial decrease in fossil energy imports are expected (European Scientific Advisory Board on Climate Change, 2023).

Decarbonisation: that activities that currently involve CO_2 emissions are changed so that the activity becomes zero emission, for example switching from cars that run on petrol/diesel to electric cars.

Emissions associated with the production and use of natural gas can be greatly reduced by separating CO_2 and converting the gas into blue hydrogen and ammonia. This relies on the availability of CCS technology solutions and infrastructure. If such solutions are implemented on a large scale, it can contribute to sustaining gas demand. The future development of these technologies is uncertain, and exaggerated expectations of such technologies could lead to misinvestment in further oil and gas production and a delayed and/or more abrupt transition to a low-emission society. Recent research also indicates that hydrogen leakage can have a major impact on climate change (Sand et al., 2023). Demand for blue hydrogen and ammonia will depend on policies to support demand, and it is not a given that fossil-based zero-emission energy carriers will be the preferred choice.

Blue hydrogen: hydrogen produced from fossil energy, but with carbon capture and storage.

The distribution of oil and gas in resource production may be affected to some extent. In the short term, Norwegian gas is an important contribution to energy security in Europe. The Committee has asked the Ministry of Petroleum and Energy for an assessment of the extent to which it is possible to influence the distribution of oil and gas at different stages of resource management (see electronic appendix). The petroleum resources underground contain both oil and gas, and the amount of resources that can be produced from oil and gas, respectively, depends in part on the type of production strategy chosen. A geological survey can help establish whether an area is likely to contain mainly gas or oil, or both. However, there will always be uncertainty associated with such assessments. In areas where exploration wells have not been drilled, such uncertainty may be high. Since oil production has historically been more profitable than gas production, oil has become a priority in terms of both exploration and production. Often, the oil is recovered from a reservoir before the gas, and gas that follows the well stream is often injected back into the reservoir in order to maintain the pressure in the reservoir and thereby increase the overall oil production. The gas will then often be recovered towards the end of the field's life. In the short term, the Ministry of Petroleum and Energy considers it possible to increase the production of gas in most fields without this compromising oil production over time. At the same time, increased gas exports depend on the availability of capacity in the export infrastructure. In the long term, a significant increase in gas production will mean a reduction in oil production.

A discussion is ongoing about whether the supply of fossil energy should be actively limited in line with the climate goals, or whether we should rely on the markets to ensure an adequate reduction in planned production. Several research contributions in political science and political economy have shown how political and economic interests and institutions associated with the production of fossil energy can be a barrier to the market ensuring an effective transition (Aklin & Urpelainen, 2013; Cullenward & Victor, 2021; Lazarus & van Asselt, 2018; Mildenberger, 2020). Investments in fossil energy production create path dependency and help sustain power relations that make transition over time more difficult. The Committee invited a selection of Norwegian social scientists to provide their academic perspectives on power relations in Norwegian climate policy. Several highlighted the petroleum industry's influence on Norwegian politics as a barrier to transition in Norway (Gulbrandsen & Handberg, 2023).

Climate policy in most countries targets the demand side, but some countries also have policies aimed at the production of fossil energy. In 2020, Germany adopted a law to phase out coal production and coal power generation by 2038. The target year was later pushed forward to 2030. As a result of the war in Ukraine, the government decided that some coal power plants would be kept open for reasons of emergency preparedness, and coal mining was allowed to expand. However, the goal of phasing out coal by 2030 remains firm. Some countries have also adopted a controlled de-escalation of oil and gas production as a supplement to ordinary targets for reduced GHG emissions. Countries such as Denmark, France, Ireland and New Zealand, and states such as California and Quebec, have established targets for phasing out existing oil and gas production or banning new activities as part of their climate policy. Proposals have also been made for an international agreement or other forms of international cooperation to limit the production of fossil energy (Asheim et al., 2019; Newell & Simms, 2020). In 2021, US President Joe Biden imposed a temporary moratorium on new licences and production permits on federal land to be able to reassess the framework conditions for petroleum production for climate reasons. The moratorium was lifted in 2022 and replaced by a new practice that prioritises production near existing infrastructure and includes more comprehensive assessments of the climate impact of new petroleum activities (The White House, 2021; US DOI, 2022).

The global impact of unilateral measures to limit the supply of fossil energy is uncertain. The direct market effect of reducing the production of a product will be a rise in price and fall in consumption. Analyses of direct market effects show that reduced Norwegian oil production will contribute to a certain reduction in global oil consumption (Fæhn et al., 2017; Rystad Energy, 2023). The overall climate benefit depends on how much is expected to be replaced and whether this oil is produced with higher or lower emissions than on the Norwegian continental shelf. The oil market is global and partly characterised by oligopoly on the supply side, and the effect of reduced Norwegian oil production depends in particular on the reaction of major players such as OPEC. In the case of gas, the market effect of reduced production can be both positive and negative for climate change, depending on what the gas is replaced by. In the short term, analyses point to a positive climate effect of gas production because the gas displaces coal power (Rystad Energy, 2023). The positive effect is enhanced by the fact that Norwegian gas is consistently produced with relatively low emissions. In the longer term, the effect is highly dependent on developments in global energy consumption and climate policy. There is broad agreement that the climate benefit of reduced production increases if several producer countries cooperate on the implementation (Asheim et al., 2019).

If many players continue to invest in fossil energy production based on isolated assessments of the direct market effects of each development, there will be a risk

of over-investment in new infrastructure for the production, transport and use of fossil energy. This can contribute to a lock-in effect that delays the energy transition and makes it more difficult to scale down the activity or shift away from it in the longer term. Large investments and a high number of employees in the sector can also make it more difficult for new industries to establish themselves or leave less room for the implementation of desirable climate action; see also the assessments of the Skills Needs Committee.

Norway's choices when it comes to future oil and gas production can send a strong political message about the direction in which the energy system should develop. In addition to direct market effects, measures to limit oil and gas production may have political effects that are difficult to quantify. Norway is now Europe's largest supplier of gas. By virtue of this role, Norway has a strong influence on energy policy assessments in the EU. What signals Norway sends about future oil and gas production may therefore also influence other players' long-term priorities. A signal from Norway about transformation of the petroleum industry could for example make it more difficult politically for other countries to increase their production of fossil energy, and strengthen willingness to invest in alternatives. A continued strong investment in fossil energy production can make Norway vulnerable to international criticism.

There has recently been an increase in 'climate lawsuits' both nationally and internationally, several of which have been related to the production of petroleum resources. One example is a complaint submitted to the European Court of Human Rights in which Norway is accused of not doing enough to reduce GHG emissions from, among other things, the petroleum sector. Nationally, the Supreme Court has also considered an action on whether the granting of exploration licences was in conflict with Article 112 of the Norwegian Constitution on the right to a healthy environment. The Supreme Court found that the decision was not invalid, but made it clear that the State has a right and a duty not to approve a plan for development and operation (PDO) if warranted by climate and environmental considerations. In August 2023, the environmental organisations Greenpeace and Nature and Youth filed a new lawsuit against the Norwegian State in which they claimed that, by not assessing the climate consequences when approving three oil and gas fields in the North Sea, the State had failed to comply with the Supreme Court's ruling.

Reducing exploration and production now does not mean that resources are lost. Although some resources may be time-critical to recover because they depend on being linked to existing infrastructure with a limited lifespan, other resources will still be recoverable at a later date. It will therefore always be possible to reconsider recovery of these resources if technology development makes oil and gas production compatible with a future low-emission society. Should this prove to be the case, the value of oil and gas that has remained in the ground may be high. In general, saving a resource for later use will be of high value when the future is uncertain. A suspension of production thus provides an option value for the resources on the Norwegian continental shelf that should be taken into account in the assessment of the socio-economic consequences of Norwegian petroleum policy.

A world that does not move in the direction of stronger climate policy, and with continued high demand for oil and gas, will exacerbate the dilemmas associated with Norwegian petroleum policy. With high demand and correspondingly high profitability in the petroleum activity, there will be strong incentives for continued high investments in exploration and production on the Norwegian continental shelf. Such a situation would reinforce a dilemma that also has ethical and moral dimensions: Should we pursue maximum production in order to meet global demand and benefit from the revenues this generates, or should we assume our fair share of global responsibility and pursue the Norwegian green transition goals, and, based on that, reduce production? The management of common resources can be based on ethical principles to determine the right action, such as the management of the GPFG when it comes to investments with negative consequences for health, the environment and human rights. On the other hand, the costs to Norwegian society of such an approach can be high, and the direct climate benefits low, if oil and gas demand remains high.

The time perspective makes this dilemma even more challenging. Neither weak climate policy nor high demand for oil and gas will necessarily last forever. It can be an accurate description of the situation at a certain point in time, but the situation may well change at a later point. Norway's choices in this situation can influence how the world develops. At the same time, the choices Norway makes for the oil and gas industry will result in significant path dependency, meaning that we become locked to a choice that may later prove not to be the most appropriate one; see Box 3.3 on path dependency.

12.4 A future without oil and gas

Petroleum policy must be changed if Norway is to become a low-emission society in 2050 and contribute to the Paris Agreement's temperature target. In the Committee's view, Norway must reduce the scope of petroleum production towards 2050 beyond current expectations. This is important to prevent the petroleum sector from laying claim to resources, including the carbon budget, needed for the transition in other sectors, and to prepare the Norwegian industry structure for a global energy system that is in line with the goals of the Paris Agreement. The Committee refers to how, according to the IPCC, global CO_2 emissions must be cut to net zero by around 2050 in order to halt global warming in line with the temperature targets of the Paris Agreement. In its scenario for how the 1.5 °C target can be achieved, the IEA states that permission should not be given for further oil and gas production beyond existing or planned fields. The OECD recommends that Norway should prepare for a future without oil and gas (OECD, 2022). The Committee supports this assessment.

Petroleum policy must be adapted to climate policy objectives. Like all other policy areas, petroleum policy must also be aligned with the target that Norwegian emissions should be within the emissions budget of 2.5–5 million tonnes of CO_2e if Norway is to achieve the 2050 climate target. As the Committee has shown in Chapter 3, there is limited scope for emissions from petroleum activities in 2050. Even with electrification and the use of CCS to reduce emissions associated with production, there will be significant emissions as long as there is activity in the industry. It is difficult to imagine completely removing emissions from, among other things, leaks, flaring, loading and unloading of petroleum, processing plants and exploration. This makes it particularly important to consider the level of activity in this sector. The higher the level of activity in the petroleum industry in 2050, the more other sectors will have to cut. Petroleum production will be reduced towards 2050 regardless of policy, but with the Government's assessed resource availability in the future, the industry will nonetheless lay claim to a substantial part of the emissions budget in 2050. This applies even if the activity is based on the use of zero-emission energy.

See discussion of remaining emissions in 2050 in Chapter 3.

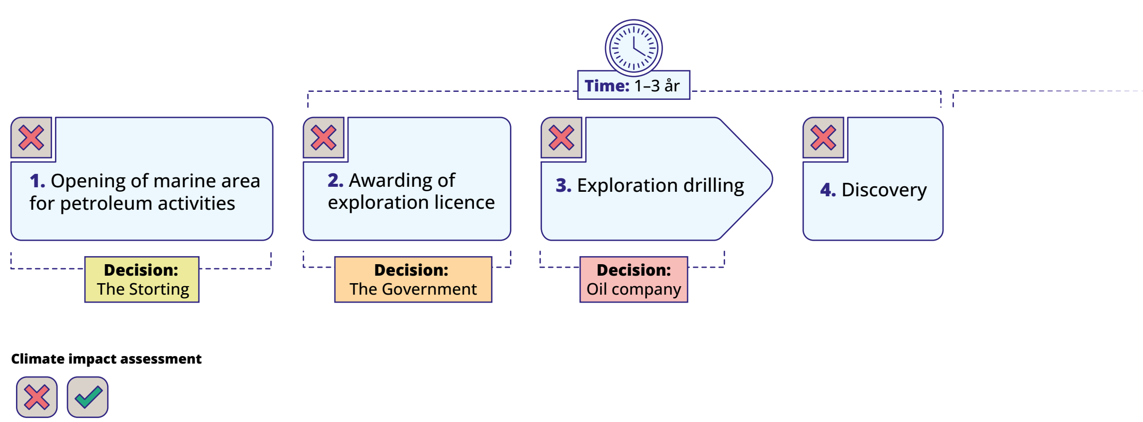
Facilitating a high level of petroleum activities towards 2050 means tying up resources that will be scarce in the transition to a low-emission society. Both the EU's and Norway's climate goals state that all oil and gas production must be powered by zero-emission energy by 2050. This means using power from shore, bioenergy, offshore wind or possibly gas power with CCS. As mentioned above, the activity will nonetheless produce some emissions that cannot be removed through electrification. High profitability associated with the production of a valuable non-renewable resource means that petroleum activities attract both capital and labour. The Skills Needs Committee emphasises that the shortage of expertise in the Norwegian labour market is exacerbated by the green transition (Skills Needs Committee, 2023). Further exploration for oil and gas resources thus set the course for prioritising power, the possibility of continued GHG emissions and, not least, expertise and labour for petroleum activities over other industries in a 2050 perspective. Such a priority can be justified by the fact that petroleum activities are expected to still generate significant revenues for society, or that it is important to maintain activity in industries that provide goods and services to the petroleum sector. At the same time, this will be a choice that entails a significant risk of a steeper and more difficult transition. Facilitating the further development of oil and gas activities is thus a choice that has consequences for other sectors of society and the development of new industries, and this must be made clear in political processes.

Today's petroleum policy facilitates a high level of activity. The Committee refers to how Norway, through the oil tax package, has facilitated a very high level of activity in the coming years. While investments at the global level have fallen in recent years, Norway has had the most stable investment level globally (Rystad Energy, 2021). As Figure 12.8 shows, development plans were submitted in 2022 with total investments of NOK 270 billion, constituting the largest total investment in submitted plans in any single year in Norwegian petroleum history. This will result in a high level of activity in the years ahead.

The assessment of the climate impact of Norwegian oil and gas production is currently inconsistent and unsystematic. In recent decades, the typical lead time from licence award to field opening has been between 10 and 13 years (see Menon Economics, 2023, for a more detailed review). Thereafter, the field's lifetime can be 20–30 years or more. This means that decisions are made today that must be balanced against expectations of climate policy over a period that extends well beyond 2050. Climate considerations nevertheless form a minor part of these decisions; see Figure 12.9. In exploration policy, no assessments are made of climate impacts or what importance should be placed on long-term climate targets in resource management on the Norwegian continental shelf. When it comes to the development of new fields, the Supreme Court ruled in 2020 that an impact assessment must be conducted of the climate consequences of combustion of oil and gas Norway has produced. Since then, the Ministry of Petroleum and Energy has introduced a new practice of calculating combustion emissions in connection with its consideration of new field developments (PDOs). No corresponding calculations are made when establishing new infrastructure such as pipelines (PIO). However, total combustion emissions from future Norwegian oil and gas production are linked to the overall production level. This is affected to a greater extent by exploration policy and decisions on significant infrastructure investments for exports. Climate assessments should therefore also be made in exploration policy and in connection with major infrastructure investments. The Committee is of the opinion that requirements for climate considerations in the management of petroleum resources should be included as an overall consideration in the Petroleum Activities Act and related regulations, and systematically incorporated into decision-making processes at all stages of

Figure 12.9 Typical lead times, decision gates and climate assessments for different stages of petroleum activity.
The times indicate the range in median lead times in the last three decades, based on calculations carried out for the 2050 Climate Change Committee (Menon Economics, 2023). Systematic assessments of climate considerations are currently only incorporated at one point, towards the end of the process.

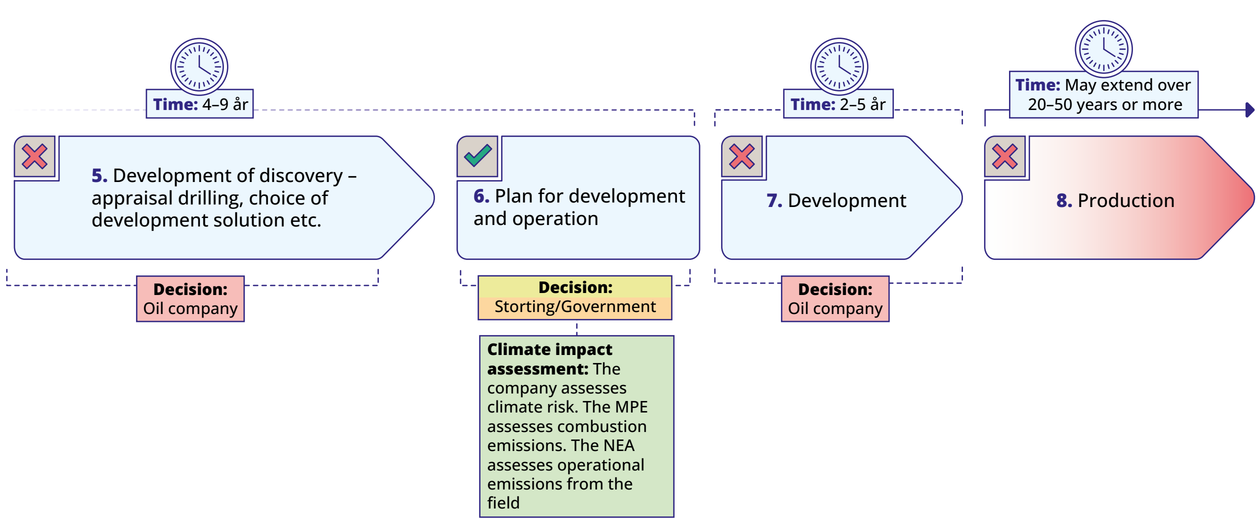
Sources: 2050 Climate Change Committee. Timeline based on Menon Economics (2023).



operations – from the opening of marine areas, nomination, awarding and renewal of licences, to the processing of PDOs, PIOs and other decisions that have a bearing on future production and infrastructure.

Petroleum policy must be developed in line with a comprehensive perspective on the transformation of the Norwegian economy and business and industry. The climate impact of Norwegian oil and gas exports cannot be reduced to an isolated question of gross exported emissions or net market effects of increasing or decreasing Norwegian production. Assessments of future activity must also include how decisions on new infrastructure will affect further activity in the petroleum industry and other industries, and the political message Norway sends by expanding or restricting petroleum activities. The assessment must be seen in the light of the fact that a slow transformation of the oil and gas industry will slow down the transition in the Norwegian economy and business and industry, while a controlled reduction will provide greater room for new industries and accelerate the transition.

Norway is better equipped than most oil-producing countries to handle a transition away from oil and gas production. As illustrated in Figure 12.10, Norway is less unilaterally dependent on oil and gas production for government revenue than most other major producers of fossil energy. A high income level, high level of education and large accumulated financial savings in the GPFG also make us well-equipped to handle the transition compared with many other producer countries.



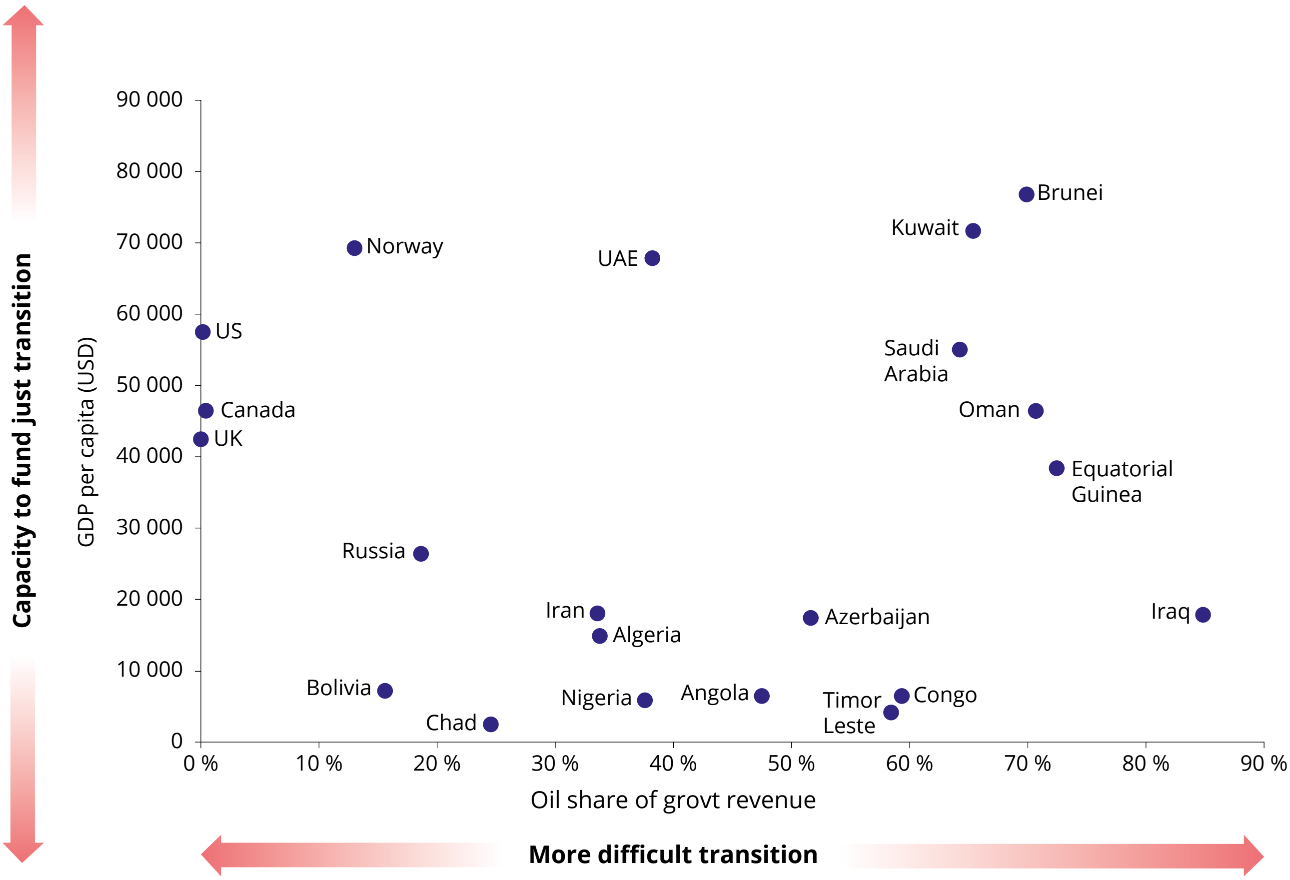


Figure 12.10 **Capacity for transition and share of government revenue from fossil energy production in different producer countries.**
The x-axis shows the proportion of government revenue from oil activities, as a measure of the government's dependence on the oil sector. The y-axis shows GNP per capita as a measure of economic capacity for transition.
Source: Muttitt and Kartha (2020)

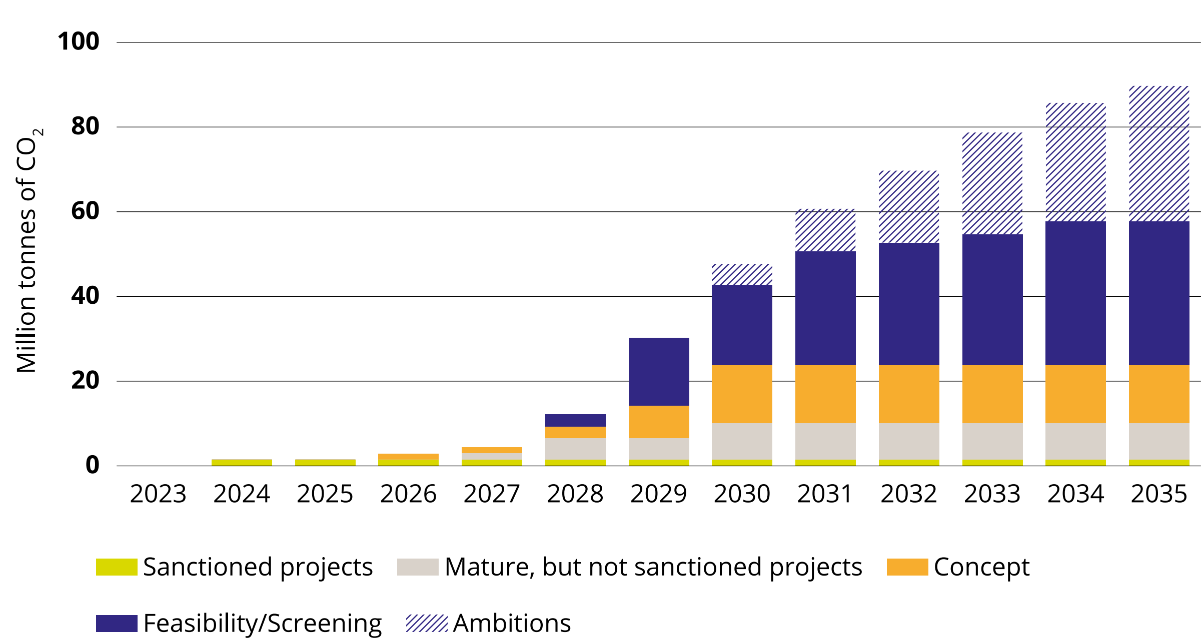
Net zero emissions: a state in which the amount of CO_2 emitted into the atmosphere from human activity is equal to the amount removed from the atmosphere through human activity over a given period of time.

The Norwegian Government has already contributed to the development of new value chains on the Norwegian continental shelf. In 2020, the Government established the Longship Project, a full-scale carbon capture and storage (CCS) project that will demonstrate the capture of CO_2 from industrial sources, as well as transport and safe storage of CO_2. The infrastructure and value chain established with the project will help industry in other countries to capture and export CO_2 for storage in the Norwegian storage facility. The Norwegian storage facility and transport solution, called Northern Lights, has been developed in partnership between Equinor, Shell and TotalEnergies. In the first phase, Northern Lights will be able to receive and store 1.5 million tonnes of CO_2 annually by 2024, but the pipeline from the onshore plant to the reservoir has a capacity of 5 million tonnes, thereby enabling upscaling of the project. Northern Lights is in dialogue with several European industry players about the storage of CO_2. The development of CCS has been supported by the EU through the European Commission's draft directive on net zero emissions from industry, in which the Commission proposes to set a target for the EU's annual injection capacity of almost 50 million tonnes of CO_2 each year by 2030. KonKraft, a partnership between stakeholders on the Norwegian continental shelf, argues in a status report from 2023 that if the storage capacity is scaled up quickly and all ambitions relating to allocated storage licences were to be realised, between 40 and 50 million tonnes could be stored each year on the Norwegian continental shelf from 2030 (see Figure 12.11). At present, an implementation decision has only been made for a small number of these projects (KonKraft, 2023). Equinor and the German company Wintershall Dea are considering the possibility of building a carbon pipeline between Norway and Germany by 2032. This should be able to transport 20 to 40 million tonnes of CO_2 a year for storage on the Norwegian continental shelf.

The establishment of CCS infrastructure on the Norwegian continental shelf also makes it possible to produce blue hydrogen. Blue hydrogen is produced by converting natural gas into hydrogen, at the same time as the CO_2 emissions from the process are captured and stored. This conversion process is very energy intensive. There are currently few projects under way on the Norwegian continental shelf, but this technology can ensure greater alignment between Norwegian gas exports to Europe and the EU's long-term climate targets. Gassco and industrial partners in Norway and Germany are jointly investigating the possibility of large-scale hydrogen transport from Norway to Germany. The EU has sent a clear political message that the gas should be emission-free in the long term, including through a decision that long-term natural gas contracts without CCS must be terminated by 2049 at the latest. At the same time, blue hydrogen is controversial in Europe, partly because hydrogen based on natural gas and CCS will also generate emissions. Hydrogen leakage also has an impact on climate change (Sand et al., 2023). In addition, the manufacturing process requires large amounts of energy. Future demand for blue hydrogen will depend on developments in technology and policy that are currently uncertain.

Figure 12.11 Annual CO_2 storage capacity for NCS projects with varying degrees of maturity.

Source: KonKraft (2023)



Oil and gas expertise can play an important role in the further development of offshore wind. Most of the offshore wind power currently being developed in the world is based on fixed installations. The development of floating installations makes it possible to exploit larger marine areas. Here, expertise from oil and gas can be useful. Developed by Equinor, Hywind Tampen is currently the world's biggest floating offshore wind farm (KonKraft, 2023).

Cooperation with the EU on new technology can be important for the transition of the Norwegian continental shelf. Both the Norwegian Government and companies on the Norwegian continental shelf are cooperating increasingly closely with European stakeholders. Norway and the EU have agreed on closer cooperation on climate and energy, and both the Government and companies on the Norwegian continental shelf are cooperating on emission reduction projects with stakeholders in several European countries.

Developments after the fall in oil prices in 2014–2016 showed that companies engaged in petroleum activities are adaptable. The supplier companies also provide services to industries outside the petroleum sector and have expertise that may be transferable to other sectors. The Norwegian labour market is also flexible. Many people who experience layoffs will find a job in other segments of the economy. There may nonetheless be negative consequences for the individual, for example if a new workplace offers a lower salary or is located elsewhere. For companies specialising in services to the petroleum industry, the transition can be demanding. The transition will often be made to related industries and there are many industries where knowledge from oil and gas can be relevant. At the same time, developments so far suggest that activity in other industries only increases when activity in the petroleum industry is reduced. This is illustrated in Figure 12.12, which shows oil and gas suppliers' activities in offshore wind power in light of fluctuations in the oil market.

Taking the expected decline in the petroleum industry towards 2050 as a basis, the societal costs of accelerating the de-escalation are likely to be limited. In 2020, Statistics Norway analysed the consequences of not granting any new exploration licences to the petroleum industry (Aune et al., 2020). This would lead to petroleum investments falling more than expected under the current policy. However, since the consequences materialise some time ahead and at a time when the oil industry is already less important for the Norwegian economy than today, the macroeconomic effects of this measure are generally small. At most, GDP in mainland Norway would fall by half a per cent compared with the reference trajectory. Real wages and consumption grow somewhat less than in the reference trajectory, but the decline is modest in relation to the growth that in any case is expected towards 2050.

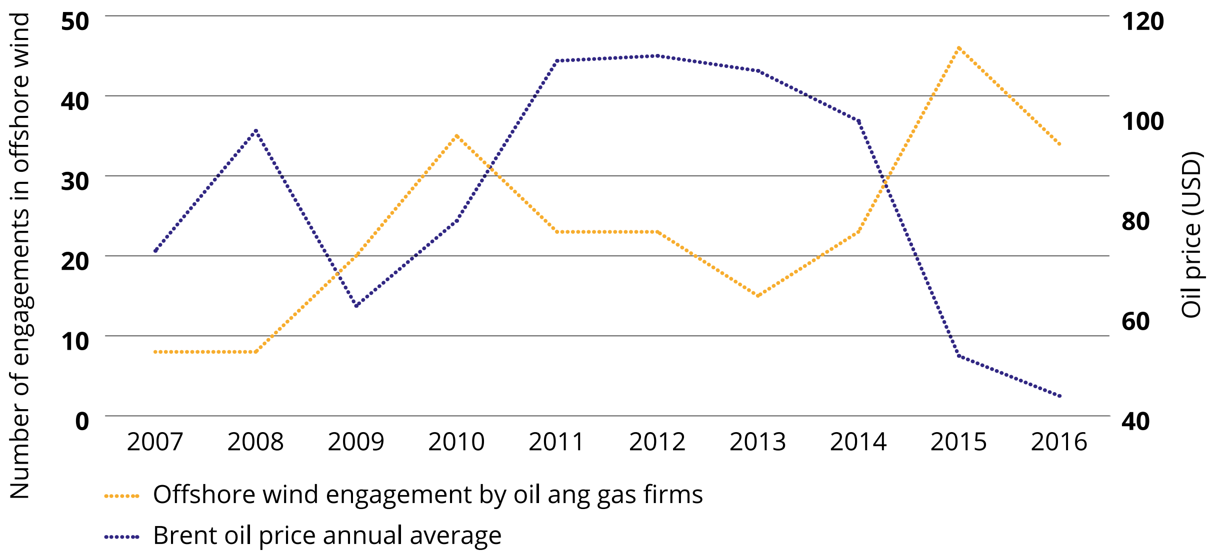


Figure 12.12 **Oil and gas supplier's offshore wind activities in light of fluctuations in the oil and gas market.**

Source: Mäkitie et al. (2019)

12.5 A pause to chart the way forward

The Committee recommends that the Government draw up a strategy for the final phase of Norwegian petroleum activities. Given the Committee's assessment that Norway must reduce the scope of petroleum production towards 2050 beyond current expectations, the Committee believes it is appropriate to draw up a strategy for the final phase of Norwegian petroleum activities. The starting point for such a strategy is recommendations to restrict exploration activities and introduce more restrictive framework conditions for new and existing production. These are discussed in section 12.6.

An overall strategy for how petroleum policy can be developed in line with Norway's climate policy commitments can make it easier to avoid misinvestment and make the transition more predictable for companies and employees. Such a strategy should be based on a broad assessment of the appropriate use of scarce resources, the possibility of promoting transformation based on the sector's expertise, and how the Government's role as owner should be adapted to the sector's reduced importance over time. An overall strategy can make it easier to meet abrupt changes in the industry in a way that promotes the transition to a low-emission society. The strategy should consider various policy instruments and their consequences for power from shore, other emission reduction measures and restrictions on exploration and production.

The Committee recommends that the Government present such a strategy to the Storting. It is important that relevant public interests are taken into account when preparing the knowledge base, and that experts on climate policy, future energy markets and industrial restructuring are involved in the work.

Decisions on further development on the Norwegian continental shelf should not be taken until such a strategy has been established. Before considering the final details of the framework conditions for petroleum activities in line with the transition to a low-emission society, it is important to consider which restrictions of the framework conditions are appropriate – and the consequences thereof. At the same time, it is important not to take the outcome of these assessments for granted and to avoid creating incentives to quickly promote new projects before decisions are made to limit further exploration and production on the continental shelf. The Committee therefore recommends avoiding decisions that contribute to investment in new activity until an overall strategy has been completed. This entails a temporary suspension of new licences for exploration or production (PDO), no licences for installation and operation (PIO) and no decisions on electrification.

The current level of activity on the Norwegian continental shelf makes it prudent to introduce a pause for thought now. Due to the oil tax package that was introduced in 2020, a very high level of investment is expected in oil and gas production on the Norwegian continental shelf in the coming years. A pause in exploration and investment decisions that are not directly related to existing installations will not therefore challenge European energy security.

12.6 Towards low emissions

12.6.1 Exploration policy

Today's oil and gas exploration will generate emissions far in the future. Both political governance and the companies' risk assessments are complicated by the long time horizon for investments in the oil and gas sector. From an area is opened for petroleum activities, via the allocation of production licences, exploration, discovery and field development, it can typically take between 10 and 15 years until the start of production. Major discoveries can then form the basis for oil and gas production for 30–50 years or even longer (see Figure 12.9). The Ekofisk field, the first field to start production on the continental shelf in 1971, may still be in production in 2050. Today's exploration policy decisions will therefore affect petroleum production well past 2050. In the shorter term of the next 10–20 years, the production level is primarily determined by recovery from existing fields, where decisions on further operation do not depend on investment costs, but operating costs.

The Committee recommends that the strategy for the final phase of Norwegian petroleum activities does not allow new infrastructure to be built that locks us to emissions towards and beyond 2050. This means, among other things, refraining from new gas infrastructure in the Barents Sea. Figure 12.13 shows that there is currently no infrastructure for gas exports, with the exception of Melkøya, north of the Norwegian Sea. Petroleum production in Norway is highly capital-intensive during the development phase, and substantial investments are associated with both petroleum-producing installations and various oil and gas export solutions such as pipelines. In mature areas of the continental shelf, new discoveries and smaller deposits can be more easily exploited, as there is already infrastructure in place to which such resources can be connected. The investment need is therefore much less for such resources in mature than in immature areas with little developed infrastructure. The petroleum authorities have often provided guidelines for export solutions that have been based on the assumed addition of more resources at a later date. This has made sense from a socio-economic perspective, but also means that decisions on infrastructure investments in immature areas make any subsequent discoveries more profitable than they would be otherwise. An important part of an overall climate strategy for petroleum policy will therefore be to consider the focus and framework of infrastructure investments in the future.

The Committee also recommends that the strategy sets out a permanent cessation of exploration activities without a direct connection to existing infrastructure. In the Committee's opinion, it is not desirable to establish infrastructure in new areas that locks us to emissions towards and beyond 2050, as discussed above. It would also then make little sense to explore such areas. If further exploration is to be permitted, it should be limited to established areas where it is possible to produce gas resources close to relevant markets, rather than tying up scarce resources to develop petroleum activities in areas where there is little existing infrastructure and where uncertainty about future discoveries prevails. This will mean halting the award of licences without immediate proximity to existing infrastructure, and that licences awarded in such areas are not renewed.

Halting exploration activities without a direct connection to existing infrastructure is a natural step on the road towards the cessation of all further exploration. It may be appropriate to maintain the possibility of further exploration where discoveries can be tied directly to existing fields, as such resources can often be developed relatively quickly by being connected to existing infrastructure and thus generate lower emissions. In particular, gas resources that can be developed and produced in the next few years can make a valuable contribution to reducing Europe's dependence on Russian gas. A complete halt in the awarding of exploration areas will send a stronger political message, but at the same time have more extensive and unpredictable economic consequences. Such considerations should be made in connection with the preparation of the comprehensive strategy recommended by the Committee.

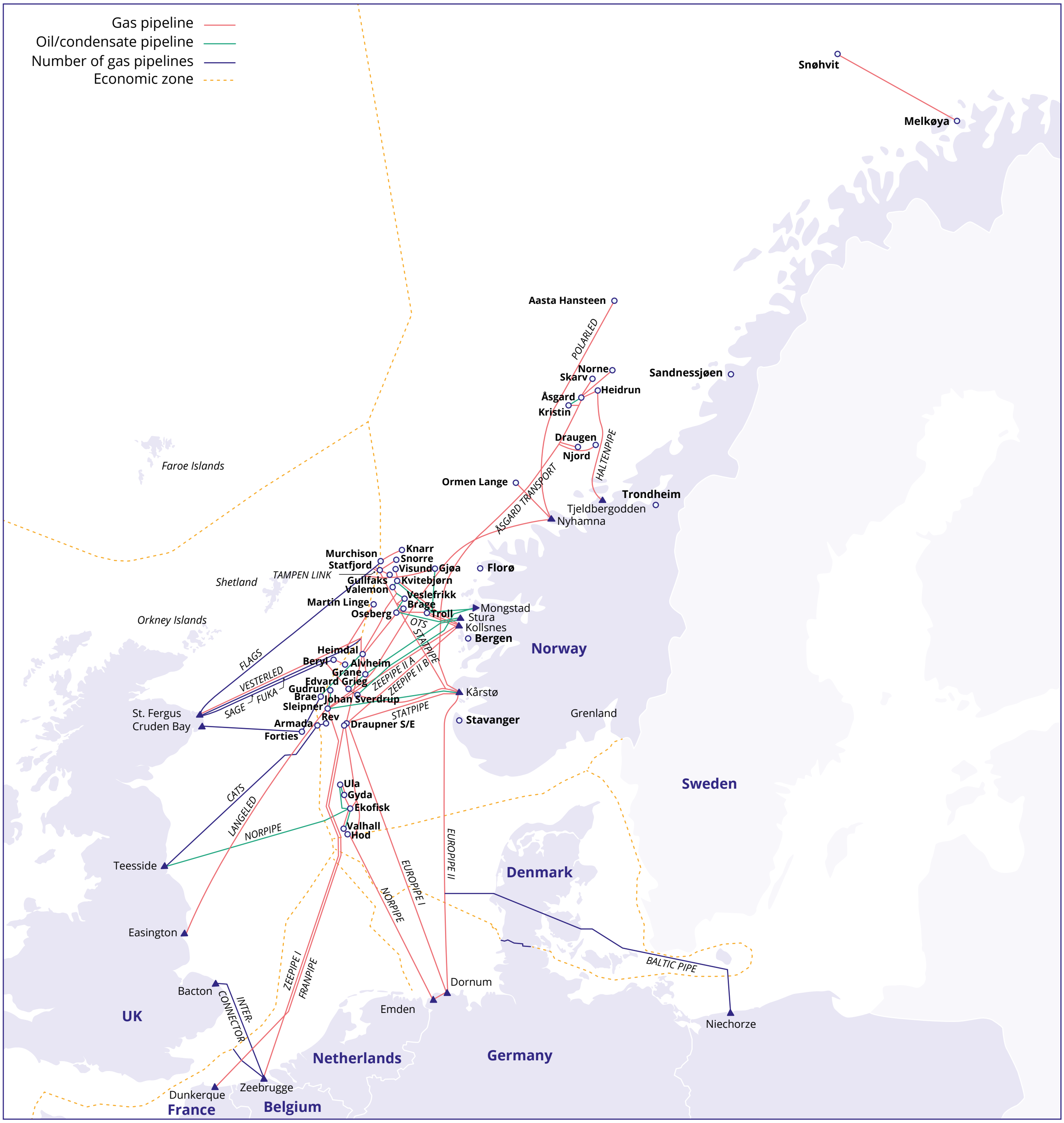


Figure 12.13 **Map of existing infrastructure on the Norwegian continental shelf.**
The illustration shows that there is currently no infrastructure for gas exports, with the exception of Melkøya, north of the Norwegian Sea.

Source: Norwegian Petroleum Directorate's Resource Report 2022

12.6.2 Existing production

Future framework conditions for petroleum activities should be made more restrictive in order to limit emissions and recovery from existing fields. The framework conditions can be changed through the tax policy for recovery from existing fields, from planned fields, or from licences that have already been awarded but where activity has not yet started. Furthermore, the environmental and climate requirements that form the basis for approval of development and operation can be made more stringent. This will raise the cost level and contribute to fewer new fields being developed. Fields could, for example, be required to close when production falls below a certain level or when energy consumption per unit of production exceeds a certain level. The Petroleum Activities Act provides for this, but it has not been done before and could be demanding both legally and politically. Economic instruments may have a similar effect and will not be legally challenging to introduce. The Government can also be more restrictive in permitting or providing incentives to projects for increased production. This could lead to faster phasing-out of marginal oil and gas fields because such measures are often needed to recover the resources (Gavenas et al., 2015).

It should not be an independent goal to increase the recovery factor from existing fields where this results in high emissions or power consumption. So far, the Norwegian State has played an active role in extending and increasing recovery from existing fields by increasing the recovery factor. This is done through support for technology development, through the tax system and direct subsidies, and through PDO processing and dialogue with oil companies on the licensing boards. According to the Norwegian Petroleum Directorate's allocation letter, one of the Directorate's prioritised sub-goals is to follow up increased production, efficient area solutions and the realisation of time-critical resources. The sub-goal is included under the overall goal of promoting socio-economically profitable petroleum production. In its annual report, the Directorate states that it pursues this sub-goal by working to maximise recovery from a field and following up the potential for increased recovery in all phases of the follow-up of production licences. Public authorities should not be drivers of increased production, efficient area solutions or the realisation of time-critical resources beyond what the companies find commercially interesting or what is socio-economically profitable.

With a rising price of emissions, petroleum production will become less profitable. The price of emissions from oil and gas will increase due to a tighter European carbon market and an increasing carbon tax on the Norwegian continental shelf, making it demanding for the most emission-intensive fields to remain competitive. Emissions per produced unit increase when an oil and gas field has little resources left to recover. This is because the natural pressure in the reservoir drops and there is an increasing water cut in the oil that is lifted, requiring more energy for recovery. This phase is often called the 'tail-end phase' of oil and gas production, and will end sooner with high carbon prices (Szulecki, 2021).

Zero-emission solutions: solutions that generate no direct greenhouse gas and exhaust emissions during use. This means, for example, the use of an electric motor in combination with a battery, or direct use of electricity or a fuel cell that utilises a carbon-free energy carrier such as hydrogen.

A production charge is an alternative way of pricing emissions that is more geared towards the level of activity than the level of emissions at an installation. In 2020, the Climate Change Commission proposed a production tax where it was possible to be granted an exemption or refund if it could be documented that the petroleum products contribute to the development of zero-emission solutions (Climate Change Commission, 2020). The Commission also recommended that the net proceeds from the tax should be earmarked for measures whose main purpose is to shift activities on the Norwegian continental shelf towards zero-emission solutions. Such a tax is intended to be linked to the global climate impact of Norwegian oil operations. Depending on how high the tax is set, it can reduce the profitability of petroleum projects and generate lower tax revenues to the public purse. The Government has undertaken to consider a transition tax on oil and gas production. This measure should also be considered in a strategy for the final phase of Norwegian petroleum production.

Norway should take an active role internationally to ensure a coordinated transition from fossil energy that includes transformation on the supply side. International cooperation in this area may include increased transparency on planned fossil energy production and infrastructure, for example as part of the reporting under the Paris Agreement. It may also involve joint initiatives with other members of the Arctic Council on a suspension of petroleum production in the Arctic.

Scope 1, 2, 3: a way of classifying emissions that a given company contributes to through its own activities and through the value chain of the product the company produces. Scope 1 concerns the company's direct emissions, i.e. emissions from factories, properties or equipment owned by the company. Scope 2 concerns emissions associated with the company's energy use. Scope 3 concerns a company's indirect emissions, i.e. emissions relating to the production of goods and services the company buys or sells.

Climate targets that take emissions from oil and gas combustion into account can contribute to a faster transition. Currently, Norwegian climate policy is mainly geared towards emissions on Norwegian territory. In some countries, such as the USA, the combustion emissions of new petroleum activities and infrastructure are already considered as part of the regular impact assessment process. In the private sector, it is common for companies to report on emissions throughout the value chain, including Scope 3 emissions, and to set goals to reduce these. For petroleum companies, Scope 3 emissions will include emissions from end-user combustion of the products. The Paris Agreement does not preclude countries from setting similar targets. Such an approach can help accelerate the transition to new industries. The question is what kind of goals and regulations may be appropriate. One possibility is to establish overall targets for emissions relating to Norwegian exports, which over time may involve a reduction in total petroleum production, and another is to decarbonise gas and export it as hydrogen.

12.6.3 Costs and spillover effects

Decisions on new investments in oil and gas activities must reflect all costs to society. The authorities must ensure that all decisions on policy measures also reflect indirect and external costs. There is great interest among companies on the Norwegian continental shelf to transport power from shore for NCS installations. This is a result of the fact that they have long been subject to a high emission cost and the measure has therefore become profitable for the companies in many cases. At the same time, there are several external costs associated with electrification that have not been priced. The companies are therefore not currently responsible for covering the real costs of the measure to society. The Committee recommends that all costs of climate measures in the oil and gas industry should be borne by the oil companies themselves as far as possible, including external costs relating, for example, to power supply. It is also essential to ensure that price falls or cost increases affecting the oil and gas industry are handled without compensatory measures in the form of industrial policy or tax. Not doing so will slow the transition.

Electrification of oil and gas production will reduce Norwegian emissions today, but it is also power-intensive. Electrification is the measure with the greatest potential to reduce emissions on the Norwegian continental shelf today. In 2023, power from shore is expected to cover about 45 per cent of power demand on the Norwegian continental shelf (Norwegian Petroleum Directorate, 2020). Increasing this proportion is an effective measure to reduce Norwegian consumption of fossil energy, but will at the same time lay claim to substantial energy resources. In 2021, petroleum activities consumed just over 8 TWh of the total Norwegian power consumption of 138 TWh. The projection of Norwegian GHG emissions towards 2030 assumes an electrification of the petroleum sector that will require 9 TWh of power on top of current power consumption, i.e. more than a doubling. This means that oil and gas production will require power equivalent to well over 10 per cent of current power production. The Norwegian Environment Agency has identified measures for further emission reductions in the petroleum sector that will require an additional 1 TWh if they are implemented (Norwegian Environment Agency, 2022a). In 2020, 16 fields had established or decided to use power from shore (Norwegian Petroleum Directorate, 2020). If all projects included in the Norwegian Petroleum Directorate's analysis are implemented, more than 50 per cent of the power demand on the Norwegian continental shelf could be met by electric power from shore (Norwegian Petroleum Directorate, 2020). However, not all installations are eligible for electrification. An assumption of full electrification of all installations in operation on the Norwegian continental shelf is not currently realistic.

Electrification of oil and gas production will, by all accounts, extend the lifetime of the industry. The companies on the Norwegian continental shelf are faced with a relatively high emission price because they are subject to a carbon tax on top of the duty to surrender allowances. This gives them stronger incentives to implement emission reduction measures than the EU ETS alone gives, and makes electrification more profitable for the oil companies. At the same time, the price that companies are willing to pay for electrification does not necessarily reflect the costs to society of such a large increase in power consumption. Thus, the price oil companies pay does not necessarily reflect optimum use of the power for society as a whole. Electrification will increase energy prices for households and other industries. It will also increase land degradation pressure to boost onshore power production. Without electrification, carbon taxes and allowances will lead to higher production costs, lower profitability and earlier field shutdowns. Supplying installations with power from shore will thus in many cases serve to extend their service life.

Electrification of the continental shelf must be considered in light of scarce power resources and the desire to prioritise objectives that are compatible with a low-emission society in 2050. The Committee believes it should be made clear which power resources will be necessary to sustain this activity. It can be seen as a paradox if scarce renewable power resources are prioritised for fossil production that aggravates the climate crisis, and that are also assumed to be phased out in a low-emission society. At the same time, electrification is more or less a prerequisite for continuing with petroleum activities in a society transitioning towards low emissions. When considering new infrastructure and new activity, special attention must therefore be paid to the need for electric power. The Committee assumes that an overall strategy for the final phase of petroleum activities will include a critical assessment of electrification strategies and that any new electrification projects are postponed until an overall assessment has been made, as discussed in more detail below. The need for adjustments to the tax system should also be considered, including interfaces between activities within and outside the petroleum tax regime.

Emission reduction measures other than power from shore should be considered on a continuous basis. In addition to electrification, emissions from petroleum production can be reduced by using technology that reduces emissions from energy production offshore or at onshore facilities, such as energy efficiency improvements, reduced leakage, CCS, use of renewable energy on installations, ammonia/hydrogen, fuel cells or other technologies. CCS will not be able to capture all CO_2 from energy production, but is an alternative to electrification. Electrification with the help of offshore wind power reduces the need to develop power on the mainland, but contributes less to emission reductions. If platforms are electrified with offshore wind power, it will probably also be necessary to maintain gas turbines to ensure power supply at low winds.

It is possible to set requirements for oil and gas producers that take into account emissions from combustion. One example is to establish decarbonisation obligations for the individual operator on the Norwegian continental shelf. Researchers at the University of Oxford have proposed a ‘carbon takeback system’, in which oil and gas production is linked to an obligation to capture and store an amount of CO_2 equivalent to that generated by combustion of the same oil and gas (Jenkins et al., 2021). One way of doing this is to include a requirement for CCS in the emission permits for the individual project or in connection with approval of PDOs. The companies should be required to make funds available for this in advance of approval. The requirement can be phased in over time so that it reaches 100 per cent in 2050. A proposal to this effect is under development in the EU, with an obligation for the individual producer to receive a certain amount of CO_2 for storage. The Committee believes that Norway should follow developments in the EU regarding requirements for CO_2 storage in connection with oil and gas production, and consider whether it is possible to go further than the EU in requiring CCS relative to production volume. This can help establish CCS infrastructure and business models, and would be wise to consider regardless of the choices made for the scope of future petroleum activities.

Transition plans should highlight whether companies' business models are profitable in the transition to a low-emission society. As discussed in Chapter 10, more detailed requirements of companies' sustainability reporting, including transition plans, are expected to start applying to the biggest listed companies from the 2024 financial year. Several of the companies operating on the Norwegian continental shelf will be subject to such new reporting requirements, but transition plans can be imposed as a requirement for all companies that wish to operate on the Norwegian continental shelf. A transition plan for petroleum companies should highlight how they will adapt in the short and long term to be compatible with a low-emission society and include an assessment of how their own direct emissions will be managed as well as how combustion emissions can be offset. It would be natural for a strategy for the final phase of Norwegian petroleum extraction to also consider the use of such transition plans in petroleum policy.

See discussion of companies' sustainability reporting in Chapter 10.

12.7 The Committee's recommendations

The Committee believes that petroleum policy must pull in the same direction as climate policy. This means that it must be based on the emissions budget for 2050 and on the fact that decisions made today can lay claim to scarce resources, such as power and expertise, making the transition to a low-emission society more difficult. Both the emissions and the activity must be reduced beyond the expected level towards 2050. Laying the course for a petroleum policy that is aligned with the climate targets is urgent, and the Committee recommends drawing up a strategy for the final phase of Norwegian petroleum activities. Below are the Committee's recommendations for the preparation of such a strategy, followed by more detailed recommendations on how petroleum policy should be changed.

To assess all aspects of petroleum policy in the context of the climate targets and the necessary transition of society towards 2050, the Committee therefore has the following recommendations:

- prepare a strategy for the final phase of Norwegian petroleum activities, and present it to the Storting as soon as possible.
- do not award further licences for development and operation (PDO) or installation and operation (PIO) until such a strategy is completed. Ensure broad public involvement when preparing the strategy's knowledge base.
- consider in the strategy:
  - how climate policy globally will affect the framework conditions for Norwegian petroleum activities and how overall petroleum policy should handle transition risks, including stress testing against different climate scenarios and profitability assessments and the role of new business models, for example relating to blue hydrogen and carbon capture and storage (CCS)
  - how much of the emissions budget for 2050 industry will lay claim to through various exploration and development strategies, including the consequences of new infrastructure for gas exports. Further, how the transition of

petroleum activities will affect and interact with the transition in other industries, particularly in terms of power, land use, labour and expertise.

- consequences for the Norwegian economy, government revenue and the labour market of reducing the scope of petroleum production towards 2050 more than is currently expected.
- how decision-making and governance systems can facilitate a broad assessment of all the consequences of decisions relating to petroleum activities, cf. the Committee's recommendation that all costs of climate measures in the oil and gas industry should be borne by the oil companies themselves as far as possible, including external costs relating, for example, to power supply.
- how exploration policy can be further tightened to facilitate a gradual reduction in activity
- how environmental and climate requirements that form the basis for approval of development and operation can be made more stringent. For example, the consequences of any new developments for emissions can be systematically assessed against the goals of the Paris Agreement.
- any need for adjustments in the tax system to facilitate the transition, including interfaces between activities within and outside the petroleum tax regime, and also consider the possibility of, for example, a production tax.
- the State's role as owner, both through Equinor and the State's Direct Financial Interest (SDFI).
- various possibilities for imposing greater responsibility on oil companies for combustion emissions from Norwegian-produced oil and gas, for example by complying with EU requirements for storage capacity or a more comprehensive 'return scheme'.
- the requirement that companies operating on the Norwegian continental shelf must draw up transition plans that highlight how the company's operations can support the transition to a low-emission society, and possible ways of designing such a requirement.
- whether it is appropriate to establish overall targets for emissions relating to Norwegian exports.

The Committee points out that the limited emissions budget resulting from the 2050 targets and the need for a broader transition provide a clear framework for future petroleum activities, and that these must form the basis of the strategy. The Committee therefore has the following recommendations:

- permanent cessation of exploration activities without a direct connection to existing infrastructure. The Committee considers this to be a natural step on the road towards the cessation of all further exploration.
- no decisions must be made to build new infrastructure that locks us to emissions towards and beyond 2050.
- ensure that price falls or cost increases affecting the oil and gas industry are handled without compensatory measures in the form of industrial policy or tax.
- all costs of climate measures in the oil and gas industry should be borne by the oil companies themselves as far as possible, including external costs relating, for example, to power supply.
- as a general rule, avoid using power from shore as an emission reduction measure for offshore installations, and assess this against scarce power resources and the desire to prioritise purposes that are compatible with a low-emission society in 2050. Emission reduction measures other than power from shore should be considered on a continuous basis.
- include the requirement for placing emphasis on climate considerations in the management of petroleum resources as an overall consideration in the Petroleum Activities Act and related regulations, and systematically incorporate this into decision-making processes at all stages of operations – from the opening of marine areas, nomination, awarding and renewal of licences, to the processing of PDOs, PIOs and other decisions that have a bearing on future production and infrastructure.
- ensure that public authorities are not drivers of increased extraction, efficient area solutions and the realisation of time-critical resources beyond what the companies find commercially interesting or what is socio-economically profitable.
- Statnett and NVE should have a role in the processing of PDOs for new oil and gas fields, and a limit should be considered for power requirements that triggers parliamentary processing of the PDO.
- Norway should take an active role internationally to ensure a coordinated transition from fossil energy that includes reorganisation on the supply side.
- cooperate with the EU on technology development to facilitate a rapid transition on the Norwegian continental shelf.

2050: The hidden costs of emission cuts

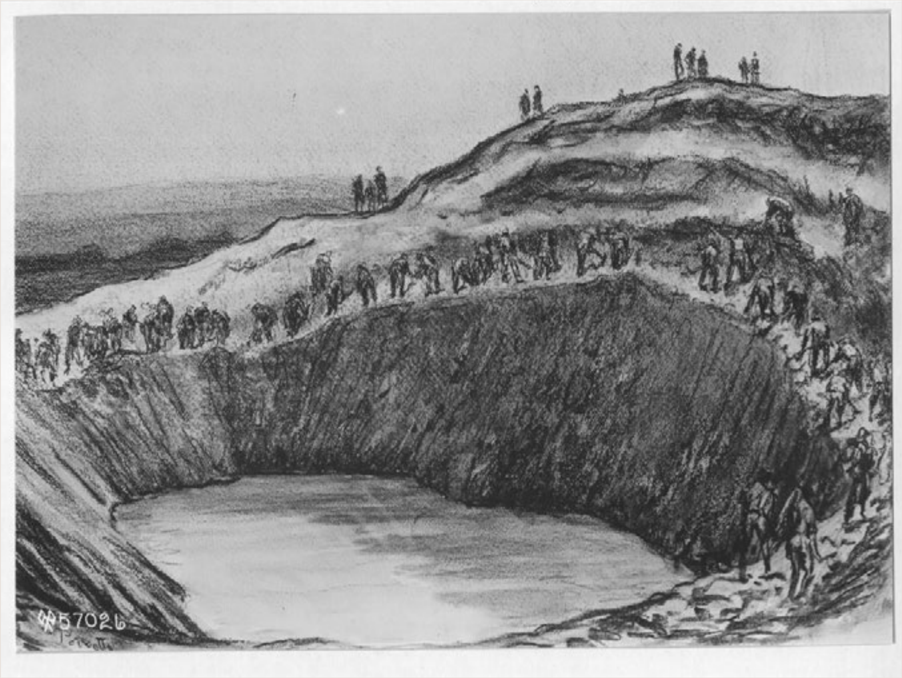


Illustration: USAs nasjonalarkiv

'Don't you feel it's wrong to continue this extraction' he begins, his voice clear as polished crystal of the highest quality. 'Do you understand that your extraction of rare minerals has left us with resource shortages?'

His gaze meets mine across the massive mahogany desk, it's like staring into the darkest winter, where nothing germinates or grows. The huge cameras and microphones radiate a smouldering threat of final damnation, a gloomy reminder that it was my turn to be judged. I close my eyes, trying to remember happier times.

I look back on 2024, the green year that distanced us from the past and chained us to the future. When electric shipping started. We started selling electric boats, but quickly switched to making them. The newspapers referred to us as a climate company and an eco-lighthouse in a bleak oil landscape. Back then, we were unstoppable.

‘I have no illusions that what we have done is beyond reproach’ I begin, trying to regain my footing in reality. But my voice, once good as gold, now rattles like rusty chains, ‘but we’ve provided greener technology and given people an alternative to fossil fuels.’

The news anchor on the other side of the table shakes his head a little and lowers his eyebrows. It was clear that although I had once been referred to as a champion of the environmental movement, I had now become an enemy of the state. And in a way, he was right. I had been involved in extracting lots of minerals. At the same time, it was my generation’s mission to reverse the climate crisis, and my electric boats had helped to remove 2gt of carbon emissions in shipping every year.

‘But you’ve made billions of dollars in profit. You must have had the means to use other minerals and to invest more in circular recycling,’ he replies in an accusatory tone. He actually had a point, but at the same time it would have killed profit. I couldn’t answer that, then they’d say that I didn’t really care. I start ‘We’ve investigated several solutions for what to do about it and we’re investigating solutions to this problem’. The man sighed as if he had been holding his breath. His eyes meet mine again. He looked at me like I had looked at those who hadn’t given a damn about the climate when I was young. I couldn’t help but think about what would have happened if I had mined sustainably from the start…

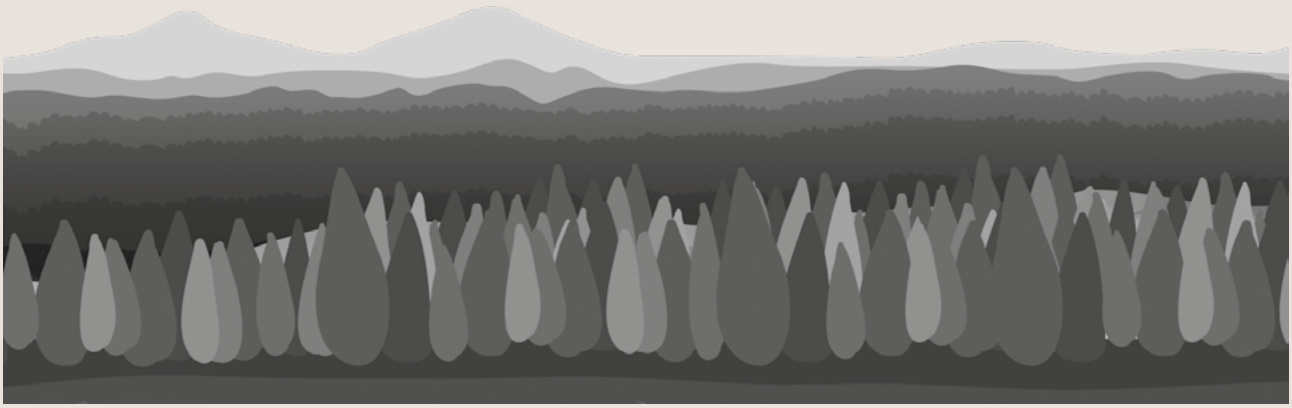
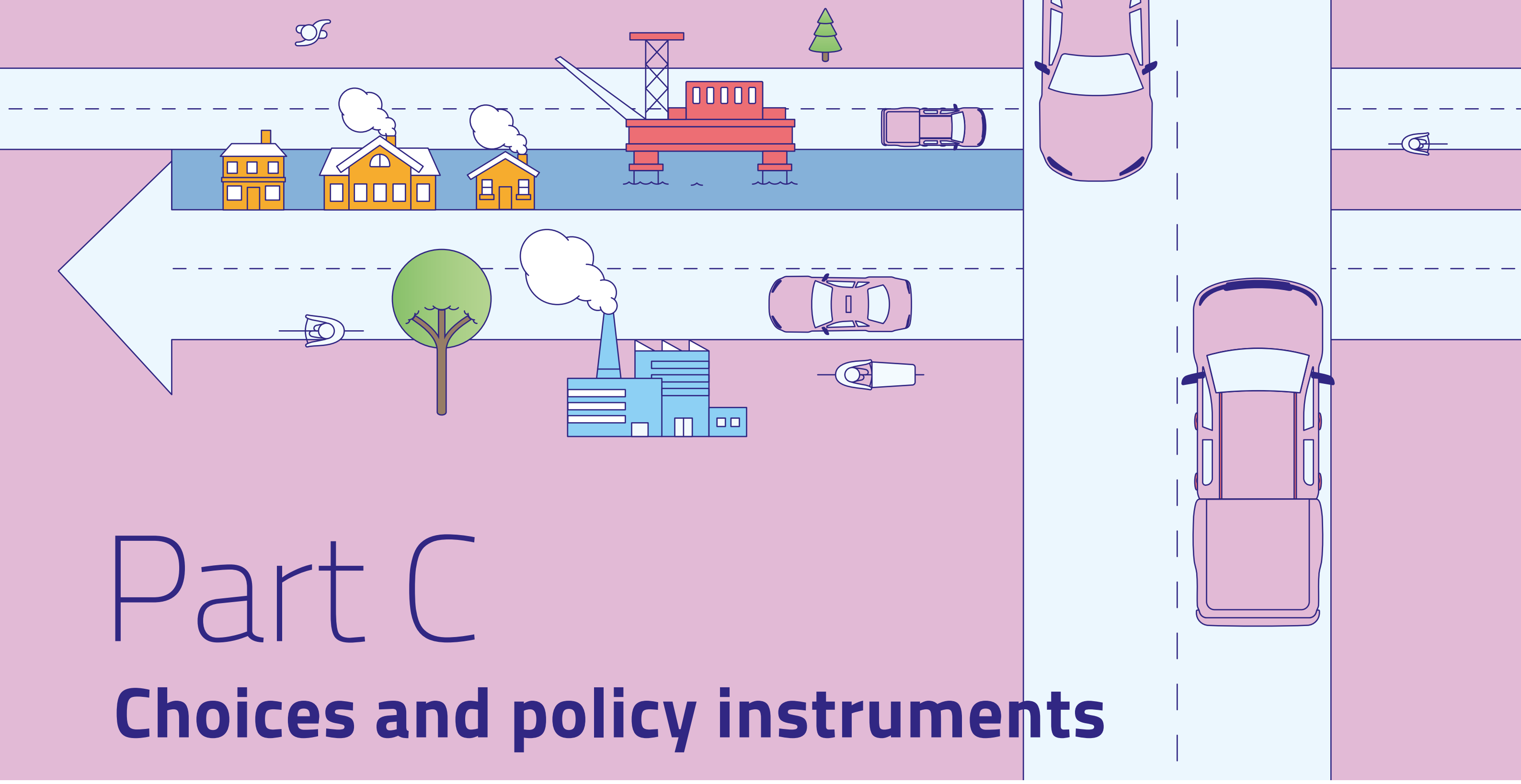


Illustration: brgfx / Freepik



Part C

Choices and policy instruments

Part C describes the key choices in the transition, before the Committee makes its recommendations on the principles such considerations should be based on and how climate policy instruments should be designed.

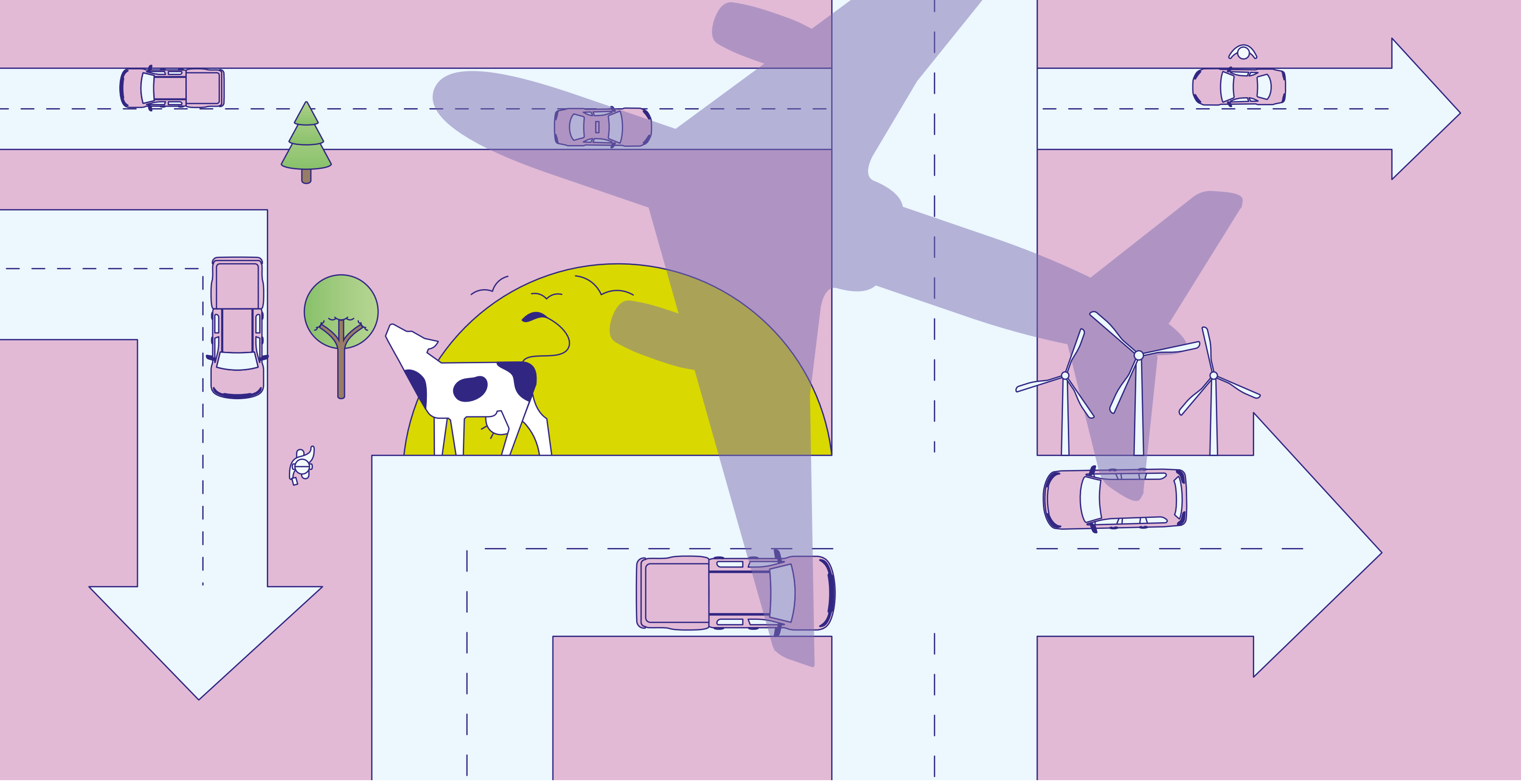
13 Pathways towards a low-emission society

In this chapter, the Committee elaborates on the various choices Norway faces on the pathway towards a low-emission society.

13.1 Fewer choices than we might think

The Committee has been asked to conduct a comprehensive assessment of the choices Norway faces to achieve the climate target by 2050. Many both major and minor decisions need to be made en route. Some create path dependency, while others can be easily undone if a different direction is more desirable later; see Box 3.3 on path dependency. Some choices make sense regardless of how the world develops otherwise, while other choices are more dependent on what other countries and stakeholders do.

Given the ambition to become a low-emission society, there are far fewer choices available than the Committee's mandate would suggest. Some of the choices are a given when the target is to reduce emissions to 2.5–5 million tonnes of CO_2e by 2050.



The technical analysis in Chapter 3 shows that virtually all emissions in most sectors must be eliminated for good in order for emissions to be reduced to this level. In the analysis, for example, there are no remaining emissions from road traffic, and emissions from aviation, shipping and fisheries are 1 per cent of the 2021 level. In the vast majority of cases, therefore, the question is in what order and how the various measures should be implemented, while also allowing society to achieve other important goals.

See discussion of the possibilities of emission reductions towards 2050 in Chapter 3.

Not choosing a direction is also a choice. Although a policy choice is basically a choice between two or more directions, *not* making a choice, i.e. to stay still, is also a choice. The Committee has assumed that the choices will show different pathways to the low-emission society. Not becoming a low-emission society is not an option. The floods caused by the storm Hans in summer 2023 show the potential costs of climate change. Compared with what we have seen elsewhere, however, the human and material costs in Norway have so far been minimal. Refusing to deal with how climate change will affect Norway and Norwegian society is not a viable option.

The transition to a low-emission society affects all areas of society. As shown in Part B, climate policy is closely linked with most other policy areas, and the goal of a low-emission society must be achieved in parallel with a number of other societal goals. Uncertainty about future developments in terms of technological, economic and social factors makes it difficult to know how different considerations can best be weighed against each other. This makes the transition complex and renders it challenging to design a policy that is both accurate and comprehensive.

The transition to a low-emission society will be shaped through trade-offs and compromises in a wide range of individual cases. To ensure that all decisions pull in the direction of low emissions, it is crucial to have processes that ensure that different considerations can be effectively weighed against each other, and clear principles that can make such trade-offs easier.

European Green Deal: a green growth strategy to help Europe become the world's first climate-neutral continent. The goal is to transform the EU into a sustainable, circular and climate-neutral economy by 2050. Climate and environmental policy must be incorporated into all policy areas, and a broad range of policy instruments must be used.

It is important that special interests or resistance to change do not define the different solutions. To be able to see different societal goals in context, climate policy should as far as possible be designed using a comprehensive approach where measures and policy instruments are considered together, not individually. A systematic overall assessment of all policies seen in relation to the transition can make it easier to ensure a positive effect on climate change while avoiding negative impacts on other societal goals, and also in some cases generating positive effects in other fields. This is in line with the EU's approach to climate policy under the European Green Deal.

Society is facing numerous complex and cross-sectoral issues. It is not only the transition to a low-emission society that requires a comprehensive, cross-sectoral approach. This also applies to areas such as defence, security, digitalisation, and healthcare. Climate change, the environment and loss of biodiversity are challenges to which there are not necessarily good solutions in a system where sectoral interests dominate. Functions that coordinate different policy areas, ensure comprehensive assessments and contribute to the different perspectives being highlighted in the decision-making processes are key. Policymaking and institutional structures must reflect this. This is elaborated in Part D of the report.

Some choices are more central to the transition than others. The different choices affect one another, providing opportunities and placing restrictions on other choices. The order of priorities is therefore not irrelevant, and in fact sets important premises for possibilities later on. Although a great many decisions affect future GHG emissions, certain policy choices will have a particularly large impact on the characteristics of a Norwegian low-emission society and the consequences of the transition for other areas of society. Common to these choices is that they show that there are several possible ways of becoming a low-emission society, but that the choices made today can have a major impact on how the transition takes place. These choices could in particular be related to the use of scarce resources. The EU Scientific Advisory Board on Climate Change illustrates this in its report, which looks at different scenarios for the same emissions targets and outlines three different development paths with emphasis on demand-side policies, a sharp increase in renewable energy and a combination of these. The comparison illustrates that the policy choices this is based on have different consequences for, among other things, fairness, emissions and the environment (European Scientific Advisory Board on Climate Change, 2023).

The choices made and the order in which they are taken are important in terms of support for climate policy. In order for private individuals to be willing to change their behaviour, it may be important to see that major stakeholders such as the government and companies make changes towards low-emission activities. It could be important for some industries to see that the transition is also happening in other industries. The order in which climate mitigation measures are implemented is also important to gain acceptance. For example, it may be easier for some to accept land degradation for the purpose of building renewable energy if a strong policy for energy efficiency and energy development in grey areas is in place first, ensuring that land degradation is the last resort. It will often be easier to gain acceptance for restrictive measures if efforts have first been made to improve access to alternatives, for example that the development of better public transport and bicycle infrastructure comes before restrictions on the use of private cars.

There are many possible low-emission societies. A society virtually free of GHG emissions can be developed in many ways. What it should look like are choices that must be made through democratic decisions. An enlightened, healthy public debate is needed that clarifies the choices we face, to avoid making choices based on old habits or decision paralysis. The Committee does not consider it part of its remit to describe an overall vision for what society should look like in 2050. The Committee encourages political parties and other sections of society to clarify their visions for societal development within the framework of the low-emission society. What a just transition is, and how the need for a just transition should be safeguarded, should also be clarified. The concept of fairness touches on political issues far beyond climate policy. The climate debate will benefit from clear visions of the future that, with different ideological and value-based assumptions, show how we can live good lives in the low-emission society.

The transition to a low-emission society takes place in a climate of uncertainty. The uncertainty surrounding the transition to a low-emission society is not necessarily greater than for other decisions made in society. The choices we make must, regardless of this, be sensible in as many different outcomes as possible. The Committee has identified several important uncertainties in the transition; see Chapter 4. In some cases, they influence the best choice of direction, but they are also important for being able to assess how demanding the transition will be.

See discussion of important uncertainty factors for the transition in Chapter 4.

Low-emission development is a continuous process. The premise for political considerations and choices of direction must remain firm, although the timeframe and pace of implementation of individual measures will vary.

The direction the EU is taking to achieve its goals is important for Norway's pathway towards 2050. Norway's various points of contact with the EU set the framework for what can and should be the content of our own national climate policy. In many ways, EU policy can be said to be a foundation on which national policy can continue to build. The EU's policy also affects what constitutes good choices for Norway. At the same time, there are some premises for the transition that make Norway stand out from many other European countries. It is therefore crucial to understand and adapt national policies to the direction the EU chooses in the transition.

13.2 The transition requires leadership

In recent decades, Norway has undergone many changes that have been important in the development of society and have affected many people. The transitions have changed the industry structure, population patterns, the labour market, diet, media habits and led to more gender equality. Transition is something that happens all the time and is not difficult or problematic in itself.

Climate transition differs from previous transitions in some regards. The climate transition is characterised by the fact that the solutions that must be in place are relatively well known, but they must be implemented in a short space of time and across sectors, and must largely be driven by overarching political goals in interaction with technological and societal change. New solutions will be needed to be able to carry out a rapid, pervasive transition. Good alternatives to emission-intensive behaviour must be available. Effective cooperation and a willingness and ability to change is required in the public and private sectors alike. This requires coordination and leadership.

Climate transition is not a purely technical or economic exercise, but a process in society. It is important to develop new technical solutions, but equally important to adopt them and get used to them. Innovation must be adapted to the social structure and how we live our lives. In some areas, it will also be necessary to change our cultures and norms. The transition must be seen as a multifaceted process, and we need many different types of knowledge, different professional perspectives and broad participation to arrive at the best solutions.

Generating support for major social changes is demanding. As a rule, efforts to change the status quo will be met by counteracting forces. When changes occur, there will often be some that are negatively affected, at least initially, while the benefits of the changes only materialise over time. It is therefore important to compile packages of policy instruments that address different interests and needs.

Political leadership is essential to succeed with the transition to a low-emission society. Leadership involves taking the lead and thinking long-term. Democratic support is the foundation on which political leadership must rest. Transition means that changes will be implemented that may first be controversial, but with time will be accepted and supported by a majority of the population. Norway has many historical examples of how political leadership has contributed to major changes in society, for example in gender equality, LGBT rights, car traffic in cities, the smoking ban, the kindergarten sector and many others. The smoking ban is often used as an example of a legislative amendment that changed societal norms and created support for policy after politicians dared to take the first step. If the policy is too far ahead, it can lead to setbacks, but if policies do not lead the way, little will happen. A clear and credible message must be given that the transition to a low-emission society guides political decisions.

Political leadership does not exist in a vacuum. Social change happens when many forces in society pull in the same direction. Popular movements and efforts by business and industry play a key role, but leadership is needed here as well. Leaders in business and industry, the trade union movement and civil society must lead the way to a low-emission society.

Demonstrating leadership is therefore a fundamental choice of direction for the transition. This applies to political leaders, but also leaders in the business sector, civil society and through the media's influence on public discourse. Without leadership, the transition of society will be reduced to limited attempts and individual initiatives.

13.3 The pace and timing of an urgent transition

Transforming Norway into a low-emission society is a matter of urgency. It is urgent to reduce emissions and to implement policies for the emissions that take time to reduce. Clear expectations must be set for when the policy will have an effect in the form of transformation and reduced emissions. The progress of the decision-making processes must also be made clear. At the same time as decision-making processes must be inclusive and transparent, and we must not allow efforts to stall the process or reluctance to change to prevail.

So far, policies have placed little emphasis on gearing Norwegian society towards low emissions. Measures to reduce emissions have been aimed at individual emissions and technology development rather than a transformation of all areas of society. Policy has been characterised by a sectoral approach. In addition, climate policy has relied on the purchase of carbon credits from other countries. This approach is not sufficient to transform Norway into a low-emission society.

A fundamental choice of direction in climate policy is whether to postpone major emission reductions in Norway and, in the short term, rely on the purchase of carbon credits pending the development of new future technologies to meet the climate targets. There may be advantages in delaying the transition in Norway until later, based on the argument that low-emission technology will be more mature and more affordable when other countries have borne the cost of developing it. This can mean lower direct costs now and less resources needed for trial and error for the company or stakeholder in Norway that will be using the technology. Starting with emission cuts now may entail higher costs in the short term. However, the total costs over time may be lower (Vogt-Schilb et al., 2018). Nor is it a given that there will be sufficient carbon credits available in future, or at a price that makes it profitable to put off emission cuts. Some technology development takes time, and it also takes time to develop the necessary infrastructure to facilitate the transition. In addition, there is always uncertainty associated with technology development when it comes to whether efforts to develop it actually succeed, how much it costs, access to scarce resources and unforeseen negative consequences.

Relying on carbon credits to achieve the climate targets for both 2030 and 2050 is therefore a risky strategy for Norway. As described in Chapter 3, there are risks associated with both the future price of credits and their quality. In addition, there are purely practical risks associated with purchasing carbon credits rather than reducing emissions, because in many cases it will be too late to reduce our own emissions by the time we know how many credits are available and at what price. The Committee believes that relying on country-level carbon credits will be a risky strategy for Norway.

A unilateral reliance on direct air capture technologies or technology that reduces the consequences of temperature increases or other climate impacts – rather than reducing emissions – increases the probability of a late and abrupt transition. Such technologies are often demanding in terms of energy, material and land and will therefore result in more degradation of nature than if emissions are reduced directly. The technologies may also have unexpected negative impacts. It will therefore not be possible to use such technologies to an extent that can replace large emission cuts in all sectors. Postponement increases the likelihood of more severe climate change and of the need for a major transition in a short space of time. The Committee is of the opinion that there is significant risk associated with such a strategy.

A clear political signal will provide greater predictability for all stakeholders and facilitate a more gradual transition. In order for such a signal to be credible, it must be followed up with comprehensive policy packages and associated policy instruments.

Early emissions cuts are most beneficial in terms of limiting climate change. Early reductions will limit climate change more than late reductions, as this strategy reduces the likelihood of exceeding carbon budgets and thus triggering irreversible and severe changes.

There are also several moral arguments for why Norway should start the transition now. A late, abrupt transition shifts the costs to future generations. Norway's moral obligations are also about how the country has already emitted large amounts of greenhouse gases per capita and earned its wealth from fossil energy. Norway has the resources, expertise and capacity for emissions cuts and transition that many other countries do not. There are therefore moral arguments for Norway leading the way and taking at least our share of responsibility, for example for necessary technology development that can be utilised globally.

The Committee therefore believes that policy transformation towards a society with low emissions in all sectors must start today, through reduced activity levels, changed behaviour and the use of zero-emission technology. The review in Chapter 3 shows that it is possible to achieve significant emission cuts through the deployment and use of existing technology, but also that changes in behaviour are necessary for Norway to achieve the target of reducing emissions by 90–95 per cent from 1990 levels by 2050. The review did not take into account that many of the resources needed – such as power, land, biomass and expertise – are scarce. Excluding bioenergy with carbon capture and storage (BECCS), the remaining emissions will exceed 6.5 million tonnes of CO_2e by 2050. The use of biomass to such an extent as the analysis assumes is unlikely to be compatible with other important societal goals. Achieving the target therefore rests on limiting high-emission behaviours and stimulating zero-emission behaviours. The use of scarce resources must be carefully considered so that priority is given to activities that are consistent with a low-emission society. This entails a transformation of key societal systems, as discussed in Part B of the report.

Biomass: the total mass of living organisms in contexts where numbers of individuals are impractical, for example the number of trees in a forest. Biomass can also be used as a term for bioenergy; fuels derived from trees and plants, fertilisers, forest waste, peat etc.

See the Committee's assessments of emission reductions in Chapter 3.

Emphasis should be placed on early, lasting emission cuts. The Committee is of the opinion that the benefits of early emission cuts must be given significant weight in policymaking. At the same time, the desire for early reductions must not lead to the implementation of measures that do not result in lasting reductions or are inconsistent with a permanent low-emission society, as discussed in Chapter 3.

In addition, a transition policy must be implemented now. Not all policies result in reduced emissions right away; some will result in gradual reductions or reductions some time ahead. This could apply to efforts to change behaviour, for example in the direction of more circularity and less use of resources, which can have a gradual effect as more and more people's behaviour changes, especially if these changes in turn lead to changes in the production of e.g. food and clothing, and travel. The same applies to emission cuts that require new technology to be developed, such as in the processing industry. The fact that it takes time for the impact of policies to materialise is not an argument for delaying policy formulation and implementation. Quite the opposite. Policies that take time to work must be implemented as quickly as possible, and be predictable, in order for the effect – when it occurs – to occur as early as possible.

The need for early, lasting emission reductions, and for transition, must be seen in context. These two perspectives must not be seen as competing or alternatives to each other. Rather, they must be combined to assess which measures contribute to the transition, and how the transition can best be adjusted to provide a rapid effect where possible. As mentioned earlier, the Committee considers extensive use of biofuels to be an example of an emission reduction measure that is not compatible with the recommendation to emphasise transformation and lasting change.

13.4 Important resources are scarce

All of the resources that are crucial to the transition to a low-emission society are scarce. Part B discussed many scarce resources that are important in the transition to a low-emission society, and the many dilemmas associated with this. Many emission reduction measures require access to resources such as power, biomass, capital, land, minerals, metals, other natural resources and expertise. The labour force cannot be employed in several places at the same time. Energy used in one place cannot be used in another, and land used for industry cannot be forest at the same time. Choices made in one sector that entail solutions that lay claim to one or more resources therefore limit opportunities in other sectors.

This perspective is not given enough weight when the transition is considered sector by sector. Delimited analyses of individual measures or individual industries do not necessarily address the issue of access to such resources, but rather assume their availability to meet demand. The Committee's review of various sectors' low-emission roadmaps shows that access to scarce resources has not been considered from an overall perspective (THEMA Consulting Group, 2023).

Policy choices govern society's use of these scarce resources. It is important that the policy choices made towards the transition take this scarcity into account. Policy choices affect both the supply and demand of scarce resources. The price of energy, land and other resources must therefore reflect their limited availability. Policies must facilitate a prioritisation that is in the interests of society, both through market solutions and policies.

Skilled labour is a scarce factor in the transition. For example, mainland industry is dependent on the availability of labour and expertise. If incentives are given for continued high activity levels in the petroleum sector, access to labour and skills for both existing and new industries will be poorer or cost more. This will delay the transition to a low-emission society. In its report, the Skills Needs Committee points out that a scarcity of skills can slow down the transformation needed to achieve the climate targets, and that it is crucial to close the skills gap in the renewables industries.

The amount of power produced and consumed in Norway affects many sectors and interests. Industry, the petroleum sector and the transport system demand more electric power to reduce their emissions. The development of new renewable energy, as well as demand for power, is significantly influenced by political decisions. More development of renewable energy means more electric power. This could make it easier to replace fossil energy and thus reduce emissions in, for example, industry. The availability and price level of power are important conditions for what kind of business and industry we have in Norway. It is therefore important that the direction and priorities of energy policy are aligned with climate policy, and that this is clearly communicated.

The development of renewable energy lays claim to other scarce resources. Extensive development of renewables relies on the assumption that part of society's resources and land will be used to develop new electric power. This will lay claim to skills, labour and land that could be used for other purposes. It will also lead to encroachments on nature and reduce natural carbon sinks and their ability to absorb GHGs. Power development may also come into conflict with indigenous rights. At the same time, the impact on nature and land is a result of society's overall use of land. Renewable energy is one of several causes of land degradation. Energy prices will depend on how much power is available. Prioritising access to affordable energy of a significant scope will place constraints on resources that will also be needed for other purposes in the transition to a low-emission society. Whether this is the best use of society's scarce resources must be carefully considered.

Resource use affects Norway's contribution to halting loss of nature both nationally and globally. Becoming a low-emission society and at the same time halting loss of nature requires a much more stringent policy for natural resources and land use than Norway is currently pursuing. The development towards a low-emission society will require the use of land, but where, how and to what extent this takes place is of central importance both to how other emissions are affected and goal achievement in other important areas of society. In the assessment of whether natural ecosystems must be degraded to increase renewable energy production, society's overall pressure on nature is key. This entails a trade-off between different forms of demand for land in society, and a prioritisation between uses. It also means that some purposes must be given lower priority and areas not suitable for different types of development must be identified, as seen in the way the National Framework for Wind Power identified areas that should not be considered for wind power development (NVE, 2019). Indigenous rights will also entail restrictions on which land can be used for what. The demand for natural resources that the transition entails is a key element in this respect. In addition to affecting nature in Norway, it also impacts nature and land use in other countries. If Norway's transition requires resources that lead to loss of nature in other countries, this will make it more difficult to achieve the objectives of the Global Diversity Framework.

The use of biomass should be limited. Biomass is a scarce resource that should only be used when no other options are available. There is a risk that biomass demand will exceed supply within the framework of sustainable land use and the objectives of the Global Diversity Framework, especially if many countries wish to use biomass to reduce their emissions. Measures relating to avoiding, limiting and streamlining resource use should therefore be given priority. It is unlikely that biomass produced in a sustainable manner will become available to the extent assumed in the technical analysis in Chapter 3. This underlines the need to reduce emissions in other ways than by using biomass, including by reducing the activities that generate emissions. Biomass is an international commodity. We therefore need to consider the impact of Norway's biomass demand beyond national borders. The European Scientific Advisory Board on Climate Change has assessed different emission levels in the EU based, among other things, on how they affect the risk of other environmental problems. On this basis, they have identified an upper quantitative limit for the use of bioenergy. Some of the Advisory Board's scenarios show little or no increase in the use of bioenergy, although most of the scenarios depict an increase. One of the three main scenarios shows that the use of bioenergy in the transport sector will peak before 2030. The Advisory Board also points out that industry's use of bioenergy should be limited to certain processes where there are no other alternatives to fossil energy. Norway should take a very conscious approach to the use of biomass and the extent of such use, for example when it comes to biofuel in transport.

Some metals and minerals will be scarce in the transition to a low-emission society. A more circular economy, which reduces and rationalises the use of resources, is central to ensuring that access to metals and minerals does not impede the transition. Reuse and material recycling must take priority over the extraction of virgin resources in order to limit loss of nature. Where virgin resources are extracted, very strict framework conditions must be required to limit adverse environmental impacts such as loss of natural carbon sinks and sequestration capacity. Increased demand could provide incentives for extraction in new, hard-to-reach areas, or for using new methods of extraction. To avoid this leading to loss of nature and other undesirable environmental impacts, regulations must be a step ahead of developments. No decision should be made to open for extraction until we know the consequences for existing carbon sinks, future carbon uptake and the condition of ecosystems.

Overall, Norway appears to have a choice between becoming a low-emission society with high consumption of resources such as power, land and minerals and metals, or a low-emission society with a lower consumption of material resources. The technical analysis in Chapter 3 has not assumed limitations on the use of resources. A society with high consumption of material resources will have a large footprint and will most likely not be compatible with a society where there is no further large-scale loss of natural diversity. Some of the consequences will arise in other countries, and some in Norway. A high level of consumption will also lay claim to resources that other countries may need in their transition.

See also discussion of resource use in the analysis of emission reductions towards 2050 in Chapter 3.

The European Scientific Advisory Board on Climate Change also makes similar assessments. In recommendations issued in 2023, the Advisory Board pointed out that pathways with lower energy and natural resource consumption advance the SDGs and energy security and reduce other risks compared with pathways that prioritise supply-side technology solutions (European Scientific Advisory Board on Climate Change, 2023).

A low-emission society with high resource use risks shifting the problem to other countries or to future generations, and is unlikely to be a solution for a permanent low-emission society. Some of the planet's resources are limited. It may be possible to reuse some of the resources at a later date, but this is not true for all of them. Although some resources are renewable or conditionally renewable under sustainable management, there are also some that are absolutely limited. The resources consumed by Norway's transition to a low-emission society will not be available to others at the same time. This means that Norway's transition guides both the opportunities available to Norway in the future and other countries in the present.

The level of resource use is a key policy choice that determines Norway's chances of becoming a low-emission society permanently. This is not about resource use in each individual solution, but in the sum of the solutions. Political decisions on preferred solutions are of great importance for stakeholders' understanding of the limitations and prioritisation of resource use.

A more circular economy is a way of making resources available to society in a situation where important resources are scarce. In isolation, this can help reduce our footprint and thus mitigate conflicts of objectives in the transition to low emissions. At the same time, a more circular economy will necessarily mean increasing the cost of or placing other constraints on resource use.

Increased circularity will not, however, eliminate the need to make priorities within a narrow framework. The footprint of our current consumption pattern is far too high and must be reduced. Even with high ambitions for increased circularity, the composition and level of private and public consumption must be aligned with the planetary boundaries. When resources are scarce, society's challenges cannot be solved sector by sector. Different interests must be weighed against each other to a greater extent, and the way decision-making systems are designed must reflect this. A pathway that entails less use of material resources should be a key political message in the transition to a low-emission society.

All sectors must be based on the premise that important resources for the transition are scarce. This applies to the work of the ministries responsible for policymaking in the various sectors, but also to work in different sectors through e.g. industry organisations on how their sector will contribute to the long-term transition and to achieving the short-term climate targets. Furthermore, resource scarcity should affect individual companies' work on their own transition plans. See the Committee's assessments in chapters 10 and 18.

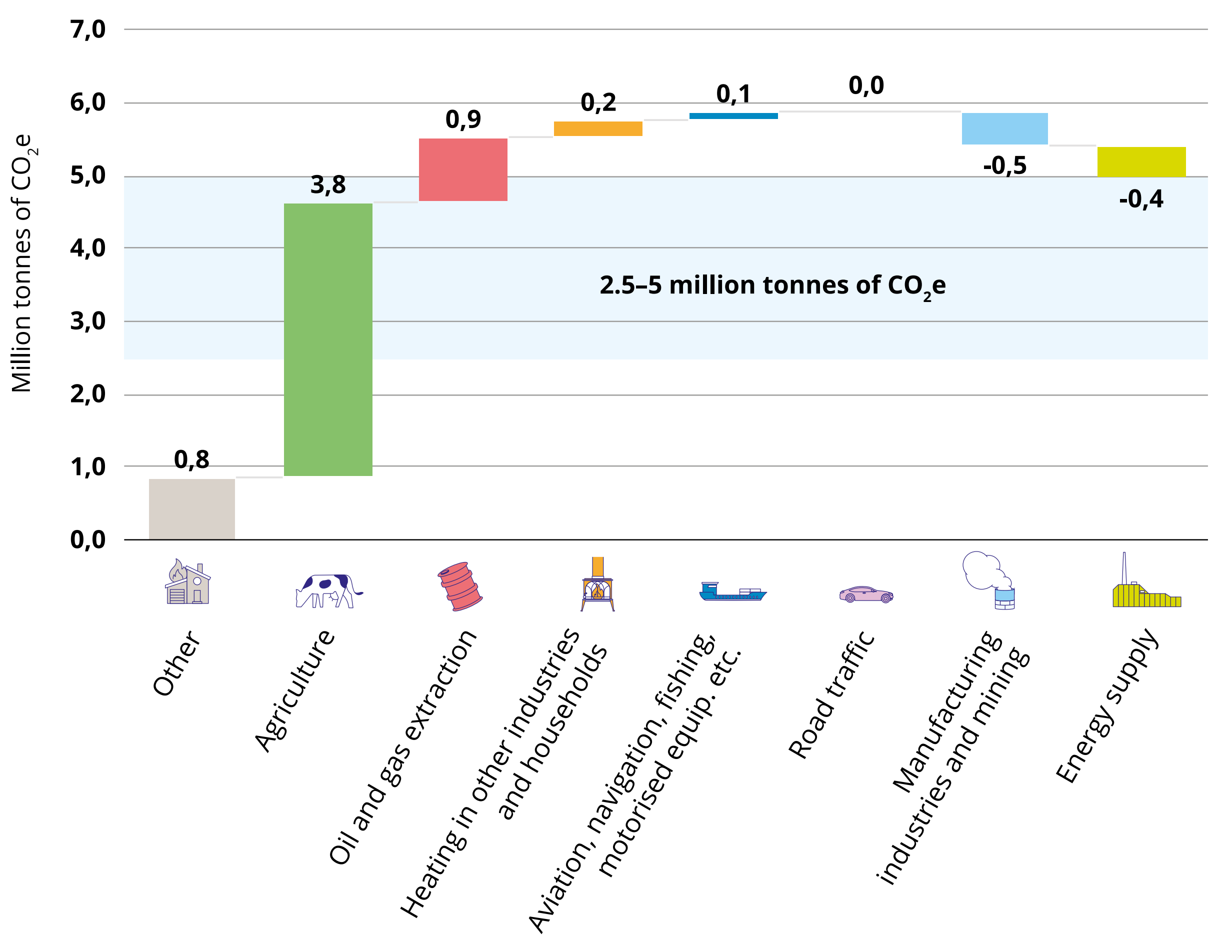
See also discussion in Chapter 3, and a discussion of agriculture and the petroleum sector in Chapters 7 and 12.

13.5 Key policy choices

Norway's choices are particularly crucial when it comes to petroleum activities and agriculture. The choices are largely about the direction of sectoral policies for petroleum activities and agriculture, which will be decisive to keeping within the emissions budget towards and beyond 2050. For other sectors, development is about eliminating virtually all emissions for good, while taking into account the scarcity of important resources. The future alignment of agricultural policy and petroleum policy will have a major impact on the amount of emissions allowed in other sectors. For the petroleum sector, electrification and possible further exploration are key decisions, as discussed in Chapter 12. Choices relating to production changes in agriculture will gradually become more urgent, since this sector is likely to account for an increasing share of GHG emissions and be by far the largest source of emissions in 2050, as discussed in chapters 3 and 7.

Figure 13.1 **Emissions in 2050.**
The figure shows the result of the technical analysis for the breakdown of emissions between the different sectors in 2050. Emissions and removals in the forestry and land use sector are not included in the figure.

Source: 2050 Climate Change Committee



Even with continental shelf electrification and CCS, significant emissions will remain from petroleum production on the Norwegian continental shelf, even without putting new fields into operation. The size of the emissions depends on the level of activity in the industry. This means that the higher the level of activity in the oil and gas industry, the more emissions must be reduced in other sectors. If it is assumed that all installations and facilities in operation in 2050 are powered by renewable energy, and that emissions from other emission sources are reduced, the Ministry of Petroleum and Energy believes it will be possible to achieve an emissions level of less than 1 million tonnes of CO_2e in 2050. This will account for a significant share of the total 2050 emissions budget of between 2.5 and 5 million tonnes.

If emissions from agriculture are not reduced from the current level, these emissions alone will constitute virtually the entire emissions budget in 2050. Today, emissions from the agricultural sector account for just under 5 million tonnes of CO_2e in the emission accounts. Emissions from energy consumption for farm buildings and machinery and equipment come in addition. If emissions in other sectors that are very challenging to avoid are taken into account, as discussed in Chapter 3, the emissions budget for 2050 will be exceeded. Emission reductions in agriculture are required to achieve the goal of a low-emission society, but significant reductions entail major changes for the agricultural sector and demanding trade-offs for society. The longer we put off these questions, the less time will be available for a difficult transition.

Emission accounts: an overview that includes all emissions and removals of greenhouse gases within a country's borders. The main gases are CO2, methane (CH4) and nitrous oxide (N2O), but also other gases such as fluorinated gases are considered greenhouse gases and included in Norway's emission accounts.

In 2050, there will be no room for current-level emissions in agriculture and the level of emissions forecast for the petroleum sector, even if all other sectors have reduced their emissions to close to zero. For Norway to achieve the goal of becoming a low-emission society by 2050, further transformation is needed in these two sectors beyond the transition envisioned today. The petroleum sector and the agricultural sector are likely to be the two largest emission sectors in Norway in 2050, as seen in Figure 13.1 showing the result of the technical analysis described in Chapter 3 for the breakdown of emissions between different sectors in 2050. Developments in these two sectors will greatly affect the scope of emissions permitted in other sectors, and will reflect on each other. Less emission reductions in one of the sectors means greater reductions in the other. Even with the somewhat unrealistic assumptions underlying the technical analysis outlined in Chapter 3, emissions in 2050 will only just manage to stay within the emissions budget for 2050.

See Figure 13.1, which shows the result of the technical analysis discussed in Chapter 3 for the breakdown of emissions between the different sectors in 2050.

A key policy choice in Norway's transition to a low-emission society is therefore to develop transition policies for the petroleum and agricultural sectors. For Norway to achieve the goal of becoming a low-emission society, policy must be tightened beyond the current level of ambition. Without this, Norway will not achieve its climate targets. The Committee's recommendations in Chapters 7 and 12 must be seen in light of this.

13.6 Cooperation with the EU

A key choice of direction for Norwegian climate policy is how closely it will be aligned with the EU's climate and energy policy until 2050 and beyond. Norway is already closely aligned with the EU's climate policy up until 2030, through the climate agreement with the EU. In many areas, Norway is strongly affected by developments in the EU independently of the climate agreement, through the EEA Agreement and other channels and because Norwegian businesses are adapting to an evolving European market. How and to what extent Norway is able to exert influence over EU policy, and what formal relationship we choose to have with the EU's climate cooperation after 2030, is nonetheless a choice of great importance not only for climate policy but for Norwegian business and industry.

The Committee believes Norway can receive good support from the EU in climate policy. The current cooperation gives us the flexibility to implement emission cuts outside Norway. This has been an important motivation for Norway's cooperation. When all emission cuts are to be made in Norway, it is not certain that this will constitute an equally important reason going forward. However, a new agreement will ensure a systematic approach and commit Norway to achieving progress year by year. Such an agreement will constitute a legally binding framework and serve as a foundation for Norway's climate policy ambitions going forward. In this way, cooperation with the EU can help increase the credibility of Norwegian climate policy. The Committee has highlighted lack of credibility in climate policy as a key challenge for Norway's transition towards a low-emission society.

The EU is also developing climate policies for many specific sectors and, through cooperation, Norway can benefit from an established regulatory framework designed to achieve rapid emission cuts. This means the transition in Norway can be implemented more quickly by cooperating with the EU. In many areas, however, Norway has been very slow to implement EU directives in Norwegian legislation. The transition may therefore potentially be delayed because neither national policies nor EU policies are introduced.

An ambitious climate policy in the EU provides a clearer direction for Norwegian policy as well. European cooperation makes it easier for individual states to pursue ambitious policies, because the EU policy creates a level playing field across national borders. This means less risk of businesses and jobs being relocated within Europe as a result of ambitious climate policies. It is therefore not clear whether an ambitious climate policy in the EU will lead to a narrower scope of action in general at the national level.

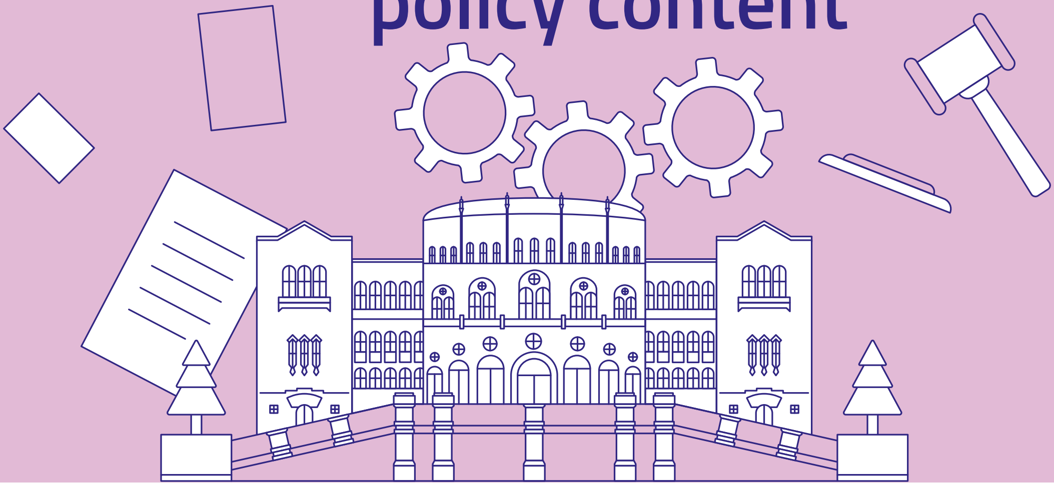
Developments in European climate and energy policy are of great significance. The EU is Norway's number one export market. Changes in the markets for key exports from Norway will therefore be significant to the future development of such goods in Norway. Whether it will be socio-economically profitable for Norway to maintain a high level of activity in the oil and gas industry is closely linked to the role of natural gas in the European energy system going forward. European industrial policy priorities are important for the development of Norway's industrial sector.

Norway will be affected by EU climate policy regardless of a dedicated climate partnership. This will take place through multiple channels. The Norwegian economy is closely linked to developments in the European economy; the EEA Agreement requires Norway to implement comprehensive EU regulations, and Norway is affected by political developments in the EU and European countries. This is of great importance for Norway's transition to a low-emission society.

The Committee recommends that Norway continues its climate cooperation with the EU and implements the EU's climate regulations leading up to 2050. Efforts should be made to obtain a political majority for a long-term continuation of the climate agreement with the EU. The climate agreement does not bind Norway to future versions of the EU's climate regulations for sectors not covered by the EU ETS or for forestry and land use. This means that Norway's participation in parts of the EU's enhanced climate regulations depends on a decision to continue the climate agreement and thus participate in new and more ambitious versions of the regulations. The Storting must consent to a continued agreement. Whether and, if so, on what terms Norway will participate in the EU's enhanced climate regulations has yet to be decided. In the Committee's view, Norway will benefit from the EU's ambitious climate policy, and this must form the framework for Norwegian climate policy. Predictability is important, and the Committee is of the opinion that any doubt about Norway's commitment to new and more ambitious versions of the EU's climate regulations should be resolved. The Committee therefore recommends that Norway upholds the climate agreement with the EU until 2050 and makes efforts to obtain a political majority for this.

14

Principles underlying policy content



In this chapter, the Committee proposes a set of overarching principles that should form the basis for political priorities and the choice of climate policy instruments. The principles are intended to provide a direction for the decisions that need to be made towards the transition to a low-emission society. To make it easier to apply the principles in practice, the Committee also proposes a simplified 'low-emission society checklist' that both the Government and other stakeholders can use to make simplified assessments of whether a decision will be consistent with the low-emission goal.

14.1 Political priorities, use of policy instruments and choice of direction

The previous chapter outlined a number of fundamental key choices in Norway's transition to a low-emission society. The choices made in these areas will have consequences far beyond the specific choice of direction. In order to succeed with an overall transformation of society, the Committee recommends basing political priorities on a number of overarching principles. The purpose is to prevent climate policy ending up as a series of inadequately coordinated measures that do not pull in the same direction.

The 2050 target of total emissions of 2.5–5 million tonnes of CO_2e must form the basis for all decisions. This means that emphasis must always be placed on climate considerations, and that the goal of a low-emission society must provide a clear direction even in cases where it may come at the expense of other societal interests.

To ensure this, the Committee recommends applying the following overarching principles:

- *Predictability and effectiveness:* Policies should help to make the transition as predictable as possible for people and businesses alike, so as to facilitate the necessary investments in a low-emission society. This can be ensured by adopting schedule plans or escalation pathways for taxes and regulations, and by not deviating from the overall objectives of climate policy in individual cases. Policy instruments should be chosen that provide the greatest possible assurance that the goals will be achieved.

- *Cost-effectiveness:* The transition will cost, and it is therefore crucial to avoid greater costs than necessary. However, cost-effectiveness should be considered in a larger perspective than the isolated cost of an individual measure, and include effects that cannot be priced. For example, the transition may be more expensive overall if it is postponed, thereby forcing many measures to be implemented in a very short space of time closer to 2050. In addition, increased consumption of electricity in one sector can make it more expensive and more difficult for other sectors to implement the necessary measures. The combined use of policy instruments should minimise society's costs associated with the transition as a whole.

- *Long-term perspective:* Choices and priorities must stand the test of time both towards and beyond 2050. The choices made today should not impede further emission cuts and GHG removal after 2050. When making long-term plans, emphasis should be placed on avoiding emissions.

- *Resource and land use efficiency:* The transition will require significant energy and natural resources, and climate change must be dealt with in parallel with other threats to nature and the environment. Measures and policy instruments should therefore generate the least possible overall impact on ecosystems. The development of society in general should be based on this point of departure.

- *National policy for global goals:* National climate goals should form the basis for policy choices, while taking into account the global effects of decisions. Consideration should be given to the extent to which a measure leads to greenhouse gas emissions in other countries, and whether it makes it easier or more difficult for other countries to transition to a low-emission society. Technology development and experience accrual are examples of effects that can facilitate the transition for others, while the risk of carbon leakage or relocation of emissions to other countries' climate accounts are examples of the opposite.

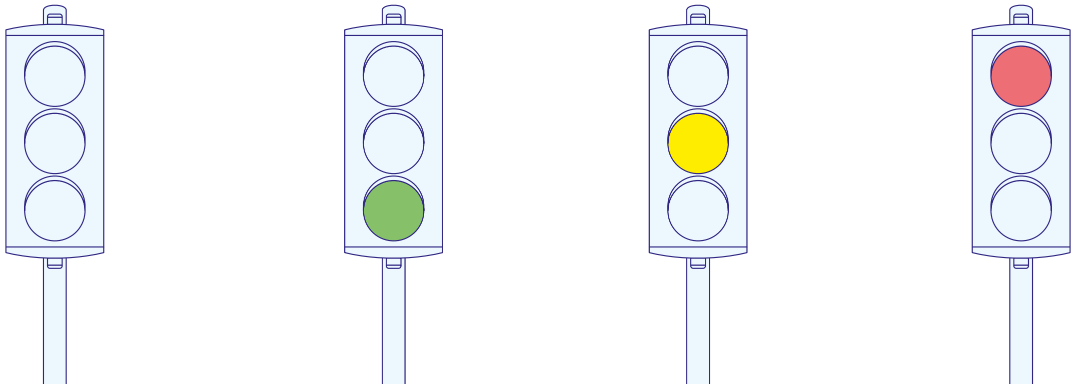
- *Considering fairness without weakening the transition:* Although distribution considerations should primarily be addressed by other policy areas, the distributional effects of climate action should be considered more systematically in political processes and choices of policy instruments. In cases where the choice is made to compensate for the effects of climate action for individual groups, the compensation must be designed so that it does not undermine the purpose of the measure.

- *Governing by where we want to go:* Many decisions are characterised by uncertainty about the future, and whether or not developments are expected to evolve in line with the climate goals can be of great importance. Social planning should be based on the goal of a low-emission society rather than forecasts based on historical or current development, for example in relation to expected future energy consumption, transport growth or the extraction of natural resources.

14.2 Low-emission society checklist

The Committee has prepared a five-point checklist that can be used to apply the principles in practical policy. The purpose of the list is to show how to assess the extent to which any decision, whether at central government or municipal level or in a company or household, is in line with the long-term goal of Norway becoming a low-emission society. The five checkpoints indicate an overall direction and have deliberately been kept at a simple level. They can thereby be understood and used to make simplified assessments, while also providing a basis for a more comprehensive methodology that can be included in more detailed reports, assessments or reporting requirements where appropriate.

The Committee's checklist does not address all aspects that should be considered in the transition to a low-emission society. Assessments of, for example, costs and distribution effects will be important in all decisions, but are not included in the checklist. Nor does it mean that any measure that gets a red light on one or more of the criteria is automatically incompatible with a low-emission society. However, several yellow or red lights on the checklist indicate that the measure can make the transition difficult or place restrictions on other areas of society, for example in relation to access to energy, land or GHG emissions. In such case, a thorough assessment must be made of what is needed to ensure that the measure does not counteract the transition to a low-emission society. The checklist thus illustrates how decisions made today also involve choices of direction. Figure 14.1 illustrates how this can be operationalised.



The 2050 Climate Change Committee's checklist

Checkpoint	Green light	Yellow light	Red light
1. GHG emissions in Norway	The project will not generate GHG emissions in Norway in 2050, and will not generate high emissions towards 2050	The project may generate GHG emissions in Norway in 2050 (e.g. depending on technological developments or policy choices in other areas), or will generate significant emissions before 2050	The project will generate GHG emissions in Norway in 2050
2. Global GHG emissions	The project does not generate significant GHG emissions outside Norway (for example through exports that generate emissions elsewhere or imports of goods that are difficult to produce without emissions) or reduces emissions	Uncertain effect on GHG emissions outside Norway	The project generates significant GHG emissions outside Norway (for example for the production of necessary inputs)
3. Use of zero-emission energy	The project makes more emission-free energy available	The project will lead to slightly increased use of emission-free energy	The project will significantly increase the use of emission-free energy
4. Nature and land use	The project does not affect natural areas or is area neutral	The project affects some natural areas – possible to introduce mitigation measures to improve the ecological condition of the land	The project occupies a significant area, or relies on land with a particularly high natural value or alternative utility value
5. Contribution to lasting transition	The project helps enable transition (for example by developing new technology, increasing support for climate policy or providing important input factors for other necessary measures)	The project is short-term or temporary, or lasting transition effects are uncertain	The project makes permanent transition or other necessary climate action more difficult (for example by creating greater path dependency)

Figure 14.1 **The 2050 Climate Change Committee's checklist for the low-emission society.**

Source: 2050 Climate Change Committee

A new world

The year is 2050, I am now 44 years old, living in a world characterised by our own consumption. We live in small, isolated communities where we care for each other. Everyone is heard and seen and we don't live like we used to.

The welfare state is not as important as it used to be, the state no longer controls the economy and there are no common goods. Nor is there anywhere to turn to for financial support if you are struggling. The labour market has changed significantly, we have machines that do all the technological work. However, they are limited in number, and they often work far away from the communities. People have returned to age-old traditions, they generate their own income and work independently. You no longer need a long education to get a job.

Politics have become more divided in every country, every society has its own form of politics with its own governments and parties. We are no longer a united nation, but are made up of a large number of independent communities. We no longer call those who work to improve the communities our politicians, we call them representatives. Each household has the opportunity to send one representative to meet the other representatives once a month. No one makes money from this, instead we get a better community that affects everyone the same.

After the ravages of the climate crisis, we have managed to restore nature as it once was all over the world, but wildlife will probably never be the same. We have enough fish in the sea and enough animals in the forest, but they have evolved and are no longer as easy to catch or see. We plant fruit and vegetable gardens and slaughter livestock in the communities, we no longer use long-distance products. Everything is done in our own areas. Nor do we travel as we once did. We mostly stay within our own areas.

Although we live in an independent community, it's very close-knit. If someone falls ill, we don't have a hospital to go to. But everyone helps where they can, many know more about caring for the sick than they used to. People do not use as much modern medicine as before, so as not to create immunity to something so important. In extreme cases, medicine is used in emergencies, the medicines are made by the machines. So you have to travel far to get hold of them.

We no longer live in a world where industry plays the same role it used to – people make what they need for their household and exchange the surplus for other products. The machines do what people can't do and the money we used to have no longer has any value. Now they're just pieces of metal and paper that are used as materials. There are more resources now that we have started to live more minimalist lives, we have discovered that the resources have increased. We no longer live in a throwaway society, everything has a function.

Everyone builds their own house that suits them, and they no longer own their own properties in the community. Everything is owned by everyone, except what you build and make yourself. The only form of electricity we have is solar panels and wind turbines. Everyone has access to electricity, which has meant that many more people survive in colder periods and tougher times. We are a technologically strong society despite our old-fashioned ways. We develop technology every day, but not in the same way as before the climate crisis. We can't all have our own technological goods at home, such as mobile phones, tablets or TVs. In most communities, we share telephones and entertainment that everyone can use if they want, for free.

We now live in a world we have created to live in for as long as we can envisage, but the future is never certain. It is good then that as a species humans are so adaptable, we have lived for thousands of years and came through the climate crisis.

15 Use of policy instruments for the transition

In this chapter, the Committee discusses various instruments that can be used in climate policy – including pricing, regulatory and other policy instruments – and how instruments can be used in combination to bring about a sweeping transition to a low-emission society.

15.1 Many market failures need to be addressed at the same time

Pollution, GHG emissions and land degradation with associated loss of biodiversity are examples of negative externalities. A negative externality occurs when an activity incurs costs to society without those responsible for the activity having the economic incentive to take this into account in their decisions. Such market failure is the reason for many types of public intervention, such as economic and regulatory policy instruments. This has been described in detail in both socio-economic literature and a number of previous official reports (NOU 1996: 9, NOU 2003: 9, NOU 2007: 8, NOU 2015: 15, NOU 2018 : 17, NOU 2022: 20)

Externalities and other forms of market failure mean that market forces alone result in poor and inefficient use of resources. A key feature of the climate problem is that almost all human activity entails GHG emissions, and since the negative consequences of emissions are not part of the market, significantly more than is economically optimal is emitted by companies and households across sectors and countries. The transition to a low-emission society requires policies in many areas and will not be solved by market mechanisms alone.

Climate change is also closely related to many other market failures. The activities that generate emissions also lead to other negative externalities, such as local air pollution and noise. These must also be addressed. At the same time, solutions that reduce emissions can result in other negative externalities. For example, many of the measures that cut emissions are demanding in terms of energy and material consumption and land use. This means that the measures must be balanced against the other problems they contribute to. One example is how the development of renewable energy can lead to land degradation, with consequences for both biodiversity and carbon sequestration. It is therefore crucial that the use of policy instruments does not unilaterally provide incentives to reduce GHG emissions, but also ensures incentives to reduce other negative externalities.

Both fossil and zero-emission technologies involve network externalities that public policy must help address. A network externality means that the value of a product or service increases with the number of users. The classic example is the prevalence of phones, because it is very easy to see how their value increases with the number of users. Many green technologies involve direct or indirect network externalities. For example, electric vehicles require charging infrastructure, and ammonia or hydrogen as aircraft and ship fuel will require infrastructure in airports and ports. This can result in a chicken-or-egg problem that may delay the development of solutions society needs, and public policy is therefore needed to manage the situation.

The development of new green technologies entails positive externalities, such as innovations that can be used by many beyond those who have paid for the innovation. As companies develop new technologies, the entire gain from the new technology will not usually accrue to them, partly because it may be possible to copy technologies. This means that companies may lack sufficient incentives to develop new technology. Parts of technology development should therefore be supported by public policy instruments (see also section 10.3). For example, the OECD recommends public sector contributions to the financing of climate-friendly investments, research and innovation, regulations, dissemination of information and to lead by example.

See discussion of policy instruments for technology development in section 10. 3.

Many decisions with consequences for emissions are not made in the market. A number of administrative decisions in the public sector also affect the scope and focus of infrastructure, building development and economic activity, and thereby GHG emissions and other externalities. The public sector makes decisions every day on the location of public services, land for development, protection of vulnerable areas and procurement of goods and services. It is important that such decisions are made with a view to keeping emissions down.

Policy instruments towards the transition should be aligned with the principles the Committee has described in Chapter 14. The authorities can use many different policy instruments to correct various type of market failure. These include direct and indirect taxes, support, regulation, standards and educational instruments such as information campaigns. Different instruments will work in different ways, and the effect of an instrument will be influenced by its interaction with other instruments. The instruments are aimed at households, companies and public authorities. Policy instruments are more likely to be adopted if they enjoy public support and will be more effective if they have high credibility among the population and in the business sector.

Norway cannot choose policy instruments independently of EU policy. The national policies of EU member states are often drawn up in response to one or more EU directives. Much of the legislation adopted in the EU is EEA-relevant, both in the energy field and in relation to climate and the environment. According to the European Environment Agency, 27 per cent of national climate policies in 2019 were not directly related to EU policy (European Environment Agency, 2019). Many EU directives in the climate and energy field are designed to provide direction for national policy. This can be done, for example, by establishing objectives and specifying how to calculate goal achievement. The policy instruments used to achieve the goals are often left up to the individual countries. At the same time, more detailed legislation is also adopted in several areas that will apply to the entire EEA. These include new requirements adopted for vehicles and for ship and aviation fuel. Norway will have to implement much of the climate legislation the EU is now adopting in Norwegian legislation.

EEA relevant: EU legislation that is defined as falling within the policy areas covered by the EEA Agreement.

15.2 Emissions must be priced

Carbon pricing is based on the polluter-pays principle – a key principle in climate and environmental policy. The principle is originally founded on law and ethics, where it entails a responsibility for polluters to pay for the clean-up and restoration of what has been damaged, even when this cost is unknown in advance, which sets it apart from, for example, a pre-paid environmental tax. The principle is based on the premise that we know who the polluter is, and that they are in a position to pay for it.

Carbon pricing is and should continue to be the bottom line of climate policy. Chapter 3 described Norway's climate goals and the use of carbon credits between countries to meet these goals. This chapter considers the use of carbon pricing and of carbon credit markets at company level. These are different markets with different functions and characteristics. See also Box 3.1 in section 3.2. The right level of carbon prices with a predictable development in line with the climate targets will facilitate an effective transition. Since GHG emissions have adverse impacts that the individual polluter does not in principle have incentives to take into consideration, the negative effects should be priced as far as possible. The Tax Committee's proposal is a good starting point in this regard (NOU 2022 : 20). Today, emissions are priced

See discussion of climate goals, the use of emission allowances and different carbon credit markets in Chapter 3.

through taxes or an emissions trading scheme, but in the last years before 2050, it is not certain that carbon credits will be available or that it will be desirable to use them. Through carbon pricing, polluters pay for their emissions. If markets are well-functioning and market participants react to price signals, setting an equal price on all emissions will lead to an accurate, cost-effective climate policy. Pricing provides incentives for the development and use of green technology. Carbon prices at a sufficiently high level and with a predictable development will facilitate an efficient transition to a low-emission society.

It is important that the scope of carbon pricing increases and that the price is raised for low or non-priced emissions. In recent years, taxes and emission trading systems have been expanded to include more sources, pricing has generally increased and been harmonised for different sources, and signals have been sent about future increases in the tax level and a reduction of the carbon credit volume. However, there are still differences in the price level of different emission sources, as seen in Figure 15.1. In order for carbon pricing to be as effective as possible, it is important that the price is as similar as possible across different types of emissions. The level must also be sufficiently high to achieve the desired emission reduction. Signals should be given about future price developments to provide predictability to stakeholders. In practice, it is often necessary to make a trade-off between equal price and high price. It is more difficult to reach political consensus on higher carbon prices in some sectors than in others. The desire for equal pricing can therefore contribute to the price being aligned with the lowest level of ambition. In recent years, the trend has moved in the right direction, although significant emissions still remain that are not priced. The emissions trading system for companies, the EU ETS, has also become more extensive over time, and with the EU's Fit for 55 package, the scope will be expanded to new sectors such as shipping. Emissions from buildings and transport are covered by a separate emissions trading system.

There should also be corresponding incentives to remove atmospheric CO_2. Today, there are no corresponding incentives to permanently remove atmospheric CO_2 through, for example, bio-CCS or direct air capture technology, as there are to reduce emissions. A corresponding incentive would, for example, be a reverse charge (subsidies per tonne of CO_2 removed equal to the tax on emissions per tonne) or payment per tonne of CO_2 removed equal to the carbon credit price per tonne. A similar economic incentive for the removal of CO_2 as for emissions will contribute to more equal pricing and a more effective incentive structure. In a report, the Norwegian Environment Agency has proposed such an incentive structure, and the Storting has asked for this to be looked into (Decision No 713, 10 June 2022) (Norwegian Environment Agency, 2023b; Norwegian Storting, 2022).

The participants face different prices of emissions. The carbon price structure outlined in Figure 15.1 shows the marginal carbon price of Norwegian GHG emissions in 2023, and the price applicable in 2013. The y-axis indicates the marginal CO_2 price, while the x-axis indicates accumulated emissions in million tonnes of CO_2e, broken down by different sectors. The figure shows that climate taxes have increased significantly. In 2013, for example, the CO_2 tax on diesel was around NOK 250 per tonne, while by 2023 it had increased to about NOK 950 per tonne (current prices). The figure also shows that the operators face very different prices of emissions, even though the gap has narrowed since 2013. The figure also shows that the price of EU ETS allowances has increased significantly since 2013, which has contributed to a more equal carbon price between emissions covered and not covered by the system. Emissions of nitrous oxide and methane from agriculture account for most of the unpriced emissions, cf. Figure 15.2.

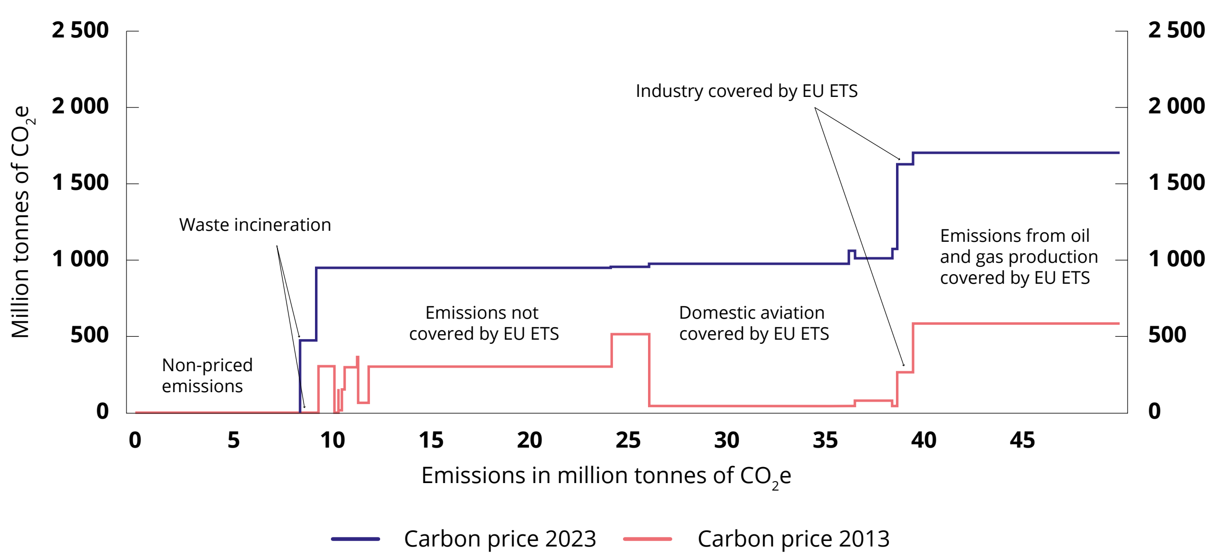


Figure 15.2 Price of GHG emissions in different sectors in 2013 and 2023.
Does not include emissions or removals from forestry and land use.
Source: Ministry of Finance

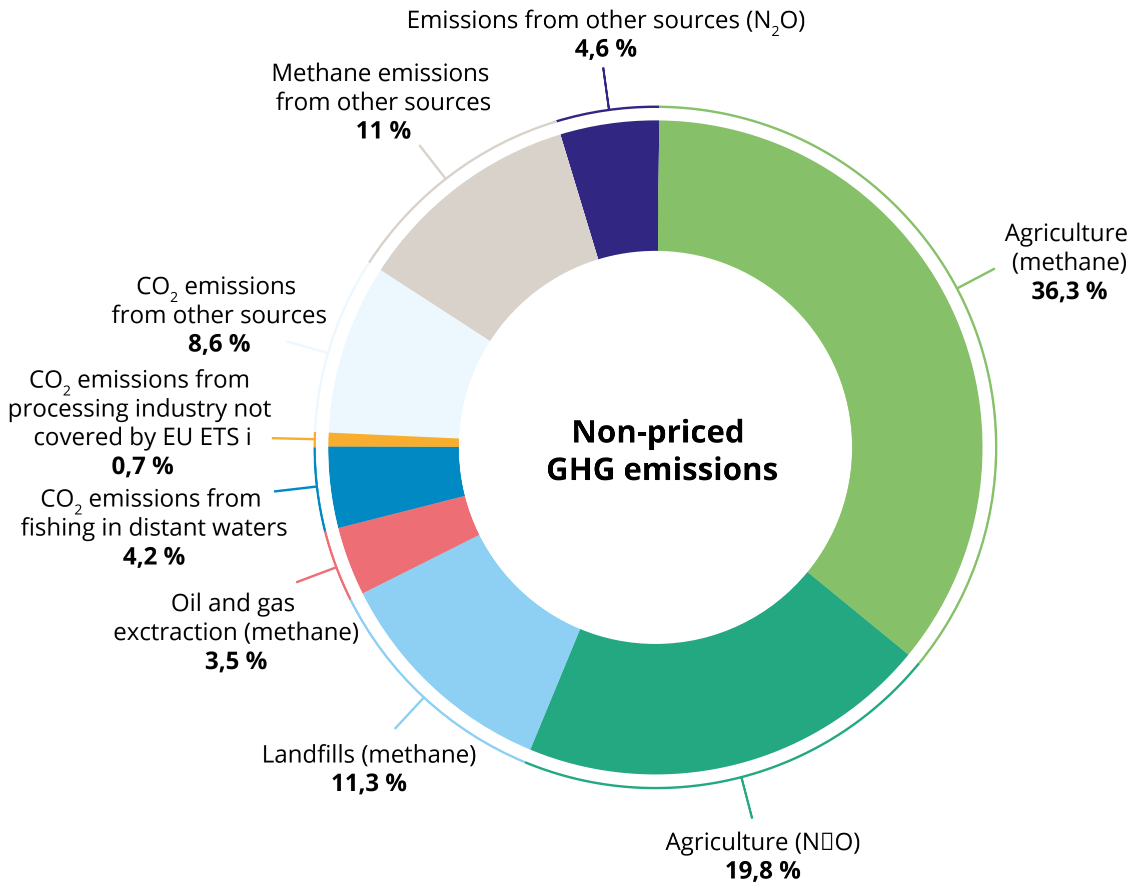


Figure 15.3 **Estimates of GHG emissions that are neither subject to EU ETS nor tax.**

Source: Proposition to the Storting (Bill and Draft Resolution) (2023–2024) Ministry of Finance

Carbon pricing generates revenues to the public purse that can finance climate action. In addition to correcting behaviour, the Government receives revenues from environmental and climate taxes and from auctioning emission allowances under the EU ETS. Overall, this is estimated to generate government revenue of about NOK 26 billion in 2023 (Advisory Panel on Fiscal Policy Analysis, 2023). There is great value in the fact that the Government is free to use revenues where they provide the greatest benefit, but it is also a well-established finding in research that using revenues from carbon pricing for climate action or transfers to the population helps make carbon pricing more acceptable (Baranzini & Carattini, 2017; Carattini et al., 2019; Klenert et al., 2018). Sufficient acceptance is a precondition for introducing indirect taxes. The EU has now introduced a requirement for member states to use all auctioning revenues for climate and energy-related purposes, with the exception of revenue used to compensate stakeholders exposed to carbon leakage. Between 2013 and 2021, on average, 75 per cent of revenues were used for such purposes (European Environment Agency, 2023). Revenues that are not channelled to member states are also used for climate purposes through the EU Innovation Fund and the EU Modernisation Fund. However, as emissions fall, the revenues will also decline. It is therefore important that budget policy is not based on the permanence of such revenues.

Developments in carbon prices should also be predictable in the long term, so that the stakeholders have the information they need when making decisions. For example, long-term investment decisions require as reliable information as possible. For the sake of maximum predictability, there should be broad political consensus on the future tax level or the volume of allowances.

The choice between emissions trading and taxes as a policy instrument is a choice between predictable costs for the participants or certain emission cuts. With the goal of given emission reductions in a given year, an emissions trading system will ensure goal achievement to a greater extent than taxes, while the price of carbon credits will depend on the cost of emission reductions. Taxes for which there is broad political agreement about the future tax level may provide greater predictability for the participants, which can result in greater certainty for investment decisions, but uncertainty about the magnitude of emission reductions a given tax level will result in.

15.3 The right carbon price is unknown

The *right* carbon price is not known. In their article, Rosendahl and Wangness (2023) assessed carbon prices for cost-benefit analysis in Norway based on a review of model results from the IPCC's 1.5-degree report. They refer to two fundamental ways of estimating the right carbon price. The first attempts to calculate the effects and costs of increased emissions and arrives at the social cost of carbon from emissions. The optimal carbon price is equal to the marginal social cost of carbon since the cost of action then equals the marginal cost of carbon. There is considerable uncertainty associated with the consequences of future climate change and pertaining costs. This is reflected in the fact that such estimates vary greatly depending on the model and assumptions used. The other way of estimating the right carbon price is to find the carbon price that will enable you to achieve a given climate target.

There is considerable variation in estimates of the right carbon price. Table 15.1 shows global carbon prices consistent with the 1.5-degree target, obtained from Rosendahl and Wangness (2023). The table illustrates the wide range of sufficient carbon price trajectories by showing the lowest and highest price scenarios, as well as the median and average. The variation in prices is the result of different assumptions and specifications in different models. The table also illustrates that higher carbon prices are needed to avoid temporarily overshooting global carbon budgets (which entail a risk of crossing the threshold of dangerous, irreversible climate change); see the penultimate column. Reasonable restrictions on the use of biomass and land also increase the required carbon price; see the last column. Based on the model review, Rosendahl and Wangness recommend various options for carbon price trajectories for use in socioeconomic analyses. Figure 15.3 shows the proposed main trajectory as well as the high and low trajectories recommended for sensitivity analyses. These prices are above the current recommended carbon price trajectories for use in socioeconomic analyses.

Table 15.1 Variations in carbon price paths consistent with the 1.5 °C target.*

Prices in 2050	Original sample	Remove studies with high overshoot	Remove studies with unsustainable BECCS
Number of studies	84	50	20
Min. price	112	125	125
Median price	480	832	806
Max. price	14236	14236	14236
Average price	1096	1433	1677

* Taken from the IAMC database for the year 2050, from the original sample to an applicable sample of price trajectories. EUR, 2016 prices.

Source: (Rosendahl, 2023).

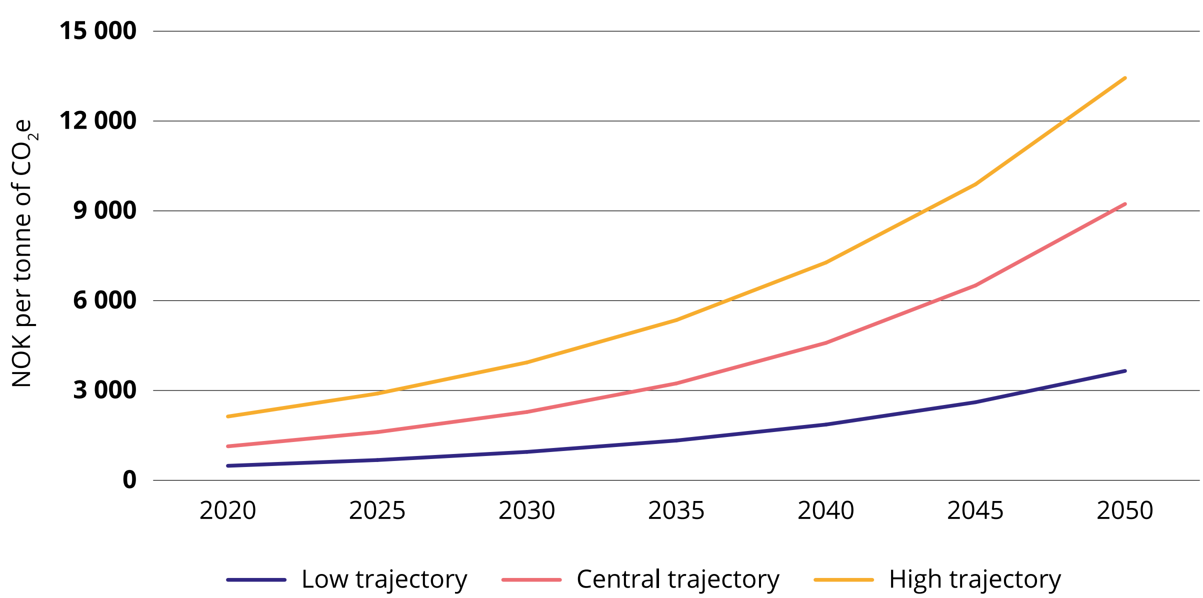


Figure 15.4 Recommended carbon price trajectories retrieved from Rosendahl and Wangness.

Source: Rosendahl and Wangness (2023), adapted by the 2050 Climate Change Committee

It is not a given that the carbon price in Norway should be at the same level as the global price needed to achieve common climate goals. Firstly, there may be ethical and rational reasons why a rich country like Norway should be willing to pay a higher price for emission reductions than what global models indicate is necessary to achieve a global climate target. Such a level of ambition can, for example, be operationalised through separate targets for national emission reductions, as Norway has set for 2030 and 2050. The Green Tax Commission recommended setting the tax on GHGs sufficiently high to achieve national emission targets if emission reductions are set in Norway (NOU 2015: 15). The optimum carbon price will then be determined by what is sufficient to achieve the emission target. A good estimate of the cost of reducing emissions is needed in such case, but this is not easy, and such estimates vary substantially.

The price needed for Norway to achieve the target of a 90–95 per cent reduction in 2050 is uncertain. In the same way, it is also uncertain what price is needed to achieve the target of reducing emissions by 55 per cent in 2030. The Government's climate status and plan for 2023 and the Norwegian Environment Agency's report on climate action towards 2030 with analyses of 85 measures that will reduce GHG emissions from all sectors, show that the current tax level and planned increase to NOK 2,000 in 2030 will not be sufficient on its own (Norwegian Environment Agency, 2023c). In its plan, the Government also refers to policy instruments other than taxes that will lead to emission reductions, such as biofuels and regulations. The Commission considers it positive that the Government has a plan for tax increases towards 2030. The Committee is also of the opinion that it would be positive if the escalation plan was made more binding, for example through cross-party consensus. A binding plan should have a longer time horizon than 2030. The plan must be based on the premise that the tax increases should not be compensated in ways that reduce their impact. In Chapter 18, the Committee looks at which carbon price pathways should be used in socioeconomic analyses.

See the Committee's assessment of what carbon price trajectories should be used in socioeconomic analyses in Chapter 18.

15.4 Carbon pricing is not always effective or possible

In order for emission pricing to be effective in terms of costs and effectiveness, a number of assumptions must be met. It is not always possible nor desirable to set emission prices at a level that results in the desired emission reductions. Developments so far have shown that it is demanding.

There must be political leeway to set the tax level sufficiently high, or the carbon credit volume sufficiently low, and all stakeholders and emissions should be subject to the same price. In practice, this can prove difficult. If there is strong resistance in some sectors, a flat emissions price will be politically demanding to introduce; see Figure 15.1. The uncertainty surrounding the price of carbon credits can make it more demanding in political terms to set a stringent target for emission reductions. Pricing is often an unpopular policy instrument, and raising prices or expanding the scope of applications evokes resistance. This may mean that political signals about high prices in future will not come across as credible. Credibility is crucial for stakeholders to choose to invest in emission reduction technology or implement costly transition processes.

Other externalities must also be appropriately priced. Externalities that are not priced will not necessarily be taken into account, for example when using resources such as energy, nature and other scarce resources. These other externalities also need to be appropriately priced and addressed to get the most cost-effective emission reductions through carbon pricing.

Subsidies that are detrimental to the climate pull in the wrong direction. The right carbon pricing will not be achieved if such subsidies are present at the same time. These should therefore be identified and removed. Activities in oil and gas, transport, agriculture and land use that generate emissions may be directly or indirectly subsidised, for example through the tax-free scheme, tax deductions for commuting and support for forest roads.

Emission pricing may result in other negative impacts. Almost all activity generates emissions, and climate policy will therefore affect wide areas of society and other societal goals. Even with optimal pricing of all externalities, adverse distribution effects may arise, both geographically and between different population groups. The development of renewable energy will entail land use, but society must also protect nature and biodiversity from encroachments. A key consideration in the design of policy instruments is therefore to manage conflicts of objectives and ensure that the achievement of one goal does not impair the achievement of others.

Pricing in one country or area should not lead to carbon leakage. In the event of carbon leakage, emissions will be shifted to other areas, making the global effect small, zero or even negative. If one country introduces carbon pricing, or other policy instruments that increase the costs for stakeholders, and other countries do not (or have lower prices on emissions), it can give companies in the countries that do not price emissions a competitive advantage. This can result in production being moved to countries without carbon pricing, with higher emissions per unit produced. This is especially true when companies in countries without carbon pricing win shares in international markets at the expense of companies (with lower emissions) that pay for their emissions. Various measures are being implemented to counteract carbon leakage, including free allocation of allowances, the CO_2 price compensation scheme and the EU's Carbon Border Adjustment Mechanism (CBAM).

Organisations and individuals do not always respond to price incentives in the most profit- or utility-maximising way. Systematic deviations from economically optimal decisions have been well documented in empirical studies. In reality, many decisions are made without us even reflecting on them. The decision-making process has become automatic, resulting in habitual behaviour. Behaviour is also influenced by social norms and preferences, often without us realising it. In addition, we often think within the framework of mental models that influence how we perceive things and how we interpret or misinterpret the information we receive. Deviations from economic rationality, such as loss aversion, present bias and reference-dependent preferences, mean that people tend to remain in the current situation or choose a known alternative, even if doing something new is profitable or results in greater welfare (Norwegian Environment Agency et al., 2020; World Bank, 2014). One example is if you usually drive to work, you can continue to do so even with the development of cheaper and better public transport. Good information about public transport options, or colleagues sharing positive experiences, may be sufficient to change your behaviour, while a price incentive as the only instrument would have to be very strong.

The price signal must reach those that are able to influence the emission level. Not all emissions can be priced in a way that gives those able to do something about it an incentive to reduce them. For example, it can be challenging to give an incentive for waste sorting by imposing taxes on companies managing the waste and not those who throw it away. In other cases, an investment in reducing emissions made by one person could benefit an entirely different person. In some cases, a tax will also represent a very small part of the total cost. This can, for example, apply to products with fluorinated gases, where only a small volume of the gases is normally used. Here, the tax must be set at a very high level to be effective.

Decisions that lead to emissions must be made in a market in order for carbon pricing to be effective. Many emissions are influenced by decisions not made in a market, including many public sector decisions on, for example, land use and infrastructure investments, even though the prices of input factors are controlled by the market.

The emission must be attributed to an 'owner' that can influence the emission level. In order for an emission to be reduced, someone must be made accountable for it. It can also be the case that the owner of an emission cannot necessarily do much to limit it, for example in the case of forest fires. There are also emissions that are difficult to attribute to an owner, for example emissions from wastewater.

It must be both technically and administratively possible to measure and report emissions. Often, standard emission factors are used, which means that measures that actually have an effect do not necessarily count.

When pricing is not effective or sufficient, other policy instruments must be used. Non-pricing instruments can be both effective as a supplement and in many cases serve as effective alternatives to carbon pricing. This will be described in further detail in the following sections.

15.5 Attitudes and preferences are important for policy instruments' feasibility and effect

There is a need for clear political leadership that creates the necessary acceptance for the use of policy instruments. Both the general legitimacy of climate policy and the specific support for or opposition to specific instruments are crucial in terms of what is politically feasible (Schaffer et al., 2022). At the same time, majority support among the public is neither necessary nor sufficient to implement a policy instrument; sometimes politicians lead the way and introduce policies that a majority does not currently support, and sometimes opposition from smaller interest groups or party policies can constitute the barrier to implementation (Kallbekken, 2023).

Politicians may be sceptical about introducing policies that are expected to lead to resistance in the population or from other influential groups. We know a great deal about acceptance of different policy instruments. Research has sought to determine what types of policies will result in more or less public resistance. Various meta-studies suggest that it is important for general public support that a policy instrument is perceived as providing a fair distribution of benefits and burdens and that it is effective (Bergquist et al., 2022). Knowledge about climate change has proved to be far less important (Dechezleprêtre et al., 2022). As with other areas of politics, policy instruments play a role in shaping perceptions, norms and political institutions. For example, climate policy will create new political winners and losers, and thereby new groups that resist the policy. How those who will be negatively affected by a political proposal are taken into account is important both for the proposal to be perceived as fair and to prevent resistance from groups that are able to mobilise against a given proposal (Gaikwad et al., 2022). The influential claim that 'new policies create a new politics' was formulated as early as in 1935 (Schattschneider, 1935). When new stakeholders gain more influence, new alliances in society can be formed that together contribute to maintaining support for stronger policy instruments over time. Thus, a positive domino effect can be established where path dependency serves to strengthen policy over time; see Box 3.3 on path dependency. Policies that affect broad sectors of the population tend to foster broader and more powerful coalitions of groups who support the policy than policies aimed at a given segment of the population, for example through means testing. This helps more universal solutions to better stand the test of time (Patashnik, 2019).

Opinions differ on whether the polluter-pays principle is fair, depending on who the polluter is. Large, commercial players can adapt their operations to limit pollution and pay for clean-up costs. Yet the polluter-pays principle can be perceived as unfair on an individual level if wealthy people can continue to lead a carbon-intensive lifestyle by paying for it, while those less well-off are forced to make adaptations and change their behaviour.

Taxes are often unpopular, but the proceeds can be used in ways that lead to greater acceptance. This acceptance will also increase if the alternatives to the activity subject to the tax are improved. A carbon fee and dividend (CFD) is an alternative form of carbon pricing that many believe will create greater acceptance for a strict climate policy. The mechanism involves earmarking income from carbon taxes for distribution to individuals/households. Canada and Switzerland have implemented policies based on the idea, but with limited effect on public support (Mildenberger et al., 2022). Research suggests that acceptance could be more effectively achieved by earmarking the tax income for climate action than returning dividends to individuals (Carattini et al., 2019; Matti et al., 2022). At the same time, CFD variants can both even out revenues and make climate policy more just without removing the incentives to reduce emissions.

Carbon fee and dividend: a proposal where revenue from taxes on greenhouse gas emissions or the production of fossil fuels are returned to the population as dividend. The purpose is to increase support for raising the relative prices of fossil fuels as quickly as possible.

Subsidies are often far more popular than taxes, but this is partly due to the fact that it is more difficult to see who actually carries the cost. Combinations of policy instruments that have different costs and benefits for different groups may be more popular because it makes it easier for more people to identify the elements that benefit them. In general, the two most important factors for acceptance are whether the instrument is perceived as fair and effective, and these considerations should therefore be given weight.

Changes in behaviour at both the individual and organisational levels are a prerequisite for emission cuts and the transition to a low-emission society with sustainable use of resources. Changes in behaviour, norms and preferences are crucial for many of the measures that contribute to emission savings, such as consumers and businesses adopting electrified solutions or reducing physical resource use. Many behavioural changes of this type are free or profitable for both the individual and society, but encouraging such behavioural change through policy instruments can be challenging.

Knowledge about what influences climate-friendly behaviour is constantly increasing and different fields have made different contributions. Psychologists, economists, sociologists and other disciplines study different aspects of what causes both individuals and organisations to make decisions and act in different ways. Research shows that a given action requires motivation, ability and awareness in the decision-making situation (Samson, 2023). It is important that the Government bases policy on such knowledge.

Individuals and organisations must be motivated for the transition, they must have knowledge and expertise, and steps must have been taken to facilitate change. Different disciplines often provide different answers to what motivates action. Economists are particularly concerned that economic incentives should facilitate the right choices, while other disciplines emphasise other aspects of motivation. Psychologists and other disciplines often distinguish between external and intrinsic motivation, and research shows, for example, that economic incentives can reduce intrinsic motivation (Rode et al., 2015). There are many potential explanations as to

See the Committee's assessments relating to a nature tax in Chapter 6.

why this happens, including that putting a price on something releases the individual of their moral responsibility to do something, reduces the satisfaction of doing something morally right, and changes the individual's choice from a moral or social mindset to an economic mindset. This is relevant for assessing the use of economic instruments in general, cf. for example the Committee's discussion of a nature tax in Chapter 6. Taxes can strengthen external motivation, but also weaken intrinsic motivation, and it is especially important to be aware of this in cases where intrinsic motivation for climate-friendly behaviour is strong.

One challenge in politics is that it is easier to design policy instruments for external motivation than for intrinsic motivation. At the same time, the transition relies on behavioural changes that require intrinsic motivation in a large part of the population. Research shows that many factors influence intrinsic motivation, and politics can facilitate motivation in the desired direction.

Social norms and the perceived meaning of an action can strengthen intrinsic motivation. The specific actions that contribute to the transition can increase people's level of engagement (Jones et al., 2017). Psychological research shows that political messages presenting challenges in a realistic way combined with concrete options have a mobilising effect. Messages that harmonise with already established norms and refer to how climate change is already well under way have the same type of effect. It is also relevant who is saying it, not just what is being said. People tend to accept more difficult messages from people they feel a sense of group identity with (Hornsey & Fielding, 2020). The degree of perceived community may be greater at the local level. The municipalities' commitment to the transition therefore has great potential. Clearer communication about the scope and necessity of the climate transition, particularly from the top political level, will also help mobilise the private sector.

See discussion of changes in norms and preferences in chapters 7 and 11.

Social norms and preferences can be changed without changing the policy instruments. Norms and preferences are constantly changing. The effect on emissions of behavioural changes due to changes in social norms and preferences, regardless of economic incentives, should not be underestimated. Attitudes toward both diet and second-hand clothing have changed, partly based on increased environmental awareness (see chapters 6 and 10). Policy instruments can also support and accelerate ongoing norm changes in the desired direction. The introduction of the smoking ban, which changed attitudes and norms relating to smoking, is an example (Nyborg & Rege, 2002). Information can be an important instrument, but at the same time it is crucial *how* the information is provided. For example, it has been shown that pre-selected options in a form greatly influence what people choose, for instance when it comes to savings and organ donation (Thaler & Sunstein, 2009). Information that compares what *you* do with what your neighbours or others are doing is also very effective (Allcott, 2011), and has been used, for example, to reduce power consumption. Preferences can also change over time, for example before and after a measure has been implemented, and are influenced by existing and changed norms.

Some may go from preferring petrol cars and meat to preferring the alternatives after having tried them. Preferences can also be influenced by policy instruments (Nyborg & Rege, 2003).

As regards behavioural changes, it is crucial to adapt the use of policy instruments to the prevalence of the behaviour. It is possible to consider sequencing for the introduction of policy instruments aimed at behavioural change. Research into technology adoption among consumers has been ongoing for a long time, and it is common to divide the phases from early innovators to early adopters, early majority, late majority and laggards. This could, for instance, be applied to the promotion of a more plant-based diet: Early adopters need information and better access to relevant products, but can accept that eating plant-based food is more demanding and more expensive, while later adopters need the plant-based options to be very easily available and not too expensive in order to change their diet (Gonera et al., 2021). Another important aspect of behavioural changes is how society's norms, expressed, for example, through regulations, such as the prohibition of certain polluting technologies, also influence what is perceived as socially acceptable. In a report, the UK Climate Change Committee has assessed how behavioural science can be used to achieve effective climate policy in a number of specific areas such as diet, reduced consumption, aviation demand, net zero skills, business transition to sustainability, land use and farming, and policy acceptability (Climate Change Committee, 2023).

Popular movements can be a source of innovation that have great social significance. In the post-war period, major social and technological innovations were carried out in Norway and other countries that had a big impact on social development. Some changes were gradual, such as the construction of the welfare state, while others were relatively rapid, for example the introduction of birth control pills. The post-war period also showed how important civil society can be in cultivating social innovation. The introduction of child care was based on experiments driven by civil society through an international kindergarten movement. Popular mobilisation for climate policy can result in the emergence of new solutions. A strong civil society can therefore provide a good basis for social innovation.

15.6 The EU ETS alone does not provide sufficient incentives

Norwegian companies are part of the EU ETS on an equal footing with companies in the EU member states. Norway has about 150 companies covered by the EU ETS that, through their obligation to surrender allowances, have an incentive to reduce emissions.

The EU ETS should continue to be one of the main instruments for reducing emissions. In theory, an emission trading scheme ensures that all measures that have lower costs than the allowance price are implemented. In such a system, the emission targets will be achieved, while the uncertainty lies in the price and extent to which it will contribute to long-term change and technology development. Companies that expect a high allowance price in the future will have incentives to adopt technology today that will make them better equipped to meet high prices. However, this assumes that they think long-term and believe that the price will rise to a level where taking action today will pay off in the longer term. From 2008 to the present, the Norwegian industrial sector has only reduced its emissions to a limited extent. Decarbonisation of the European energy sector has led to low allowance prices, and the EU ETS has made little contribution to the transition in Norway.

Decarbonisation: that activities that currently involve CO_2 emissions are changed so that the activity becomes zero emission, for example switching from cars that run on petrol/diesel to electric cars.

Low allowance prices in the short term must not result in an abrupt, expensive national transition. In the period leading up to 2050, the volume of allowances in the EU ETS will be significantly reduced. With the planned reduction in volume, no more allowances will be made available to companies from around 2040. If Norway waits to cut emissions covered by the EU ETS until the cuts are cost-effective in a European context, we may risk having to make much of the cuts close to 2050, which can lead to high transition costs over a short period. This can be a good reason for further use of policy instruments aimed at emissions covered by the EU ETS, so that the transition is intensified already now. The Committee believes EU policy should be regarded as a floor rather than a ceiling where possible. A national emission reduction target will signal that companies subject to emissions trading must also reduce emissions from their own activities in Norway.

Box 15.1 EU ETS

The emission trading system EU ETS was introduced in 2005 for certain activities in industrial enterprises. Since 2005, the system has been expanded to include more activities and greenhouse gases, and the emissions cap, i.e. the number of allowances issued (made available) each year, has been gradually reduced. Norway has been an integral part of the system since 2008. With the EU's Fit-for-55 package, the cap was further reduced; see Figure 15.4. The figure also illustrates that actual emissions have been lower than the cap. Since the allowances can be saved and used later, a large surplus of allowances has accumulated. This, in turn, has led to various measures to reduce the allowance volume, including faster de-escalation, one-off cancellation and the introduction of the market stabilisation reserve (MSR). The MSR means that a surplus of allowances above a certain threshold are cancelled. If the de-escalation introduced with Fit-for-55 is continued after 2030, the emissions cap will be zero in 2040. At the same time, as the figure illustrates, there is a significant number of allowances available. The European Commission will also propose regulations that could include emissions removed from the atmosphere, for example through the capture and storage of biogenic CO_2 and direct air capture and storage of CO_2. This means that, even if no new allowances are issued after 2040, there will still be some available. The figure also shows the development in the price of allowances, which has increased sharply since 2018.

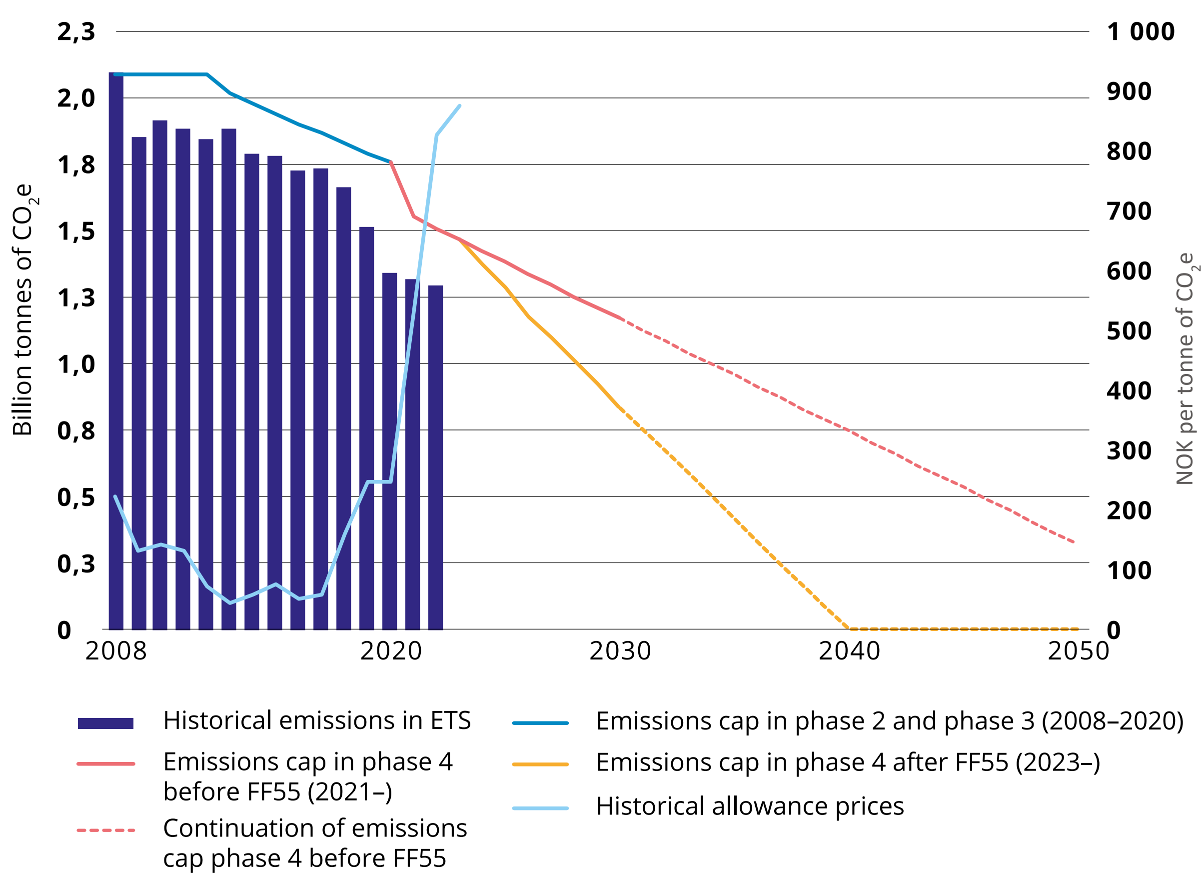


Figure 15.5 Development in the number and price of allowances.
The figure shows historical emissions and caps, and developments in the cap going forward (for the EU ETS excluding aviation and shipping), as well as price developments. It also shows the tightening of the cap with the adoption of the Fit-for-55 package. A continuation of the agreed reduction in the emissions cap after 2030 is indicated by the dotted line.

Source: Norwegian Environment Agency

Several measures have been introduced to ensure the competitiveness of European industry, with a view to avoiding carbon leakage. With overcapacity in Asia and increasing political regionalisation, attention to carbon leakage is high. Measures that have been initiated among the EU member states to reduce the risk of carbon leakage include free allowances, the CO_2 price compensation scheme and the CBAM. With the introduction of the Net-Zero Industry Act, the EU seeks to contribute to faster permit processes, facilitate more investments and enhance skills (Directorate-General for Internal Market, 2023). The Critical Raw Materials Act highlights the EU's dependence on imported materials (Directorate-General for Internal Market Industry Entrepreneurship and SMEs, 2023). In the EU, where steel production is important, dedicated strategies have also been developed for reducing GHGs in combination with maintaining competitiveness (European Commission, 2021)

Norwegian companies have been allocated a large proportion of free allowances. Many companies in the EU ETS have not had to buy allowances because they have been allocated more than enough free of charge. Norwegian industry has received a relatively large share of free allowances because much of our industry is considered to be exposed to carbon leakage and because Norway has a small proportion of fossil power production. In addition to the fact that a large share of the allowances have been allocated to the companies free of charge, it became possible in 2013 for countries to introduce CO_2 price compensation.

The CO_2 price compensation scheme is intended to compensate power-intensive sectors for high energy prices as a result of allowance costs for power producers. During the 2013–2020 allowance period, Norway was one of the few countries that introduced such a scheme. The Norwegian CO_2 price compensation scheme does not utilise the full scope of action provided by the EU guidelines. Most major industrialised countries in the EU have introduced a CO_2 price compensation scheme. Some have chosen to make it a condition that all recipients use part of the support received for emission reduction measures. The Committee believes that a similar requirement should be introduced in Norway. The EU has decided that the arrangements to counteract carbon leakage over time will be replaced by other mechanisms such as the CBAM.

15.7 Access to free allowances can displace emission cuts

Although the emissions included in the EU ETS cover about half of Norway's territorial emissions, only a few Norwegian companies are obliged to surrender allowances. There are over half a million companies in Norway, and only about 150 of these are covered by the EU ETS. This means that, for the majority of Norwegian companies, the transition to a low-emission society must rely on other policy instruments.

GHG emissions from Norwegian companies are linked to emissions both in Norway and in other countries. Many of the companies have low national emissions. The emissions are primarily from transport, and some from industry and energy production. For many companies, most of the emissions occur in other countries, because neither the production of goods that the companies sell nor the extraction of raw materials used in the manufacturing process take place in Norway.

The fact that emissions associated with Norwegian companies often occur in other countries suggests that other policies are needed to target these emissions. This requires knowledge of the circumstances in other countries, and dialogue both with other governments and stakeholders in the value chains. In recent years, there has been a development, particularly driven by the EU and, to some extent, the USA, attempting to deal with non-domestic emissions relating to their own economy. The EU Regulation on deforestation-free value chains is an example of this.

An increasing number of companies have in recent years set climate neutrality goals for themselves, in which purchases in the voluntary carbon market are a key part of the strategy. Private companies play an important role in the transition to a low-emission society. More and more companies want to contribute, and have therefore adopted climate targets that they plan to achieve. Private companies setting ambitious climate goals and working to achieve them is an important contribution to achieving the Paris Agreement's temperature targets and can help stimulate the transition. However, a company's climate goals will not necessarily be achieved by cutting emissions from their own organisation or production line. More than half of the Norwegian companies that have set such targets use carbon credits in the voluntary market and a further 16 per cent say they will do so in the future (PwC & Zero, 2022 p. 15).

The fact that companies adopt goals to reduce their emissions through the use of carbon credits from the voluntary market is problematic in several respects. The effect of these credits on emissions is often varied and uncertain. For some measures, such as afforestation, there can be a big difference between the assessment of the effect and the feasibility of an individual measure, and a corresponding assessment of the sum of all such planned measures if many companies implement them at the same time. Zero and PWC have described major challenges associated with carbon credits in the voluntary market, and that it is demanding for companies to assess the effect on emissions of the credits they buy. In the low-emission society, there is only room for a minimum of emissions.

The Committee believes companies' attention must be directed towards cutting emissions from their own activities, and not to the use of carbon credits to compensate for emissions. Norges Bank signals the same priority in its views on companies' voluntary use of carbon credits (Ihenacho & Verpe, 2023). Resources spent on purchasing credits can displace a company's efforts to cut its own direct and indirect emissions. The use of carbon credits with an uncertain climate benefit may also be in conflict with good marketing practice and constitute greenwashing.

The authorities should not, through their policies, encourage companies to use the voluntary carbon market to achieve their climate goals. Dialogue with private companies on emission reductions should concern efforts to reduce the companies' own emissions. This applies to dialogue in both industrial policy and other relevant policy areas such as foreign policy and development policy. To the extent that the voluntary market is to be used, requirements should be imposed on companies' use of such carbon credits. A key element should be prioritisation of companies' efforts to reduce their own emissions, both from core activities and in the value chain. The purchase of carbon credits in the voluntary market must come in addition to this work. It is also important to ensure transparency about how companies achieve their climate goals. This is also in line with Norges Bank's view (Ihenacho & Verpe, 2023). The report from Zero and PWC proposes a traffic light system that can be considered (PwC, 2022). Finland has also recently produced a guide for the use of carbon credits in the voluntary market (Ministry of Agriculture and Forestry & Ministry of the Environment, 2023).

15.8 Other policy instruments are required

When carbon pricing alone is not effective or sufficient, other policy instruments must be used. Other effective instruments in climate policy can be legal instruments such as requirements, bans and obligations; financial support for, e.g., technology, infrastructure and skills development; educational instruments such as labelling schemes, knowledge and information; and, finally, various requirements and rules for official decisions, for example with regard to public procurement and public infrastructure investments. GHG emissions are affected by policies in many areas aside from climate policy, such as energy, transport, taxation and public procurement. To become a low-emission society, it is therefore a prerequisite that instruments in other policy areas also support the climate goals.

For emissions to be removed for good, there are convincing reasons to consider policy instruments other than just pricing. A tax does not necessarily ensure zero emissions, and an emissions trading system without carbon credits is meaningless. Where good alternatives without emissions are deemed to exist, it may be more appropriate to ban the emissions than to impose a tax or introduce an emissions trading system where there are no carbon credits to trade. In such cases, a ban will give a clearer political signal and may also have greater public legitimacy by imposing the same requirements for transition on all stakeholders. Examples are the ban on the use of mineral oil for heating, which was announced well in advance, and the ban on the disposal of biodegradable waste. It has also proved easier to remove or reduce a tax than to remove regulations once they have been introduced. This may be due to stakeholders with political influence having adapted to official requirements and making investments, thereby giving them an interest in the requirements being upheld.

Legal instruments such as requirements, obligations and bans are key to the transition to a low-emission society, but should be used in a way that is predictable for stakeholders. The Committee believes such instruments must be used to a greater extent than has been done so far. Bans that involve investments in new technology should be announced well before they are introduced to allow stakeholders to prepare. The Climate Cure 2030 report outlined various possible bans on fossil energy use in industry, district heating and buildings. Some of these proposals have since been subject to an impact assessment, but have not yet been adopted. In contrast, the ban on the use of mineral oil for heating buildings introduced in 2020 was adopted by the Storting through the 2012 Climate Agreement, while the official studies and impact assessments were carried out afterwards, including an assessment of necessary exceptions.

Thorough assessments of the consequences of intervening measures such as bans are important, but for the stakeholders, the predictability of early warning has clear benefits. Prior to the mineral oil ban, targeted support for phasing out was provided through Enova, and the Norwegian Environment Agency contributed to the dissemination of information. Emissions from heating have been reduced by 80 per cent since 1990, partly due to the ban and more stringent energy requirements, and emission reductions started long before the ban entered into force in 2020.

At the same time, advance notification of some types of bans may provide unfortunate incentives for adaptation. As the Norwegian Environment Agency states, requirements must be used with care (Norwegian Environment Agency, 2023c). Requirements and bans entail forcing new technology and solutions into use despite additional costs or other factors that prevent widespread use. Requirements or bans are therefore best suited for rolling out relatively mature technologies and solutions, or in segments where stakeholders can bear the additional cost of technology development. The timing of new requirements and bans should be adapted to expectations in technology development. The advantage of such regulations is that they ensure emission reductions and provide predictability for manufacturers of green technology. Requirements that do not concern new technology must also be carefully considered. Advance notification of the ban on cultivation of peatland may have led to more peatland being cultivated prior to the ban.

Legal instruments are often effective, in particular the use of bans and obligations. They are clearly defined and entail low administrative costs for the authorities. At the same time, legal instruments may be less cost-effective if they provide little room for manoeuvre for the individual actor to find good solutions or prevent the development of technology-neutral solutions to climate challenges (IPCC, 2022b, Chapter 13). There may also be a difference between what is cost-effective for the individual actor and for society as a whole. Legal instruments can also be effective in stimulating innovation and technology development and the deployment of low-emission technology.

The Pollution Control Act is an example of legislation that should be used more actively in the transition to a low-emission society. The Act has been applied to the climate change field to a limited extent, even though it covers GHG emissions. The main reason is that several types of emissions are wholly or partly exempt from the Act, and the Act is limited to directly regulating GHG emissions covered by the EU ETS. At the same time, the Act provides for the possibility of imposing technology requirements and conditions in permits that all polluting companies are required to have, also for emissions covered by the EU ETS. A possible requirement may be to introduce zero-emission technology within a certain time, allowing sufficient time to develop zero-emission alternatives, while also providing an incentive to develop and introduce them. The Pollution Control Act may also provide legal authority for bans as described above, such as bans on using or converting fossil energy for a certain purpose.

The use of procedural requirements may also be of great importance. Laws and regulations can be used to introduce requirements for how a process is conducted or that certain assessments must have been carried out before a decision can be made. Requirements for assessing climate impact or emphasising climate considerations are examples of procedural requirements that should be used to a greater extent in the transition to a low-emission society. Statutory requirements for assessing and taking into account climate change in decision-making processes are also important, and should be a key policy instrument. Climate legislation is often used to impose statutory requirements for how the Government should pursue climate policy development. Part D elaborates on the possibility of introducing such requirements in various legislation.

Support for emission reduction measures can be effective in terms of both results and costs. There are many different types of subsidies in climate policy, such as support for R&D in emission reduction technology, favouring zero-emission vehicles in the tax system, subsidies for energy efficiency measures in buildings, or support for the demonstration and testing of CCS solutions. Subsidies for emission reduction technology can potentially be cost-effective, depending on granting support to the right projects and having an appropriate system design; see also Chapter 10. Ensuring that the Government, rather than companies, possesses sufficient knowledge to be able to assess different technologies against each other can also be demanding in terms of resources. The ripple effects of innovation, where one innovation creates the basis for new innovations and new business development, can further increase the socio-economic benefits of such support. At the same time, there is a significant risk that selective support for individual projects will be unsuccessful, because it is difficult for the authorities to 'pick winning technologies'. Broader general support schemes with a high degree of competition may therefore be a better option, and it is often appropriate to design schemes that are technology-neutral. This can be done, for example, by ensuring support for projects that result in zero-emission solutions, without specifying how this should be done.

See discussion of public funding for technology development in Chapter 10.

Zero-emission solutions: solutions that generate no direct greenhouse gas and exhaust emissions during use. This means, for example, the use of an electric motor in combination with a battery, or direct use of electricity or a fuel cell that utilises a carbon-free energy carrier such as hydrogen.

A framework can be adopted that influences official decisions in the right direction, such as rules that the environment must be given emphasis in public procurement. The public sector procures goods and services for around NOK 740 billion per year. Requiring all these procurements to be in line with the transition to a low-emission society could provide important support in the transition and raise the level of awareness and expertise among both public authorities and the companies that deliver the goods and services. From 1 January 2024, a requirement will apply whereby climate and environmental criteria must, as a rule, be emphasised with a minimum of 30 per cent in public procurement. A legislative committee has also been established to promote proposals for how environmental sustainability, social sustainability and increased innovation in public procurement can contribute to the green transition. This committee will present its report in November 2023. The Climate Change Committee believes that more stringent regulatory requirements for emphasising environmental criteria are a good example of how legal instruments can be used to accelerate and steer the transition in the right direction.

Educational measures such as awareness campaigns and labelling schemes can be effective, especially in combination with other measures. Informative instruments can make it easier for consumers to make climate-friendly choices. Labelling of CO_2 emissions or energy labelling of various goods and services can be useful (Carlsson et al., 2021). The impact of large and broad awareness campaigns has typically been small or difficult to measure. At the same time, some campaigns have had a major impact, such as the civil society campaign to limit the use of palm oil in food. Energy guidance aimed at companies has proven to have a positive effect in several countries. In addition to contributing to emission cuts, awareness campaigns can be useful for creating a broader understanding in society that personal choices play a role on the path to a low-emission society. The cost of such measures is variable (from cheap social media campaigns to expensive consultancy-based services), they are often popular and, as a rule, are not associated with problematic distributional effects. Educational measures can have a particularly big impact if they are used to support economic instruments (Gravert & Shreedhar, 2022).

In the transition, it will be necessary to establish new norms or support existing norms in society. Here, legal instruments such as standards, bans and obligations can signal what is socially acceptable and not acceptable, and help influence norms in the desired direction. Educational measures and official decisions and investments can also contribute to influencing norms in the desired direction.

15.9 Combinations of policy instruments and changes in the use of instruments over time

There can be good reasons to combine different policy instruments both in packages and through changes in the use of instruments over time. The climate challenge, as well as the consequences of climate solutions, affect all areas of society. Policies in most fields affect structures that lead to GHG emissions. At the same time, society influences what kind of climate solutions are considered good and desirable. Many different externalities at once and other important societal goals suggest using a combination of policy instruments. As technology and market solutions mature and preferences change, it is also important that the use of policy instruments is adapted to developments.

Packages of policy instruments can be an important strategy to address the complexity of tackling the climate problem. Given major coordination problems across sectors and actors, policy instruments must to a greater extent be seen in context. The EU and other major players have increasingly moved in the direction of policy packages and defined social missions. Most countries' climate policies consist of an extensive portfolio of different policy instruments. In addition to the choice of instruments included in the portfolio, a crucial question is how these should change over time to achieve set goals.

Policy packages are necessary to bring about necessary structural changes in key systems in society. A comprehensive systemic change towards a low-emission society, where many different elements need to be changed simultaneously, must necessarily be based on a broad range of policy instruments, since each element of the change has different properties. The IPCC points out that emission reductions are not just about dealing with market failures, but that structural changes are necessary for the transition, including infrastructure (for example, that the power system must handle a large share of variable production). Explicit systemic changes are also required, including coordination of stakeholders across different fields, such as climate policy and industrial policy, and across governance levels. One instrument, such as carbon pricing, can work well if zero-emission technology is to replace existing technology in an unchanged system, such as switching from fossil oil to bio-oil in the same boiler. However, if an entire system is to be changed in fundamental ways, for example conversion from a system based on private cars to mobility services, policy packages can be crucial. In parallel, society must develop and adopt new technologies, change behaviour, apply new business models, and reduce resource and land use. By combining policy instruments, we can achieve synergies and manage conflicts of objectives, increase acceptance of the policy and overall achieve effective low-emission strategies that at the same time take into account cost-effectiveness, distributional effects and are politically feasible (Bouma et al., 2019; Givoni et al., 2013).

Barriers other than cost also prevent new technology from being taken into use. Barriers such as a lack of knowledge, resistance to change, social norms and accessibility also prevent the rapid spread of new zero-emission solutions. Most of the measures explored by the Norwegian Environment Agency face more than one barrier (2023c). Figure 15.5 illustrates barriers faced by operators considering CCS in waste incineration plants. Another example is the barriers faced when considering buying an electric lorry, such as a lack of knowledge, immature and expensive technology and a lack of charging infrastructure. The Agency points out that, because most climate mitigation measures are faced with several barriers, one policy instrument alone will rarely be sufficient.

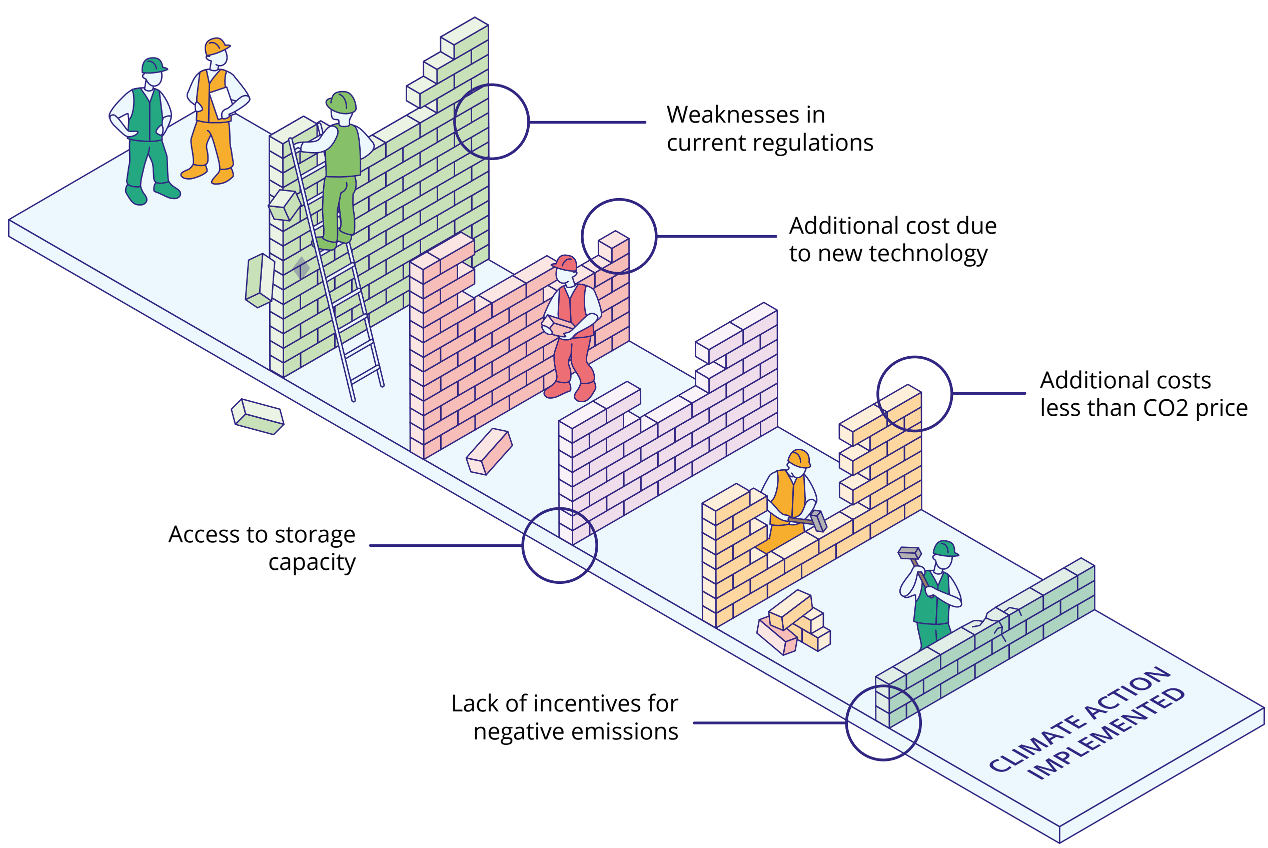


Figure 15.6 **Barriers faced when considering CCS in waste incineration. Illustration.**

Source: Norwegian Environment Agency, adapted by the 2050 Climate Change Committee

It is crucial that policy instruments are quickly deployed in areas where the transition takes a long time, or is demanding, for example due to path dependency or network effects. This includes instruments for the development of green technology, efficient land use, agriculture, the development of infrastructure necessary to break out of path dependency (such as the development of charging stations, value chains for new fuels and CO_2 transport and storage infrastructure), in addition to the development of necessary knowledge; see Box 3.3 on path dependency. This must be addressed through measures that complement carbon pricing (such as technology development subsidies, building regulations and public infrastructure investments).

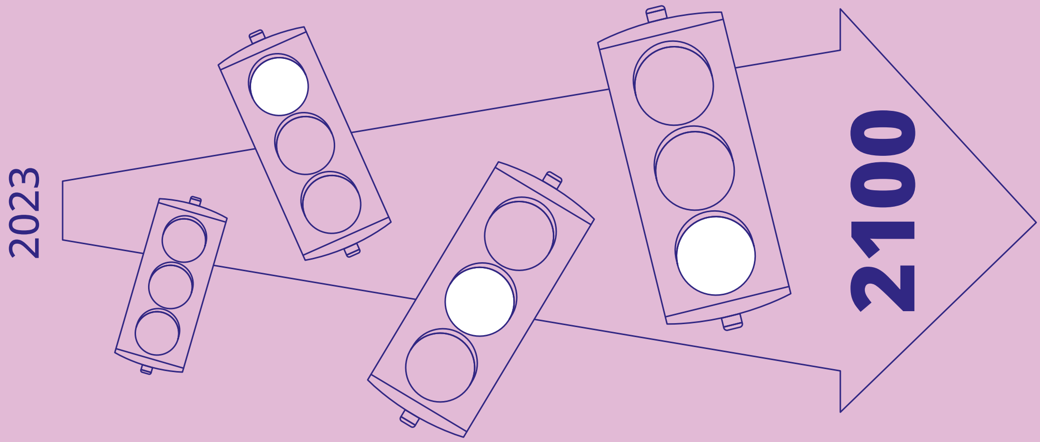
Eliminating virtually all emissions quickly through the phasing-in of a wide range of new technologies requires strong policy instruments in several areas. In most segments of land-based transport, zero-emission solutions are already available, or are expected to be soon, which means rapid phasing-in should be emphasised. Rapid phase-in of new technologies relies on the necessary infrastructure and systems being in place, in addition to financial incentives. This means emphasising physical facilitation through, for example, charging infrastructure in addition to financial incentives for private individuals or actors.

The stringency of the policy must be as predictable as possible for those affected by it, while being adaptable over time. The Storting has endorsed an increase of the carbon tax to NOK 2,000 by 2030. This has provided more financial predictability for stakeholders and a better basis for making good investment decisions. Similarly, the European Commission has given clear signals about the long-term development of the EU ETS in terms of the emissions cap and which emissions are covered. Many corporate decisions have long time horizons, so signals should be given about planned policy development beyond the next ten years. At the same time, there is uncertainty associated with knowledge about climate change, technology development, costs and social development, which make it difficult to determine the tax or emissions cap far into the future. This means that predictability must also be combined with transparency and clear communication about what the goal is and where overall emissions should end.

Policy instruments should be coordinated in a way that leads to adequate emission cuts, achieves synergies, manages conflicts of objectives, and is politically feasible. At the same time, it is important to prevent instruments from being combined in ways that undermine other considerations. Some research has been done on effective combinations of policy instruments, and also on what works less well. In general, taxes work far better in interaction with other instruments than an emission trading system does. From an economic perspective, the most effective policy packages consist of a combination of carbon pricing and support for the development of new technologies that the carbon price is not sufficient to trigger. Another perspective on the issue is that it is about 'pushing' and 'pulling'. Measures to push society away from the old solutions also include removing subsidies that preserve existing solutions and strategies to shift funding, resources and expertise from old to new industries. By combining policy instruments that push and pull, the overall use of instruments can also be more easily accepted (Bergquist et al., 2020).

There is no one answer to which combinations of policy instruments will most effectively contribute to the transition in Norway while at the same time safeguarding other considerations. It is therefore crucial to incorporate opportunities for systematic learning. There is plenty of experience of successful emission cuts to build on from different sectors and other countries, but no experience of the use of policy instruments that have made an entire country emission-free. Governments will make mistakes, and the use of policy instruments will need to be adjusted along the way. A key element in a knowledge-building strategy is systematic testing followed by evaluation. Today, greater resources are often devoted to assessing instruments before they are introduced. Opportunities for learning, and evaluation milestones, should be incorporated as part of the policy system. Experimentation and learning can be better facilitated, for example by introducing instruments gradually or in different areas or for different user groups at different times.

16 The Committee's recommendations for Part C



Climate policy must be based on emissions in 2050, and the transition to a low-emission society must start now. To reduce the uncertainty under which companies, households and public authorities must make decisions, it is important that the policy presented is credible and incorporates a long-term perspective.

Carbon pricing is the bedrock of climate policy, but it is not sufficient on its own to bring about the required transformation or to take sufficient account of scarce resources. It is crucial that policy instruments are quickly deployed in areas where the transition takes a long time, or is demanding, for example due to path dependency or network effects.

Many choices are given when the goal is to become a low-emission society. A key remaining policy choice in Norway's transition to a low-emission society is developing further transition policies for the petroleum and agricultural sectors. For Norway to achieve the goal of becoming a low-emission society, it is necessary to further develop policy beyond the current ambitions. Without this, Norway will not achieve its climate targets. The Committee encourages political parties and other sections of society to clarify their visions for societal development within the framework of the low-emission society. The Committee therefore has the following recommendations:

- base the transition to a low-emission society on eliminating or substantially reducing existing emissions through reduced activity levels, changed behaviour and the use of zero-emission technology.

- start the transition to a low-emission society now, and avoid relying on strategies such as emissions trading or uncertain new technologies instead of reducing emissions in Norway.

- gear the transition to limit the use of resources and facilitate a more circular economy.

- further develop a transition policy for the petroleum and agricultural sectors beyond the current level of ambition. Without this, Norway will not achieve its 2050 climate targets.

- ensure that Norway continues its climate cooperation with the EU and implements the EU's climate regulations leading up to 2050, and that efforts are made to obtain a political majority for this.

- ensure that decision-makers at all levels use the 'checklist for the low-emission society' as a starting point for assessing the extent to which a decision contributes to facilitating or hindering the transition, and that the principles are also used to assess the design of policy instruments:
  - Predictability and effectiveness
  - Cost-effectiveness
  - Long-term perspective
  - Resource and land use efficiency
  - National policy for global goals
  - Considering fairness without weakening the transition
  - Governing by where we want to go

- ensure that carbon taxes constitute the bedrock of climate policy in that:
  - efforts are continuously made to expand the scope of carbon taxes and to increase the price of low-priced emissions.
  - efforts are made to achieve a cross-party binding plan for a gradual increase of the carbon tax, also after 2030, that is in line with national climate targets.
  - equivalent price incentives are introduced for environmentally sound removal of atmospheric CO_2 as for emissions.
  - subsidies that are detrimental to nature or the climate are identified and removed.
  - undesirable distributional effects are managed through the tax system and welfare schemes.

- use other policy instruments when carbon pricing is not sufficient, possible or effective, such as regulatory and educational instruments Including to:
  - policy instrument packages are necessary to deal with the complexity of the climate problem and to bring about the necessary structural changes in key societal systems.
  - assess whether policy instruments other than pricing are more effective and provide more favourable distributional effects, such as legal and educational instruments and the use of public procurement.
  - legal instruments such as requirements, obligations and bans, and procedural requirements for assessing climate impacts or emphasising climate considerations, are often effective and should be used to a greater extent (see also proposals in parts C and D).
  - funding for emission reduction measures can be both effective and cost-efficient for the purpose of technology development and for creating acceptance and support for the climate transition.
  - to influence behaviour, norms and preferences in the direction of the low-emission society, legal instruments such as standards, bans and obligations, and other instruments such as educational and public decisions and investments, can be effective and should always be considered.
  - consider using revenues from emissions trading and funds allocated to the CO_2 price compensation scheme towards net-zero transitions in companies covered by the EU ETS.

- companies' attention must be directed towards cutting emissions from their own activities, and not to the use of carbon credits to compensate for their emissions. To the extent that companies are to use voluntary emission credits, environmental integrity requirements should be imposed on the use of such credits from the voluntary market to prevent greenwashing.

There is no one answer to which combinations of policy instruments will most effectively contribute to the transition in Norway while at the same time safeguarding other considerations. Knowledge of effective instruments is important, and the Committee therefore has the following recommendations:

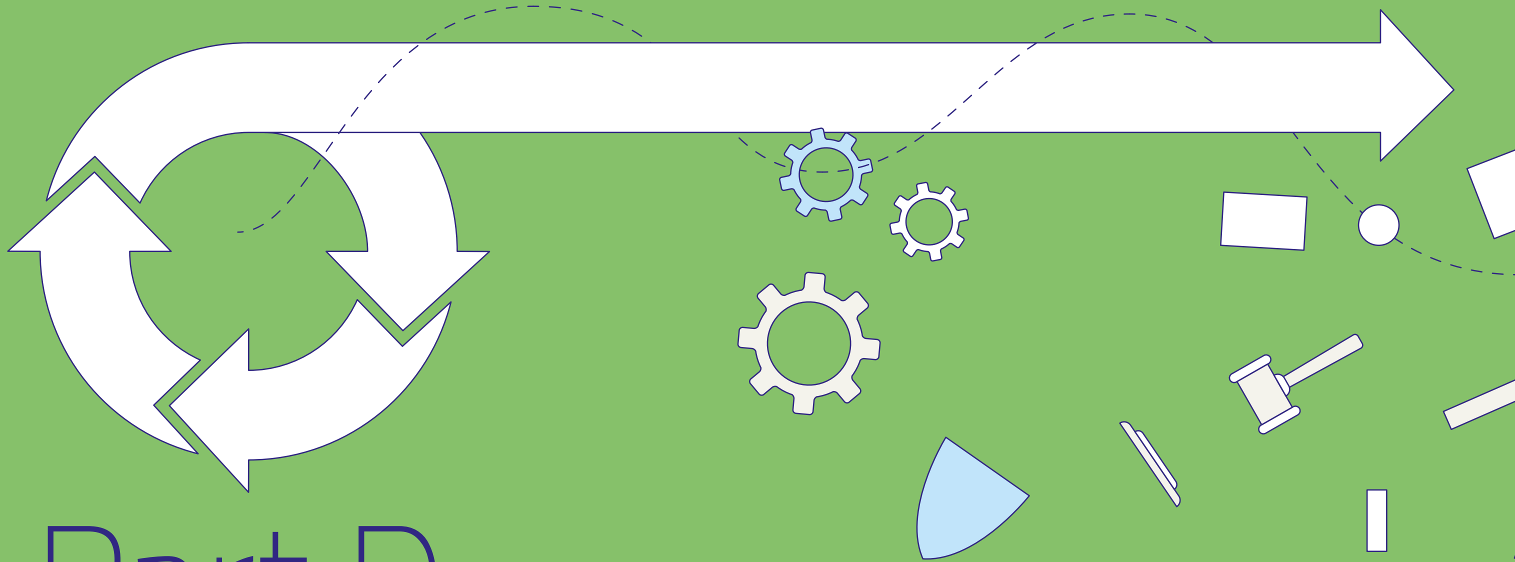
- incorporate opportunities for systematic learning.
- develop policies to influence the behaviours and decisions of individuals and organisations based on up-to-date knowledge.

For the future

27 years in the future
What will I be doing?
I'll be 42 years old, have probably had a lot of fun
Fingers crossed anyway or it will just be sad
I don't often think that far into the future
Often I just think about what I'm going to put on the next day
Sometimes I dream about what it will be like to be an adult
That sometimes gets a bit weird
I look forward to the normal and perhaps boring things that for me now sound almost glamorous
Studying
Getting a job
Voting in an election
Spending my own money
Laughing at adult jokes, that us children are not meant to understand
Doing whatever I want
You know, really adult stuff
But sometimes I think about something that makes me really worried
After 27 years, what will the world be like?
Because now we get to what many people take for granted
Something we humans have taken and used for our own purposes
And returned damaged and irreversible
Our little planet
It's starting to wither
Because of something we can prevent
It will get worse and worse,
until it can't be stopped
Are we really going to pass all this on to the coming generations?
That children and adults will suffer because of their ancestors' mistakes?

I would like future generations of children not to have to think about whether they can go to school because there has been a natural disaster and the road is too dangerous
Or about where they will live after their house has been ripped away by some kind of extreme weather
Small changes that may feel unimportant to the individual but that mean a lot when everyone is on board
Our strongest asset is cooperation
Let's use it before it's too late
I want children to grow up in a world where people and nature co-exist in harmony
In a world where children smile to mother earth and she smiles back.

That's what I want for the future.



Part D
Organisation for climate transition

This part of the report considers the organisation of Norwegian society in the transition towards low emissions, given a limited emissions budget, scarce resources and undesirable path dependency. The Committee describes how effective planning, implementation and evaluation of climate policy can be facilitated.

17 An overarching climate governance system

In this chapter, the Committee explains why there is a need for a strengthened governance system in Norway. The chapter also looks at other countries' governance systems.

17.1 A system for pursuing a longer-term, broader and more comprehensive approach

Norway needs a stronger framework and a system that helps us pursue a longer term, broader and more comprehensive approach to the transition to a low-emission society. In the Committee's opinion, we need a new systematic approach to how climate and nature considerations are safeguarded. The climate transition must be organised based on the premise that in 2050, there will be a very limited emissions budget and scarce resources, and that undesirable path dependency must be avoided (see Box 3.3. on path dependency).

The transition to a low-emission society must be the premise underlying all decisions that have a bearing on the transition. In sum, a number of political and administrative decisions are implemented at all levels of the public administration that will affect the transition to a low-emission society. Many decisions are made on a daily basis that have an impact on the scope and focus of economic activity, and thus greenhouse gas emissions and loss of nature. Central and local authorities set the framework for decisions on consumption and investments in households and businesses, and make decisions on public investments and operations.

The Committee believes that an enhanced climate governance system should quickly be established in order to transition Norway to a virtually emission-free society by 2050. A climate transition system should consist of three main pillars:

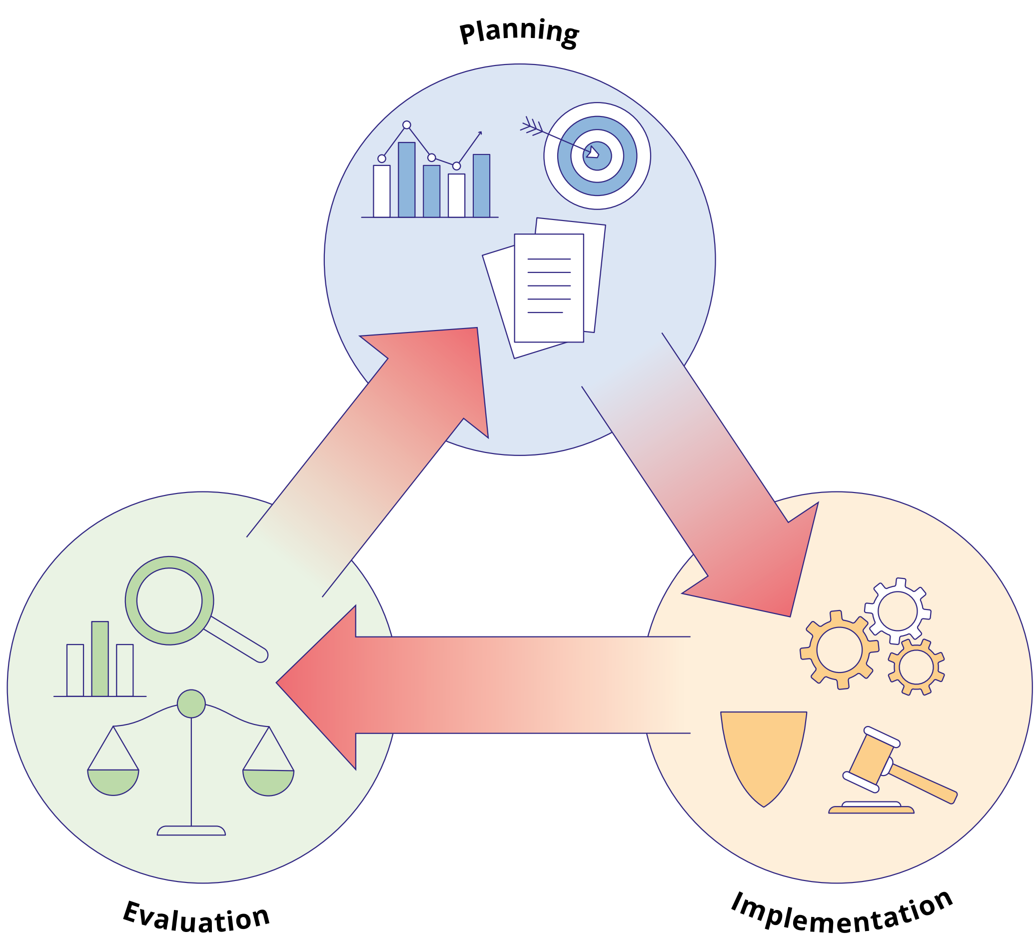
- *Planning:* Plans must be in place in order for the goals to be achieved. All planning must be based on the premise that Norway will be a low-emission society with virtually no emissions by 2050, that resources are scarce and that undesirable path dependency is avoided. Climate policy must be integrated across and within all levels of the public administration and society in general.
- *Implementation:* Good organisation, coordination, knowledge and skills are important for rapid and effective policy implementation.
- *Evaluation:* Efforts and progress must be evaluated along the way. The course must be adjusted when progress is not sufficient or circumstances change. Transparent, accountable reporting is an essential tool. It also enables the population to follow developments and hold politicians accountable in elections.

A climate governance system must ensure a sufficient pace and be flexible enough to accommodate changes along the way. The main pillars of the Committee's proposal are dynamic and provide for smooth transitions and overlaps between the different pillars. Figure 17.1 illustrates that the different elements will build on each other and be repeated over time. Planning must lead to implementation, and evaluation will contribute to changes in planning as necessary.

A more systematic approach to the climate transition will require resources and entail some costs, but can also increase efficiency and reduce other costs. A stronger governance system must not contribute to making processes more cumbersome and complicated, but ensure a more efficient and predictable transition for everyone. More interaction between different policy areas can contribute to more coherent policies. A more systematic approach and greater transparency can make it easier to hold politicians accountable. This can help strengthen the legitimacy of decisions and reduce the likelihood of policy backlash disrupting the continuity of policy development. A more predictable transition process can reduce the risk of misinvestment in both the public and private sectors. It is important to carefully consider whether a challenge can be solved within the existing institutional and regulatory framework. In many areas, there is no need for major changes to the system that has already been established. New institutions, laws and regulations always come at a cost.

Figure 17.1 **An overarching climate governance system.** The figure shows the three main pillars the Committee believes an overall climate governance system should comprise. The process is conducted on a rolling basis.

Source: 2050 Climate Change Committee



A public climate governance system can draw inspiration from the private sector. Private companies have increasingly worked systematically on climate-related issues in recent years. Recommendations from various initiatives, such as the Task Force on Climate-related Financial Disclosures (TCFD), have raised awareness of climate-related consequences for companies' profitability and risk, and led to more stringent regulatory requirements for corporate reporting on sustainability and climate change. Listed companies have increasingly integrated climate-related issues into their ordinary strategy and governance processes, and regulatory developments in the area are rapid. Companies' contributions to the transition and corporate reporting are described in more detail in Chapter 10, and constitute an important and complementary addition to the overall governance system outlined in this chapter.

See discussion of companies' sustainability reporting in Chapter 10.

More and more countries are establishing a statutory system for climate policy. The Committee has reviewed how Sweden, Denmark, Finland, Germany, France and the UK organise and manage their climate policies. The EU has also established a comprehensive climate governance system including a European Climate Law. All the above-mentioned countries have systems that contribute to continuity and predictability, and much is enshrined in their national climate laws. The focus of the laws varies a great deal, but they comprise many of the same main elements. Relevant examples include requirements for regular climate action plans, reporting and the establishment of independent climate councils; see Table 17.1 for a comparison of the countries' different governance requirements.

Norway should draw greater inspiration from how other countries use climate legislation as a governance tool, and the Committee recommends further developing the Norwegian Climate Change Act. Norway's Climate Change Act, adopted in 2017, is very general and to a limited extent serves as an operational governance tool. The three main pillars planning, implementation and evaluation should be enshrined in the Climate Change Act through different requirements for processes and governance. Statutory requirements contribute to predictability and continuity for the Government, the Storting and the general public. The next chapters elaborate on which elements and requirements the Committee believes should be included in an updated version of the Climate Change Act. At the same time, the Committee considers it important to leave room for different political choices and changes of course along the way. Climate legislation must not determine the content of policy; this should be determined through ongoing political processes. Nor must climate legislation be an obstacle to adjusting policy along the way, for example based on new knowledge. Figure 17.2 provides a summary of the Committee's proposal for a stronger governance system, which is reviewed in this part of the report.

The Committee's review of several countries' governance systems is described in more detail in the digital appendix to the report. The review largely shows that:

- all countries have updated their climate laws in recent years and codified several requirements for the process and management of climate policy.
- all countries include requirements for regular climate action plans that show

how the goals are to be achieved.
- in some countries, sectoral ministries have their own emissions budgets and develop their own strategies to meet climate goals.
- in all countries, the ministry of climate has been merged with either the ministry of industry or the ministry of energy.
- in several of the countries, the parliament plays a prominent role in the development of climate policy, and the progress of the climate transition is debated in the parliaments at regular intervals. Some of the countries also have mechanisms that allow the parliament to request additional policies to achieve the climate goals.
- all countries have established independent climate councils that monitor and assess progress. In many of the countries, the parliament can also ask for statements and reports from the climate councils.
- Sweden and Denmark formulate policy on the basis of broad parliamentary agreements.

Norway passed the Climate Change Act in 2017. The Act lays down Norway's climate goals in law and obliges the Government to report annually to the Storting on the status of climate change, but, over and above that, it sets out few specific requirements for process and governance.

The UK was early in establishing a legally binding framework, and has since 2008 had a Climate Change Act that obliges the government to adopt binding carbon budgets for emission cuts (UK Climate Change Act, 2008). These are set for five-year periods, and the government is obliged to present proposals for policies to meet the budgets. If the emission budgets are not met, a public statement is required showing the plan for achieving the outstanding emission reductions. A Climate Change Committee has been established with a broad remit to advise, monitor and report to parliament on the UK's efforts to reduce emissions.

Germany has laid down its climate targets towards 2050 in law (Federal Climate Change Act, 2021). The Act has separate targets for carbon removals in the forestry and land use sector, and also lays down targets for the various sectors. The minister for the various sectors is responsible for specifying the policy instruments to be used to achieve the sectoral goals. The Act also sets out annual emission targets for the period 2031–2040. According to the Act, a climate action programme must be drawn up that specifies how the targets are to be achieved. Germany has also established a climate council to assess emission data and background material for the proposed policy instruments. Both the government and parliament may ask the council for special reports.

Sweden has a relatively recent Climate Act adopted in 2017 (Swedish Climate Act, 2017). Each year, the government must present a climate policy action plan showing adopted and planned actions and their effect. Sweden has established an independent climate council that evaluates the government's policy to achieve the goals. The council also participates in public debate.

Table 17.1 Comparison of governance systems in selected countries.

Element	UK	Finland	Denmark	Sweden	France	Germany	Norway
When was the climate law introduced?	2008	2015	2014	2017	2015	2019	2017
Has the country expanded the law since its adoption?	Nei	Yes, in 2022	Yes, in 2020	No	Yes, in 2019	Yes, in 2021	No, but adjusted with more ambitious climate targets for 2030
Climate council?	Yes	Yes	Yes	Yes	Yes	Yes	No
Citizens' council?	A citizens' council (Climate Assembly) that submitted a final report in 2020	Nei	Yes (Borgertinget)	Nei	Yes (Citizens' Convention on Climate)	Yes (The Citizens' Assembly on Climate)	No
Requirement for presenting climate action plans	Yes	Yes	Yes	Yes	Yes	Yes	No
Main responsibility for national climate policy overall	Department for Energy Security and Net Zero	Shared between Ministry of Economic Affairs and Employment and Ministry of the Environment	Ministry of Climate, Energy and Utilities	Ministry of Climate and Enterprise	Ministry of Ecological Transition	Federal Ministry for Economic Affairs and Climate Action	Ministry of Climate and Environment

Source: The countries' climate laws; see also digital appendix to this report

Denmark updated and strengthened its Climate Act in 2020 (Danish Climate Act, 2021). It lays down Denmark's climate goals in law and stipulates that interim goals must be set every five years. The Act establishes an annual cycle for presenting a climate programme and reporting on progress in an annual climate status report to the Danish parliament (Folketinget). An independent climate council has been established to advise on Danish climate policy and whether current policy is sufficient. The Act also codifies a duty to act that is triggered if it cannot be substantiated that the climate goals will be achieved. Each year, the climate council is tasked with conducting a scientific assessment of whether the government has a duty to do more to achieve the goals, i.e. whether the duty to act is triggered.

Finland established a Climate Act in 2015 and updated it in 2022 (Finnish Climate Act, 2022). The Act obliges the government to establish a climate policy system. It sets out a requirement to draw up four different action climate plans that show how the statutory goals are to be achieved. Separate processes have been established to safeguard Sami interests in the preparation of the plans. The responsibilities of the various ministries are also specified in the Act. The Act has been made applicable to local governments and contains requirements for municipal climate action plans. Finland has explicitly provided for the possibility of the Act being enforced by the courts. A climate council has been established to provide scientific advice and assess whether current climate policy is sufficient.

France has adopted a climate act that sets out the nation's goal of becoming carbon neutral by 2050, as well as several quantified targets for the energy sector (French Law on Energy and Climate, 2019). The Act establishes an independent climate council. The purpose of the Act is to promote research and innovation policies that contribute to the energy transition. In addition, France has adopted a separate act that proposes various measures and policy instruments to achieve the climate targets (Law No 2021-1104 on the fight against climate change and the reinforcement of resilience in the face of its effects, 2021).

The EU has adopted the European Climate Law with a view to making the EU climate neutral by 2050 (European Climate Law, 2021). It establishes processes for assessing collective and national progress towards the goals every five years. If progress is insufficient, new policy instruments must be implemented. The act also establishes an independent European climate council. The council's remit includes to advise on the EU's policy instruments, targets and indicative climate budget, and to identify measures and opportunities that are necessary for the EU to achieve its climate goals. Each member state is also invited to establish a national advisory body on climate change.

System and process requirements provide predictability and stability. A climate governance system must make the attainment of long-term goals credible. It must be flexible enough to meet future changes in technological, social and economic circumstances. The IPCC has referred to how countries that have robust climate policy management systems are better qualified to achieve a comprehensive societal transition (IPCC, 2022b). For policies where there is widespread disagreement about the right solution, it is also important that the processes are legitimate – both because it improves the content of the policy and because processes that are not perceived as legitimate can be a source of strong popular opposition to the proposed solutions. That those who disagree with policy choices still accept the political decision as legitimate is important for democratic stability (Arnesen, 2018). A predictable governance system alone is not enough to ensure the transition to a low-emission society; there are a number of other prerequisites that must be in place. Political will is one of the most important factors, but also the ability, competence and resources to implement the necessary changes and decisions.

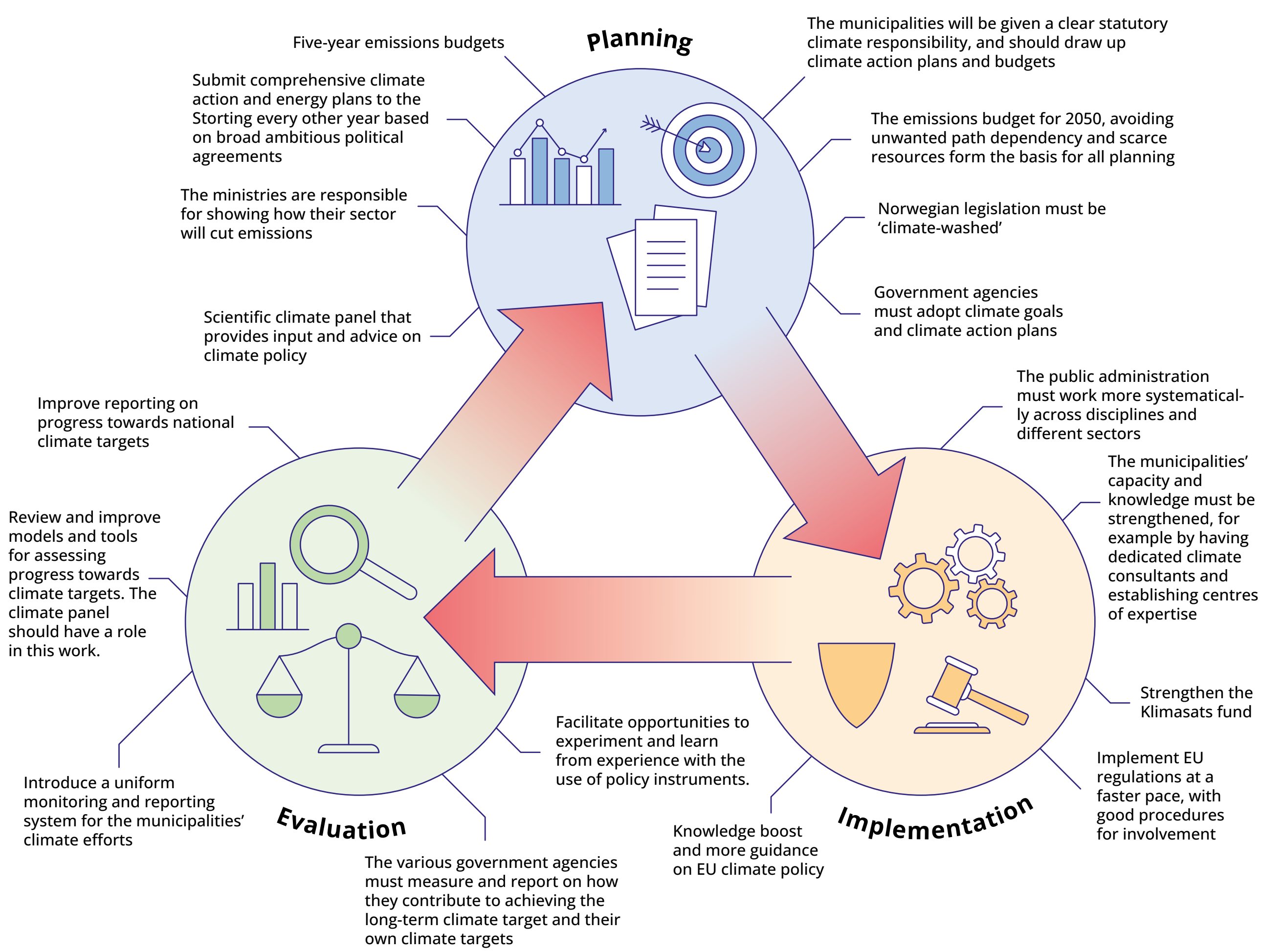


Figure 17.2 Summary of the Committee's proposal for a stronger governance system.

Source: 2050 Climate Change Committee

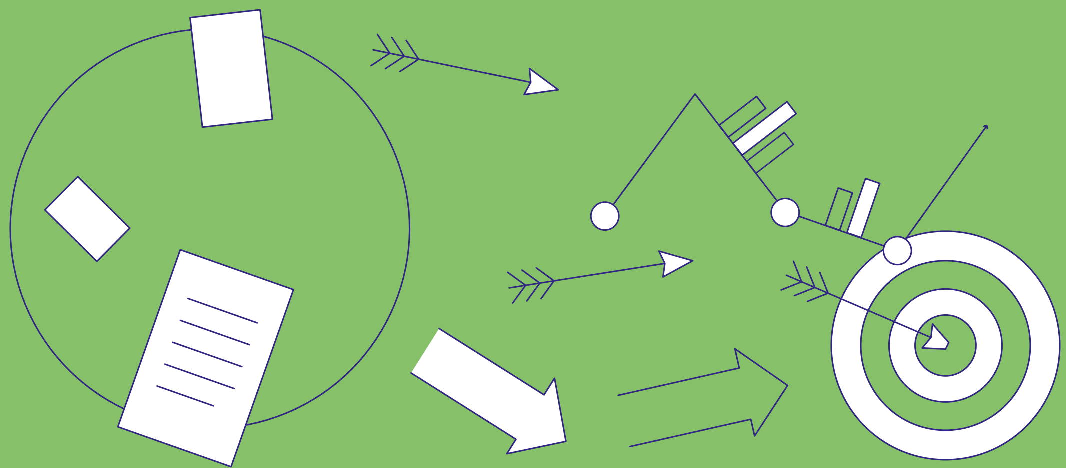
Norway must reduce conflicts of objectives and ensure that policy seen as a whole sets a credible direction for eliminating the vast majority of emissions. Norway has a strong democracy and is well positioned for the transition. At the same time, there are some features of Norwegian society that make a rapid transition to a low-emission society challenging. With the assistance of Menon Economics and the Fridtjof Nansen Institute, the Committee invited several social scientists to contribute 15 brief analyses of which stakeholders are most influential in Norwegian climate policy (Gulbrandsen & Handberg, 2023). The analyses were compiled into a report showing that various stakeholders exert a strong influence over policy and that a strong sectoral orientation in Norwegian public administration can make it challenging to solve the cross-sectoral challenge the transition to a low-emission society represents. A status analysis of Norwegian democracy conducted in 2023 recommended greater transparency in the relationship between politicians and various interest groups to prevent resourceful groups from gaining disproportionate influence in the political system (Knutsen et al., 2023).

Sector principle: that the central government administration is organised in accordance with the ministers' defined responsibilities. It is generally understood to mean that, when an activity is established, funds allocated, measures implemented and follow-up organised and this affects the responsibilities of several ministers, a single minister is nonetheless to be held accountable for this to the Storting.

The sector principle can make it difficult to deal with cross-sectoral issues. The Norwegian Defence Commission (NOU 2023: 14), the Healthcare Personnel Commission (NOU 2023: 4) and the Coronavirus Commission (NOU 2021: 6) all pointed out that the sector principle is a key part of Norway's system of governance and contributes to a clear division of responsibilities, but makes it difficult to deal with cross-sectoral problems because no one has overall responsibility. The sector orientation in Norwegian policy is reflected, among other things, in the Norwegian governance model. Each ministry is oriented towards its own sector and its own sectoral goals, while cross-cutting transition is given low priority in practice. In 2019, the Norwegian Agency for Public and Financial Management looked at the ministries' role in promoting a transition in central government (Difi & DFØ, 2019), and recommended that the ministries should strengthen their role as strategic players. They also found that coordination ministries generally have little impact because the sector principle is so strong. The Ministry of Climate and Environment is an example of a ministry that has been assigned a coordinating function.

Planning climate policy

18



All major and minor decisions that are important for the low-emission society must be based on the premise of a limited emissions budget in 2050, the risk of unwanted path dependency and scarce access to resources. This chapter discusses the tools the Committee believes are necessary to plan for the climate transition.

18.1 Government planning is needed in order to achieve the climate goals

Achieving Norway's climate goals requires good planning and regular revision. The Committee proposes several tools to ensure that the transition to a low-emission society permeates all planning. Figure 18.1 shows the tools the Committee believes will be important to ensure that we pursue a longer-term, broader and more comprehensive approach to planning. Larger and comprehensive climate action plans and reports on how Norway is to achieve its climate targets have so far been published at irregular intervals. This makes it unclear which policy actually applies and what the specific plan is to achieve the targets. Uncertainty has been especially marked during changes of government. Several other countries have adopted statutory requirements for when climate policy plans are to be submitted and updated. Norway does not have a corresponding requirement, but since 2018, the Government has annually reported on Norway's climate status in line with requirements in the Climate Change Act. This provides information to the Storting and the public about the status of climate policy.

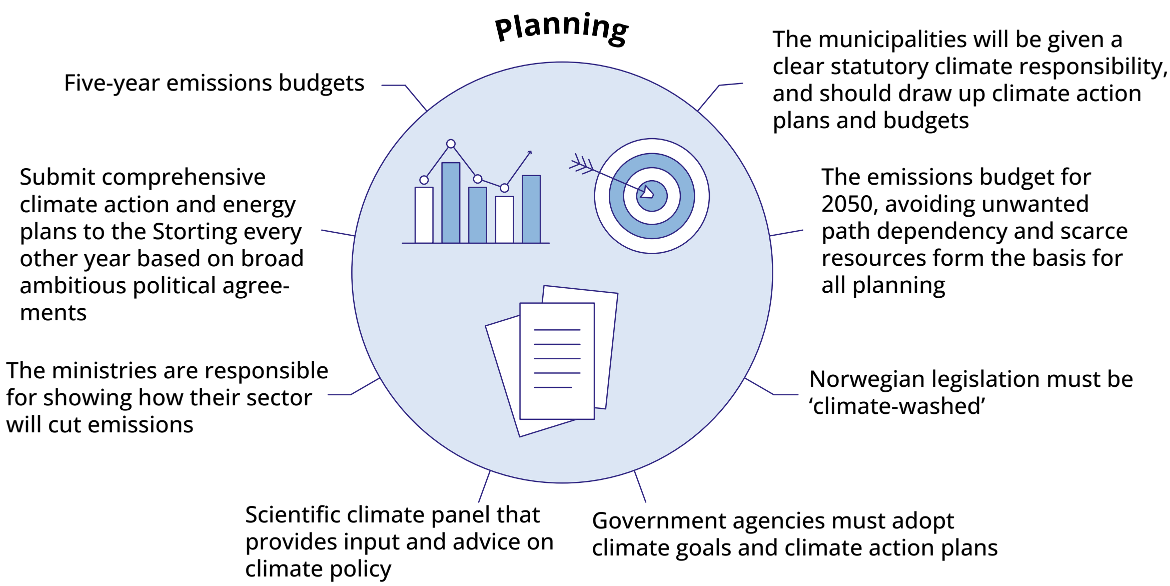


Figure 18.1 **Summary of tools under the pillar *planning* in the Committee's proposal for a stronger climate governance system.**

Source: 2050 Climate Change Committee

Comprehensive plans on how Norway will achieve its climate goals should be discussed and aligned with the Storting on a regular basis. Reporting under the Climate Change Act gives the Storting information about the status of climate policy, but the Act does not outline a cycle for parliamentary consideration of the policy. According to the Government's climate status and plan for 2022, an appendix must be enclosed with the national budget every year showing the Government's plan, policy development, emission effects and reporting, with a climate governance system that will be further developed (Ministry of Climate and Environment, 2022). This is a step in the right direction, but does not necessarily entail comprehensive parliamentary consideration of climate policy and the specific measures and policy instruments required to achieve the goals. In its planning and follow-up of the policy, the Storting should be given an opportunity to actively decide on and consider the policy that is planned and implemented to achieve the climate targets. If the Storting is regularly given an opportunity to consider and adjust climate policy, it can also help ensure progress in the transition to a low-emission society. Ambitious cross-party agreements can also provide increased predictability and credibility in climate policy and help ensure a continuation of climate policy, also in the event of changes of government. Broad support for the policy in the Storting is therefore important.

The Committee recommends that comprehensive climate and energy plans are submitted in the form of a white paper every other year. The Committee sees a need for an overall plan for how both long-term and short-term climate goals are to be achieved, how this is related to other policy areas, and how the policy will be made more stringent over time. Climate and energy policy are closely integrated and interdependent, and together play a crucial role in the transition in many other sectors, such as transport and industry. The need for energy and reinforced grid capacity are examples of this. A comprehensive climate and energy plan should consider how all policy areas need to be adjusted to facilitate the transition, and both the risk of undesirable path dependency and prioritisation of scarce resources should be considered. In its report, the Energy Commission pointed out that the Storting should be regularly informed about the overall status of energy and climate policy (NOU 2023: 3, 2023). EU member states are also obliged to draw up comprehensive climate and energy plans through the EU's governance system.

In the Committee's opinion, it is important that not only energy and climate policy are assessed, but that also other policy areas such as petroleum policy, industrial policy, land use policy and agricultural policy, are assessed against the emissions budget in 2050 and the allocation of scarce resources. The Committee believes a comprehensive climate and energy plan should be based on a long-term perspective that shows planned escalation of the policy, at the same time as showing in concrete terms how the short-term climate targets are to be achieved. The plan should contain a comprehensive overview of the measures and policy instruments that must be implemented to achieve Norway's climate targets and how Norway is to be transformed into a low-emission society with a limited emissions budget and scarce resources. The plans should also include an analysis of when and how the different emissions can be phased out, as recommended by the Committee in Chapter 3.

See also discussion of the need for analyses in Chapter 3.

The Committee believes it must be made clear what the different sectors should contribute and what resources are needed. In a review of Norway's climate policy in 2022, the IEA recommends that Norway should establish separate sector-based emission strategies towards 2030 and 2050, and that these should include sectoral goals and policies to achieve them (IEA, 2022). Many sectors of society are also crucial to securing the necessary resources for the transition. The energy sector can help increase the supply of renewable energy, which will be necessary for the transition in most other sectors. The transport sector can contribute to a transport system that lays claim to as little land and energy as possible. The education and research sector can help provide society with the necessary expertise to ensure low emissions, a high level of welfare and a competitive business sector. Several other countries have codified the ministries' responsibility to reduce emissions from their own sector. The Committee believes that the ministries responsible for the various sectors must plan for how their sector will contribute to the long-term transition and to achieving the short-term climate targets, while avoiding conflict with other environmental goals, for example those relating to nature. This will form an important part of the overall climate and energy plans and must be decisive for the competent ministry's priorities. It should be considered whether such responsibility should be codified in the Climate Change Act.

The plans must be seen in the context of other key policy documents. In the years when the plan coincides with the National Transport Plan and the white paper on long-term perspectives on the Norwegian economy, these documents should be seen in context with each other and placed within a comprehensive framework. Figure 18.2 shows a timeline for when these documents should be presented and in which years they coincide. In the long term, the documents should be drawn up jointly across ministries and agencies to ensure coherence between different policy areas.

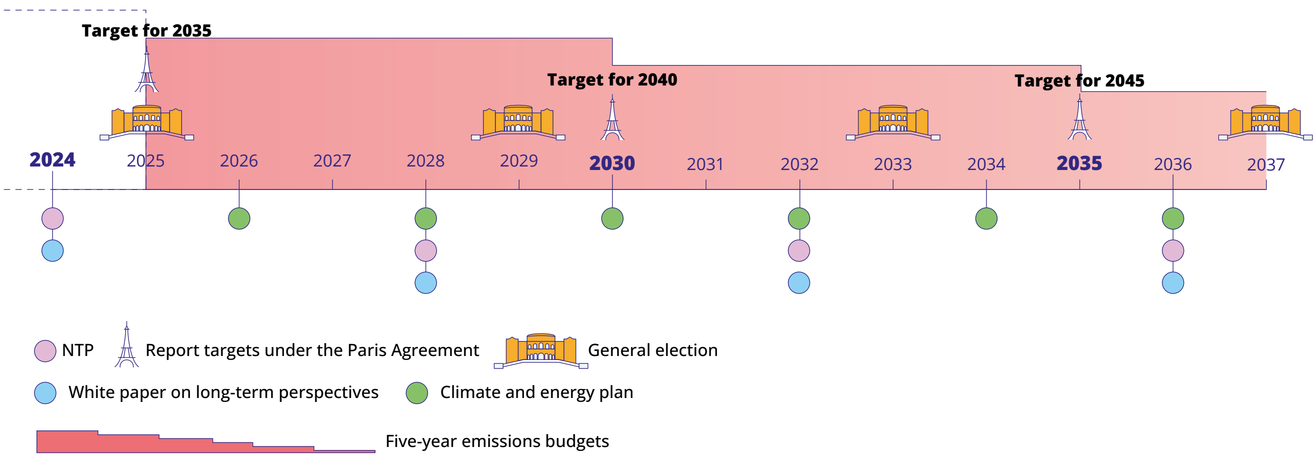
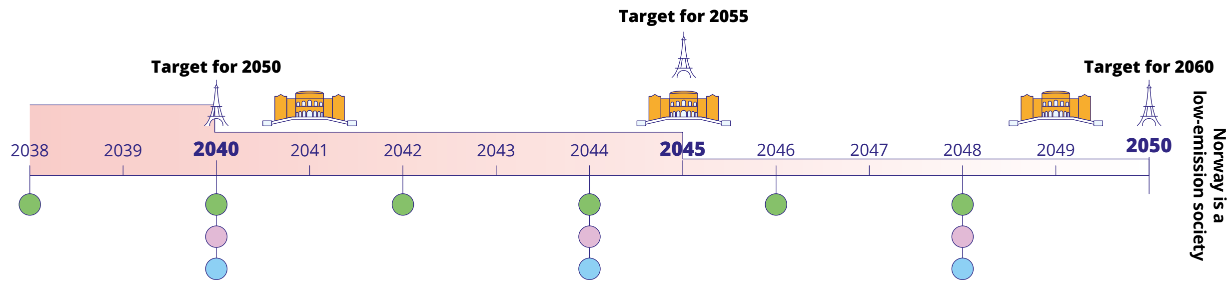


Figure 18.2 Policy timeline.
Timeline showing when the National Transport Plan and the white paper on long-term perspectives on the Norwegian economy will be presented, when Norway is scheduled to announce a new target under the Paris Agreement and which years general elections take place. In addition, the figure shows how the Committee's proposal to present comprehensive climate and energy plans every other year fits into the timeline. The figure also shows an illustration of how the five-year emissions budget is reduced towards 2050.
Source: 2050 Climate Change Committee

Fixed times for presenting climate and energy plans provide predictability for the Government, the Storting and the public. The Storting's consideration of a comprehensive white paper on climate change and energy on a regular basis can contribute to more continuity in the implementation of policy, also with changes of government. It will also help ensure that the Storting regularly updates climate policy if it is not sufficient to achieve the goals. The Committee considers it appropriate that the plans are submitted for consideration by the Storting every two years, but that the climate and energy plans must build on each other and be further developed as the policy is implemented and evaluated. It is important that the Government and the Storting periodically consider the need to change course, and the Committee believes that two-year intervals will help keep climate policy on the agenda while allowing time for the policy to take effect and be seen in the context of other policy areas. The Committee recommends codifying a requirement to present comprehensive climate and energy plans to the Storting every other year in the Climate Change Act.

Broad, ambitious agreements on climate and energy plans with policy packages will contribute to greater credibility of long-term targets. If climate policy is credible and predictable, it will affect current investment decisions and priorities in the private sector in a way that reinforces and supports public initiatives. This can lead to faster and more comprehensive emission cuts than we have so far seen.

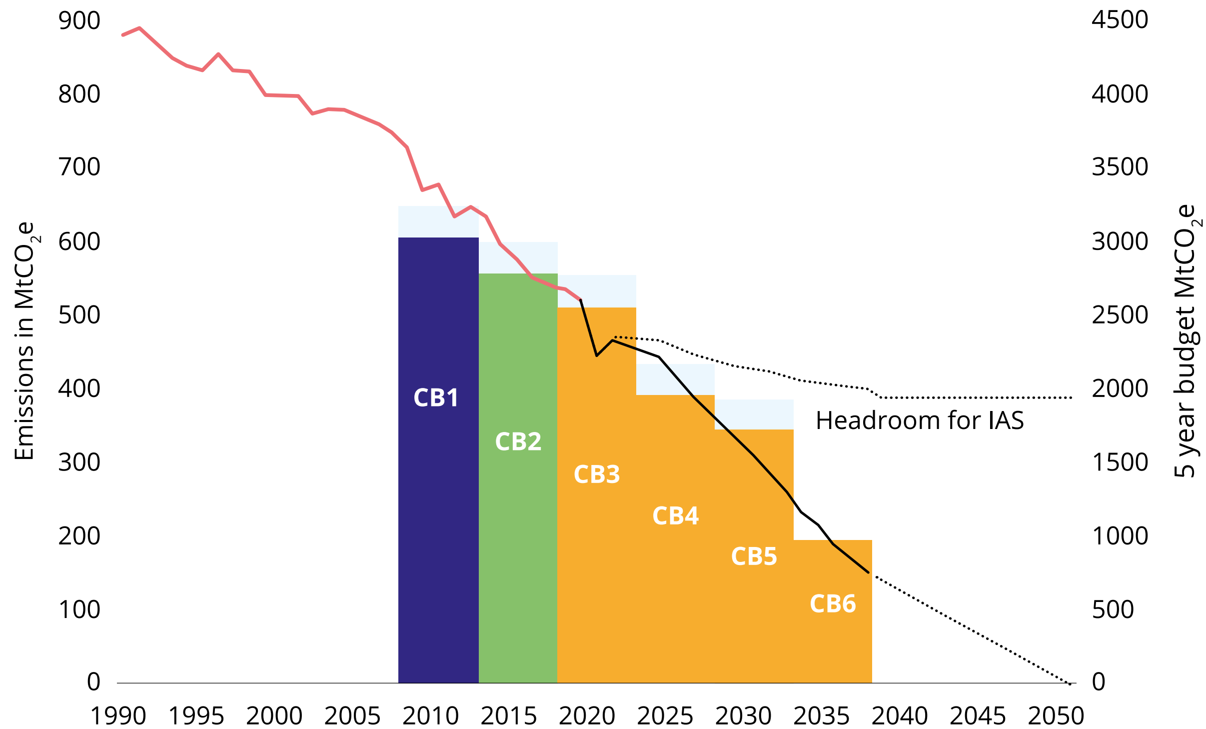
The Committee recommends that Norway draw up five-year emissions budgets until 2050. In the years leading up to 2050, Norwegian emissions must be drastically reduced. In order to plan for a gradual reduction of emissions that will ensure a



smoother transition, the long-term target for 2050 should be operationalised in five-year emissions budgets that show how short-term policy affects the long-term target. An emissions budget should set a cap on Norway's emissions over a five-year period, and the budgets should extend to 2050. Since 2008, the UK has worked with five-year carbon budgets with a quantified cap on emissions; see Figure 18.3. The budgets are set 12 years in advance, which means that the budget for the period 2033–2037 was decided in 2021. Five-year emissions budgets for Norway can help ensure predictable planning. Five-year periods also fit well with the system outlined in the Paris Agreement, where the parties to the agreement are strongly encouraged to adopt goals with a timeframe of five years. Five-year budgets will be a supplement to annual budgets for emissions not covered by the EU ETS that Norway will be bound by through the climate agreement with the EU.

A requirement for five-year emissions budgets and when they should be updated should be codified in the Norwegian Climate Change Act. The UK has enacted its carbon budgets in its national Climate Change Act, and has undertaken commitments several years ahead. In the Committee's view, it is not appropriate for the emissions budget itself to be laid down in law, but a legal requirement for Norway to have an emissions budget should be codified. If the emissions budget itself is enacted, the process of adjusting the budget as a result of, for example, changed assumptions will be unnecessarily time and resource-consuming.

The climate and energy plans must demonstrate how the five-year emissions budgets can be achieved. The emissions budget system should be prepared on a rolling basis, with increasingly binding budgets for the next two five-year periods that set out specific emission reduction plans. The Committee believes emissions budgets for five years at a time until 2050 will provide greater flexibility and allow for the fact that many factors will influence emissions in a single year. Emissions budgets should also be presented further into the future, but there should be more room for adaptation of the budgets to take account of new knowledge, technology and cost developments.



2025 – 55% reduction (exluding international aviation and shipping emissions)

2030 – NDC target for at least 68% reduction (exluding international aviation and shipping)

2035 – 78% reduction (including international aviation and shipping)

2050 – 100% reduction
To meet whole-economy net zero target

Figure 18.3 **The UK's six five-year carbon budgets from 2008 until 2037.**

Source: The 2021 Net Zero Strategy prepared by the UK Government and presented to Parliament. Adapted by the 2050 Climate Change Committee (UK Government, 2021).

Annual government budget documents must reflect and contribute to the long-term transition. The national budget sets out important climate policy guidelines and is an important part of both the planning and implementation of the transition year by year. The Government's climate status and plan for 2022 outlines closer integration of climate concerns in the work of drawing up the national budget, in the form of a climate budget. According to the Government, a climate budget is a systematic presentation of how the national budget and the various budget proposals affect the climate, and how they will impact emissions. The Committee believes it is important that climate considerations are integrated into the internal budget processes, and that it must more clearly reflect how budget proposals affect the long-term climate targets. At present, the Government's climate budget is primarily aimed at assessing how Norway meets the current emissions budget for emissions not covered by the EU ETS, in the current and future years. The annual budget documents must be seen in the context of the comprehensive climate and energy plan, and be used to set the framework for how the plan is implemented.

Planning of climate policy depends on an up-to-date and high-quality scientific basis. The measures and policy instruments must at all times be founded on a scientific basis that can be used to reduce emissions while also providing an overview of the resources required, such as the amount of power and land. This will give the Government and the Storting a good basis for further developing climate policy. The Committee notes that the analysis of measures and policy instruments for 2030 that was presented by the Norwegian Environment Agency in June 2023 will now be presented on an annual basis. This is positive, and it is important that this work is further developed to include longer-term and more comprehensive analyses of various cross-cutting issues relating to the transition. The Committee recommends laying down a requirement for such an updated common scientific basis from the Norwegian Environment Agency and the various sector agencies in the Climate Change Act.

A number of countries have set up climate councils in recent years. The purpose of these councils is to help ensure that climate policy is research-based, to support transparency in policy development and to make it easier for the population to hold politicians accountable for policy and goal attainment. The UK was quick to establish a climate council, and Sweden, Denmark, Finland and a number of other countries have followed suit. The climate councils fulfil different functions in different countries. The EU has also established a Scientific Advisory Board for Climate Change, and the European Climate Law encourages all member states to do the same. A study of European climate governance systems and various countries' climate councils conducted on behalf of the European Environment Agency showed that, if a climate council is independent of the government and reports to parliament, it is more likely to fulfil the role of 'climate watchdog' and facilitate a broader and more informed public debate (Evans et al., 2021). Norway has not established a separate climate council with a similar function as other countries.

The Committee recommends establishing a Norwegian climate panel tasked with contributing to a scientific basis for climate policy and identifying opportunities and challenges. The Committee believes an independent panel is needed that can provide input and advice on climate policy, and contribute new knowledge and perspectives. The panel's advice can form part of the basis for policy decisions. It is important that such a panel contributes to proper implementation of the climate goals. A climate panel should be composed of members from a variety of professional backgrounds to safeguard different perspectives. It should be possible for both the Storting and the Government to request specific reports and scientific recommendations from the council that can form the basis for policy development. This will provide a better decision-making basis for politicians and increase public confidence in climate policy, but is not a substitute for the policy. Political decisions must rest with the Storting and the Government. The Committee also proposes giving the climate panel a role in assessing methods and tools for expedient climate reporting, and both build on and further develop the work of the technical committee responsible for calculations in the field of climate change mitigation.

See Chapter 20 for a discussion of the technical committee responsible for calculations in the field of climate change mitigation.

18.2 Municipalities must be given a clear role in the climate transition

Local and regional authorities play a central role in Norwegian social development, and are important in the transition to a low-emission society. If Norway does not succeed with the transition in the municipalities, we will not become a low-emission society. Authorities at all levels play an important role in contributing to ambitious climate efforts in the municipalities. The municipalities are central in both the planning and implementation of measures that set an important framework for the transition through choices of direction that can lead to path dependency and guidelines for the use of resources.

A high number of municipalities with very different characteristics entails both challenges and opportunities for the transition. There are major differences between the municipalities in terms of size, geography, industry structure, demographics and infrastructure. Some have greater resources and more expertise than others to rely on in the transition, entailing different starting points and different approaches. The low-carbon transition is currently integrated to varying degrees in the municipalities' planning and activities. At the same time, the Norwegian governance model enables testing of different policy instruments and measures to reduce emissions and adapt policy to local conditions. The lessons learned in one municipality can constitute valuable knowledge for other municipalities. In order for learning to be shared as effectively as possible, good dialogue both between the central and local levels and between different municipalities and counties is important. Many municipalities have already taken the lead in the transition to a low-emission society, and have tried new methods to accelerate the process. Oslo was the first municipality to introduce a climate budget, and several have followed suit. Flakstad was the first municipality in Norway to introduce a goal of area neutrality. Many municipalities are also working actively to integrate climate and circularity considerations in the municipality's operations and procurements. Viken county authority has a project where they provide assistance and guidance in green procurement, to make it easier for the municipalities to make climate-friendly choices when purchasing vehicles, transport services and materials for buildings and infrastructure.

Land use neutrality: net zero loss of nature by restoring as much land as is degraded.

The Committee believes the municipalities must be assigned explicit responsibility for contributing to the transition to a low-emission society. Much of the decision-making authority in Norway is decentralised, and the municipalities have ample opportunity to influence social development. They play an essential role through their role in community development, exercise of authority, provision of services, procurement, ownership and operations. The municipalities have several key policy instruments at hand, including through land use planning. Norwegian municipalities and county authorities are separate legal entities with their own elected leadership, at the same time as local self-government is exercised within a national framework set by law or the national budget. The attainment of national goals depends on contributions from the municipalities. This also applies to the climate transition, where the municipalities are responsible for important areas such as land use planning, waste management, transport and education. In addition, municipalities can play an important role as driving forces and initiators. If contributions to achieving national goals are not given weight by the individual municipality, it will result in impaired goal attainment at the national level. In Chapter 6, the Committee points out a need for stronger governmental control of land use and marine spatial policy. The Committee considers it appropriate for the central government to set clear requirements for the municipalities to help achieve the goals and for the central government to increasingly steer municipalities towards the low-emission society.

See also Chapter 6 on the need for stronger governmental control of land use policy and marine spatial management.

The Committee recommends that the municipalities' responsibility for the transition towards low emissions be laid down in law. Legal requirements may be introduced for the municipalities' contributions to the transition, but both the Local Government Act and the Planning and Building Act are key pieces of legislation in the municipal transition. The current Local Government Act contains requirements for the preparation of coordinated and realistic plans for the municipalities' own activities and financial affairs, and for the development of the local community or region. Among other things, the fiscal plan must demonstrate how long-term challenges, goals and strategies in municipal and regional plans should be followed up. An annual budget must also be drawn up that is binding on the municipality. In addition, the Local Government Act contains requirements for municipalities and county authorities to report to the central government on finances, use of resources and services. The county governor exercises government control of municipalities and county authorities with a financial imbalance. One way of securing the municipalities' contribution to the transition is to amend the Local Government Act to include a requirement for drawing up and adopting climate goals with a corresponding plan of action to cut emissions and increase removals in line with the goals, and a climate budget that applies to emissions in each municipality's geographical area. These can be followed up in much the same way as financial management, and a requirement for reporting on the follow-up should also be included, in the same way as for the finance plan. The greenhouse gas accounts for municipalities and counties, published annually by the Norwegian Environment Agency, can be a useful tool in this context. This solution must be seen in close conjunction with the Planning and Building Act, which is of major significance to the municipalities' work on social development and planning. Other legislation, such as the Climate Change Act, could also be considered suitable for codification of the municipalities' role.

The Government also has responsibility for enabling municipalities to pursue an ambitious climate policy and for breaking down barriers that can impede municipal climate action. The municipalities' climate efforts are also dependent on the central government facilitating municipal transition. Many cross-sectoral policy instruments are available at the central government level, and it is important that the municipalities are given the room for manoeuvre needed to pursue an ambitious climate policy. A concrete example of barriers that can restrict the municipalities' work on climate mitigation measures is the lack of legal authority to impose climate requirements in zoning plans. The City of Oslo and several other municipalities have set, or wish to set, requirements in zoning plans for construction sites to be fossil-free. It is unclear whether the Planning and Building Act allows this, and municipalities that adopt such requirements thus run a risk that the requirement is unlawful. In an interpretative statement, the Ministry of Local Government and Regional Development has concluded that there is no legal basis for establishing such requirements, but has not yet proposed to amend the Act to give municipalities legal authority to impose requirements for fossil-free construction sites (Ministry of Local Government and Regional Development, 2021). The Committee believes that the Government has a responsibility to break down and remove barriers that prevent municipalities from planning and pursuing an ambitious climate policy.

The Committee recommends revising the Planning and Building Act to make it a more efficient governance tool in achieving a low-emission society. This applies both to provisions on how climate considerations should be incorporated into the social and land use elements of the municipal master plan, and how national authorities set the framework for land use policy at the municipal and county level. The scientific basis for such a revision already exists. A number of assessments have been made of how the Planning and Building Act can be increasingly adapted to aid the low-carbon transition, including a report written on assignment for the Committee by the consultancy firm Holth & Winge (Holth & Winge AS, 2023).

The role of the county governor should be further developed in terms of coordination and guidance of the municipalities' work on the social and land use elements of the municipal master plan. At present, the municipalities develop their own plans. The Committee believes the municipalities should retain this role, but that the county governor could to a greater extent coordinate different plans and priorities for land use, transport and economic activity in each region. The county governors also play an important role in providing guidance and as a resource centre. The right to object to municipal plans that take little account of climate goals must be exercised where necessary. Such changes may be laid down in a revised Planning and Building Act and new official instructions to the county governors regarding the use of objections.

See the Committee's assessment of the municipalities' role in land use policy in Chapter 6.

Climate agreements between the central and local governments can promote municipal climate transition, but are difficult to achieve in practice. In a report on governmental control, the Norwegian Agency for Public and Financial Management (DFØ) states that agreements are an effective municipal control instrument as long as they are used to a moderate extent and thus constitute a genuine signal about prioritisation (Difi, 2019). An example of such an agreement is the State's agreement on the settlement of refugees. Sweden has used this instrument in climate policy and has established several long-term agreements on the climate transition between the central and local governments. The Swedish Agency for Public Management (Statskontoret) has carried out an assessment of such agreements and concluded that they can be an effective instrument to complement more direct forms of governance

(Swedish Agency for Public Management, 2022). Urban growth agreements – a zero growth scheme for passenger transport by car – are also examples of agreements between the central and local governments, as are rural growth agreements, which are currently being tested. Such agreements can demonstrate how the municipalities will contribute to achieving the national climate goals and reducing their emissions. The agreements require a negotiation process in which the central and governments agree on what to include. One challenge is that it will be very resource-intensive to negotiate such agreements for all of Norway's municipalities. In a negotiated solution, it is also uncertain what degree of commitment can be achieved. In the Committee's opinion, it makes sense to continue testing and expanding the scope of agreements with different types of municipalities on contributions to the transition and fulfilment of Norway's climate goals, and to consider this as a possible addition or alternative to other policy instruments.

18.3 The 2050 emissions budget must form the basis for all planning

Norway currently has general requirements to incorporate climate considerations in several pieces of legislation, instructions, guidelines and guides, but the requirement is assessed and emphasised to varying degrees in the respective decision-making processes. There are many different reasons for this, including a lack of political will in some cases, and in others unclear regulations, prioritisation or lack of knowledge about climate impacts. Everything from white papers, letters of allocation to subordinate agencies and individual decisions in the municipalities can affect GHG emissions and Norway's transition to a low-emission society.

The EU has codified a requirement for all draft legislation and budgets to be assessed against the 2050 climate target (European Climate Law, 2021). If the assessment shows that the draft is not compatible with the EU's climate neutrality target, special justification must be provided for proceeding with the proposal. The purpose of the requirement is to highlight the impact of all policies on the EU's long-term target and how policy contributes to or impedes goal attainment.

The Committee recommends introducing a requirement in the Norwegian Climate Change Act that ensures that major government decisions are assessed on the basis of the goal of a low-emission society. This means that white papers, budget proposals and draft legislation must be considered in light of the impact the decision will have on a limited emissions budget in 2050, scarce resources and undesirable path dependency. Such a requirement will help make climate transition a leading consideration already at the planning stage. Among other things, this will mean that the parliamentary documents must increasingly reflect the consequences of various proposals for emissions, use of land and other scarce resources, and what material footprint they will bring about in the long term. The basis for policymaking in other areas, such as transport or petroleum activities, must also show the consequences of the policy for the transition to a low-emission society, and this must inform the policy being proposed. It is important that official studies that form the basis for decisions look at both how the decision affects the climate, and vice versa. The Committee also recommends preparing a guide for such assessments. This has been done in several other countries, including New Zealand and Sweden (New Zealand Ministry for the Environment, 2019; Swedish Environmental Protection Agency et al., 2022). The Climate Change Committee's checklist in Chapter 14 should also be used as inspiration.

18.4 Legislation needs to be 'climate washed'

Many decisions are based on the public administration's professional and political judgement, and there is a high likelihood that short-term financial gains and other interests take precedence over climate considerations. In this way, many major and minor decisions can be made that are neither aligned with nor contribute to Norway's transition to a low-emission society. This will affect the emissions budget in 2050, lead to undesirable path dependency and could be at the expense of scarce resources.

The public administration must have clear requirements for and the legal authority to emphasise the transition to a low-emission society in the decisions it makes. This is a premise for climate policy to be implemented in both major and minor decisions. One example where the requirements for emphasising climate considerations have been strengthened is public procurement. It has long been voluntary in tender procedures to include the environment as one of the selection criteria, at the same time as there has been a requirement to align procurement practices so that they contribute to reducing harmful environmental impacts and promote climate-friendly solutions. In a survey conducted in 2022, the Office of the Auditor General concluded that the public sector does not exercise its purchasing power to a sufficient extent and a requirement has now been introduced that the environment selection criterion, as a general rule, must be weighted at least 30 per cent (Office of the Auditor General of Norway, 2021). A legislative committee has also been established to promote proposals for how environmental sustainability, social sustainability and increased innovation in public procurement can contribute to the green transition.

The cross-sectoral nature of climate considerations indicates taking a comprehensive approach to all legislation of importance to climate change. Holth & Winge have conducted a review of the status of climate considerations in current legislation on assignment for the Committee (Holth & Winge AS, 2023). The review shows that there are few explicit procedural requirements to take climate considerations into account. This highlights the need for a comprehensive review of all legislation, the aim of which is to provide provisions that ensure that climate considerations are assessed and emphasised across public administration sectors. Requirements should be set for how decision-making processes take place and what they should encompass. However, it is not the case that the problem will be solved by merely integrating climate considerations and allowing them to permeate all relevant legislation. A number of other prerequisites must also be in place, including political and administrative willingness to rank climate considerations ahead of other considerations. Another prerequisite is knowledge of the regulations and expertise and resources to assess how different decisions affect the climate. In other words, ensuring that climate considerations are taken into account across sectors and the public administration is a complex and challenging task that is not solved purely by setting out requirements in legislation.

Explicit, specific statutory requirements to demonstrate effects on emissions could give climate considerations greater legal significance than is currently the case. It could also contribute to a clear legal obligation being imposed on all levels of the public administration to demonstrate how the decision affects the climate transition. This applies to case processing by municipalities, county governors, agencies and ministries. There are different ways to help ensure that climate considerations are taken into account across the board. One way is to set specific legal requirements, such as the requirement mentioned above that environmental criteria must account for at least 30 per cent in public procurements. This sets a minimum threshold specifying how much weight should be given. In their review, Holth & Winge point out the possibility of expanding the scope of the Climate Change Act to include the public administration's case processing. Norway currently has a Nature Diversity Act that requires the public administration to consider and take nature into account when exercising authority that may affect biodiversity. Holth & Winge's review suggests that a climate act can serve the same purpose for climate considerations. Such an amendment will be binding on the public administration at all levels and entail a significant change in the legal status of the Climate Change Act in that it becomes an act that confers rights and obligations and can be enforced by the courts. Currently, the Act is only binding on the Storting and the Government, and cannot be enforced by the courts.

The Committee recommends 'climate washing' relevant legislation with a view to strengthening the legal status of climate considerations. Figure 18.4 shows selected acts that may have an impact on the transition to a low-emission society. The review by Holth & Winge shows that climate considerations should be better integrated into sectoral legislation, and that it can strengthen the status of climate considerations when decisions are made that may impact whether and how Norway achieves its climate goals. Climate washing will involve considering how requirements to take into account climate change, transition and emission reductions can be better integrated into legislation to ensure that relevant acts are geared towards helping Norway become a low-emission society. Such an assessment should look at the need to strengthen legislation that is important for climate change and Norway's transition to low emissions. In addition to a general assessment of the need to strengthen climate considerations in Norwegian legislation, the Committee has issued specific recommendations on sectoral legislation where the need for updating is greatest; see, inter alia, Part B. Here, the Committee points out that there is a need for amendments to the Petroleum Activities Act, the Planning and Building Act, the Nature Diversity Act, the Forestry Act, the Regulations on Impact Assessments and legislation relating to marine areas.

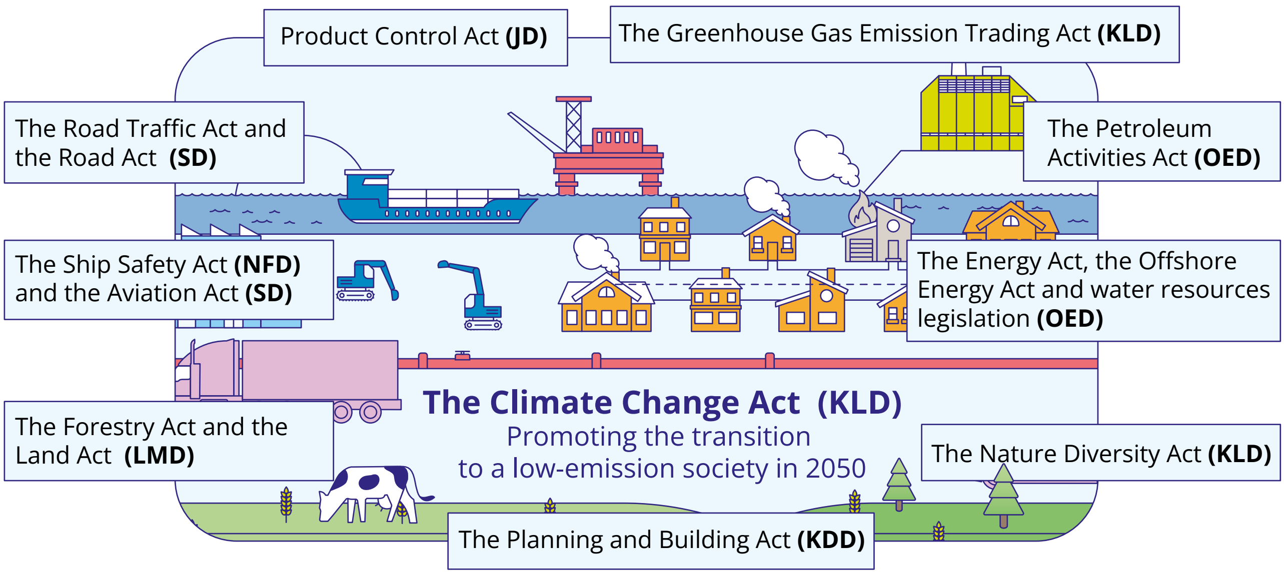


Figure 18.4 **Legislation that may have an impact on the transition to a low-emission society.**
Legislation that should be reviewed with a view to strengthening the legal status of climate considerations. The list is not exhaustive. The competent ministry is shown in brackets.
Source: Holth & Winge and 2050 Climate Change Committee

18.5 The Government's tool for ensuring climate transition at all stages

All societal goals must be aligned with the goal of a low-emission society. The Committee believes that the goals society is governed by must be based on the 2050 emissions budget. In line with the Swedish Climate Policy Council, the Committee therefore recommends that the Norwegian Government reviews all climate-relevant societal goals and ensures that they are compatible with the long-term climate targets. For example, the National Transport Plan should aim to contribute to a transport-efficient society, with zero-emission transport that is aligned with nature and environmental goals well before 2050. All societal goals must be based on assessments of how the goal will contribute to the elimination of virtually all emissions by 2050, and what resources goal attainment will lay claim to.

Projections and premises for planning in different sectors must be based on Norway becoming a low-emission society. Different projections form the basis for much of the Government's long-term strategy work in different sectors. Assumptions about the future are often based on historical developments. Instead, the projections should be based on where we want to be in 2050, and look at what needs to be done to get there, and then adapt policies to achieve other goals on this basis.

The Instructions for Official Studies and Reports and the pertaining guidelines must ensure that impacts on climate change, natural diversity and circularity are emphasised in decision-making processes. The Instructions are intended to provide a good basis for decisions on governmental measures, and set out minimum requirements for official studies when such measures are to be carried out. The guidelines to the Instructions clearly prescribe emphasising both priced and non-priced consequences. The challenge is that, although priced consequences are well documented, they often prove difficult to emphasise in final decisions. Priority must be given to developing methods and procedures that emphasise such consequences. Expert reports, such as choice of concept evaluations (KVU), for government projects must also emphasise such assessments and these must be included in general guidelines (circular on the Government's project model – requirements for assessment, planning and quality assurance of large investment projects) and pertaining guidance material.

Internal government memos where policy proposals are discussed and the mandates of government committees must also be based on the goal of a low-emission society. The Government's internal decision memos are drafted according to a predetermined template, which includes requirements for highlighting financial and administrative consequences. What consequences the proposal will have for the transition to a low-emission society should also clearly presented, so that it forms part of the Government's decision-making basis. When appointing government committees, the consequences for the climate transition should also be part of the committee's mandate, and such requirements should be standard for all official studies that may impact climate change.

The carbon price trajectories used in government decisions must be aligned with targets for Norwegian emission reductions. This is especially important for prices in the short term, as longer-term prices have less influence on profitability assessments. Today's recommended carbon prices are most likely insufficient to achieve Norway's climate targets. They also entail different trajectories for different emission sources, as well as an uneven increase over time, accelerating towards the end of the century; see Figure 18.5. Given that Norway has adopted climate targets for both the medium (2030) and long term (2050) that entail economy-wide emission cuts, the Committee considers it reasonable that carbon prices for use in socio-economic analyses should be the same across sectors and emission sources. This is also in line with the recommendations of Rosendahl and Wangsness discussed in Chapter 15 (Rosendahl, 2023).

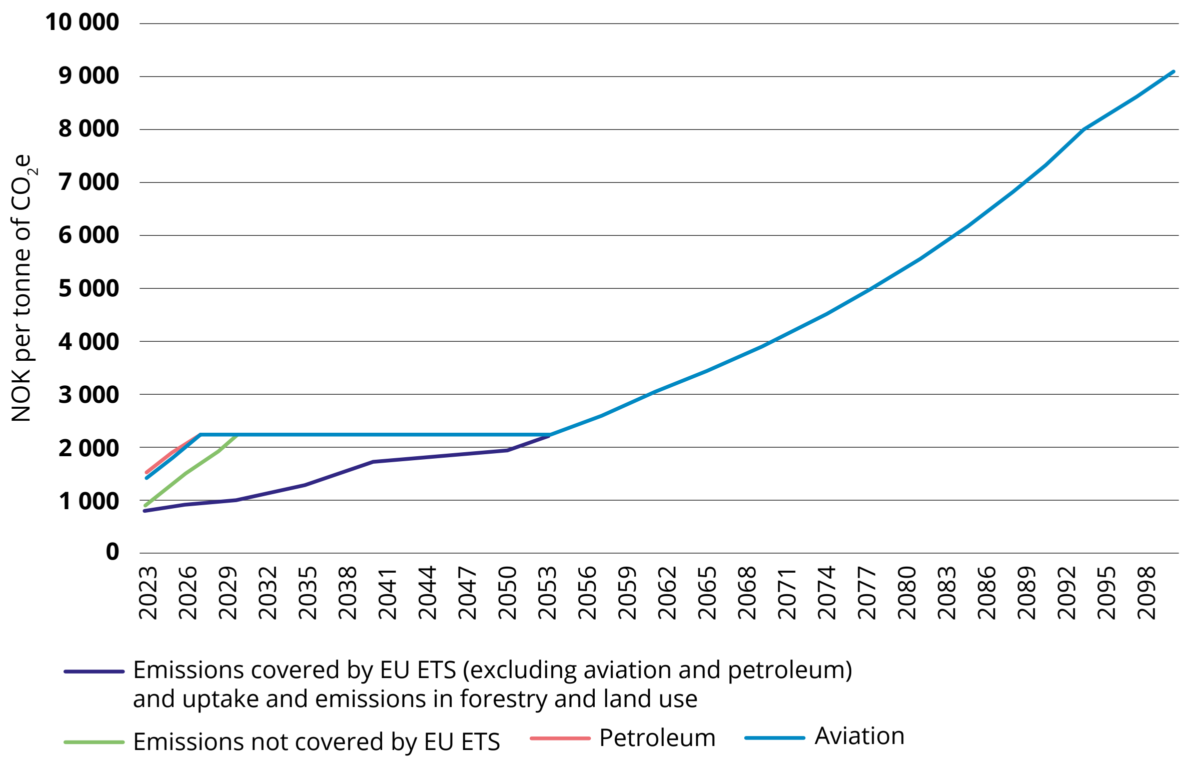


Figure 18.5 **Carbon price trajectories for use in socio-economic analyses in 2023.**

Source: Ministry of Finance

The starting point for discussions in the white papers on long-term perspectives on the Norwegian economy, which are published every four years, must be that the climate goals will be achieved. The white papers describe key developments and challenges for the Norwegian economy and the Norwegian welfare schemes in a long-term perspective. The Committee believes that several changes should be made to ensure that the white papers also reflect and discuss the transition to a low-emission society to a greater extent, including by:

- producing analyses and projections based on attainment of the climate targets and other sustainability goals.
- highlighting the relationship between projections of key macroeconomic variables such as GDP, consumption and investment and the Sustainable Development Goals, including whether and how continued economic growth will be consistent with the climate targets.
- describing how public finances are expected to develop in step with the transition to a low-emission society, which includes highlighting the distribution of costs between private enterprises and public authorities for investments relating to this transition.

At the same time, the white papers should also assess the consequences for Norwegian society and the Norwegian economy if global developments do not move in the desired direction.

The National Transport Plan provides important guidelines for future transport infrastructure and mobility patterns, and the goal of the plan must be aligned with goal of a low-emission society. The process leading up to the presentation of the National Transport Plan is also important. On behalf of the Government, the Ministry of Transport and Communications defines the starting point and premise for the plan, while the transport companies prepare the technical documentation. Traditionally, the National Transport Plan is based on projections of current and historical mobility patterns, and the technical basis is prepared by the individual transport agencies, each of which is responsible for different modes of transport. In order to become a low-emission society, the Committee believes that the starting point must be zero-emission mobility without greater land occupation in 2050 than today, as well as reduced demand for resources. There are many different ways to solve this, which the planning process can effectively elucidate, but the technical basis must rest on the premise that the transport system will be emission-free and resource and energy-efficient, and that modes of transport must be viewed in context so that the transport system as a whole is in line with the low-emission target. The Committee is of the view that the following should be done to improve the National Transport Plan:

- Avoid forecasting current transport patterns and historical transport developments to map future transport demand, and instead assume that mobility in 2050 will be zero emission and not entail greater land occupation than today.
- More of the technical basis for the National Transport Plan should be prepared across different modes of transport and expertise, rather than individual agencies responsible for parts of the transport system.

Circulars and guidelines can help strengthen the role of climate considerations. Circulars are briefings on the interpretation of laws and regulations prepared by ministries for those affected by them. For example, a ministry may prepare circulars for the municipalities or county governors. The aim of a circular may be to contribute to more uniform administrative practices in a field, for example climate and the environment. Guidelines provide guidance on how matters should be dealt with. The Committee is of the opinion that circulars and guidelines should be used more actively to clarify how laws and regulations that affect climate and nature should be applied.

Letters of allocation are government agencies' most important governance signal. The letters outline the financial framework and explain priorities, goals and reporting requirements. On assignment for the 2050 Climate Change Committee, the Fridtjof Nansen Institute has reviewed the ministries' allocation letters to the agencies to determine to what extent and how climate work is included in the management of the agencies (Bjander & Gulbrandsen, 2022). The analysis shows great variation in how climate action and emission reductions are emphasised in allocation letters and instructions. For example, they point out that climate change governance signals to the Directorate of Agriculture, the Norwegian Petroleum Directorate and the Norwegian Water Resources and Energy Directorate (NVE) are neither specific nor binding, despite the fact that these agencies represent important sectors in the transition to a low-emission society. The Committee is of the opinion that all government agencies should be given clear guidelines on how to contribute to Norway becoming a low-emission society. These guidelines must include both the agencies' own footprints and more general efforts towards low emissions. The Government may issue joint guidelines applicable to all allocation letters and thus also to all subordinate agencies. In 2022, for example, the Government issued joint guidelines on how to reduce the use of consultants. The Committee is of the opinion that joint guidelines must be issued to all subordinate agencies urging them to help Norway transition to low emissions, and how they must contribute.

The sectoral agencies must be given clear guidelines to prioritise work on emission reductions and to consider which climate mitigation measures and instruments are necessary in the transition to a low-emission society. The Norwegian Environment Agency has cross-cutting responsibility at agency level for making regular and comparable assessments of climate mitigation measures and instruments, but it is also important to build on the expertise of the various sectoral agencies. The agencies should therefore be explicitly requested to prioritise this. A formalised partnership has been established across government agencies and it is important that this is developed further. Letters of allocation and assignments to the sectoral agencies must provide clear guidelines on prioritising work on emission reductions in the transition to a low-emission society.

See also discussion in Chapter 10 of why effective planning and implementation of public investment projects is central to the successful transition to a low-emission society.

The public administration has an important role to play in ensuring that its own activities support the transition. This applies to both investments and how government agencies work to reduce emissions from their own activities. Chapter 10 discusses why effective planning and implementation of public investment projects is central to the successful transition to a low-emission society. In the view of the Committee, all government agencies (including ministries) must have climate goals and action plans for their own operations to ensure that the activities of their respective organisations contribute to the transition. This should also be reported on; see further explanation in Chapter 20.

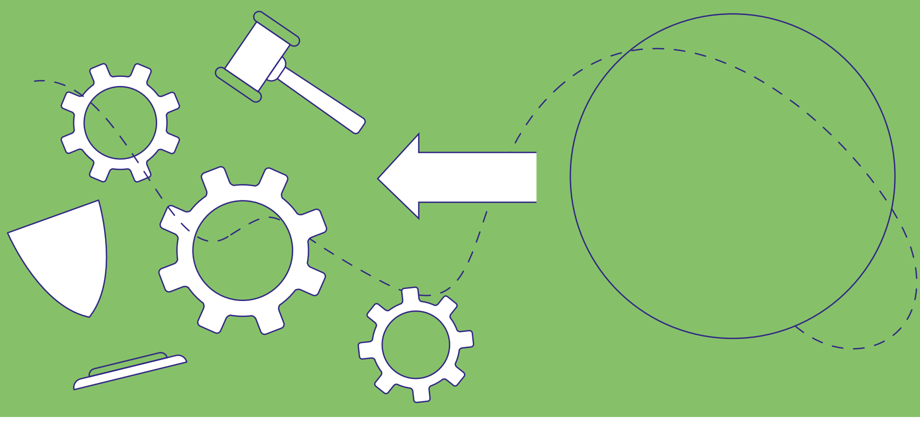
See the Committee's assessment of the need for good and understandable reporting in Chapter 20.

The State plays an important role through its direct ownership of several companies. The Government's ownership policy report describes how state ownership can contribute to maximum returns and good services, at the same time as the companies demonstrate responsible business conduct and help accelerate the green transition (Ministry of Trade, Industry and Fisheries, 2022). The report conveys that the State expects companies to set targets and take measures to reduce GHG emissions in the short and long term in line with the Paris Agreement, through concrete action plans. The State expects the goals to be reported on and for them to be based on science where possible.

The general public must be given genuine opportunities to participate and to influence decisions that are important for Norway's transition to a low-emission society. The purpose of the Environmental Information Act is to ensure public access to environmental information, making it easier to influence public and private decision-makers in environmental matters. The Act states that public authorities shall promote public participation in decision-making processes of significance to the environment. It is the duty of public authorities to give the public an opportunity to provide input in the planning of various climate mitigation measures and instruments. This applies to legislation, plans and programmes aimed at reducing emissions, but also when they will potentially contribute to increasing emissions and make it more difficult for Norway to achieve the climate targets. It is important that this duty is fulfilled by public authorities in the transition to a low-emission society. Legitimate processes and public involvement are essential, and the Committee elaborates on how this can be safeguarded in Chapter 4.

See the Committee's assessment of the need for public involvement and participation in climate policy in Chapter 4.

19 Implementing climate policy



In this chapter, the Committee looks at elements for a rapid and effective implementation of the transition, including organisation and coordination, and the need for knowledge and skills to implement climate policy.

19.1 Organisation and coordination to achieve more coherent policies

Norway must be rigged to implement the transition to a low-emission society. Figure 19.1 shows a summary of what the Committee believes can contribute to better organisation and coordination. It also shows the Committee's proposals for knowledge and skills development. A number of governance and planning tools are also important for implementing climate policy. The distinction between planning and implementation is not always clear, and several of the Committee's assessments in Chapter 18 are relevant to the implementation of climate policy.

Sector principle: that the central government administration is organised in accordance with the ministers' defined responsibilities. It is generally understood to mean that, when an activity is established, funds allocated, measures implemented and follow-up organised and this affects the responsibilities of several ministers, a single minister is nonetheless to be held accountable for this to the Storting.

The sectoral ministries and specialist agencies play a major role in implementing climate policy towards a transition in Norway. It must be ensured that all government institutions are on board with the long-term goal of becoming a low-emission society by 2050, including where the sector principle is strong. Norway must consider whether the current organisation is good enough to achieve a comprehensive transition. It may be necessary to change some institutions or possibly create new ones.

Coordination across sectors and policy areas is demanding in the Norwegian public administration. This is not the first time proposals for public sector reforms have been centred around coordination. According to a report from the Norwegian Agency for Public and Financial Management, the need for coordination has become more relevant now that public administration is facing more problems and of a more cross-sectoral nature than before (Difi & DFØ, 2019). Among other things, one of the issues criticised by the 22 July Commission was the public administration's weak capacity for coordination and interaction. The Office of the Auditor General has also criticised the public administration's lack of coordination. The DFØ report refers to a research project on governance reforms in Europe that showed that senior central government managers in Norway and 10 other European countries saw coordination as one of the most important reform trends. At the same time, the majority felt that there had been little or no actual improvement in the coordination. Coordination with other policy areas and across levels of government is considered significantly more demanding than coordination within a sector. This is also pointed out by the Norwegian Defence Commission, the Health Personnel Commission and the Coronavirus Commission, as referred to in Chapter 17.

See the Committee's assessment of the need for comprehensive policy development in Chapter 17.

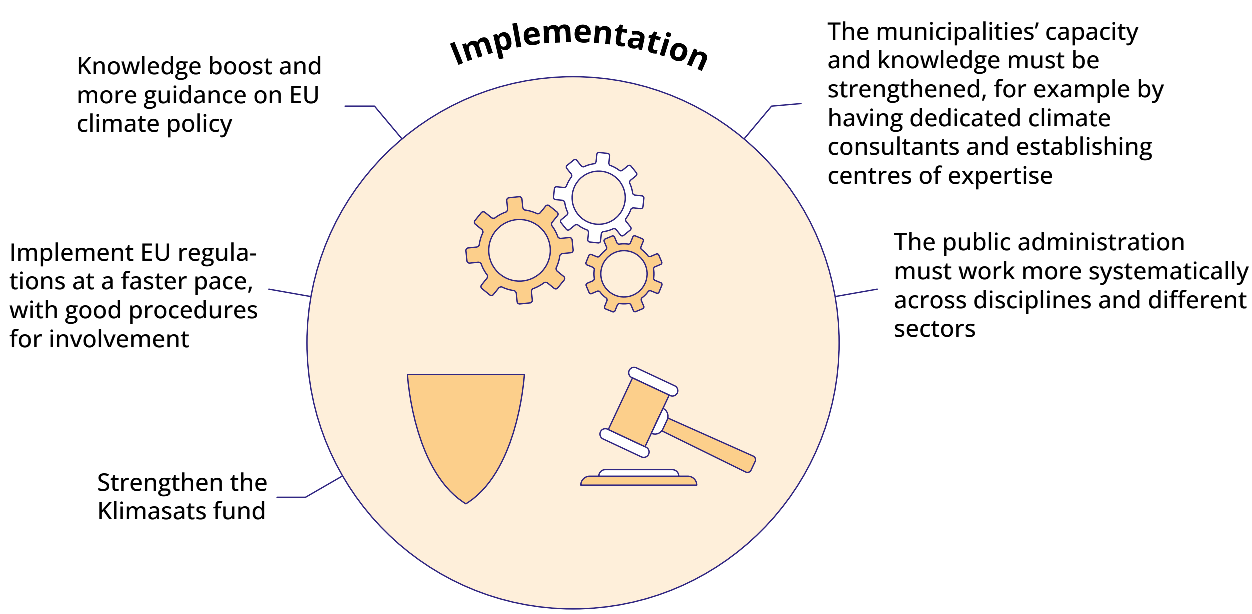


Figure 19.1 **Summary of the Committee's main recommendations under the pillar *implementation* in the proposal for a stronger climate governance system.**

Source: 2050 Climate Change Committee

However, sector orientation does not have to be problematic if the public administration strengthens its ability to coordinate decisions. In many cases, the decisions of one administrative body will affect or interfere with the responsibilities or priorities of another. Norwegian legislation often leaves considerable scope for discretionary assessment for the public administration to be able to handle such conflicts of objectives. However, some sectoral agencies may be under strong pressure to achieve sector-specific objectives at the expense of other important considerations. The OECD highlighted this as a challenge for Norway in the governance of land management (OECD, 2022). The Committee is of the opinion that the ministries and agencies should establish more cross-sectoral project groups across agencies to deal with specific tasks.

The ministries must work to achieve coordination across the board. The Committee has considered various measures for improved coordination that a selection of countries have implemented; see the digital appendix to the report. The governments of several of the countries have established dedicated intra-government groups or units for the transition to a low-emission society. These deal with initiatives and issues across policy areas that are important for the green transition, and have secretariats in the public administration that are responsible for coordinating work with the other ministries. As part of the joint ministerial strategy, several core groups have been established at secretary general level to meet the need for more coordinated, strategic and long-term governance. The groups will help safeguard sectoral policy goals and achieve better and more effective goal attainment across the ministries. A core group for climate and transition has been established that is chaired by the secretary general of the Ministry of Climate and Environment and consists of the secretary generals of the Ministry of Agriculture and Food, the Ministry of Trade, Industry and Fisheries, the Ministry of Transport and Communications, the Ministry of Petroleum and Energy, the Ministry of Local Government and Regional Development and the Ministry of Finance. According to the group's mandate, it will look at how existing processes and procedures can be improved and followed up in practice, and what signals and instructions it is appropriate for the secretary generals to give their ministries. One goal is for climate change and the transition to a low-emission society to be given sufficient priority in the ministries and agencies. It is also a goal for climate considerations to be integrated into and aligned with the values of sectoral policy. The Committee believes this is a good initiative and that it should be continued and further developed, for example in the form of collaborative groups at different levels of ministries and agencies, addressing various issues and processes. This will contribute to cross-sectoral coordination and ensure that climate policy is implemented by all ministries to a greater extent.

Climate change is one of several complex societal challenges that require collaboration and coordination across sectors. The Defence Commission refers to the need for measures to strengthen the Government and central authorities' ability to lead, manage, plan and develop policies for crisis management, security and preparedness, and to the need for a more comprehensive strategic approach to the challenges Norway may encounter (NOU 2023: 14, 2023). Similar assessments also apply to the transition to a low-emission society. The Defence Commission points out that, compared with many other countries, Norway has weaker traditions for employing a comprehensive, long-term approach in policy development. This is particularly true across sectors. Furthermore, the Commission highlights that, in order to build a stronger strategic culture, we need to strengthen existing arenas for collaboration at the central, regional and local level. More comprehensive strategic thinking is also needed to achieve the transition to a low-emission society. Strengthening the functions affiliated to the Office of the Prime Minister can contribute to greater predictability and long-term thinking across sectors, if these functions support a responsibility for coherent policies.

The Norwegian public administration is geared towards gradual change and is less well-equipped to carry out a major transition swiftly. The transition to a low-emission society requires the public administration to contribute to comprehensive societal change in a short space of time and as soon as possible. In relation to power production, for example, we may need to reduce the time it takes to plan, process applications and licences and develop new infrastructure. At the same time, there is a risk that this will come at the expense of assessments and emphasis on other considerations. This could be resolved by adopting a clearer framework for such decisions at regional or national level, as was done for example in the National Framework for Wind Power (NVE, 2019), where the Grid Development Committee presented a number of measures to achieve faster case processing (NOU 2022: 6). There may also be a need to change the organisational culture in parts of the public administration. The transport sector is an example where the current organisation is spread across several different agencies that are responsible for different parts of the sector, such as road, aviation and rail. In Sweden, the Swedish Transport Administration is responsible for the long-term planning of infrastructure for road, rail, maritime transport and aviation. In addition, the agency is responsible for the construction and operation of national roads and railways. A similar organisation may also be appropriate in Norway and should be considered. See Chapter 8 for a more detailed discussion of the transport system. Increased mobility across ministries and sectoral agencies, and more systematic collaboration across disciplines, can help case officers employ a comprehensive approach and work for a rapid, comprehensive change in society.

See discussion of the transport system in Chapter 8.

19.2 Strengthen municipalities' ability and willingness to contribute to the low-emission society

Municipalities must be given resources to deliver on the task at hand. Legal requirements, official guidelines or other guidance to take climate considerations into account are of little help if there are no resources available to implement measures. About half of the Norwegian municipalities have fewer than 5,000 inhabitants. These municipalities are home to 7 per cent of the population, but lay claim to 55 per cent of the land. As a result, they have limited resources compared with their geographical size, as the block grant for the municipalities is allocated on the basis of population figures rather than size. Such constraints mean that local climate ambitions may come into conflict with the overall goal of a municipality, which will always be to provide good services to the public. Norwegian municipalities do not currently have a statutory responsibility to work towards the transition to a low-emission society. With a tight budget, such work can often be given lower priority. In Chapter 18, the Committee recommends codifying municipalities' responsibility to contribute to the transition.

See also Chapter 18 for the Committee's recommendation to codify municipalities' responsibility to contribute to the transition to a low-emission society.

The need for providing financial incentives to the municipalities should be considered to enable them to contribute more towards national climate goals. The Government has established a grant scheme for the testing of rural development agreements, the objective of which is to contribute to increased settlement, access to skilled labour and forward-looking business development in the most peripheral parts of rural Norway. At present, climate mitigation measures are supported locally through the national Klimasats fund. The Norwegian Environment Agency has carried out an evaluation of the fund, which shows that it has benefits over and beyond direct emission cuts (Norwegian Environment Agency, 2023a). The main findings of the evaluation are that Klimasats has led to GHG emission cuts, mobilised municipalities across the country, reduced important barriers, changed practices and attitudes, provided experience of new technology and resulted in the development of methods and solutions with a huge diffusion potential. It has also specified and highlighted what climate action entails, and many of the measures have received considerable local attention and public support. The Committee is of the opinion that the Klimasats fund is important for the municipalities' capacity and ability to work on the transition to a low-emission society, and that it should be continued.

The municipalities' capacity for and expertise in climate and environmental management should be strengthened. It can be demanding for the public administration at all levels to have sufficient capacity and expertise to correctly understand, interpret and enforce the legislation that applies to climate and environmental management, but this challenge is often greater where less resources are available. Some municipalities have dedicated climate and environmental advisers, but this only applies to a minority. In Sweden, a system of local climate advisers has been established, which could also be considered in Norway. Ireland has established four Climate Action Regional Offices that work on both emission reductions and climate adaptation locally. In France, the agency for ecological transition (*Agence de la transition écologiue)* has local offices that contribute to the implementation of measures. The Committee has pointed out in several chapters that it should be easier for the municipalities to access expertise, for example in connection with land use management, circular economy and energy efficiency. The Committee recommends establishing municipal centres of expertise for this purpose. Such centres can be based on knowledge and experience gained through work on the Klimasats fund.

Circular economy: value chains in which the products/materials are used in different ways for as long as possible and then reused in a cycle. In a circular economy, products must last as long as possible, be repaired, upgraded and reused to a greater extent. When the products cannot be reused, the waste can be recycled and used as raw materials in new production. In this way, we use the same resources several times and generate the least possible loss.

Uneven distribution of expertise contributes to uneven implementation of national regulations and guidelines. Holth & Winge point out that the interpretation and enforcement of land use regulations require both overview and insight into a comprehensive, complex area of law (Holth & Winge AS, 2023). Better guidance material can contribute to that end. Legislative changes that make it clear which considerations should be emphasised in the application of law can also contribute to a better understanding in the public administration. There may be a need for a reprioritisation of existing resources, or a strengthening of the municipalities. The availability of continuing education and guidance can be important for the municipalities to fulfil their role in the transition. Building expertise among municipal elected representatives is also important. On behalf of the Ministry of Local Government and Regional Development, researchers at the University of Oslo have considered climate change adaptation measures in rural areas and recommend, among other things, the establishment of transitional regions where the county authorities and possibly the county governors can play a central role by serving as an ambulatory expert environment in support of rural municipalities' transition work (Centre for Development and the Environment (SUM), 2021).

19.3 Norway's cooperation with the EU

Norway's climate and energy policy is closely integrated with the EU's ambitious policy. The EEA Agreement and the climate agreement with the EU provide an important framework for Norway's climate policy. In Part C, the Committee recommends that Norway should continue its climate cooperation with the EU. Policy and regulatory development in the EU is rapid and affects a number of policy areas in Norway. This means that Norway must take steps at the national level to get the most out of the cooperation and be able to effectively integrate the EU's climate and energy regulations.

Norway will get more out of its climate cooperation with the EU by pursuing a more cross-sectoral approach. Work on assessing EU policy should be more cross-sectoral and facilitate a proactive Norwegian role in EU policy development. The Norwegian public administration and the process for assessing EEA relevance are currently linked to various sectors and areas of law. This can make it difficult to understand the complexity of a proposal at an early stage of the process. The EU's cross-sectoral approach to climate policy entails both opportunities and challenges for Norway. The Norwegian public administration currently deals with EU policy based on which sector the policy can be assigned to. This becomes increasingly difficult to define when the EU develops policy packages that create synergies between different fields of politics. Another challenge is that policies are being developed at a fast pace. It is demanding for the Norwegian public administration to keep up with regulatory developments in the EU and implement policies on a running basis. This, in turn, poses challenges for affected private companies in Norway, which need guidance and predictable framework conditions. At the same time, the ambition to maintain a fast pace in policy development has allowed the EU to make use of other types of cooperation that are less bound by formal rules for cooperation within the union. This can make it easier for Norway to influence policy before decisions are made.

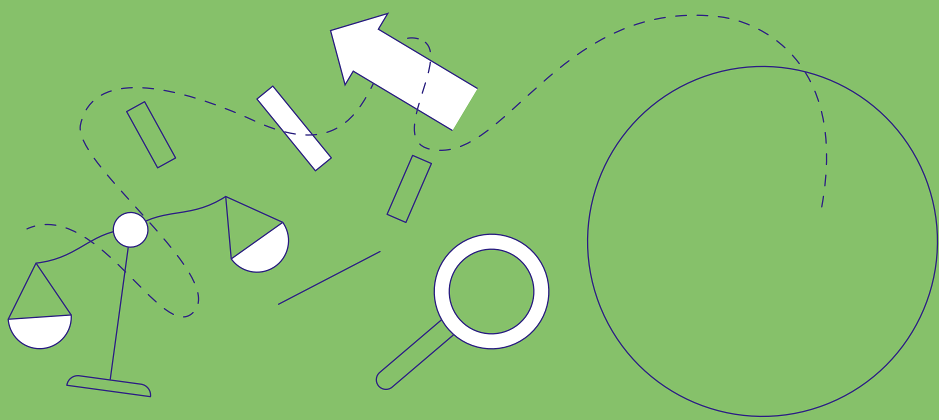
Early and broad public debate on EU climate policy is important to ensure legitimacy. At present, public debate on EU policy is often not initiated until the policy is to be incorporated into Norwegian legislation. Earlier involvement and increased public debate will strengthen legitimacy nationally and improve our ability to influence EU policy. This may become increasingly important as EU climate policy is tightened and has greater implications in Norway. Broader public debate could also give the Norwegian public a better understanding of the EU's importance for the transition of the Norwegian economy. Better procedures should be introduced for establishing Norway's position and public involvement to ensure broad public debate and support for EU climate policy at an early stage.

The Committee believes that the ministries jointly and the competent authorities must prioritise sufficient capacity and expertise to enable Norway to follow the pace and extent of the EU transition. How quickly Norway is able to make the transition is closely linked to our ability to swiftly implement EU policy. Limited capacity can be a barrier to this. One analysis refers to the European Green Deal as a democratic challenge for Norway, because it may be more difficult – at a stage when Norway is still able to influence policy – to get an overview of what consequences the policy will have (Farstad et al., 2021). Through the EEA Agreement, Norway is also dependent on Iceland and Liechtenstein not blocking decisions to introduce EU legislation in the EEA Committee. Implementation can thus also be limited by capacity challenges in Iceland and Liechtenstein. Lack of capacity and prioritisation can become a democratic challenge because it limits the ability of the Norwegian public administration to contribute to policy development in the EU. The public administration must have the capacity to identify and exercise Norway's freedom of action so that we can ensure adaptation to local conditions where needed. With greater capacity, Norway can also take part in initiatives and alliances on a more voluntary basis, which can also affect the transition in industries with many Norwegian companies.

European Green Deal: a green growth strategy to help Europe become the world's first climate-neutral continent. The goal is to transform the EU into a sustainable, circular and climate-neutral economy by 2050. Climate and environmental policy must be incorporated into all policy areas, and a broad range of policy instruments must be used.

We need more knowledge-building and guidance on EU climate policy. Much of EU policy that is implemented will affect Norwegian companies. If Norway effectively implements regulations and strategies, it can contribute to faster national emission cuts. An assessment should be made of the business sector's need for available information, guidance and standards that can help companies in their climate efforts and to meet their own climate goals. Both the Government and the public sector must work to improve environmental reporting. For example, the Government can make environmental reporting easier for Norwegian companies by facilitating better and more accessible information about reporting in line with the EU's criteria for sustainable business activities. The authorities should also consider the possibility of providing better guidance to Norwegian companies on the implementation of EU climate policy.

20 Evaluating climate policy



In this chapter, the committee looks at tools for regular assessment and further development of climate policy.

20.1 Thorough and understandable reporting

Climate policy evaluations are necessary to see what works and what needs to be adjusted. Transparency and reporting are important for the public to be able to monitor developments. Figure 20.1 shows a summary of what the Committee believes can contribute to a better assessment and evaluation of where we are heading and whether we are on track to achieving the climate targets.

Transparent, accountable information is a prerequisite for gaining popular support and ensuring the legitimacy of the policy pursued. The population must be able to rely on the information provided and monitor whether the policy is being implemented. It must be possible to hold decision-makers accountable for the policy they pursue. Reporting is an important tool for transparency and verifiability.

Regular reporting on progress towards the goals and transparency about how the policy is implemented will show whether Norway is on the right track. Reporting under the Climate Change Act has been a permanent item in the Ministry of Climate and Environment's budget proposal to the Storting for the past five years. The reporting has helped raise awareness of how the Government works on climate policy. At the same time, much of the content of the reporting has been difficult to access, and it has not always been easy to get a clear picture of Norway's status towards fulfilment of the climate targets and whether the transition is on the right track.

The Committee believes annual climate reporting should increasingly contribute to transparency, public debate and to communicating clearer information about Norway's status in this respect. In Chapter 18, the Committee proposes presenting climate and energy action plans every other year. Reporting should be based on this plan and provide a simple presentation of status. The Committee recommends including a separate chapter that evaluates the implementation of the comprehensive climate and energy action plan, and which policies have been implemented and which have not (and why). The Committee believes reporting should also be further developed so as to better elucidate the impact of planned and adopted measures in the short, medium and long term, and how the policy facilitates the transition. The main purpose of reporting must be to obtain a good basis for assessing whether climate policy should be updated or adjusted to achieve the targets, so that this can be incorporated into the next action plan. It should also be considered how indicators and their further development can be used in reporting. The Committee recommends revising the Climate Change Act's provision on reporting to reflect the recommendations described above.

See also chapter 18 for a proposal to present climate and energy action plans every other year.

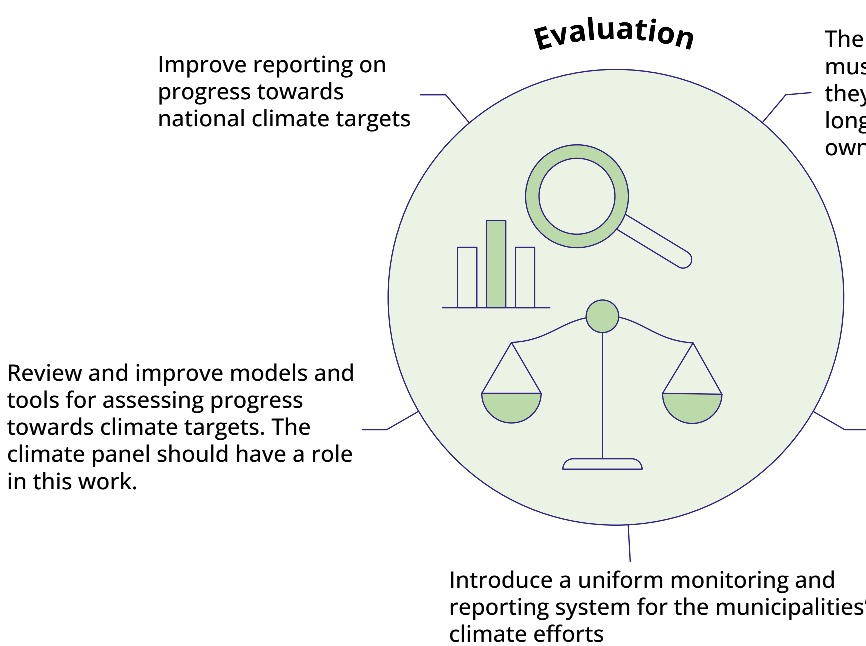


Figure 20.1 Summary of the Committee's main recommendations under the pillar *evaluation* in the proposal for a stronger climate governance system.

Source: 2050 Climate Change Committee

Effective monitoring of compliance can increase the legitimacy of the policy. Well-functioning control mechanisms that monitor how the Government follows up requirements can help create trust. Several bodies have been established in Norway to oversee the Government and the public administration:

– The *Office of the Auditor General* (OAG) is the Storting's most important supervisory body. The OAG ensures that government assets are managed in a prudent manner in accordance with the Storting's resolutions and assumptions,

that the Storting's resolutions are implemented effectively, and that the county governors work in accordance with laws and regulations.
- *The Parliamentary Ombudsman* is tasked with overseeing that the public sector treats the population fairly.
- The *Norwegian Better Regulation Council* is a free, independent administrative body that aims to promote good decision-making and effective regulation of business and industry. The Council comments on regulatory proposals aimed at the business sector when they are distributed for consultation.
- *The Norwegian National Human Rights Institution (NIM)* is tasked with promoting and safeguarding human rights in Norway, and is an independent public body organised under the Storting. NIM contributes specialist knowledge and provides advice and guidance to enable government authorities to effectively fulfil their human rights responsibility.
- In connection with the consideration of the Climate Change Act in 2017, the Storting decided to appoint a technical committee responsible for calculations in the field of climate change mitigation (*Teknisk beregningsutvalg for klima*). The commission is tasked with proposing methods and calculating how the national budget affects the climate, and with providing advice on how existing methods for climate action and policy instrument analyses can be improved.
- In addition, the *EFTA Surveillance Authority (ESA)* evaluates Norway's progress towards meeting its obligations in the EU's climate regulations, and conducts a technical expert audit of reporting under the United Nations Framework Convention on Climate Change (UNFCCC) (EFTA Surveillance Authority, 2022).

See Chapter 18, where the Committee points out that a climate panel can help facilitate the implementation of climate policy by providing independent expert advice and contributing new knowledge.

The policy choices needed to become a low-emission society must be made by elected representatives. The Committee considers it important that politicians, and not institutions, are tasked with making decisions on how Norway will become a low-emission society, to prevent a shift away from democratic processes. The Committee does not see a need to appoint a new body to monitor compliance with climate policy. As pointed out in Chapter 18, however, the Committee believes that a climate panel can help facilitate the implementation of climate policy by providing independent expert advice and contributing new knowledge.

Models and tools for assessing progress towards the climate targets should be improved. As described above, the Climate Change Act contains a requirement for the Government to annually report the status and progress to the Storting, and the Committee believes this reporting should be further developed. One challenge is that it is difficult to assess the figures, methods and projections presented, and the assumptions on which they are based. There is also a need to improve the methods and tools used in reporting. In its report from 2022, the technical committee responsible for calculations in the field of climate change mitigation identified a need for more systematic and better documentation of the methods used, and of the assumptions that form the basis for emission projections, in order to increase transparency (Technical committee responsible for calculations in the field of climate change mitigation, 2022). The responsibility for assessing and improving methods and tools for reporting should rest with the climate panel the Committee has recommended establishing (see Chapter 18). The Committee is of the opinion that this work must be based on the work of the technical committee.

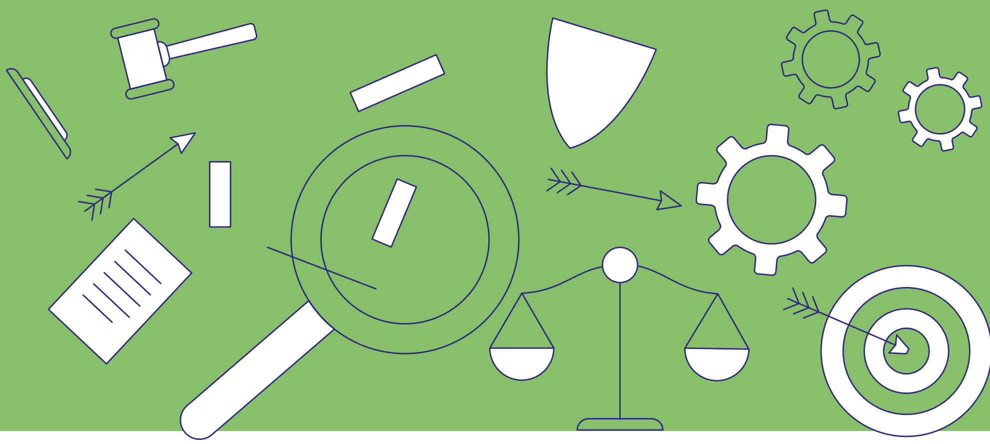
The various government bodies and agencies must be measured on how they contribute to achieving the long-term climate targets. In Chapter 18, the Committee recommends that government agencies should have their own climate goals and action plans to contribute to the transition, and that the Government should maintain overall control of how underlying bodies and agencies work to reduce emissions. Reporting and monitoring procedures should be established as part of this effort. Such monitoring and reporting can contribute to a better and more comprehensive overview of the activities of the various agencies and bodies. There is already an established management control system for the central government, which includes performance management, where such monitoring and reporting can be included (DFØ, 2023a).

A uniform monitoring and reporting system should be introduced for the municipalities' climate efforts. In Chapter 18, the Committee recommends codifying the municipalities' responsibility towards the transition, and that consideration should be given to introducing requirements for plans that outline their climate mitigation measures and climate budgets. In order to monitor their fulfilment, this responsibility should also include reporting. Under the Local Government Act, municipalities are required to disclose information about finances, use of resources and services to the central government through a national information system (KOSTRA). This provides information about the performance of municipal and county activities. In the Committee's opinion, it should be considered whether to introduce a similar monitoring and reporting system for the municipalities' climate efforts, or to integrate such reporting into the current information system. This will also help give the Government a more comprehensive picture of the municipalities' progress.

There is also a need for better knowledge about the effects and consequences of policies and measures implemented by municipalities and county authorities. This applies in particular to how decisions relating to waste, transport and land use contribute to achieving climate and environmental goals. Such information can be included as part of a uniform monitoring and reporting system for the municipalities' climate efforts. It will also help provide the Government with more information about the combined effects of municipal and county-level decisions on the transition to a low-emission society. This was one of the key recommendations in the OECD's review of Norway's climate and environmental policy in 2022 (OECD, 2022). Information about municipalities' climate efforts should be easily accessible to the public to ensure transparency and verifiability. In Chapter 15, the Committee recommends that the Government should more effectively facilitate learning from experience as new policy instruments are introduced. The Committee recommends better facilitation of experimentation and learning, for example by introducing instruments gradually or in different areas or for different user groups at different times. Municipalities and county authorities can be good arenas for such policy development. Experimentation must be followed by an impact evaluation to be able to assess the effect of a policy instrument (Nygård, 2023).

See also Chapter 15, where the Committee recommends that the government should more effectively facilitate learning from experience as new policy instruments are introduced.

21 The Committee's recommendations for Part D



The Committee believes that Norway needs a stronger framework and a system that helps us pursue a longer term, broader and more comprehensive approach to the transition to a low-emission society. There is a need for a new systematic approach to how climate and nature considerations are safeguarded. The climate transition must be organised based on the premise that, in 2050, there will be a very limited emissions budget and scarce resources, and that undesirable path dependency must be avoided. The Committee therefore has the following recommendations:

- quickly establish an enhanced climate governance system in the work on transitioning Norway to an almost emission-free society in 2050.
- ensure that Norway draws greater inspiration from how other countries use climate legislation as a management tool and that we further develop the Norwegian Climate Change Act.
- establish five-year emission budgets leading up to 2050, where the budget for the next two five-year periods is more binding.
- present comprehensive climate and energy plans in the form of a white paper every other year, and see these in the context of other key policy documents.
- ensure that the ministries responsible for the various sectors are given responsibility for showing how their sector will contribute to the long-term transition and to achieving the short-term targets.
- base plans on broad and ambitious political agreements.

- ensure that climate and energy plans include:
  - various sectors' contribution to emission reductions and removals, with concrete plans for emission cuts and an assessment of what resources this will require.
  - an analysis of when and how the different emissions can be phased out.
  - an overarching assessment of the overall supply and demand of various resources.

- climate policy and climate and energy plans must be based on an up-to-date scientific basis and knowledge, and therefore:
  - the Norwegian Environment Agency should be required by law to present an annual scientific basis for climate policy measures and instruments in collaboration with other sector agencies that includes long-term and comprehensive analyses.
  - an independent climate panel should be established in Norway that provides input and advice on climate policy and helps to generate new knowledge and perspectives.

- stipulate a requirement in the Climate Change Act to create five-year emission budgets, present comprehensive climate and energy plans every other year and to present a joint scientific basis every year.

- assign the municipalities a clear statutory responsibility to contribute to Norway's transition to a low-emission society, and strengthen key legislation such as the Municipalities Act and the Planning and Building Act as tools for the municipalities' climate transition.

- ensure that the Government takes responsibility for enabling municipalities to pursue an ambitious climate policy and removes barriers that can restrict their climate efforts.

- ensure that all planning is based on the emissions budget for 2050, avoiding unwanted path dependency and the scarcity of resources by:
  - introducing an overriding requirement in the Climate Change Act to assess the consequences for climate transition, inspired by the European Climate Law.
  - 'climate-washing' Norwegian legislation to strengthen the legal position of climate considerations so that the public administration is subject to clear requirements for and the legal authority to emphasise the transition to a low-emission society.
  - using circulars and guidelines more actively to clarify how laws and regulations that affect climate and nature are applied.

- ensuring that all key decision-making tools and Norwegian societal goals are consistent with Norway becoming a low-emission society, including for:
  - forecasts and premises for planning in different sectors
  - the National Transport Plan
  - the white paper on long-term perspectives for the Norwegian economy
  - the Basic Agricultural Agreement
  - the Instructions for Official Studies and Reports and pertaining guidelines
  - choice of concept assessments (KVU)
  - the carbon price trajectories used in government decisions

- give all subordinate agencies clear guidelines (common guidelines) to help Norway transition into a low-emission society and show how they can contribute.

- the public sector must ensure that its own activities support the transition to a low-emission society. Government agencies should be required to adopt climate targets and action plans for their own activities.

To contribute to the implementation of policies aimed at becoming a low-emission society, the Committee has the following recommendations:

- ensure that ministries and sector agencies work more systematically across disciplines, for example by creating cross-sectoral project groups across entities and increasing mobility across different sectors.

- build capacity and expertise in the municipalities' climate and environmental management, for example by having dedicated climate consultants. Centres of expertise should be established for the municipalities that can help raise competence in land use management, the circular economy and energy efficiency in Norwegian municipalities.

- strengthen the Klimasats fund as an important competence-raising measure for the municipalities.

- implement EU transition regulations at a faster pace, and increase capacity, knowledge and expertise.

- introduce improved procedures for public involvement to ensure broad public debate and support for EU climate policy at an early stage.

- stimulate a knowledge boost and provide more guidance on EU climate policy to the public administration, businesses and the public.

In order to systematically evaluate progress in climate policy, the Committee has the following recommendations:

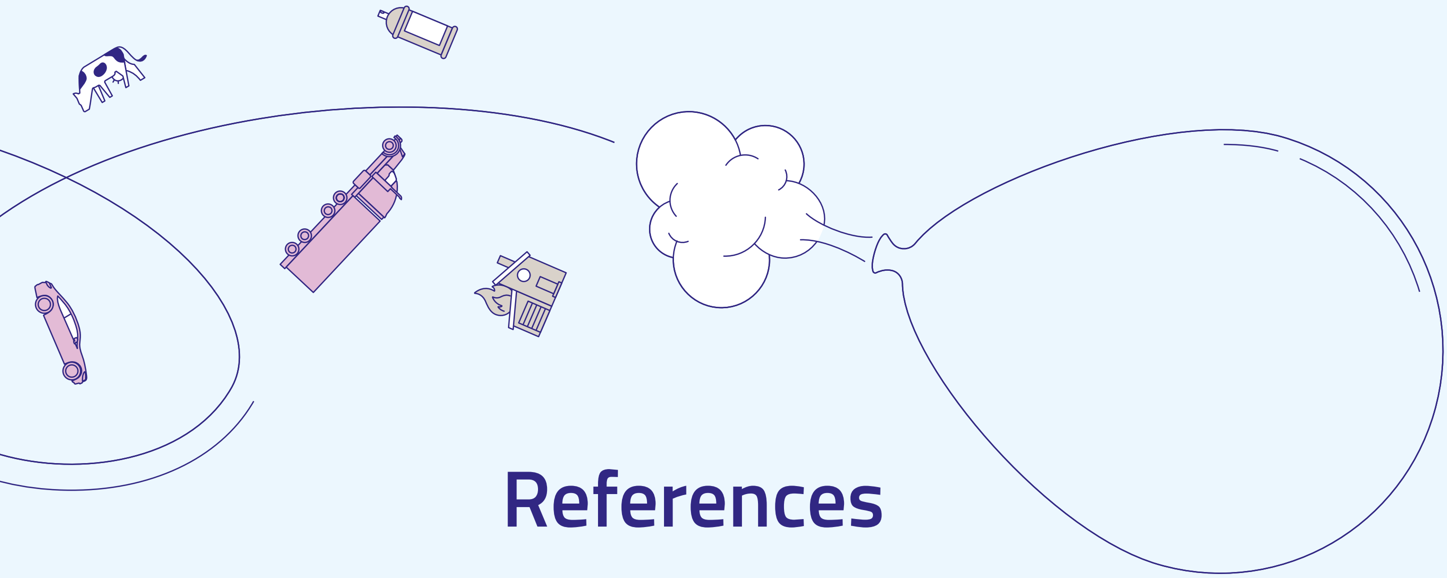
- further develop annual reporting under the Climate Change Act to:
  - increasingly contribute to transparency, public debate and to communicating clearer information about Norway's status on fulfilment of climate targets.
  - include a separate chapter that evaluates the implementation of the comprehensive climate and energy plan, which policies have been implemented and which have not (and why).
  - better elucidate the impact of planned and adopted measures in the short, medium and long term, and how the policy facilitates the transition.

- review and improve models and tools for assessing progress towards climate targets. The climate panel proposed by the Norwegian commission for estimating emission effects of climate change measures should have a role in this work. The Committee is of the opinion that such a climate panel must further develop the commission's work.

- introduce a uniform measurement and reporting system for municipalities' climate work and ensure that this is seen in the context of the statutory requirement for municipalities to contribute to the transition.

- ensure that the State's various subordinate agencies are measured on their performance and that they report on how they contribute to achieving the long-term climate target, their own climate targets and action plans.

- facilitate opportunities to experiment and learn from experience with the use of policy instruments. Such experimentation must be followed by an impact evaluation to be able to assess the effect of a policy instrument.



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Overview of meetings, events, contributions and introductory speakers

The following have given introductory talks at committee meetings:

- Tim Benton, Chatham House
- Yngve Birkelund and Johannes Fjell Hojem – UiT Arctic Centre for Sustainable Energy
- Anne Marit Bjørnflåten – Oceanfood AS
- Torjus Bolkesjø – NMBU
- Helge Brattebø, Arild Gustavsen and Terje Jacobsen – FME ZEN SINTEF/NTNU
- Annechen Bahr Bugge – Oslomet
- Pernilla Marianne Carlsson – NIVA
- Marianne Chesak – Rogaland county authority
- Bent Dreyer – Nofima
- Odd Edvardsen, Elisabeth Rønning and Terje Wikstrøm – Hammerfest municipality
- Henrik Hallgrim Eriksen, Anne Gislerud, Nina Rør and Hilde Hallre Le Tessier – Ministry of Climate and Environment
- Ole Kristian Fauchald – FNI/UiO
- Rune Dahl Fitjar – UiS
- Henrik Gade, Øyvind Kristoffersen, Birgitte Laird, Christine Maass and Mats Nordum – Norwegian Environment Agency
- Per Arild Garnåsjorden, Kristine Grimsrud, Trine Randen and Margrete Steinnes – Statistics Norway
- Kasper Hancke – NIVA
- Jon Ødegård Hansen and Jarand Rystad – Rystad Energy
- Bård Harstad – UiO
- Edgar Hertwich – NTNU
- Fredrik Holth and Nikolai Winge – Holth and Winge
- Birthe Ivars, Tom Oddgeir Johnsen and Ragnar Semundseth – Mission of Norway to the EU
- Tom Eirik Jakobsen – Horisont Energi
- Åsa Johansson – OECD
- Youth Climate Change Committee, represented by Anam Amer – Red Cross Youth, Hannah Baarøy – the School Student Union of Norway, Silje Brekke Bakken – the Norwegian Children and Youth Council (LNU), Ingrid Theminda Larsen – YWCA-YMCA Guides and Scouts of Norway, Sofie Gilstedt Odberg – Norwegian Rural Youth, and Thea Tuset – the National Union of Students in Higher Vocational Education and Training in Norway
- Christian A Klöckner – NTNU
- Kristiane Mauno Krystad – Arctic Energy Partners

- Svein Kvernstuen and Kristin Skofteland – Beyonder Battery Factory
- Svein-Håkon Lorentsen – NINA
- Silje Karine Muotka – Sami Parliament
- Norunn Sæther Myklebust – NINA
- Nils Kristian Nakstad – Enova
- Arvid Nesse – Norwegian Offshore Wind Cluster
- Karen O'Brien – UiO
- Lennart Olsson – Lund University
- Gunn-Britt Retter – Saami Council
- Johan Rockstrøm – Potsdam Institute for Climate Impact Research
- Knut Einar Rosendahl – NMBU
- Pierre Schellekens – European Commission
- Jon Arne Silgjerd – Wise Group Automasjon og Data
- Anna Skarin – Swedish University of Agricultural Sciences
- Solrun F Skjellum – NIVA
- Thomas Moe Skjølsvold – NTNU
- Gunnhild Sørgard – NIBIO
- Berit Tennbakk – Thema Consulting
- David G Victor – University of California San Diego
- Hege Westskog – UiO
- Therese Hugstmyr Woie – Norwegian Society for the Conservation of Nature, Finnmark and Troms branch

The Committee has organised several meetings to gather input from external stakeholders. In autumn 2022, the Committee organised dialogue meetings on various resources of relevance to the transition to a low-emission society. The following gave introductory talks at committee meetings:

- Anne Kjersti Bakken – NIBIO
- Anders Bjartnes – Energi og Klima
- Jan Bråten – Statnett
- Koen Deconinck – OECD
- Peter Haugan – Institute of Marine Research
- Kjetil Lund – NVE
- Klaus Mittenzwei – Ruralis
- Mats Nordum – Norwegian Environment Agency
- Solrun Figenschau Skjellum – NIVA
- Christian Anton Smedshaug – Agrianalyse
- Aud Tennøy – Institute of Transport Economics
- Bente Torstensen – Nofima
- Vigdis Vandvik – UiB