City of Oslo
Municipality of Oslo

Climate budget 2018

Preliminaries / Climate budget 2018 / Tehnical report

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1. Preliminaries

Extract from the introduction to the municipal budget

A GREENER CITY

The Oslo City Government is pursuing an ambitious environmental and climate policy that is beginning to produce results. Oslo has been awarded the title European Green Capital 2019. This commits us to be a role model for other cities, and to boost the commitment of our citizens, knowledge communities, businesses and organizations. The City Government will continue its work to create additional green public spaces, improve air quality, increase the number of cycle routes, and make public transport even better.

In 2018 we will continue our work to reduce greenhouse gas emissions and improve air quality for the city's inhabitants. Oslo's Climate Budget is a means of showing where emissions must be reduced and who is responsible for doing so. We are expanding the public-transport and cycle-route networks in order to improve the city's transport system and living environment. The city centre should be a pleasant place, with commerce, restaurants and cultural activities. In 2018 we will continue to work on the Car-free City Life project and to refurbish the city's public spaces.

GREEN MOBILITY

To ensure that even more people will benefit from a better public transport system, we propose a significant increase in funding to Ruter (the local public transport authority) during the period covered by the city's current Economic Plan. Among other things, this will assist in the roll-out of electric buses from 2019 and our commitment to the electrification of the island and Nesodden ferries. We estimate that increasing funding to Ruter will boost public transport capacity by 5 percent. This is equivalent to 14 million additional journeys. The Oslo Package 3 envisages increases in Ruter fares. The City Government wants a competitive public-transport system and will work to reach an agreement with Akershus County Council to avoid fare increases. There is a proposal to set aside NOK 46 million in 2018 and NOK 95 million in 2019 to facilitate such an agreement.

The City Government wants more people to choose to cycle. It should be safe and easy to cycle in Oslo. To achieve this aim we are allocating NOK 1.4 billion to invest in cycle routes during the period covered by the city's Economic Plan. The City Government proposes boosting the operational management of the cycle-route network in 2018 and increased funding for snow removal, gritting and sweeping pavements and walkways. We are conducting a pilot project for age-friendly public transport with pink buses offering door-to-door transport for people aged over 67 in the Nordre Aker district of Oslo.

CLEANER AIR AND LOWER GREENHOUSE GAS EMISSIONS

The City Government wishes to make it easier for the city's inhabitants to make climate-friendly choices, thereby improving public health. Oslo's inhabitants should not have to breathe toxic air. In addition to our increased commitment to public transportation, cycling and walking, we have allocated approximately NOK 50 million during 2018 to various climate-related initiatives. Examples of such initiatives are reduced leakage of methane gas at Rommen landfill, operating charging stations for electric vehicles, and increasing post-collection sorting of commercial waste. As a measure to increase the proportion of zero-emission cars, we have allocated NOK 99 million in 2018–2020 to install approximately 1,500 new charging stations for electric vehicles. In addition, we are introducing a new system of toll-ring charges that will favour zero- and low-emission vehicles and impose a congestion charge during rush hours.

The City Government will continue its enhanced commitment to street washing and reducing road dust. The City Government has resolved to build new shore power stations in 2018. We proposed increasing the funding available from Oslo's Climate and Energy Fund to NOK 80 million. Among other things, this additional funding will be used to promote zero-emission transport. The City Government's goal is that most of the new municipal buildings are to be energy-positive. We propose to grant NOK 72.5 million in 2018 for measures to increase energy efficiency in existing buildings. Our aim is for at least 50 percent of construction sites to be fossil-free from 2018 onwards.

PRIORITIZING PEOPLE AND ACTIVE CITY LIFE

Through its Car-Free City Life initiative, the City Government will make Oslo city centre a more pleasant and accessible environment. There will be more commerce, outdoor café seating, public green spaces, benches, cycle routes, playgrounds, events and art installations in the heart of Oslo. In 2018 the City Government will commence pre-project planning for the upgrading of five city streets.

AN ACCESSIBLE AND PLEASANT CITY

The city should be accessible for everyone. For many older people and people with functional impairments it is important to have places to rest while out on a walk. Initially we propose to install 150 benches to provide resting places along streets and roads, including along routes to and from bus and tram stops. The City Government also proposes to allocate NOK 5 million to follow-up the strategy described in "Flourishing Garden Oslo – a place for everyone in the city's green spaces" («Spirende Oslo – Plass til alle i byens grønne rom») in order to facilitate, for example, urban food production and the provision of allotments for the enjoyment of the city's population.

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2. Climate budget 2018

Chapter 2 in the municipal budget

2.1 INTRODUCTION

This is the second time that the City of Oslo has published a separate Climate Budget. The first, Climate Budget 2017, attracted significant national and international attention. This is a ground breaking project that provides important knowledge and practice for the City of Oslo's future efforts to reduce GHG (greenhouse gas) emissions. We hope that our efforts will also benefit other municipalities, cities, businesses and countries. Accordingly, we emphasize being transparent about the experiences we gain from this work.

The purpose of the Climate Budget is to ensure implementation of the measures necessary to fulfil Oslo's climate goals. The Climate Budget provides an overview of the measures that the City Government is planning to implement within the period of its current economic plan in order to fulfil Oslo's climate goals. The Climate Budget is not restricted, however, to measures under municipal control. The budget also encompasses measures implemented or funded by the national government that have a direct impact on GHG emissions from Oslo.

The goals for the Climate Budget are set in tonnes of CO_2-equivalents (tonnes CO_2e) for a given year. In 2015, Oslo's GHG emissions totalled 1 226 000 tonnes CO_2e. The City Government has set goals of reducing the city's emissions to 1 054 000 tonnes CO_2e in 2018 and 765 000 tonnes CO_2e in 2020. These goals are linked to a series of specific measures, whose effects have been quantified and which are designed to ensure attainment of the framework goals for CO_2-emissions. These measures are listed in Table 2.2A on page 19. The table specifies the municipal entity responsible for the implementation of each measure, along with the estimated effect of each measure in tonnes CO_2e.

The measures in the Climate Budget have been developed on the basis of Oslo's adopted Climate and Energy Strategy. In order to achieve Oslo's climate goals for 2020, GHG emissions in the years from 2015 to 2020 must be reduced by approximately 460 000 tonnes CO_2e. In the period to 2020, the measures in Table 2.2A are estimated to have an emission-reducing effect of approximately 360 000 tonnes CO_2e. This is approximately 100 000 tonnes short of the the City Government's goal for 2020. Additional measures, whose effects are not yet fully quantified, are anticipated to deliver well over the 100 000 tonnes CO_2e required *(see Table 2.2.B on page 21)*. Although there is considerable uncertainty in this estimate, the City Government nevertheless maintains its goals for 2020.

The measures proposed during the current economic plan shall result in attainment of the 2020 goal and form the basis for further reductions in GHG emissions in the period to 2030.

Key focus areas in the Climate Budget 2018

- Ensure implementation of new rush-hour toll-ring charges; lower tolls for low- and zero-emission vehicles; and new toll stations in accordance with the Oslo Package 3 agreement. The first stage (new toll-ring charges) is being introduced in autumn 2017. Implementation of the second stage (new toll stations and revised toll-ring charges) is expected in March 2019.
- Implement further upgrades to public transport to encourage more people to choose environment-friendly forms of transport instead of making journeys by car.
- Increase public transport capacity by 5 percent in 2018.
- Ensure that public transport fares are competitive with the cost of using a private car.
- Continue to introduce zero-emission public transport vehicles (buses and ferries).
- Continue the strong commitment to cycle-path construction and improve the already high operational standards of the cycle route network.
- Significantly increase commitment to the installation of charging points for electric vehicles in the form of fast chargers, semi-fast chargers, sidewalk chargers, and subsidies for the installation of charging points in housing cooperatives.
- Increase the limit for Climate Fund grants and prioritize funding for measures that will reduce GHG emissions from mobile sources.
- Phase out oil-fired heating in Oslo, in accordance with the national ban scheduled to apply from 2020.
- Impose stringent climate requirements for municipal procurement.
- Increase capacity in the city planning department in order to ensure climate-friendly urban development in the period to 2030.

In chapter 19 of the municipal budget (not included in this document), the City Government receommends that the City Council adopt the following decisions in connection with the Climate Budget:

1. Set GHG emissions limits for 2018-2020 as indicated in the Climate Budget, Table 2.1.
2. Adopt the following resolutions:

   a. The City Council supports the measures listed in Table 2.2A and Table 2.2B in Chapter 2 of the Climate Budget in City Council Proposition 1/2018.
   b. The City Government will report on the extent to which it anticipates successful attainment of the climate goals for 2018 as part of its ordinary reporting to the City Council. This reporting will be based on the measures that appear in Table 2.2A and Table 2.2B in Chapter 2 of the Climate Budget in City Council Proposition 1/2018, together with the set of indicators developed to track GHG emissions in Oslo, the "Climate Barometer".

2.2 CLIMATE MEASURES WILL MAKE OSLO A BETTER CITY TO LIVE IN

The efforts to meet Oslo's climate goals represent not only an important contribution to the battle against damaging global warming. The efforts will also make Oslo an even better and more modern city to live in. The following are examples of climate measures that will have additional, positive effects for Oslo's environment and residents.

- Less traffic and a cleaner vehicle fleet will make Oslo's air better to breathe, as well as being better for the climate.
- Oil-fired boilers will be removed. This is good for nature and good for the climate.
- Food waste from households in Oslo will be converted into fuel (biogas) and biofertilizer.
- In order to prepare the city for climate change, we are opening up waterways and making new constructed rain garden.
- Oslo is the European Green Capital in 2019. This is a major opportunity to showcase the environmental solutions and innovations adopted by Oslo's businesses, residents and public sector.
- Oslo's "green economy" is growing. In recent years, Oslo and Akershus have experienced growth in "green value creation".

2.3 THE CITY GOVERNMENT'S CLIMATE GOALS FOR 2020 AND 2030

Revised 2020 climate goal

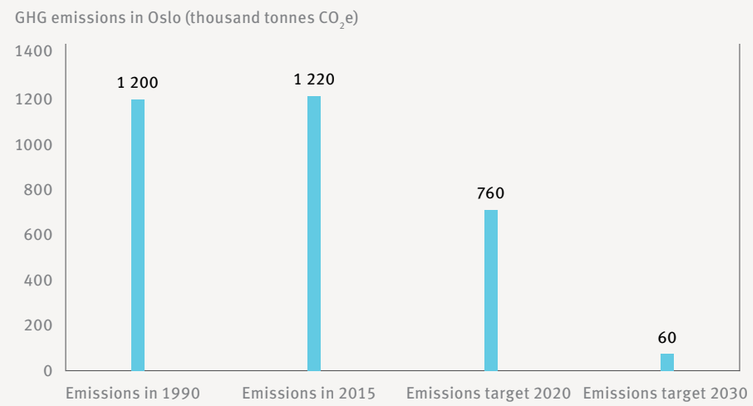
Previously, the City Government and the City Council set targets for reducing Oslo's GHG emissions by 50 percent by 2020 and 95 percent by 2030 compared with 1990-levels (City Council Proposition 195/16). The underlying City Council Proposition emphasized that achievement of the 2020 goal was conditional on the involvement of national government concerning the implementation of full-scale carbon capture and storage (CCS) at the Klemetsrud waste incineration facility. In its Climate Compromise, the Norwegian parliament (Storting) has made a commitment to realize at least one full-scale CCS plant by 2020.

The Klemetsrud facility is one of the largest land-based industrial enterprises in Eastern Norway and is Oslo's largest single source of GHG emissions. The implementation of CCS at Klemetsrud is the largest single measure in Oslo's Climate and Energy Strategy. We estimate that implementation of this measure would reduce Oslo's GHG emissions by 165 000 tonnes CO_2e, equivalent to 25 percent of the amount necessary to halve Oslo's GHG emissions by 2020.

In spring 2017, the Klemetsrud plant was one of three industrial enterprises to be allocated funding by Gassnova for concept studies of full-scale CCS. Under current plans, the Norwegian parliament will be asked to make a decision on CCS investment in the spring of 2019. If the Norwegian parliament approves investment in Klemetsrud in spring 2019, the earliest completion date for a full-scale CCS plant will be in 2022.

Accordingly, the schedule imposed by national government means that Oslo's 2020 goals have had to be scaled back by 165 000 tonnes CO_2e. The revised goal for 2020 is to reduce Oslo's GHG emissions by at least 461 000 tonnes, to a maximum of 765 000 tonnes CO_2e. This is equivalent to a reduction of 36 percent compared to 1990. Figure 2.1 shows GHG emissions in relation to climate goals.

Figure 2.1 Overview of GHG emissions and climate goals.



Goal to cut emissions by at least 50 percent as soon as possible after 2022

As noted above, the schedule set by national government means that the earliest a full-scale CCS plant can be completed at Klemetsrud is 2022. Since it will take some time before the plant is fully operational, it is unlikely that full contribution emission-reducing effects will be achieved before 2023.

Goal for 2030 remains unchanged

The City Government wishes to emphasize that the goal of reducing GHG emissions by 95 percent by 2030 remains unchanged. This goal is also dependent on CO_2e being removed from emissions from the waste incineration plant at Klemetsrud.

New climate strategy for 2020 – 2030

In 2018, the City Government will commence work on a new Climate Strategy for Oslo for 2020-2030, with the intention of presenting the strategy to the City Council in spring 2019.

Most of the measures in Oslo's current climate and energy strategy are directed at attainment of the 2020 goal. If we are to achieve our objective of a virtually zero-emission city by 2030, we will have to take advantage of the many new possibilities offered by new technology and climate-smart city governance. The strategy must also assess how new climate measures implemented by national government may be anticipated to contribute to reducing Oslo's emissions in the period 2020-2030.

2.4 GREENHOUSE GAS EMISSIONS IN OSLO BY SECTOR

Distributiion greenhouse gas emissions by source

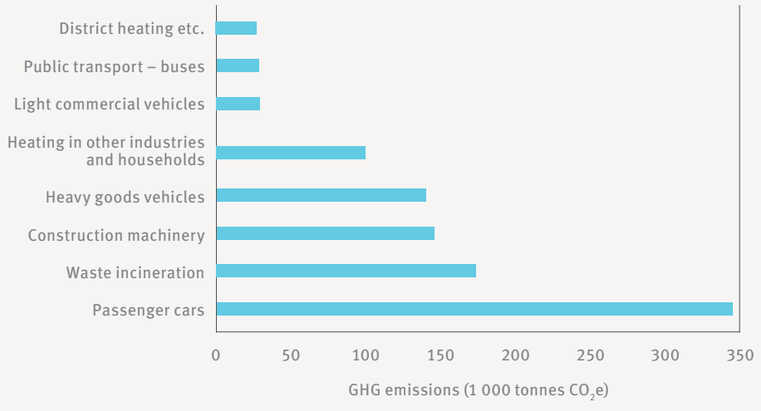
In spring 2017, Statistics Norway published statistics showing a 16 percent reduction in GHG emissions in Oslo in the period 2013-2015. This excellent result is due primarily to significant reductions in emissions from building heating systems and construction machinery. This reduction exceeded the prognoses made in connection with the Climate Budget 2017.

Oslo's direct GHG emissions in 2015 were slightly greater than 1.2 million tonnes CO_2-equivalents. This was approximately the same level of emissions as in 1990. One particular challenge when preparing the Climate Budget is that Statistics Norway publishes updated statistics only every other year – these statistics thus have a two-year "delay".

Accordingly, in 2017, the most recent emissions statistics available from Statistics Norway were for the year 2015. Oslo and other municipalities are in dialogue with Statistics Norway regarding possibilities to receive emissions statistics annually. In the meantime, to compensate for the lack of data, the City of Oslo has developed a set of indicators to track the development of key emissions parameters. Updated information for these indicators is published quarterly on the Climate Agency's website (www.klimaoslo.no). For the first half of 2017, these indicators showed that GHG emissions in Oslo were continuing to fall.

Figure 2.2 shows GHG emissions by source in 2015. Emissions from the transport sector (vehicles and construction machinery) comprise nearly two-thirds of emissions, while emissions from the waste, buildings, and energy sectors account for approximately one-third.

Figure 2.2 GHG emissions by source in 2015



Source: Figures for GHG emissions by municipality from Statistics Norway, broken down into sub-categories based on other sources and calculations performed by the Climate Agency.

2.5 CURRENT STATUS

As described in the Climate Budget 2017, the City Council receives a Climate and Environment Report each year that documents trends in energy consumption and GHG emissions both in Oslo as a whole and in municipal agencies.

Better climate management

2017 marked a significant boost for Oslo's climate work. The municipality's Climate and Environment Strategy is being implemented, with the Climate Budget as a key management tool. Since the first quarterly report for 2017, follow-up reporting on the Climate Budget has been integral to the City Government's reporting to the City Council.

Procurement and establishment of climate-smart markets

From this year onwards, all tenders issued by Omsorgsbygg (Oslo's Municipal Undertaking for Social Service Buildings) insist on fossil-free construction sites.

A new municipal procurement strategy will be finalized in autumn 2017. This will state that vehicles and construction machinery used by the City of Oslo must as a general rule be zero-emission or run on sustainable biofuel.

Oslo Package 3

The revised Oslo Package 3 agreement for 2017-2036 includes a goal of reducing traffic through the toll ring by 15 percent. Progress in achieving this goal shall be reported in the annual Oslo Package 3 rolling action plans.

Urban Environment Agreement and the Fornebu Light Railway

The City of Oslo, Akershus County Council and the national government have entered into an Urban Environment Agreement for 2017-2023. The overarching goal of the agreement is to prevent a growth in car traffic in Oslo and Akershus. The agreement recognizes that Oslo has set a goal of reducing car traffic by 20 percent within the current City Council term. A new municipal agency, the Agency for Fornebubanen, has been formed to oversee the construction of the Fornebu Light Railway.

Passenger growth on public transport

In 2016, the public transport company Ruter experienced a 4.9 percent growth in traffic. This represents 16 million more passenger journeys than the previous year, or 44 000 more passenger journeys each day in 2016 than in 2015. In 2016, for the first time, more journeys were made by public transport than by car. Figures from Ruter for the first quarter of 2017 show that the market share of motorized journeys performed by public transport in Oslo is 53 percent.

Figure 2.3 Trends in private-car and public-transport use in Oslo and Akershus County from 2000 up to and including 2016

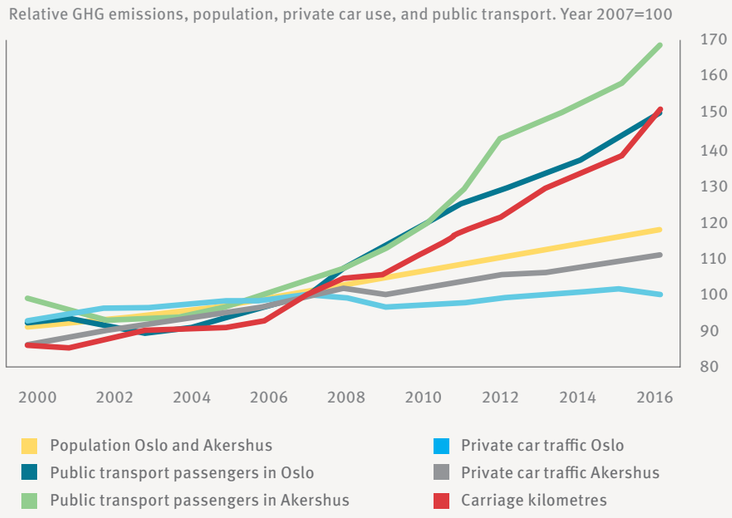


Figure 2.3 shows trends in private car and public transport use in Oslo and Akershus County from 2000 up to and including 2016. Car use in Oslo (blue line) has remained fairly stable since 2007, despite significant population growth (yellow line) during this period. In the same period, there was a sharp increase in both public-transport capacity (number of carriage-kilometres) and the number of passengers using public transport (dark-green line). The proportion of electric vehicles passing through the toll-ring increased from 7 percent in the first quarter of 2016 to 10 percent in the same period in 2017. Attainment of Oslo's climate goals is conditional on a continued increase in the proportion of zero-emission cars.

More journeys by bicycle
A study of travel habits with a particular focus on cycling is being conducted in the autumn of 2017, and the results will be available in early 2018.

Low-emission zone
A proposal for a local regulation on a low-emission zone for heavy vehicles (classified below the Euro VI standard) is currently being drafted.

Encourage the emergence of new markets for climate-smart solutions
In 2017, the Climate and Energy Fund introduced several new subsidy schemes designed to help upgrade Oslo to become a city with lower emissions.

Phasing-out of oil-fired heating
The City of Oslo has offered advice on switching fuel source to all owners of residential buildings containing up to four accommodation units, and which are registered as having an oil-fired heating system.

Behavioural change and information
Work to disseminate information about practical climate-friendly measures and about municipal work in this area has been significantly boosted in 2017, in particular through the launch of the communications platform klimaoslo.no.

Partnerships with business
The City of Oslo continued to cooperate with businesses on climate measures during 2017. Nine more businesses have joined the "Businesses for the Climate" initiative. The initiative now includes 85 businesses and represents an important channel for exchanges of ideas and for collaborative efforts between businesses and the municipal authorities in Oslo.

European recognition
In May 2017, the European Commission announced that Oslo had been awarded the title of "European Green Capital 2019". This is a major recognition of the climate and environment-related work that has been continuing for a long period in Oslo by the city's residents, municipal authorities, voluntary organizations and businesses.

New national government measures will make an important contribution
Biofuel blending requirement. In connection with the national budget for 2017, the national government announced a gradual increase in the biofuel blending requirement from the current level of 5.5 percent biofuel in petrol and diesel to 20 percent in 2020.

Ban on oil-fired heating. From 1 January 2020, the use of oil or paraffin for heating will be banned in Norway.

2.6 CLIMATE BUDGET EMISSIONS LIMITS FOR 2018-2020

The Climate Agency has projected emissions in Oslo up to and including 2020. These projections take into account the measures in this Climate Budget. These projections also include an anticipated emissions reduction of 100 000 tonnes resulting from measures that so far have not been individually quantified (see Table 2B).

In general, it is expected that these measures will have greater effect towards 2020, as several of them are currently in the planning or early implementation phase. Therefore, we do not expect to see major emission reductions until shortly before 2020. There is uncertainty regarding both the calculations of the measures' emission-reducing effects and the anticipated timing of the reductions.

The City Government recommends that the City Council set the limits for overall emissions in 2018 and 2020 as shown in Table 2.1.

Table 2.1 Limits for annual CO_2-emissions in the City of Oslo in 2018 and 2020

Sector	1990	2015	2018	2020
Stationary		425 000	358 000	267 000
Mobile		801 000	696 000	499 000
TOTAL	**1 200 000**	**1 226 000**	**1 054 000**	**766 000**
Anticipated cuts in CO_2e emissions compared to 2015 levels			172 000	460 000

Emissions measured in tonnes CO_2e

2.7 MEASURES IN THE CLIMATE BUDGET 2018-2020

Inpreparing this budget, the Climate Agency has assessed the expected emissions-reducing effect of each measure. The Climate Agency's technical documentation report is available at www.klimaoslo.no/klimabudsjett2018.

The measures in the Climate Budget 2018 are designed to ensure that the limit for the annual GHG emissions are attained. The municipal agency responsible for implementing each measure is shown in the tabeles, and where possible, the estimated effect of each measure (in tonnes CO_2e).

Table 2.2a Measures with estimated emissions-reducing effect

MEASURES	Responsibility for implementation (Responsibility for reporting in parentheses)	Estimated effect of measure, 2015-2020 (tonnes CO_2e)
Phase out the use of heating oil in municipal buildings and undertakings	Undertakings that use heating oil (KLI)	121 450
Phase out the use of fossil fuel in privately owned buildings by 2020 through a combination of bans and subsidies (Climate and Energy Fund and Enova)	KLI	
Reduced emissions of landfill gas from Grønmo and Rommen	EGE and EBY	6 900
Phase out the use of fossil fuel and gas in district heating (peak load)	NOE	5 600
Increase material recycling of household waste and boost re-use	REN	4 300
Conclude documentation of nitrous oxide volumes in wastewater, with the aim of correcting figures supplied by Statistics Norway'	VAV	20 500
Introduce a new toll-ring payment system, including new toll stations, in 2019. Note that the effect assumes the implementation of the measures listed below in italics:	MOS	93 300
Installation of new charging stations for passenger and commercial vehicles, including a pilot project for car-sharing schemes	BYM	
Increase public transport capacity to cope with population growth and reduction in private vehicle traffic	Ruter	
Better provision for cyclists	BYM	3 400
National requirement for 20% blended biofuel to be implemented by 2020	National government	53 900
Fossil-free public transport by 2020	Ruter	29 500
Introduce new licensing rules for taxis with requirement for zero-emission taxis by 2022. Note that the effect assumes the implementation of the measure listed below in italics:	BYM	13 400
Install new charging stations for taxis	BYM	
Switch to zero-emission vehicles in the City of Oslo's own vehicle fleet, possibly using sustainable biofuels	All (UKE)	4 100
Establish a low-emission zone for heavy goods vehicles in Oslo	BYM	2 800
TOTAL REDUCTION IN 2020		**360 000**

The individual measures are discussed in more detail towards the end of this Climate Budget.

The effects of the measures have been calculated to the extent possible. The effects of some measures are technically more difficult to assess than others, and uncertainty is attached to most of the assessments of potential effects. Some measures require further development and analysis before it will be possible to calculate their effects. Accordingly, the overview of measures includes an entry labelled "unallocated", which includes two types of measures: measures for which effects have not been calculated; and possible new measures that require further study.

Table 2.2b Measures with unallocated emissions-reducing effect

MEASURES	Responsibility for implementation (Responsibility for reporting in parentheses)	Unallocated reduction (CO_2e)
Increased supply of biogas for use as a fuel from water/wasterwater (VEAS)	VEAS	
Increased supply of biogas for use as a fuel from Bekkelaget Wastewater Treatment Plant and Romerike Biogas Plant	VAV and EGE	
Improve parking and traffic management by continuing work on the development of Intelligent Transport Systems (ITS), including sensor technology	BYM	
Continue work on package of 100 initiatives to reduce delays on public transport	BYM	
Better provision for pedestrians	BYM	
Car-Free City Life within Ring 1, including establishment of loading/unloading spaces for commercial vehicles	[BYM/Car-Free City Life]	
Car parking measures (e.g. roll-out of residents' parking zones)	BYM	
Climate-friendly urban development including densification around transport hubs	BYM, EBY, PBE	
Increase material recycling of commercial waste	REN-næring	
Implementation of fossil-free/zero-emission construction site programme at new municipal buildings and construction sites.	Municipal construction undertakings (UBF/KID/OBY/Boligbygg) and other municipal developers.	100 000
Continue existing, and introduce new, subsidy schemes, from the Climate and Energy Fund to reduce GHG emissions.	KLI	
Acquire sites for municipal climate measures (incl. energy stations)	EBY	
Establish energy stations supplying at least two renewable fuels for passenger cars and light and heavy commercial vehicles (incl. Alnabru)	KLI	
Mandatory requirement for zero-emission (or fossil-free) solutions when procuring transport services	All procurement officers (UKE)	
Upgraded and new shore power facilities for international ferries	Oslo Harbour	
Reports on packages of measures to increase the certainty of goal attainment: • Encourage climate-friendly travel to and from work • Gradual transition to a fossil-free city centre within Ring 3 by 2024 through the implementation of low-emission zones • More efficient and climate-friendly commercial transport • Increased proportion of low- and zero-emission vehicles and machines on construction	MOS	

The individual measures are discussed in more detail towards the end of this Climate Budget.

The technical report indicates that, as of today, we cannot say with certainty that the climate measures already implemented will enable attainment of the 2020 goal. Accordingly, the City Government wishes to study a set of measure packages, which can be implemented in 2018 and 2019, and thus increase the likelihood of goal attainment. These studies will focus primarily on measures that could contribute to further reductions in emissions from mobile sources, since this is where there is a great potential for further reductions.

The City Government's assessment is that if the measures in the budget are implemented, and if the studies of the additional packages of measures result in the implementation of successful new measures, it will be possible to achieve the goal of reducing Oslo's GHG emissions to 765 000 tonnes CO_2e in 2020.

Table 2.3 Measures in the period to 2030

MEASURES	Responsibility for implementation
Carbon capture and storage at Klemetsrudanlegget A/S	NOE
New Fornebu Light Railway	The Fornebu Agency
New central metro tunnel	MOS
Tram programme	MOS
New signalling and interlocking plant for the metro	MOS
Several new public tranport infrastructure projects, including a new rail tunnel under Oslo, and a new Romerike/Groruddalen rail interchange.	MOS

Measures relating to information, mobilization and involvement
The City of Oslo's climate efforts also include a group of measures that aim to disseminate information to residents and businesses, and to raise awareness of the potential for value creation in a green transition. These measures are essential for ensuring that the City of Oslo's climate efforts will have lasting long-term results, but it is not possible to estimate the emission-reducing effects of such measures.

Advertise Enova's subsidy schemes in Oslo. Responsibility for implementation: KLI
The national government fund Enova provides subsidies for measures designed to reduce GHG emissions and improve energy-efficiency. Private individuals and businesses in Oslo make less use of Enova's subsidy schemes than people and businesses elsewhere in Norway. Increased awareness of Enova's subsidy schemes could increase the rate at which climate measures are implemented.

Disseminate information about climate solutions to encourage behavioural change. Responsibility for implementation: KLI
Work to disseminate information about practical climate-friendly measures and about municipal work in this area has been boosted in 2017, and will be boosted further in 2018.
The online communications platform KlimaOslo.no is central to these efforts to encourage behavioural change.

Businesses for the Climate. Responsibility for implementation: KLI
This initiative includes 85 businesses and is an important channel for the exchange of ideas and collaboration between Oslo's business sector and the city authorities. In 2018, Businesses for the Climate will endeavour, among other things, to raise awareness in Oslo's business sector about the opportunities available through Enova's subsidy schemes.

Bykuben – Centre for Urban Ecology. Responsibility for implementation: PBE
Bykuben shall be established in a city-centre street-level location and shall be open to everyone who wants to learn about and/or participate in, ecological work in the urban environment. The centre will help the city's residents to feel a sense of ownership over, and see the potential in, the green shift towards becoming a zero-emissions society.

Efforts to boost demand for biogas. Responsibility for implementation: EGE
Document, and disseminate information about, the climate benefits of using biogas as a fuel source.

2.8 NEW FUNDING FOR CLIMATE MEASURES IN 2018-2021

The tables below present a general overview of additional funding for climate measures in 2018-2021, exceeding what is already included in the city's budget and economic plan.

CLIMATE MEASURES IN THE OPERATING BUDGET

Table 2.4 Climate measures in the operating budget
Figures in NOK 1 000s

CHAPTER	MEASURES	2018	2019	2020	2021
711	Funding for Ruter*	10 000	109 000	191 000	218 000
761	Increased maintenance of cycle-path network	6 000	12 000	18 000	24 000
542	Operation of charging stations	2 000	2 000	2 000	2 000
542	Car-Free City Life	15 000			
609/400	Urban development climate measures	12 000	12 000	8 000	8 000
400	Area development	11 000	11 000	11 000	11 000
542	Area development	10 000	10 000	10 000	10 000
542	Increased winter maintenance of pavements and walkways	8 500	8 500		
643	Reception and post-collection sorting of commercial waste	9 000	9 000	9 000	9 000
771	Climate strategy for 2020 – 2030	2 000	1 000		
	TOTAL	**85 500**	**174 500**	**249 000**	**282 000**

** The figures in the table do not take into account the cost of avoiding fare increases due to Oslo Package 3 in 2018 (NOK 46 million) and 2019 (NOK 95 million). The forthcoming economic plan for Oslo includes subsidies for Ruter totalling NOK 8 038 million.*

770	Increased funding commitment limit for Climate and Energy Measures**	10 000	10 000	10 000	10 000

*** The funding commitment limit will be increased by NOK 10 million compared with the revised budget for 2017.*

The increased funding commitment limit for the Climate and Energy Fund will be financed by the fund, and will not impact the City Treasury.

CLIMATE MEASURES IN THE INVESTMENT BUDGET

Table 2.5 Climate measures in the investment budget
Figures in NOK 1 000s

CHAPTER	MEASURES	2018	2019	2020	2021
308	Electric vehicle schemes in city districts			20 000	20 000
542	Car-Free City Life	13 500			
542	EV charging infrastructure	39 000	30 000	30 000	
501	Replacement of oil-fired heating systems	1 000			
542	Low-emission zone	29 500			
542	Public transport priorities	82 500	-81 250	-223 750	208 375
590	Refurbishment of Alfaset Crematorium*		38 000	19 000	
645	Landfill gas recovery at Grønmo	2 000	12 000		
761	Cycle paths	-80 000	-50 000	-65 000	400 000
	Total	**87 500**	**-51 250**	**-219 750**	**628 375**

** Only part of this measure will have an impact on GHG emissions*

The funding limit for Ch. 761 has been reduced by NOK 80.0 million in 2018, NOK 50.0 million in 2019, and NOK 65.0 million in 2020. Nevertheless, the City Government anticipates increasing the rate of expansion for new cycling infrastructure. In 2018, the City Government intends to complete 12 km of new cycling infrastructure, compared to 3.5 km in 2015. A review of the amount of investment actually needed to achieve this has resulted in the changed use of some Oslo Package 3 funding, with it being re-allocated to Ch. 761. These funds have been reallocated in order to implement the “Overall plan to upgrade tram infrastructure”, which is also financed from Oslo Package 3 funding. The forthcoming economic plan for Oslo includes an investment of NOK 1 405 million in cycle paths. The plan also takes account of a reallocation of funding in order to implement the “Overall plan to upgrade tram infrastructure”, which is also financed from Oslo Package 3 funding. The funding limit for Ch. 542 is increased by NOK 82.5 million to NOK 380.75 million in 2018, reduced by NOK 81.25 million to NOK 227.25 million in 2019, and reduced by NOK 223.75 million to NOK 31.5 million in 2020. The forthcoming economic plan for Oslo includes an investment budget of NOK 848 million for public transport priorities. The changed spending schedule has been calculated on the basis of the projects’ actual investment needs. The objective of establishing 60 km of segregated cycle lanes/paths, cycle lanes, and car-free streets during this City Council term, remains unchanged.

2.9 INCREASED EFFORTS FOR NATIONAL MEASURES THAT WILL REDUCE EMISSIONS IN OSLO

National regulatory requirements have significant impact on the GHG emissions in Oslo. Therefore, the City of Oslo works actively to improve national regulatory requirements in order to reduce emissions. Particular focus areas include the following:

- Promoting the Klemetsrud waste incineration plant as a candidate for national-government investment in CCS;
- Working to strengthen urban environment agreements and national infrastructure projects that may contribute to reducing emissions in Oslo;
- Promoting beneficial subsidy schemes available through Enova to encourage Oslo's residents and businesses to choose zero-emission solutions;
- Promoting good national regulatory conditions for zero-emission vehicles, whether passenger cars, light commercial vehicles, or heavy goods vehicles;
- Working to ensure that national-government construction projects in Oslo use fossil-fuel-free construction practices and apply stringent energy and environmental requirements to buildings and other infrastructure;
- Clarifying that low-emission zones can be implemented on climate-related grounds; and
- Avoiding the expansion of capacity on the national road network and working to implement additional public-transport and transport-sharing schemes.

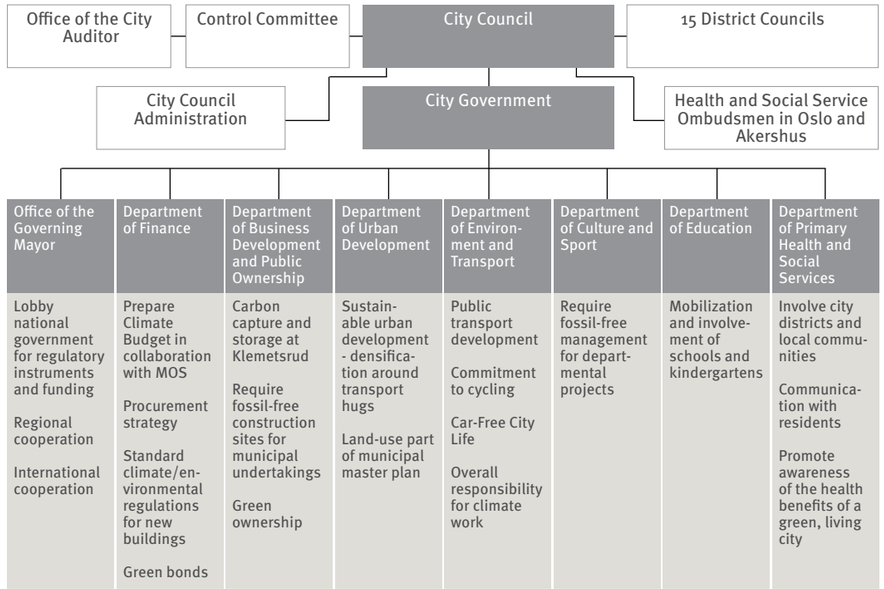
Organization of municipal climate efforts

Oslo shall become a more climate- and environment-friendly city, and this entails that all municipal agencies and undertakings must contribute within their areas of responsibility (figure 2.4). Oslo's Department for Environment and Transport (MOS) has overall responsibility for following up climate work in Oslo. The Climate Agency operates under the auspices of MOS, and was established to act as a coordinator and centre of expertise for climate work in the City of Oslo. The Climate Agency is responsible for ensuring, in cooperation with other municipal agencies, city districts and municipal undertakings, that climate measures and studies are executed.

The City Government's Department of Finance (FIN) is responsible for Oslo's Climate Budgets and related reporting, in cooperation with MOS and other departments.

The City Government's agencies play various roles in Oslo's climate work. All agencies and undertakings are responsible for measures that contribute to climate-smart city management, for example through insisting on environment- and climate-friendly procurement.

Figure 2.4 Organization of climate work in the City of Oslo



Reporting on the status of climate work.

The implementation of the measures in the Climate Budget is part of the ordinary management system in the City of Oslo. In the funding allocation letters for 2018, all municipal undertakings will be assigned goals and reporting requirements for climate work within their areas of responsibility. This will ensure that reporting continues as part of city governance throughout the year. The individual undertakings will report on the implementation of measures, not on quantified emissions reductions. In 2017, the Climate Agency developed a set of indicators to enable it to track trends in GHG emissions in Oslo. This set of indicators will supplement the statistics supplied by Statistics Norway, which are published only every other year. The indicators will provide information that is relevant for the governance of the city and will also facilitate communications with Oslo's residents regarding emissions trends. The indicators will be disseminated using the digital platform known as the Climate Barometer at www.klimaoslo.no.

Measures with estimated emissions reduction effect

Phase out the use of heating oil in municipal buildings and undertakings. At the start of 2018, there will still be 10-12 municipal buildings with heating systems running on fossil fuel. Heating

from renewable sources will be installed at these buildings. In addition, the use of fossil fuels will be phased out in crematoria.

Phase out the use of fossil fuel in all privately-owned buildings by 2020, through a combination of bans and subsidies. From 2020, there will be a national ban on the use of heating oil and paraffin to heat buildings. The Climate and Energy Fund has committed to phasing out oil-fired heating in 200 large, privately-owned buildings in Oslo during 2018. In addition, Oslo City Council will take active steps to inform homeowners of the impending ban and of the opportunity to apply for a subsidy from Enova, a Norwegian state enterprise, to replace oil-fired heating.

Conclude documentation of nitrous oxide in wastewater, with the aim of correcting Statistics Norway's emissions figures. During 2017 and 2018, the Agency for Water and Wastewater Services (VAV) will take measurements at the city's main sewers and wastewater treatment plants in order to quantify the City of Oslo's nitrous oxide emissions. This work is being conducted the figures produced by Statistics Norway for GHG emissions from wastewater in Oslo are believed to be too high.

Reduced emissions of landfill gas from Grønmo and Rommen. The County Governor requires energy to be recovered from landfill gas at Grønmo. Currently, landfill gas from the sites at Grønmo is used to fuel gas engines that produce electricity and heat. These gas engines are now out-dated. In addition, the amount of methane in the landfill gas has fallen. Accordingly, a new method is required to recover energy from the landfill gas. Otherwise there is a high risk that the gas will have to be flared. In addition, other measures at the site will ensure reduced emissions of landfill gas. The assessment of the effect of these measures assumes a natural reduction in emissions from landfill sites.

Phase out the use of fossil oil and gas in district heating (peak load) In order to achieve its target of fossil-free district heating in an average year, Fortum is now making several investments in its existing boilers at Haraldrud, Vika and Ullevål in order to increase the amount of biofuel that can be used during peak load periods.

Introduce a new payment system at the toll ring, including new toll stations, in 2019. In June 2017, the parties to the Oslo Package 3 entered into a supplementary agreement, which facilitated the introduction of new toll-ring fees (rush hour surcharges and lower fees for environment-friendly vehicles) and additional toll stations at the city border and within Oslo. The first stage (new toll-ring charges) was introduced in autumn 2017. The second stage (new toll stations and revised toll-ring charges) is expected to be implemented in March 2019.

Installation of new charging stations for passenger and commercial vehicles, including a pilot project for car-sharing schemes. In addition to boosting the programme for installing publicly accessible charging points, funding is increasing funding for charging infrastructure in housing cooperatives and jointly-owned apartment buildings through the Climate and Energy Fund. The charging infrastructure market is changing rapidly. In 2018, the City Government will conduct studies and present proposals on changes to the organization of the installation programme with the aim of giving a larger role to private-sector participants, including a system that in the longer term could be run on a commercial fee-paying basis.

Increase public transport capacity to cope with population growth and reduction in private vehicle traffic. Ruter is working continually to expand the public transport network. The purpose is to ensure a continued high rate of public transport growth in order to make travelling by public transport more competitive than by private car.

National biolfuel blending regulations. In connection with the national budget for 2017, the government announced a gradual increase in the biofuel blending requirement from the current level of 5.5 percent biofuel in petrol and diesel to 20 percent in 2020. The Climate Agency calculates that the biofuel blending requirement will reduce GHG emissions from passenger cars, light commercial vehicles and heavy goods vehicles by 11 percent in 2020.

Fossil-free public transport by 2020. All public transport operated by Ruter must be fossil-free by the end of 2020.

Introduce new zero-emission taxi-licensing regulations. New taxi-licensing regulations are planned for implementation in 2018. These regulations will impose a four-year deadline for all taxis to be zero-emission. By 2022, all of Oslo's close-to 2000 taxis will be zero-emission vehicles. Successful implementation of this policy is dependent on adequate provision of charging facilities.

Install new charging stations for taxis. Facilitate the installation of charging infrastructure for taxis on municipal land, with two new rapid charging stations and 100 new fast charging stations.

Switch to zero-emission vehicles in the City of Oslo's own vehicle fleet, possibly using biofuels. Ensure that all the approximately 1200 vehicles in the municipal fleet are zero-emission vehicles. Currently approximately half of the vehicles in the fleet are zero-emission. In addition, all municipal heavy goods vehicles and construction machinery must be zero-emission by 2020, or run on renewable fuel.

Better provision for cyclists. Facilitating year-round cycling is important for achieving the goal that 25 percent of journeys should be made by cycle by 2025. The first winter during which the city's cycle paths were maintained saw a 38-percent increase in the number of winter cyclists. Accordingly, there are proposals to increase funding for cycle path maintenance. There are also plans to accelerate the construction of cycle paths and to boost work on the planning of new cycle paths.

Establish a low-emission zone for heavy goods vehicles in Oslo. A proposal for a local regulation on a low-emission zone for vehicles with heavy-duty diesel engines (classified below the Euro VI standard) is currently at the drafting stage. This measure will contribute primarily to improving local air quality, as is required under national regulatory standards.

Measures with unallocatet emission reduction effect:
Increased supply of biogas for use as a fuel. The VEAS wastewater treatment plant serves much of Oslo's population. The sludge that is separated out in the water treatment process provides large quantities of biogas. VEAS is considering investment in equipment to upgrade this biogas to fuel

quality. At Romerike Biogas Plant, which produces biogas from food waste disposed of by Oslo's residents, work on resolving technical issues will continue with the aim of boosting supplies of biogas.

Improve parking and traffic management by continuing development of Intelligent Transport Systems (ITS) and sensor technology. ITS has the potential to improve traffic management in Oslo.

Continue work on package of 100 initiatives to reduce delays on public transport. Approximately 20 measures will be implemented to improve the punctuality and attractiveness of public transport.

Better provision for pedestrians. Wintertime maintenance of pavements and walkways will be boosted. This will make walking more attractive even during the winter, such that the proportion of everyday journeys made on foot will increase also during the winter.

Car-Free City Life within Ring 1, including establishment of loading/unloading spaces for commercial vehicles. Efforts to improve the quality of urban life in various streets in Oslo city centre are continuing. Several more pilot areas will be established. Analysis, and subsequently establishment of dedicated loading/unloading spaces for commercial vehicles, will reduce the number of vehicles driving around looking for loading/unloading spaces and to make loading/loading more efficient.

Car parking measures (e.g. roll-out of residents' parking zones). 25 000 fee-based parking spaces will be reserved for residents by 2019. In addition, 1 100 parking spaces in the city centre or close to tram routes will be removed.

Climate-friendly urban development including densification around transport hubs. Urban development projects will be continued in accordance with the Agency for Planning and Building Services' planning portfolio.

Increase material recycling of household and commercial waste and boost re-use. In 2018, the Agency for Waste Management will work to achieve a target of 40-percent material recycling for household waste and 35-percent for commercial waste. Facilities will be improved to allow increased reception and post-sorting of commercial waste. The climate effects of material recycling will be achieved mainly outside Oslo or in other sectors, such as through energy recovery or reduced need for transport.

Fossil-free/zero-emission construction sites at new municipal buildings and building projects. Oslo's real-estate agencies will require construction sites in general to be fossil-free.

Acquire sites for municipal climate measures (including energy stations). As needed, contribute to identifying suitable areas for the implementation of climate measures. This measure is particular directed towards sites for energy stations and associated infrastructure, but can also be applied in other contexts.

Establish energy stations supplying at least two renewable fuels for passenger cars and light and heavy commercial vehicles (including Alnabru). Plan and contribute to the establishment at Alnabru of an energy station primarily intended to serve light and heavy commercial vehicles. In addition, establish three other energy stations for passenger cars. These stations will supply a combination of at least two renewable fuels such as biogas, biodiesel, hydrogen and electricity.

Mandatory requirement for zero-emission (or fossil-free) solutions when procuring transport service. Implementation of new municipal procurement strategy.

Upgraded and new shore power facilities for international ferries. Shore power facilities have been installed for Color Line ferries at Filipstad. In 2018, the Oslo Port Authority will install shore power facilities for international ferries at Vippetangen. In addition, work is in progress to install a shared facility for Ruter's ferry services (the island ferries and the Nesodden ferry). This measure will not affect Oslo's climate accounting, as GHG emissions from the maritime sector are not included. This measure is nonetheless estimated to reduce national GHG emissions by 3 200 tonnes CO_2e.

Study of packages of measures to increase the certainty of goal achievement:
Development of a package of measures to encourage climate-friendly travel to and from work. The proportion of journeys to and from work made by car in the City of Oslo is lower than in other municipalities, but nonetheless accounts for a significant proportion of the city's GHG emissions and traffic. There is significant potential for reducing GHG emissions and traffic volumes if more people choose alternative methods of travel to and from work. In addition to an increased commitment to boost public transport and expand the cycle-route network, the City Government will develop a package of measures designed to increase the proportion of environment-friendly trips to and from work, and to reduce the number of journeys to and from work made by private car.

Report on the implementation of measures to achieve a fossil-free city centre within Ring 3 by 2024. In its City Government Platform, the City Government set a goal to achieve a fossil-free city centre within Ring 3 by 2024. The implementation of a low emission zone for heavy goods vehicles is currently out for consultation. The City Government will prepare a more detailed report on its strategy for achieving a fossil-free city centre by 2024.

Report on more efficient and climate-friendly commercial transport. Commercial transport accounts for a significant proportion of traffic in Oslo. Currently only a very limited proportion of commercial transport is performed using fossil-free or zero-emission vehicles. A report will be prepared on possible measures to hasten the transition to fossil-free vehicles, as well as measures to contribute to reducing the need for road transport, e.g. shared transport of goods and assisting businesses to plan for more efficient transport.

Report on increasing the proportion of low- and zero-emission vehicles and machines on construction sites. Diesel used by construction machinery accounts for a significant proportion of Oslo's GHG emissions. Several successful pilot projects for fossil-free construction sites have been completed, and assess possible measures to promote fossil-free construction in other public- and private-sector construction projects within Oslo, as well as the potential emissions reductions that such measures could achieve.

3. Technical report prepared by the Climate Agency in Oslo

1 INTRODUCTION

The City of Oslo's Climate Agency has compiled this technical report for the Climate Budget 2018 (City Council Proposition 1 2018). The report summarizes the methods and sources used to assess the various measures in the Climate Budget, including an estimate for emission reductions.

Chapter 2 examines the status of Oslo's annual greenhouse gas (GHG) emissions in light of the most recent available data. Chapter 3 describes Oslo's projected GHG emissions in the absence of new emission-reducing measures. Chapter 4 describes the emission reduction potential of the measures in the Climate Budget 2018. Chapter 5 projects how the effects of the measures in the Climate Budget 2018 will develop towards 2020. Finally, Chapter 6 contains the Climate Agency's assessment of the potential for Oslo's achievement of its 2020 target.

The City Government and the City Council have previously set targets for reducing GHG emissions by 50 percent by 2020 and by 95 percent by 2030, compared with 1990 emission levels (City Council Proposition 195/16). A prerequisite to the target to reduce emissions by 50 percent by 2020 was full-scale carbon capture and storage (CCS) at the Klemetsrud waste-to-energy facility. Central government has postponed its decision on funding for CCS at Klemetsrud until spring 2019, meaning that the CCS plant cannot be operational until earliest by 2022. Accordingly, the 2020 target has been revised to an emission reduction of 36 percent, compared to 1990 emission levels. The assessments in this report are based on the revised target.

Assessing the potential effect of measures to reduce GHC emissions is a highly complex process. Accordingly, the results are tinged with uncertainty, both with regard to future emissions trends, with or without the implementation of emission-reducing measures, and also with regard to when and to what extent such measures will take effect. The emission mitigation potentials are based on a number of assumptions, and the results may in practice be higher or lower than the figures published in this report.

2 THE CITY OF OSLO'S GREENHOUSE GAS EMISSIONS 1990-2015

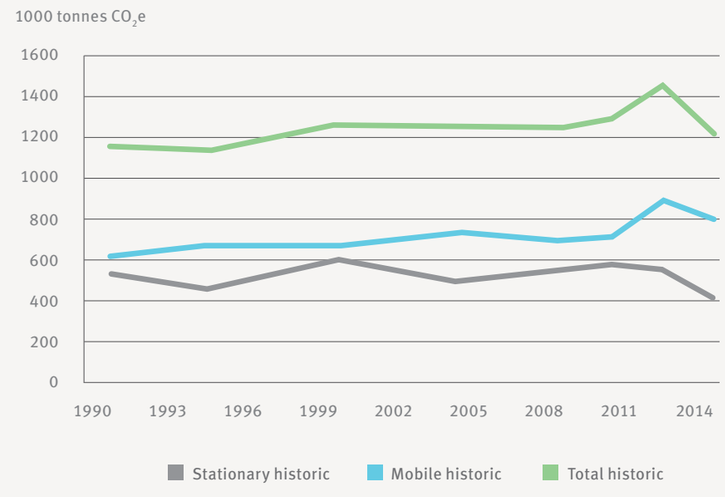
The figures for GHG emissions for Oslo are based on Statistics Norway's municipal statistics.[1] The statistics are published every other year and covers emissions of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) occurring within the geographical system boundary defined as the City of Oslo.[2] The figures do not include indirect GHG emissions, such as emissions that occur outside Oslo but that are related to supplies of goods and services to the city. Emissions are shown as tonnes of CO_2-equivalents (tonnes CO_2e) per annum, with methane and nitrous oxide being converted to CO_2e in accordance with guidelines established by the Intergovernmental Panel on Climate Change (IPCC).

GHG emissions from the maritime sector are not included in Statistics Norway's municipal emissions statistics. When preparing reports in accordance with the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) in the past, however, the Climate Agency has obtained emissions statistics for the maritime sector. These figures have been included as background information when designing mitigation measures, but are not included in the emissions statistics.

2.1 RESULTS

Statistics Norway published its municipal emissions statistics in March 2017, including emissions data from 1990 to 2015. Oslo's direct GHG emissions in 2015 slightly exceeded 1.2 million tonnes CO_2e, as shown in Figure 1. This is the same level of emissions as in 1990. After many years of increasing GHG emissions, the statistics show that Oslo's emissions fell by 16 percent from 2013 to 2015. The principal contributing factor was a major reduction in emissions from buildings, most likely due to the impending 2020 ban on the use of oil for heating; the low price of electricity compared to heating oil; and subsidies for phasing-out oil heating and transitioning to renewable energy. In addition, a reduction in sales of duty-free (off-road) diesel fell resulted in lower emissions from motorized machinery.

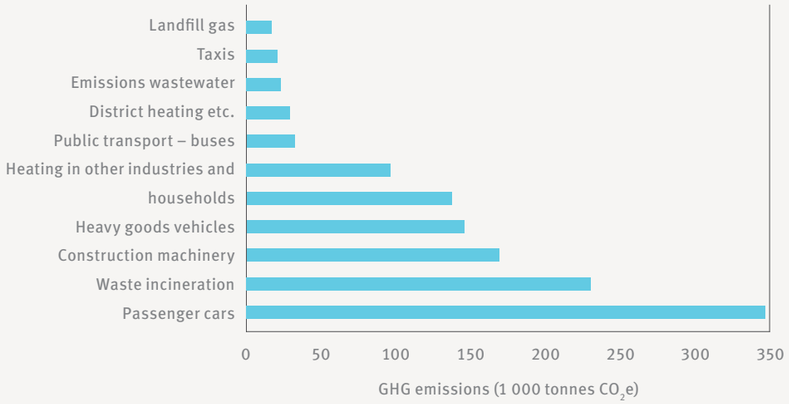
Figure 1: Historic GHG emissions for Oslo



[1] Statistics Norway, 2017: Oslo's GHG emissions for 2015 as reported

[2] Statistics Norway publish emissions statistics by municipality for the following sources: road traffic, heating, agriculture, landfill gas, other wastewater and waste management, and motorized equipment. Oil and gas extraction, industry, mining and energy supply constitute a single source. The Climate Agency has categorized emissions sources into two sectors: stationary and mobile.

Figure 2: Oslo's GHG emissions by sub-category in 2015



Statistics Norway is the main source for the emissions statistics in the Climate Budget, but the data has been further processed and divided it into sub-categories. Data from Statistics Norway has been supplemented by more detailed data collected from various sources. Figure 2 illustrates emissions in 2015 by sub-categories.

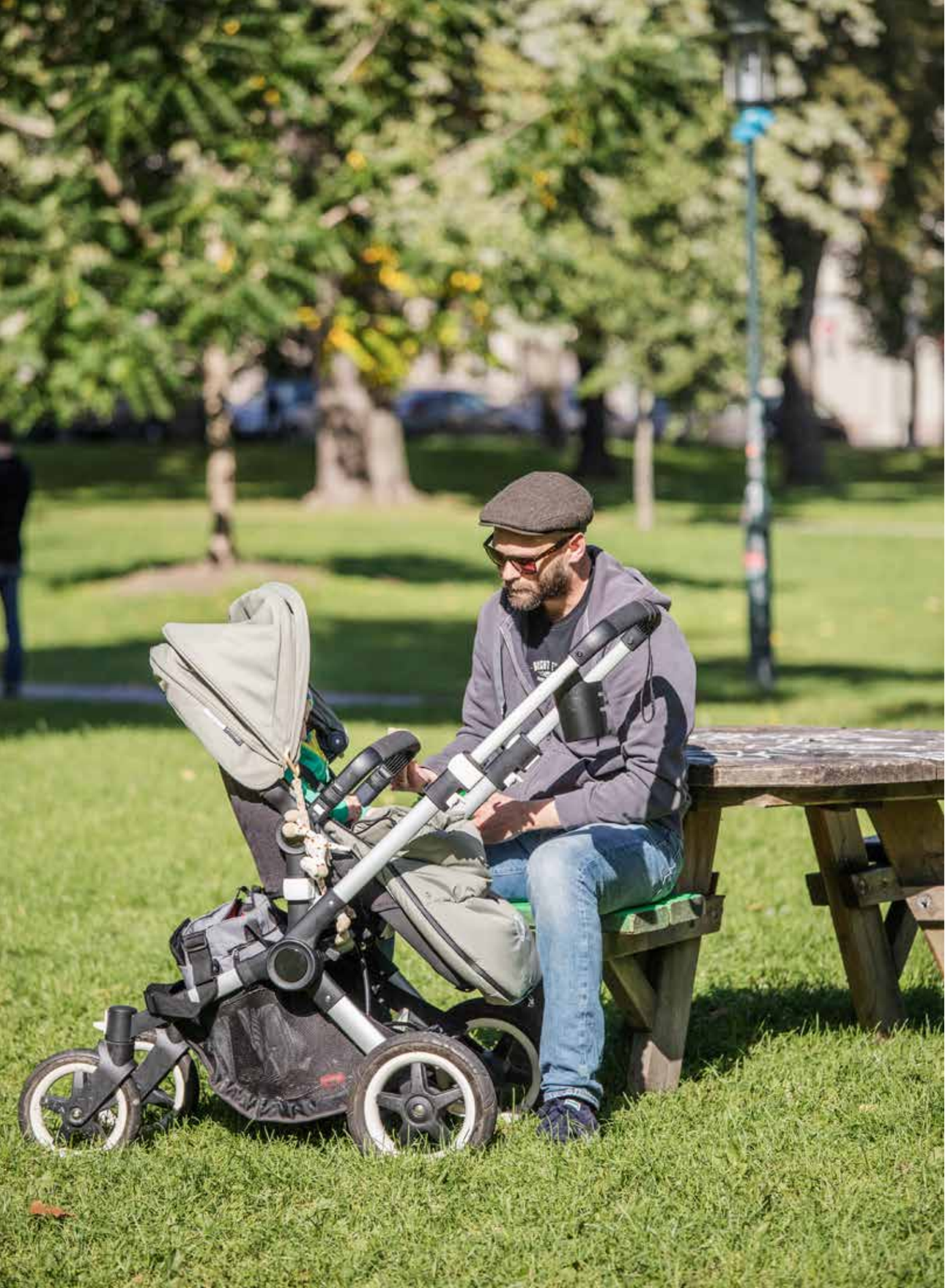
2.2 METHODOLOGY

Table 1 presents the same figures as those shown in Figure 2, but with an explanation of how emissions are assessed for the City of Oslo.[3]

Table 1: GHG emissions for Oslo in 2015 (1 000 tonnes CO_2e), sources and commentary

SOURCES OF EMISSIONS	2015	SOURCE/COMMENTARY
Heating in other industries and households	134.7	The Statistics Norway category is "Heating in other industries and households". These figures have been extracted but not subjected to additional processing.
District heating etc.	26.8	The Climate Agency has allocated these emissions between two categories: waste incineration and district heating. Based on an email received from Statistics Norway on 14 June 2017, 226 000 of a total of 252 800 tonnes in this category can be attributed to waste incineration at Klemetsrud and Haraldrud. The remainder is attributed to district heating etc., which also includes emissions from stationary combustion in industry.
Waste incineration	226.0	The Statistics Norway category is "Mining, quarrying, oil and gas extraction, including service activities". This is an umbrella category covering several sources of emissions that in aggregate amount to 252 800 tonnes CO_2e. The Climate Agency has apportioned these emissions between two categories: waste incineration and district heating. Based on an email received from Statistics Norway on 14 June 2017, 226 000 of a total of 252 800 tonnes in this category can be attributed to waste incineration at Klemetsrud and Haraldrud. The remainder is allocated to district heating etc.
Landfill gas	15.1	The Statistics Norway category is "Gas from landfill waste". These figures have been extracted but not subjected to additional processing.
Wastewater	22.5	The Statistics Norway category is "Wastewater and waste - excluding landfill". These figures have been extracted but not subjected to further processing.
Public transport - buses	31.0	Fossil-fuel CO_2 emissions from buses in Oslo. Emissions have been calculated based on total fossil-fuel emissions from buses in Oslo and Akershus for 2015 (59 678 tonnes). A distribution formula has then been applied based on fossil-fuel emissions from buses (public transport) in Oslo and Akershus in 2016 (52 percent of emissions were attributed to Oslo), and it is assumed that the distribution og emissions for 2015 was the same. The data source is Ruter's Annual Energy and Environment Report for 2016, received from Ruter via email on 9 March 2017.
Taxis	20.1	Emissions are taken from the Agency for Urban Development's estimate in conjunctions with the Report on environmental requirements in taxi licence regulations, Spring 2017. The emissions are based on Statistics Norway mileage data (Source: Table 11271, taxis, main figures Oslo), number of taxi licences in Oslo (Source: Agency for Urban Development) and Institute of Transport Economics emissions factors (Source: Institute of Transport Economics (TØI) Report 1168/2011 - NO_2 emissions from vehicle fleets in major Norwegian cities).
Passenger cars	346.3	The Statistics Norway category is "Road traffic - light vehicles incl. mopeds/motorcycles". Emissions from taxis and LCVs have been subtracted from this total and allocated to their own separate categories.
Light commercial vehicles	94.5	The Statistics Norway category is "Road traffic - light vehicles incl. mopeds/motorcycles". Emissions for light commercial vehicles (LCVs) are calculated by estimating the proportion of LCVs compared to the aggregate number of light vehicles based on registration statistics for passenger cars and LCVs in Oslo (Statistics Norway, 2017: Registered vehicles, table 07832 for the City of Oslo, 2015).
Heavy goods vehicles	142.2	The Statistics Norway category is "Heavy vehicles". GHG emissions from buses operating in the public transport sector are subtracted from this total and allocated to their own separate category.
Construction machinery	166.7	The Statistics Norway category is "Diesel-powered motorized equipment" which includes items other than machinery used in the construction industry (e.g. lawnmowers, tractors and chainsaws). However, according to an oral statement made by a representative of Statistics Norway, construction machinery is assumed to be the largest source of emissions in Oslo, and more accurately describes the category's content.
TOTAL	**1225.9**	

[3] For more detailed information about the methods employed by Statistics Norway, please refer to the following methodological document: Statistics Norway, 2016: Breakdown of atmospheric GHG emissions by municipality. Documentation of methodology and results



3 REFERENCE-LEVEL

Greenhouse gas emissions in Oslo result from the behaviour of hundreds of thousands of people and thousands of businesses. This is a complex and dynamic system that is influenced by many factors, including population growth, economic growth, changes in the behaviour of people and businesses, technological development and municipal- and central-government measures.

Baselines are often used to estimate potential development in emissions, if no new measures were implemented. A baseline approach allows for better assessment of the magnitude of the challenge we face in achieving Oslo's climate targets.

It is important to clarify that the benchmark for the City of Oslo's climate targets is total GHG emissions in 1990, and it is this figure against which target achievement must be assessed. Unlike the situation at national level, Oslo's climate targets are not linked to a baseline. The main reason for calculating a baseline for Oslo is to make it clear that the targets will not be met without extensive new measures, and that the mitigation measures in the Climate Budget will play a decisive role in achieving these targets.

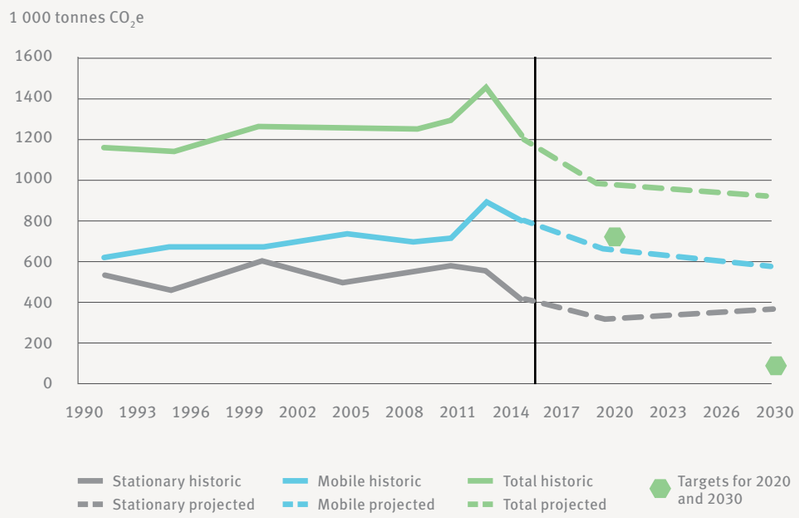
Establishing a baseline can be demanding. The Climate Agency has created a relatively simple model for Oslo, with separate projections for potential emissions trends in the stationary and mobile sectors. The projections are based on a number of assumptions, which are summarized in sub-chapter 3.2.

If we had opted to devote greater resources to this project, we could have used more detailed data and analyses to develop a more sophisticated baseline. Given the uncertainty to such projections, especially in light of Oslo's relatively limited geographical area and economy, this has not been prioritized.

3.1 RESULTS

The baseline is shown in Figure 3. The solid lines show historic GHG emissions in Oslo, while the dashed lines show the baseline projections. The green line represents total emissions, i.e. aggregate emissions from the stationary and mobile sectors. The two green circles represent Oslo's updated climate targets for 2020 and 2030, specifying total emissions of 765 000 and 60 000 tonnes CO_2e respectively.

Figure 3: Historic and projected baseline for GHG emissions in Oslo



The projected reduction in GHG emissions from the stationary sector in the period towards 2020 is due largely to the political drive to ban the use of fossil fuels for heating.[4] The effect of this ban will more than offset the effect of population growth in the same period. After 2020, emissions will increase to some extent, however, as – in the absence of new measures – we experience the effects of population growth.

Emissions from the mobile sector are expected to gradually decline. The reduction in emissions due to phasing in low- and zero-emission vehicles is expected to exceed the increase in emissions resulting from an expected growth in transport volumes. Another important factor will be the impact of biofuel-blending regulations for road transport, with the current blending requirement of 5.5 percent being raised to 20 percent in 2020. The baseline is corrected to account for the double-counting of advanced biofuels in the regulations, which means that the actual volume of blended biofuels is expected to be 16 percent in 2020.

[4] The Solberg Government, 2017: Introduce a ban on the use of mineral oil to heat buildings from 2020, https://www.regjeringen.no/no/aktuelt/oljefyr/id2556868/.
[5] The Solberg Government, 2017: Perspective Report 2017 - Report to the Storting 29 (2016-2017), https://www.regjeringen.no/no/dokumenter/meld.-st.-29-20162017/id2546674/.

Overall, the baseline shows that GHG emissions will fall in the period to 2030, but not at a rate sufficient to meet Oslo's climate target. Projected emissions for 2020 are approximately one million tonnes CO_2e, i.e. 230 000 tonnes CO_2e more than the target for 2020. Correspondingly, the baseline shows emissions of approximately 930 000 tonnes CO_2e in 2030, approximately 870 000 tonnes CO_2e higher than the target for 2030.

3.2 METHODOLOGY

The most recent projections for GHG emissions at national level are set forth in the government's Perspective Report 2017.[5] These projections are based on Norway's National Inventory Report and national data from Statistics Norway as inputs to an economic model supplemented by more detailed analyses. In the period 2015 to 2030, Norway's GHG emissions are projected to fall from 53.9 to 48.3 million tonnes CO_2e, a reduction of approximately ten percent.

Several factors indicate, however, that the trend will not necessarily be the same in Oslo. For example, sources of GHG emissions are very different in Oslo than in Norway in general. More than 50 percent of national GHG emissions derive from sectors that have very little impact in Oslo, such as oil and gas production, industry, mining, agriculture and so on. In addition, projections for population growth also differ: estimates for national population growth in the period 2015-2030 are somewhat in excess of ten percent, while the corresponding figure for Oslo is over 30 percent. As a result of this and other factors (e.g. differences in expected economic growth), the national baseline has no direct application to Oslo.

Population growth

Population growth is expected to affect GHG emissions from both the stationary and mobile sectors. In general, we anticipate that emissions will increase in direct proportion to population growth. In reality, this is probably an over-estimate, as population growth will not affect all types of emissions in Oslo. In addition, per capita emissions in Oslo in the period 1990-2015 have fallen from 2.4 tonnes to 1.9 tonnes CO_2e. No factor has been developed to correct for this, however, so the direct proportionate increase has been retained. In other words, if all other factors remain constant, a ten-percent growth in population is expected to result in a ten-percent increase in emissions.

We have used population growth to estimate trends for GHG emissions in the stationary sector. For the mobile sector, we have used a different method, in which population growth has already been taken into account in the factor used to calculate emissions trends. Accordingly, if we had included Oslo's factor in these calculations, the result would have been a form of double counting. This is explained in more detail in the sections concerning the mobile sector.

We have assumed a consistent rate of Oslo's population growth, from 658 390 inhabitants in 2016 to 890 000 inhabitants in 2040, i.e. total growth of 35 percent. This figure accords with the City of Oslo's population projections. The Climate Agency has assumed that the city's population will increase by the same percentage each year between 2015 and 2030, so that total growth of 35 percent in 2015-2040 implies annual growth of 1.3 percent in 2015-2030.

Source for population growth data; City of Oslo, 2017: Population projections https://www.oslo.kommune.no/politikk-og-administrasjon/statistikk/befolkning/befolkningsfremskrivinger/.

Economic growth

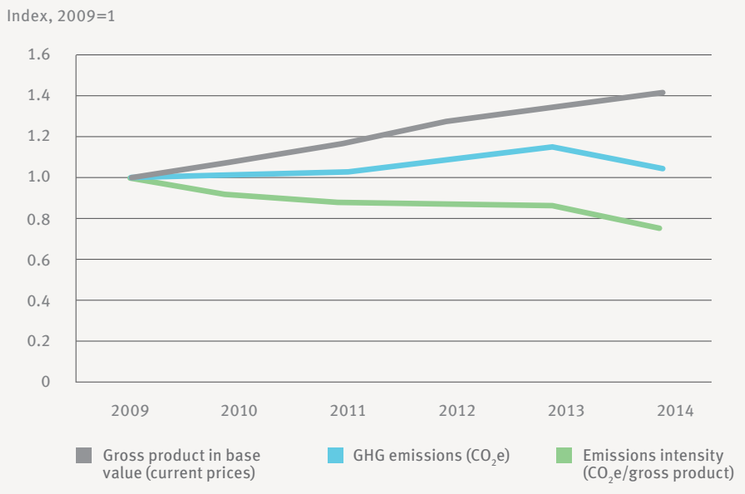
There is a positive correlation between economic growth and GHG emissions. However, analyses for both Norway on a national basis and Oslo on a stand-alone basis show a relative decoupling of economic

growth and emissions. At a national level, Statistics Norway attributes this trend to the relatively strong economic growth of industries that are less emissions-intensive compared to other industrial sectors.[7] In Oslo, the phasing out of fossil-fuel heating in buildings has stabilized emissions, which has resulted in a relative decoupling of economic growth and emissions.

Despite the relative decoupling of the correlation between economic growth and emissions, there is no absolute decoupling. An absolute decoupling would mean that GHG emissions were completely unrelated to economic growth. We lack sufficient evidence to calculate a specific factor linking economic growth and GHG emissions, and accordingly have omitted the effect of economic growth from the baseline.

We have prepared an analysis for Oslo, however, illustrated in Figure 4[8], which shows that GHG emissions are increasing more slowly than the city's gross product. This conclusion is based on the

Figure 4: Total GHG emissions (CO_2e), production (current prices) and emissions intensity for Oslo, 2009-2014. Note that emissions for even-numbered years are interpolated.



[7] Statistics Norway, 2016: Emissions from Norwegian economic activity, 1990-2015, https://www.ssb.no/natur-og-miljostatistikkernrmiljo
[8] Statistics Norway 2016: Regional accounts, Oslo, https://www.ssb.no/en/nasjonalregnskap-og-konjunkturer/statistikker/fnr

fact that emissions intensity in Oslo (tonnes CO_2e emitted per NOK 1 gross product) has fallen by 24 percent in the period 2009-1914.

3.2.1 Trends in the stationary sector

GHG emissions from buildings

This sector accounts for the use of fossil-fuel energy to heat buildings. We anticipate the following trends:

- a 90 percent reduction in emissions from heating in buildings from 2015 to 2020, linearly distributed over the period. This projection is made in light of the recently announced ban from 2020 on the use of mineral oil and paraffin to heat buildings. The ban does not apply to gas. Accordingly, we estimate that approximately ten percent of emissions will still occur in 2020; and
- a 1.3 percent per annum increase in emissions as a result of population growth in the period 2015-2030.

These two effects are added together in the period in which they both take place. In other words, between 2015 and 2020, the reduction in emissions that results from the ban will be partially offset by an annual increase attributable to population growth. We say "partially offset" because the effect of the ban is far greater than the effect of population growth.

GHG emissions from energy

This sector accounts for the use of fossil-fuel energy for district heating and industry etc. We anticipate the following trend:

- a 1.3 percent per annum increase as a result of population growth per annum in the period 2015-2030.

GHG emissions from waste

This sector covers emissions from waste, including waste incineration, wastewater and landfill gas. We anticipate the following trend:

- a 1.3 percent per annum increase as a result of population growth per annum in the period 2015-2030.

We have taken account of the fact that approximately one-third of emissions from waste incineration derive from waste that originates outside the municipal boundaries, and we have assumed that this proportion of emissions will remain constant throughout the period. This estimated split has been supplied by the Waste-to-Energy Agency. Accordingly population growth affects only two-thirds of GHG emissions from waste incineration.

3.2.2 TRENDS IN THE MOBILE SECTOR

This sector accounts for emissions from passenger cars, light commercial vehicles (LCVs), heavy goods vehicles (HGVs), taxis, public transportation and construction machinery. Our summarized projected trend, explained in more detail below, is the following:

- a 1.6 percent reduction per annum in emissions from passenger cars, LCVs, HGVs, taxis and public transportation in the period 2015-2030. This takes into consideration the transition to low- and zero-emission vehicles (reducing emissions) and an increase in transport performance in light of population growth (increasing emissions);
- the increased blending requirement for biofuels, assuming a linear increase from 5.5 percent in 2015 to 16 percent in 2020. This applies to passenger cars, LCVs, HGVs, taxis, public transportation, but not to construction machinery; and
- a 1.6 percent annual reduction in emissions from construction machinery in the period 2015-2030.

Source for emissions data for the use of gas-fired heating in buildings: Email correspondence with Statistics Norway, represented by Trond Sandmo, 19 March 2015.

Source for the new ban: the Norwegian Government, 2017: Introduce a ban on the use of mineral oil to heat buildings from 2020, https://www.regjeringen.no/no/aktuelt/oljefyr/id2556868/

For passenger cars, LCVs, HGVs, taxis and public transportation (assessed as a whole), we have projected a 1.6 percent reduction in GHG emissions for the period 2016-2020. This is based on a trend for GHG emissions from Norwegian road transportation, as described in a report recently published by the Institute of Transport Economics (TØI). The Norwegian motor vehicle fleet's total national CO_2-emissions are projected to be 21 percent lower in 2030 than in 2015. In light of this study, the Climate Agency has made its calculations on the assumption that emissions will fall by an equal percentage each year between 2015 and 2030, i.e. approximately a 1.6 percent reduction per annum from 2015 to 2030.

This approach has been adopted at a national level and includes an increase in emissions due to population growth, which in turn is anticipated to cause growth in transport performance. Since Oslo's population is expected to grow at a higher rate than the national population (see the section regarding population growth), emissions may fall less in Oslo than nationally. This will be offset to some extent by Oslo's expected more rapid adoption of low- and zero-emission vehicles, but we have not quantified this effect. Accordingly we have retained the factor of a 1.6 percent reduction per annum.

Given the lack of information regarding projections specific to construction machinery, we have made a general assumption that this sector will follow the same trend as that for other vehicles, with a 1.6 percent reduction per annum in the period 2016 to 2030.

When calculating the per annum reduction in emissions of 1.6 percent, we have not taken into account the effect of the increased biofuel blending requirement. We have made a simplified assumption that the effect of the blending requirement will increase on a linear basis from 5.5 percent in 2015 to 16 percent in 2020, and remain constant thereafter. Note that advanced biofuels are double-counted in the biofuel blending regulations, which means that the actual volume of blended biofuels is expected to be 16 percent in 2020, not 20 percent. Accordingly the associated climate benefit has been calculated on the basis that the actual amount of blended biofuel is 16 percent. Also note that fuel for construction machinery is not covered by the fuel blending regulations.

Source: Institute of Transport Economics (TØI), 2016 Vehicle fleet forecasts based on stock-flow modelling.

4 EFFECTIVENESS OF MEASURES

This chapter describes the assessment of the GHG emission reduction potential of the measures in the Climate Budget. In so far as possible, given the information available, the Climate Agency has quantified the effects of the measures in the Climate Budget 2018. Where it has not been possible to quantify the effect of a measure, we have made a qualitative assessment of its emission reduction potential.

The assessments of effects set forth in Chapter 4.1 are based on emissions statistics from Statistics Norway, separate figures collated by the Climate Agency, and third-party analyses. The Climate Agency has endeavoured to obtain the most recent figures available.

The assessment of the effects of measures contained in sub-chapter 4.2 is qualitative, and the potential is presented as an interval. In addition, a brief assessment of major measures expected to take effect after 2020 is contained in sub-chapter 4.3, together with planned measures relating to information, mobilization and involvement in sub-chapter 4.4. A summary of the measures in the Climate Budget 2018 appears in Table 2.

Measures to promote energy efficiency are not part of the Climate Budget 2018, but are nevertheless described in sub-chapter 4.5, as the Climate and Energy Strategy for Oslo includes energy-efficiency targets, and these measures were included in the Climate Budget 2017.

Table 2: Measures in the Climate Budget 2018

Measures	Estimated effect of measures in 2020, compared with emissions in 2015 (round-figure tonnes CO_2e)	Effect of measures post-2020
Measures with estimated emissions reduction effect	360 000	Yes
Measures with unallocated emissions reduction effect	25 000 – 140 000	Yes
Measures in the period to 2030	-	Yes
Measures relating to information, mobilization and involvement	-	Yes

4.1 MEASURES WITH ESTIMATED EMISSIONS REDUCTION EFFECT

Although the effect of each measure is assessed individually, in all likelihood they will interact. Some measures will have mutually reinforcing effects, where the effect of the measures when implemented simultaneously is greater than it would have been if the measures had been implemented separately. Other measures may have offsetting effects, so that two such measures implemented simultaneously may have less impact than the same two measures implemented separately. Systematic relationships between effects of mitigation measures are complex and have not been quantified in our assessment of GHG emission reduction effects.

We have attempted to correct for any double-counting by ensuring that, in general, measures are directed towards specific sources of emissions, without overlap. This works well for the stationary sector, but in the mobile sector there are several measures that simultaneously affect the same sources of emissions. Accordingly, the assessment of effects for the mobile sector carries more uncertainty than is the case for the stationary sector. In a further attempt to avoid any possible double-counting of emissions reductions, the Climate Agency has chosen to include potential emissions-reducing effects from the commitment to electric vehicles under the effects of the Oslo Package 3, because this anticipates a large electric share.

The measures are summarized in Table 3 and described in the following sub-chapters. Given the fulfilment of the necessary preconditions for each measure, and the full implementation of each measure without delays, we estimate that the measures can have a total emission-reducing effect in 2020 of about 360 000 tonnes CO_2e.

Table 3: Measures with estimated emissions reduction effect

MEASURES	Responsible entity for implementation (responsibility for reporting in parentheses)	Estimated effect of measure in 2020, compared with emissions in 2015 (tonnes CO_2e)	Effect of measure post-2020 (tonnes CO_2e)
Stationary emissions			
Phase out the use of heating oil in municipal buildings and activities	Units that use heating oil (KLI)	121 450	No
Phase out the use of fossil fuel in privately owned buildings through the use of bans and subsidies (Climate and Energy Fund and Enova) by 2020.	KLI		No
Reduce emissions of landfill gas from Grønmo and Rommen	EGE, REN and EBY	6 900	600
Phase out the use of fossil fuel and gas in district heating (peak load)	NOE	5 600	No
Increase recycling of materials in household waste and boost re-use	REN	4 300	400
Conclude documentation of nitrous oxide volumes from wastewater, with aim of correcting Statistics Norway's emissions data	VEAS	20 500*	No
Mobile emissions			
Introduce a new toll-ring payment system, including new toll stations, in 2019. Note that the effect assumes the implementation of the measures listed below in italics:	MOS	93 300	No
Install new charging stations for passenger and commercial vehicles, including in pilot projects for car-sharing schemes	BYM		
Increase public transport capacity to cope with population growth and reduction in private vehicle traffic	Ruter		
Better provision for cyclists	BYM	3 400	1 700
National 20% biofuel blending requirement to be implemented by 2020	Central government	53 900	No
Fossil-free public transport by 2020	Ruter	29 500	1500
Introduce new taxi licensing rules requiring zero-emission taxis by 2022. Note that the effect assumes the implementation of the measure listed below in italics:	BYM	13 400	3 400
Install new charging stations for taxis	*BYM*		
Switch to zero-emission vehicles in the municipal fleet, possibly using sustainable biofuels	All (UKE)	4 100	No
Establish a low-emission zone for HGVs in Oslo	BYM	2 800	No
Overall effect of measures in 2020		359 150	

** Technical adjustment, not a real reduction*

4.1.1 Phasing out of fossil fuels

Three measures:

- Phase out the use of heating oil in municipal buildings and enterprises;
- Phase out the use of fossil fuel in privately owned buildings by 2020 through a combination of bans and subsidies (Climate and Energy Fund and Enova); and
- Modify Alfaset Crematorium to run on renewable energy.

Estimated effect of measure 2015-2020: 121 450 tonnes CO_2e
Estimated effect of measure in 2021: 0

The ban on using fossil-fuel oil and paraffin to heat buildings will come into force on 1 January 2020, pursuant to the Regulation promulgated on 15 June 2017. The effect of this regulation is that all use of fossil fuels to heat buildings must cease before 2020. Natural gas, which accounts for approximately ten percent of emissions in Oslo (according to an email from Statistics Norway) will continue to be utilized in the Buildings sector in 2020. The ban on fossil-fuel oil and paraffin, combined with subsidies from central and local government (ENOVA and Oslo's Climate and Energy Fund respectively), is expected to result in a complete cessation of emissions from the combustion of mineral oil for heating from the start of 2020. In 2015, the use of fossil fuels for heating accounted for emissions equivalent to 134 700 tonnes of CO_2e in Oslo. These measures are designed to remove 90 percent of these emissions.

The use of heating oil at Alfraset Crematorium in Oslo causes emissions of about 250 tonnes CO_2e per annum. Accordingly, the phasing out of heating oil will reduce emissions by 250 tonnes CO_2e. Our assessment of the effect of this measure assumes that crematoria in the City of Oslo will be upgraded to use renewable sources of energy.

Source: The Solberg Government, 2017: Introduce a ban on the use of mineral oil to heat buildings from 2020, https://www.regjeringen.no/no/aktuelt/oljefyr/id2556868/. Source for GHG emissions: Email correspondence with Statistics Norway, represented by Trond Sandmo, 19 March 2015.

Source for renewable energy at crematoria: Cemeteries and Burials Agency, 2017: Annual environmental and climate report from the Cemeteries and Burials Agency, from the Environment and Climate Report 2016 for the City of Oslo.

4.1.2 Reduced emissions of landfill gas from Grønmo and Rommen

Estimated effect of measure 2015-2020: 6 900 tonnes CO_2e
Estimated effect of measure in 2021: 600 tonnes CO_2e

The assessment of the effect of this measure assumes a natural reduction in emissions from landfill sites and an increase in landfill gas collection. This effect is obtained by implementation of several measures, such as the installation of more gas wells and methane oxidation layers/biocovers; better decomposition of waste; landfill gas collection by reducing water levels in wells; and by improving systems for landfill gas management.

It is very difficult to calculate the effect of these measures. In 2015, landfill gas emissions were responsible for approximately 15 100 tonnes CO_2e. The Agency for Waste Management estimates that the quantities of gas are reducing naturally by approximately seven percent per annum. Accordingly, the Climate Agency has estimated a total reduction by natural means of approximately 30 percent for the period 2016-2020. In addition, we have made a rough assumption that the measures listed above will lead to a total further reduction of 15 percent between 2015 and 2020.

For 2021, the figure takes into account only the natural reduction in emissions of seven percent per annum.

Source: Agency for Waste Management, 2017 Environmental report 2016, https://ren-miljorapporten2016.herokuapp.com/REN_miljorapport_2016.pdf, Ch. 6.1.

4.1.3 Phase out the use of fossil fuel and gas for district heating during peak-load periods

Estimated effect of measure 2015-2020: 5 600 tonnes CO_2e.
Estimated effect of measure 2021: 0

Our assessment of the effect of this measure assumes that Fortum (formerly Hafslund) will accomplish its goal of phasing out the use of fossil oil and gas for district heating during peak-load periods. In 2016, this use accounted for emissions totalling approximately 5 600 tonnes CO_2e. Fortum has informed us that fossil oil and gas accounted for 1.3 percent of the energy used for district heating during 2016. This percentage was the same in 2015. Accordingly we have assumed that emissions in 2015 were the same as in 2016.

Sources: Hafslund, 2017: Key figures 2016, https://www.hafslund.no/om-hafslund/nokkeltall/7132
Hafslund, 2017: Environmental impact of Hafslund District Heating, 2017, https://www.hafslund.no/fjernvarme/miljopaavirkning_fra_hafslund_varme/7134.

4.1.4 Increase material recycling of household waste and boost re-use

Estimated effect of measure 2015-2020: 4 300 tonnes CO_2e.
Estimated effect of measure 2021: 400 tonnes CO_2e.

Our starting point for assessing the effect of this measure is the Agency for Waste Management's target of material recycling 60 percent of household plastic and food waste by 2025. This target was contained in the draft new Waste Strategy, consultation draft dated 29 April 2016, sub-targets 1.3 and 1.4.

In 2015, the level of source separation was 38.2 percent for food waste and 30 percent for plastics, which is equivalent to 15 923 tonnes of food waste and 2 125 tonnes of plastic. According to Table 4 in the Agency for Waste Management's Environment Report 2015, each tonne of plastic waste that is material recycled rather than energy recycled reduces CO_2-emissions by 2.3 tonnes. Correspondingly, each tonne of food waste that is material recycled instead of energy recycled reduces CO_2-emissions by 0.150 tonnes.

In this assessment we have assumed recycling rates in 2020 of 55 percent for food waste and 50 percent for plastic. In 2021, we have assumed recycling rates of 56 percent for food waste and 52 percent for plastic. The total amount of waste is approximately the same as in 2015.

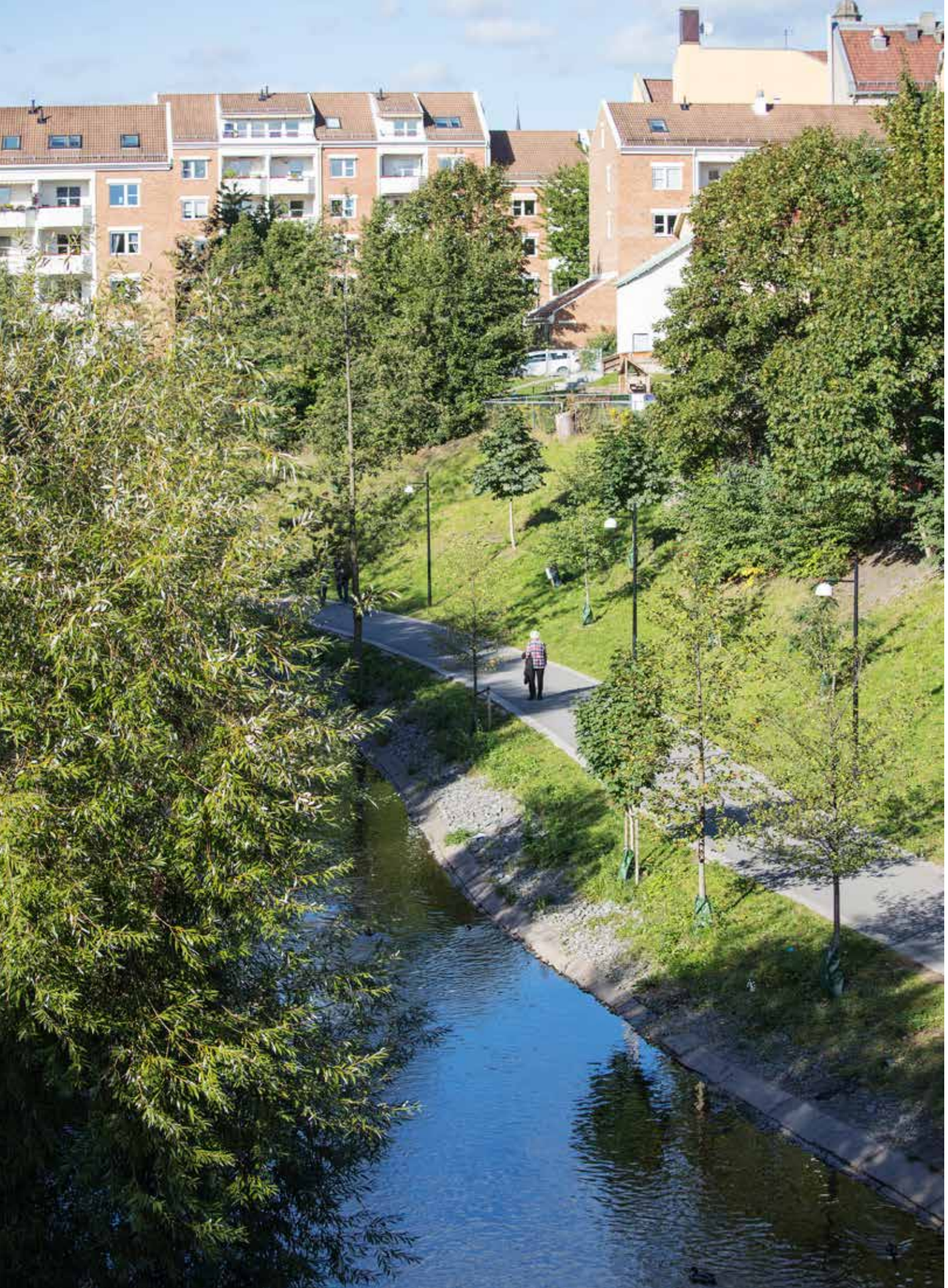
Sources: City of Oslo, 2016: Waste strategy for Oslo to 2025, Consultation draft dated 29 April 2016.
City of Oslo, 2016: Agency for Waste Management, Environment Report 2015 https://ren-miljorapporten2015.herokuapp.com/REN_miljorapport_2015.pdf.

4.1.5 Conclude documentation of nitrous oxide volumes in wastewater, with the aim of correcting Statistics Norway's emissions data

Estimated effect of measure 2015-2020: 20 500 tonnes CO_2e.
Estimated effect of measure 2021: 0

The Agency for Water and Wastewater Services (VEAS) stated in its written submission attached to Proposition 156/15 that Statistics Norway's figures for emissions from wastewater were not specifically applicable to the agency's plant at Bekkelaget. By applying methods used by the Swedish Water & Wastewater Association, the VEAS had calculated that its emissions totalled approximately 1 900 tonnes CO_2e per annum. This measure assumes completion of the evidence-gathering process so that emissions figures for Bekkelaget can be lowered. Accordingly, this measure will not result in an actual cut in emissions, but rather an adjustment to the emissions inventory. The effect attributed to this measure reflects the VEAS's submission and assumes that emissions will be established at approximately 2 000 tonnes CO_2e once the evidence-gathering process has been completed.

Source: City of Oslo, 2015: 156 3. Written submission attached to draft Climate and Energy Strategy for Oslo, p. 79. See attachment to a Climate and Energy Strategy for Oslo – City Council Proposition 156 of 26 June 2015.



Statistics Norway's figures for 2015 indicate emissions from wastewater of 22 500 tonnes CO_2e. Statistics Norway is waiting for further evidence for the City of Oslo before amending its data.

4.1.6 Introduce a new toll-ring payment system, including new toll stations, in 2019.
Assuming implementation of previous measure:

- installation of new charging stations for passenger and commercial vehicles, including in pilot projects for car-sharing schemes
- Increase public transport capacity to cope with population growth and a reduction in private vehicle traffic

Estimated effect of measure 2015-2020: 93 300 tonnes CO_2e.
Estimated effect of measure 2021: Greater than 0, but not quantified.

The effect of this measure has been calculated by the Norwegian Institute for Air Research (NILU). NILU concluded that CO_2-emissions would fall by 16 percent in the period 2014-2020. The calculation was based on figures for 2014. Emissions from road transportation in Oslo in 2013 and 2015 were almost identical. Accordingly, we assume that the 16 percent reduction also applies if we take emissions in 2015 as our starting point. Accordingly, the reduction corresponds to a 16 percent reduction in emissions from passenger cars, LCVs and HGVs in Oslo compared to levels in 2015. Buses and taxis are excluded from this calculation.

NILU's calculations show both a decline in transport performance and an increase in the proportion of zero-emission vehicles. Among other things, the calculations assume that 26 percent of vehicles passing through the toll ring will be electric. The Climate Agency considers this percentage extremely high. It is achievable only if all other measures in the Climate Budget relevant to electric vehicles are implemented and central government continues its policy on electric vehicles, in particular, expanding the charging infrastructure for passenger cars. Unless the charging infrastructure is expanded so that capacity exceeds demand, it is not realistic to assume such a high proportion of electric vehicles. In this case, the reduction in emissions will be less than the amount calculated by NILU.

NILU's calculations are not based on figures from Statistics Norway, unlike those in the Climate Budget. The model employed by NILU (RTM 23 +) is not limited to Oslo, but covers densely built-up areas of the City of Oslo and Bærum County, as well as parts of Skedsmo, Lørenskog, Asker, Nesodden, Kolbotn, Enebakk, Ski and Ås. According to NILU's calculations, emissions for the whole of Oslo and parts of Akershus County total 1 460 000 tonnes CO_2e, while according to Statistics Norway, total emissions for the whole of Oslo and Akershus Country total 1 960 000 tonnes CO_2e. The methods used to calculate these figures are relatively similar. Accordingly, the Climate Agency considers it a reasonable methodological practice to take the 16 percent emission reduction from NILU's model and apply it unchanged to Oslo's road traffic emissions. Ideally, a separate modelling process would have been conducted solely for road transportation in Oslo.

4.1.7 Better provision for cyclists
Estimated effect of measure 2015-2020: 3 400 tonnes CO_2e.
Estimated effect of measure 2021: 1 700 tonnes CO_2e.

Sources: NILU, 2017 Memorandum - Effect of Oslo Package 3 toll charges on local air quality, 27 June 2017. The Climate Agency, 2017: Shift from fossil to renewable/zero-emission fuels. Proposal for an action place to achieve the goal of shifting the vehicle fleet from fossil to renewable/zero-emission fuels.

This emissions reduction is a rough estimate by the Climate Agency based on the following assumptions and estimates: Eight percent of daily journeys made by bicycle in 2015, compared to 16 percent in 2020 (in accordance with targets set in the Climate and Energy Strategy). We have assumed that half of road users who switch to cycling would formerly have travelled by car, while the other half would have used public transport or walked, and accordingly make very little or no difference to emissions. We have assumed 240 travelling days per annum.

Where a car driver has switched to cycling, we have assumed an unchanged daily round trip of four kilometres. We have assumed average car emissions of 138 g CO_2/km. We have assumed the population of Oslo remains constant at 650 000. The average reduction in emissions for every person who switches to cycling is within the range of estimates in the Institute of Transport Economics' calculations in the report referred to below.

In assessing the effect of this measure for 2021, we have assumed a further four percent increase in the proportion of cycle journeys to a total of 20 percent.

Sources: Institute of Transport Economics (TØI), 2016: Institute of Transport Economics (TØI) report 1498/2016: Effect of subsidy scheme for electric bicycles in Oslo on bicycle use, transport distribution and carbon emissions https://www.toi.no/getfile.php?mnfileid=43454.
City of Oslo, 2014: Oslo Cycling Strategy 2015-2025 http://www.oslo.kommune.no/dok/Vedlegg/2014_12/1083158_1_1.PDF.

4.1.8 National requirement for 20 percent biofuel blending to be implemented by 2020
Estimated effect of measure 2015-2020: 53 900 tonnes CO_2e.
Estimated effect of measure 2021: 0

In assessing the effect of this measure, we have assumed that blending requirements for biofuels will be increased from 5.5 percent in 2015 to 20 percent in 2020. This affects GHG emissions from passenger cars, LCVs and HGVs. Although the value chain for the production and transport of biofuels causes GHG emissions, the actual combustion of biofuel in vehicles is assumed to be emission-free.

As mentioned above in Chapter 2, advanced biofuels are double-counted in the fuel blending regulations, which means that the actual volume of blended biofuels is expected to be 16 percent in 2020, not 20 percent. Accordingly, the effect of this measure has been calculated on the basis that the actual amount of blended biofuel is 16 percent. The increase in the blending requirement will thus reduce GHG emissions from passenger cars, LCVs and HGVs by 11 percent in the period 2015 to 2020.

We have assumed that NILU's calculation of a 16-percent cut in emissions due to revised toll-ring charges (lower tolls for low- and zero-emission vehicles and the introduction of rush-hour charges) does not take account of the increased proportion of biofuel consumed by vehicles. Accordingly, the increase in the blending requirement will only apply to the net amount of emissions following a deduction to take account of the impact of the new toll-ring charges.

This measure is not expected to have any effect in 2021, since the increased blending requirement will already have come into effect and no further action is anticipated.

Sources: Norwegian Environment Agency, 2017: Facts about biofuels, http://www.miljodirektoratet.no/no/Nyheter/Nyheter/2017/Februar-2017/Fakta-om-biodrivstoff1/
NILU, 2017: Memorandum - Effect of Oslo Package 3 toll charges on local air quality, 27 June 2017.

4.1.9 Fossil-free public transport by 2020
Estimated effect of measure 2015-2020: 29 500 tonnes CO_2e
Estimated effect of measure in 2021: 1 500 tonnes CO_2e

Ruter's project Fossil Free 2020 aims to make all public transport in Oslo and Akershus fossil-free by the end of 2020. In 2015, GHG emissions from buses in Oslo totalled 31 000 tonnes CO_2e. Since the Fossil Free 2020 project is scheduled for completion before the end of 2020, we have assumed residual emissions of approximately 1 500 tonnes CO_2e, which comprises five percent of 2015 emissions. These emissions will be elimated by 2021.

Note that although the Fossil Free 2020 project also includes ferries, GHG emissions from boats are not included in the emissions statistics for Oslo as calculated by Statistics Norway. Accordingly, measures by the maritime sector will reduce GHG emissions, but will not affect Oslo's emissions statistics.

The report includes emissions from buses and ferries serving Oslo and Akershus. The Climate Agency has also obtained emissions figures for buses and ferries operating specifically in Oslo from the report's supporting documentation.

Source: City of Oslo, 2017: Environment and Climate Report 2016, https://www.oslo.kommune.no/getfile.php/13215073/Innhold/Politikk%20og%20administrasjon/Statistikk/Milj%C3%B8-%20og%20klimarapport%202016.pdf.

4.1.10 Introduce new licensing rules for taxis requiring zero-emission vehicles by 2022
Assuming completion of prior measure:
• Installation of new charging stations for taxis

Estimated effect of measure 2015-2020: 13 400 tonnes CO_2e
Estimated effect of measure in 2021: 3 400 tonnes CO_2e

When assessing the effect of this measure we have assumed the adoption of new rules in 2018 requiring all taxis to be zero-emission vehicles subject to a deadline to be set at least four years ahead. This requirement is in accordance with the new Public/Commercial Transport Act, section 9, fourth paragraph. Given that licensed taxi drivers typically keep their cars for three to four years, we expect two-thirds of drivers to have switched to zero-emission taxis by 2020. This expectation differs somewhat from the assumptions made in the Climate Budget 2017. At that time the Public/Commercial Transport Act had not been amended to allow for a four-year deadline, and we assumed that all taxis could be zero-emission vehicles by 2020. Based on this amendment allowing a four-year deadline, the Climate Budget 2018 postpones full-scale achievement of this target until 2022.

The effect of the measure in 2021 is assessed to be half of the remaining emissions from this sub-sector.

Source: The Solberg Government, 2017: county councils and the City of Oslo can impose environmental requirements on taxis, https://www.regjeringen.no/no/aktuelt/fylkeskommunane-og-oslo-kommune-kan-stille-miljokrav-til-drosjene/id2545069/.

4.1.11 Switch to zero-emission vehicles for the municipal fleet, possibly using sustainable biofuels
Estimated effect of measure 2015-2020: 4 100 tonnes CO_2e
Estimated effect of measure in 2021: 0

The effect of the measure has been assessed on the basis that all passenger cars and LCVs in the municipal fleet, as well as vehicles over 3.5 tonnes, will be fossil-free or zero-emission by 2020. GHG emissions in 2015 totalled 2 500 tonnes CO_2e from light vehicles and 1,550 tonnes CO_2e from HGVs/construction machinery.

Source: City of Oslo, 2017: Environment and Climate Report 2016, https://www.oslo.kommune.no/getfile.php/13215073/Innhold/Politikk%20og%20administrasjon/Statistikk/Milj%C3%B8-%20og%20klimarapport%202016.pdf.

4.1.12 Establish a low emission zone for heavy goods vehicles in Oslo
Estimated effect of measure 2015-2020: 2 800 tonnes CO_2e
Estimated effect of measure in 2021: Greater than 0, but not quantified

We have assumed a two-percent reduction in GHG emissions from HGVs. The calculations contained in the Concept Evaluation Report were prepared by NILU, and based on the same traffic model as the calculations regarding the toll ring: RTM 23 +. In 2018, these calculations show a two-percent reduction in GHG emissions due to the low-emission zone as compared to the baseline scenario. The baseline scenario in the Concept Evaluation Report for Low Emission Zones describes a zero-emission alternative that includes the measures that were adopted for implementation in connection with the amended Oslo Package 3 Agreement dated 5 June 2015.

The Climate Agency interprets that this two-percent reduction in emissions will be in addition to the effects of the implementation of new toll-ring fees/charges. In a commentary to the Climate Agency, NILU has indicated that the calculations are somewhat complicated, and that the calculation year for the Concept Evaluation Report on Low Emission Zones was 2018, while the calculations concerning the impact of the new toll-ring fees/charges have focused on 2020 and 2022.

It is expected that the low emission zone will continue to have an impact throughout 2020, but this effect has not been quantified.

Source: City of Oslo, 2017: Consultation on local regulations concerning a low emission zone for heavy vehicles in the City of Oslo, with attached Concept Evaluation Report (5 July 2017), https://www.oslo.kommune.no/politikk-og-administrasjon/etater-og-foretak/bymiljoetaten/kunngjoringer/horing-av-lokal-forskrift-om-lavutslippssone-for-tunge-biler-i-oslo-kommune-article83707.html.

4.2 MEASURES WITH UNALLOCATED EMISSIONS REDUCTION EFFECT

The Climate Budget contains several measures whose effects cannot be assessed on an individual basis. The reasons for this include, among other things, the facts that some of the measures have not been finalized or need further study; the relevant statistics are unavailable; or the measures are so closely intertwined with other measures that it is difficult to isolate their effects. Several of these measures will have emission-reducing effects in the short term, and accordingly contribute to achieving the targets for 2020. Some of the measures, on the other hand, are larger in scale and more complex, and will take full effect only after 2020, although early implementation will be crucial for achieving the goals for 2030. The measures are summarized in Table 4 and described in the following sub-chapters.

The Climate Agency have roughly estimated the effect of these measures to have the potential to reduce emissions by a range of 25 000 to 140 000 tonnes CO_2e by 2020, depending on how the measures are implemented. Assessing the overall effect of these measures is challenging, and our estimate has a high degree of uncertainty. We have chosen to provide a rough estimate, however, to highlight areas with potential for reducing emissions and possibilities that need to be studied so that new measures can be implemented if necessary.

The lower end of the range is a conservative estimate and assumes, essentially, that all the measures are either abandoned or have no effect, except for the two packages of measures designed to achieve a “fossil-free city centre within Ring 3 by 2024” and “an increased proportion of low- and zero-emission vehicles and construction machinery”, which are assumed to be implemented but with low effect. Achieving the figure at the upper end of the range requires the measures to have maximum effect,

and trigger new markets for climate-friendly technologies.

Table 4: Measures with unallocated emissions reduction effect

MEASURES	Responsible entity for implementation (responsibility for reporting in parentheses)
Increased supply of biogas for use as a fuel from water/wasterwater (VEAS)	VEAS
Increased supply of biogas for use as a fuel from Bekkelaget Wastewater Treatment Plant and Romerike Biogas Plant	VEAS and EGE
Continue development of Intelligent Transport Systems (ITS), development of sensor technology	BYM
Continue work on package of 100 initiatives to reduce delays on public transport	BYM
Better provision for pedestrians	BYM
Car-Free City Life within Ring 1, including establishment of loading/unloading spaces for commercial vehicles	BYM/Car-Free City Life
Car parking measures (e.g. roll-out of resident-only parking zones)	BYM
Climate-friendly urban development including densification around transport hubs	BYM, EBY, PBE
Increase material recycling of commercial waste	REN
Fossil-free/zero-emission construction sites for municipal building projects	Municipal construction enterprises (UBF/KID/OBY/Boligbygg) and other municipal developers
Continue existing, and introduce new, subsidy schemes, from the Climate and Energy Fund to reduce GHG emissions	KLI
Acquire sites for municipal climate measures (incl. energy stations)	EBY
Establish energy stations supplying at least two renewable fuels for passenger cars and light and heavy commercial vehicles (incl. Alnabru)	KLI
Mandatory requirement for zero-emission (or fossil-free) solutions when procuring transport services	All procurement officers (UKE)
Upgraded and new shore power facilities for international ferries	Oslo Harbour
Reports on packages of measures: *- Stimulate to climate-friendly travel to and from work* *- Gradual transition to a fossil-free city centre within Ring 3 by 2024 through the implementation of low-emission zones* *- More efficient and climate-friendly goods transport* *- Increased proportion of low- and zero-emission vehicles and machines on construction sites*	MOS
TOTAL EFFECT OF MEASURES IN 2020	**25 000 -140 000 TONNES CO_2e.**

4.2.1 Increased supply of biogas for use as fuel from water/wastewater (VEAS) and increased supply of biogas for use as fuel from Bekkelaget Wastewater Treatment Plant and Romerike Biogas Plant
Biogas is a climate-friendly alternative fuel source that offers opportunities to reduce emissions from, among other sectors, heavy goods transport. Biogas helps reduce GHG emissions when used as a replacement for fossil fuels. If the increased supplies of biogas are used to fuel vehicles in Oslo, these measures can have a major impact.

4.2.2 Continue development of Intelligent Transport Systems (ITS), development of sensor technology
Given the way Intelligent Transport Systems (ITS) operate today, it is difficult to estimate any major effect in the form of reduced traffic. Further development of ITS may contribute however to reducing transport performance, when seen in isolation, by encouraging more efficient transport performance. A report prepared by Rambøll for the Climate Budget 2017 indicated an emission reduction potential of 30 000 tonnes CO_2e. This measure will be one of several with potential to reduce transport performance, and accordingly GHG emissions.

4.2.3 Continue work on package of 100 initiatives to reduce delays on public transport
This measure includes removal of parking spaces adjacent to tram tracks to reduce delays on the tram system. It is difficult to isolate the direct contribution of this measure to reducing emissions, but the measure is very important for ensuring efficient public transport, and also contributes directly to reducing traffic in the city centre due to the removal of parking spaces.

4.2.4 Better provision for pedestrians
This measure aims to increase the number of journeys made on foot in the city. The emission reduction effect will probably be relatively small, but the measure will help reduce car traffic to some extent and perhaps free up some public transport capacity. We lack the data necessary to calculate the emission-reducing effect in the way we have calculated the effect of measures to improve cycling.

4.2.5 Car-Free City Life within Ring 1, including establishment of loading/unloading spaces for commercial vehicles
The measures in the Car-Free City Life project that are relevant to GHG emission reduction involve the removal of parking spaces and the establishment of car-free zones, with the intention of reducing car traffic. It is difficult to isolate the effect of these measures; their effect also depends on the further implementation of the measures, and on the extent to which commercial traffic in the city centre can be made more efficient and climate-friendly.

4.2.6 Car parking measures (e.g. roll-out of resident-only parking zones)
Measures by the Agency for Urban Environment (BYM) envisage that up to 25 000 fee-based parking spaces will be reserved for residents by 2019. In addition, 1 100 parking spaces in the city centre will be eliminated. These measures will help reduce traffic entering the city, and act as an incentive to make journeys by public transport, cycle or on foot.

4.2.7 Climate-friendly urban development with densification around public transport hubs
An approach to urban development that focuses on densification around public transport hubs will contribute to allowing Oslo's population to grow without large increases in GHG emissions. A continued

strategy of concentrating new development around public transport hubs is essential for avoiding a rise in emissions in the period to 2030.

4.2.8 Increase material recycling of commercial waste
The Agency for Waste Management (REN) has set a target for increasing the material recycling of commercial waste, equivalent to 35 percent recycling. The main strategy for achieving this is to facilitate increased reception and post-collection sorting of commercial waste, which is an important factor in the transition to a circular economy.

4.2.9 Fossil-free/zero-emission construction sites at municipal building projects
Currently, Oslo's municipal construction enterprises in general require construction sites to be fossil-free. Steps are also being taken to introduce zero-emission construction where possible.

4.2.10 Continue existing, and introduce new subsidy schemes from the Climate and Energy Fund to reduce GHG emissions.
The subsidy schemes arranged through the Climate and Energy Fund are designed to help people save energy, reduce GHG emissions, and create new markets for the implementation of climate-friendly solutions. The subsidy scheme for phasing out oil-fired heating has played an important role in reducing emissions, as we have seen in Oslo, and is described in sub-chapter 4.1.1. The target for the Climate and Energy Fund for 2018 is to assist in reducing emissions by 15 000 tonnes CO_2e. The reduction in emissions has been ascribed primarily to the measure described in sub-chapter 4.1.1. Subsidies for the installation of charging stations in cooperative housing developments will enable more people to use electric cars, but the emission-reducing effect of this measure has been ascribed to the measure described in sub-chapter 4.1.6 (the new toll-ring system resulting in 26 percent of cars being electric). The other new measures will contribute primarily to creating new markets and are expected to have a multiplying effect, which is difficult to calculate.

4.2.11 Acquire sites for municipal climate measures (incl. energy stations)
Several of the measures in the Climate Budget require access to areas of land. Such measures include building energy stations where vehicles can be fuelled with biogas and zero-emission fuel. Accordingly this measure will contribute to reducing GHG emissions from the transport sector.

4.2.12 Establish energy stations supplying at least two renewable fuels for passenger cars and light and heavy commercial vehicles (incl. Alnabru)
Implementation of this measure is an important precondition for the supply of biogas and zero-emission fuel, particularly to LCVs and HGVs. Accordingly this measure will contribute to reducing GHG emissions from the transport sector.

4.2.13 Mandatory requirement for zero-emission (or fossil-free) solutions when procuring transport services
As part of the implementation of a new City of Oslo procurement strategy, all municipal procurements of transport services must require the use of zero-emission fuel (electricity or hydrogen). Where this is not possible, a sustainable biofuel will be an acceptable alternative.

4.2.14 Upgraded and new shore power facilities for international ferries.
Since Statistics Norway does not currently include the maritime sector in its municipal emissions statistics, this measure will not have a direct effect on Oslo's climate accounting. Calculations made by the ReCharge project,[9] however, show potential emission reductions per annum of approximately 3 200 tonnes CO_2e.[10]

4.2.15 Studies of packages of measures:
The Climate Budget contains four packages of measures that require further study to increase the likelihood of Oslo achieving its 2020 and 2030 targets. All four packages relate to the mobile sector, as this sector offers the greatest emission reduction potential for the City of Oslo. The further assessments will cover the measures' expected emission-reducing effects, legal bases, practical considerations, and socio-economic consequences. These studies should involve relevant municipal personnel and units, business, and the voluntary sector.

The final implementation of the measures will depend on the results of these studies. It is too early to estimate the emissions-reducing effects of the measures. In the descriptions of the relevant packages of measures, however, we provide examples to demonstrate the potential for reducing emissions. These are very rough estimates that must be further clarified by the studies.

All the studies must consider possible applications of intelligent transport systems (ITS) for reducing emissions. A report prepared by Rambøll for the Climate Budget 2017 indicated that ITS had a GHG emission reduction potential of 30 000 tonnes CO_2e owing to lower levels of transport performance.

Package of measures to encourage climate-friendly travel to and from work
Travel to and from work continues to account for a significant share of traffic in Oslo. Accordingly a package of measures to promote climate-friendly travel to and from work could make a large contribution to reducing car traffic. The study will make a detailed assessment of incentives and disincentives for walking, cycling or using public transport to travel to and from work. Examples of possible incentives to encourage more climate-friendly travel to and from work include subsidies for workplace cycle initiatives (installation of cycle storage, e-bike lending schemes, and so on) and measures to promote the use of public transport.

A possible disincentive for choosing a climate-friendly means of travel is access to free or heavily subsidized parking at work. According to the Institute of Transport Economics (TØI), removing workplace parking is a powerful instrument for reducing traffic.[11] One example of how we could reveal the potential emissions cuts that could be achieved through a package of measures for climate-friendly travel to and from work, would be to calculate the effects of means of reducing the number of workplace parking spaces. We assume that approx. 10 000 people have access to a parking space at work,

[9] https://www.tu.no/artikler/dette-verktoyet-forteller-hvilke-skip-havner-og-kaier-som-forurenser-mest-og-hvilke-som-vil-ha-best-nytte-av-landstrom/382605.
[10] http://www.ohv.oslo.no/filestore/Milj/2017ReChargerapport-endeligbarriererlandstrmhybridogforretningsmodel.pdf.

and that 50 percent of these people have access to free parking. Further, we assume that 4 000 employees take advantage of this opportunity. The application of a parking fee could reduce the per capita mileage by approximately 6 000 km per annum, primarily as a result of fewer car journeys to and from work. We have assumed that on average a car generates 138 grams CO_2/km. This very low assumed effect would cut emissions by 3 500 tonnes CO_2e per annum by 2020. A more optimistic scenario is that a higher number of people, say 15 000, reduce their annual mileage as a result of parking fees being imposed at their workplace. This could happen if some major public-sector and private-sector employers were to spearhead this strategy, and smaller businesses were to follow their lead. If we otherwise apply the same assumptions as above, the measure would have the potential to reduce GHG emissions by 20 000 tonnes CO_2e per annum by 2020.

Package of measures for a gradual transition to a "fossil-free city centre within Ring 3 by 2024" through the implementation of low-emission zones

The measures in Oslo Package 3 include the introduction of a new toll ring along Ring 2 and, in autumn 2017, a new system of toll-ring charges that will favour zero- and low-emission vehicles and impose a congestion charge during rush hours. A proposal regarding a low-emission zone for HGVs is out for consultation.

Nevertheless, achievement of the City Council's declared aim to achieve a fossil-free city centre within Ring 3 by 2024 requires the implementation of measures that go beyond those approved for implementation as of today. The package of measures will follow up the City Council's aim to achieve "fossil-free city centre within Ring 3 by 2024". Our study will examine various measures that could be taken to promote achievement of this goal.

If we assume that we succeed in cutting traffic by up to 15 percent through implementation of the new system of toll-ring charges (including the implementation of the concept known as "Ring 2 with 'arms'"), and if 76 percent of traffic passes through the toll ring, overall this will comprise approximately 11 percent of traffic. This means that traffic needs to be cut by a further nine percentage points if we are to achieve the target of reducing traffic by 20 percent by 2020.

If we assume that this reduction will be achieved through the implementation of a low-emission zone aimed at freight vehicles and passenger cars, an emission reduction of approximately 40 000 tonnes CO_2e could result. A low estimate, assuming a weaker implementation of the low-emission zone, could result in a reduction of 10 000 tonnes CO_2e.

In addition, a low-emission zone could help shift the vehicle fleet towards a higher share of electric vehicles than the 26 percent that is assumed in the effect calculations for the new toll-ring charging system. This effect has not been quantified, however.

Package of measures for more efficient and climate-friendly road freight

Reducing emissions from road freight is a challenging area. There are fewer zero-emission solutions available than for the passenger-car segment, although alternatives are on their way to the market.

[11] https://www.toi.no/getfile.php?mmfileid=43774.

Accordingly it is important to assist in generating a market for climate-friendly transport in industry.

Among other things, the study will assess the potential of freight consolidation schemes, for example by subsidizing the cost of professional consultations to help businesses plan to reduce their transport requirements.

Assuming that the measure shows that it is possible to make freight more efficient, this will reduce transport performance and accordingly cut direct GHG emissions. Insufficient progress has been made with this measure to enable us to isolate any effects in the form of reduced GHG emissions.

Package of measures to increase the proportion of low- and zero-emission vehicles and machines on construction sites
The construction sector in Oslo is a major source of emissions and is responsible for 170 000 tonnes CO_2e per annum. Since 2016, six pilot projects on fossil-free construction have been initiated and completed, and the City of Oslo's procurement strategy imposes environmental and emissions requirements on construction activities. In order to achieve the largest possible emissions reductions from construction activities, it is nonetheless important to develop a package of measures that will stimulate the use of an increased share of low- and zero-emission vehicles and machines in the construction sector.

Accordingly the City of Oslo will study the effects of measures to boost in the phasing in of low- and zero-emission vehicles and machines in the construction sector. This study will, for example, assess the effect of discounted toll charges for vehicles fuelled by biogas, boost efforts to build energy stations, and increase the focus on the transition to fossil-free and zero-emission construction machinery.

One example to demonstrate the potential is given for the construction sector. If we assume that rentals of construction machinery by the City of Oslo account for 20 percent of GHG emissions from this source, while construction machinery rentals by central government are responsible for ten percent, and we assume that the City of Oslo and central government both implement measures to reduce emissions in the construction sector by 15 percent, but private-sector businesses implement projects that reduce emissions by three percent, the potential outcome is a reduction of 11 000 tonnes CO_2e by 2020.

For a higher estimate, we could assume that 20 percent of total emissions from construction machinery are eliminated through the use of renewable alternatives. Achieving this would probably require more stringent national measures, for example, wider application of the fuel blending regulation to off-road diesel, or increased duties on off-road diesel in order to balance the competition between biofuels and fossil fuels. This very low assumed effect would cut emissions by 33 000 tonnes CO_2e.

4.3 MEASURES IN THE PERIOD TO 2030

Oslo has set ambitious climate targets for 2020 and 2030. If we are to succeed in reducing emissions by 95 percent by 2030, it is important to think long-term. Some measures that will contribute to major cuts in emissions after 2020 require investment before 2020. These measures are shown in Table 5.

Table 5: Measures in the period to 2030

MEASURES	Responsible entity for implementation
Carbon capture and storage at Klemetsrudanlegget A/S	NOE
New Fornebu metro line	Fornebu Agency
New central metro tunnel	MOS
The tram programme	MOS
New signalling and interlocking plant for the metro	MOS
Several new projects for public tranport infrastructure	MOS

4.3.1 Carbon capture and storage at Klemetsrudanlegget A/S

The Klemetsrud waste-to-energy plant is Oslo's largest single source of GHG emissions, and the implementation of carbon capture and storage (CCS) at Klemetsrud is the largest single measure in Oslo's Climate and Energy Strategy. The implementation of this measure had been estimated to reduce GHG emissions by 165 000 tonnes CO_2e by 2020. In spring 2017, the Klemetsrud plant was one of three industrial enterprises allocated funding by Gassnova for concept studies of full-scale carbon capture. Central government has warned that owing to the need to identify solutions for the entire CCS value chain, completion of a full-scale plant is impossible before 2022. According to current plans, the Norwegian parliament will be asked to vote on the necessary investment in spring 2019. If the plans gain parliamentary approval in spring 2019, the earliest completion date for a full-scale CCS plant at Klemetsrud will be 2022. The Climate Agency recommends that the City of Oslo should resolve to complete the Klemetsrud CCS facility by 2022, subject to a positive decision on investment by central government.

4.3.2 New Fornebu metro line

The new Fornebu metro line will increase public transport capacity in the West Corridor, and increase the public transport mode share of transport performance. Accordingly this is a crucial measure for cutting emissions from the transport sector post-2020.

4.3.3 New central metro tunnel

A new central metro tunnel is a crucial measure for cutting emissions from transport sector post-2020. It will hugely increase capacity on the city's metro network, and will make it possible to increase the public transport mode share of transport performance.

4.3.4 Tram programme

The tram programme is an investment programme involving the purchase of 87 new trams, including the upgrade of associated infrastructure, tram tracks and tram depots. The tram programme is headed by Sporveien, in collaboration with the Agency for Urban Development, Oslo Vognselskap, Ruter and the Agency for Water and Wastewater Services. Test-driving of the new trams is planned

to commence in 2020, with all new trams entering operation by the end of 2024.

4.3.5 New signalling and interlocking plant on the Oslo metro
Work is currently being carried out to install new signalling and interlocking plant on the Oslo metro. This is a large-scale upgrade programme and will contribute to smoother traffic flow, faster train speeds, and safer operations. For example, calculations show that the upgraded system could increase capacity through the central tunnel from 36 to 40 trains per hour. The upgrade work commenced in 2015 and is scheduled for completion in 2025.

4.3.6 Several new projects for public transport infrastructure
In addition to the measures described above, several other major public transport infrastructure projects are under development, including a new railway tunnel under Oslo, [??and a Romerike/ Groruddalen rail interchange]. These projects will increase capacity and enable more efficient public-transport with improved coverage, making it easier for Oslo's inhabitants to travel by public transport.

4.4 Measures relating to information, mobilization and involvement
As part of the preparations for meeting the targets for 2030, the Climate Budget contains measures for planning, communications and involvement. These measures are considered essential if the climate targets for 2030 are to be met, and are presented in Table 6.

Table 6: Measures relating to information, mobilization and involvement

MEASURES	Responsible entity for implementation
Market Enova's subsidy schemes in Oslo	KLI
Business for Climate	KLI
Communications about climate solutions to encourage behavioural change	KLI
Bykuben – Centre for Urban Ecology	PBE
Efforts to boost demand for biogas	EGE

4.4.1 Market Enova's subsidy schemes in Oslo

In 2016, only five percent of the recipients of subsidy payments from Enova for various climate-friendly energy and mobility measures were located in Oslo, although approximately 16 percent of Norway's population was living in Oslo. Accordingly Oslo receives only a small share of the subsidy schemes for which Enova is responsible. More targeted marketing of the subsidy schemes has the potential to sharply increase aggregate payments to Oslo.
Enova's subsidy schemes are crucial to Oslo's efforts to phase out oil-fired heating in private-sector housing, to encourage smarter energy consumption, and to promote transition to renewable energy. Enova's subsidy schemes can also play an important role in reducing emissions from the transport sector.

4.4.2 Businesses for the Climate

Cooperation between the City of Oslo and business on meeting climate targets is a key strategy for mobilizing businesses to commit to climate-friendly initiatives. In 2017, nine further businesses have signed up to the "Businesses for the Climate" initiative, which now includes 85 businesses and is an important channel for the exchange of ideas and collaboration between Oslo's business sector and the city authorities. The Climate Agency recommends boosting these efforts in 2018.

4.4.3 Communications about climate solutions to encourage behavioural change

The City of Oslo's Climate and Energy Strategy emphasizes the need to encourage behavioural changes among the population at large in order to cut GHG emissions. Work to disseminate information about practical climate-friendly measures and about municipal work in this area has been boosted in 2017, and will be boosted further in 2018. The online communications platform KlimaOslo.no is a central element in these efforts to encourage behavioural change.

4.4.4 Bykuben – Centre for Urban Ecology

Bykuben - the Oslo Centre for Urban Ecology - will help the city's population feel a sense of ownership over, and see the potential in, the green shift towards becoming a low-emissions society. The centre will be established in city-centre premises at street level and will be open to everyone who wants to learn more about, and participate actively in, ecological work in the urban environment.

4.4.5 Efforts to boost demand for biogas

Currently demand for biogas outstrips what the City of Oslo's biogas plants can supply. In the long-term, however, it is important to position biogas as a climate-friendly alternative in the competition with other biofuels. Accordingly the Climate Agency recommends that efforts should be made to boost demand for biogas, and that discounts should apply to biogas-fuelled vehicles passing through the toll ring.

4.5 MEASURES TO BOOST ENERGY EFFICIENCY

Reducing electricity consumption in the stationary sector is of great importance. This is because all energy consumption has environmental consequences. However, this will not contribute to a reduction in Oslo's direct GHG emissions, as Oslo's electricity supply is assumed to be emission-free. Nevertheless, these measures may bring about reductions in GHG emissions in other areas. For this reason these measures are listed here, although their emissions-reducing effects have not been evaluated.

The Climate and Energy Strategy for Oslo provides specifically for improving energy efficiency. Initiative 10 states that "The City of Oslo shall work to reduce energy consumption in buildings by 1.5 TWh by 2020. This reduction will be achieved through national and local instruments."

Current measures to improve energy efficiency include
- Implementing measures to improve energy efficiency and reduce GHG emissions in new and existing municipal buildings and construction sites;
- The pilot project at Furuset to implement an energy flexible neighbourhood is ready for construction; and
- Continue the "Futurebuilt" programme with the addition of new model projects (including Trygve Lies Plass).

5 EMISSIONS PROJECTIONS

Oslo's projected emissions for the period 2016 to 2020 have been calculated given the mitigation measures in the climate budget. These projections are based on the effects of the various measures over time, and provide a picture of how GHG emissions may develop over the next few years. The projections gives us an indication of what we need to do to achieve our climate goals.

In addition to uncertainty about the emission reducing effects of the measures, there is also uncertainty about when the effects will occur. In general, we expect the effects of the measures to increase as we approach 2020, since several measures are now at the planning and early implementation stages. Accordingly we do not expect to see major reductions in emissions before 2018, 2019 and 2020.

5.1 RESULTS

Table 7 shows the emissions projections by category within the stationary and mobile sectors. These projections assume that the quantified measures described in sub-chapter 4.1 reduce emissions by approximately 360 000 tonnes CO_2e, and that the implementation of measures described in sub-chapter 4.2 reduce emissions by approximately 100 000 tonnes CO_2e over the period 2015 to 2020. These estimates have been made in light of the goals set in Proposition 1, Climate Budget 2018, according to which total emissions in 2020 must not exceed 765 000 tonnes CO_2e.

Table 7: Emissions projections towards 2020 (tonnes CO_2e)

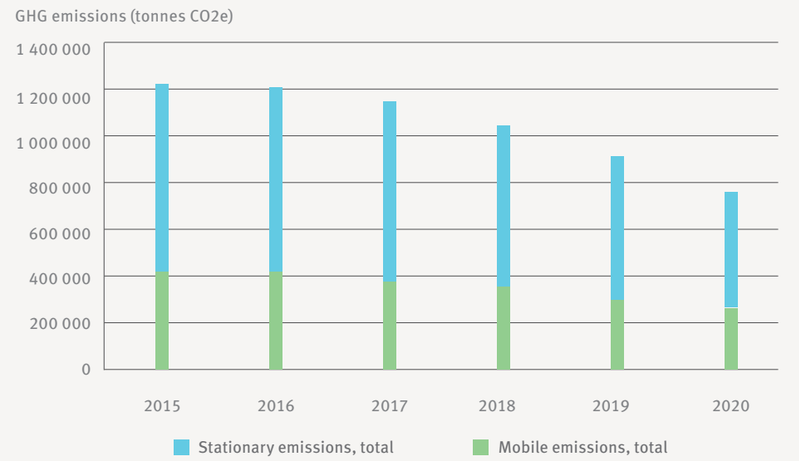
SECTOR	Emissions source	2015	2016	2017	2018	2019	2020	Total reduction	% reduction
STATIONARY	Heating in other industries and households	134 700	134 700	122 600	98 300	49 900	13 500	121 200	90 %
	District heating etc	26 800	24 000	21 200	21 200	21 200	21 200	5 600	21 %
	Waste incineration	226 000	225 600	225 100	224 300	222 600	221 700	4 300	2 %
	Landfill gas	15 100	14 400	13 000	11 700	10 300	8 200	6 900	46 %
	Wastewater emissions	22 500	22 500	2 000	2 000	2 000	2 000	20 500	91 %
	Stationary emissions. total	**425 100**	**421 200**	**383 900**	**357 500**	**306 000**	**266 600**	**158 500**	**37 %**
MOBILE	Public transport – buses	31 000	28 100	25 100	19 200	7 400	1 500	29 500	95 %
	Taxis	20 100	19 400	18 100	16 100	10 700	6 700	13 400	67 %
	Passenger cars	346 300	343 700	333 100	300 200	267 300	214 700	131 600	38 %
	LCVs	94 500	93 800	90 800	81 400	72 000	57 100	37 400	40 %
	HGVs	142 200	142 200	137 000	124 100	111 100	90 400	51 800	36 %
	Construction machinery	166 700	165 900	160 900	155 200	143 700	128 400	38 300	23 %
	Mobile emissions. total	**800 800**	**793 100**	**765 000**	**696 200**	**612 200**	**498 800**	**302 000**	**38 %**
	Total emissions	**1 225 900**	**1 214 300**	**1 148 900**	**1 053 700**	**918 200**	**765 400**		
	Emissions reduction compared to 2015 levels	0	11 600	77 000	172 200	307 700	460 500		
	% emissions reduction compared to 1990 levels	-	-	4.3 %	12.2 %	23.5 %	36.2 %		

Emissions trends at an aggregated level are shown in Figure 5. Overall, we expect the effects of the measures to increase as we approach 2020, meaning the first considerable results will be seen in 2018 and 2019.

It is relevant to compare the projected emissions with the baseline figures (Chapter 3), which assume that no new measures are implemented.

The emissions statistics show that we need to reduce emissions by approximately 460 000 tonnes CO_2e compared to 2015 levels in order to achieve the 2020 target. The baseline shows a reduction in emissions as a result of previously-adopted policies, such as the ban on heating oil to heat buildings and the increased biofuel blending requirement. These measures are also included in the Climate

Figure 5: Projected total emissions for the stationary and mobile sectors



Budget, together with instruments that will boost the effect of the heating-oil ban and the biofuel blending requirement.

The baseline and the measures in the Climate Budget overlap to some extent in the effects that they assess, but the assessments have been derived in completely different ways. The baseline has been derived from a high-level perspective and is based on general emissions reductions in the included sectors. In the Climate Budget, however, emissions reductions are assessed using a far more detailed and sector-specific approach. Accordingly, one should not simply deduct the baseline figures from those in the Climate Budget in order to isolate the budget's effects.

We do not present a projection of emissions post-2020 or forward towards 2030. This is because measures that will contribute to achieving the 2030 target will be developed in connection with the preparation of a new Climate Strategy for 2020-2030. Overall, the baseline figures indicate very small reductions in emissions post-2020, of approximatley one percent per annum. Accordingly there will be an even more pressing need than there is today for additional measures in the period 2020-2030.

5.2 METHODOLOGY

The baseline for the projection is level of GHG emissions in 2015, and applies, in general, the effects calculated for each measure as described in Chapter 4, distributed over time, to estimate Oslo's GHG emissions over the coming years.

However, the projections for passenger cars, LCVs, HGVs and construction machinery are not derived directly from the calculations of effects for each measure. Partly this is because some major measures in the mobile sector will affect several sources of emissions simultaneously, e.g. the new toll-ring charging system envisaged in Oslo Package 3 and the increased biofuel blending requirement. This result is also explained by the fact that the Climate Budget contains a number of measures concerning the mobile sector whose potential effects have not been measured, but which are nonetheless expected to have a major impact. Three examples of such measures are the requirement for zero-emission (or fossil-free) solutions in municipal transport procurement; various parking measures; and a more stringent approach to low emission zones. Particularly when making projections for these four categories, we have assumed the operation of some general factors. These factors, and related comments, are summarized in the following paragraphs.

As mentioned previously in this report, advanced biofuels are double-counted in the fuel blending regulations, which means that the actual volume of blended biofuels is expected to be 16 percent in 2020, not 20 percent. Accordingly the potential emission reduction effect of this measure has been calculated on the basis that the actual amount of blended biofuel is 16 percent.

For passenger cars, we assume a 20-percent reduction in traffic in accordance with the target for 2020, an increase in blended biofuel from 5.5 percent to 16 percent, and an increase in the share of electric cars in total car park from four percent to 14 percent. The overall reduction in traffic resulting from all measures is uncertain, but the new system of toll-ring charges, the greater commitment to public transport and restrictions on parking is expected to contribute to a significant rejective effect. The percentage of biofuels accords with plans to increase the fuel blending requirement. While there is some uncertaintly about the increase in the percentage of electric passenger cars, the emission calculations made with regard to the new toll-charging system in Oslo Package 3 assume a 26 percent share of "light vehicles" (passenger cars and LCVs combined) passing through the toll ring. By way of comparison, currently approximately six percent of passenger cars in Oslo are electric, and about ten percent of vehicles passing through the toll ring are "light vehicles". The ratio between electric cars passing through the toll ring and the total number of electric cars in Oslo forecast for 2020 is accordingly approximately the same as today.

For LCVs, we assume a 20-percent reduction in traffic, an increase in blended biofuel from 5.5 percent to 16 percent, and an increase in the percentage of electric vehicles from two percent to 15 percent. These are the same final figures as for passenger cars, although LCVs start with a smaller share of electric vehicles. We expect that a reduction in traffic will be more difficult to achieve, but that more expensive transport in and out of the city, combined with possible freight consolidation centres and better parking solutions for LCVs, will contribute to reducing traffic. Although the percentage of LCVs that are electric is currently lower than the percentage of passenger cars that are electric, we anticipate that the availability of new improved models, combined with more stringent procurement require-

ments and higher toll-ring charges may incentivize faster adoption of electric LCVs than of electric passenger cars.

For HGVs, we assume a 20-percent reduction in traffic, an increase in blended biofuel from 5.5 percent to 16 percent, and an increase in the percentage of electric/hydrogen vehicles from zero percent to five percent. As with LCVs, we expect that it will be more difficult to reduce HGV traffic than to reduce passenger-car traffic. The share of biofuel is greater than for passenger cars or LCVs. It is likely that biogas will play a more important role for HGVs and biogas is not included in the fuel-blending requirement. We estimate this biogas will account for four percentage points of the 20-percent biofuel share, while the balance will come from the fuel-blending requirement. There are some electric and hydrogen projects, but it is only when such vehicles are mass produced that we can expect changes in the market. This will happen in the period just before 2020.

For construction machinery we assume a 20-percent biofuel share and three-percent zero-emission. Data for the current pool of construction machinery is not easy to come by, but we assume that these shares are currently close to zero. In recent years, however, interest in fossil-free and zero-emission construction operations has rocketed, and we see that more and more parties are imposing requirements in their tender documents.

The emission projection should be seen as a rough estimate, but it does indicate where we need to be over the next few years in order to achieve the 2020 target. It is also relevant to compare this projection with updated emission figures from Statistics Norway. These are published only every other year, however, so that the next set of figures will be published in 2019. Accordingly the Climate Agency has developed selected climate indicators across the stationary and mobile sectors, and will issue quarterly reports for these indicators. The projection will thus indicate how Oslo is positioned for achieving its climate targets in relation to the Climate Budget.

6 THE CLIMATE AGENCY'S PROBABILITY ASSESSMENT FOR TARGET ACHIEVEMENT

If the target of reducing emissions by 36 percent by 2020 is to be achieved, GHG emissions must be reduced by approximately 460 000 tonnes CO_2e compared to 2015 levels. The Climate Agency's assessment of the effects of the various measures in sub-chapter 4.1 shows that together these measures can reduce emissions by approximately 360 000 tonnes CO_2e.

In addition, Oslo City Council has implemented further measures that will contribute to reducing emissions. It has not been possible to assess the effects of these measures individually (sub-chapter 4.2). Although the effects of the individual measures are difficult to quantify, the Climate Agency considers them to constitute important climate measures. The Climate Budget contains four packages of measures that require further study to increase the likelihood of achieving Oslo's 2020 and 2030 targets. Accordingly it is too early to establish the effect of these measures, and this is a very rough estimate that needs to be refined through further studies. Overall, it is likely that these measures will reduce emissions by between 25 000 and 140 000 tonnes CO_2e in 2020. The magnitude of the emission reduction will depend on the design of individual measures, the timing of implementation, and the covariation of partially overlapping measures.

The Climate Agency would emphasize the importance of the study of measures and instruments to promote the gradual move towards a fossil-free city centre within Ring 3 by 2024. If designed correctly, this could play an important and complementary role to the changes to the toll-ring system contained in the Oslo Package 3, and contribute to both reducing traffic and the shift towards low- and zero-emission vehicles. The implementation of this measure is crucial to the Climate Agency's assessment of the probability of Oslo's emissions reduction targets being achieved in 2020. Several of the relevant measures in the four packages to be studied will also potentially contribute to further emission reductions post-2020.

The achievement of Oslo's targets requires that all the measures in the Climate Budget must be implemented satisfactorily and without delays. Subject to these conditions, the Climate Agency considers that achievement of the 2020 target is probable.

The Climate Agency wishes to underline the importance of continually assessing possible ways to make the measures more effective, and of developing new measures and instruments designed to reduce GHG emissions in the period to 2030. This work will be boosted in 2018 as a result of the work on a new Climate Strategy for 2020-2030, and as a result of the increased capacity built up by the Climate Agency during 2017.

The Climate budget is an integrated part of the ordinary budget for the Municipality of Oslo, and was approved by the City Council December 13th 2017. The Climate budget is based on the Technical Report from the Climate Agency in Oslo Municipality.

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