Oslo

Supporting Materials for Climate Budget 2025

Appendix to Proposition 1/2025

Foto: Fartein Rudjord

1. Introduction

This document is a technical appendix to the Climate Budget 2025, Proposition 1/2025, the City Government's 2025 budget proposal, and the financial plan for 2025-2028. The document outlines the methodology behind the results shown in the Climate Budget 2025. This includes how approved measures have been calculated and the uncertainties in these calculations. Additionally, it describes identified measures that are not yet adopted but could help close the gap toward achieving the climate goals.

1.1 About the Climate Budget

The City of Oslo uses the climate budget as a governance tool to systematize and target its climate work. The climate budget is an integrated part of the financial budget and puts climate work on the agenda in all municipal budget discussions. Climate considerations are also included in the city's formal budget documents for the agencies.

The climate budget contains measures to be implemented during the financial plan period and assigns responsibility for implementation and reporting. The measures in the climate budget are reported on three times a year, in line with other budget reporting, providing a clear overview of progress and opportunities for adjustments.

A central part of the climate budget is assessing the impact of the measures and whether Oslo will meet its climate goals for 2030. These analyses help strengthen existing measures and highlight where additional measures are needed to fill gaps. For emissions within Oslo's boundaries, the municipal-level greenhouse gas inventory from the Norwegian Environment Agency is used to assess progress and goal achievement. For other goals, there are currently no comparable national inventories that are updated annually. Therefore, the Agency for Climate has developed the Climate Barometer and Energy Barometer, which include indicators showing progress in key areas for each of the climate goals. Since the municipal-level inventory is not updated as frequently as the city's reporting, indicators from the Climate Barometer are also used to supplement the assessment of how Oslo is progressing in reducing direct emissions.

Oslo's municipal government, businesses, and population contribute to emissions both within the city's boundaries (direct emissions) and outside (indirect emissions). The Greenhouse Gas Protocol divides these emissions into three "Scopes": Scope 1 emissions are direct emissions occurring within Oslo's borders. Scope 2 emissions are those from energy production outside the city that is consumed within Oslo. Scope 3 emissions mainly consist of emissions from the production and transport of goods and services outside the city limits, driven by consumption within the city. Oslo has climate goals to reduce all these emissions. Additionally, the city aims to manage its natural carbon sinks effectively, increase carbon uptake, and enhance Oslo's resilience to climate change.

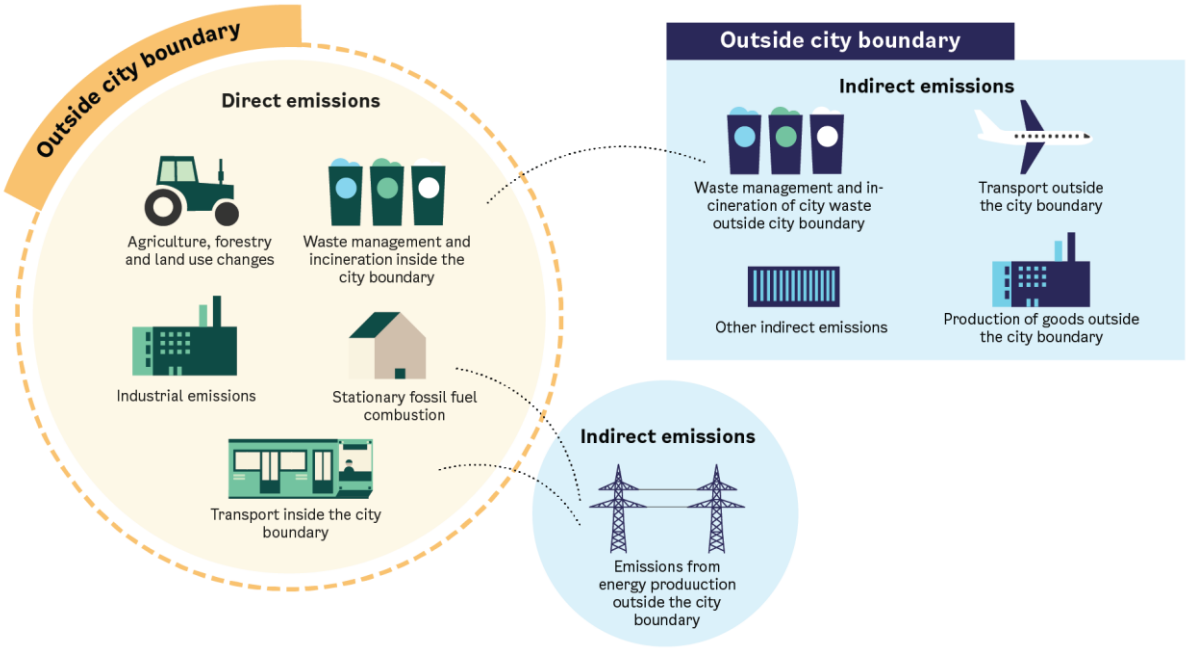


Figure 1: System boundaries for direct and indirect emissions, Scope 1, 2, and 3

1.2 Other Benefits and Cost Effects

Several measures in the climate budget provide positive effects beyond reducing greenhouse gas emissions. Measures that reduce traffic and increase the use of zero-emission technologies improve air quality and reduce noise. The electrification of vehicles and machinery also leads to less vibration and better working conditions for employees. Measures that promote cycling and walking, as well as the preservation of nature, trees, and green spaces, provide health benefits. Local energy production measures, such as rooftop solar panels, reduce the need for land interventions elsewhere. Improved stormwater management and water purification lead to better water quality in the Oslofjord. Measures aimed at reducing indirect emissions help reduce the use of land, water, materials, and fossil fuels beyond Oslo's borders. By being better adapted to climate change, the city reduces potential future damage costs. Additionally, many energy-related measures improve indoor climate and lower energy costs.

However, these measures may have economic consequences beyond what the city budget covers. For instance, requirements for businesses to adopt zero-emission solutions may be more costly in the short term than fossil-based alternatives. Nevertheless, companies that reduce emissions early may gain a competitive advantage by being better prepared for new regulations and restrictions in a rapidly transitioning world.

Transportation and construction are expected to be the sectors where climate measures have the greatest impact on the population and businesses. Measures targeting businesses may entail economic risks during the transition to new solutions, with varying impacts on large and small companies. To avoid uneven distributional effects, the municipality is considering the need for mitigating measures. Additionally, the municipality has grant schemes to reduce the costs of the transition for businesses, through the Climate and Energy Fund. Further assessments of distributional effects related to specific measures are discussed in the sector chapters below.

2. Direct Emissions

Oslo has a goal to reduce direct greenhouse gas emissions by 95% by 2030 compared to 2009 levels.

2.1 Historical Development in Greenhouse Gas Emissions

The Norwegian Environment Agency's municipal-level greenhouse gas inventory provides emissions data for the years 2009, 2011, 2013, and 2015-2022. Figure 2 shows the distribution of emissions by sector in Oslo for 2022. The road transport sector is further divided into light vehicles (passenger and delivery cars) and heavy vehicles (trucks and buses) to provide more detailed information.

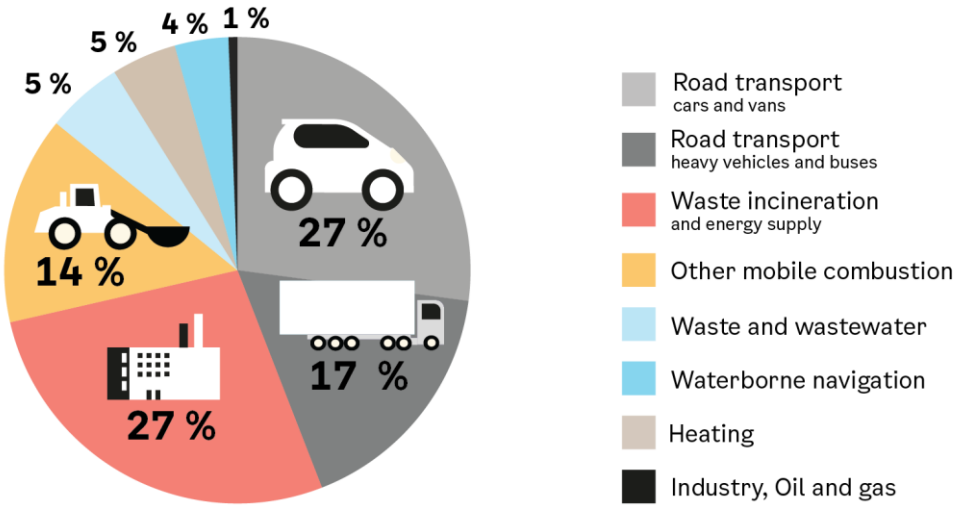


Figure 2: Greenhouse gas emissions in Oslo in 2022.

In 2022, emissions in Oslo amounted to 965,395 tons of CO2 equivalents. The largest sources of emissions are road transport (44%), waste incineration and energy supply (27%, primarily from the incineration of fossil waste), and other mobile combustion (14%, mainly the use of construction diesel).

The greenhouse gas inventory shows a 28% reduction in emissions since 2009. This decrease is mainly due to the ban on the use of mineral oil for heating, the increase in electric vehicles, and the use of biofuels in road transport and construction activities. From 2021 to 2022, emissions decreased by 0.2%.

All sectors except heating and industry, oil, and gas saw a reduction in emissions from 2021 to 2022. Emissions from industry, oil, and gas in 2022 amounted to just under 5,900 tons of CO2 equivalents, but only include emissions from facilities reporting to the Norwegian Environment Agency. Statistics Norway calculates emissions from industrial plants that do not report to the Norwegian Environment Agency, but this is excluded from the greenhouse gas inventory due to significant uncertainty. In 2022, these emissions were estimated to be around 18,000 tons of CO2 equivalents in Oslo. This suggests that emissions from industry are underestimated in the Norwegian Environment Agency's greenhouse gas inventory. Emissions from the use of fossil oil for building heating increased by 13,000 tons of CO2 equivalents, but these figures are highly uncertain.

2.1.1 Uncertainties in the Greenhouse Gas Inventory

The Norwegian Environment Agency's greenhouse gas inventory is continuously being improved but still has uncertainties. When methodologies are improved, the entire emissions series is adjusted back to 2009.

The availability of data sources varies between emission sources, leading to differences in the certainty of the emission figures in the inventory. Where direct reported figures are not available from the municipality, allocation keys or models are used to distribute national emissions among municipalities. There are particularly large uncertainties in the inventory where emissions are allocated based on population or the number of employees in an industry. This applies, for example, to the "Other mobile combustion" sector, which includes non-road machinery. As a result, reductions from Oslo's zero-emission construction sites are not correctly allocated to Oslo but are instead distributed across all municipalities. The municipality's own reporting shows that in 2022, emissions of around 14,000 tons of CO2 equivalents were avoided due to the use of fossil-free and zero-emission machinery. These are conservative figures, as reporting from all projects is not sufficiently comprehensive.

For non-road machinery not used on construction sites, the Climate Agency's assessment is that Oslo may have been allocated too high an emission value. For example, the source "Services related to transportation" (over 58,000 tons of CO2 equivalents in 2022) is primarily allocated based on the number of employees in the industry. Oslo has many headquarters with large numbers of employees. The Climate Agency has also collected data and information from major operators such as DB Schenker and Bring, which should have many machines attributed to this source. They report annual diesel consumption equivalent to 2-3% of emissions within the "Services related to transportation" source. While there are likely a few other operators of similar size, this suggests that the emissions attributed to Oslo in the greenhouse gas inventory are too high.

Similar challenges exist within the "Heating" sector, where many emissions are allocated to wholesalers. If there is no information on where the wholesalers sell their products, the entire sale is attributed to the municipality where the wholesaler is registered. This could result in a higher emission figure for Oslo than is accurate, but the extent of this is unclear.

The Norwegian Environment Agency's greenhouse gas inventory provides important management information for Norwegian municipalities. It is therefore crucial that the Norwegian Environment Agency continues to develop the greenhouse gas inventory to reflect actual emissions in the municipalities. The City of Oslo, through the Climate Agency, is working with the Environment Agency to improve the greenhouse gas inventory.

2.2 Climate Budget Analysis for Direct Emissions

This chapter explains the analysis of direct emissions in the Climate Budget 2025. The climate budget shows estimates for how emissions may develop toward 2030, considering both adopted and identified measures, and outlines the gap remaining to reach the 95% reduction target by 2030. The climate impact of all measures in the climate budget is calculated using a baseline path that shows emission trends under the current situation. This gap analysis is presented in Proposition 1 Climate Budget 2025 and depicted in Figure 3. Table 1 shows the data underlying the figure, as well as the development of the underlying baseline path. The following subsections explain the use of the baseline for impact calculations and how this, combined with measure calculations, is used in the annual climate budget analysis.

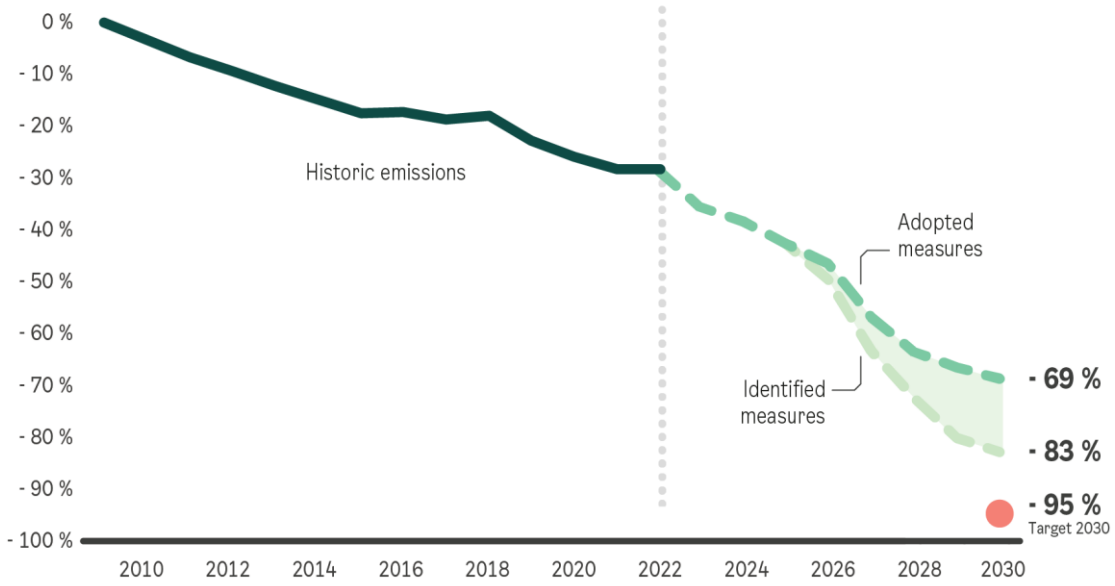


Figure 3: Estimated emission trends toward 2030 as a result of adopted measures and the potential for emission cuts if newly identified measures are adopted.

Table 1: Calculated emission reductions within Oslo's boundaries in the baseline and with adopted and identified measures (data basis for Figure 2 in Climate Budget 2025)

	2025	2026	2027	2028	2029	2030
Baseline	-37 %	-39 %	-41 %	-43 %	-45 %	-47 %
Adopted measures	-43 %	-46 %	-57 %	-63 %	-66 %	-69 %
Identified measures	-43 %	-49 %	-63 %	-72 %	-80 %	-83 %

2.2.1 Projections of Greenhouse Gas Emissions Toward 2030 (Baseline)

The climate impact of all measures in the climate budget is calculated based on a baseline that shows the projected development of emissions under the current situation. The baseline is a projection of how greenhouse gas emissions in Oslo might develop toward 2030, assuming that current national and local measures continue. It is based on the best available knowledge of historical greenhouse gas emissions and trends (Norwegian Environment Agency, 2024), as well as forecasts for future population growth, technological development, activity levels, and economic development toward 2030. The baseline is updated annually by the Climate Agency. Using a baseline for calculating the climate impact of measures ensures the most consistent calculations possible and prevents over- or underestimations of the effect, as the baseline accounts for underlying societal developments.

In the baseline, a 47% reduction in greenhouse gas emissions by 2030 compared to 2009 levels is projected (Cicero, 2022). The emission reduction in the baseline is almost entirely due to a decrease in emissions from road transport, driven by an increasing share of zero-emission vehicles. Most of the reduction comes from passenger cars, with some reductions from vans and heavy vehicles.

Emissions also decrease in the Waste and Wastewater sector due to the gradual decline in methane production from closed waste landfills as the waste breaks down and diminishes. Additionally, emissions from heating decrease due to the phase-out of fossil oil and kerosene for heating. Emissions from maritime transport are projected to remain relatively stable toward 2030.

Emissions from waste incineration and energy supply are expected to remain relatively stable toward 2030, with a slight decline late in the period due to increased sorting of plastic from households and businesses. For other mobile combustion, a slightly rising trend in emissions is projected due to population growth and economic expansion, which leads to increased construction activity. In the remaining sectors, there are small or insignificant changes in emissions between 2022 and 2030.

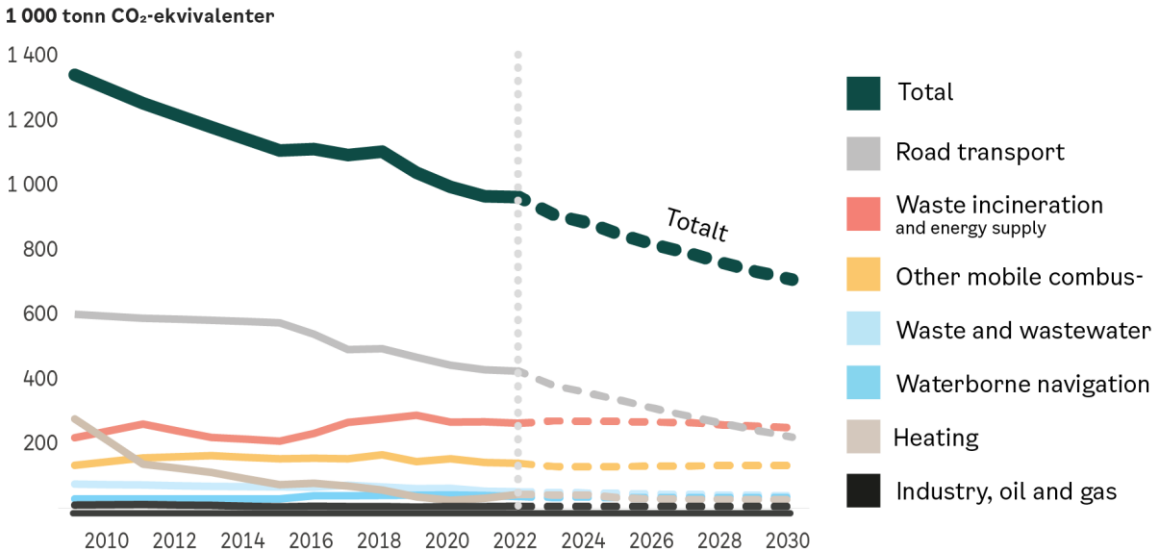


Figure 4: Baseline with historical emissions trends for the years 2009-2022 and emission projections for the years 2022-2030 without additional measures after 2022

The starting point for Oslo's baseline is set at the presentation of the previous climate budget each year. The impact of measures implemented before the baseline's starting point is included in the baseline, in accordance with international guidelines and the approach taken by the Ministry of Finance in the national baseline. These are measures either fully implemented or adopted through regulations or tax decisions. Municipal measures implemented after the baseline's starting point are included in the climate budget. This ensures that all municipal measures are generally reflected in the Climate Budget as an adopted measure at least once before their effect is incorporated into the baseline. State-level measures implemented in reasonable time for the presentation of the upcoming climate budget are directly included in the baseline, as long as they don't require municipal follow-up. In Climate Budget 2025, the impact of the *Shore Power for Cement Ships* measure, which was listed in the table of adopted measures in Climate Budget 2024, is now included in the baseline, as the facility is operational.

For measures where part of the measure has been implemented, but the effect is not yet captured in the greenhouse gas inventory, the completed portion's effect is included in the baseline, while the remaining effect is kept under adopted measures. For example, the impact of purchasing zero-emission vehicles in the municipality in 2023 and 2024 is not yet reflected in the greenhouse gas inventory, as the data only covers up to 2022. Therefore, the effect of vehicles already purchased (in 2023 and 2024) is included in the baseline, while the impact of future vehicle purchases remains under adopted measures. This adjustment is new for Climate Budget 2025 and applies to measures 2, 3, 19, and 20 in the table *Measures to Reduce Direct Emissions* in Proposition 1 of Climate Budget 2025. This may cause some measures to appear less effective than in previous climate budgets.

There is significant uncertainty regarding the development of the baseline. Nevertheless, the baseline provides a useful overview of how underlying societal trends will affect emissions and serves as a solid foundation for further analysis and calculation of the climate impact of adopted and identified measures.

2.2.2 Calculation of the Climate Impact of Measures

The annual emission-reducing effect of the measures is calculated as the reduction in greenhouse gas emissions compared to the emission level in the baseline for the same year. This means that only the additional effect beyond what is already projected in the baseline is included. This approach highlights the impact of the new or strengthened measure compared to current policies and the underlying emission trends. How each measure is calculated depends on the type of measure, as well as the available data and calculation tools. The sectoral descriptions in the next chapter explain how each measure is calculated.

Measures in the climate budget can be divided into two categories:

Adopted measures: These are measures for which an official decision has been made and/or there is a clear commitment to implementation, such as allocated financial resources or manpower. All adopted measures are presented in the climate budget at least once before they are considered fully implemented. However, many will remain in the climate budget over time, as they require follow-up to trigger their emission-reducing effects, such as through funding, reporting, or further processes. The impact of adopted measures is shown in the table *Measures to Reduce Direct Emissions* in Proposition 1 of Climate Budget 2025. The effects account for overlaps between measures to ensure the total effect can be summed (see overlap assessments).

Identified measures: These are potential new measures that have not been adopted yet but could reduce emissions if implemented. The estimated impact of these is shown in the table Identified Measures to Reduce Direct Emissions. The effect shown represents the additional impact of the identified measures beyond the adopted ones, without considering overlap with other identified measures.

Overlap Assessments

Many measures in the climate budget target the same emission source or technological change, which can result in overlapping effects. When calculating the total effect of the measures, care is taken to ensure the impact of one measure is not counted twice. This is particularly relevant in the road transport sector. For instance, if car traffic is reduced, the effect of electrification of the vehicle fleet will be correspondingly reduced.

Uncertainty Assessments

The calculations of the measures vary in their degree of uncertainty. At the end of each sectoral description, the uncertainty in the calculations for each adopted measure is described. Uncertainty is classified as either high, medium, or low, based on assessments by the Climate Agency, taking into account available data sources and uncertainty in the greenhouse gas inventory.

The potential impact of uncertainty on goal achievement is also considered. If the uncertainty in the calculation is deemed to affect more than 10,000 tons of CO2 equivalents, the consequence is considered high. Uncertainty in the range of 5,000 to 10,000 tons of CO2 equivalents is classified as medium, and below 5,000 tons of CO2 equivalents is classified as low.

The uncertainty for identified measures is always considered high, as the scope, direction, or timing of implementation is not yet clear. Therefore, no evaluation similar to the intervals mentioned above is provided; the uncertainty is only described.

2.3 Sectoral Roadmaps

The following chapters present the status of greenhouse gas emissions in each sector, along with a detailed description of identified measures and an explanation of how both adopted and identified measures are calculated. The Climate Agency has compiled this information into sectoral roadmaps. These roadmaps are used to analyze the gap between adopted measures, identified measures, and the goal of a 95% reduction in emissions by 2030. They also provide an assessment of the emission reduction needed in each sector to reach the 2030 target (reduction requirement).

The reduction requirement is a professional assessment of where emissions can be reduced by 2030, ensuring that the total reductions across all sectors sum up to a 95% reduction compared to 2009 levels. In some sectors, it is theoretically possible to eliminate almost all emissions, while in other sectors it will be more difficult. The latter might be due to the unavailability of sufficient technology by 2030. In several sectors, there is a lack of identified measures that can deliver the necessary reductions to meet the 95% reduction target by 2030.

The roadmaps clarify that where zero-emission technology is available today, it must be fully utilized if the 2030 climate goal is to be achieved. In the roadmaps, the sectors of road transport, waste and wastewater, and waste incineration and energy supply each have residual emissions of between 10,000 and 30,000 tons of CO2 equivalents in 2030. The remaining sectors have residual emissions of less than 5,000 tons of CO2 equivalents each.

2.3.1 Waste Incineration and Energy Supply – 27% of Oslo's Emissions

Emissions in this sector mainly come from waste incineration (both industrial and household waste), in addition to some emissions from the use of fossil fuels for district heating production, primarily peak load. In 2022, the sector accounted for 27% of Oslo's emissions, equivalent to 263,800 tons of CO2 equivalents. Over 80% of the emissions come from Hafslund Oslo Celsio's waste incineration plants at Klemetsrud and Haraldrud, while the remainder is from the Agency for Waste Management's incineration plant at Haraldrud. The emissions mainly result from the combustion of fossil fractions in the waste, such as plastic and, to some extent, synthetic textiles.

Emissions from waste incineration and energy supply have been stable in recent years and depend on the amount of waste incinerated, which varies from year to year. From 2021 to 2022, emissions decreased by 1.5%, equivalent to 4,100 tons of CO2 equivalents. This decline was due to a reduction in the amount

of waste incinerated at Hafslund Celsio's incineration plant at Haraldrud. The use of fossil energy for district heating dropped significantly from 2009 to 2013 and now accounts for only about 1.5% of the energy consumption for district heating production. The use of fossil sources for peak load production has fluctuated in scale since 2015, depending on temperature, electricity prices, and the needs of the district heating network.

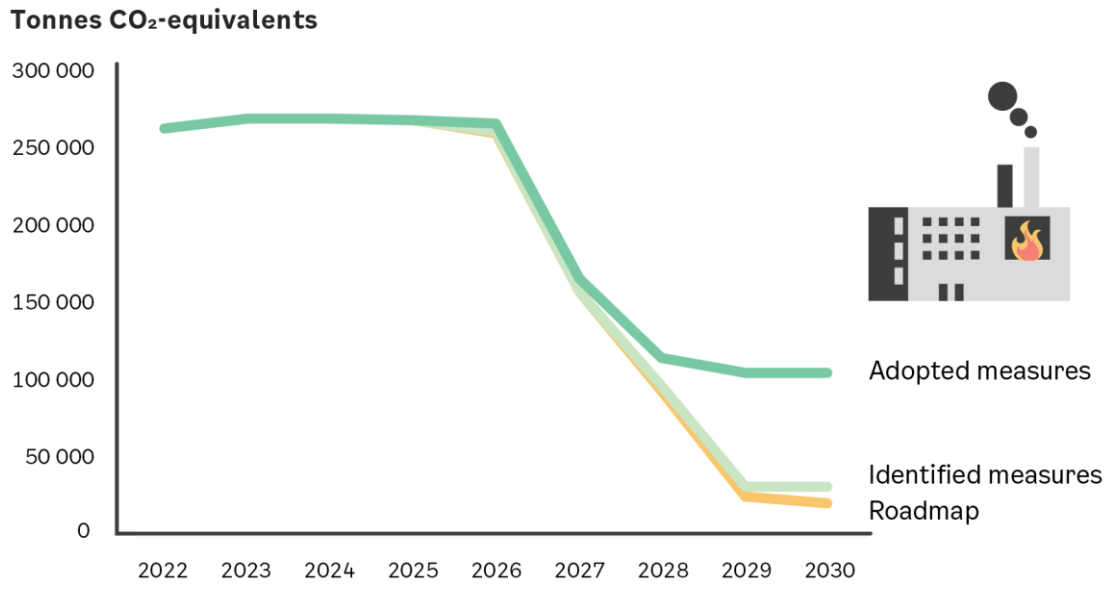


Figure 5: Roadmap for Waste Incineration and Energy Supply 2022-2030

Roadmap

In the roadmap for waste incineration and energy supply, emissions are estimated to reach 268,700 tons of CO2 equivalents in 2025. If the carbon capture project at Klemetsrud is completed, emissions could be reduced to around 105,600 tons of CO2 equivalents in 2030, 52% lower than in 2009. If the identified measures are also implemented, sector emissions could be reduced to around 32,000 tons of CO2 equivalents, corresponding to a reduction of over 85% in 2030 compared to 2009 levels.

Even if the identified measures are implemented, some CO2 emissions from the incineration of fossil plastics will remain. This is because carbon capture facilities are expected to capture 90% of CO2 emissions. Methane and nitrous oxide emissions are not captured and are challenging to reduce. Further CO2 reductions can be achieved by reducing plastic consumption or increasing the sorting and recycling of plastics before waste is sent for incineration. This applies especially to plastics from construction activities, but also to household waste from nearby municipalities incinerated in Oslo. It has not been assessed which measures could trigger the required reductions.

To meet the reduction target, emissions should be reduced to around 20,000 tons of CO2 equivalents, corresponding to a 90% reduction compared to 2009.

Adopted Measures

No. 1 Carbon capture at the Klemetsrud facility

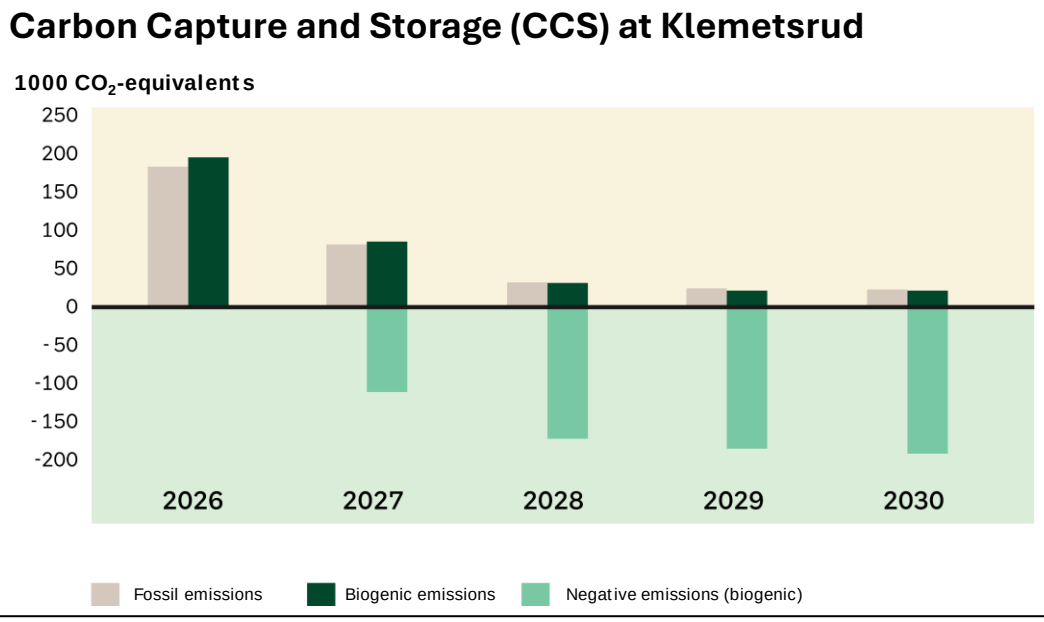
The construction of the carbon capture facility at Klemetsrud has been delayed due to increased costs. The company has announced that they are working to present a new project plan with updated and verified cost estimates in the fall of 2024.

Emission reductions from the Klemetsrud waste incineration plant are estimated at around 143,000 tons of CO2 equivalents by 2028, assuming the plant operates around 80% of the time. The plant is expected to achieve near full operation by 2029. The calculation is based on fossil CO2 emissions at Klemetsrud, reported to *norskeutslipp.no* for the years up to and including 2022, and projections of waste quantities in the baseline from 2022 to 2030. The expected capture rate of emissions is 90%, an estimate that considers likely maintenance downtime during a normal operational year.

Carbon Capture and Storage from Waste Incineration

A waste incineration plant emits CO2, methane, and nitrous oxide generated from the combustion of both fossil materials (such as plastics) and biogenic materials (such as wood and cardboard). CO2 emissions from the combustion of biogenic materials are not included in the greenhouse gas inventory, as the CO2 released during combustion is reabsorbed by plants and trees in the short carbon cycle, provided that the land is sustainably managed.

At the same time, if biogenic CO2 is captured and stored, it is referred to as negative emissions. Such negative emissions are currently not reflected in either the national or municipal greenhouse gas inventories, but they are just as valuable for the atmosphere as reductions in fossil emissions. The carbon capture facility at Klemetsrud can capture up to 95% of both biogenic and fossil CO2. This is illustrated graphically in the figure below. The gray and dark green bars show emissions at the Klemetsrud facility before carbon capture (2026) and the estimated residual emissions through 2030 with carbon capture. The light green bars represent expected negative emissions resulting from the carbon capture facility.



Identified Measures

Carbon capture from household waste from the City of Oslo

In November 2022, Rambøll completed a study on behalf of the Agency for Waste Management (REG), comparing the municipality's options for incinerating household waste with carbon capture internally versus outsourcing the service. This study will be reviewed and followed up further in 2025.

It is estimated that emissions from household waste could be captured using carbon capture technology by 2029, with a capture rate of 90%. This would reduce emissions by around 40,000–50,000 tons of CO2 equivalents. If the sorting measures described above are implemented, there would be overlapping

effects. After adjusting for overlaps, the effect of carbon capture would be around 20,000 tons of CO2 equivalents.

Carbon capture or fuel switching at Hafslund Celsio's waste incineration plant at Haraldrud

In recent years, between 35,000 and 50,000 tons of industrial waste have been incinerated at Hafslund Oslo Celsio's Haraldrud plant, resulting in emissions of 20,000–30,000 tons of fossil CO2. The Climate Agency is not aware of any plans to reduce emissions from the plant. The options to reduce these emissions include ensuring that the waste is treated with carbon capture, reducing the fossil content of the waste, or switching to renewable fuel such as wood chips. It is estimated that annual emissions could be reduced by 21,000–27,000 tons of CO2 equivalents, corresponding to a 90% reduction that could be achieved with carbon capture.

Materials recovery facility for household waste from the City of Oslo

A new waste regulation came into effect on January 1, 2023, requiring 50%, 60%, and 70% of plastic suitable for recycling to be sorted by 2028, 2030, and 2035, respectively. The Agency for Waste Management (REG) is investigating what is required to meet the regulatory mandate. It is assumed that household waste will be sorted at a modern post-sorting facility, capable of sorting out at least 80% of the plastic (REG, 2022). This could result in a reduction of 15,000–22,000 tons of CO2 equivalents by reducing the amount of plastic sent for incineration. The effect of the measure is included from 2028, when the regulation takes effect. Increased sorting and recycling can also reduce indirect emissions by replacing virgin materials with recycled plastic.

Increased textile recycling

According to the Agency for Waste Management (REG, 2022), it may be possible to increase the sorting rate from 56% to 85% by introducing household collection units for textiles. This could reduce emissions by 2,000–4,000 tons of CO2 equivalents by reducing the amount of synthetic textiles incinerated. The effect is included from 2026, as it is assumed that this measure can be implemented relatively quickly if desired. Increased sorting and recycling of textiles can also reduce indirect emissions by replacing virgin materials with recycled products.

100 % fossil-free district heating

District heating production in Oslo mainly uses energy from renewable sources and waste incineration. However, during periods of high electricity prices or low temperatures, some fossil gas is still used. The amount of fossil gas used varies depending on temperature, electricity prices, and demand for district heating. The measure aims to replace fossil gas with renewable sources such as biogas. The calculation assumes a gradual phase-out of fossil gas, with a 40% reduction from 2026 and a linear decrease to fully fossil-free operation by January 1, 2028. This corresponds to an annual reduction of 1,000–9,000 tons of CO2 equivalents from 2028. The wide range reflects the large annual variation in the need for peak-load energy.

identified measures not calculated

Measures for capturing biologically sourced CO2

The state is currently considering new measures to promote industrial CO2 removal, such as carbon capture and storage (Ministry of Energy, 2024), and has recently put a report out for consultation. One option being considered is a reverse CO2 tax, where the state pays for each ton of non-fossil CO2 that is captured and stored. Reverse auctions, where participants compete for support funds, are also being considered (Oslo Economics, 2024). A reverse CO2 tax providing predictable support would improve the profitability of carbon capture projects in Oslo, and together with an increased incineration tax, would increase incentives for plastic sorting.

Differentiating the price of waste incineration based on CO2 content at Hafslund Oslo Celsio (gate fee)

The gate fee is the price a waste owner (such as a municipality or business) pays to have waste delivered and treated at a waste incineration plant. In principle, the fee can be differentiated based on the amount of plastic and other fossil-based materials in the waste. A high price for waste containing significant plastic content could incentivize increased plastic sorting. This system would depend on, for example, the installation of automatic measurements of fossil CO2 content at the facilities, so that emission reductions can be documented, or alternatively, the waste incineration customers documenting the plastic content of their waste.

Uncertainty in the calculations

Adopted measures	
Measure	**Description of Uncertainty**
Carbon capture at the Klemetsrud facility Uncertainty: Low Consequence: High	The calculation has low uncertainty. The carbon capture technology is proven, and the plant has processed a stable amount of waste in recent years. The uncertainty lies in overestimating the short-term effect due to project delays. Despite the low uncertainty in the data, the potential consequence is high, as the facility accounts for a significant portion of Oslo's total greenhouse gas emissions.
Identified measures	
Materials recovery facility for household waste from the City of Oslo	The emission reduction will vary depending on whether the municipality chooses to send waste to a facility outside the municipality, builds a materials recovery facility within municipal borders, and the specific design of the sorting facility chosen.
Increased textile recycling	The calculation is based on data from other schemes, and it is uncertain how the population will respond to more localized collection units. There is also variation in the amount of textiles ending up in residual waste in recent years.
Carbon capture from household waste from the City of Oslo	The calculation is based on a scenario where emissions are reduced by 90%. The actual emission reduction will depend on whether the municipality decides to build its own carbon capture facility or procure the service from the market
Reducing emissions from industrial waste incineration at Hafslund Oslo Celsio's Haraldrud plant	The calculation assumes a 90% emission reduction from the plant, corresponding to establishing carbon capture. A solution where alternative fuel sources, such as wood chips, or waste with lower fossil carbon content is used could yield a different effect.
100% fossil-free district heating	The uncertainty in the calculation lies in the annual variations in peak load usage

2.3.2 Other Mobile Combustion – 14% of Oslo's Emissions

Emissions in this sector come from the use of diesel-powered machinery that is not road-based. This includes construction equipment, excavators, snowmobiles, and machinery used in forestry. In 2022, the other mobile combustion sector accounted for 14% of Oslo's total emissions, equivalent to 139,400 tons of CO2 equivalents. Around 40% of these emissions come from construction activities. The remaining emissions are from machinery and vehicles used in industry ("other industries"), in transport-related activities (such as freight terminals and ports), and machinery used in waste processing. From 2021 to 2022, emissions in this sector decreased by 2%, equivalent to 2,900 tons of CO2 equivalents.

Emissions fluctuate from year to year depending on factors such as construction activity. There are no comprehensive overviews of actual fossil fuel usage per municipality in this sector, so the emission estimates are uncertain. National emissions from fossil fuel use are distributed to municipalities based on different allocation keys, including the number of employees in the industry and population size. Emissions from the source "services related to transport" (over 58,000 tons of CO2 equivalents in 2022)

are likely overestimated. Additionally, the emission inventory does not account for local measures like zero-emission construction sites. See the chapter on uncertainty in the greenhouse gas inventory.

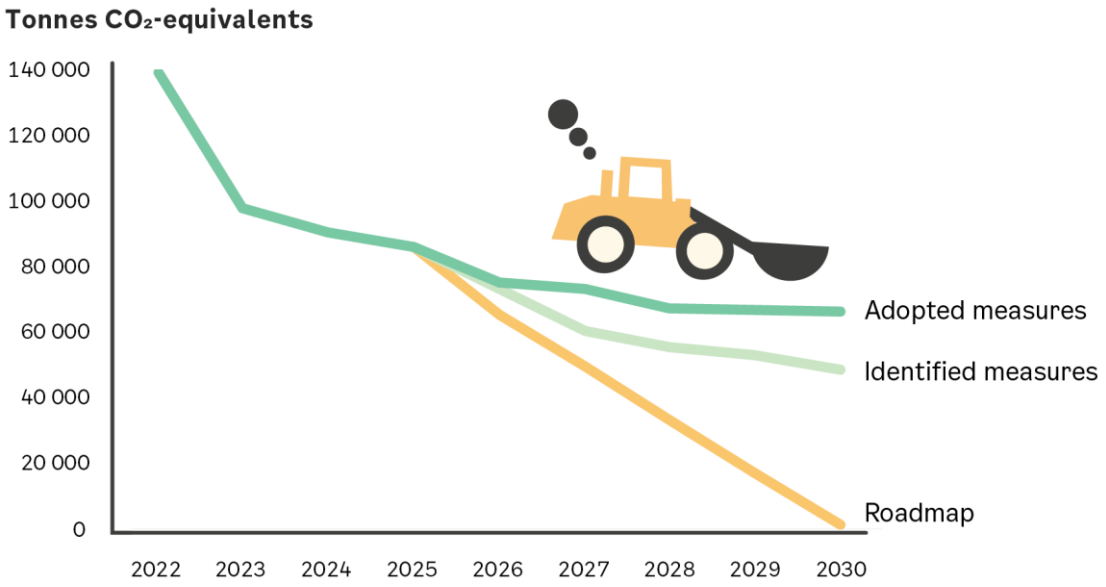


Figure 6: Roadmap for Other Mobile Combustion 2022-2030

Roadmap

In the roadmap, emissions from the other mobile combustion sector are projected to be approximately 86,000 tons of CO2 equivalents in 2025. If all adopted measures are implemented according to the assumed schedule, emissions could be reduced to around 67,000 tons CO2 equivalents by 2030, representing a 50% reduction compared to 2009 levels. If the identified measures are also implemented, emissions could decrease further to around 49,000 tons CO2 equivalents, corresponding to a 63% reduction by 2030 compared to 2009. It is estimated that with the identified measures, emissions from construction sites will be minimal by 2030. However, for these reductions to be reflected in the Norwegian Environment Agency's greenhouse gas inventory, improvements in calculation methods are needed.

For Oslo to meet its 2030 climate target, emissions in this sector must be minimized. Remaining emissions after implementing identified measures will come from various machines used in waste facilities, freight terminals, industry, and other sectors. These machines are likely to switch to electric power, as the technology already exists and they operate within limited areas with charging infrastructure. However, many machines need to be electrified, including specialized equipment, for which zero-emission models are currently limited. Therefore, while the roadmap may seem optimistic, it is necessary for Oslo to reach its 2030 climate goal. Conversely, the Climate Agency believes that emissions are overestimated due to how the Norwegian Environment Agency distributes emissions to municipalities. Improvements in the emissions inventory toward 2030 could help reduce the gap to the necessary reductions.

Adopted Measures

No. 16 Requirement for Zero-Emission Construction and Civil Engineering Work on Municipal Projects from 2025

The emission-reducing effect of this requirement is estimated at 18,500 tons CO2 equivalents in 2025 and 18,600 tons CO2 equivalents in 2028. According to *Byggfakta* reports, municipal construction accounts for 30% of total construction activity in Oslo (Byggfakta, 2023). The requirement mandates that

all municipal construction work must be fossil-free from 2020 and zero-emission from 2025. Some biodiesel use is expected until 2027 (10%), with full zero-emission operation from 2028.

No. 17 Requirement for Fossil-Free Construction in Regulatory Plans
The climate impact is estimated to be 21,300 tons of CO2 equivalents in 2025 and 35,600 tons of CO2 equivalents in 2028. The requirement applies to state and private construction projects. *Byggfakta* has a database of private and public construction projects. Based on their municipal reports from 2020 to 2023, it is estimated that private and state actors collectively account for 70% of construction activity in Oslo (Byggfakta, 2023). The phasing-in rate for the calculation is based on an assessment by the Planning and Building Agency (PBE) of how many regulatory plans will be subject to the requirement up until 2030. The assessment estimates that the requirement will cover 55% of construction sites in 2025, 84% in 2028, and 86% in 2030. The calculation is made by reducing 70% of emissions in the construction sector compared to the baseline using this phasing-in rate

No. 18 Facilitating Zero-Emission Cargo Handling at the Port of Oslo

The emission-reducing effect of transitioning to zero-emission cargo handling at the Port of Oslo is estimated to be around 1,900 tons of CO2 equivalents in 2025 and 2,600 tons of CO2 equivalents in 2028. The calculation includes machines such as reach stackers (used to handle and move containers at the port), tractors, and cranes that currently use tax-exempt diesel at the port, which can switch to renewable fuels by 2030. The calculation is based on data from the Port of Oslo on diesel consumption from operators at the port in 2021. Furthermore, based on discussions with the port, it is assumed that 60% of the activity related to cargo handling at the port will be zero-emission by 2025, and 95% by 2030. This is lower than the goal of zero-emission operations by 2025, outlined in the Zero-Emission Port action plan from 2018.

No. 19 Procurement of Zero-Emission Machinery for Oslo Municipality's Fleet

The emission-reducing effect of replacing Oslo municipality's machinery fleet with zero-emission equipment is estimated at 600 tons of CO2 equivalents in 2025 and 2,700 tons of CO2 equivalents in 2028. The calculation is based on reported data from municipal operations regarding diesel, biodiesel, and electricity consumption for construction machinery up to and including 2023.

No. 20 Subsidies for Zero-Emission Equipment and Facilitating Power Supply for Outdoor Events

he transition to zero-emission equipment and zero-emission events, which previously used diesel generators, is estimated to reduce emissions by a total of 1,200 tons of CO2 equivalents in 2025 and 4,700 tons of CO2 equivalents in 2028. The calculation for powering events is based on the estimated amount of diesel replaced by establishing more power outlets. The estimated impact of subsidies for zero-emission equipment is based on the number of grants issued by the Climate and Energy Fund in 2021, 2022, and 2023, with a projected increase toward 2027. It is uncertain whether the subsidy scheme will continue after 2027, so no further effects are included beyond that year. A gradual increase in grants, up to 50 by 2027, is expected, although this is uncertain.

Identified measures

Requirement for all construction sites to be zero-emission by 2030

In August 2024, the Norwegian Environment Agency submitted a proposal for municipalities to require zero-emission construction sites for public consultation. The requirement is proposed to be anchored in the Pollution Control Act. Prior to this, the City of Oslo, in its revised municipal plan (KPA) provisions, which were submitted for consultation in 2023, included a requirement for all construction sites to be zero-emission by 2030 (anchored in the Planning and Building Act). The municipal plan will be sent out for a new consultation. If adopted, the requirement (through either the KPA or the Pollution Control Act) will replace the fossil-free construction site requirement in new regulatory plans.

The impact of this requirement is calculated using a top-down approach, where all emissions related to construction sites in the baseline are removed. A phased implementation of 70% by 2027 and 100% by 2030 is assumed for this measure. This is expected to result in a reduction of 7,000 – 9,000 tons of CO2 equivalents by 2030. This reduction is in addition to the impact of the adopted measure requiring fossil-free construction, which is estimated to reduce emissions by 35,600 tons of CO2 equivalents by 2028.

Increase of National Biofuel Blending Requirement to 28% for Non-Road Machinery

In the 2024 national budget, the government announced a plan to increase the biofuel blending requirement for non-road machinery to 28% by 2030 (Regjeringen, 2023). The specific timeline for this increase will be revisited every other year at "control points," with the first review in the 2025 national budget.

The climate impact is calculated based on the difference between the 28% blending requirement and the proportion of biofuel in the baseline. In Oslo's baseline, the share of biofuel in the other mobile combustion sector is set at 10% (by volume) for the period from 2024 to 2030. For this measure, a linear increase to 28% from 2025 to 2030 is assumed. This corresponds to an emission reduction of approximately 9,000 to 12,000 tons of CO2 equivalents by 2030. The effect of the measure has been slightly adjusted to avoid double counting with the requirements in regulatory plans, which already contribute to a high biofuel share in the construction sector.

The climate impact is calculated based on the difference between the 28% blending requirement and the proportion of biofuel in the baseline. In Oslo's baseline, the share of biofuel in the other mobile combustion sector is set at 10% (by volume) for the period from 2024 to 2030. For this measure, a linear increase to 28% from 2025 to 2030 is assumed. This corresponds to an emission reduction of approximately 9,000 to 12,000 tons of CO2 equivalents by 2030. The effect of the measure has been slightly adjusted to avoid double counting with the requirements in regulatory plans, which already contribute to a high biofuel share in the construction sector.

Uncalculated Identified Measures

Requirement for Zero-Emission Machinery and Equipment in All Municipal Contracts

Oslo municipality currently has standard requirements for the procurement of construction and civil engineering services, and for transport where necessary, which occurs on average once a week. Municipal operations contracts fall under standard transport requirements, meaning that there are no climate and environmental requirements for zero-emission machinery and equipment in these contracts. This measure proposes that zero-emission machinery and equipment be required in all municipal contracts, regardless of contract type.

Enova Support for Machinery Used in Freight Terminals, Industry, etc.

Enova currently offers a competitive subsidy scheme for zero-emission construction machinery. In 2024, support is only provided for excavators and wheel loaders. Nationally, emissions from non-road machinery outside of the construction sector are greater than emissions from just the construction sector. In Oslo, these emissions are also significant. The Enova subsidy scheme could be expanded to support all types of zero-emission non-road machinery.

Uncertainty in the Calculations

Adopted measures	
Measure	**Description of Uncertainty**
Requirement for zero-emission construction on municipal projects Uncertainty: High Consequence: Medium	The data on greenhouse gas emissions from construction sites in Oslo is incomplete, making the uncertainty high. The consequence is considered medium since municipal projects are estimated to account for only around 30% of the city's construction activity. There are uncertainties related to this estimate.
Requirement for fossil-free construction in regulatory plans Uncertainty: High Consequence: High	It is estimated that private and state-owned projects account for 70% of emissions from construction sites in Oslo. This percentage is uncertain and may vary year by year. The greenhouse gas inventory also contains significant uncertainties. This measure represents a large portion of the total estimated emission reduction potential, so the consequence is considered high.
Facilitating zero-emission cargo handling at the Port of Oslo Uncertainty: Medium Consequence: Low	The calculated climate effect is based on data from the Port of Oslo on fuel consumption. The uncertainty lies mainly in the phasing-in rate, as there is uncertainty regarding the types of machinery that will become available in the future.
Innkjøp av utslippsfrie maskiner i Oslo kommunes maskinpark Usikkerhet: Middels Konsekvens: Liten	The municipality has good control over replacing its own machinery. However, there is uncertainty regarding when various machines will become available, which affects the phasing-in rate of this measure.
Subsidies for zero-emission equipment and facilitating power supply for outdoor events. Uncertainty: Medium Consequence: Low	The calculation is considered to have medium uncertainty. There is good data on how much fossil fuel can be replaced, but it is uncertain how many will take advantage of the scheme.
Identified Measures	
Measures	**Description of Uncertainty**
Requirement for all construction sites to be zero-emission by 2030	The calculation is based on the emissions Oslo is allocated in the municipal greenhouse gas inventory for construction, while the method used by the Norwegian Environment Agency is highly uncertain. Therefore, the uncertainty lies in the potential errors in the Norwegian Environment Agency's data, rather than in the Climate Agency's calculation.
Increase of national biofuel blending requirement to 28% for non-road machinery	The calculation is based on current usage of tax-exempt diesel and biofuel blending. The uncertainty in the calculation relates to how operators will adapt to the requirement and the extent to which they will use flexibility mechanisms between blending requirements for road traffic and maritime transport.

Distributional Effects

Meeting the requirements for using zero-emission construction machinery may be challenging for some actors, likely smaller ones with limited access to capital. To counter potential distributional effects that could favor larger companies, the City of Oslo has worked in stages and with a long-term approach. It has been important for the municipality to give the industry ample time to adapt to new regulations, with a focus on predictability. The first procurement of a zero-emission construction site took place in 2019. That same year, the city government decided that all municipal construction sites must be zero-emission by 2025. The goal has been to clearly communicate what will be required in the future. Through this approach, the municipality has gradually shifted from rewarding companies that can offer zero-emission solutions (as selection criteria) to eventually requiring such solutions.

2.2.3 Road Traffic – 44 % of Oslo's emissions

Road traffic accounted for 44% of Oslo's emissions in 2022, equivalent to around 426,000 tons of CO2 equivalents. Passenger cars remain the largest source of emissions within road traffic, contributing 37% of the sector's emissions in 2022. Heavy vehicles accounted for 29%, vans for 24%, and buses for 9%.

Since 2009, road traffic emissions have been reduced by 29%, driven by the electrification of passenger cars and increased blending of biofuels. From 2021 to 2022, emissions decreased by around 1%, primarily due to the electrification of passenger cars, despite a slight increase in traffic related to the post-pandemic period and a lower biofuel blending rate. Emissions from passenger cars decreased by 6%, while emissions from vans increased by 7%, and emissions from heavy vehicles remained nearly unchanged.

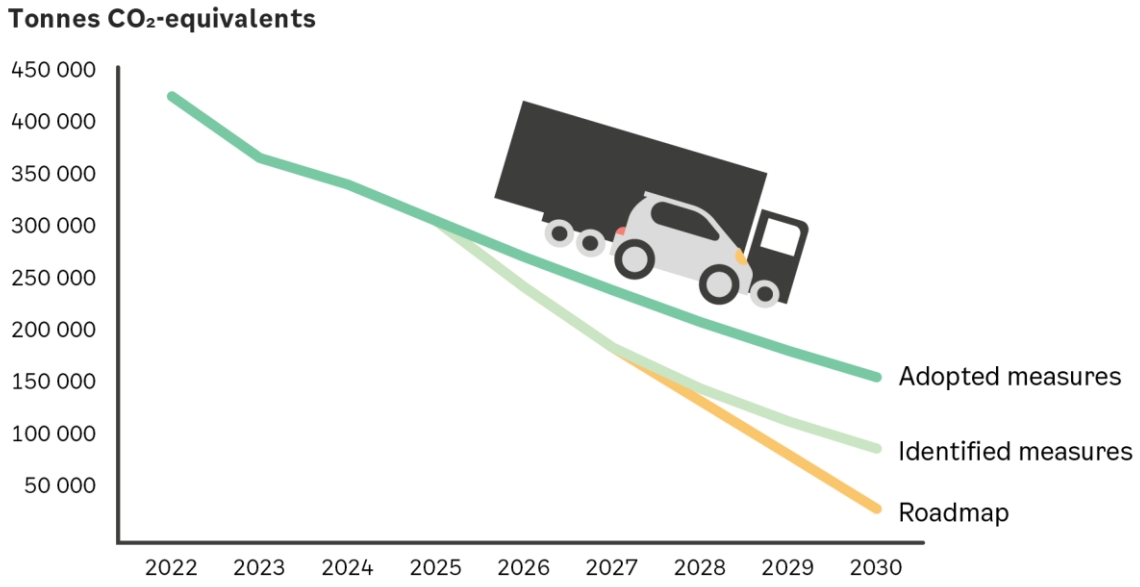


Figure 7: Roadmap for Road Traffic 2022-2030

Roadmap

In the roadmap for road traffic, emissions are estimated at 306,300 tons of CO2 equivalents in 2025. If all the adopted measures are implemented as planned, emissions can be reduced to around 156,200 tons of CO2 equivalents by 2030, representing a 74% reduction from 2009 levels. If the identified measures are introduced, emissions in the sector can be reduced to approximately 87,900 tons of CO2 equivalents, equivalent to an 85% reduction by 2030 compared to 2009. About half of the remaining emissions in 2030 will come from passenger cars and vans, while the other half will come from trucks.

To achieve a 95% reduction, only about 30,000 tons of CO2 equivalents can remain in 2030. This residual emission is likely to come from transit traffic by heavy vehicles, while emissions from passenger cars, vans, and buses must be minimized

Adopted measures

Several of the measures in road traffic affect the same activities and/or sources of emissions. Therefore, the climate impact of the adopted measures in the climate budget is adjusted for overlap. For instance, the impact of the measure *Incentives for zero-emission vans* is reduced to account for the fact that some vans are already electrified through the city's *Procurement of zero- and fossil-free vehicles*, which is listed first in the table *Measures to reduce direct emissions* in Proposition 1 of the 2025 Climate Budget. This means the effect of *Incentives for zero-emission vans* appears somewhat lower than if it had been calculated in isolation without considering other measures. Furthermore, several traffic-reducing measures have not been quantified. At the same time, the projected traffic growth in the reference path

for passenger cars has been sharply reduced in this climate budget compared to previous ones, from a 14% increase during 2020–2030 in the 2024 Climate Budget to a 4% increase in the 2025 Climate Budget with the adopted measures. This is partly due to Oslo's targeted efforts to reduce traffic.

No. 3 Procurement of zero-emission (including biogas) vehicles in the municipality

It is estimated that the procurement of new zero-emission (including biogas) vehicles for the municipality will result in an emissions reduction of 3,600 tons of CO2 equivalents in 2025 and 4,600 tons in 2028. These estimates are based on data from the Agency for Improvement and Development on the number of vehicles and the share of electric vehicles in the municipal fleet (UKE, 2024). The calculations assume that, starting from 2025, all the municipality's passenger cars and approximately 70% of vans and heavy vehicles will be zero-emission. For vans, it is assumed that all will be electric by 2028, while for heavy vehicles, 75% will use biogas and the remaining 25% will be electric

No. 4 Zero-emission (including biogas) and transport-efficient delivery of goods and services for municipal contracts

All vehicles used for the delivery of goods or services to the City of Oslo will use either fossil-free fuel, zero-emission, or biogas technology. The effect of this measure is calculated based on data from suppliers on the number of kilometers driven for deliveries using various fuels (UKE, 2024). It is estimated that this measure will reduce emissions by 8,600 tons of CO2 equivalents in 2025 and 9,000 tons in 2028. The use of the various technologies is assumed to remain at 2023 levels throughout the period

No. 11 Incentives for zero-emission taxis

All taxis in Oslo must be zero-emission by November 1, 2024. The effect is calculated based on the annual mileage for taxis in Oslo (SSB, 2023b), with an estimated traffic growth in line with the baseline path and actual data on the share of renewable energy in the taxi fleet from taxi companies (BYM, 2021) (Oslo taxi, 2024) (Norgestaxi, 2024). This results in an emissions reduction of 12,900 tons of CO2 equivalents in 2025 and 11,000 tons in 2028.

No. 12 Incentives for zero-emission vans (infrastructure subsidies, consolidation centers, pilot program allowing businesses to use school charging infrastructure at night, zero toll until 2030)

To break down the barriers to choosing zero-emission vans, a package of measures is required. It has not been possible to isolate the effects of the individual measures, so the calculation reflects the estimated combined effect of the measures. The Agency for Climate, in collaboration with Zero, has made an assessment of the development in new sales of electric vans toward 2030 based on the adopted package of measures. The assessment is based on trends in the number of registered electric vans (OFV, 2024), combined with knowledge of technology development and model availability across all van categories toward 2030, and cost analyses showing how economic measures like toll exemptions impact the competitiveness of electric versus fossil-fuel vans in various segments. This is supplemented with information from dealers on which models are in demand in the market. The combined effect of the measures is estimated to reduce emissions by 3,000 tons of CO2 equivalents in 2025 and 9,800 tons in 2028

No. 14 Requirement to use zero-emission trucks for mass and waste transport for municipal contracts and Nr. 15 Incentives for zero-emission heavy transport in Oslo (zero toll until 2030, increased fossil fuel tolls from 2026, subsidies for charging infrastructure, areas for energy stations, etc.)

To break down the barriers to choosing zero-emission or biogas trucks, a package of measures is required. It has not been possible to isolate the effects of the individual measures, so the calculation reflects the estimated combined effect. The climate impact of these measures is estimated to reduce emissions by 18,500 tons of CO2 equivalents in 2028. This estimate is based on an assessment of the development in new sales of electric and biogas trucks toward 2030 and what effect this may have on greenhouse gas emissions in Oslo. The assessment is based on historical trends in the number of

registered electric and biogas trucks (OFV, 2024), knowledge of technology and model development toward 2030 (Miljødirektoratet, 2023), and cost analyses showing how economic measures like increased fossil fuel tolls impact the competitiveness of electric, biogas, and fossil fuel trucks in different segments

No. 5- 10 and 13 Non-quantified measures that reduce traffic or contribute to electrification

The following measures have been adopted but are not quantified, as there is insufficient basis to determine how much they reduce car traffic or contribute to electrification beyond the other measures in the climate budget that affect the same emission sources:

- No. 5 Develop a green mobility plan to enhance the appeal of walking, cycling, and public transport
- No. 6 Incentives for increased cycling and walking (subsidies for climate-friendly work trips, cycling infrastructure)
- No. 7 Improve public transport
- No. 8 Allocate municipal road space for car sharing, electric bikes, etc.
- No. 9 Reduce transport of mass and waste
- No. 10 Establish charging infrastructure for passenger cars
- No. 13 Incentives for zero-emission tour and express buses

Identified measures

CO2 tax equivalent to NOK 2,000 in 2030 without compensatory measures

The Parliament increased the CO2 tax in 2024 (approximately NOK 0.55 per liter) to NOK 1,176 per ton, and there is political agreement for an increase to NOK 2,000 per ton by 2030 in 2020 prices[1].

For road traffic, the fuel tax has been reduced as compensation for the increase in the CO2 tax. The reduced fuel tax lowers the pump price and diminishes the effect of the increased CO2 tax. The government has not announced whether it will compensate for the increased CO2 tax by further reducing the fuel tax in future budgets.

The impact of the increased CO2 tax for Oslo is estimated based on updated data from the Institute of Transport Economics (TØI, 2023), which compiled studies on the effect of fuel price increases on passenger cars. Estimates for vans and heavy vehicles, derived from national data by the Norwegian Environment Agency in 2021, are more uncertain as they are based on 2019 prices (Miljødirektoratet, 2021a) (TØI, 2020b). Such calculations are always subject to significant uncertainty.

The effect shown in the table *Identified measures to reduce emissions within Oslo's borders* reflects changes in emissions from passenger cars, vans, and heavy vehicles. It is estimated that an increased CO_2 tax without a reduction in the road usage tax could reduce emissions by approximately 9,000–17,000 tons of CO_2 equivalents.

Increase in the biofuel blending mandate to 33% for road traffic by 2030

In the 2024 national budget, the government announced a plan to increase the biofuel blending mandate for road traffic to 33% by 2030. The government will review the progress biennially through control points, starting with the 2025 national budget (Regjeringen, 2023). Since this is only an announcement and has not yet been regulated, this ambition for 2030 is not included in the baseline path.

[1] NOK 2,000 per ton in 2020 prices corresponds to approximately NOK 2,300 per ton in 2023 prices due to inflation.

The climate effect of this measure is calculated based on the difference between the 33% blending mandate and the biofuel share in the baseline path. In Oslo's baseline path, the biofuel share in road transport is set at 14.9% (measured in volume percentage) from 2023 to 2030, based on current regulations. An increase in the blending mandate corresponds to an emissions reduction of approximately 30,000–44,000 tons of CO2 equivalents.

Double toll rates for new fossil-fuel passenger cars purchased by 2026

Oslopakke 3 decided to introduce double toll rates for new fossil-fuel passenger cars by 2026. This measure assumes that national authorities establish a new toll category. It is estimated that this measure could reduce emissions by 1,500–3,000 tons of CO2 equivalents.

The calculation is based on an estimate of the proportion of total driving in Oslo that will be done by cars purchased between 2026 and 2030. This estimate is based on the average new car registrations in Oslo and Akershus compared to the total vehicle stock development (OFV, 2024). The phase-in of electric vehicles in new car sales is adjusted based on data from the baseline path and a calculation of how higher toll rates will increase the cost of purchasing a fossil-fuel car in 2026 compared to an electric equivalent (total cost of ownership)[2]. It is assumed that double toll rates will have an effect nearly equivalent to a ban on new fossil-fuel cars in Oslo.

Double toll rates for new fossil-fuel vans purchased from 2027

The double toll rate for new fossil-fuel vans from 2027 also depends on national authorities establishing a new toll category. While not explicitly part of the revised Oslopakke 3 agreement, it is mentioned in the agreement that additional incentives for transitioning the van fleet from fossil fuels to zero emissions will be considered during the agreement period. Double toll rates for vans purchased from 2027 could prevent new fossil-fuel vans from entering the fleet and reduce emissions by 2,000–4,000 tons of CO2 equivalents. The climate effect of double toll rates is calculated similarly to that for passenger cars (see above).

Zero-emission zone

In 2023, the Agency for Urban Environment (BYM) submitted a professional recommendation for the design and rollout process of a zero-emission zone in Oslo. BYM's recommendation was to establish the zone in two stages: first, a zone restricted to zero-emission commercial transport, limited to the inner toll ring (along Ring 2) from 2025, followed by the inclusion of passenger cars two years later, assuming legal authority is granted by 2023. In the zone, only zero-emission vehicles will be allowed, though some vehicle groups will be exempt from the ban (BYM, 2023). The Norwegian Public Roads Administration has prepared a proposal for the necessary legal framework, but the government has yet to send this out for consultation. As a result, the City of Oslo still lacks the legal authority to establish the zone and has repeatedly requested clarification from the state. Since no resolution has been reached regarding the legal framework, the measure cannot be implemented according to the timeline recommended in the report.

There are two identified measures with calculated effects: *Zero-emission zone for vans and heavy vehicles within Ring 2 (inner toll ring) from January 1, 2027* and *Zero-emission zone for passenger cars within Ring 2 (inner toll ring) from January 1, 2028.* The calculations are based on Norconsult's report on the emission effects of zero-emission zones in Oslo (Norconsult, 2021) and show the estimated effect within Oslo's borders. A zero-emission zone will also have an impact outside Oslo's borders, as the vehicles that are converted to zero emissions will also travel beyond the municipality. Implementing a

[2] Total cost of ownership (TCO) is a cost calculation that accounts for the total expenses of owning, for example, a vehicle over its economic lifespan. The calculation includes both investment costs and operating costs.

zero-emission zone can influence the behavior of thousands of individuals, who may adapt to the measure in various ways. Such calculations are always subject to uncertainty.

For the calculation of the zero-emission zone for vans and heavy vehicles within Ring 2 (inner toll ring) starting January 1, 2027, it is assumed that 8% of vans and 25% of heavy vehicles will be exempt from the ban. It is estimated that this measure could reduce emissions by approximately 9,000–17,000 tons of CO2 equivalents annually.

For the calculation of the zero-emission zone for passenger cars within Ring 2 from January 1, 2028, it is assumed that 25% of passenger cars will be exempt from the ban. This measure is estimated to reduce emissions by approximately 1,000–2,000 tons of CO2 equivalents annually.

Parking measures at municipal workplaces

The Climate Agency's travel habit survey shows that one in four employees in the City of Oslo commutes to and from work by car, and that half of these trips are made with fossil-fuel or hybrid vehicles (TØI, 2023). In 2022, this commuting resulted in approximately 2,000 tons of CO2 equivalents in emissions. The likelihood of driving to work is closely tied to the availability and cost of parking provided by the employer. The Climate Agency has examined the climate impact of introducing parking fees and reallocating municipal parking spaces starting in 2026, with a parking ban on fossil-fuel cars from 2030. This measure would help reduce car usage and consequently lower greenhouse gas emissions.

In the calculation of the identified measure, it is assumed that all parking spaces at municipal workplaces will be reallocated by 2026. In the outer city, parking fees will be introduced, with a predictable increase from NOK 100 per day in 2026 to NOK 300 per day by 2029 for fossil-fuel vehicles. By 2030, it is assumed that parking fossil-fuel cars at Oslo municipality workplaces will no longer be allowed, in line with the goal of making all passenger car traffic emission-free by 2030. Exemptions are made for disabled parking, delivery vehicles, and service vehicles, as well as consideration for shift workers. It is estimated that 10-30% of employees who currently drive fossil-fuel cars to work will continue to do so in 2030, assuming there will still be non-municipal parking options nearby. This measure is estimated to reduce emissions by 1,000 to 2,000 tons of CO2 equivalents annually between 2026 and 2030.

Enhanced local measures for vans

The calculated package of measures includes:

- Development of better normal charging options for vans, including the rollout of overnight charging at municipal employee parking lots.
- Increased environmental differentiation between fossil-fuel and zero-emission vans in the toll ring.
- Expansion of requirements for using electric vans for municipal contracts.
- Permission for electric vans to drive in bus lanes without passengers.
- More delivery areas reserved for zero-emission vehicles

The calculation of the climate effect of this package was carried out by Zero in collaboration with the Climate Agency. It is based on a detailed review of new van sales and the models expected to be available by 2030. This is combined with an assessment of how a local package of measures can address known barriers, such as insufficient charging infrastructure, lack of profitability, and limited information about the benefits of electric vans, and how these factors could influence new van sales. The assessment was done as a package evaluation, making it difficult to isolate the effect of individual measures. It is estimated that this package as a whole could reduce emissions by approximately 2,000–4,000 tons of CO2 equivalents by 2030.

National package of economic measures for heavy vehicles

In the 2024 budget agreement between the government and the Socialist Left Party (SV), a long-term goal was set for all new heavy vehicle sales to be zero-emission or biogas by 2030. In 2023, the

Norwegian Environment Agency and the Norwegian Public Roads Administration conducted an analysis to determine the types of measures that could ensure electric trucks become a profitable investment for most stakeholders. Their assessment was that the following package of measures could secure profitability in nearly all segments from around 2024.

- Enova support covering at least 40% of the additional cost for vehicles and depot charging.
- Introduction of a one-time fee of at least NOK 50,000 for new fossil-fuel heavy vehicles.
- Gradual increase of the CO2 tax to NOK 2,000 per ton (2020 prices).
- Affordable fast charging at NOK 4 per kWh or lower.

The calculation is based on current heavy vehicle sales in Oslo and the assumption that the national package of measures will be sufficient to achieve almost 100% zero-emission new vehicle sales by 2030 in Oslo and Akershus. These economic measures could also be replaced or supplemented by other strong national measures, such as toll exemptions for biogas vehicles across the country, where currently only electric vehicles benefit from exemptions. It is estimated that this package could reduce emissions by around 4,000–8,000 tons of CO2 equivalents by 2030.

Requirements in licenses for buses operating in Oslo (beyond Ruter)

In connection with the 2023 national budget, the Parliament requested the government to investigate and propose amendments to the Professional Transport Act to enable the imposition of zero-emission requirements on all licensed transport activities where possible by the end of 2023. This could affect Oslo municipality as a licensing authority, providing the opportunity to impose zero-emission requirements in the licenses granted to routes operating in Oslo, such as airport buses and tourist buses with fixed routes (Hop-on Hop-off). No legislative changes have been made yet. However, the initiative has been followed up in the National Transport Plan (NTP), adopted in the spring of 2024. As part of the work on introducing zero-emission requirements for all licensed transport activities, the government will assess the possibility of requiring public authorities to set zero-emission standards when purchasing services for long-distance buses (Class 3).

Only a limited portion of bus traffic in Oslo is under county control. Oslo grants route licenses only for fixed routes within the county and some cross-county routes. The Agency for Urban Environment (BYM) is compiling information on the current licenses and their expiration dates. Based on this, the effect of this measure is estimated to reduce emissions by 2,000–3,000 tons of CO2 equivalents by 2030.

Non-calculated identified measures

Taxation of employer-paid parking

In the Norwegian tax system, all benefits provided by employers are generally taxable, whether received as salary or fringe benefits. This applies to items like phones, insurance, or private use of loaned bicycles or bike services at the workplace. Parking, however, is an exception to this rule. Many employers subsidize or cover the cost of parking spaces for employees at the workplace without it being taxed. This differs from neighboring countries like Sweden, where parking is taxed as a benefit.
To reduce car use and greenhouse gas emissions, increasing parking costs could be an effective measure. While it is uncertain how much of an impact a tax change would have on car usage and emissions, taxing employer-paid parking could generate significant tax revenue. Changing the current practice, where employer-paid parking is tax-free, would require an instruction from the Ministry of Finance to the Tax Administration or, alternatively, a legal amendment. This is a national regulation that the municipality cannot change on its own.

Requirement for private entities to charge for parking at workplaces, shopping centers, etc.

Free parking at the workplace is a significant driver for people choosing to drive to work. Most workplace parking spaces in Oslo are privately owned. The City of Oslo does not currently have the legal authority

to require private workplaces, shopping centers, etc., to charge for parking. However, Oslo has requested this authority from national authorities. If a legal amendment is passed and Oslo decides to require paid parking, this could lead to both traffic reductions and reductions in greenhouse gas emissions.

Facilitating the shift from cars to electric motorcycles (e-mopeds and e-motorcycles)

Shifting from fossil-fuel cars to electric motorcycles can reduce emissions, traffic, energy consumption, land use, air pollution, and noise. The Climate Agency assesses that the barrier to switching from cars to e-mopeds is lower than to e-motorcycles, mainly due to price and licensing requirements. Therefore, the measures are primarily aimed at promoting e-mopeds. E-mopeds are technologically mature, relatively inexpensive to purchase (NOK 15,000 – 25,000) and operate, and buyers can receive up to NOK 3,500 in Enova support. Car usage is highest in the outer city, where public transport, cycling, and walking are less developed. A barrier to the transition to electric motorcycles is the lack of parking for motorcycles. Reallocating parking spaces from car parking to free e-MC parking, combined with communication efforts, are measures that could encourage fossil-fuel car users to switch to e-mopeds.

Requirement for zero-emission transport in procurements under NOK 500,000 and less frequent than once a week

The current requirement for zero-emission transport in the municipality's procurements could be expanded to include deliveries under NOK 500,000 and goods and services delivered less frequently than once a week during the contract period. The requirements for zero-emission deliveries to construction sites could also be extended to include the transport of goods and services, including the transport of waste from construction sites. As of January 1, 2025, there is a requirement that mass transport must be zero-emission. The emissions impact of this measure has not been calculated, but a smaller portion of the effect is included in the *Enhanced local measure package for vans* (see the description above).

Access for zero-emission/biogas-powered heavy vehicles and vans in bus lanes

The Norwegian Public Roads Administration, Ruter, the Agency for Urban Environment (BYM), and the Climate Agency (KLI) conducted a study on the use of bus lanes. The working group recommends that electric passenger cars should no longer have access to bus lanes. However, the Norwegian Public Roads Administration, BYM, and KLI recommend that zero-emission and biogas-powered heavy vehicles should have access to the bus lanes. Additionally, BYM and KLI recommend that electric vans be granted access. The study was submitted to the Ministry of Transport in April 2024. The climate effect of this measure has not been calculated, but the impact on vans is included in the "Enhanced local measure package for vans." In connection with the Ring 1 closure project, the City of Oslo has requested that the Minister of Transport consider granting electric trucks and vans access to bus lanes.

Reduced speed limits from 80 to 70 km/h

Lowering speed limits can help improve the competitiveness of public transport, cycling, and walking compared to passenger cars in Oslo, potentially leading to a reduction in traffic. This is an initiative the Norwegian Public Roads Administration has explored (Statens vegvesen, 2024). It could also have positive effects in other areas, such as improved air quality, reduced noise pollution, and enhanced traffic safety.

Uncertainty in the calculations

Adopted Measures	
Measures	**Description of uncertainty**

Procurement of zero- and fossil-free vehicles in the municipality Uncertainty: Low Consequence: Low	The uncertainty is low, as the municipality has good control over its own vehicles and vehicle replacement.
Zero-emission (including biogas) delivery of goods and services on behalf of the municipality Uncertainty: Low Consequence: Low	The uncertainty is low, but there is some uncertainty related to the distribution between kilometers for heavy vehicles and vans, as the Climate Agency only has information on total kilometers per technology and not distributed by vehicle category.
Incentives for zero-emission taxis from 2025 (requirements, subsidies, charging infrastructure, etc.) Uncertainty: Low Consequence: Low	The uncertainty is considered low as it is only for the years 2023 and 2024 that the effect is uncertain. There is some uncertainty related to whether exemptions from the requirement will be granted.
Incentives for zero-emission vans Uncertainty: High Consequence: Medium	The calculation of the climate effect is based on an expert assessment of trends in the sales of new electric vans. Such analyses always carry significant uncertainty. The measure accounts for a relatively small portion of the total emission reduction potential. The consequence is considered medium.
Requirement for the use of zero-emission trucks on behalf of the municipality and Incentives for zero-emission heavy transport in Oslo Uncertainty: High Consequence: High	The calculation of the climate effect is based on an expert assessment of trends in the sales of new electric and biogas trucks. Such analyses always carry significant uncertainty. For trucks, there is particularly high uncertainty related to the existing national support system for electric trucks, which is based on competition, as well as the behavior of actors in the coming years. The measure accounts for a significant portion of the total calculated emission reduction potential, and the consequence is considered high.
Identified measures	
Measures	**Description of uncertainty**
CO2 tax equivalent to NOK 2,000 in 2030 without compensatory measures	The calculation of the climate effect of economic measures always has high uncertainty since the emission effect depends on the behavior of thousands of individuals and businesses. Particularly how an increasing tax will affect vans and heavy transport is uncertain, as the model selection of electric vehicles is rapidly evolving.
Increase of the national biofuel blending mandate to 33% in road traffic by 2030	The calculation has relatively low uncertainty, but due to the structure of the blending mandate, which allows flexibility between sectors, some of the potential increases may occur in sectors other than road traffic.
Double toll rates for new fossil-fuel passenger cars by 2026	The calculation is based on expert assessments of trends in new car sales and an assessment that double toll rates can be considered a near-ban on new fossil-fuel cars. However, the uncertainty is still high since behavior is difficult to predict, and the last fossil-fuel car buyers may be the hardest to shift to electric.
Double toll rates for new fossil-fuel vans from 2027	The calculation is based on the same methodology as for passenger cars. The uncertainty is somewhat higher since there is currently not as broad a model selection as for passenger cars, and new van sales today are not as high as for passenger cars. This increases the range of potential outcomes.
Zero-emission zone for vans and heavy vehicles within Ring 2 (along the inner toll ring) from 1.1.2027	The calculation has high uncertainty. The effect depends on the behavior of many individuals and businesses. Additionally, there is uncertainty regarding potential exemptions from the ban.

Zero-emission zone for passenger cars within Ring 2 (along the inner toll ring) from 1.1.2028	The calculation has high uncertainty. The effect depends on the behavior of many individuals and businesses. Additionally, there is uncertainty regarding potential exemptions from the ban.
Parking measures at municipal workplaces	The calculation is based on a survey on employees' travel habits. Surveys have greater uncertainty than studies based on observed behavior. Additionally, there is uncertainty regarding the availability of alternative parking near the municipal parking spaces.
Enhanced local measure package for vans	The calculation has high uncertainty since it is based on an expert assessment of trends in new van sales. It is assumed that with an enhanced package of measures, nearly all new buyers of various types of vans in Oslo and partly Akershus will choose electric once the right models become available.
National package of economic measures for heavy vehicles	The uncertainty is considered high. The effect is assessed conservatively. The package of measures being considered would make it profitable for almost everyone to choose electric vehicles starting from 2025, so it is possible to approach 100% new sales of electric and biogas vehicles before 2030, particularly in the Oslo region, if the package is implemented quickly. The effect is assessed conservatively because political changes like a one-time fee on new fossil-fuel trucks often take a long time to implement.

Assessment of distributional effects

The measures for reducing traffic and promoting electrification contribute to lower NOx emissions, less noise, and a better urban environment for those living and spending time in areas where transport occurs. There are also several health benefits associated with active travel.

Investments in public transport, toll rings, and the use of space for pedestrians and cyclists instead of parking represent a redistribution of resources from those with access to cars to those without. Almost 40% of Oslo's population does not have access to a car, and seven out of ten travelers walk, cycle, or use public transport. Women and low-income groups walk more and use public transport more frequently. Broadly, these groups will benefit from this redistribution. A connected and safe cycling network is key to making cycling attractive, even for those who do not feel safe cycling on the road.

In recent years, the City of Oslo has reallocated a number of parking spaces in favor of cyclists, public transport, and increased urban life. The reduction in the number of on-street parking spaces may cause disadvantages for certain groups, such as people with reduced mobility and businesses dependent on goods and service transport. Emphasis has therefore been placed on ensuring parking access for those with disability cards (HC permits), providing opportunities for goods deliveries, and offering a good resident parking scheme. However, no systematic evaluation of Oslo’s parking policies has been conducted.

Increased use of shared solutions, such as car-sharing, electric scooters, and e-bikes, provides more people with the opportunity to move around the city without owning a vehicle. Currently, there are few such shared solutions outside Ring 3. Moreover, these services do not yet reach the neighborhoods with the lowest incomes. However, the municipality is working to expand access to shared e-scooters and e-bikes in outer districts, and at least 30% of shared car spaces on municipal land will be located in the outer city. Additionally, innovative mobility solutions are being explored in the Groruddalen area, such as establishing mobility hubs through the MOVE 21 project and Ruter's self-driving vehicle project.

2.3.4 Heating – 5 % of Oslo’s emissions

Emissions from heating primarily come from the use of fossil oil, LPG (liquefied petroleum gas), and wood burning. Heating emissions have been reduced by nearly 90% since 2009 due to the ban on the use of fossil oil for heating, which took effect on January 1, 2020. In 2022, emissions from the sector amounted to 43,600 tons of CO2 equivalents, an increase of nearly 13,000 tons of CO2 equivalents from 2021, resulting from increased use of fossil oil and some gas. There is significant uncertainty in the Norwegian Environment Agency's climate inventory for this emission source, and it is likely that the increase is due to methodological weaknesses (see 2.1.1 on uncertainty). It is assumed that the national increase in fossil

oil use can be explained by high electricity prices, leading those with buildings exempt from the oil heating ban (such as holiday homes) to choose oil heating over electricity.

Roadmap

In this year's climate budget, there are no adopted measures within the heating sector. Therefore, the adopted measures in Figure 8 reflect the development in the baseline path. In the roadmap for heating, emissions in 2025 are estimated to be around 31,000 tons of CO2 equivalents. Emissions are expected to decrease towards 2030 as the ban on the use of heating oil for heating will be extended from January 1, 2025, to include agriculture and others who have not yet been covered by the ban. It is estimated that emissions in 2030 will be around 27,000 tons of CO2 equivalents if no new measures are introduced.

If a national ban on the use of gas for heating is implemented (an identified measure), total emissions from the sector in 2030 could be around 10,000 tons of CO2 equivalents. To meet the climate target, all fossil emissions from the sector should be eliminated by 2030, with remaining emissions coming only from wood burning and bioenergy.

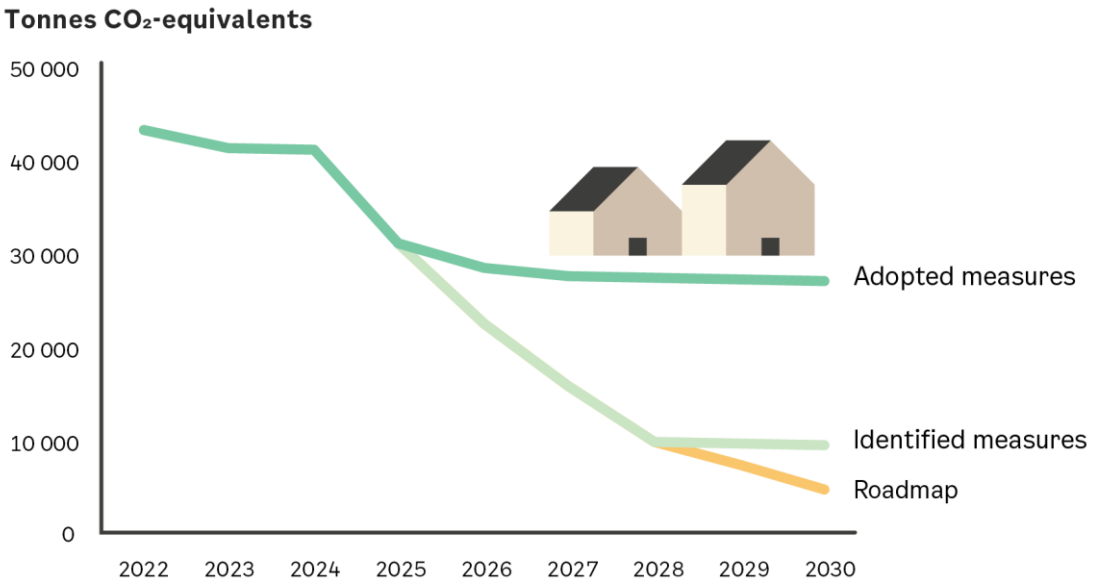


Figure 8: Roadmap for heating 2022-2030

Identified measures

National ban on the use of gas for heating and construction heating

Emissions from the use of gas for heating have increased since 2019. A national ban on the use of gas for heating, if implemented without significant exemptions, could eliminate all emissions from gas combustion in this sector, as also mentioned in *Climate Measures in Norway Towards 2030*. The Norwegian Environment Agency has assessed that this measure could reduce national emissions by over 700,000 tons of CO2 equivalents. For Oslo, the ban could reduce emissions by 15,000–20,000 tons of CO2 equivalents. The phasing in of the effect is expected to start in 2026 at 33%, with a linear increase until full effect is achieved by January 1, 2028.

A proposal for a regulation banning the use of fossil gas for construction heating was submitted for consultation in the summer of 2024. The proposal covers only temporary heating for buildings under construction and renovation, not the permanent heating of buildings.

Uncertainty in the calculations

Identified measures	
Instrument	**Description of uncertainty**
National ban on the use of gas for heating and construction heating	There is uncertainty related to the design of a potential regulation, possible exemptions, and the underlying development of emissions without new measures.

2.3.5 Waterborne navigation – 4 % of Oslo's emissions

Emissions include commercial and passenger traffic on the sea within the city's boundaries. In 2022, emissions from shipping accounted for approximately 4% of Oslo's greenhouse gas emissions, equivalent to 36,000 tons of CO2 equivalents. International ferries to Copenhagen and Kiel were responsible for just over one-third of these emissions (13,500 tons of CO2 equivalents), as they operate daily throughout the year. Cruise ships were the second-largest source, contributing around 8,000 tons of CO2 equivalents in 2022.

Since 2009, emissions from shipping have increased by 6,500 tons of CO2 equivalents, primarily due to increased activity from both freight and passenger ships. From 2021 to 2022, emissions decreased by 8%, largely due to reduced emissions from passenger ferries. This decline was a result of normalized activity following the pandemic. In 2021, the international ferries between Oslo and Kiel spent more time than usual within the city's boundaries, which increased emissions. In 2022, these ferries returned to normal operations. At the same time, cruise ship traffic doubled in 2022 compared to pre-pandemic levels, rising from around 4,000 to 8,000 tons of CO2 equivalents. This increase was due to more operators choosing Oslo as a substitute destination following the invasion of Ukraine, replacing trips to Russian ports.

Roadmap

In the roadmap for shipping, emissions are estimated at 29,000 tons of CO2 equivalents in 2025. With the implementation of approved shore power measures, emissions can be reduced to around 22,000 tons of CO2 equivalents by 2030, which is about 24% lower than in 2009. If the identified measures are also implemented, emissions in the sector could be reduced to around 9,000 tons of CO2 equivalents, representing a reduction of just under 70% by 2030 compared to 2009.

Remaining emissions, assuming the identified measures are carried out, will come from cargo and cruise ships. These emissions will result from both port stays that cannot be electrified with shore power and from emissions during entry and exit of the port. To achieve the necessary reductions, more ships need to adopt renewable energy for propulsion. It is estimated that by 2030, emissions could be reduced to around 3,000 tons of CO2 equivalents, a 90% reduction from 2009 levels. The remaining emissions will be from cargo ships that rarely call at the Port of Oslo.

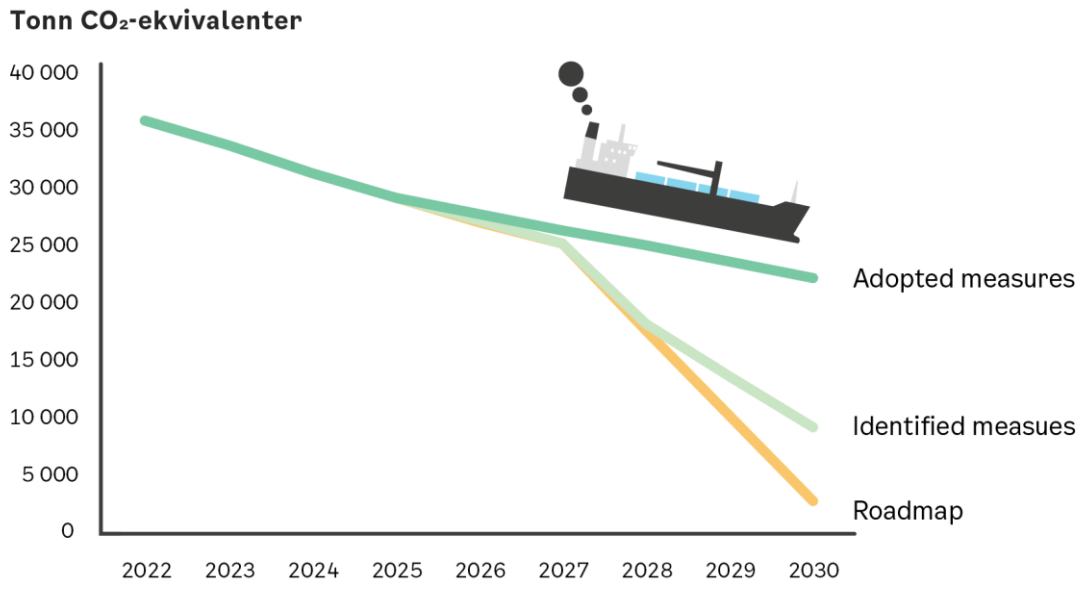


Figure 9: Roadmap for Shipping 2022-2030

Adopted measures

No. 21 Establish shore power for tankers and cruise ships, and follow up on the use of shore power for container ships

The climate effect of establishing shore power for tankers and cruise ships, along with ensuring the use of shore power for container ships, is estimated to reduce emissions by 3,400 tons of CO2 equivalents in 2025 and 8,000 tons in 2028. The effect calculation is based on information from the Port of Oslo regarding the timeline for the installation of shore power facilities and assessments of how much energy usage at the port can be replaced, as well as the pace at which ships will be upgraded to use shore power. The EU has also adopted regulations requiring the use of shore power for container and passenger ships larger than 5,000 gross tons by 2030, which will further contribute to the use of these facilities before 2030.

Identified measures

Requirements or incentives for zero-emission solutions for international ferries

This measure involves either setting requirements or using economic incentives to encourage international ferries to adopt zero-emission fuels. The 2018 action plan for the Port of Oslo states that requirements should be set when new routes are established, existing routes are tendered, contracts are renewed, or when circumstances allow. Environmental differentiation of port fees could also be a strong incentive to encourage international ferries to adopt zero-emission solutions.

If all international ferries adopt zero-emission solutions for entry and exit, the isolated effect would be in the range of 8,000-10,000 tons of CO2 equivalents. This effect is factored into the roadmap with a gradual phase-in during the years 2028-2030.

Establishment of shore power for cargo ships

Shore power replaces the use of fossil fuels when ships are docked. This measure involves expanding shore power infrastructure for ships that are not currently planned for. Assuming the facilities are used,

this could reduce emissions by 1,000-3,000 tons of CO2 equivalents. The effect depends on environmental differentiation of port fees (see below) and is factored in with a gradual phase-in from 2026-2030.

Environmental differentiation of port fees for shore power use

Shore power facilities will only have an effect if they are utilized. To adopt shore power, arriving ships must also be upgraded. Increased port fees for ships that do not use shore power could stimulate its use. In the roadmap, it is assumed that this measure will be phased in as shore power infrastructure is expanded. The effect is included in the estimates for shore power expansion described above.

Non-calculated identified measures

Incentives for zero-emission entry and exit for all ship types (environmental differentiation, priority access to docks and other areas)

To further reduce emissions from shipping, it is necessary for more ships (such as container and general cargo ships, or tankers) to adopt renewable fuels such as hydrogen or electricity. This measure involves strengthening environmental differentiation of port fees for all ship types to encourage the use of renewable fuels. In addition, priority access to docks and other areas can be granted to ships using renewable fuels. It is important that the measure is designed in a way that does not shift freight transport to roads.

Strategic collaboration with other cities/ports (refueling infrastructure, environmental differentiation, and green corridors)

Collaboration with other cities and ports is necessary to reduce emissions from shipping. New technologies and fuels are still in early stages and will likely require a more diverse fuel infrastructure. This may mean that more ports (including Oslo) need to offer refueling compared to the current situation, and efforts should be coordinated. The Port of Oslo initiated an environmental collaboration with seven ports around the Oslofjord in 2019 (Oslofjord collaboration). This work can be intensified, focusing on refueling infrastructure for renewable fuels and environmental differentiation of port fees. Additionally, during the 2021 climate negotiations (COP26), Norway and 21 other countries signed the Clydebank Declaration on green shipping corridors. A green corridor is a transport route between two or more ports where ships use zero-emission fuels. In 2023, Rotterdam and Oslo signed a letter of intent to establish a green corridor. Two hydrogen container ships are currently being built to operate between these cities. It is important to use the lessons from this corridor to facilitate more zero-emission ships. This measure is not calculated and serves to support other measures.

Uncertainty in the calculations

Adopted measures	
Measure	**Description of uncertainty**
Establish shore power for tankers and cruise ships, and follow up on the use of shore power for container ships Uncertainty: Medium Consequence: Low	The calculation is based on assessments by the Port of Oslo regarding when shore power facilities can be completed and to what extent these facilities will be used in the future. There is particular uncertainty about how much the shore power facilities will be utilized, as this depends on the adaptations made on individual ships and could be influenced by the environmental differentiation of port fees.
Identified measures	
Requirements or incentives for zero-emission entry and exit for international ferries	The calculation assumes that emissions from international ferries will be eliminated. However, there is uncertainty about the feasibility of implementing this measure. It may be possible to impose requirements during contract renewal for DFDS ships traveling to Copenhagen, but the contract for Colorline ships will not be renewed

	until after 2030. These ships may instead rely on economic incentives like environmentally differentiated port fees. There is significant uncertainty about whether these incentives will be sufficient to achieve zero-emission solutions before 2030.
Shore power for cargo ships	The calculation is based on assessments by the Port of Oslo regarding when shore power facilities for cargo ships can be completed and to what extent they will be used. As with other ships, there is significant uncertainty about the level of utilization of shore power facilities, as this depends on ship-specific adaptations and may be influenced by environmentally differentiated port fees.

2.3.6 Waste and wastewater – 5% of Oslo's emissions

The waste and wastewater sector includes emissions from landfill gas, biological waste treatment, and wastewater. 79% of the sector's emissions come from landfill gas produced at the closed landfills in Oslo. The landfills are the largest source of methane emissions in Oslo. The Oslo Municipality's Agency for Real Estate and Urban Renewal is responsible for managing the landfills.

In 2022, emissions from the sector were approximately 51,200 tons of CO2 equivalents, a 4% reduction from 2021. This reduction was due to a decrease in landfill gas emissions equivalent to 8,200 tons of CO2 equivalents, resulting from both lower methane production and increased gas capture. However, emissions from wastewater and biological waste treatment increased from 2021 to 2022.

Roadmap

In the roadmap for waste and wastewater, emissions are estimated to be 46,000 tons of CO2 equivalents in 2025. With the adopted measures, emissions from the sector could be reduced to around 39,000 tons of CO2 equivalents by 2030. The expected reduction towards 2030 is due to the natural decline in methane emissions from the landfills.

No additional measures have been identified that could further reduce emissions in the sector. Landfill gas emissions must be cut for Oslo to meet its climate targets. The Climate Agency and the Agency for Real Estate and Urban Renewal are working to identify new measures to reduce emissions from the sector.

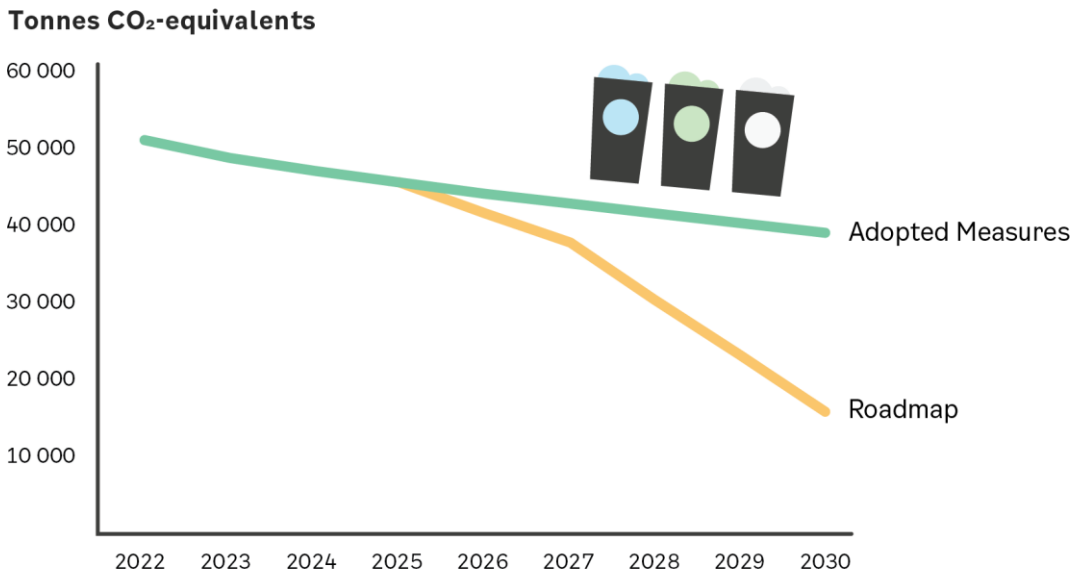


Figure 10: Roadmap for waste and wastewater 2022-2030

Adopted measures

No. 2: Maintenance of landfill gas facilities at Rommen and Grønmo

The emission-reducing effect of the upgrades completed by 2022 at the landfill gas facilities is captured in the municipality's climate inventory and is therefore included in the baseline path. However, these emission reductions require continuous maintenance of the facilities.

Non-calculated identified measures

Improvement of wells at Rommen landfill

Wells are a source of methane leaks. Improving the wells could increase the capture of methane gas from the landfill. The wells that need improvement can be identified through measurements.

New cover for Rommen landfill

The landfill at Rommen has an old cover that is not sealed, leading to methane gas leaks. A new cover could reduce leaks and increase the collection of landfill gas. This measure should be considered in light of the final results from measurements conducted by the Agency for Real Estate and Urban Renewal.

3. Indirect emissions

Oslo's indirect emissions are estimated to be 12 tons of CO2 equivalents per person (Asplan Viak, 2018). These indirect emissions mainly stem from our consumption of goods and services produced outside of Oslo. Additionally, investments and transportation outside Oslo's borders, carried out by the city's population, contribute significantly to indirect emissions. In 2023, the City Council adopted the *Circular Economy Action Plan*. Measures to promote a more circular economy typically reduce indirect emissions.

3.1 Challenges with indirect emissions calculations and data sources

3.1.1 Challenges in calculating indirect emissions/use of indicators

There is no comprehensive overview of Oslo's indirect emissions or their development over time. Estimates for the city as a whole (Asplan Viak, 2018) and for municipal operations (Asplan Viak, 2018) provide good indications of the largest sources of emissions. However, to measure these emissions annually from 2020 to 2030, data on the sale of goods and services in Oslo and a more standardized calculation methodology are required. Current consumption-based emissions inventories are marked by significant uncertainty and are not detailed enough to determine the effects of adopted measures.

For example, there can be large variations in emission factors within the same product group, but available datasets are not detailed enough to account for these differences. The emission factors for beef used in DFØ's Climate Calculator for food procurement range from 24 to 77 kg CO2 equivalents, depending on the source of the meat (Cicero, 2021). However, we know that red meat is the largest source of emissions among food items. The Climate Agency, therefore, tracks the indicator of kilograms of meat purchased by municipal operations. The same approach applies to other product and material groups. Although the exact emissions figures are uncertain, the relative differences between product groups are well understood. Based on this data and the city's scope of action, construction materials, meat consumption (especially red meat), and consumables such as ICT, furniture, and textiles in municipal operations have been prioritized as focus areas. The Climate Agency has published indicators for indirect emissions on the Climate Barometer to monitor trends in emission levels within these categories.

It has not been possible to quantify the indirect climate effect of the adopted measures in the 2025 Climate Budget for indirect emissions, with the exception of climate requirements for materials used in

the construction of the Fornebubanen (Fornebu metro line), see the status description of the measures. Quantification of more measures will be considered as the data basis develops.

3.1.2 Data sources

Estimates of consumption-based emissions by the Norwegian Environment Agency

In 2024, the Norwegian Environment Agency published figures for Norwegians' consumption-based emissions for the first time (Vector Sustainability & XIO Sustainability Analytics A/S, 2023). The figures show that Norwegians' consumption-based emissions are among the highest in the world, with a carbon footprint of 13 tons of CO2 equivalents per person in 2020. Over 60% of these emissions occurred outside of Norway and are classified as Norway's indirect emissions. The figure below illustrates the distribution of Norway's consumption-based emissions across different sectors.

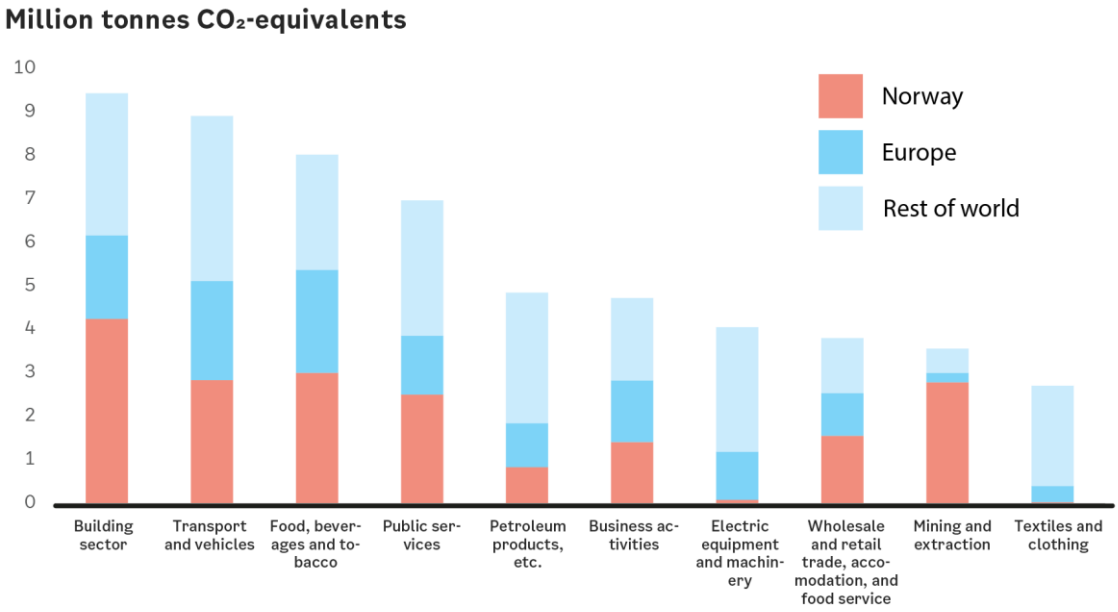


Figure 11: Greenhouse gas emissions from Norwegian consumption by major sectors. Source: Norwegian Environment Agency

According to the report, construction is the largest source of Norway's consumption-based emissions when emissions are allocated by end-user. This sector includes emissions from the production of materials and construction work. Over half of these emissions occur outside of Norway. The emissions from the production of construction materials and machinery are larger than those from the actual construction work.

The transport and transport vehicles sector includes emissions from the production of household vehicles and emissions from transport services (public transport, flights, etc.), but does not include direct emissions from household personal transport. Emissions from the production of fuel are included in the petroleum products sector, while emissions from the transport of goods and services are attributed to the respective sectors.

More than 60% of the emissions from food, beverages, and tobacco come from imported products. For Oslo, this proportion would be closer to 100% due to very little food production within the city limits.

Emissions from public services are also a significant source of consumption-based emissions. For the operation of the City of Oslo, this includes emissions from the procurement of goods and services worth over NOK 60 billion annually. Asplan Viak estimated that the carbon footprint of Oslo's municipal operations in 2016 amounted to over 700,000 tons of CO2 equivalents (Asplan Viak, 2018).

The textiles and clothing sector stands out, as almost all emissions occur outside of Norway. Additionally, Norway has large indirect emissions associated with business activities.

Municipal procurement – Carbon Key
The Agency for Development and Competence (UKE) has data on the municipality's total procurement. In collaboration with the Climate Agency, they are testing a system called *Carbon Key*, which calculates the greenhouse gas emissions associated with goods and services purchased by the municipality. The data quality varies between different product groups, but the system provides a good indication of which product groups in municipal procurement contribute the most to emissions and how the data foundation can be improved.

The Climate Survey
Since 2017, the Climate Agency has conducted an annual survey that maps the behavior and attitudes towards climate measures among Oslo's residents, businesses, and the population of the former Akershus municipalities. Although self-reported data carries high uncertainty, such surveys are still useful for understanding people's attitudes, willingness to change, and level of knowledge.

Over the past three years, about a quarter of the population has reported that they consume less than before. Nearly half of the residents also stated they have become better at reducing food waste, while the proportion of those who have reduced their meat consumption has steadily increased in recent years (Verian, 2024).

Among Oslo's businesses, over eight out of ten companies report that they track emissions from procured goods and services to a significant or moderate extent. While only half of businesses imposed climate and environmental requirements on their suppliers in 2017, this has now risen to nearly two-thirds. Around four in ten businesses also report having implemented measures to reduce their consumption of electronics, furniture and interior items, food waste, and air travel (Verian, 2024).

Consumer Survey
Statistics Norway (SSB) publishes the *Consumer Survey* every ten years, which aims to map out what Norwegian households spend their money on. The most recent publication was in 2023 (SSB, 2024). The results showed that in 2022, the largest expenses for Norwegian households were housing, electricity, and fuel (35.3%), transport (14.5%), food and non-alcoholic beverages (11.9%), and leisure, sports, and culture (8.1%).

3.2 Status, sectoral analyses (ASI framework), and identified measures
To achieve the goal of significantly reducing indirect emissions by 2030, efforts must be intensified, and new measures must be adopted.

To reduce greenhouse gas emissions and other negative environmental impacts, the most cost-effective approach is to avoid an activity (e.g., avoid flying), then shift the activity (e.g., use trains instead of planes), and finally improve the activity that must be carried out (e.g., use zero-emission fuels). This concept of *Avoid, Shift, and Improve* is referred to as the ASI framework. The framework is a central part of the report on how Norway can transition to a low-emission society from the *Climate Panel 2050* (Klimautvalget 2050, 2023).

In the following chapters, the ASI framework is used to present measures for reducing Oslo's indirect emissions. Identified measures to trigger these measures are described. See Proposition *1 Climate Budget 2025* for adopted measures.

3.2.1 Material consumption

Norwegians' consumption levels are among the highest in the world, and we purchase more than twice as many shoes and clothes as the average in Europe (Forskning.no, 2023). Many of our consumer goods are produced in the Global South, where there are significant challenges related to water and soil pollution and unsafe working conditions.

The City of Oslo purchases goods worth over half a billion kroner annually. Emissions from furniture and fixtures are estimated at around 12,000-15,000 tons of CO2 equivalents per year, while emissions from ICT equipment (mainly computers) are estimated at 16,000–20,000 tons of CO2 equivalents annually. For textiles used for clothing, the estimate is approximately 1,700 tons of CO2 equivalents per year. Emissions for all categories have increased since 2021, but there are annual variations in how much is purchased. It is assumed that fewer purchases were made during the pandemic, which may explain why the 2021 figures are lower. These figures carry significant uncertainty.

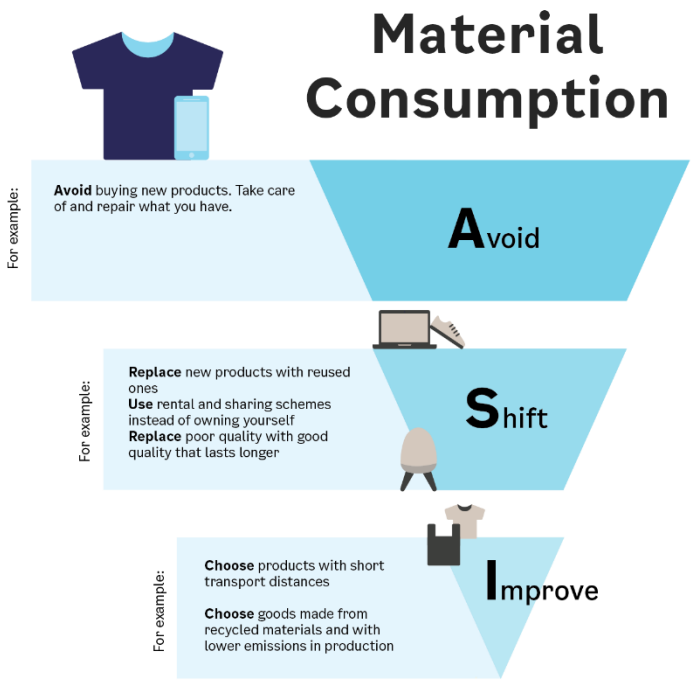


Figure 12: Emission-reducing measures for consumable materials in the ASI framework

Reducing emissions from the consumption of textiles, ICT, and furniture can often be cost-saving, as the most effective measures in the ASI framework (Figure 13) focus on avoiding new purchases by taking better care of existing products, as well as shifting consumption to second-hand goods and rental or sharing schemes.

Identified measures

- **Incentives for using second-hand furniture in procurement:** This aims to increase the proportion of used furniture in municipal procurement, encouraging circular practices and reducing the need for new products.
- **Establishing a reuse warehouse:** Linked to the municipality's reuse platform, this warehouse would provide sufficient storage space for reused items. This has been identified as crucial in the Agency for Development and Competence's efforts to reduce indirect emissions from furniture.
- **High-quality snowsuit lending program in municipal kindergartens:** Suppliers would be responsible for the maintenance and repair of the snowsuits, encouraging extended use and lowering consumption. This initiative could also help reduce social inequality by ensuring equal access to high-quality clothing.
- **National VAT exemption on second-hand goods, repair, and redesign services:** This would shift relative prices in favor of more circular goods and services instead of purchasing new items. The government has previously announced an investigation into VAT exemptions for repairs and second-hand goods (NRK, 2023), and the Finance Minister has stated that any exemption would need to be addressed in the state budget (Stortinget, 2024).

- **National regulation on the import of ultra-fast fashion/textiles:** This measure seeks to reduce the consumption of poor-quality, plastic-based textiles that cannot be recycled, addressing the environmental impacts of fast fashion.

3.2.2 Food

The global food system accounts for between 21% and 37% of global greenhouse gas emissions (IPCC, 2019). According to the Norwegian Environment Agency, food consumption is also the largest source of emissions from Norwegian households (Vector Sustainability & XIO Sustainability Analytics A/S, 2023). These emissions are mainly related to the production of animal-based food. About one-third of emissions from food are from goods imported from developing countries, another third from Europe, and the remaining third from Norway. According to Nibio, the production of red meat accounts for about 60% of agricultural emissions in Norway (Nibio, 2016). Since very little food is produced in Oslo, food-related emissions are classified as indirect emissions for the city.

As shown in Figure 14, avoiding food waste and shifting consumption to plant-based alternatives are crucial for reducing emissions from food production. The Norwegian Environment Agency's report "Climate Measures in Norway towards 2030" indicates that if meat consumption is reduced in line with dietary guidelines, emissions from Norwegian agriculture could be cut by 25% by 2030 (Miljødirektoratet, 2023c).

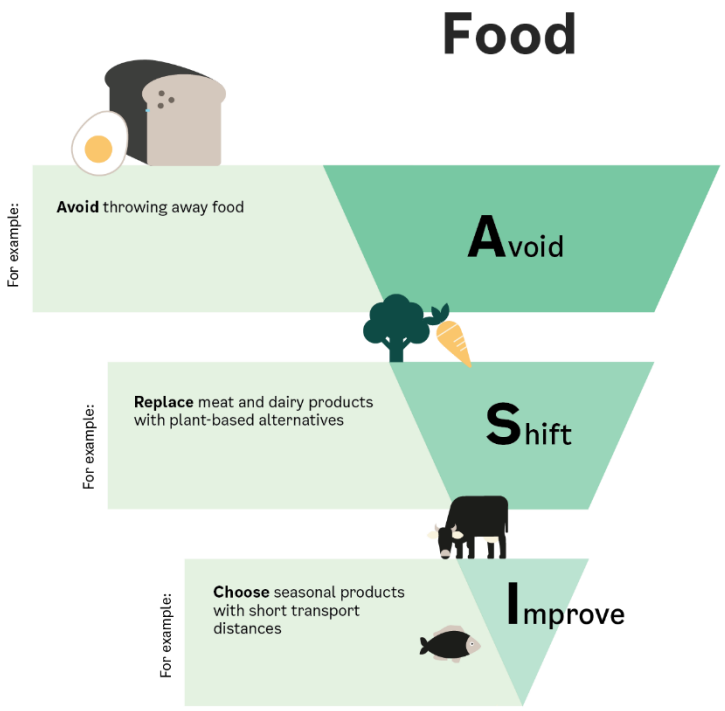


Figure 13: Emission-reducing measures for food in the ASI framework

Food procurement in the city's operations is estimated to contribute around 11,000 tons of CO2 equivalents in 2023. A large portion of this comes from the purchase of beef, primarily for hospitals and elderly care homes. From 2019 to 2023, meat consumption is estimated to have increased by just under 4%. However, there is considerable uncertainty surrounding these estimates.

Identified measures

- **More fish and other seafood, legumes, vegetables, grains, pork, chicken, dairy products, and eggs instead of beef and lamb in the menus of municipal hospitals and elderly care homes:** In line with the Action Plan for Sustainable Meals in the Nursing Home Agency, there is a need to better follow up on measures to reduce meat consumption in municipal operations. New measures should focus specifically on reducing beef consumption. Meat consumption in nursing homes and districts accounts for 50% and 30% of the municipality's total meat consumption, respectively.
- **Vegetarian days and always offering a vegan option in cafeterias covered by lease agreements:** These cafeterias are not currently included in the measures from the action plan for sustainable, healthy, and more plant-based food. These measures can be promoted during renegotiation processes of lease agreements or through cooperation with other tenants.

- **Lower prices for plant-based meals compared to equivalent meals containing meat or fish in municipal cafeterias and those covered by lease agreements**

3.2.3 Vehicles, machinery, and fuel

The production of vehicles, machinery, and fuel used by Oslo's residents and businesses is a significant source of indirect emissions. In addition, the construction of new roads contributes to indirect emissions from material use. Driving by Oslo's population with gasoline and diesel vehicles outside of the city's borders is also categorized as indirect emissions.

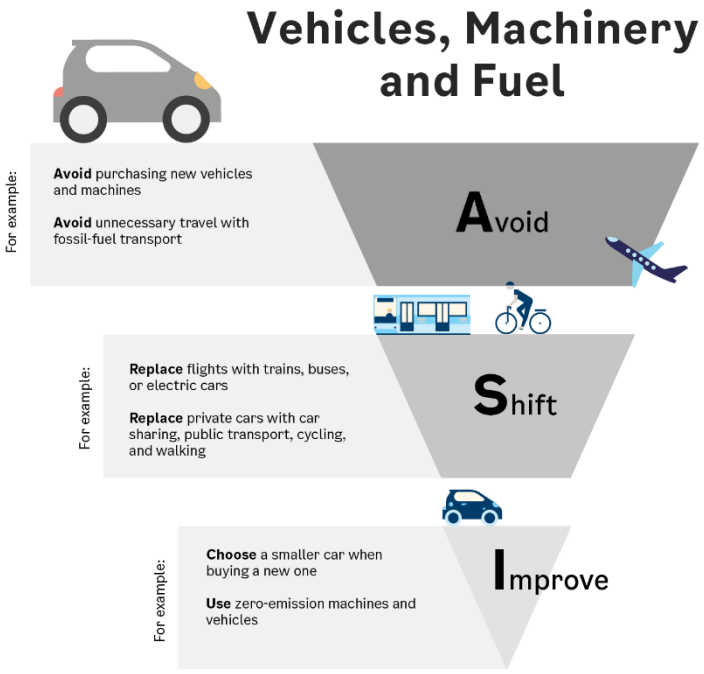


Figure 14: Emission-reducing measures for vehicles and machinery in the ASI framework

As shown in Figure 15, the most important measure for reducing indirect emissions from vehicles, machinery, and fuel is to avoid purchasing new items or to avoid travel altogether. For trips that cannot be avoided, shifting from air travel and private cars to public transport, walking, and cycling is key. Ownership can be shifted to car-sharing services to increase the usage rate of purchased vehicles. If vehicles must be acquired, the environmental footprint can be improved by choosing smaller, zero-emission models, as electric cars have lower life-cycle emissions than fossil-fuel cars. In Oslo, the number of cars per 1,000 inhabitants has remained stable at around 360 cars in recent years. Measures that contribute to reduced transport and a transition to electric vehicles and machinery are discussed in the chapter on direct emissions.

Identified measures

- **Increase the number of parking spaces allocated to electric car-sharing vehicles** on municipal land in central areas: An evaluation of the trial program for parking permits for car-sharing in Oslo suggests that car-sharing services contribute to reduced car ownership and lower indirect emissions *(Asplan Viak, 2022)*.
- **Joint travel policy for municipal operations** with guidelines to choose climate-friendly options when possible: By setting an example and demonstrating that climate-friendly travel is the standard for municipal business trips, the city can influence other municipalities and businesses to adopt similar practices.

3.2.4 Building and construction materials

Building and construction materials are primarily produced outside Oslo's borders and are assumed to be the largest source of indirect emissions both in Oslo as a whole and within the municipality's own operations. The exact scale of these emissions is unknown. Cement production alone accounts for about 4% of global emissions (Andrew, 2019). For the period from 2020 to 2030, it is estimated that greenhouse gas emissions from material use due to construction in Oslo could amount to up to 3,500,000 tons of CO2 equivalents under current practices, excluding major projects like the Fornebubanen and New Water Supply (Asplan Viak, 2020). These estimates are highly uncertain.

Emissions from material use in municipal construction and major renovation projects are estimated to be nearly 74,000 tons of CO2 equivalents for the period from 2021 to 2023. In addition, the projects *New Water Supply* and *Fornebubanen* (FOB) contribute significantly to material-use emissions, even though climate requirements are imposed on material use in these projects (Instrument No. 15 for indirect emissions in *Proposition 1 Climate Budget*).

In 2022, the City Council adopted a goal to reduce greenhouse gas emissions from materials used in the municipality's new and renovated buildings by 30% compared to the emission levels in FutureBuilt ZERO's reference path. Oslobygg is expected to achieve a 9% reduction in 2024. As shown in Figure 15, Oslo Municipality should demolish less and prioritize rehabilitation over new construction. It is also crucial to reduce the need for foundations in new buildings by avoiding sites with challenging ground conditions or those that require the construction of basements or the accommodation of rooftop spaces. Before new construction projects are approved, the City Council must thoroughly assess whether the needs can be met by rehabilitating existing buildings, where practical and climate-friendly. This assessment must be documented in the concept selection study or other early-phase evaluation.

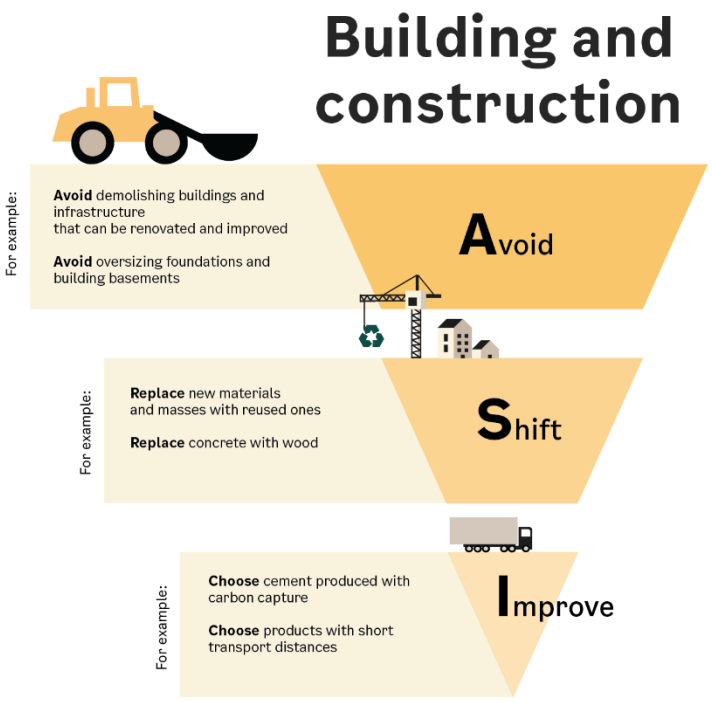


Figure 15: Emission-reducing measures for building and construction materials in the ASI framework

Calculation of adopted measure – Climate requirements for procurement of construction materials and in contracts

The Fornebu line (FOB) project has estimated that using climate-friendly materials (low-carbon concrete A, cross-laminated timber, natural stone/LECA) and prefabricated concrete instead of cast-in-place in its contracts, along with reduced material use, will result in avoided emissions of at least 40,000 tons of CO2 equivalents compared to reference projects (baseline). This corresponds to a 19% reduction in emissions from the material production phase. Approximately 40% of the reduction comes from the use of climate-friendly materials, while 60% comes from reduced material usage. FOB expects the actual emissions reductions could be greater. The estimated emissions reduction from Skøyen station is not yet available and is not included in this estimate.

Identified measures

- **Climate considerations in concept selection studies (KVU):** This ensures that climate goals are integrated into the objectives of construction and infrastructure projects. Material choices made during the design and execution phases often have less impact than decisions related to building design requirements made in the early stages.
- **Improved planning and procedures for excavation work**: This aims to avoid unnecessary digging in roads and streets, which leads to increased material use and transportation of excavated materials. Oslo Municipality's excavation guidelines currently include a two-year moratorium on road construction following excavation to protect the road's quality and accessibility. Better planning and adherence to the two-year restriction, coordinated through the excavation system (Kgrav), could reduce indirect emissions from material use. Consideration could also be given to extending the moratorium beyond two years. In addition to reducing indirect emissions, avoiding unnecessary excavation could provide societal benefits such as lower costs and fewer inconveniences for residents in the affected areas.
- **Requirements for gradually reduced emissions from materials for all developers**: Private developers are responsible for most construction in Oslo. Imposing emission reduction requirements on private developers—30% by 2025, 40% by 2027, and 60% by 2030—could result in an annual reduction potential of 100,000 to 150,000 tons of CO2 equivalents by 2030 for residential and commercial buildings. This is the most impactful measure identified for reducing indirect emissions.
- **Requirements for reuse assessments in municipal construction projects**: For example, projects that involve removing old infrastructure and generating over 10 tons of waste should include an assessment of material reuse. While TEK 17 requires reuse assessments for building materials, there are currently no similar requirements for construction materials.

4. Energy

4.1 Methodology

The Energy barometer monitors energy use in Oslo, and how this has developed over time. It also depicts trends across various sectors, as well as what energy sources are used for different types of activities. The data is based on the Norwegian Environment Agency's municipality-level greenhouse gas inventory, Enova's energy certification statistics, district heating companies, and Statistics Norway (SSB). Oslo's energy accounts are currently updated with data for 2022.

4.1.1 Development in energy use in Oslo

In 2022, Oslo's energy consumption was 13.2 TWh, which is a 13 % reduction compared to 2009. During the same period, Oslo's population increased by around 140,000 inhabitants, resulting in a 28 % reduction in energy consumption per capita. The largest reductions in energy use come from the

electrification of the passenger car fleet (stemming from the approximately tripled efficiency of electric engines compared to gasoline/diesel engines), the phase-out of oil heating, and more energy-efficient buildings.

According to Elvia, the peak electricity demand in Oslo, which is the maximum simultaneous electricity consumption per hour in the grid, has been slightly decreasing in recent years. This trend has occurred despite the electrification of a large portion of the car fleet, nearly all Ruter's buses, and an increasing share of construction sites and port activities in recent years. Additionally, the increased use of district heating, the conversion of commercial areas to residential use, and new building regulations with stricter energy requirements have also contributed to the overall trend. Rising energy prices in 2021 may also have contributed to the decrease in energy consumption and the downward trend in peak demand.

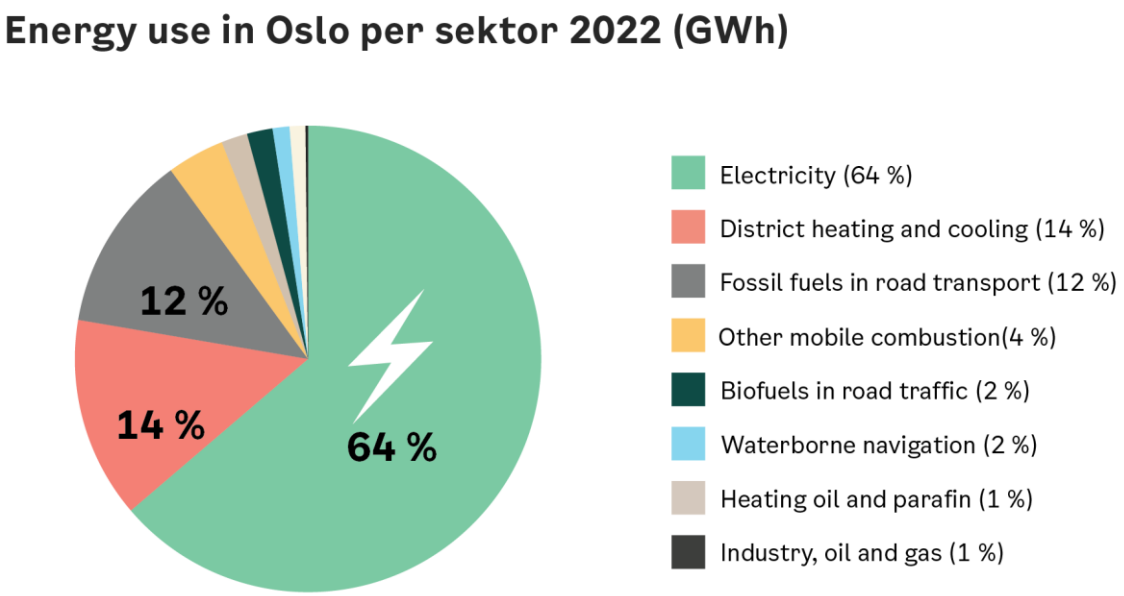


Figure 16: Energy use in Oslo in 2022 by sector

The pie chart above shows the distribution of energy consumption in Oslo in 2022 by sector. 81% of the energy used in Oslo is renewable, with 64 % coming from electricity, 14% from district heating, and 4% from biofuels in road traffic and wood burning.

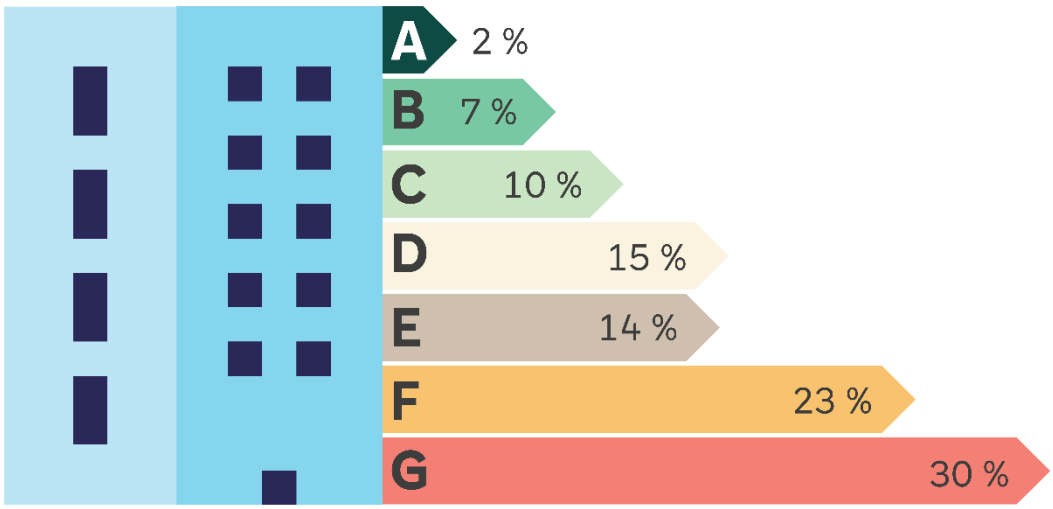


Figure 17: Energy character for buildings in Oslo

Approximately 75% of Oslo's total energy consumption is used for buildings, and 50% of the city's total electricity consumption goes towards heating buildings and domestic hot water. The figure above shows the energy performance rating for buildings in Oslo according to Enova. In Enova's energy labeling system, buildings are given an energy rating on a scale from A (best) to G (weakest). This rating is based on a calculation of theoretical energy use under normal conditions. A large proportion of Oslo's building stock consists of older buildings with poor energy standards. The figure shows that over 50 % of the energy-labeled buildings in Oslo have an energy rating of F or G.

Even though Oslo's overall energy use has decreased, and peak demand has remained stable, there is a need to develop measures to ensure Oslo's energy system is robust and fit for the climate transition. Significant demand changes are expected as heavy sectors like construction, port operations, and heavy transport increase their degree of electrification. This transition will be energy-intensive, and measures are needed to adapt Oslo's energy system to meet the city's climate targets.

4.1.2 Calculation of the effects of energy-related measures

The effects listed in the table for Measures in Energy in Proposition 1 Climate Budget 2025 only include energy and peak demand within the municipality's boundaries. Any effects these measures may have on energy use outside the municipality are not considered in the calculations.

The calculation of the measures is based on the best available information on how the measures directly affect municipal activity, how they influence the behavior of the population or businesses, and how these behavioral changes contribute to changes in energy consumption.

4.2 Explanation of calculations and identified measures

Below is a description of how the measures with specified effects, savings, or energy production have been calculated. All figures apply to 2030. Adopted measures that do not have calculations in *Sak 1 Climate Budget 2025* are not discussed.

4.2.1 Energy efficiency

The City of Oslo facilitates the efficient use of electricity and heat in buildings and aims to reduce energy consumption. In the planning and construction of buildings in Oslo, the *Standard Requirements Specification for the City of Oslo* (SKOK) is used. SKOK includes stricter energy use requirements for new buildings compared to the minimum requirements in the *Building Code* (TEK17).

Adopted measures

Identify and implement cost-effective efficiency measures in the municipality's building stock

All municipal entities that own buildings are required to identify and implement energy efficiency measures during the economic planning period and report on energy savings. The effect of this measure is based on calculations by Hafslund Rådgivning and Zero for the *Energy Measures Analysis* for Oslo (Hafslund rådgivning og Zero, 2024). The calculations are based on the 2,000 buildings managed by Oslobygg, assuming that energy measures will be profitable for one-fifth of these buildings. An average energy improvement of 100 kWh/m² has been assumed. The annual energy savings are 10,800 MWh, with an annual cost of 80.5 million NOK. The cumulative annual energy savings by 2030 are expected to reach 54,000 MWh, equivalent to the annual energy consumption of around 3,200 households (assuming 17,000 kWh per household).

Increase energy efficiency and reduce energy consumption in water and sewage systems

The city's water and sewage systems account for a significant portion of total energy consumption. The Water and Sewerage Agency aims to reduce energy use by lowering water pressure in the network at night, replacing old pumps, optimizing temperature control at all facilities, and reducing stormwater and infiltration water in the sewage pipes, which increases pumping work and requires unnecessary treatment. The Water and Sewerage Agency estimates that these measures will save approximately 2,500 MWh/year, equivalent to the energy consumption of 150 households.

"Catch the Energy Thief" in buildings operated by the City of Oslo

Oslobygg participates annually in the "Catch the Energy Thief" program, where energy advisors inspect energy systems in selected buildings to identify operational errors and energy inefficiencies. In 2023, "Catch the Energy Thief" was conducted at four schools and two kindergartens, revealing inefficiencies totaling around 550 MWh annually. In 2025, Oslobygg plans to conduct the program in at least ten buildings, with expected savings of 500 MWh/year, while also contributing to more flexible energy use in the buildings.

Identified measures

- **Changes to the national electricity support scheme to promote energy efficiency and local energy production**: The current electricity support scheme provides 90% subsidies when electricity prices exceed 73 øre. This makes investments in energy efficiency and solar energy less profitable, as the payback period for such investments increases under the current scheme.

- **Differentiate property tax based on the building's energy class**: This would create a strong incentive for upgrading commercial buildings in Oslo to a higher energy class. Implementing this measure would require an amendment to the Property Tax Act, allowing the municipality to differentiate property tax based on energy efficiency.

- **Increased public subsidies for energy efficiency in buildings from national authorities (Enova) and the municipality**: These subsidies would target owners of single-family homes, terraced houses, housing cooperatives, condominiums, and commercial building owners. Measures could include window replacements, insulation upgrades, heat pump installations, and similar improvements. Hafslund Rådgivning and Zero estimate that a 20% subsidy for energy upgrades could result in annual energy savings of around 15,000 MWh in Oslo, equivalent to 125,000 MWh (the energy consumption of 7,350 households) over five years. The calculation assumes that 5% of single-family homes and row houses, 700 housing cooperatives and

condominiums, and 700 commercial buildings in Oslo will improve their energy efficiency by 30% during this period.

- **Minimum energy label requirements in the municipality's lease contracts**: Fewer than 20% of office buildings in Oslo have an energy class of C or better. According to a DNB Real Estate Market survey, many businesses prefer office spaces with a good environmental profile, but willingness to pay extra is low (DNB, 2023). If the municipality requires energy labels in its lease agreements and encourages energy efficiency measures for building owners, it could incentivize private actors to upgrade their existing buildings. Assuming the municipality includes energy efficiency requirements in 10 new leases per year for spaces averaging 1,325 m², and this leads to an energy improvement of 100 kWh/m² (1,350 MWh annually), the cumulative energy savings after five years would be 6,750 MWh annually, equivalent to the energy consumption of 400 households.

4.2.2 Increased energy flexibility

The electrification of construction sites, port operations, and heavy transport will require increased access to electrical power. This creates a need for comprehensive energy planning in urban development and new solutions for more flexible energy use, such as markets for buying and selling energy flexibility and the use of batteries to always ensure sufficient energy and power.

Adopted measures

Pilot project on flexibility services using municipal resources

This pilot project will offer flexibility to the power system during periods of capacity scarcity. For example, municipal entities can disconnect electric boilers to free up capacity in the grid. It is estimated that the project will provide 12.7 MW of capacity to the flexibility market (Hafslund rådgivning og Zero, 2024).

Grant scheme for participation in flexibility markets

The Climate and Energy Fund has established a grant scheme where buildings or other electricity consumption points can participate in the flexibility market. The estimated effect of the grant scheme is 30 MW, which is just over 1% of Oslo's peak power demand (which occurs on the coldest winter day). While it is difficult to estimate the capacity offered per load, an assumption of 300 kW per load is used. The maximum effect of the scheme is estimated to be up to 150 MW, but since the loads will not be available simultaneously, a more conservative estimate suggests that 30 MW, or at least 20% of the offered capacity, will be available at the same time.

Identified measures

- **Support scheme for converting building systems to waterborne heating:** A national (Enova) or municipal support scheme targeting larger housing cooperatives, condominiums, and commercial buildings. This measure would encourage increased use of thermal heating in buildings, helping to relieve pressure on the electrical grid. Enova currently has a support scheme for converting to waterborne heating, but it only applies to smaller row houses and single-family homes. The necessary subsidy rate to make conversion projects profitable enough to trigger investments is uncertain. Hafslund Celsio, the district heating company in Oslo, is currently assessing costs, potential business models, and the required level of support.
- **Pilot area for low-temperature district heating networks utilizing surplus heat:** A "microgrid" with lower temperature is a more energy-efficient district heating solution, but it requires buildings capable of receiving low-temperature heat. Currently, few buildings can accommodate low-temperature district heating. This measure is thus primarily relevant in a long-term perspective (7-10 years) and for new development areas or areas undergoing total renovation, as it is challenging to implement in already developed areas.

4.2.3 Increased local energy production

Energy production in Oslo has increased in recent years, but efforts need to be strengthened to boost local energy production on rooftops, walls, and gray areas such as parking lots, noise barriers, etc., to reduce the need for energy production in untouched nature. The Planning and Building Agency has conducted an analysis of the potential for solar energy production in Oslo. According to the analysis, there is significant potential for local solar energy production on rooftops in Oslo, estimated at up to 1.2 TWh for solar panels.

Adopted measures

Increase energy production in municipal operations

During the economic planning period, the municipal entities in Oslo that own buildings will assess the potential for installing solar energy systems. Oslobygg will continuously install solar panels on rooftops and facades and in total renovation projects where feasible. They will also work to retrofit solar panels on existing roofs during renovations. Oslobygg aims to establish 3 MWp of new solar production by 2026. By 2030, the effect of this measure is expected to result in 23,600 MWh of energy production and 27 MW of installed capacity. The calculations are based on the installation of solar panels on 18 buildings annually until 2030, with an average rooftop size of 1,600 m² and an average annual production of 262.5 MWh per rooftop. This would yield approximately 4,700 MWh of new production each year, with an annual cost of around 65 million NOK. The energy production in 2030 will be equivalent to the energy consumption of approximately 1,400 households (assuming 17,000 kWh per household).

The Water and Sewage Agency will complete a water turbine at the St. Hanshaugen reservoir, which will provide an annual energy production of 500 MWh, equivalent to the energy consumption of approximately 30 households (assuming 17,000 kWh per household).

Support scheme for solar energy systems for housing cooperatives and condominiums

Through the Climate and Energy Fund, housing cooperatives and condominiums can receive 20% of the investment cost for solar panel systems. Additionally, they may receive supplementary support from Enova when upgrading the building's energy efficiency. With Oslo's many gray rooftop areas, the city has strong potential to utilize these spaces for solar energy production and contribute to the national goal of 8 TWh by 2030. Based on cost assumptions from the *Energy Measures Analysis for Oslo*, the support scheme is expected to trigger 6 MWp of solar capacity by 2025, producing 5.3 GWh of solar power in a

normal year. With an annual increase of 6 MWp from 2025 to 2030, the scheme could support the installation of a total of 30 MWp, with a normal year production of 26.3 GWh. This would more than double the total solar panel capacity in Oslo by the end of 2023 and provide enough electricity for nearly 1,550 households (assuming 17,000 kWh per household).

Identified measures

- **Increased subsidies for solar energy systems for homeowners and commercial buildings**: Expanding the municipal support scheme for solar panels to include commercial buildings, small houses, and single-family homes, with a 20% subsidy, is seen as sufficient to incentivize development according to energy and housing sector actors. This would nearly halve the payback period for many installations. A support scheme for rooftop solar panels may have distributional effects, as not everyone can afford the upfront cost of a solar system, and regulations may limit installations on heritage buildings. A funded solar panel system would reduce installation costs for those who can afford the upfront investment, lowering their energy expenses. A scheme with a budget of 15 million NOK could trigger 20 new solar energy systems annually (assuming an average cost of 3.6 million NOK per system). With an average capacity of 300 kW and annual production of 265,000 kWh per system, the scheme could enable the installation of 30 MW and 26.25 GWh annually over five years, equivalent to the energy consumption of 1,500 households.
- **Make municipal areas available for local power production, such as solar panels**: Suitable municipal areas for local solar power production can be made available to private developers through competitive tenders. The competition could include a subsidy if necessary. This would reduce barriers related to limited available space and increase opportunities for new power generation. By 2025, Oslobygg will map gray areas on its properties for solar energy development. The municipality can also identify other suitable areas and earmark them for local power production, and regulate them for energy purposes if needed. If 100,000 m² of space is developed for solar energy, it could provide a capacity of 19 MW and produce 16.6 GWh annually, assuming 0.19 kW/m² and an annual production of 166.3 kWh/m². This would be equivalent to the energy consumption of 980 households annually.
- **Require local renewable energy production in the development of new residential and commercial areas**: This measure could help trigger large-scale local energy production. If it is assumed that 360,000 m² of new rooftop area will be developed by 2030, with approximately 50% utilized for solar energy production, this requirement could enable 33 MW of new renewable energy production and 29.3 GWh annually, equivalent to the energy consumption of 1,700 households.

4.3 Assessment of distributional effects

In Norway and Oslo, access to clean energy is very good. However, high energy prices can increase inequality and lead to energy poverty. Support schemes for energy measures can have both positive and negative distributional effects, depending on how they are designed and who they target. We see that housing cooperatives and condominiums face significant structural and financial barriers to implement energy measures. In 2025, the Climate Agency will continue information campaigns about energy measures, specifically targeting groups with high economic barriers to undertaking such measures.

Municipal entities, including Boligbygg, are tasked with mapping and implementing energy measures. Boligbygg rents out municipal housing to Oslo residents facing various social challenges. The energy efficiency measures proposed by Boligbygg as additional suggestions will have positive distributional effects, benefiting low-income residents. Efficiency measures implemented by Oslobygg will also contribute to better indoor climates in schools and other public buildings.

5. Climate adaptation and natural carbon storage

5.1 Methodology

Determining whether Oslo is adequately adapted to climate change is challenging and, as of today, difficult to quantify meaningfully. The Climate Agency is working on developing overarching indicators that can provide insight into Oslo's ability to cope with various climate-related changes, such as heavy rainfall events. In parallel, the agency has developed Oslo's climate vulnerability analysis, a comprehensive assessment of the city's current and future climate resilience. The analysis identifies where Oslo is robust in facing climate change and where vulnerabilities exist, requiring adaptation measures. The current analysis is from 2018 and will be updated. Additionally, metrics such as the average monthly temperature in Oslo (from 1940–2020), daily precipitation by month (from 1920–2020), as well as the number of opened streams, restored wetlands, and urban trees are displayed in the Climate Barometer.

The Norwegian Environment Agency's territorial emissions inventory for forests and land use shows how carbon uptake in Oslo has developed, reflecting whether the city has managed to preserve or enhance its carbon stocks. However, a major issue is that the inventory has not been updated for several years, with data available only for 2010 and 2015. The Climate Agency has clearly communicated the need for an updated and improved inventory to the Norwegian Environment Agency.

Oslo's green accounting tracks the city's green areas, their distribution, and how they change over time (Oslo Municipality, 2024). This accounting is updated every four years and provides crucial knowledge for the municipality's spatial planning strategy. The latest report covers the period from 2017 to 2021 and reveals that green spaces in Oslo are under significant pressure. From 2017 to 2021, 9,062 decares of vegetation were lost to development, while 4,970 decares of new vegetation were established, resulting in a net decrease of 6% (4,091 decares). The analysis also shows that Oslo has seen a reduction of over 1,500 decares of tree canopy between 2017 and 2021.

5.2 Explanation of measures table and identified measures

As climate adaptation and natural carbon storage are included in the Climate Budget for the first time, a detailed explanation of these sectors is provided in the table "Measures for Climate Adaptation and Natural Carbon Storage" in Proposition 1 of the 2025 Climate Budget. A more detailed description of the identified measures is also included.

5.2.1 Land use in the city, Marka, and the fjord

The risk of flooding, landslides, and erosion increases with heavy rainfall, which is exacerbated by climate change. Measures in this sector focus on securing safe building grounds and designating areas to handle stormwater and large snow volumes. Trees and green spaces absorb rainwater, clean the air, regulate temperature, and prevent erosion, playing a key role in making the city climate-resilient. Protecting and expanding green areas in the city while preventing development in Marka and the fjord also enhances carbon storage. For Oslo to better cope with climate change and strengthen and preserve carbon sinks, it is essential to maintain the ecosystem services provided by nature. Below are identified measures that contribute to this goal.

Identified measures

- **Develop a land-use accounting system** to support the monitoring and establishment of routines and principles for what land neutrality entails in practice. This is also a measure mentioned in the biodiversity action plan for Oslo but requires future budget allocations.
- **Implement measures to achieve land neutrality**, as outlined in the draft City Development Strategy in the Municipal Plan's Social Section, which is open for public consultation until October 28, 2024. Land neutrality is a powerful and effective measure to protect nature and preserve Oslo's ability to cope with climate change
- **Review old zoning plans** to safeguard areas with significant biodiversity, carbon storage, and/or contribute to climate adaptation in the city, as per the biodiversity action plan for Oslo, contingent on future budget allocations. Zoning plans may include ecosystems for which Oslo is responsible, but these were not considered in older plans. At the same time, the city's green accounting shows that 47% of the construction zone in Oslo is covered with vegetation, but only 27% is zoned for "green" purposes. This means that many green areas in the construction zone are at risk of being developed. A review of old zoning plans, focusing on areas with vital biodiversity, carbon storage, or contributions to climate adaptation, can better prepare the city for climate change and strengthen natural carbon uptake.

5.2.2 Buildings and Outdoor Areas

Climate adaptation of buildings and infrastructure means they must withstand climate change impacts while also ensuring they do not exacerbate climate challenges in surrounding areas. This category includes measures to ensure that buildings in Oslo are better adapted to the climate throughout their entire lifespan, such as using materials that are more resistant to moisture. It also covers measures to ensure that outdoor areas associated with buildings do not contribute to urban heat island effects or exacerbate stormwater issues. Since most of the city is already developed, the management, operation, and maintenance of buildings are crucial to making the city climate-resilient.

5.2.3 Streets and infrastructure

Climate-resilient streets and infrastructure mean that they can withstand climate change while also not exacerbating its consequences. For example, city streets should be able to handle more intense rainfall without increasing the challenges of polluted stormwater runoff. As with buildings, the design of streets and infrastructure must consider climate factors when choosing location, materials, and design. The water and sewage system is affected by both a wetter and warmer climate: drought increases the need for water conservation and access to water reserves, higher temperatures pose challenges for drinking water quality, and heavy rainfall puts stress on the sewage system. This category includes measures to address these challenges.

5.2.4 Nature Management and Restoration

Oslo is the municipality with the greatest biodiversity in Norway, but also with the highest number of threatened species. Biodiversity is under threat from interventions in natural areas, overgrowth, the introduction and spread of invasive species, increased use of natural spaces, and pollution of watercourses and the fjord. Rising temperatures and a changing climate alter the conditions for species and cause disturbances in ecosystems. A diverse natural environment is more resilient to climate change and can provide better ecosystem services to the city's inhabitants. Therefore, the municipality's efforts to preserve and enhance biodiversity through more sustainable management, nature restoration, and species monitoring are vital contributions to making Oslo a climate-resilient city and increasing carbon sequestration.

The ecological condition of the Oslo Fjord is poor. Efforts to restore nature that strengthen the ecological condition are important for the fjord's ability to withstand a changing climate. Additionally, it contributes to increasing carbon uptake in the sea.

5.2.5 Preparedness for Health and Public Safety

Long-term climate adaptation must be supplemented with climate-adjusted preparedness. This means that emergency preparedness must always be ready to respond to extreme natural events that can occur in today's climate. As the climate changes, preparedness must also be adjusted accordingly. In Oslo, heavy rainfall and drought especially require climate-adjusted preparedness. Climate change affects both the quantity and quality of drinking water. At the same time, the municipality already has several emergency routines in place, which are part of regular operations. The Water and Sewerage Agency (VAV) has emergency routines for low water reservoirs, including watering restrictions and connections to other municipalities' drinking water sources. The Agency for Urban Environment monitors air quality at 15 stations in Oslo. In situations where high levels of coarse particulate matter (road dust/PM10) are forecasted, dust control measures are carried out. The Agency for Urban Environment also monitors and issues warnings if the limits for bathing water quality are exceeded. The Norwegian Meteorological Institute provides warnings for heavy rainfall and forest fires. The Oslo Fire and Rescue Service coordinates and trains the municipal forest fire crew (the Urban Environment Agency's Section for North and East Marka), which also implements preventive measures during drought periods, such as campfire bans. The Water and Sewerage Agency is responsible for regulating dams in Marka and water flow in the Akerselva River as a preventive measure against flooding during heavy rainfall. In 2024, the Emergency Preparedness Agency will complete an analysis report on coordinated operational preparedness for surface water flooding during heavy rainfall. The Steering Group for Stormwater Management will decide how this analysis report will be followed up in 2025.

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