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**“EUROPEAN GREEN CAPITAL AWARD 2019”
- A CASE STUDY OF OSLO AND ITS PATH TOWARDS A
SUSTAINABLE CITY**

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Anno Accademico 2019-2020

Table of Contents

Abstract	1
Introduction.....	1
1. Green cities: how and why they are nominated	3
2. The Oslo case	5
2.1 Study area	5
2.2 Ambitions and goals	5
2.3 Oslo technical assessment	6
<i>Climate change: Mitigation & Adaptation</i>	6
<i>Local transports</i>	9
<i>Green urban areas incorporating sustainable land use</i>	12
<i>Nature and biodiversity</i>	15
<i>Ambient air quality</i>	16
<i>Quality of the acoustic environment</i>	22
<i>Waste production and management</i>	27
<i>Water management</i>	30
<i>Wastewater Management</i>	32
<i>Eco innovation and sustainable employment</i>	36
<i>Energy performance</i>	38
<i>Integrated environmental management</i>	43
3. Climate Budget: a key governance tool to achieve the objectives	48
4. Tax cut for electric cars and diesel taxes: the Green Taxation Shift.....	51
5. Reorganisation of urban spaces	52
5.1 Car free city-centre.....	53
5.2 Fjord city (Fjordbyen)	55
5.3 Bjørvika	56
5.4 Bjørvika: Losæter	58
5.5 Vulkan	59
5.6 Preserving the ecosystem: the bee highway.....	59
6. Oslo as a Smart City	60
Conclusions: achievements of the policies adopted	63

Abstract

In this study I decided to debate the topic of green cities with particular regard to Oslo, the Norwegian capital, nominated European Green Capital for 2019 by the European Commission. For data collection I executed a literature review of dissertations and qualitative and quantitative secondary data search through the websites of the Norwegian Statistical Office (Statistikk Sentralbyrå), the Oslo Council (Oslo Kommune), the Norwegian Government (Regjering.no) and the Norwegian Environment Agency (Miljødirektoratet) in order to analyse the policies adopted by the city of Oslo and verify their effectiveness. I also have performed research of articles related to environmental issues through the main Norwegian news websites. My final aim is to analyse the recent transformations of the Norwegian capital from an environmental, structural, urban and social point of view, focusing the attention on the objectives that the city intends to achieve within the next decades and objectively evaluating through statistical data which goals the city has already achieved and which ones it is actually achieving.

Introduction

Nowadays, more than a half of the world's population lives in cities, and according to the United Nations, by 2050 approximately two thirds will be living in an urban area. In Europe, two thirds of the population lives in towns and cities, and according to statistics, it is the third most urbanised continent in the world, after Northern America and Latin America and the Caribbean (Statista, 2019). Urban areas pose very important challenges to society regarding environmental issues. One of the consequences of rapid urbanisation is a diminishing area of green spaces such as parks, forests and gardens, as well as blue spaces like lakes, rivers and wetlands (NUISSL et al 2009). The European Commission has long recognised the important role that local authorities play in improving the environment, and their high level of commitment to progress.

European Green Capital (EGCA) is a program conceived by the European Union exactly to promote and reward cities' efforts to innovate and advance sustainable development. The award aims to incentivise cities to inspire each other and share best practices. The efforts of the cities participating will contribute to create more enjoyable spaces to live and work in.

The present study focuses on the city of Oslo, the capital and most populous city of Norway. The reason why I decided to discuss the city of Oslo is due to my interest in Nordic countries' culture and lifestyle. After spending a few days in the Norwegian capital some years ago, I was impressed by the mix of nature and architecture of the city, and a desire for knowledge of the environmental

issues of Oslo was unleashed in me. Furthermore, as a language enthusiast, I found this as an opportunity to upgrade my Norwegian language skills and broadening possibilities for working abroad.

The main aim of the present study is to analyse the measures and policies concerning environmental issues adopted by the City of Oslo and to verify their effectiveness. In order to do this, first of all, I have analysed the application submitted by the city of Oslo to apply for the EGCA. Since the application was submitted in 2015 the information is not up-to-date or even incomplete or missing. Actually, in the meantime some strategies have been carried out after the year of the submission of the city for the EGCA, so the application does not show the actual results of some of the policies and measures adopted.

Thus, I have also decided to execute a literature review of dissertations, articles and scientific materials and to collect qualitative and quantitative data through the official governmental and municipal websites.

Oslo represents both a county and a municipality and is the economic and political centre of Norway. Population growth creates a great need for new and increased municipal investment and services for the population. With population growth, the pressure on the environment increases, and so does pollution. Tackling climate change is a high priority goal for Oslo. Thus, the Norwegian capital has launched a CO₂ reduction process divided into several periods. More precisely, the city aspires to cut emissions by 50% by 2022 (compared to 1990), by 95% by 2030 and to become a zero-emission city by 2050. In order to reach these ambitious goals, it is important to change the way energy is produced and consumed, by implementing measures for the various municipal sectors. As regards the transport sector, the most important challenge is to ensure the transition from individual car transport to public transport, cycling and walking. (Rydningen et al. 2017, p.3)

The city of Oslo has consequently introduced several measures, for example promoting zero-emission transport and thus becoming the world capital of electric vehicles, with 30% of all vehicles sold electric.

Compared to other Norwegian cities, there are relatively few cars in Oslo. A 2014 report shows that 37% of citizens travel by car in Oslo, 26% take shared transport, 5% by bike and 32% on foot (Tønnesen et al.). The centre of Oslo is served by buses, trams, rapid transit (T-bane), and railways. The city is also working to develop new tram lines and new subway stations and to increase the number of cyclists. Other essential measures include the implementation of a car-free centre, the

improvement of cycling infrastructures and public transport, and incentives for the use of electric vehicles. All these measures will not only help the city to achieve its climate goals but will also significantly reduce visual and noise pollution, creating more vibrant and pleasant places to live in. Innovation and the promotion of new jobs in the circular economy are of great importance for Oslo and the city is at the forefront of the circular use of available resources. Biogas produced from organic waste, for example, is used to power city buses and refuse collection vehicles. To cope with the impact that commercial activities have on the climate, Oslo has established the "Business for Climate Network" with the aim of promoting cooperation between the business community, citizens and NGOs.

In order to achieve the goals, cooperation will be essential not only between local stakeholders but also at regional, national and international level. In 2016, a key governance tool for reaching the target, namely the Climate Budget was introduced. It is an initiative that includes 42 distinct measures in three sectors: energy and built environment, transport and resources. The Climate Budget shows how the targets will be achieved, what mitigation measures have been put in place and who is responsible for completing them. To comprehensively present research results, the paper is organized as follows: the first chapter introduces the European Green Capital Award and the logic of assigning the prize to cities.

Norway is a major producer of renewable energy and over 90% of electricity production comes from hydroelectric plants. According to appraisals made by the Norwegian statistics bureau (Statistics Norway, 2020), the part of hydroelectricity in total electricity production in July 2020 reached 92.9%. Compared to the same month of the previous year, the use of wind energy increased (+ 15,9%).

1. Green cities: how and why they are nominated

The European Green Capital Award is an initiative taken by 15 European cities with the association of Estonian cities and launched in 2008 by the European Commission in order to reward cities' commitments to a better quality of their urban environment. The competition is open to all cities of a EU Member or candidate State and Schengen country. Cities willing to participate must have a population of more than 10,000 inhabitants. The European Green Capital is chosen every year by an expert panel of the European Commission, which rewards a city that has achieved high environmental standards over time, committed to achieving ambitious goals for further environmental improvement and sustainable development. Every judge of the panel has different

skills and knowledge in the various areas of assessment. The EGCA can serve as a model to inspire other European cities to follow the example of the awarded cities and commit to ambitious goals for further environmental improvement (European Commission). Awarding the title would give an additional stimulus to make the urban environment healthier and safer, create new opportunities for citizens and strengthen environmental cooperation at all levels.

Being a European Green Capital has many advantages, including a greater focus on environmental projects, increased international media coverage of the city, support to local pride, increased foreign investment, development of the local economy and creation of employment. The winner of the award also receives a tribute as a boost for its environmental programme. Winner and finalist cities also obtain access to the European Green Capital Network, within which they can share knowledge and environmental best-practice and discuss how to overcome the challenges they face.

To select the winner of the EGCA, an Expert Panel conducts technical assessment of the applications received by the city applying for the award.

12 indicators are taken into consideration in the technical assessment when choosing the European environmental capital:

1. Climate change: mitigation and adaptation
2. Local transport
3. Green urban areas incorporating sustainable land use
4. Nature and biodiversity
5. Ambient air quality
6. Quality of the acoustic environment
7. Waste production and management
8. Water management
9. Wastewater management
10. Eco innovation and sustainable employment
11. Energy performance
12. Integrated environmental management

2. The Oslo case

2.1 Study area

Oslo is the capital and most populous city of Norway and covers an area of 454.12 Km². The city is located in the northern innermost portion of the Oslo Fjord in Eastern Norway (59°54'50"N 10°45'8"E) and is surrounded by the Marka Forest, a nationally protected area which makes up 307 km² of the total area of the city, and the Oslo Fjord, both connected by a number of waterways (European Commission). The city of Oslo is considered both a county and a municipality. His administrative unit comprises the fjord section between the mouth of the Lysaker River in the west and the mouth of the Gjersjø River in the southeast and stretches northwards all the way to the border with the Inland (formerly Oppland) and Viken (formerly Buskeruds) far in Nordmarka (Oslo City Council)¹. Two rivers flow across Oslo, Akerselva and Alna, of which the former divides the city into two parts, East and West Oslo. Protected forests, hills and lakes cover two-thirds of the city. Oslo's population is relatively small compared to other European countries, 694,086 inhabitants at the beginning of the second quarter 2020 (Statistics Norway, 2020)². However, the city has one of the highest growth rates in Europe, +1.82% during the last year, and the population is expected to increase approximately by 12% by 2040 (compared to 2020). Growing population is one of the major challenges that the Norwegian capital needs to face, as it poses increasing pressure both on the urban and natural environment. To accommodate increasing population, Oslo has adopted residential densification policies aiming to limit urban sprawl and excessive soil consumption, and to protect the surrounding forests. Oslo's overall population density is 1,628/km² and is actually considerably higher than those in the country's other urban areas. The area covered by buildings accounts for 23.72 km².

2.2 Ambitions and goals

The city of Oslo is considered a green city not only thanks to his large parks and forest areas. Many actors, including urban planners, politicians and businesses have strongly worked together in order to reduce the carbon footprint and ensure a sustainable future for all the citizens.³ Their effort and cooperation drew the European commission's attention, which consequently decided to appoint Oslo Green Capital for 2019. The Norwegian capital was chosen between 13 other candidate European cities. Oslo is today among the fastest growing European capitals and major construction

¹ See more info here: www.countryaah.com/norway-faqs/

² See more info here: www.ssb.no/kommunefakta/oslo

³ See more info here: www.visitoslo.com/en/articles/oslo-european-green-capital-2019/

projects have left their mark on the city in recent decades. Sustainability has been the basis for many of them. The city of Oslo aspires to become a zero-carbon city by 2050. The path towards a completely zero-emission city is still long but during the last decades Oslo has shown to the public that with determination and cooperation between all the stakeholders everything is possible.

2.3 Oslo technical assessment

In this chapter I will focus more deeply on the twelve indicators taken in consideration by the European Commission to assess the efforts of the EGCA participating cities. As anticipated, Oslo has always had a deep attention to sustainability issues. The city is aware of its natural heritage and has always done its best to preserve it. But this is not the only reason why Oslo has been awarded. Oslo adopted one of the most ambitious climate strategies in line with the Paris Agreement and is the first city in the world with its own climate budget. In addition, the Norwegian capital scored the highest in eight areas of 12. The jury has highlighted the entirety of Oslo's urban development work, ie. that climate and the environment run a common thread through all policy areas in the city - from public health to integration⁴.

Climate change: Mitigation & Adaptation

"Whereas the need for mitigation has become clear, the need for adaptation is less prominent in public discourse. The urgency of adaptation measures increases dramatically, if we fail in climate change mitigation." (Skålin et al., 2019). The IPCC (Intergovernmental Panel on Climate Change) defines:

- Mitigation as "the human intervention to reduce the sources or enhance the sinks of greenhouse gases".

- Adaptation as "the process of adjustment to actual or expected climate and its effects." Mitigation, therefore, attends to the causes of climate change, while adaptation addresses its impacts.

In order to limit global warming, urgent measures aiming to cut greenhouse gases emissions are required in all sectors. Oslo must be prepared to deal with growing extreme events, such as more powerful rainfalls, higher temperatures and stronger wind. The city has consequently elaborated the Climate Change Adaptation Strategy 2014-2030 so as to reduce vulnerability and become more

⁴ See more info here: www.miljohovedstaden.no/om-miljohovedstaden

climate-resilient. This strategy envisages a dual approach to climate change through both mitigation and adaptation. Cross-sectoral cooperation will be crucial for both approaches. Therewith, data collection on climate change and greenhouse gases emissions and knowledge building will be essential so as to make possible the implementation of suitable measures (Climate Change Adaptation Strategy for the City of Oslo).

Six action points will be prioritised:

1. Storm-water management: through the “Stormwater Management Strategy for Oslo” the city has established a course of action in order to better manage stormwater by reducing the risk of flooding. The strategy was adopted by the City Council in 2014 and describes the measures to be executed for the following five years. This will provide added value in urban development and contribute to the transportation of clean stormwater to watercourses.
2. Climate data: Over the years, Oslo has collected data regarding the emissions of the city. The time series presented date back to 1990, starting year for the comparison of the emissions. This demonstrates that the city disposes of a solid monitoring system that is a key for policy decision making. A series of measures aiming to reduce greenhouse emissions have been implemented in a wide range of sectors. These measures focus on developing the sectors which contribute the most to the energy profile and promote the use of local renewable electricity in different sectors (RPS Limited Group, 2017).
3. Awareness raising: In order to build a more climate-resilient society it is necessary to spread knowledge on the effects of climate change, for instance, how it affects buildings, which invasive species or new diseases could arrive in the country.
4. Cross-sectoral cooperation: it is essential for both mitigation and adaptation approaches. “To be effective, climate change planning requires a comprehensive and integrated cross-sectoral approach, with actors working across administrative boundaries” (Tuts et al., 2015, c.3 p.10).
5. Underground mapping: due to the rapid growth of the city the underground space is expected to develop further. Underground space is already largely used for transportation, storage, extraction of heat and for foundations of buildings and infrastructure (Eriksson et al., 2016).
6. International cooperation: cooperation with other countries is a key factor when working toward a sustainable and resilient city. The city of Oslo hosts events and meetings, supports various initiatives, participates in international organisations and networks, and is an

important partner in many EU-projects (Oslo City Council, n.d)⁵. Among the most important networks and organisations of which Oslo is member there are the C40 Cities Climate Leadership group, the Carbon Neutral Cities Alliance, the ICLEI Local Government for Sustainability and Eurocities.

Hence, a cross-sectoral group in Oslo has listed six priority areas that the city must face in relation with the future climate:

1. Water: The combination of more extreme precipitation events with an increasing proportion of impermeable surfaces between buildings reduces natural drainage and makes the city more susceptible to flooding. Preventative measures adopted by the city to reduce flooding include the reopening of waterways, the creation of new parks and urban green spaces, construction of fountains and the installation of green roofs. The city also made use of the blue-green factor (BGF) to ensure the safeguard of blue-green structures and elevating the status of such structures in the urban area through awareness raising. The BGF developed for Oslo focuses on urban flood control functions of green and blue structures.
2. Land use: growing population is causing increasing pressure on city spaces impacting on nature. A densification project has been carried out in order to limit urban sprawl and protect the surrounding forests. The city has strengthened sustainable land use through the implementation of diverse projects carried out in cooperation with the citizens, such as the Losæter Urban Farm in the Bjørvika neighbourhood.
3. Emergency response: it is necessary to handle extreme weather related impacts through emergency response planning. The Agency for Emergency Response carries out a holistic Risk and Vulnerability Assessment (RVA), with focus on climate change in the long term.
4. Natural environment: loss of biodiversity and invasive species on a local level are among the main environmental concerns. One of the most important measures to prevent the loss of biodiversity is the reopening of the waterways. Waterways provide vital ecosystem services, wildlife habitat and enable the city to control the risk of flooding. New non-native invasive species are constantly being discovered in Norway. The spread of invasive alien species has negative impacts on the health of people, animals, plants, and the economy, therefore, the city of Oslo is trying to eradicate their presence.

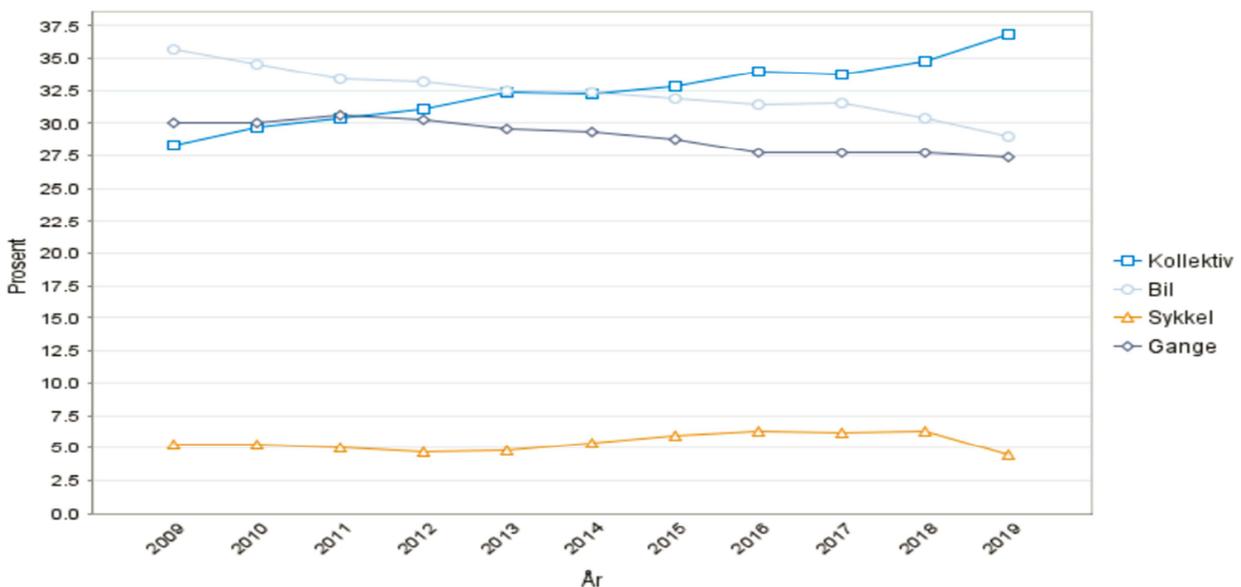
⁵ See more info here: www.oslo.kommune.no/politics-and-administration/politics/international-cooperation/

5. Infrastructure: with regard to infrastructure a main focus is put on erosion and weathering of roads, buildings, tracks and power grids.
6. Health: increased risk of poor quality of drinking water and increased volume of microorganisms.

Local transports

The public transport infrastructure in Oslo consists of metro, buses, trams, trains and boats. Compared to other norwegian cities, Oslo has a low share of cars. The city centre is served by bus, tram, rapid transit (T-bane) and railways. A survey from 2014 showed that 37% of the population travelled around the city by car, 26% by public transport, 5% by bicycle and 32% on foot (Tønnesen et al, 2016). Unfortunately, some data are in contrast with those provided by the main statistics website (Statistikkbanken). The latter, actually, shows that only 32% of the residents moved by car, 32% by public transport, 5% by bicycle and 29% on foot. Again according to Oslo's statistics website, in 2019, 29% of Oslo's residents' daily journeys took place by car, 37% by public transport, 6% by bicycles and more than 27% on foot.

Tab 1. Distribution of means of transport daily travel in Oslo (2009-2019), Oslo City Council, Statistics Bank, 2020



It is however noticeable by the graph here above that, the share of people moving by car has decreased over the years. Likewise, the share of people going on foot has decreased. This could be explained by the improved infrastructure of the public transport and more frequent routes.

However, private cars and freight transports are the main cause of CO₂ emissions in the city of Oslo. Therefore, the Municipality has the desire to increase the share of people travelling by bicycle as well. To achieve this, the City is implementing new cycle lanes and infrastructures for bikers. According to the Municipality's bicycle strategy 2015-2025, Oslo's bicycle share of total journeys will be increased to 25% by 2025. This is an ambitious measure but not sufficient in order to realise the transition. Actually, with regard to the increase in the share of cyclists the city does not seem to be on the good track, as evidenced by the data. Despite this, Oslo has made progress in leaps and bounds in terms of local transports through the implementation of extensive measures aiming to reduce GHG emissions and create a more vibrant and less congested urban environment. Over the past years, Oslo has also implemented a series of measures to create a more energy efficient and environmentally friendly public transport (Application Form for the European Green Capital Award 2019 - Indicator 2, p.6). Zero-emissions vehicles play a key role in the city's strategy to reduce carbon emissions.

Among the range of measures implemented by the city to reduce car traffic and the derived pollution there are:

- extension and improvement of the quality of infrastructures for urban transport: the city has been extending the public transport network and upgrading the infrastructure in order to encourage people to travel by public transport. Moreover, the city is emphasising compact urban development in central areas and around public transportation hubs to give people the opportunity to access to public transport within a few minutes.
- introduction of Intermodal Transport Control System (ITCS), Real Time Passenger Information (RTPI) and digital ticketing: for years, Oslo's passengers have been provided with reliable RTPI. However, a modern telematics system should, in the future, not only provide RTPI, but also optimise the operational performance and then enable the Oslo transport authorities to make their services more faster and efficient. In 2016, the largest transport company in Norway, Ruter, installed sensors on more than 400 Oslo's buses to count passenger numbers. On-board sensors also collect other types of information such as traffic speed, light, noise and pollution; sending data to the control centre and making them publicly available. Before upgrading, Oslo city buses used seven private-owned, on-board systems operating separately, such as ticketing , passenger information, location tracking and reporting and technical maintenance. In 2018, Ruter announced its will to implement an

open and standards-based platform. “The immediate benefit for the company was easier data management, improved access and shorter implementation times for new functions” (Reimer, 2020). This constitutes an opportunity to create new services integrated in the platform. Customers, vendors and other users contribute by sharing their data.

- extension of the cycle route: presently, there are 1,770 cycle routes in the city.
- introduction of congestion based pricing on the toll ring: The congestion based price on the toll ring is an important financing tool for public transport investments. Currently, 60% of the toll income is being for investments and maintenance of public transport. Congestion in peak periods is still a great problem in Oslo. Congestion imposes two external costs: an environmental and a time cost. Therefore, the introduction of higher tolls during peak hours helps the city to reduce the queues of cars and so unnecessary pollution. Drivers do not only pay for the private cost that is too low, but also for the marginal cost that they impose on society. If traffic is flowing freely, the marginal queuing cost will be approximately zero, time loss will be reduced, efficiency will increase together with environmental quality (Aasnes, 2014, p.90).

Oslo has a combined congestion charge and low emission zone. The cost of the road toll is dependent on the Euro standard and fuel type, as well as time, distance, and time of the day. During rush hour fares are higher. Diesel car drivers pay more than everyone else. The Norwegian toll system is based on vehicle emissions. Electric vehicles are exempted from the congestion charge.⁶

- comprehensive public transport network. The bus, metro, tram and ferry networks are integrated and 90% of the city’s population lives within 300 metres of an hourly or more frequent public transport service. The Oslo public transport utilises a zone-based system in which the price for a trip varies depending on how many zones passengers pass through.⁷

Other measures have been taken at a national level. These measures include:

- incentives for the purchase of electric and zero emission vehicles: the Norwegian incentives for electric vehicles started to evolve in the early 1990’s as a way to support the rising Norwegian Electric Vehicle industry (Haugneland et al, 2017, p.2).

The Norwegian Government has decided to exempt zero-emission vehicles from paying

⁶ See more info here: urbanaccessregulations.eu/countries-mainmenu-147/norway-mainmenu-197/oslo-charging-scheme

⁷ See more info here: ruter.no/en/buying-tickets/zones/

VAT until the end of 2021. After 2021 the incentives will be revised and adjusted according to the market development. Electric cars buyers are exempted from 25% VAT on purchase and on leasing. Citizens are also encouraged to purchase electric vehicles through free parking and grants for EV charging stations. However, in 2018, a parking fee for EVs was introduced locally with an upper limit of a maximum 50% of the full price.

- discouraging the citizens to purchase diesel-driven vehicles through taxation and high fees: according to “the polluter pays principle” high emission cars are taxed more than low and zero emission cars. High taxation on polluting cars can finance incentives for zero-emission cars without any loss in revenues. As decided by the Norwegian Parliament, all new cars sold by 2025 should be zero (battery electric or hydrogen) emission.
- circumscription of a car-free city centre.

As far as it concerns the transport of goods, DB Schenker, a global logistics service provider, aims to achieve zero emissions across the city distribution in Norway by the end of 2020. The company has opened the Oslo City Hub, its first low-carbon city distribution centre in the Norwegian capital. The building is located in Filipstadkaia, in the centre of the city. The use of electric cars and e-bikes will ensure the reduction of CO2 emissions from distribution of goods by 80% within Ring 3, a beltway limited-access road circumnavigating the city. The Oslo City Hub project is the first project launched by the delivery company DB Schenker to attain this goal. The company is now using electric cargo bikes, that is to say bikes with two boxes on the rear transporting goods. These bikes are sufficiently little to travel in cycle lanes avoiding traffic, but sufficiently big to transport over 250kg of packages. Oslo City Hub is part of Electric City, the Oslo district’s focus on activities related to its status as European Green Capital 2019.

Green urban areas incorporating sustainable land use

The term “land use” describes built-up areas by socio-economic purpose, and covers for example areas used for dwellings, business, recreation or roads (Statistics Norway)⁸.

The compactness of the city with high residential density combined with the large distribution of green areas and the integration of several aspects, such as mobility, stormwater management and

⁸ See more info here: www.ssb.no/en/natur-og-miljo/statistikker/arealstat/aar/2019-05-27?fane=om#content

recreation denote Oslo's approach to green urban areas incorporating sustainable land use (EGCA Technical Assessment, 2017, p.44).

Oslo occupies an unusual land area for its relatively small population. The city is surrounded by forested hills known as Marka, with Nordmarka to the north and Østmarka to the east. In total, Marka amounts to approximately 1,700 km², and 307 km² of the area belongs to Oslo, making up two thirds of the city's total area (Oslo City Council, n.d). The remaining 147 km² of the city make up the built-up area; of these 90.5 km² are regulated for housing and construction, 24.4 km² for transport and technical infrastructure, 22.3 km² for green infrastructure not including the forests. (Oslo City Council, 2014).⁹ Since the city is mainly made up of forest, land use is specified for the urban area, the inner city (Indre By) and the overall city (Ytre By).

Oslo has a small population, compared to other European cities. Despite that, it's growth rate is one of the highest in Europe. Therefore, in order to accommodate the growing population, the municipality has started a process of regeneration of industrial areas and conversion of detached and semi-detached dwellings into high-density housing. The aim is to ensure the protection of the surrounding forest by creating a more compact city and at the same time allowing all the inhabitants to live within a 300 metres radius of a green area.

Marka is actually a nationally protected area and construction has been forbidden by law (Markaloven, §5. Forbud mot bygge- og anleggstiltak)¹⁰ since 2009, with some exceptions for primary industries. For instance, farming and forestry are permitted but with some restriction. The protection of the forest border against urbanisation has largely been enforced by Oslo's politicians with the purpose of facilitating outdoor activities, but first of all ensure the sustainable use of the area. The forest's boundaries function to limit urban sprawl. Furthermore, the law has given certain areas more strict protection as a nature reserve. Marka is a major recreational offer for the population of Oslo. Ten waterways flow from Marka into the fjord, transecting the city and providing vital ecosystem services, including recreational opportunities, wildlife habitat and avenues for flood control. With its fish-rich lakes, Marka offers opportunities for fishing and fish cultivation is practiced. There are many hiking trails in Marka, for trips during all the seasons, cross-country skiing.

⁹ See more info here: www.oslo.kommune.no/politics-and-administration/statistics/environment-status/area-and-open-areas/

¹⁰ Markaloven, § 5. Forbud mot bygge- og anleggstiltak (Prohibition of building and construction measures).

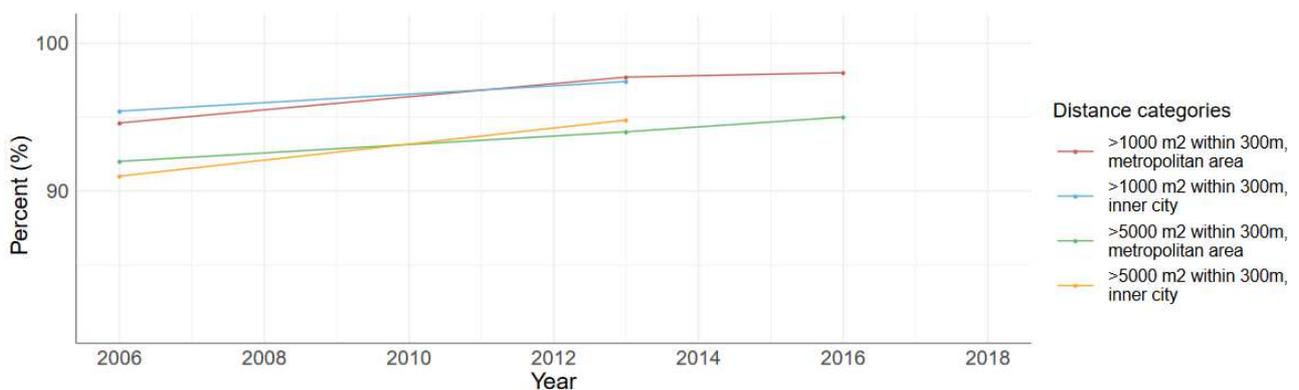
Oslo is one of the best illustrations of cities implementing sustainable land use. In the city there are several hundred green urban projects incorporating sustainable land use. Two very specific projects are remarkable:

1. The subsurface project: the main aim of this project was to improve the management of the infrastructure and groundwater, secure ground stability and clarify the needs for regulations.
2. The assessment of potential for green roofs: tools for solving urban environmental challenges such as storm-water management, habitats for biodiversity, improving air quality, increased access to recreation and visual upgrading of the city.

When it comes to urban planning, spreading green spaces can have many benefits and be the solution to environmental challenges of today’s cities. Research in urban development notes positive links between green areas and improvements in health. Modern urban life is more and more associated with rush, stress, limited physical activity and pollution. Therefore, urban green spaces, such as parks, playgrounds and residential greenery can improve mental and physical health, reduce mortality by providing stress alleviation, stimulate physical activity and social cohesion, and reduce exposure to air pollutants and noise (Egorov et al., 2016).

As already anticipated, political strategies for urban development in Oslo have focused on densification also to give all the inhabitants the possibility to live within 300m of a green urban area. According to land use data provided in 2016 by Oslo, the percentage of people living within 300m of green urban areas, of at least 1000m² in the metropolitan area, is more than 98%. As we can see in the graph below, the most significant growth of people living next to a green space has been in the period between 2006 and 2013.

Graph 1. Accessibility of green areas for inhabitants in Oslo, Agency for Planning and Building Services



Several parks in the city have been upgraded. Sports equipment has been improved and so the aesthetic of the areas. Parks adjacent to waterways play an important role by functioning as water retention basins during extreme weather events, such as powerful rainfalls.

Nature and biodiversity

Oslo is very aware of its natural heritage. The city has the highest species diversity of any municipality in Norway, with a large number of species found in-between buildings in the built zone (Nowell et al., n.d). The Municipality of Oslo conducts continuous and extensive biological surveying. Spatial data is important for decision-making and good planning of development. The blue-green urban structure is well-developed and the city has a consistent number of nationally and locally protected sites. The built-up area has a variety of green and blue surfaces, comprising ten waterways running from the Marka forest through the urban area and flowing into the fjord, a comprehensive network of parks, recreation areas and green corridors. Blue and green spaces make up 21% of the built environment of the city (Application form for the European Green Capital Award 2019 – Indicator 3, p.4).

Moreover, the city, situated at the end of the Oslo Fjord, is surrounded to the south by islands, each one with its own distinctive character, and to the north and the east by the Marka forest. The blue-green urban structure of the city provides habitats for many species, but also calm places where to take a break and practice outdoor activities. Outdoor activities are central to the life of many Norwegians. Actually, an important part of the country's cultural heritage is the Right to Roam (called in Norwegian *Allemannsretten*). The Right to Roam gives people the right to walk freely in protected areas and to engage in recreation activities. This right must be exercised with consideration and responsibility, so that animals and plants are not harmed or disturbed¹¹. Environmental protection is therefore given priority over financial gains. However, the growing population in Oslo is a threat for biologically valuable areas in the built zone, hence development of the urban area without impacting on nature and biodiversity is also a challenge for the city. The city's Urban Ecology Program 2011-2026 states that, among many other measures, Oslo will maintain and strengthen its blue-green structure and that urban development will be environmentally sustainable, with an environmentally sound built environment and urban spaces. The 2015 Municipal Master Plan (MMP) defines the conditions for land use, pointing out that urban development will happen through densification close to public transport nodes. The plan will focus

¹¹ See more info here: www.fylkesmannen.no/en/Oslo-and-Akershus/Climate-and-the-environment/Protected-areas/

on the protection of the blue-green structure within the built-up zone and contains the regulations to protect valuable habitat types.

Generally, measures to preserve biodiversity in Oslo have focused on reducing its main threats:

- Loss and degradation of important habitats: the degradation and fragmentation of natural habitats is the greatest threat to biodiversity in the whole country (Norwegian Environment Agency, 2016)¹². By establishing national parks and protected areas it is possible to safeguard threatened and vulnerable habitats. The City of Oslo has mapped on land, in freshwater and in the sea 1730 areas with valuable habitat types and 332 important wildlife areas. After mapping, some of the 332 wildlife areas received national protection status. Of the city's 35 national nature conservation areas, 22 have been established or expanded since 2006. With regards to areas without a national protection status, it has been decided by the City Council to protect them through zoning provisions. (Application Form for the European Green Capital Award 2019 - indicator 4, p.7).
- Overgrowing of valuable cultural landscapes due to change in agricultural practices.
- Spread of invasive non-native species: not only Oslo but in the same way the whole country are under the constant threat of unwanted alien species. These species have been introduced most commonly through import or travel. Oslo is monitoring and combating non-native plant species in collaboration with neighbouring counties, volunteers and other organisations (Oslo City Council, n.d)¹³.

One of the most essential measures of ecological restoration is the reopening of the city's waterways. Originally, there were 354 km of rivers and streams in the built-up zone (Application form for the European Green Capital – Indicator 4, p.16). In 2015, more than 66% of this was enclosed in culverts. All the measures implemented by the city in the field of nature and biodiversity conservation have benefited both wildlife and citizens.

Ambient air quality

By definition, an air pollutant is any substance which may harm humans, animals, vegetation or material (Kampa and Kastanas, 2007, p.362). Air pollutants are emitted from almost every economic and social activity (European Environment Agency, 2014). Air pollution is one of the environmental factors which contribute most to diseases and death worldwide. Air pollution

¹² See more info here: www.environment.no/topics/biodiversity/protected-areas/

¹³ See more info here: www.oslo.kommune.no/politics-and-administration/statistics/environment-status/nature-and-biodiversity/#toc-1

consists of both airborne dust (PM_{2.5} and PM₁₀) and gases (nitrogen dioxide) that, depending on the concentration in which they are found, can contribute to negative health effects. The relation between exposure to airborne particles and various negative health effects, such as increased risk of premature death, is well documented (Bølling et al., 2018, p.6). In the Global Burden of Disease (GBD) project, it was estimated that long-term exposure to fine particulate matter (PM_{2.5}) contributed to approximately 4.1 million premature deaths globally of which approximately 1,100 in Norway in 2016 (Bølling et al, 2018, p.8). Therefore, air pollution constitutes an important challenge also for Norway. The main challenge for the city of Oslo is to reduce pollution deriving from road transport and wood-burning stoves, accounting in 2016 respectively for 61% and 17% of the total city's total emissions (Carbon Neutral Cities Alliance)¹⁴. Therefore air quality measures targeting these sectors are needed to help reduce air pollution (Norwegian Institute of Public Health, 2017). The city of Oslo is located in a large bowl shaped formation in the northern innermost portion of the Oslo Fjord in Eastern Norway and is enclosed in the North and in the East by forested hills. Due to the sheltered location of the city, the wind strength is moderate. Local climate along with geographical factors contribute to enhanced level pollution, which results in exceedances of particulate matter. Actually, in high pressure situations during the winter months, there is little horizontal and vertical exchange of air, with a tendency for air pollution to accumulate over the lower parts of the city (Dannevig, 2019).

In high pressure situations often occurs the phenomenon known as temperature inversion, that is an increase in temperature in the troposphere as the altitude increases. It manifests itself with a layer of cold air under a warm layer leading to poor air exchange and trapping air pollution close to the ground. Moreover, winters in Oslo are cold and snowy with average temperatures around -4°C. Winter air quality varies throughout the city and is affected by the emissions from heating appliances and emissions from cold starting of vehicles. In addition, studded winter tyres, which are used to improve traction on icy roads, have the disadvantage of increasing wear on bare asphalt compared with non-studded alternatives. On the other hand, during summer months air quality is generally good thanks to the meteorological conditions, with unstable air masses diluting emissions. The city of Oslo started monitoring air quality in 1950 and today has a very good knowledge about its emissions. A network of 11 monitoring stations around the city monitor pollutants in the air, such as nitrogen dioxide (NO₂), particulate matter (PM₁₀ and PM_{2.5}), ozone (O₃), and others. In the past, both PM₁₀ and NO₂ concentrations in the air exceeded the limits. However, The EU

¹⁴ See more info here: <https://carbonneutralcities.org/cities/oslo/>

Directive's limit value for the annual mean concentration of PM10 has not been exceeded at any monitoring station in Oslo in the past decade. (Application Form for the European Green Capital Award 2019 - indicator 5). Diesel-driven vehicles are the main source of NO2 emissions (up to 50% of the city total emissions) and PM10, whilst road dust, studded winter tyres and wood burning in households are the main source of PM2,5 emissions.

PM10 are particles smaller than 10 µm, while PM2.5 are particles smaller than 2,5 µm. PM2,5 (fine particles) are more dangerous than PM10, because they can get into the deep parts of the lungs, or even of blood. The main sources of PM10 in Oslo is derived from the wear and tear of pavement, tyres and brake pads while PM2.5 are derived from combustion, for example from wood fired ovens and vehicle exhausts (Oslo City Council, n.d). With regards to NO2, the main sources are diesel car exhausts. Since the reduction of PM10 has been achieved, today the main focus of the city is on NO2. In order to manage air quality, Oslo's City Council has adopted an action plan with the main aim of reducing traffic by 20% in the period 2015-2019 and emissions of NO2 by 60% before 2022. Limit values are based on pollution regulations (Norwegian Institute of Public Health, 2017). In addition to the European Union limit value for NO2, the Norwegian Institute of Public Health (NIPH) and the Norwegian Environment Agency have set stricter limit values with respect to PM10 and PM2,5 compared to those established by the EU (Oslo City Council, n.d). The yearly limit values set by Norway are 25 µg/m³ for PM10 and 15 µg/m³ for PM2.5 (Oslo City Council, n.d), while the European Union has set the legal yearly values at 40 µg/m³ and 25 µg/m³ respectively¹⁵. The action plan has been revised every year and includes tariffs on toll roads, fees for the usage of winter studded tyres, reduction of speed limits. All these measures have already contributed to reducing levels of NO2 and dust particles in the air.

Among the initiative targeting road transport and aiming to reduce air pollution there are:

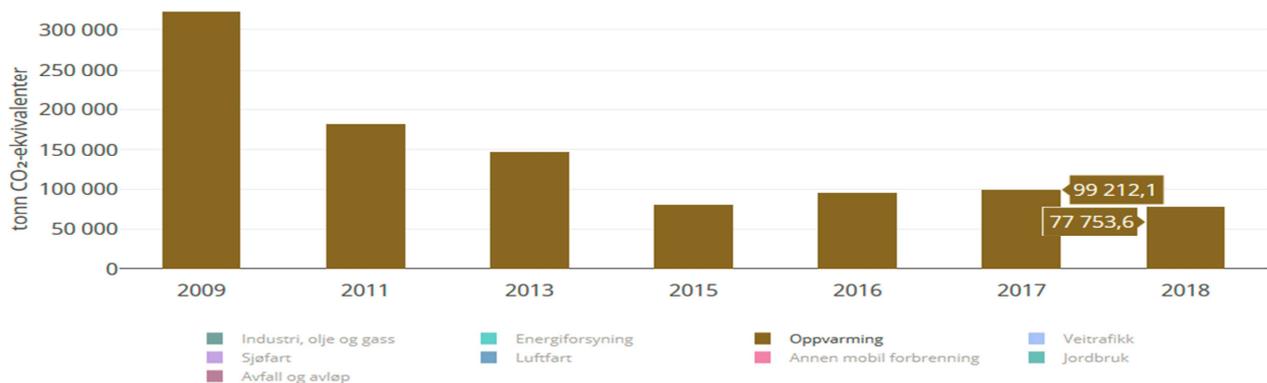
- the introduction of toll ring in the city
- free parking and toll ring passage for electric vehicles
- implementation of Environmental Speed Limits (ELS) reduction of speed limits: higher speed leads to higher air pollution.
- fees on studded winter tyres and their ban on municipal cars: the use of studded tyres enhances road wear and consequently particle emissions from road traffic.
- more frequent street cleaning from dust with magnesium chloride solution¹⁶

¹⁵ See more info here: ec.europa.eu/environment/air/quality/standards.htm

¹⁶ See more info here: http://www.airqualitynow.eu/city_info/oslo/page4.php

Construction constitutes an environmental problem for Oslo, as well, accounting for 7% of the city’s total emissions (C40 Cities Climate Leadership Group, Inc., 2020). The city of Oslo has initially focused on tackling emissions from municipal buildings (including schools), which represent 20% of the city’s construction market. The use of fossil heating oil in buildings was the main cause of emissions, accounting for 17% of the total CO2 emissions in 2016. As a first step, the Municipality decided to adopt biofuel. However, even if biofuels are fossil-free, they do not help to reduce local pollution. Therefore, through the Climate Budget for 2019, the city of Oslo set out measures to support the move from fossil-fuel-powered to electrified construction equipment. The Municipality has provided support for the phasing out of oil heating and introduced a ban on fossil oil heating in January 2020 (KlimaOslo, 2020)¹⁷. Thanks to these measures, emissions from building heating dropped sharply during the period 2017-2018 (22%), as we can see in the table below.

Tab. 1 Heating emissions in Oslo per year, Norwegian Environment Agency

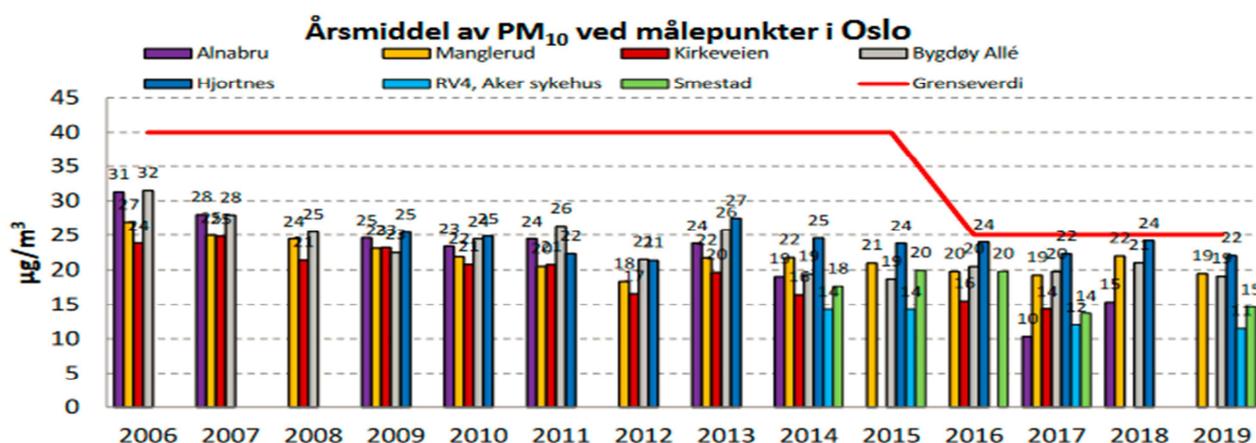


The yearly limits for PM10 in the air set by the European Union are 40 µg/m³. Annual average of PM10 at measuring points in Oslo does not exceed 25 µg/m³ (Tab.1) The yearly limits for PM2.5 in the air set by the European Union are 25 µg/m³ over. The annual average of PM2.5 at measuring points in Oslo does not exceed 25 µg/m³ (Tab.2) However, from 2016, Norway has set stricter limit values for PM10 and PM2.5 than the EU limit values. The yearly limit values set by Oslo are 25 µg/m³ for PM10 and 15 µg/m³ for PM2.5 (Oslo City Council, n.d). The yearly limits for NO₂ in the air have been set both by the European Union and the Municipality of Oslo at 40 µg/m³. The annual average of NO₂ exceeded 40 µg/m³ at minimum 3 out of 7 measuring points in Oslo until 2017 (Tab.3). Measurements show that yearly

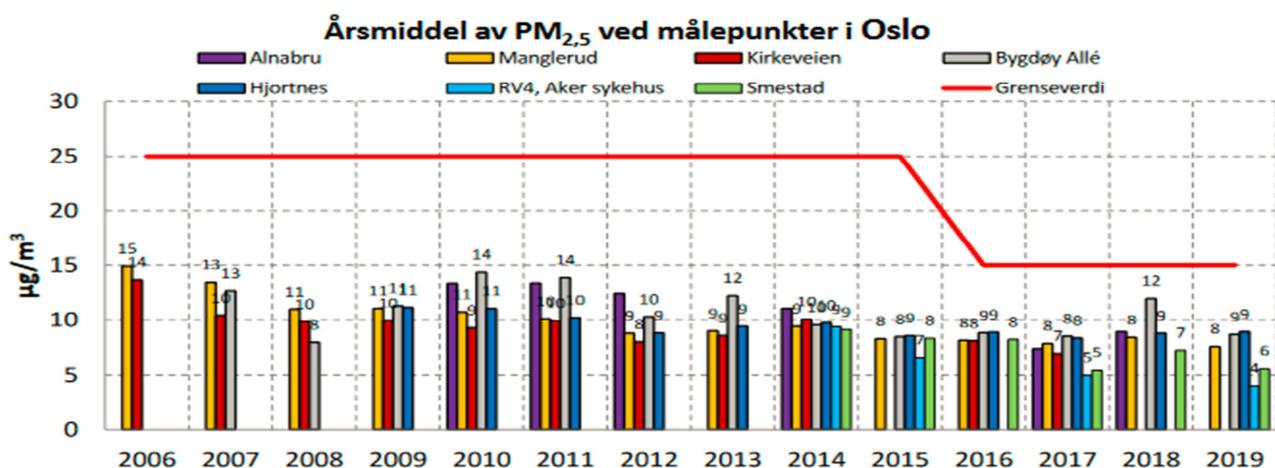
¹⁷ See more info here: <https://www.klimaoslo.no/2020/04/23/klimagassutslipp-i-2018-oslo/>

averages of NO₂ in the air have been significantly reduced over the last year, and in 2018, for the first time, all monitoring sites in Oslo met the yearly limits for NO₂, without exceeding 40 µg/m³. However, the values are very close to the legal limits. The main reasons for the decrease in NO₂ is most likely due to the presence in the city of cleaner vehicles combined with a slight decrease in the number of cars passing the toll ring. It also seems that warmer winters have contributed to the decrease (Oslo City Council, n.d)¹⁸.

Tab. 1 Annual average of PM₁₀ at measuring point in Oslo, luftkvalitet
<http://www.luftkvalitet.info>

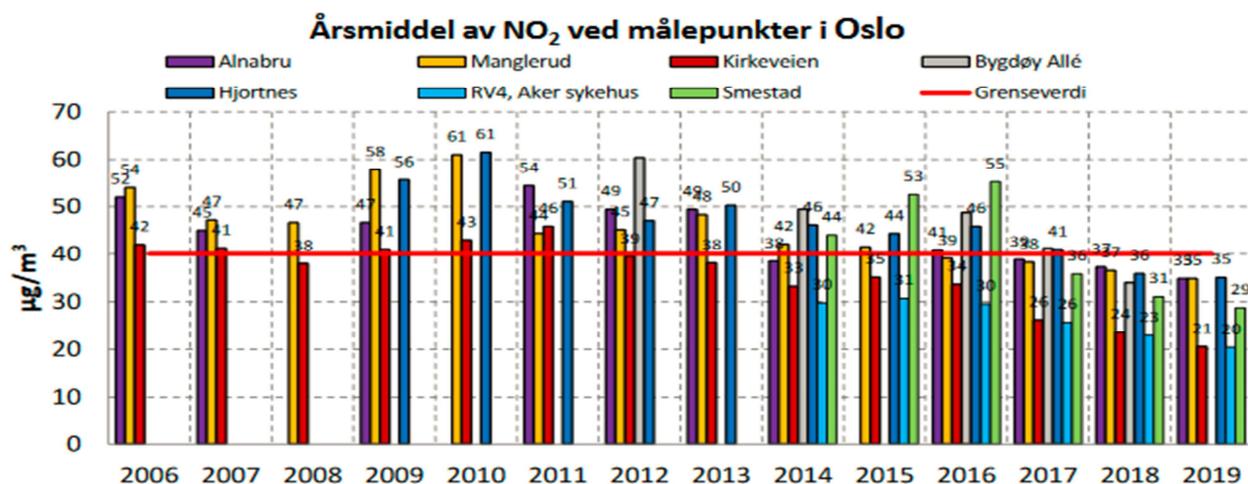


Tab. 2 Annual average of PM_{2,5} at measuring point in Oslo, luftkvalitet
<http://www.luftkvalitet.info>



¹⁸ See more info here: <https://www.oslo.kommune.no/politics-and-administration/statistics/environment-status/air-quality-statistics/>

Tab. 3 Annual average of NO₂ at measuring point in Oslo, luftkvalitet
<http://www.luftkvalitet.info>



The significant reduction of little particles and other gases in Oslo demonstrated that local measures have had a good effect on the quality of air, but there is still much to do. Exceedances for hourly concentrations of NO₂ are still observed at some measuring stations in highly trafficked areas. The hourly limit value for NO₂ is 200 µg /m³ on average over one hour. In accordance with the Pollution Control Regulations, this value shall not be exceeded more than 18 hours per year. The health authorities' recommended air quality criterion is an hourly limit value of 100 µg /m³ which must not be exceeded. In 2019, this limit value was exceeded 10 (RV 4 and Smestad) to 341 (E6 Alna center) times. The number of times the limit values are exceeded can vary significantly from year to year. More significant variations are measured during winter months due to stable weather conditions combined with lack of wind and larger emissions. The levels of tropospheric ozone are well under the EU target value because of rapid, local breakdown by the NO component of NO_x emitted from road traffic (Application Form for the European Green Capital Award 2019 - indicator 5, p.3). The limit for ozone (the eight hour average ozone concentration) is calculated as an average over a three year period where the concentrations cannot exceed 120 µg/m³ during an 8 hour period for more than 25 days a year (Oslo City Council, n.d).

Oslo has had ambitious emission reduction targets for a long time. Originally, the aim was to reduce emissions by 50% by 2020. According to climate budget statistics GHG emissions (exclusive of maritime traffic and aviation) reached 1,200,000 tonnes in 1990 and 1,085,215 in 2016 (Climate Budget 2019). This was a significant reduction of CO₂ emissions (-9.6%) but not yet sufficient to reach the target for 2020. As a result of delays in the national government's decision-making about

funding full-chain CCS projects, the city council decided in 2017 to establish a lower target in its Climate and Energy Strategy, namely a 36% reduction in total emissions (C40 Cities Climate Leadership Group, Inc., 2019). Accordingly, the amended climate target for 2020 is to cap emissions at 766,000 tonnes CO₂e (Climate Budget for 2019).

For the moment, it is not possible to know until 2022 whether the City of Oslo has achieved its emission reduction targets for 2020, since these figures are not available until two years after the emissions have occurred and because it takes time to collect the data and compile the statistics. However, judging by the data, it seems that the city is still far from achieving the desired reduction target.

Quality of the acoustic environment

Noise exposure has great and negative impacts on people's health and well-being. The World Health Organisation defines environmental noise as an underestimated threat. Excessive noise can disturb sleep, cause cardiovascular and psychophysiological effects, reduce performance and provoke annoyance responses and changes in social behaviour (World Health Organisation, n.d)¹⁹.

According to Sygna et al. (2012), in Norway, approximately 1.5 million people (33%) are exposed to sound levels above 55 dB outside of their dwellings, which is the highest recommended average noise level. Over the years the number of norwegian exposed to noise continued to increase. The largest source of noise pollution in 2014 was road traffic, with 1.9 million people affected, i.e. 35% of the population (Statistisk sentralbyrå, 2016)²⁰.

In Oslo, an increasing number of residents are exposed to noise annoyances outside of their dwellings. Population growth and densification in the inner city are the main causes. In order to address the problem, the city has implemented a series of measures to reduce noise pollution, particularly in the field of transportation. The city has set a goal to reduce the noise annoyance by 10% by 2020 compared to 1999. Also in the capital, the major source of noise is road traffic (Oslo City Council, 2008)²¹. This problem intensifies during the winter months. In order to mitigate the problem the city has implemented a series of measures for private vehicles, such as lower speed limits and charge for studded tyres, which cause greater wear and tear on roads. Since teared roads cause an increase in noise emissions, road surfaces are regularly renewed by the city. Other efforts

¹⁹ See more info here: <https://www.euro.who.int/en/health-topics/environment-and-health/noise>

²⁰ See more info here: <https://www.ssb.no/en/natur-og-miljo/artikler-og-publikasjoner/growing-number-of-norwegians-are-exposed-to-noise>

²¹ See more info here: <https://www.oslo.kommune.no/politics-and-administration/statistics/environment-status/traffic-noise-and-quiet-areas>

include the construction of tunnels with the aim of reducing noise, congestion and getting better traffic flow. Direct noise mitigation measures include the construction of noise barriers along carriageways (European Commission, 2008)²².

Rail traffic has decreased in many parts of Norway, but in Eastern Norway, especially around Oslo, there has been an opposite trend. This is mainly due to an increase in rail traffic around Oslo, which is a very dense populated area (Statistisk sentralbyrå, 2016).

Therefore, while the overall level of traffic noise in Oslo is decreasing, there is an increase in noises associated with trams, subways and trains because of their more frequent routes. In order to mitigate the problem the city has focused on direct measures, such as the erection of noise barriers along tracks, and measures addressing the problem at source, such as a more constant maintenance of the tracks and their lubrication so as to reduce squealing, replacement of old trains with newer ones (European Commission, 2008).

The Port of Oslo (Oslo Havn, KF2013) has also introduced several noise reduction measures in order to mitigate noise annoyances. Ports generate high noise levels due to the nature of their activities and the close proximity of the Oslo Havn to the residential area causes a disturbance to the inhabitants.

Handling of containers can generate noise emissions exceeding EU regulation levels, therefore more attention has been paid to this activity. Empty containers have also been stacked in walls close to the surrounding built-up areas and used as noise barriers. Vegetation zones and noise barriers have also been placed in the terminal area. In order to reduce vibration, the port terminal has been completely asphalted.

Other measures conducted by the port authorities include:

- Development of a programme simulating noise effects
- Replacement of forklifts and reach-stackers with gantry cranes with rubber tyres
- Substitution of diesel-powered engines with electric power
- Reduction of noise from warning bells
- Insulation of machinery room
- Installation of rubber bricks on trailer trucks preventing sharp noise
- The terminal ground has been asphalted in order to level the surface.
- Establishment of a noise deflection wall

²² See more info here: <https://greenbestpractice.jrc.ec.europa.eu/node/655>

The results of the measures adopted have been successful, however inhabitants of the surrounding areas are still subjected to noise nuisances beyond the limit values (Oslo Havn KF, 2013).

The city of Oslo has intervened granting subsidies to people living in the surrounding area of the port and enabling them to insulate and soundproof their properties (European Commission, 2008).

Noise is a complex and large subject area and feedback from the inhabitants is essential for port authorities to know how they affect the surrounding neighbourhoods, therefore there is an open dialogue between the authorities and the inhabitants (Oslo Havn KF, 2013).

The Port of Oslo participates in the Noise Management in European Ports (NoMEPorts) project. The main objective of this project is reduction of noise annoyances and noise-related health problems of people living around port industrial areas through noise mapping and management systems²³.

As a measure to reduce noise exposure, the city has designated silent areas. In the Municipal Master Plan against noise (MMP) 2008-2013, 14 quiet areas were pointed out, where Oslo is actively investing in soundscapes and outdoor life in order to achieve a better urban environment (Oslo City Council, n.d)²⁴. Together, the quiet areas cover about 10% of the city and include rivers, streams and forests.

In order to measure noise exposure in the City of Oslo, the Urban Environment Agency (called Bymiljøetaten) has calculated how many people are exposed to noise from road and railways. Noise is measured as an average level in Db (A) over a 24-hour period. These statistics take into account noise from road and railways, but it would be interesting to know the percentage of people exposed to other types of noise (port, construction sites and other business activities). Since the nearest airport (Oslo Gardermoen International) is located 35 km northeast of the city centre, airport noise exposure is not taken into consideration here.

Although the number of people exposed to road noise is increasing, the proportion of the population exposed to road noise is relatively unchanged. The last noise mapping (2016) showed that 61% of the inhabitants in Oslo are exposed to traffic noise and 12% to railway noise (tram, metro and trains) with noise levels exceeding an average of 55dB over a 24-hour period (Lden) (Table n.1)

²³ See more info here: <http://www.renoslofjord.no/english/environment/environmen/noise-mana/>

²⁴ See more info here: <https://www.miljohovedstaden.no/utfordring/opplev-oslos-stillhet>

Table n.1 Traffic noise - percentage of inhabitants exposed to noise (>55 dB) over 24 hours, Statistics Norway

År	2006	2011	2016
Utsatt for støy fra veitrafikk	62	62	61
Utsatt for støy fra banetrafikk	10	11	12

Graph n.1 Traffic noise - percentage of inhabitants exposed to noise (>55 dB) over 24 hours, Agency for Urban Development

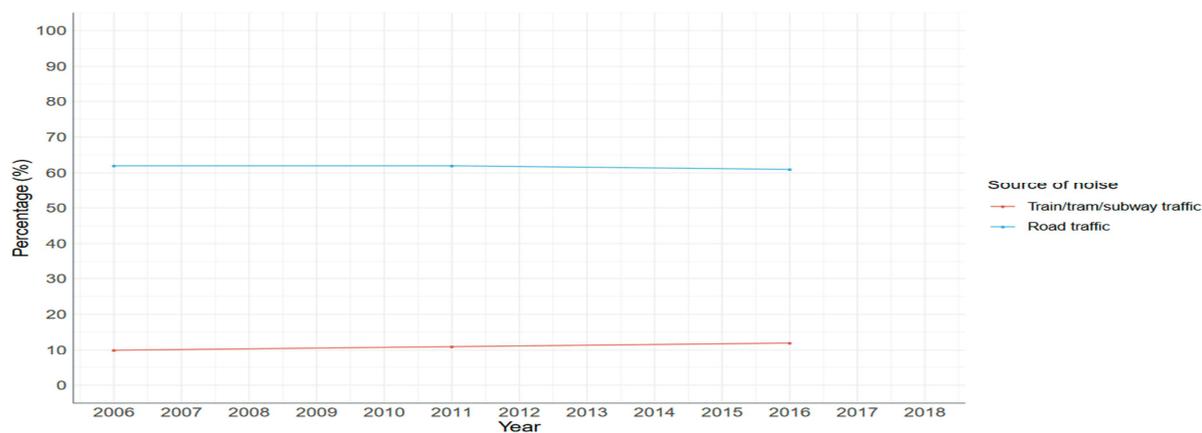
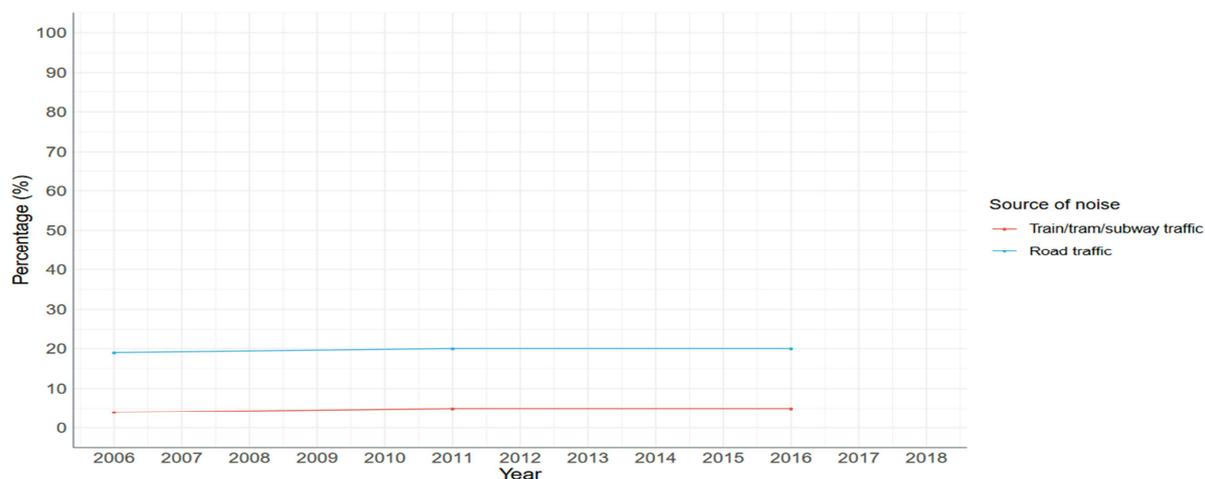


Table n.2 Traffic noise - Percentage of inhabitants that are especially exposed to noise (>65 dB) over 24 hours, Statistics Norway

År	2006	2011	2016
Svært utsatt for støy fra veitrafikk	19	20	20
Svært utsatt for støy fra banetrafikk	4	5	5

Graph n.2 Traffic noise - Percentage of inhabitants that are especially exposed to noise (>65 dB) over 24 hours, Agency for Urban Development



The total sum of noise affecting kindergartens and schools with levels of 55-65 dB has also seen an increase in the period 2006-2016 (Tab 3.). However, for noise levels exceeding 65 dB, the number of kindergartens and schools affected by road traffic has decreased by 2011 but did not change in relation to noises associated with railways (tram, metro and trains).

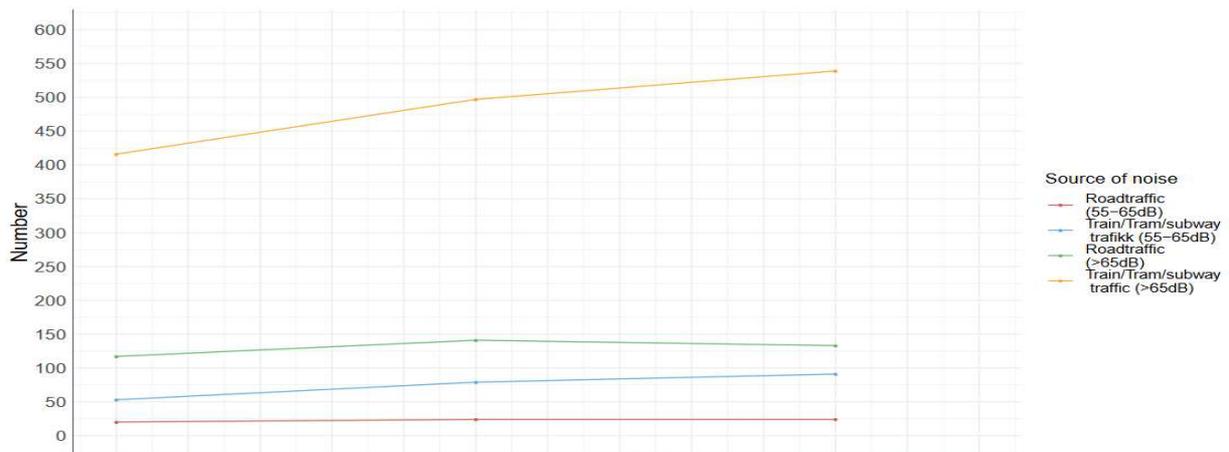
The statistics are taken from the strategic noise survey, which is carried out every five years. (Oslo City Council, n.d). The noise calculations have been carried out with the calculation tool CADnaA, using the Nordic calculation method 1996 for noise from roads and railways.

Nevertheless, permissible indoor noise levels as well as noise limits in protected outdoor environments have become stricter. All new dwellings are required to have at least one quiet facade. By law, no dwellings should be exposed to indoor noise-levels exceeding LpAeq24h 42dB (Application Form for the European Green Capital Award 2019 - indicator 6, p.6).

Tab n.3 Number of kindergartens and nursing homes that are exposed to noise (L-den 55-65) and over 65

År	2006	2011	2016
Støy fra veitrafikk, 55-65 dB	416	497	539
Støy fra banetrafikk, 55-65 dB	53	79	91
Støy fra veitrafikk, over 65 dB	117	141	133
Støy fra banetrafikk, over 65 dB	20	24	24

Graph n.3 Number of kindergartens and nursing homes that are exposed to noise (L-den 55-65) and over 65



Unfortunately, the lack of up-to-date data for 2020 does not allow us to verify with certainty whether Oslo has reached its 10% reduction target within the year under consideration. As reported in the Application for the European Green Capital Award 2019 (Indicator 6), in 2011, noise annoyance had been reduced by 6.5% compared to 1999 levels, thus, the city was on the right track to reduce total noise. In order to reach the target, the city adopted a first Noise Action Plan in 2008. The revision is carried out every five years.

Waste production and management

The city of Oslo has a highly developed integrated waste management system based on the Waste Management Hierarchy and the circular economy principles.

The hierarchy says the priority are:

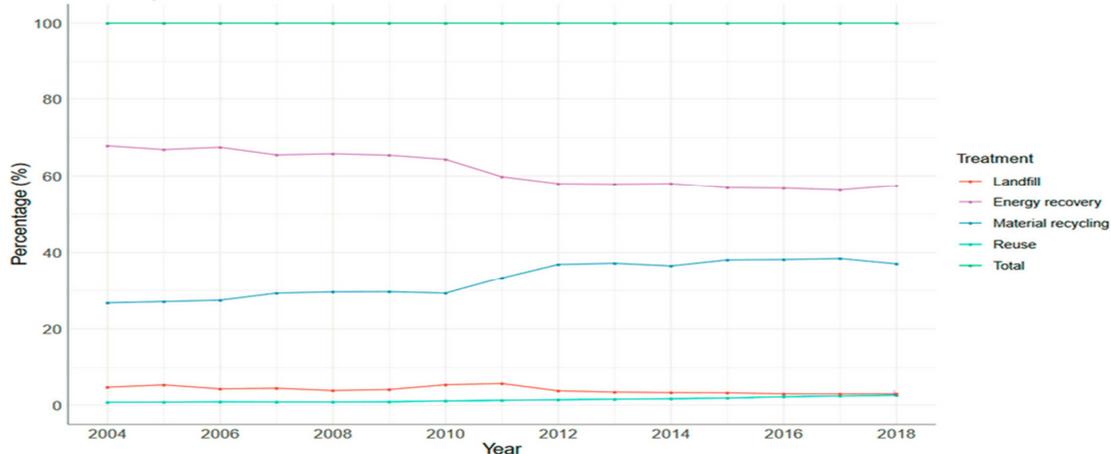
- Waste reduction/prevention: From 2011 onwards, despite increased consumption and economic growth (Oslo City Council, n.d), household waste production has undergone a significant decrease. In 2015, each person generated 342 kg household waste (Application Form for the European Green Capital Award 2019 - Indicator 7, p.1), while in 2018, the average annual waste production per capita in Oslo was 321 kg (Oslo City Council, n.d)²⁵. In order to reduce waste production the city has adopted several ambitious measures.
 - Cooperation to reduce food waste: in order to reduce food waste the City of Oslo has partnered with the Confederation of Norwegian Enterprise (NHO) achieving a national reduction of 12% since 2010. In addition to prevention measures, food waste is used for fuel and fertiliser.
 - Raising awareness among school children
 - Incentives to promote the use of cloth papers
 - Communication campaigns and public seminars
 - Preparation of a strategy to reduce consumption
- Re-use of objects: reuse is the most environmentally friendly stage of waste management. Reuse stands scattered throughout the city give citizens the opportunity to exchange objects they no longer need (Green Visits, n.d.).
- Recycling (Material Recovery): recycling is a process implying the transformation of old used materials into new products. By recycling, other processes such as extraction of raw materials, distribution and processing are avoided. This process requires less energy than the

²⁵ See more info here: <https://www.oslo.kommune.no/politics-and-administration/statistics/environment-status/waste-and-recycling-statistics/#toc-1>

production of plastics. The City of Oslo had set the target to grow the recycling rate from the household waste to 50% by 2018 (Nilssen and Sylthe, 2017, p.4). However, in that year the recycle rate was still under 40% (see graph n.1 here below), thus this raised the question whether the objective of 50% is achievable (p.4). Anyway, judging by the data, the achievement of the goal is still far and it seems that the city will have to postpone it. Nilssen and Sylthe, in the “Measure Package” report, have listed some important measures to increase the recycle rate, such as the increasing in the number of waste fractions from curbside collection schemes, the optimisation of collection frequency and the volume of source separated in order to avoid overfillings, good communication and incentives (Nilssen and Sylthe, 2016).

- Incineration with energy recovery (Waste-to-Energy): residual waste in Oslo is used in waste-to-energy plants with high energy efficiency. In Oslo there are two waste-to-energy plants incinerating residual waste. The energy produced from waste is used for district heating and electricity generation in schools. Klemetsrud Plant is the largest waste-to-energy plant in Norway. Together with landfill, incineration is the less desired process for waste management as it emits large quantities of CO₂. To compensate this and reduce emissions from the process, Oslo became the first city in the world to pilot capture and storage technology on a waste-to-energy plant (Green Visits, n.d.).
- Landfill (for inert waste only): it represents the last resort of waste management within Oslo’s strategy, as we can see in the graph below. In 2016, only 3% of household waste ended in landfills²⁶.

Graph n.1 Recovery of household waste in Oslo, Agency for Waste Management



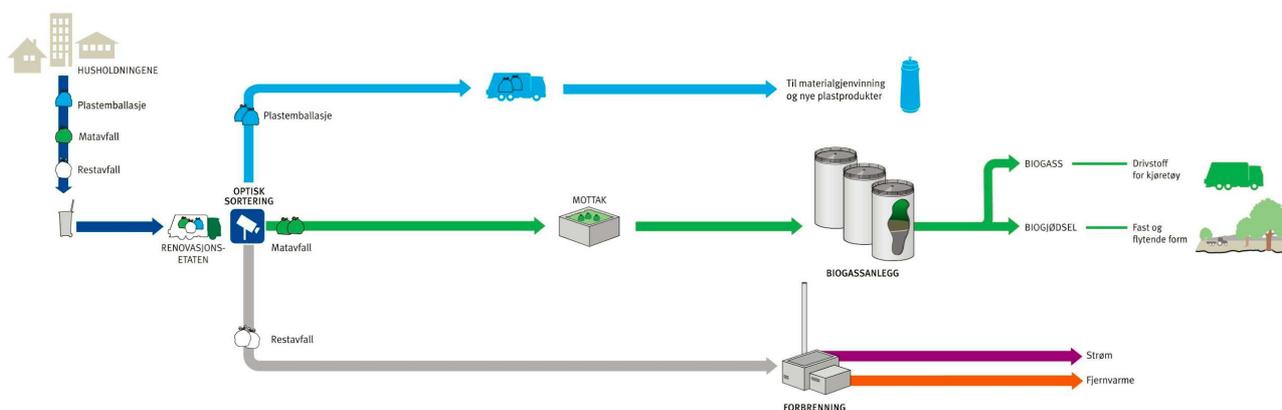
²⁶ See more info here: <https://circulareconomy.europa.eu/platform/en/good-practices/oslo-takes-integrated-approach-treat-waste-circular-bio-resources>

In 2006 Oslo launched its first Waste Management Strategy (WMS) aiming to establish a “recycle and reuse” society. A new strategy has been developed for the 2015-2025 period with enhanced goals and a closer linking to the circular economy. The Waste Management Strategy sets targets for sorting of plastic bags and food waste and aims to contribute to the reduction of CO2 emissions by several actions (C40 Cities Climate Leadership Group Inc., 2016).

A large part of the WMS concentrates on the awareness of the citizens. Incineration and landfill are seen as the less desirable course of action of the strategy. As such, collaboration with organisations, awareness raising through campaigns and websites and the extension of the local collection site network will be cardinal in order to carry out waste reduction, reuse and recycling (C40 Cities Climate Leadership Group, Inc., 2012).

In 2012, Oslo implemented the circular waste management system which includes recycling, producing biogas and bio-fertilizer from bio waste, and energy recovery for district heating and electricity production. According to the current Oslo’s waste management strategy household waste is sorted by the citizens into various fractions. Plastic packaging is deposited in blue bags, food waste in green bags and residual waste in white bags. Every bag is subsequently sorted in the Klemetsrud Plant with the aid of a fully automated optical sorting process. The major advantage of this system is that different waste bags can be loaded into the same refuse collection vehicle and sorted later in the waste management facility. As we can see in the diagram here below, plastic (blue bags) is recycled to produce new plastic products, food waste (green bags) is supplied to a biological treatment plant and used as raw material in biogas and bio-fertilizer production. Biogas subsequently becomes fuel for public transport and refuse collection vehicles. From incineration of residual waste (white bags) the city derives electricity and district heating.

Waste Management System in Oslo diagram, unknown author, www.sustainablecity-oslo-samansayip.weebly.com/waste-recycling.html



To make the system work, the good will on the part of the citizens to sort is obviously required. However, changing citizens' behaviour is still a challenge for the city of Oslo. Most food waste is not properly separated by the citizens, thus, raising awareness will be a key factor in order to reach this objective.

Water management

Oslo is a city in growth and approximately 700,000 citizens must be provided with clean drinking water.

“The water supply system of the city consists of two water treatment plants and four back-up plants, 18 elevated basins, 30 pump stations, 1,600 km of public water pipes and 1,600 km of private service pipes” (Application Form for the European Green Capital Award 2019, Indicator 8, p.1).

The two main water treatment plants, one at Oset by the lake Maridalsvannet and one at Skullerud at Elvåga lake, together supply the city's inhabitants with fresh water, with 90% and 10% of total supply capacity respectively (Behzadian and Kapelan, 2013, p.3; Oslo City Council, n.d).²⁷

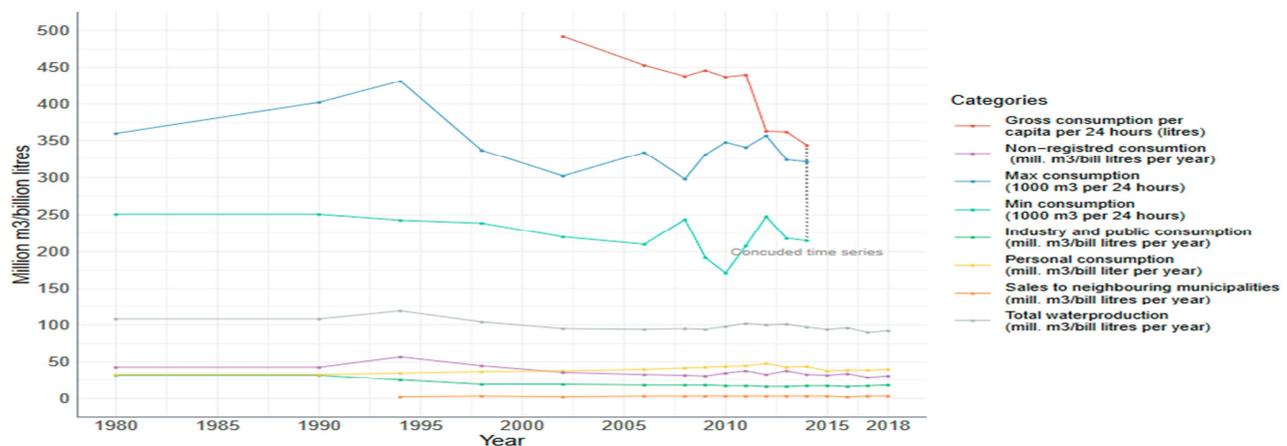
However, for several years Oslo has been looking for new water sources in order to ensure a continuous supply of fresh drinking water. According to NIRAS Gruppen A/S (2018), an international consulting group specialised in engineering and professional services, if two or more years of drought occur in a row, there may be a lack of drinking water from the two lakes.

Nevertheless, new water sources to supply all the inhabitants of the city are not easy to find, therefore the city needs a new strategy. The answer may be to save water by reducing leakage. This may serve as a temporary solution, until the city has secured a new source to supply the city (Jansen and Høgh, 2018). Because of the high quality of surface water, urban consumption and distribution losses are quite high (EGCA Technical Assessment). The consultancy firm Norconsult, has collected figures for specific water consumption and has a good overview of historical development and future trends for specific water consumption and the factors affecting it. Household consumptions and water leakage are the main factors affecting water consumption, accounting for 40% and 35% respectively (Bomo, 2016). As also claimed by Jansen and Høgh (2018), in Oslo 35% of the clean water is lost on the way from waterworks to tap. However, thanks to the works of renovation of water pipes and improvement of technology to detect water losses from pipes the percentage of leakage has been halved in the period 1995-2015 (Application form for the European Green Capital Award 2019, Indicator 8, p.1). The main reason for high household consumption is

²⁷ See more info here: <https://www.oslo.kommune.no/vann-og-avlop/drikkevannskvalitet/#gref>

low water prices, which gives lower motivation to save water and consequently higher consumption (Bomo A.M. et Schade M, 2015, p.179). According to data from Statistics Norway (2018), Norwegians consume an average of 180 litres of water per capita per day. However, the average household consumption per person per day decreased significantly during the last decade (-14.8% in the period 2011-2019). In the period 2018-2019 the average household consumption per person per day decreased from 182 to 178 litres (-2.2%)²⁸.

Table n.1 Water production and consumption in Oslo municipality, Oslo City Council



Drinking water

Because of their role as a source of drinking water, swimming and fishing are prohibited in Maridalsvannet and Elvåga lakes as well as all the blue water surfaces that flow from and into them. Drinking water in Oslo is of high quality and is safe to drink. The water sources and their catchments are continuously monitored and regulated to ensure adequate water quality. Starting from 2008 the treatment facility in Oset has been upgraded to a full water treatment plant (WTP). As a consequence, all the inhabitants of Oslo now have high quality potable water that satisfies the requirements of the potable water regulations (Oslo City Council, n.d)²⁹.

However, the quality in the main watercourses in Oslo is not good enough. The city of Oslo has ten main watercourses flowing from Marka forest into the fjord, and their quality is assessed in reference to the ecological status of benthic organisms. As reported by the Oslo Council website, none of these waterways has received a good assessment in terms of water quality. The main

²⁸ See more info here: https://www.ssb.no/en/natur-og-miljo/statistikker/vann_kostraaar

²⁹ See more info here: <https://www.oslo.kommune.no/politics-and-administration/statistics/environment-status/water-and-waterways/>

sources of pollution come from sewer systems, run offs from roads and other dense areas as well as leakage.

Reopening waterways

Today waterways will once again play an important role for the city. In the 1980's, waterways have been covered and buried in culvert and pipes in order to give space to urbanisation and facilitate construction. Furthermore, they were considered problematic because of emissions and spills, which contributed to their pollution, and the leakages from the sewage system. More frequent and powerful rainfalls have put culverts and pipes under pressure and exposed the city of Oslo to increasingly frequent flood events. Consequently, by the end of the 1990's the city has decided to reopen its waterways as a strategy for reaching its environmental goals, adapting to climate change, becoming resilient to flood risk and more attractive and livable for the citizens and tourists. The opening of the waterways will enable the city to manage stormwater and prevent flooding but will also contribute to increased biodiversity and benefit the health and wellbeing of Oslo's inhabitants by providing new recreational spaces and improving the quality of water. In order to control pollution, the city has resorted to the creation of natural cleaning systems, with sedimentation basins, water rapids and shallow waters. However, reopening rivers and streams is a long-term process which can be costly and challenging due to the presence of buildings and infrastructure, both above and below the ground. As of 2016, of 354 kilometres of river and streams running through the city, 2.81 km have been reopened. The city has planned to reopen 30 more stretches in the future. Reopening waterways will be essential in the context of Stormwater Management Strategy, a well-set adaptation plan with the aim of better management of stormwater and reducing the risk of flooding. The strategy was adopted by the City Council in 2014 and describes the measures to be executed for the following five years. This will provide added value in urban development and contribute to the transportation of clean stormwater to watercourses³⁰.

Wastewater Management

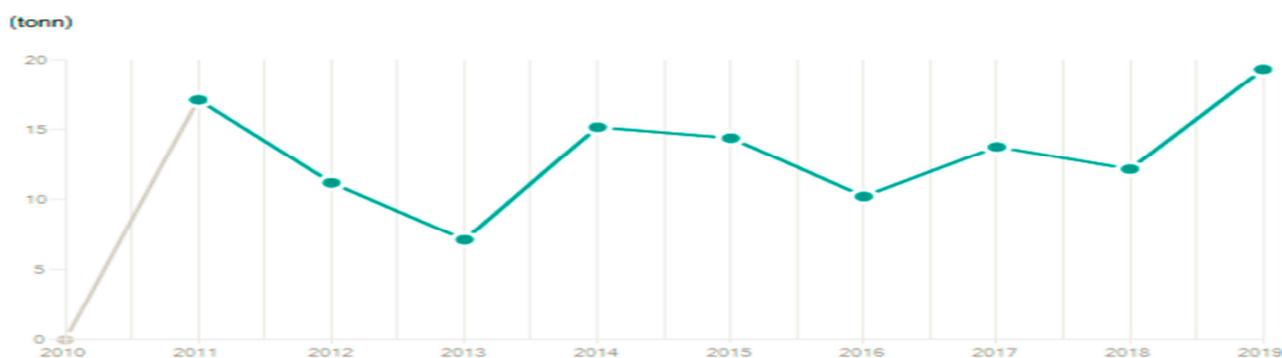
The sewage system in Oslo consists of 2350 km of sewers, 57 pumping stations, 11 retention basins and two Wastewater Treatment Plants (WWTP). Today all wastewater in Oslo is treated in the Bekkelaget or VEAS plants. Actually, only the Bekkelaget plant is located in Oslo and it is the second largest WWTP in Norway, after VEAS plant, which is co-owned by three municipalities,

³⁰ See more info here: <https://www.oslo.kommune.no/politics-and-administration/green-oslo/best-practices/reopening-waterways/>

with Oslo being the largest owner. Several upgradings of the Bekkelaget WWTP have been undertaken since its enactment and in 2000 it came into full operation. The plant treats wastewater from Oslo's eastern parts served 280.000 p.e (population equivalent) in 2015. Almost the whole treatment plant is constructed in underground rock caverns in order not to disturb the environment or the local population. As reported in the EGCA application, the WWTPs produce biogas as a by-product, which is subsequently upgraded to biomethane and used to power buses and refuse collection vehicles in the city. The two WWTPs process the sludge differently. 89% of the total sludge produced by them is used in agriculture. However, the use of the remaining 11% is not discussed in the application. The production of biogas from the Bekkelaget WWTP has contributed to reducing GHG emissions in Oslo.

Both WWTP remove organic matter, phosphorus and nitrogen from wastewater. The effluent from the facility flows into the Oslofjord, which is a threshold fjord with limited water exchange. (Føllesdal et al., n.d, p.2) Despite the high rates of phosphorus and nitrogen removal, it is estimated that even after this treatment, annually 60-90 tons of phosphorus and 3400-3900 tons of nitrogen are discharged into the fjord³¹. According to statistics from the Norwegian Environment Agency, approximately 20 tons of phosphorus and 455 tons of nitrogen were discharged into the fjord from the Bekkelaget plant in 2019. As we can see in the two graphics below, this is a drastic increase compared to previous years.³²

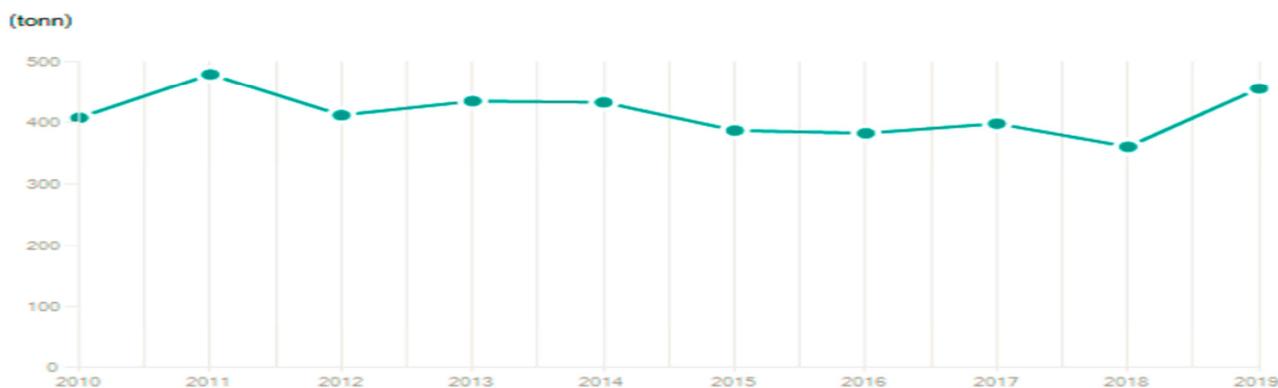
Tab. 1 Bekkelaget basin treatment plant with supply tunnels and overflow - Discharges of phosphorus into the Oslofjord (in tons per year), The Norwegian Environment Agency



³¹ See more info here: http://www.helsinki.fi/envirohist/seaandcities/cities/osl/osl_tech.htm

³² See more info here: www.norskeutslipp.no/Templates/NorskeUtslipp/Pages/company.aspx?id=61&CompanyID=17692&epslanguage=en

Tab.2 Bekkelaget basin treatment plant with supply tunnels and overflow - Discharges of nitrogen into the Oslofjord (in tons per year), The Norwegian Environment Agency



Nitrogen and phosphorus are nutrients that are natural parts of aquatic ecosystems and support the growth of algae and aquatic plants, which provide food and habitat for fish and other small organisms that live in water. But a high quantity of nitrogen and phosphorus in water leads to pollution, as it causes algae to grow faster than the ecosystem can handle, consequently harming water quality, food resources and habitats, reducing oxygen in water and so, leading to loss of many bottom-dwelling species. Rapid growths of microscopic and unicellular algae are called algal blooms, and some of them are harmful to humans as they produce a high quantity of toxins and bacteria making people sick through contact with polluted water or consuming contaminated fish or water (United States Environmental Protection Agency, n.d)³³.

The “Monitoring of the Outer Oslofjord 2014-2018” technical report from the Norwegian Institute for Water Research (NIVA) blamed agriculture as the largest activity contributing to poorer water quality in the Oslo Fjord as it provides the largest source of man-made nutrients (phosphorus and nitrogen) in the fjord. The main source of these substances are fertilisers. This leads to an increase of algae and oxygen-poor water (Reppe P.H, 2018). At the same time, more people living around the Oslo fjord place greater demand on capacity in the treatment plants. High-grade treatment plants have proper technology to remove pollutants such as phosphorus and organic matter before being discharged into water but only a few plants can remove nitrogen (Johansen O. J, 1991; Aftenposten, 2018).

However, agriculture is not the only factor contributing to low water quality in the inner Oslo fjord. The city’s population continues to grow, as a result, pipeline networks and treatment plants are charged over their maximum capacity. In addition, there are climate changes that result in more

³³ See more info here: www.epa.gov/nutrientpollution/issue

frequent and intense precipitation events. In the event of extreme precipitations, it may happen that untreated wastewater is discharged into the water mixing with rain water and leading to poor water quality. Water may contain large amounts of intestinal bacteria after heavy precipitation, so the municipality of Oslo usually advises against swimming in the fjord at least for one day after rainfall. Treatment plants cannot take away everything, so large quantities of untreated water flow into the fjord. In an interview conducted by the Norwegian newspaper “Dagavisen” (2019), the section leader of the water and sewerage authority Frode Hult argues that Oslo municipality takes weekly samples in the fjord from spring through summer to measure bathing water quality, mostly showing excellent water quality. So, the water quality in the Oslo fjord is excellent for swimming and other recreation, with the exception of one day after heavy rainfall³⁴. Experts however advise to pay special attention to the water’s tint. The color of water is an indicator of overall quality, and if water quality is poor, it is coloured or foul-smelling.

However, treatment efficiencies are generally higher on the eastern part of the country and in the Trøndelag area, where treatment permits are stricter and recipient capacity is quite lower (Statistisk Sentralbyrå, 2017)³⁵. The Bekkelaget WWTP was built to meet new and more stricter discharge limits on phosphorus and nitrogen. Because of the limited water exchange of the Oslofjord, high quality treatment is fundamental. Oslo’s population is expected to grow up to 795,000 people in 2030. This will cause higher loads on the sewage system, thus the city will need to upgrade it. In spite of several capacity expansions, the Bekkelaget WWTP is overloaded because of population growth, so a new plant has been commissioned for the end of 2020 to the structural engineering company PNC Norge AS. The plant’s increased capacity will allow it to treat the wastewater produced by 500,000 residents, instead of the current 280,000³⁶.

As reported on the company website, once the plant is complete, all wastewater, rainwater and meltwater (up to 7 m³/s or 850 million m³/year) will be treated.

The VEAS WWTP, handling 60% of all wastewater from Oslo, also will undergo a gradual expansion programme starting from 2020.

³⁴ See more info here: www.dagsavisen.no/oslo/det-blir-ikke-pumpet-dritt-ut-i-fjorden-1.1555791 (Norwegian)

³⁵ See more info here: www.ssb.no/en/natur-og-miljo/artikler-og-publikasjoner/wastewater-statistics-mapped-out

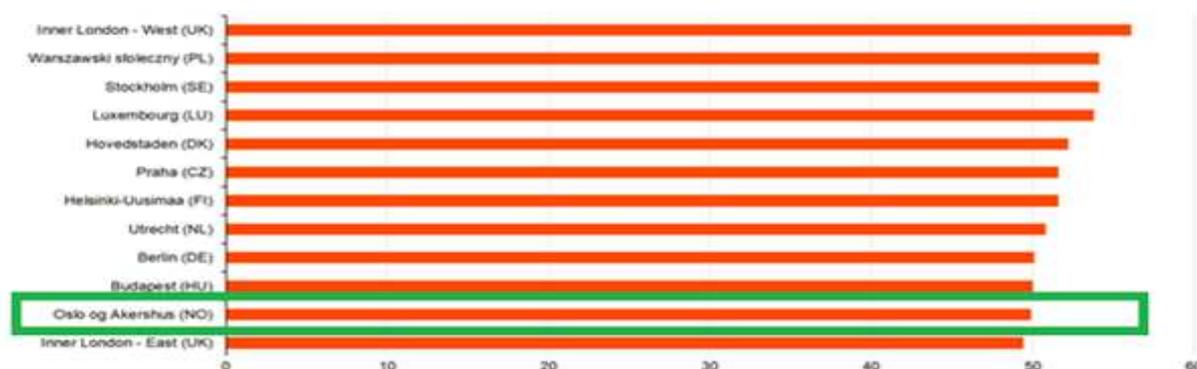
³⁶ See more info here: www.pnc-norge.no/en/projects/ubra-bekkelaget-oslo/

Eco innovation and sustainable employment

Oslo strives to become a frontrunner in eco-innovation and sustainable employment.

The Oslo region (Oslo and the neighbouring county of Akershus) owns one of the highest HRST share (Highly skilled Human Resources in Science and Technology) in Europe, accounting approximately for 50% in the active population (Eurostat, 2019).

The 25 NUTS 2 regions with the highest shares of HRSTO core in the active population (2019), EUROSTAT



Green jobs

After the recent economic and financial crises, greening the economy has drawn increasing attention both nationally and internationally (Skjelvik et al., 2011). It is important to measure “green sectors” and “green technologies” in order to get the necessary information helping to understand the transition towards a green economy (Hass J. et al., 2013, p.6).

Many different organisations have embraced “green economy” and tried to give a definition of the concept, develop indicators and make strategies.

The interpretations of the concept of “green job” given by the different organisations vary according to whether these jobs are found exclusively in environmental sectors (e.g. economic activities whose main purpose is to scale back or completely eliminate pressures on the environment or to make the use of natural resources more efficient), and the extent and novelty to which the “green” skills are required in the job (Cox A. et Foley B., 2013, p.2). A well-known definition of “green job” is that given by the International Labour Organisation (ILO), according to which “jobs are green when they help reduce negative environmental impact ultimately leading to environmentally, economically and socially sustainable enterprises and economies. More precisely green jobs are decent jobs that:

- reduce consumption of energy and raw materials;

- limit greenhouse gas emissions;
- minimize waste and pollution;
- protect and restore ecosystems.”

Green jobs may contribute to achieve targets for mitigating the effects of climate change and environmental degradation. In addition, they offer important employment policy opportunities (Cox A. et Foley B., 2013, p.2)

It has been calculated that, in 2015, 35 196 people were employed in green sectors in the city of Oslo, with a growth of 5,4% compared to the previous year. The highest level of actual growth occurred in Wave & Tidal, Additional Energy Sources, Renewable Consultancy, Wind, Biomass and Building Technologies.(Application Form for the European Green Capital Award 2019 - Indicator 10).

With regard to eco-innovation, the city has implemented a range of policies and programmes supporting it. SKATTEFUNN is a programme stimulating research, development and innovation through a 20% tax deduction on ambitious projects developed by any business. Other initiatives, measures and collaborations supporting and stimulating eco-innovation include:

- Phasing out fossil heating of buildings: In Oslo, district heating is sourced by renewable energy, mainly from biomass from residual waste. In 2008 the city of Oslo decided to phase out all fossil fuels for heating of all public buildings (including schools) by the end of 2011 and of all other buildings by 2020. This decision has created additional opportunities for suppliers of renewable alternatives. Before the start of the procurement procedure, 52 out of 177 schools in Oslo used fossil fuels for heating. In 2011, the City Council successfully phased out all the 52 non-renewable systems. The project helped the City of Oslo to achieve an annual reduction of approximately 3,000 tonnes CO₂³⁷.
- Grants to climate and energy efficiency projects: The Oslo climate and energy fund was developed to stimulate energy savings and facilitate the transition towards renewable energy, mainly targeting the building sector. Oslo’s climate and energy fund gave grants to climate and energy efficiency projects in 2015. In that year, special focus was directed towards solar energy in the city.
- Business for climate: The local business community is invited to sign the Oslo Climate Pact committing to reduce emissions in line with the City’s targets.

³⁷

See

more

info

here:

ec.europa.eu/environment/gpp/pdf/news_alert/Issue25_Case_Study55_Oslo_heating.pdf

- Green accounting: the Oslo City Council publishes once a year a report on the environmental and climate performance of the municipal agencies. To monitor the progress of the city's climate policy, a digital solution has been developed so as to produce real-time climate and energy data, combined with trends. The idea is to enable citizens, businesses, organisations and authorities to stay up to date.
- FutureBuilt: ten-year programme (2010-2020) launched by Oslo along with with three other municipalities with the aim to develop 50 projects (of which 27 in the capital) including buildings and city areas. These projects will help to reduce greenhouse gas emissions from transport, energy and material consumption. The idea of this programme is to show that climate neutral urban areas, based on high quality architecture, are possible, and spur a change in practices in the building sector. Among the most renowned examples in Oslo there are the Bjørnsletta school, the first school in the city that achieved passive house standards and Kilden kindergarten, one of the first plus-energy house kindergartens integrating photovoltaics in the architecture. Another important project is the revitalisation of the satellite city of Furuset, an area with a young multicultural population, good public transport coverage and a large green area³⁸.
- Zero emission construction vehicles and machinery through public procurement

Energy performance

Exponential growing in population leads to increased environmental concerns such as global warming, decreasing biodiversity, rapid resource depletion and deforestation. Under the Paris Agreement, almost every country in the world has agreed to adopt measures in order to limit global warming to a maximum of 2 degrees and keep temperature increase under 1.5 degrees. In accordance with the Paris Agreement, the Norwegian capital has developed the Oslo Climate and Energy Strategy. The strategy shows how the green transformation will be implemented in order to reach the climate targets for 2030³⁹. Norway is a country extremely rich in energy resources. The country has abundant oil and natural gas resources in the North Sea, Barents sea and Norwegian sea. Oil was discovered in the North Sea in the late 1960's and the fast growth of Norwegian oil production led to the low oil prices in the beginning of the 1990s. However, in 2001 Norway reached its peak production and began to decline (Höök and Aleklett, 2008). Norway is one of the most important suppliers of oil and gas to the

³⁸ See more info here: www.futurebuilt.no/English/Pilot-projects#

³⁹ See more info here: www.klimaoslo.no/2020/06/10/oslos-new-climate-strategy/

global market, and almost all its production is exported⁴⁰. However, the country's biggest oil reserves in the North Sea are about to run dry and the future of oil and gas in the Barents Sea remains uncertain. Norway has moreover decided to progressively abandon the production of energy through non-renewable resources and to adopt a sustainable approach. The country, together with Sweden, Denmark and Finland is part of the common Nordic electricity market. The four nordic countries work together in a unique way in order to secure their electricity supply. Each country has its own particular strength when it comes to renewable energy sources. This benefits all countries in the joint electricity market. Norway is today a major producer of renewable energy and over 90% of electricity production comes from hydroelectric plants. According to appraisals made by the Norwegian statistical office (Statistisk sentralbyrå), the part of hydroelectricity in total electricity production in July 2020 reached 92.9%. The rest of the energy is produced through wind and thermal power, respectively 4.5% and 2.6% of the total energy produced in July 2020.

With regard to solar energy, Oslo's application for EGCA only touched upon the issue. Further discussion of the specific potentials of wind and solar energy is very limited in the application. Norway produces more energy from hydro power than it consumes. In Oslo, almost 60% of the total energy consumption was from hydropower in 2014 (Application Form for the European Green Capital Award 2019 - indicator 11, p.1). As of 2019, there were around 1,660 hydropower stations in Norway⁴¹. In Oslo there is only one hydroelectric power station, the Hammeren Kraftstasjon, which is among one of the oldest power stations still running in the country. Norway has been a net importer of hydroelectricity since 2010. According to the International Energy Agency (IEA) in 2015 Norway exported about 15% of its electricity generation and imported about 5%, and the net electricity export was 14.645 TWh. Hydroelectricity production was 125.8 TWh in 2019, 9.8% lower than in 2018, reaching its lowest level, because of drier weather conditions in large parts of the Scandinavian peninsula⁴². In 2019, for the first time the country imported more energy than it exported. Although this, the net quantity of electricity that was purchased was relatively small. The majority of the imported power came from Sweden and Denmark. The reason for higher imports of energy can be traced back to the dry summer of the previous year which led to low water levels in large parts of the country and little quantity of water in the reservoirs. The heatwave also resulted in operating problems in many power plants and higher power consumption. As a consequence of this,

⁴⁰ See more info here: www.norskpetroleum.no/en/production-and-exports/exports-of-oil-and-gas/

⁴¹ See more info here: energifaktanorge.no/en/norsk-energiforsyning/kraftproduksjon/

⁴² See more info here: www.iea.org/articles/key-electricity-trends-2019

power companies decided to save water during periods in which electricity was cheaper abroad. The Norwegian Water Resources and Energy Directorate (Norges Vassdrags og Energidirektorat - NVE) said it could not comment on whether net import will become a regular practice, as this is something which varies every year, depending on how much it rains and how much power production can be developed in the form of wind farms⁴³. Electricity accounts for a large proportion of energy use in Norway and it is widely used to heat buildings and water. Temperature is the main influencing factor for energy consumption in buildings. In the table below, we can see that 2010 was a peak year in energy consumption in Oslo; this could be explained by the extremely cold winter.

Total electricity consumption (GWh), by region, consumer group, contents and year (2008-2018), Statistics Norway

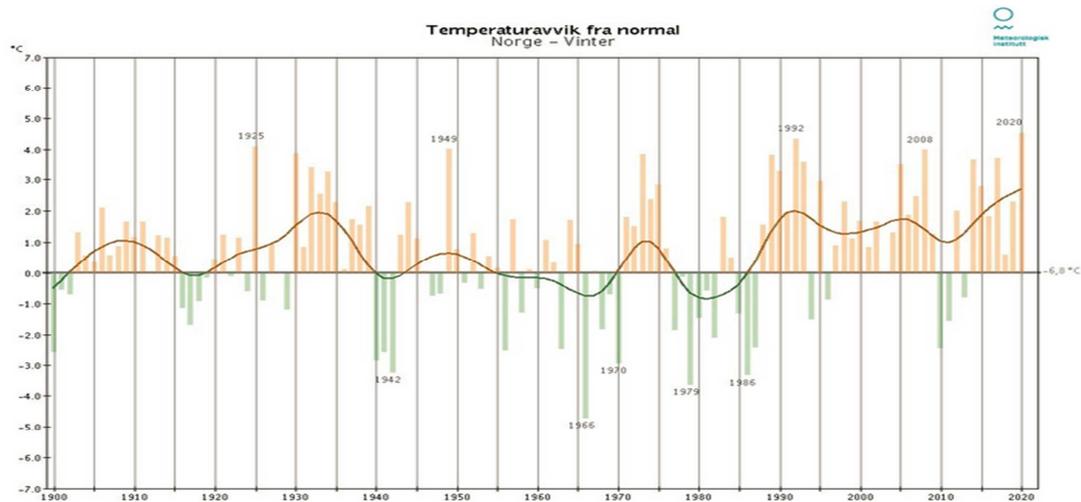
08312: Net consumption of electricity (GWh), by year. Oslo, ALL CONSUMER GROUPS, Total consumption of electricity.



The reduction in electricity consumption could be explained by warmer winters during the last years. Actually, as we can see in the graphic below, there has been a significant increase in temperature during winters from 2011.

⁴³ See more info here: www.nrk.no/norge/noreg-importerte-meir-straum-enn-vi-eksporterte-1.14844211

Table 2. Temperature deviations in Norway, Norwegian Meteorological Institute



However, according to the website “Energifaktanorge.no”, Norway consumes large amounts of fossil fuels, as well, especially for transports, in construction and agricultural machinery. Buildings in urban areas are one of the major sources of greenhouse gas emissions⁴⁴. The consumption of fossil heating oil in buildings accounted for 17% of the total CO₂ emissions in 2016. Oslo, therefore aims to phase out fuels for heating by the end of 2020 in all buildings and replacing them with renewable energy. Today, Oslo has strict building regulations. From 2014 all new municipal buildings comply with passive house or equivalent standards and use 100% renewable energy, while from 2019 the city’s heating system is powered by 80% renewable energy. In addition, in September 2019, the governing mayor of Oslo, Raymond Johansen signed the C40’s Net Zero Carbon Building Declaration and stated that new nursing homes and kindergartens will be built according to the highest energy standard and will produce more energy than they actually consume. As regards the existing buildings, new investments will be undertaken for energy efficiency. Local energy production and energy auto sufficiency will be developed where possible. (C40 Cities Climate Leadership Group, Inc., n.d). Such action will be fundamental to limit global temperature rise to below 1.5°C, as established by the Paris agreement⁴⁵. The city of Oslo is also working to reduce energy consumption in buildings by 1.5 TWh by 2020. This reduction will be achieved through both national and local measures⁴⁶. Energy efficiency is a topic that concerns not only buildings but also street lighting. Oslo managed to reduce energy

⁴⁴ See more info here: energifaktanorge.no/en/norsk-energibruk/energibruken-i-ulike-sektorer/

⁴⁵ See more info here: https://www.c40.org/press_releases/oslo-heidelberg-net-zero-buildings

⁴⁶ See more info here: <https://www.iea.org/policies/2878-climate-and-energy-strategy-for-oslo>

consumption by 70% and CO2 emissions by 1440 tonnes per year since 2004 by introducing an innovative and energy-efficient form of street lighting system. The city replaced old fixtures containing Polychlorinated biphenyl (PCB) and mercury with 10,000 high-pressure sodium lights which use an intelligent lighting system that adjusts light according to needs. The intelligent street light system remotely monitors the lights, dimming them when needs are low, consequently saving energy and cutting pollution. Light adjustment is based on weather and traffic conditions and available light. Since each lamp contains electronic gears that measure rates of consumption by the different consumers, it is possible to accurately measure and tax energy consumption. Each lamp can be dimmed individually depending on traffic and climate conditions. This allow to generate high economic and energy savings, because of longer life expectancy of lamps. Moreover, thanks to a powerline allowing the transmission of data to a GIS-database containing information on every fixture it is possible to identify the lamps that have or soon will burn out. Lightning in Oslo is 100% provided by hydropower sources. This new system also enables the city to accurately tax end users, as they are not billed on the anticipated volume of use but their actual consumption. Older systems, in fact, are often based on fixed operating hours. Overall, the system has performed well and there has been no increase in the level of public complaints. According to data provided by Oslo's Agency for Road and Transport to New York City Global Partners, if oil had been used to power the lights, the city would have emitted 1,440 tons CO2/year for 10,000 lights (NYC Global Partners, 2011). It is estimated that the energy saving potential has been to the point of approximately 5 GWh/year⁴⁷.

As stated at the beginning of the paragraph, Oslo is a city rich in resources, and thanks to this it has the opportunity to become a leading city internationally. If Oslo became energy self-sufficient, it is due to the desire over the years to invest in energy conservation. In 1982, the city adopted a Climate and Energy Fund (The Ekon Fund); namely, a revolving fund (type of loan fund, financed by the State) for households and businesses in order to meet future energy demand. It is financed through an extra tax of 0.16 ¢/kWh on the energy bill applied on each kilowatt-hour sold in the city and it aims to provide and facilitate capital to be used for energy conservation measures in the private sector. The Oslo Ekon Fund represents a perfect financing mechanism for energy efficiency and capital accumulation. It is estimated that since its enactment, the fund has contributed to approximately 2,258 GWh of energy savings. The Ekon fund has been generally underutilised in Oslo itself and surcharge on energy bills ended in 1991 as it became self-sufficient. Besides

⁴⁷ See more info here: <https://www.iea.org/policies/2878-climate-and-energy-strategy-for-oslo>

financing energy conservation, the fund supports renewable energy production like solar energy and gives grants to shift from old and polluting burning stoves to clean burning stoves. Oslo inhabitants can apply for funding from a national funding scheme, called Enova⁴⁸. As stated at the beginning of the introduction, more than a half of the world's population lives in cities, and according to the United Nations, by 2050 approximately two thirds will be living in an urban area.

Integrated environmental management

Oslo has adopted a focused and long-term approach to improving the environment. Diverse strategies and plans have been put in place by the city and implemented in more specific policy documents aimed at realising the measures defined in the more general Municipal Master Plan (MMP) and the Urban Ecology Programme by improving a specific area, field or sector of the city. The Municipal Master Plan is the general strategic document for the further development of the city; it presents the challenges to be faced by the municipality, sets the long-term goals to be reached and selects the relative strategies to achieve these goals. Most strategies and action plans are systematically evaluated every four years, concurrently with the revision of the MMP. Assessments are carried out by the City's experts, research institutes, consultants and through user surveys (including in-depth evaluations of the implementation and follow-up of cross-sectoral environmental targets). Such assessments can ameliorate the effectiveness of municipal policies and should be a core activity for many cities (EGCA Technical Assessment, 2019, p.52).

The Urban Ecology Programme 2011-2016 lists eight measures for environmental management, namely:

1. Reduction of noise levels, air pollution and GHG emissions
2. Implementation of an eco-efficient transport system
3. Environmentally sustainable urban development
4. Waste management based on a life-cycle approach
5. Maintain and strengthen the city's blue-green structure
6. Develop an eco-efficient city administration
7. Cooperate with the inhabitants, the business sector and the central government
8. Take part in the regional, national and global cooperation

⁴⁸ See more info here: www.iiec.org/news/298-results-center/profiles/307-oslo-norway-comprehensive-municipal-energy-efficiency-profile-79

The implementation of the Urban Ecology Programme has given birth to a variety of new environmental projects and sustainability initiatives, such as the improved recycling scheme in Oslo, the phasing out of oil heating in municipal buildings, the mitigation for low emission vehicles in the municipal vehicle fleet, and the introduction of environmental certification, of which the ‘Eco Lighthouse’ is a prime example⁴⁹. The city of Oslo has also adopted a Climate budget, an effective tool to share the responsibility for climate activities within the city administration and among partner organisations.

But one should be aware that there are more aspects to integrated environmental policy than climate targets alone. Oslo is an example of a city that has faced climate challenges in cooperation with local authorities, civil society and businesses. Stakeholders are involved through open meetings and public hearings, online channels, social media, working-groups, living labs and networks.

A Youth Council, an Elder Council and a Disabled Council are also present in the city. All these councils give political advice to the City Council and the City Government on matters concerning them. The City Council is obliged to take in consideration and evaluate all the initiatives supported by at least 300 inhabitants. Every citizen is encouraged to actively participate in the improvement of the city. Different mobile applications have been developed, for children and young people as well in order to enable them to report different problems and hazards in the city, such as slippery pavements, busy streets, cars parked in the wrong place, speeding vehicles, and so on. Several projects, such as the urban farm Losæter, have been realised with the help of the citizens, as well.

Highlights and Weaknesses of the measures adopted by Oslo

For each indicator, score, highlights (upper box) and weaknesses (lower box) are indicated

<p>Climate change: mitigation and adaptation Score: 1</p>	<p>Oslo has adopted a Climate Change Adaptation Strategy in order to become more climate resilient.</p> <p>Prevention will play a key role. Actually, among the most important measures there is the reopening of the ten main waterways also to prevent floods. Cross-sectorial and international cooperation and awareness raising are key factors for the strategy.</p>
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⁴⁹ See more info here: www.climateaction.org/climate-leader-papers/urban_ecology_in_oslo

<p>Local transport Score: 1</p>	<p>Extended and efficient public transport and cycle infrastructure encourage people to travel sustainably. Car use is discouraged by a car-free city centre. The purchase of diesel-driven vehicles is discouraged through high taxes. At the same time, the purchase of electric and plug-in hybrid vehicles is encouraged through low taxes.</p>
<p>Green urban areas incorporating sustainable land use Score: 2</p>	<p>The city of Oslo is compact, with high residential buildings, a large distribution of green areas providing recreation opportunities, high frequency public transport and bicycle infrastructures.</p> <p>This has benefited the Marka forest, which has been protected from urban sprawl.</p> <p>More of 98% of the population lives at least 300m next to a green area of 1000m².</p>
<p>Nature and biodiversity Score: 1</p>	<p>Nature and biodiversity conservation placed before incomes. Reopening waterways and protection of the Marka forest from urban sprawling to preserve biodiversity.</p>
<p>Ambient air quality Score: 1</p>	<p>PM10 reduction achieved.</p> <p>The levels of PM2,5 also went down.</p> <p>As of 2018, the levels of PM2.5, PM10 and NO2 comply both with European and Norwegian regulations.</p> <p>CO2 emissions are expected to go down in the next years.</p> <hr/> <p>For now, we can't say whether the 2020 goals have been achieved. However, the reduction in CO2 emissions was only 9.6% from 1990 to 2016, still not enough to reach the target set for 2020, which establishes that the reduction must be 36%.</p>

<p>Quality of the acoustic environment</p> <p>Score: 1</p>	<p>Noise reduction measures include lower speed limits and charges on studded tyres, construction of tunnels and noise barriers along carriageways and rails, regular maintenance of rails and road infrastructure and replacement of old trains with new ones. Indirect measures include grants to people living next to the port to enable them to insulate their dwellings. At the same time, the port of Oslo has built noise deflection walls, replaced noisy diesel engines with electric ones or asphalted the ground.</p>
	<p>One of the biggest problems of high-density cities is the increase in noise exposure. Therefore, measures addressing the problem are needed in order to avoid conflicts and altercations between citizens. Oslo has adopted several measures targeting different sectors in order to reduce noise levels. Despite this, noises beyond the thresholds still persist in some areas of the cities, e.g. along the busiest streets or by the waterfront. More and more conflicts have arisen between residents living next to the waterfront in the revitalised areas of the city and the general public, who have the right to waterfront access.</p>
<p>Waste production and management</p> <p>Score: 1</p>	<p>Well-developed Waste Management System based on the Waste Management Hierarchy and circle economy.</p> <p>Incineration and landfills are the less used forms of waste management.</p>
	<p>Although a large part of the WMS focuses on the awareness of the citizens, most of the food waste is not properly separated by them.</p>
<p>Water management</p> <p>Score: 6</p>	<p>Good quality of surface water sources.</p> <p>Works of renovation of water pipes and improvement of technology to detect water losses have halved water losses in the period 1995-2015. The reopening of the city's watercourses will also ensure better water management.</p>

	<p>High water consumption and distribution losses.</p> <p>Prices should be higher in order to discourage people from using too much water. Raising awareness should not be underestimated, as well.</p>
<p>Wastewater management</p> <p>Score: 7</p>	<p>Overall quality of bathing water is almost always excellent with the exception of rainy days.</p> <p>In the Masterplan for Sewage and Water Environment 2014-2030 the city outlined the need for safe wastewater management, climate change adaptation and indicated the concern regarding increasing pressure on the sewage system due to expected increase in population.</p> <p>The increasing population in Oslo is leading to a greater pressure on the sewage system. Therefore, the city must extend the capacity of its WWTPs.</p> <p>The application form for the EGCA does not take into account other considerable pollutants flowing into the Oslofjord (arsenic, cadmium, copper, lead, mercury and nickel). Swimming in the inner Oslofjord is now safe, contrary to a few years ago when swimming was not recommended because of poor water quality. However, increased attention must be paid to overflow discharges, leakage from sewers and treatment capacity.</p>
<p>Eco innovation and sustainable employment</p> <p>Score: 1</p>	<p>The Oslo Region (Oslo and the neighbouring county of Akershus) ranks between the first 25 countries with the highest HRST shares.</p> <p>With transition towards clean energy new jobs opportunities are arising. Increase of 5,4% in green jobs from 2014 to 2015.</p> <p>Development of a range of policies and programmes supporting eco-innovation. The Business for Climate Network, grants to climate, energy efficiency projects and social innovation programmes are among the most innovative ideas of the Norwegian capital.</p>

<p style="text-align: center;">Energy performance Score: 1</p>	<p>More than 90% of total electricity production in Norway is generated by hydroelectricity.</p> <p>Focus on phasing out fossil heating in buildings and replacing it with renewable energy.</p> <p>As of 2014 all new municipal buildings in Oslo comply with passive, zero energy or plus house standards.</p> <p>Massive electrification of the transport sector.</p> <p>In 2015, over 30% of new cars sold were electric or plug-in hybrids.</p> <hr/> <p>In this field, the involvement of all the stakeholders, citizens included, should be broadened, such as for strategy development processes.</p>
<p style="text-align: center;">Integrated environmental management Score: 2</p>	<p>Oslo has developed forward-looking, clear and integrated strategies in order to reach its targets. Systematic assessment programme for most strategies and action plans is carried out by City's experts, research institutes, consultants and through user surveys. Such evaluations should be carried out by more cities as they can significantly improve the effectiveness of policies.</p> <p>Oslo has a young technological-friendly society and is internationally well connected.</p>

3. Climate Budget: a key governance tool to achieve the objectives

In order to achieve the targets set, the Norwegian capital has introduced a key governance tool, namely the Oslo Climate's Budget. This tool works quite much like the city's finances. It was adopted by the City Council (the highest decision-making body in the city) in 2016, who introduced it as an integral component of the overall municipal financial budget.

It sets out the targets to be achieved, the measures to be adopted in order to reduce the carbon footprint and delineate the lines of responsibility. The greenhouse gases emissions concern all the actors of the city, citizens, businesses and the Government.

The main goal of the Climate Budget is cutting greenhouse gases emissions by 36% compared to 1990 levels by 2020, 50% by 2022 and by 95% in 2030. Carbon neutrality (setting GHG emissions to zero) is expected for 2050. The climate budget is revised every year and contains measures preventing excess emissions for the following years. All entities of the city of Oslo are responsible for taking the GHG emissions effects into consideration and for suggesting new effective measures to be introduced in the annual climate budgets. The City of Oslo's Climate Agency is responsible for calculating and monitoring the effects of the measures adopted. To this extent, it is possible to arrange a list of mitigations measures and their effect, which can be used as a governance tool allowing the reduction of the emissions. When it comes to GHG emissions, it is necessary to discern between direct and indirect emissions.

In this case, direct emissions are greenhouse gases emitted in Oslo as a result of actions within the city borders, for instance driving a high emission car in the city. Indirect emissions take place outside the city, but as a consequence of citizens' actions. In Oslo, only direct emissions are taken into account by the Climate Budget, since this is where the city can have a direct influence and control⁵⁰.

The methods used to create the statistics are steadily worked out and developed. However, this tool only makes conjectures about the future, thus the estimates are also uncertain. Nevertheless, annual improvements and the integration of new assessments have been lowering this uncertainty each year. A comprehensive analysis of the entire package of the measures is carried out in order to monitor the achievements of the annual goals.

The Oslo Climate budget is divided into more generation initiatives. The first generation initiative consists of 42 measures developed around the energy and build environment, resources and transport sectors. With the intention of achieving the total cumulative reduction, the CO2 reductions for each sector have been split up into single and distinct targets concerning energy/buildings, resources and transport.

The second generation initiative, launched in 2017 as part of the City's financial budget, consists of 36 measures developed to tackle GHG emissions from waste, buildings and transport sector, or rather the targets set out in Oslo's Climate and Energy Strategy. The aim of the measures is to cut 460,000 tonn emissions by 2020.

The third generation initiative was launched in 2018 (Climate Budget 2019). This third generation initiative remains a pioneering project in the sense that, the Climate Agency has been established as

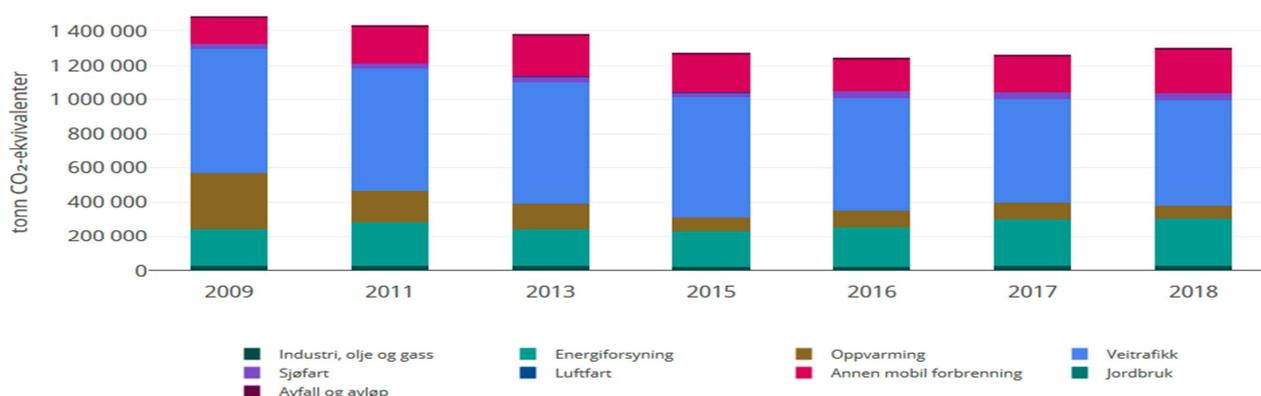
⁵⁰ See more info here: www.klimaoslo.no/2019/10/29/the-climate-budget-for-dummies/

a new specialist entity within the City and plays an important role by giving the analytical basis for the planning of the City's Climate Budget. As already anticipated, the Climate Budget 2019 has the ambition to bring the city's total emissions down by 36% by the end of 2020.

Hitherto, it is not possible to know until 2022 whether the City of Oslo has achieved its emission reduction targets for 2020, since these figures are not available until two years after the emissions have occurred, because it takes time to collect the data and compile the statistics.

However, Heidi Sørensen, Director of the City of Oslo's Climate Agency, stated that from what it is possible to see from the Climate Budget for 2020, the emissions are progressively decreasing and are expected to continue to fall in the future. (KlimaOslo, 2019). Drastic changes have been made in the transport sector, as cars especially and other means of transports are the biggest source of GHG emissions in the city, accounting in 2018 for 47% of the total emissions. The statistics have shown that the total emissions significantly decreased annually from 2009 to 2016. At the same time, emissions from road traffic went down, but increased again by 1.8% in 2018. The decrease in emissions from road traffic is the result of the forward-looking and efficient measures introduced in the transport sector and the larger share of electric cars. Likewise, emissions from building heating went down thanks to the support provided by the City of Oslo for the phasing out of oil heating and a ban on fossil oil heating. However, total greenhouse emissions in the city rose again by 2,9% from 2017 to 2018. In 2018, total emissions were 1.3% million tonnes of CO2 equivalents, of which 47% were from road traffic. Although passenger cars are the largest source of emissions (34%), these fell down by 1.4%, contrary to emissions from vans, heavy vehicles and buses which increased by 4.7% and 3% respectively. The increase in GHG emissions is mainly due to increased activity on construction sites (Andresen , 2020). From 2017 to 2018, only emissions from building heating went down (-21,6%) as shown by the graphic of the Norwegian Environment Agency.

Tab. 2 Sector-distributed emissions in Oslo per year, Norwegian Environment Agency



The calculations include the direct, physical emissions that occur within the municipality's geographical boundary. Carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) are included in the calculations. The emission figures are shown with unit CO₂ equivalents.

4. Tax cut for electric cars and diesel taxes: the Green Taxation Shift

Norway ranks first as the country with most electric cars purchased in the world. The country's success as leader in the promotion of electric vehicles is due to early and comprehensive policy interventions targeting both monetary aspects of vehicle purchases and aspects related to the comfort of use of low and zero-emission vehicles. According to a non-binding decision of the Norwegian Government, by 2025, all new passenger road vehicles sold in Norway should be zero-emission vehicles (ZEVs) (Steinbacher et al., 2018, p.1).

According to Statista (2020), Norway is today the country with the highest share of sales of plug-in electric vehicles. 48% of the vehicles sold in the country are battery electric vehicles and 20.4% are plug-in hybrid electric vehicles. According to the Norwegian Road Federation (OFV), of the total new cars sold in 2020 in Norway 52.8% were zero-emission cars. In Oslo, more than 30 % of all new cars sold in 2015 and 2016 (by Sept.) were EVs or plug-in hybrids. (Application form for the European Green Capital 2019 - Indicator 10). In 2017, the share of new fully battery electric and plug-in hybrid cars sold reached more than 50%. Today, electric cars make up 16% of total cars in Oslo, with 9% fully electric cars and 7% plug-in hybrids (Portvik S. & Christiansen S. E., 2018). Norway's leadership in the production of electric cars is driven by the government, supporting the growth of the market not with bans on diesel cars but with a wide range of incentives and benefits made progressively available since the 1990's. In order to incentivise the purchase of electric cars, the government has decided to introduce a tax exemption policy. Zero-emission vehicles are exempted from paying VAT until the end of 2021. Thereafter, the incentives will be revised and adjusted according to the market development. People deciding to buy plug-in cars are exempted from import tax and VAT on purchase, road tolls, ferry fees and city emissions charge. Citizens are also encouraged to purchase electric vehicles through free parking and grants for EV charging stations. However, in 2018, a parking fee for EVs was introduced locally with an upper limit of a maximum 50% of the full price. Furthermore, electric vehicles are allowed to drive on bus lanes. This measure, however, caused discontent among the public transport operators who claimed that congestion was not eliminated, actually it was increased on bus lanes (Steinbacher et al., 2018, p.6). Another challenge encountered by the Norwegian electric vehicle boom is the lack of charging

infrastructure compared to the high number of EVs on the road (p.1). In 2009-2010 the national charging infrastructure for rechargeable vehicles was being built. According to NOBIL's statistics, in march 2020, the whole country had 2,700 electric charging stations (ladestasjoner) and 15,525 charging points (ladepunkt), of which 14,178 were public⁵¹. Norway is doing a lot of efforts to solve the problem of lacking infrastructures for EVs, by making it smarter and more efficient. In cooperation with private companies, the City Council of Oslo will build fast chargers in the corridors in and out of the city.

Judging by the increasing share of people purchasing electric vehicles it seems that taxes on polluting vehicles and incentives have worked. The exponential growth of EVs has been possible by the public sector which gave people the opportunity to make affordable and simple choices. Road traffic is expected to decline as more people choose to travel by bicycle, by public transport or on foot.

5. Reorganisation of urban spaces

In this chapter I am going to examine some of the major projects which have contributed to changing the face of the city with the participation of the local community, as well.

Oslo is among Europe's fastest growing cities. During the last years the city has changed so fast and a reorganisation of urban spaces took place.

Oslo is the Norwegian municipality with the highest dwelling density. The built-up area makes up 147 km² of the total area and it has an estimated population density of 1628 inhabitants/km² (Statistics Norway, 2020)⁵².

Contrary to the predominant pattern of urban sprawl and geographical expansion, Oslo is characterised by an inner city with a compact structure combined with a high residential density and a mix of various activities. This urban structure enables the city to protect the surrounding forests from urban sprawl and at the same time allow people to live within 300 metres radius of a green area and to have infrastructure and services close at hand. Oslo is not the only Norwegian city to have developed this land use model. The compact city has been put forward as a way of obtaining sustainable cities in Norway for almost twenty years (Falleth and Saglie, 2013, p.1). The basic idea is to increase the density within already built-up areas so as to reduce the need for cars and therefore greenhouse gas emissions, and to protect green areas in the urban environment (Ministry of the

⁵¹ See more info here: info.nobil.no/eng

⁵² See more info here: www.ssb.no/kommunefakta/oslo

Environment 1992). In order to ensure sustainable modes of transport, densification and development of the city occurs along the railway, tram and metro networks as well as public transport nodes (International Energy Agency, 2019).

According to Falleth (2013, p.39) focus on the compact city in a sustainable development can be traced back to the World Commission on Environment and Development report “Our Common Future” from 1987, which in Norway gave inspiration to the “Nature and environmentally friendly Urban Development”, (NAMIT) research project.

As reported in many studies, the compact city can promote sustainability by reducing the amount of travel and shortening commute time, decreasing car dependency, lowering per capita rates of energy use, limiting the consumption of building and infrastructure material, mitigating pollution, maintaining the diversity of choice among workplaces, service facilities, and social contacts; and limiting the loss of green and natural areas (Bibri et al., 2020, p.1).

Compact cities and densification projects, however, also have downsides. Social segregation, gentrification, exclusion within public spaces, de-contextualised architecture, lack of social infrastructure and compromises regarding essential qualities of life are among the negative outcomes of the compact urban development strategy.

In the next paragraphs I am going to describe all the measures in the field of reorganisation of urban spaces that the city has implemented in order to reach its objectives.

5.1 Car free city-centre

The transportation sector accounts for the largest share of greenhouse gas emissions in Oslo. Following a significant reduction of 15% from 2009, the sector accounted in 2018 for 47% of the city’s total emissions, of which private cars are the main source (Oslo City Council, n.d). As a part of reduction of the CO2 emission, the city has decided to implement a car-free zone. In 2015, the Labour Party, the Green Party and the Socialist Left Party signed a statement for the period 2015-2019. This gave the foundation for the planning of a car-free centre in Oslo (Tønnesen et al., 2016, p.11). In 2017, the first changes in the centre of the city have taken place in order to give more room to pedestrians and cyclists, and create a vibrant space without cars. As part of the project, the city has removed parking spaces from the centre and other districts, and built new cycle lanes. At the same time, the number of parking spaces for disabled people has increased together with parking spots and loading zones for businesses (Wijnen, 2018). Apropos, if car traffic inside the city centre will be banned, then the consequences need to be evaluated. Actually, the concern for

disabled, good transportations, public transit and residents must be safeguarded. (Rydningen et al, 2017, p.3)

Other measures aiming to get cars outside of the city centre include grants to citizens for the purchase of electric cargo bikes.

As many other cities, Oslo has a ring road system. Oslo's road system consists of three rings. The car-free zone includes the entire area within the innermost ring, Ring 1. The area is 1.9 km², and includes the central railway station, Oslo's main commercial streets, shopping malls, and major nightlife districts (p.4). There are just over 1,000 people living within Ring 1, but 90,000 work in the same area (Johansen R, 2016, p.10). According to Rydningen at al. (2017, p.13) that residents within Ring 1 can be affected both positively and negatively in a pedestrian city centre. A city centre without cars offers many advantages for the residents, such as less road noise and air pollution. There will also be many opportunities for cultural events. On the other hand, cultural events and festivals lead to another type of noise for residents. In addition, if restrictions on cars are introduced before the extension of the public transport network, it would be bothersome for them to travel. However, as city centres are usually well provided with public transport, the residents living in this area have access to a wide range of transports. Oslo city centre is served by buses, trams, rapid transit (T-bane), and railways. Important public transport hubs are located on each side of side of the city centre area, by the National Theatre and the Central Station. (Tønnesen et al., 2016, p.9). The city is also working to develop new tram lines and new subway stations, to meet population growth. In 2019, the City Council, decided to launch a plan for the construction of a new metro tunnel from Majorstuen via the Parliament building to Tøyen. In further planning phases, it will be considered whether the tunnel should be extended further, besides the city centre. The number of stations and the specific location of stairwells will be considered in further planning phases. As reported by the public transport authority Ruter AS on its website, the new subway tunnel will double the capacity of the subway system.

Ruter AS also announced in 2019 its intent to develop a network of autonomous vehicles as an integral part of the public transport system in Oslo.

However, the public transport network extension is not sufficient to get cars away from the centre. The city of Oslo had already in 2005 an ambitious plan. In order to get the traffic away from the Bjørvika neighbourhood, a traffic tunnel (Bjørvikatunnel) was built under the port area and the Losæter municipal gardens, connecting Festningtunnel in the west with Ekeberg tunnel in the east. The tunnel has a length of 1.1 km, of which 675 built as a submerged tunnel, lower to the bottom of

the Oslofjord. When the tunnel was opened in 2010, large road areas in Bjørvika were released from cars for urban regeneration⁵³.



Before and after: Parking spots in Oslo's Huitfeldts Gate have been replaced by cycle lanes, Agency for Urban Environment, City of Oslo

5.2 Fjord city (Fjordbyen)

In January 2000, faced with the choice of developing Oslo as a Port City or as a Fjord City, the City Council chose the latter. It was a decision which meant that former port areas were to be freed-up for urban development. Consequently, the container port of the city was concentrated in the Sydhavna peninsula, while ferries and cruise ships still arrive at quay in the areas of Vippetangen, Revierkaia, Hjortnes and Akershusstranda. The Fjord City is an urban regeneration project concerning Oslo's waterfront, or rather an area stretching along 10 km of shoreline from Frognerkilen in the west to Sydhavna in the south-east with a total area of 228 ha. These areas overlooking the fjord of Oslo are meant to be used for housing, recreational facilities and businesses. In this way the city opens up towards the fjord and the waterfront becomes accessible for the citizens. Areas once dominated by port facilities, industry, road systems and other heavy infrastructure are now characterised by the presence of new public spaces, bathing places, promenades, residential areas, offices, cafes and restaurants; everything fully integrated with the fjord landscape and the surrounding forests (Nordregio, 2018)⁵⁴. The new project also provided new housing for approximately 9,000 and employment for 50,000.

Fjordbyen consists of thirteen development areas, each with specific objectives, times and actors. Each area has its own physical and historical preconditions for development; this adds variety and diversity to this large long-term regeneration project. The first waterfront developments took place

⁵³ See more info here: devi.danfoss.com/norway/prosjekteksempler/bjoervikatunnelen-oslo/

⁵⁴ See more info here: nordregio.org/sustainable_cities/fjordbyen/

in Aker Brygge in the 1980's, a former industrial port with shipyards reconverted into a wharf and currently characterised by the presence of cafes and restaurants.

After the renovation of Akerbrygge there has been a time gap in which the waterfront remained unchanged until 2008, year of the approbation of the Fjord City Plan by the City Council⁵⁵.

5.3 Bjørvika

The area that today constitutes Bjørvika neighbourhood represents important parts of Oslo's history before the Middle Ages up to the present day. It is exactly in this area, located in the middle of the rivers Akerselva and Alna, that the foundation of the city of Oslo started. In the past, Bjørvika played a key role in terms of military and communicative advantages and was an exchange point between the sea and the rich inland areas of Eastern Norway. After the city fire in 1624, King Christian IV decided that the city should not be rebuilt, but that a new city, Christiana (former name of Oslo), should be built on the west side of Bjørvika, with the consequent loss of centrality of the latter (Røisland & Co, n.d)⁵⁶. Today Bjørvika is a vibrant neighbourhood and it is here that the most fundamental changes took place. For decades, this area has been full of barriers (highways, railways and closed container ports) hindering Oslo from having access to the waterfront. The decision to relocate the industrial port outside the city limits and to divert the E18 motorway into a submarine tunnel gave back to Bjørvika district his crucial role in Oslo's future development, allowing the construction of new public areas, work and residential areas (Labadini A., 2014)⁵⁷. The area where shipyards, loading docks and boat sheds dominated, is now people centred. Work and social life will be the leitmotiv of the reconverted neighbourhood. Bjørvika will be Oslo's new cultural centre, as activities and organisations are moving here. Iconic in Bjørvika are the new Oslo's Opera House (Operahuset) and the Barcode row of commercial and residential buildings. It is here that the construction of the new Munch Museum and the Deichman Public Library took place.

A focus of the Bjørvika project was put on environmentally friendly building materials and energy efficient alternatives. A key concept in the development project is "sustainable development", but it is unclear what the concept implies (Skrede J., 2013, p.1).

According to Skrede (2013), "one of the leading discourses on sustainable development in Bjørvika is the discourse on densification and sustainable mobility; it stresses the importance of clustering as many people as possible near public transport hubs, thus relieving them of the need to travel by

⁵⁵ See more info here: theportandthecity.wordpress.com/category/oslo/

⁵⁶ See more info here: boibjorvika.no/om-bjorvika/historien-om-bjorvika-fra-middelalderen-til-i-dag

⁵⁷ See more info here: www.area-arch.it/greetings-from-fjordbyen/ (Italian)

car”. Tower blocks, such as the Barcode row, are a method of increasing density at transport hubs and central areas, and the higher the concentrations, the fewer reasons there will be to drive (Fossen E., 2004, p.40). In this way, the city is able to reduce the emissions from cars as people living in proximity to their workplace and transport hubs can move on foot or by bicycle. According to Kine Halvorsen Thorén, teacher at the university of Ås, densification is basically taken to mean sustainability, but it needs to be “balanced against the need of having outdoor spaces and green lungs close to where people live” (Lundgaard H., 2007a, p. 9). As reported on the website of Bjørvika Utvikling AS, the society having the overall responsibility for all public space construction in Bjørvika, 40% of the neighbourhood’s area will be turned into parks, commons and a 3km long waterfront promenade. In 2015, the park and the swimming area at the edge of Sørenga opened to the public and Losæter, a place where art and urban agriculture intermingle, has been established. The TØI report “Environmental effects of central hub development/Miljøeffekter av sentral knutepunktsutvikling” (2013) shows that construction of office buildings for 12,500 jobs in Bjørvika will save Oslo 7.300 car trips and 104.000 vkm a day. This saves 12 tonnes CO₂emissions, 12 kg NO_x emissions and 7 kg NO₂ emissions a day, as well as 18 MWh of energy for transport.

However, when we talk about sustainability, we refer to four dimensions which must be taken in consideration in a balanced and integrated manner and monitored in all the phases of a project: environmental, social, human and economic. People have a need for recreation as well. Their right to outdoor recreational areas and green lungs is of primary importance, as it can affect health and quality of life. Environment and air quality are interconnected, as vegetation filters and absorbs polluted air from harmful particles and dust. The discourse about green lungs accentuate the ecological conditions of human beings. This is a necessary but not sufficient measure when it comes to social sustainability. Particular attention should be paid to ordinary people's needs, as they could be excluded from these types of projects. Developments projects (in particular densification projects) not taking into account the needs of the lower classes provide fertile ground for social segregation, gentrification and exclusion with public spaces. Many fear that Bjørvika could become an area only for rich people, preventing access to the less well-off. Despite the concerns, Bjørvika Infrastruktur, a wholly owned subsidiary of Bjørvika Utvikling, sought to assure people that the renovated neighbourhood would provide housing for everyone and that different housing size and price would underpin social sustainability by including different groups of people from the very beginning (Bjørvika Infrastruktur, 2007, p. 29). Lars Bratseth, Real Estate Agent at Røisland & Co,

claimed that, considering the unique location, buying a new apartment in Bjørvika is relatively cheap compared to other new residential areas in the city. Bratseth continued, pointing to historical examples of solid price growth in the neighbourhood. According to his words, several of those who chose to buy an apartment in Bjørvika at an early stage have already been able to bring with them a solid increase in value. The RA Agent used as an example the case of a two-room apartment in the KLP building part of the Barcode complex which was purchased in 2010 and resold in 2019 with an increase in value of 66%⁵⁸. However, there are still many concerns regarding the issue of accessibility. According to Ingeborg Apall-Olsen (2012) the diversity in Bjørvika is limited to a certain variation in material components, such as different urban spaces with different functions and offerings. According to her, the development of the neighbourhood is moving towards a socially and culturally homogeneous society. Furthermore, the area is designed with elements that can be perceived as exclusive to parts of the population and that it risks becoming an uninteresting district for many groups (p.92)

5.4 Bjørvika: Losæter

One of the most important projects in terms of environment and urban regeneration has been realised by Flatbread Society, a group of people with different professional backgrounds (farmers, oven builders, bakers, soil scientists, artists and so on). In 2013, the Flatbread Society together with the artist group Future Farmers, built a temporary bakehouse in one of Bjørvika's seven common lands (called in Norwegian "allmenninger"), namely a place for events related to art and urban agriculture. In 2015, different farmers from all over Norway transported soil from their farms to the area around the bakehouse, giving birth to the first urban farm in Oslo, Losæter. Before the industrialisation and development of the port, Losæter, located along the waterfront of Bjørvika neighbourhood, was already an important urban agricultural area, and now it is once again making agriculture a central part of Bjørvika's cultural landscape. Losæter is actually part of Bjørvika Utvikling (Bjørvika development) public art program and the goal is to make the area a permanent social place for food production, architecture, education, art and culture. Since 2012, Flatbread society has been working in this permanent common area with local people in order to establish a coherent and common vision for its use. In order to enhance people's awareness about the importance of this project, different workshops have been organised in Losæter. Today, more than 400 people from different parts of the community are involved in this project. The initiative will be

⁵⁸ See more info here: boibjorvika.no/om-bjorvika/trygt-a-kjope-nytt-i-bjorvika

an opportunity to stimulate social cohesion, exchange knowledge and relationships, but also safeguard and renew living traditions of different cultures.⁵⁹

5.5 Vulkan

One of Oslo's most innovative and sustainable urban development projects has been realised in a former industrial site on the western bank of Akerselva River, in Grünerløkka district. Built upon the idea of sharing localities and resources, the regenerated area of Vulkan is characterised by multi-functionality and diversity. The area, nearly self-sufficient in energy for heating and cooling, is home to innovative and ecological architecture. All the new buildings in the area have an energy classification A or B. Distinctive in Vulkan are a local power plant with geothermal wells reaching up to 300 meters deep and an office building, the Bellonahuset, using solar panels for heating and cooling. The area also includes two hotels, an advertising school, a food hall, office spaces, restaurants and apartments.

The Vulkan district brings together many different actors in the field of culture and creative business. Dialogue and cooperation between the municipality and the developers have been a successful factor in the regeneration of one of the gloomiest and least accessible downtown areas in Oslo. The attractiveness Vulkan is influenced by the mix functions and, between historic and modern architecture.⁶⁰

5.6 Preserving the ecosystem: the bee highway

Increasing population and anthropogenic land use are among the main causes of biodiversity change and loss, negatively impacting some species groups, including insects. (Theodorou et al, 2020, p.2) Pollinating insects are an integral part of cities' natural capital and support important ecosystem services (Stange et al, 2017) such as pollination, soil formation and control of herbivorous pest species. Pollination is a crucial ecosystem service not only in natural but also in agricultural and urban ecosystems (Theodorou et al, 2020, p.2). Therefore, integrating the conservation of biodiversity and ecosystem services into urban planning is essential when it comes to plan the urban space. That's why Oslo decided to create a "bee highway", aiming to give the insects a safe passage through the city. Finding places to eat and sleep is actually challenging for bees, especially in bigger cities. Bybi, an organisation with focus on biodiversity, applied measures making it possible for bees to settle in the city. Green roofs and lush parks enable bees to find resting places and food

⁵⁹ See more info here: www.bjorvikautvikling.no/portfolio-item/art-projects/

⁶⁰ See more info here: [//vulkanoslo.no/en/about-vulkan/](http://vulkanoslo.no/en/about-vulkan/)

almost everywhere in the city. Locals plant flowers on balconies and roofs, bug hotels and beehives contribute not only to preserving the ecosystem but also to increasing green in cities and enhancing their attractiveness.

6. Oslo as a Smart City

The challenges of the cities are changing rapidly. Cities are growing and urban population is rising, but so are congestion, air pollution, road accidents and climate change. Moreover, cities are responsible, directly or indirectly, for approximately three quarters of all energy consumption and greenhouse gas emissions (European Commission). Therefore, they are required to rethink their development models and keep up with innovations and the digital revolution if they want to become more sustainable, livable for citizens and attractive internationally. Being a globally recognised smart-city is nowadays paramount in order to attract investment and talent (IMD Alumni network, 2019)⁶¹. By the same token, new mobility management and governance models that enhance public transport and introduce new types of sustainable transport models have to be developed. “The creation of smart cities is a motivator for growth, new jobs and is a productive investment in Europe’s future, leading to a sustainable, low carbon and environmentally friendly economy, as well as putting Europe at the forefront of renewable energy production” (European Commission). “The transformation of the way energy is produced, consumed and transported in the EU will require commitment, dedication and innovation with and between actors in many sectors” (European Commission). What is the definition of a Smart City and what are the criteria for which Oslo can be considered as such? At present, there is no official and generally accepted definition of the concept of “smart city” (Naydenov K, 2019, p.528). However, anyone agrees on the fact that a Smart City utilises and integrates multiple information and communication technology (ICT) and Internet of Things (IoT) solutions in a secure manner to develop and manage a city’s key area. Through the use of technology Smart Cities try to reach sustainable development, increase the quality of life of the citizens and improve the efficiency of the existing and new infrastructure. Berntzen and Johannessen (2016, p.2) define a Smart city “a label or statement to indicate that the city is actively pursuing use of modern technology to increase the quality of life in urban space, both by improving the environmental conditions and delivering better services to its citizens.” There are many dimensions that contribute to making “smart” a city: a sustainable environment, intelligent and integrated mobility, dynamic and safe social living, a

⁶¹ See more info here: www.imd.org/research-knowledge/reports/imd-smart-city-index-2019/

well-governed, informed and participatory city. However, nowadays the definition of Smart City is increasingly linked with human-centred approaches and governance models. The idea of Smart City as a technological city has been criticised by many academics. Söderström (2014), stated that the transformation of a city into a “smart” one is a hidden excuse for ITC companies to gain more power, going against the idea of technology as a cure-all for the progress of cities. According to Söderström this idea takes over the essential role of policies. Hollands (2008, p.315) instead indicates the need to adopt “a more progressive form of smart cities”, starting with people and the human capital rather than believing that IT can automatically transform and improve cities. Hollands took this subject up again in 2014 by introducing the idea of an “alternative smart city” where technology is used for social purpose, to empower local communities and to monitor equal access to urban infrastructure. In this context, a smart city reveals itself when bottom-up initiatives find support in the use of new technologies that contribute to the emancipation of local communities (Diamantini and Borrelli, n.d, p.117). Other scholars, such as Deakin and Cruickshank (2014, p.150) on the contrary, prefer to make a distinction between Smart Cities and Digital Cities. In particular, they argue that although the technological aspect is central in both models, unlike Digital Cities, Smart Cities also give great importance to the human dimension. Komninos (2013) introduces the concept of a “people-centred smart city”, asserting that a Smart City must give space to learning and innovation and that it is based on the creativity of its local community and its institutions, both on digital infrastructures for communication and knowledge management. The technological dimension, which derives from the Digital City model, is fundamental in a smart city, but it is not enough. Innovation, creativity, knowledge, individuals of the local community and technology are all elements of a Smart City. According to Komninos, a Smart city is a collective city that arises from collaboration. For a city to be defined “smart”, cooperation between citizens and administrators is essential. Participation, involvement, dialogue, interaction and listening are all elements that make the administration of a city transparent and without them a Smart City can’t exist. A prerequisite for effective participation is that citizens are actually heard, and their opinions evaluated (Berntzen and Johannessen, 2016, p.5). “Participation can be achieved in different ways, with or without the use of technology. Focus groups, surveys, polls, dialogues, and town-hall meetings may be significant measures to collect citizen opinions” (p.13). As already discussed in this study, Oslo is an example of a city that has worked and faced climate challenges in cooperation with local authorities, the inhabitants and the business sector. The city has adopted a bottom-up approach, enabling private people and organisations to have a voice and express their needs and

desires. Stakeholders have been involved through open meetings and public hearings, online channels, social media, working-groups, living labs and networks. The success of Oslo as a Smart City is mainly due to the culture and the social structure of the country. Norway has an informal and egalitarian society and there is a short distance between people and power. Moreover, Oslo has a very young and technology friendly society and the city has everything it needs to create an innovative environment. The norwegian capital aims not only to become economically sustainable and energy self-sufficient, but is also attentive to the quality of life and needs of its citizens. Actually, being a “smart city” also means being attentive to the needs and desires of the citizens (Berntzen and Johannessen, 2016, p.13). Oslo is a city that innovates with the citizens’ interest and well-being at the core (Oslo City Council, n.d). The city has pursued an active and innovative approach to include citizens in their plans (European Commission, 2019). Information and communication technologies play an important role in citizens’ decision making. It is “a considerable opportunity for ICTs to reshape how citizens and states engage with respect to urban planning and development processes” (Smørðal et al., n.d, p.7). Smørðal continues by saying that, “enhancing citizen participation is however not only a question about developing and introducing new technical tools, but also about actually making them work in urban planning processes and systems of urban planning practice.” A “Business for Climate Network” fosters cooperation between the city and its business community, citizens and NGO’s in addressing the impact business operations have on the climate. (European Commission, 2019). “Democratic design experiments focusing on green mobility and blue-green infrastructures have been carried out in selected Norwegian cities in collaboration with planners, citizens, and other actors to identify their needs, challenges and interests, and to develop, test and evaluate ideas and prototypes for digital tools that can be applied both in Norway and in other global cities” (Smørðal et al., n.d, p1). Oslo immediately recognised the importance of investing in smart projects and today is one of the most forward-looking cities in the world. The vision for the city is to make it smarter, greener, more inclusive and creative for all citizens (Oslo City Council, n.d). The city of Oslo ranked 3rd in the IMD Smart City Index 2019 presented by the IMD World’s competitiveness Centre’s Smart City Observatory. The evaluation has taken into account five indicators: health and safety, mobility activities, opportunities (work and school) and governance. There is a wide range of smart projects in Oslo, from testing el-buses, zero emission construction sites and retrofitting existing buildings to developing circle-based waste management and green energy systems (Oslo City Council, n.d)⁶².

⁶² See more info here: www.oslo.kommune.no/politics-and-administration/smart-oslo/smart-oslo-strategy/

The city has also developed a wide range of public city apps. Among the most important there are:

- Activities app for youth in the diverse districts of the city
- BYMelding: is an app allowing citizens to report issues and deficiencies in the city through smart phone functionalities such as pictures, GPS positions and textual messages. The reports are processed immediately by the Urban Environment Agency of Oslo (Bymiljøetaten) and forwarded to the correct sub-contractors so that they can deal with the issues.
- Ruter's mobile app enables users to buy tickets before getting on board of any public transport.
- PEL: gives access to parking for electric cars in the city

Conclusions: achievements of the policies adopted

The main aim of this study was to examine the recent transformations of the Norwegian capital from an environmental, urban and social point of view and to show changes in the urban structure and the quality of air during the last years through historical data. First of all, I have researched and examined all the measures that the City of Oslo has introduced to satisfy the twelve indicators established by the European Commission for the EGCA. It is important to clarify that the European Green Capital Award does not only focus on cutting greenhouse gas emissions, but also provides a series of indicators that cities must satisfy in order to be awarded. Most of the twelve indicators of the EGCA concern environmental aspects but also take in consideration all the four pillars of sustainable development (social, human, economic and environmental). Oslo has always paid particular attention to sustainability issues. The city has adopted a holistic approach in order to preserve the environment and support its citizens . But this is not the only reason why Oslo has been chosen by the European Commission. Oslo has adopted one of the most ambitious climate strategies in line with the Paris Agreement and is the first city in the world with its own climate budget. The city has launched a CO2 reduction process aiming to cut emissions by 50% by 2022 (compared to 1990 levels), by 95% by 2030 and to become a zero-emission city by 2050. Therefore, in order to analyse the emission trends in Oslo, I have decided to conduct a research on the Norwegian Institute for Air Research (NILU - Norsk Institutt for Luftforskning) and the Norwegian statistic websites. Subsequently, I have checked the emission limits for the most common air pollutants set by the European Union and by Norway and to compare them with actual emissions. In this context, the results showed that the air quality in the city has significantly improved over the last years. Both the

annual average of PM10 and PM2.5 at measuring points in Oslo comply with the limit values established by the NIPH and the Norwegian Environmental Agency. Annual average of NO₂ exceeded 40 µg/m³ at 3 out of 7 measuring points in Oslo until 2017. Measurements clearly showed that yearly averages of NO₂ in the air have been significantly reduced over the last years, and in 2018, for the first time, all monitoring sites in Oslo met the yearly limits for NO₂, without exceeding 40 µg/m³. However, the values are still close to the legal limits. The main reasons for the decrease in NO₂ can be attributed to the introduction in the city of cleaner vehicles and the slight reduction in the number of cars passing the toll ring. It also seems that warmer winters have contributed to the decrease (Oslo City Council, n.d). However, exceedances for hourly concentrations of NO₂ are still observed at some measuring stations in highly trafficked areas. Hitherto, it is not possible to know until 2022 whether the City of Oslo has achieved its emission reduction targets for 2020, because this data is only available two years after the emissions have occurred and it takes time to collect the data and compile the statistics. According to climate budget statistics GHG emissions (exclusive of maritime traffic and aviation) reached 1,200,000 tonnes in 1990 and 1,085,215 in 2016 (Climate Budget 2019). This is a significant reduction of CO₂ emissions (-9.6%) but not yet sufficient to reach the target for 2020. After all, thanks to the increasing share of electric vehicles and all the other measures implemented by the city to reduce cars, emissions from road traffic have rapidly decreased, accounting for 47% of total city emissions in 2018. Emissions from the building sector have significantly decreased, as well, from 17% to 6%. It is clear that measure banning the use of fossil fuels for heating and establishing a transition towards electric heating worked perfectly. All that remains is to wait until 2022 for the figures of emissions in 2020 in order to know if the city has managed to completely cut emissions from buildings. However, judging by the drastic reduction over the last years, the transition towards electric heating and the construction of new buildings satisfying the highest energy standards, one could think that this target has been achieved.

The success of Oslo as a model for sustainable development is largely due to its urban structure. Thanks to its natural and local conditions, the city has managed to grow up compact and implement several measures promoting sustainability. Through the construction of high buildings with high residential density, efficient public transport, proximity of dwellings to public transport stops, workplaces and shops, Oslo has limited urban sprawl and protected the surrounding forests. One of the most important measures has been the implementation of a car-free city centre, which enabled the city to prioritise people over cars. In addition, the urban zone of Oslo is flat and for this reason it

is suitable for cyclists. In my opinion, this model is hardly applicable in big cities with hugely different levels of elevation. For instance, it would be really challenging to increase the share of cyclists in cities with many uphill; but also with large distances between workplaces, dwellings, shops and other spaces where daily life takes place. Climate is another factor influencing the travel mode choice. Rain and snow precipitations have a strong impact on mode choice much more than wind. Comparing Oslo with another Norwegian city on the coast, such as Stavanger, it is possible to understand the differences between cities when it comes to choose the travel mode. Wind and rain precipitation have a stronger effect in Stavanger than in Oslo, therefore car use is much more higher in the former case. According to a report by TØI, in Stavanger, car-driving is typical in all seasons on both commuting and shopping, while in Oslo people travel by public transport to and from work, and around 60% walk when shopping (HJORTHOL, 2016, p.28). Obviously, there are other factors determining the choice of the means of transport, such as socio-demographic variables and people's values and attitudes. However, in this case I have decided to focus my attention only on natural and local conditions rather than social variables. Despite the differences between cities in urban structure and natural conditions I believe that Oslo can be a model for other cities willing to build a more sustainable society to live in and that many of its policies are replicable. Whether a city is small, medium or big size, cooperation between all the stakeholders is paramount. Oslo has been able to achieve many of the goals because of close collaboration between all the stakeholders and the adoption of a bottom-up approach. When it comes to make management decisions these aspects should never be underestimated. Anyhow, I believe that, citizens as well, must show willingness and readiness to change; in fact, many do not always agree with the measures adopted by city authorities. Therefore, good communication between all the stakeholders and involvement of citizens in city decisions is indispensable, as some measures implemented by authorities might negatively affect some residents' life. In this case, it comes to my mind the implementation of the car-free city centre, a decision overturning habits of people living in the centre. However, as already discussed, the consequences of the traffic ban in the city centre have been evaluated by Oslo before the implementation of the measures and an extended and efficient public transport network has been introduced already before the ban on fossil fuels vehicles.

The success of Oslo as a sustainable city is mainly due to the culture and the social structure of the country. Relations between people in the Norwegian society are quite informal and the distance between people and power is really short. Moreover, Oslo's young population is tech-oriented and, as highlighted in the statistics conducted by Eurostat, the Oslo region ranks between the first 25

countries with the highest Human Resources in Science and Technology rate. According to the Organisation for Economic Cooperation and Development (2019), Norway has an above-average share of the population aged 25-64 with tertiary education (44% compared to the OECD average of 39%). With this in mind, it is noticeable how the City has been able to demonstrate that education contributes to community development and betterment of society. To conclude, we can't be sure whether the City of Oslo will achieve all its goals and become a zero-emission city by 2050, but we can say that it could be defined as a sustainable city. The Norwegian capital has taken in consideration all the four pillars of sustainable development by: ensuring environment conservation, meeting the needs of the population without compromising the needs of future generations, promoting social inclusion and relationships, supporting equality and ensuring access to essential services, investing in health and education systems, giving citizens the opportunity for self-development, and last but not least, ensuring economic sustainability by maintaining high and stable levels of economic growth.

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