

GRØNN STRATEGI

GREEN STRATEGY

CLIMATE AND ENERGY ACTION PLAN FOR BERGEN

Decided by the City Council on september 21st 2016



BERGEN
KOMMUNE

Preface

The biggest challenge of our time is anthropogenic climate change. Solving the climate problem requires effort on the part of the general public, business and industry and public authorities. Sustainable growth in the biggest towns and cities is a prerequisite if Norway is to attain its climate goals. Bergen shall be a driving force for renewable energy and green, sustainable business. The City Government's ambition is for Bergen to become the greenest city in Norway.

Green urban development is the key to a sustainable city. Bergen must cooperate more closely with its neighbouring municipalities on new development plans. The pace of development must be increased considerably in order to accommodate the population growth. New development projects that contribute to increased emissions from the transport sector shall, as a rule, not be granted approval.

Buildings account for a large proportion of the city's energy consumption. The City Government will work to promote increased use of more sustainable, efficient land-use solutions such as passive houses, plus houses, green roofs, climate-friendly ventilation systems and the use of solar energy. The municipality has particular responsibility for ensuring that public buildings are as environmentally friendly as possible.

The City Government will strengthen its efforts relating to the removal of toxic material in the sea and in the soil, for example in the Puddefjord, in Store Lungegårdsvannet lake and in the Slettebakken area. We will make use of national funding schemes and apply for state aid for major projects.

Driving a car shall not be a prerequisite for leading a good life in Bergen. Pedestrians, cyclists, buses and light rail shall be prioritised ahead of private cars. Pedestrian lanes and footpaths shall therefore be included in new zoning plans. The City Government will work to establish bus and taxi lanes on the most heavily trafficked roads leading into Bergen.

Car traffic is a major contributor to local and global pollution. The City Government will employ restrictive measures to limit car traffic. The City Government endorses the City Council's goal of a 10% reduction in car traffic by 2020. At the same time, we must encourage the use of more environmentally friendly cars. The financial advantages for electric cars, hydrogen cars and other zero-emission cars at the municipality's disposal should largely be upheld until 2020.

Shipping is a major contributor to local air pollution. The City Government will continue the work on electrifying the port, and use its authority to turn away ships on days when the air pollution reaches harmful levels. The work on environmentally differentiated port charges must continue.

Cycling is an environmentally friendly and healthy alternative to cars and public transport. The City Government will work to accelerate the construction of pedestrian and cycling lanes in the municipality. Coherent cycling lanes through the city centre shall be given priority. The City Government will propose a city bike scheme, modelled on other European cities.

Efficient waste management and recovery is a precondition for good, local environmental policy. The City Government will work to promote increased recovery of household waste and environmentally friendly waste management. The underground vacuum waste collection system must be further expanded.

The municipality shall include requirements for climate and environmental considerations in competitive tendering processes, and emphasise innovation. The City Government wants to raise the

level of expertise relating to tendering and procurement processes in the municipality, and will work to achieve better quality control and follow-up of contracts. Growth takes place in the biggest towns and cities. So it is there that the climate problems must be solved.

Julie Andersland
Commissioner for Climate, Culture and Business Development

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Fløybanen funicular. PHOTO: Håvard Holme

1. Green strategy for Bergen

Bergen shall play an active role in realising the UN's sustainable development goals. Global warming is the biggest environmental challenge of our time. Big cities have a special responsibility for ensuring that development becomes more sustainable. It is here that the population increases the most, and a greater proportion of the Norwegian and global population will live in cities in the future.

At the UN Climate Change Conference in Paris in December 2015, the participating countries agreed to limit global warming to 1.5 °C. The agreement entails a commitment to pursue the goal of a maximum temperature increase of 1.5 °C above pre-industrial levels. The UN Intergovernmental Panel on Climate Change states that an increase in the Earth's mean temperature of 2 °C is the tipping point for when climate change becomes catastrophic and irreversible.

Bergen wishes to lead the way towards a sustainable planet and therefore introduces the concept of the 1.5-degree city by 2050. The goal is for the people of Bergen to limit their climate footprint in line with the UN agreement on climate change. In 2050, we will have succeeded in ensuring that the people of Bergen do not contribute more greenhouse gas emissions than the Earth can handle. Renewable energy, resource efficiency and a circular economy shall help to ensure that the city grows without causing a corresponding increase in its climate footprint.

The City of Bergen shall be a pioneering municipality in environmental friendliness, sustainable development and adaptation to climate change. Environmental considerations shall be the principle governing all activities and planning. Leading an environmentally friendly life shall be easy in Bergen.

Achieving these goals requires the involvement of all parts of the city. The business sector, universities and university colleges, non-profit organisations and the people of Bergen are important players in this context. The City of Bergen plays the role of municipal authority, facilitator and driving force, and shall set a good example as a green enterprise. The Green Strategy demonstrates Bergen's clear ambition to reduce its contribution to greenhouse gas emissions.

Greenhouse gas emissions include both direct and indirect emissions. Direct emissions can be linked directly to an activity. An example of this is driving, which causes CO₂ to be emitted from the exhaust pipe because of the combustion of petrol in the engine. Indirect emissions are not linked directly to an activity, but to the production of a product or service. Eating meat or buying a new shirt or a new computer does not cause direct greenhouse gas emissions, but the production has involved the use of energy and the emission of greenhouse gases.

The Green Strategy emphasises Bergen's direct emissions, because it is these the municipality has the greatest chance of doing something about in the short term. The goals refer to these emissions. Indirect emissions and the people of Bergen's climate footprint are only discussed to a limited extent. We have nonetheless chosen to include the use of materials in buildings and measures concerning consumption patterns because here the indirect emissions far exceed the direct emissions in total. The next time the Climate and Energy Action Plan is reviewed, indirect emissions will therefore be an important topic.

The Green Strategy is a plan for the city that shows how it can become fossil-free by 2030. The plan is based on the social element of the municipal master plan, which was adopted in 2015. Work has begun on the land-use part of the municipal master plan, which will be based on the social element and the Green Strategy.

Concrete goals and measures to be implemented in the municipality's operations will be set out in a dedicated Climate and Environmental Plan for the City of Bergen's activities.

1.1. *Framework and conditions*

Population growth

The City of Bergen's own prognoses indicate that the population will exceed 325,000 in 2030 and 355,000 in 2040. We must handle this growth without increasing our energy demand and our impact on the climate and environment. The principles of reducing greenhouse gas emissions and protecting biodiversity shall form the basis for the further development of the city.

Bergen does not buy emission allowances

Emission allowances are not part of the City of Bergen's strategy for a fossil-free society. In Bergen, we will use our resources to create a climate-smart society by implementing measures in our own organisation and in the city. In order to achieve good, lasting results, we will learn from others and develop good solutions by cooperating at the regional, national and international level.

Norwegian law

The goals and priorities set out in the Norwegian Government's climate policy towards 2030 entail that Norway is to reduce its emissions by 40% from 1990 to 2030. The goal shall be achieved without the use of international credits. The decision made it clear that Norway shall achieve substantial national reductions in sectors that are not subject to the duty to surrender emission allowances, especially the transport sector and the building and construction industry, and that Norway shall continue the practice of additional policy instruments in sectors that *are* subject to the duty to surrender allowances, especially in industry and in the petroleum sector.

In March 2015, the Storting asked the Government to present a draft climate bill. It shall define long-term climate goals for 2030 and 2050, and ensure that the goals are achieved.

1.2. *Challenges outside the municipality's remit*

The climate challenges for the Norwegian transport industry can be simplified and summarised in three main points:

- private cars
- air travel
- goods transport by road and sea

Climate measures that make a difference are initiatives that, directly or indirectly, manage to drastically reduce greenhouse gas emissions from one or more of these sources.

Railway transport is energy efficient. For example, there are no direct greenhouse gas emissions from electric trains. A high-speed train connection between Oslo and Bergen can reduce the number of journeys made by plane considerably. Electrification of road and sea transport, and the use of biofuel, biogas, hydrogen and hybrid technology all represent a huge potential to reduce greenhouse gas emissions.

The use of taxes and charges has a major impact on people's choices. For example, there has been a marked increase in the sale of electric cars in Hordaland county. So far in 2016, every third car sold in Bergen has been an electric car.

The biggest urban regions will play an important role in a major national initiative to make the transport sector more environmentally friendly. For example, cooperation between national and local authorities will be decisive in the phasing in of hydrogen for transport purposes.

Transport needs are affected by cooperation between several municipalities. Many different factors play a role in this context, including where residential areas, service institutions, workplaces and shops are located, in and between the municipalities in a region. It is important that the municipality cooperates with its neighbouring municipalities, at the regional level, especially with the county authority as a regional planning authority, and with public agencies such as the Norwegian Public Roads Administration, the airport operator Avinor, the Norwegian Rail Administration and the Norwegian Coastal Administration on reducing emissions.



PHOTO: Christine Hvidsten

1.3. *The municipal master plan governs the climate action plan*

The social element of the municipal master plan, called *Bergen 2030*, was adopted by the City Council on 24 June 2015. Our vision for the future is an ACTIVE and ATTRACTIVE city. The City of Bergen will meet the challenges it faces in the period up until 2030 by developing a more compact, well-functioning city where people move more in their day-to-day lives.

The plan governs future climate efforts in Bergen. The plan states that ‘Bergen shall take its part of the responsibility for preventing global warming by facilitating a climate-smart society by 2030’ and ‘Bergen shall be forward-looking by facilitating a climate-smart society’.

The social element of the municipal master plan addresses the following areas, among others:

- considerations of the climate and environment
- living conditions and public health
- a well-functioning urban structure with forward-looking transport solutions
- house building
- regional cooperation
- value creation and knowledge development
- the municipality as the biggest workplace in the region
- good services for the city’s inhabitants

The plan describes five key strategic areas for realising the vision of an active city: *pedestrian-friendly, forward-looking, green, committed and driving force in the region*. In addition, four key strategic areas are defined for realising the vision of an attractive city: *compact, diverse, safe and unique*.

The main goal of ‘green’ comprises the following initiatives:

1. Bergen shall see sustainable growth that takes considerations of the climate and environment into account.
2. Bergen shall invest in modern, environmentally friendly architecture and renewable energy.
3. Bergen shall invest in smart, green mobility that better utilises the capacity in the transport system.
4. The City of Bergen shall facilitate smart resource use by promoting shared use and a culture based on sharing.
5. Bergen shall facilitate and contribute to the green shift in research and business.

‘Compact’ is another main goal that sets many guidelines for a climate-smart city, for example by focusing on zero growth in passenger car traffic. In order to achieve this goal, the transport and land-use policy must be defined with a view to changing people’s travel habits in the direction of more walking, cycling and use of public transport.

In addition, the plan describes several other initiatives that are important in the municipality’s work on reducing greenhouse gas emissions:

- Bergen shall establish good cycling facilities.
- The City of Bergen shall facilitate densification.
- Bergen shall have infrastructure that facilitates sustainable transport.

1.4. *Implementation and financing*

The plan is prepared by the Climate Section, organised under the Department of Climate, Culture and Business Development, in cooperation with a number of parties in and outside the municipality.

The Climate Section is tasked with coordinating the implementation of the plan.

Measures and activities shall be assessed on an annual basis and shall be seen in conjunction with the municipality's budget processes.

In June 2007, the City Council decided to establish a climate fund. The climate fund was converted into a new climate, environment and energy fund in 2010. In 2015, the climate, environment and energy fund was replaced by a climate and environment fund. NOK 500,000 is allocated for the climate and environment fund in the annual budget. Grants from the fund shall underpin and help to achieve the goals set out in the Green Strategy.

1.5. *Bergen shall reduce noise, air pollution and greenhouse gas emissions*

The Green Strategy for Bergen describes how the municipality is to reduce greenhouse gas emissions and increase energy efficiency. Topics related to the environment, air quality and noise are addressed in the following plans:

The land-use part of the municipal master plan (KPA), which is to be reviewed in the course of 2016, will define how Bergen is to become a more compact city, among other things through densification of the city centre, the city districts and along the Bergen Light Rail line. It also defines infrastructure solutions. The land-use part consists of legally binding plan maps, regulations and plan descriptions. Among other things, the plan looks at applicable parking regulations.

There are also a number of other plans and processes that govern the work of reducing greenhouse gas emissions and making Bergen more adapted to climate change. The most important are:

- Climate Plan for Hordaland, 2014–2030
- Public Transport Strategy for Hordaland, 2014
- Environmental Strategy for Skyss, 2013
- Cycling Strategy for Bergen, 2010–2019
- Assessment report and action plan for improved air quality in Bergen, 2015
- Action Plan against Noise, 2013–2018
- Waste plan for BIR Privat 2010–2015 – a new waste strategy will be adopted in 2016
- Master plan for Wastewater and Water Environments and Master plan for Water Supply, 2015–2024
- The Bergen Programme for transport, urban development and the environment

Work is under way on entering into an urban environment agreement for Bergen. The Ministry of Transport and Communications has defined the framework for the urban environment agreements. The parties to the agreement will be Hordaland County Council, the City of Bergen, the Norwegian Public Roads Administration (NPRA) and the Norwegian Rail Administration.

1.6. *Important definitions*

- That Bergen shall be a fossil-free city means that Bergen shall not use fossil energy sources.
- That Bergen shall be a 1.5-degree city means that Bergen shall play an active role in the green shift. The inhabitants and businesses of Bergen shall have a climate footprint that is small enough to ensure that Bergen as a city does not exceed its climate quota, so as to achieve the goal of a maximum temperature increase of 1.5 degrees.
- A fossil-free zone means a geographically limited area where no fossil energy sources are used.
- A zero-emission zone means a geographically limited area with no local emissions (nitrogen oxides) and no greenhouse gas emissions (carbon dioxide).
- A low-emission zone means a geographically limited area where the local authorities seek to reduce emissions with the help of instruments targeting the emission properties of vehicles.

2. Developments since the previous Climate and Energy Action Plan

The current Climate and Energy Action Plan was prepared and adopted in 2010. Below is a brief summary of what has happened since then. A more detailed list of measures and results is included in Annex 2.

Together with 12 other cities, Bergen has participated in the Cities of the Future programme, which is about achieving the lowest possible greenhouse gas emissions and a good urban environment. For Bergen, it was important to link cooperation in the programme with the city's overall urban development strategies. The action plan for the Cities of the Future programme was therefore also consistent with the Climate and Energy Action Plan.

Cities of the Future comprises four focus areas: land use and transport, stationary energy, consumption patterns and waste, and adaptation to climate change. Bergen implemented a number of projects in all the focus areas. The project period lasted for six years, from 2009 to 2014, and a final report was prepared after the programme was completed.

In 2013, the City of Bergen received the Urban Environment Award because the municipality, through a targeted, clear strategy, shows how a Norwegian city can develop urban residential areas characterised by good density and a good suburban centre structure linked to sustainable infrastructure, such as the development of Bergen Light Rail.

The travel habits survey of 2013 showed that long-term strategies work, and that travel habits can be changed. In Bergen, the use of public transport has increased and the number of trips made by car decreased since 2009.

Bergen has signed a 'cycle city agreement'. Many zoning plans that contain cycling initiatives are under way, which overall will result in better cycling conditions in the long term.

A new shoreside power system has been established in Bergen port.

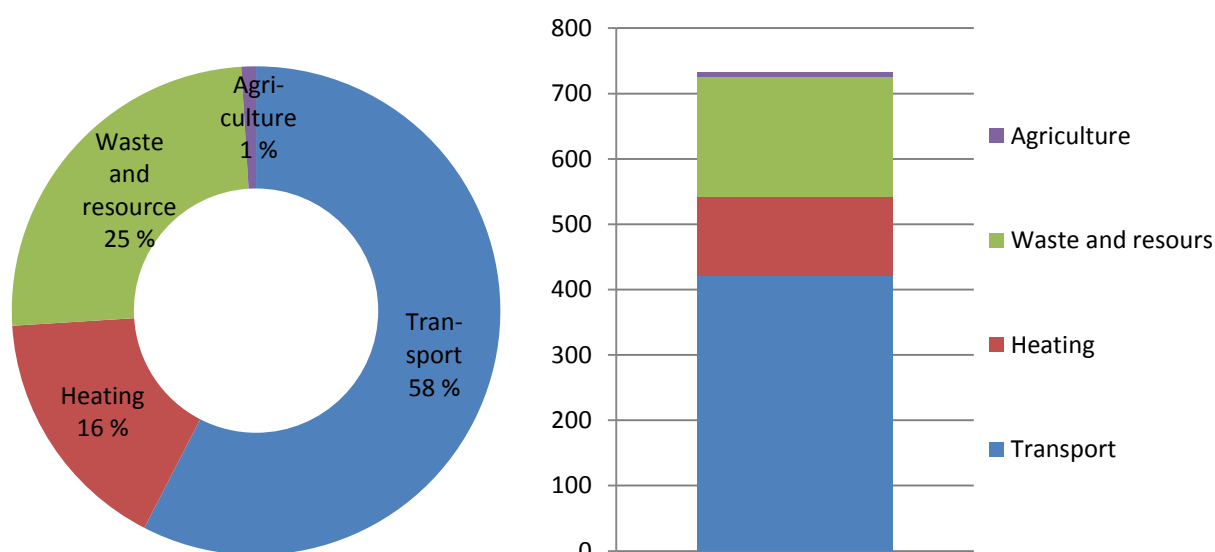
Several schools and other buildings with good energy solutions have been built.

Bergen is a leading example in waste collection, demonstrated by, among other things, the opening of the underground waste collection system in autumn 2015. Refuse trucks will no longer be seen in the city centre, which will lead to less greenhouse gas emissions and better air quality.

Work on adaptation to climate change is an integral part of the municipality's activities. It is included in the land-use part of the municipal master plan and in the municipality's work on risk and vulnerability.

Figure 2.2.1 shows greenhouse gas emissions in Bergen. The figure is based on Statistics Norway's most recent statistics broken down by municipalities and on data from the waste management company BIR and the power company BKK Varmer on waste incineration and district heating. Data on industrial emissions were impossible to retrieve. They have therefore been left out. Statistics Norway's statistics are available at miljostatus.no. The data from BIR and BKK Varmer are available at norskeutslipp.no and on BKK's website. The figure shows greenhouse gas emissions in Bergen by sector. On this basis, an assessment has been made of which areas we should focus on in the coming years if Bergen is to become fossil-free by 2030.

Figure 2.2.1 Breakdown of greenhouse gas emissions in Bergen in 2013 by sector



Source: Statistics Norway, BIR and BKK Varmer

The figures are somewhat lower than previous statistics at municipal level, among other things because emissions from shipping and air transport are not included. Combined with local data on different topics, this gives us a relatively good overview of the situation.

Local statistics, such as the travel habits survey for Bergen, the number of cars passing a toll point and the register of oil-fired stoves, confirm indications that we are headed in the right direction. The conclusion for Bergen is that the greenhouse gas curve is flattening out and decreasing slightly, but it takes greater efforts than we have seen so far to really reverse the trend. For a more detailed status, see Annex 1.

In connection with the preparation of the assessment report and action plan for air quality in the City of Bergen in 2015, the model for calculating air pollution from 2008 was updated with data on today's road network and current traffic figures. New figures were then estimated for air pollution and greenhouse gas emissions for some measures that will lead to traffic reduction.

The results for estimates of climate effects are shown in Table 2.1. Emissions from road traffic, without the implementation of measures, are estimated at 297,800 tonnes of greenhouse gases per year. These are emissions from driving on the county and national road network in Bergen, plus a few heavily trafficked municipal roads.

Based on the estimated greenhouse gas emissions, the measures outlined in the assessment report for improved air quality could lead to a reduction in greenhouse gas emissions of between 73,000 and 124,000 tonnes per year. This means that the measures listed in the table below, which are described in more detail in Chapter 4, are capable of reducing emissions from road traffic by between 24 and 41%.

Table 2.1 Climate effects of measures outlined in the assessment report for improved air quality in Bergen

Measure	Reduction in CO ₂ emissions as a result of the measure [%]	Reduction in CO ₂ emissions as a result of the measure [tonnes of CO ₂ equivalents per year]
Time-differentiated road tolls combined with attractive public transport services	14–16%	41,700–47,600
Building park-and-ride facilities combined with parking restrictions in the city centre	1–3%	3,000–8,900
A low-emission zone and promoting the use of low-emission vehicles	3–5%	8,900–14,900
Shoreside power for ships at berth	Not quantified	11,100
Good travel and driving habits	2–12%	6,000–35,700
Zero-emission cars replacing diesel and petrol cars	1–2%	3,000–6,000

Source: Norconsult



PHOTO: Anne Kringstad

3. The green shift in Bergen

3.1. *Goals for a fossil-free Bergen in 2030*

The goal of a fossil-free city in 2030 shall be achieved in accordance with the following plan:

- 2020:** Bergen will reverse the trend and reduce direct greenhouse gas emissions by 30% compared with 1991.
- 2030:** Bergen will be fossil-free, meaning that no oil, coal or gas is used in Bergen.
- 2050:** Bergen will be a 1.5-degree city. The goal is for the people of Bergen to limit their climate footprint in line with the UN agreement on climate change.

Bergen shall be fossil-free by 2030

In order to achieve this goal, we have to work on fossil-free transport, a fossil-free port, fossil-free heating and fossil-free waste management.

Fossil-free transport

This is possible through investments in charging infrastructure and filling stations for renewable fuel. Zero-emission zones shall be established in the city centre and the city districts; good, fossil-free public transport, goods distribution and work machinery shall be available; and land-use planning shall reduce the need for transport. Second-generation biodiesel made by forest raw materials and waste will help to achieve this goal.

Fossil-free port

Bergen got its first shoreside power facility in 2015, and new EU regulations will require all major ports to install shoreside power systems by 2025. The Norwegian shipping industry is far along in the process of developing and building green ships. The possibilities of succeeding are therefore great.

Fossil-free heating

There are approximately 10,000 oil-fired stoves in Bergen. The Climate Agreement states that, by 2020, using oil for heating shall be prohibited. There are many good alternatives available: big water-borne systems can be replaced by bigger pellets-fired systems, water-to-water heat pumps or bio-oil, and small, free-standing stoves can be replaced by pellets stoves, a simple heat pump or the use of bio-oil. Upgrading old, outdated oil-fired systems often results in lower heating costs.

Fossil-free waste management

Waste incineration causes extensive greenhouse gas emissions. The possibility of reducing such emissions depends on whether waste incineration facilities manage to achieve carbon capture and storage. A trial project for carbon capture and storage is now starting at Hafslund's facility in Oslo, to be completed in 2020. The City of Bergen expects BIR to take an active role in this project and to start using new technology at the facility in Bergen as soon as possible.

The period up until 2020

Reductions up until 2020 shall be achieved by phasing out oil-fired heating, through technological developments that lead to lower emissions from transport, and through the effects of increased carpooling, walking, cycling and the extension of the Bergen Light Rail network.

Reducing direct greenhouse gas emissions by 30% by 2020 will be demanding. Among other things, it will require additional funding to speed up the work of phasing out fossil solutions and introducing new technology. There will also be a need for stronger efforts to change people's mobility habits and increase the amount of cycling and walking.

Targeted charges and restrictions on polluting traffic will reduce emissions further, for example time-differentiated road tolls and the establishment of low-emission/zero-emission zones; see Table 2.1.

Phasing out fossil energy sources is necessary to be able to reduce greenhouse gas emissions from the transport sector. Access to alternative, sustainable fuel, electricity and hydrogen, and incentives that ensure sufficient long-term predictability for the choice of vehicle, are necessary to be able to achieve a transition and a significant reduction in greenhouse gas emissions from the transport sector.

The municipality will work to achieve a fossil-free city centre with fossil-free public transport and goods delivery. The concept of a fossil-free city centre will be tested in city streets that are not part of the main road network. The project must be implemented in small pilot areas first. The experience gained in these pilot projects must be used and understood so that the next phase can address the challenges identified in the preceding phases.

There are currently no fossil-free zones in any European cities.

In order to achieve a reduction in greenhouse gas emissions, it is necessary to coordinate a number of national, regional and municipal climate initiatives that must be implemented in a way that also ensures clean air and good local solutions for the city's inhabitants.

New technology is the key to realising the green shift. Energy can be produced by many small producers instead of a few big ones. The energy system will become more decentralised. The development of better batteries and other storage media will boost development. Smart technology in the energy grid will create new opportunities for smarter use of energy.

Travel habits and the car fleet in Bergen are changing. Bergen Light Rail is a popular means of public transport that sees good growth in the number of users. The electric car revolution is under way in Norway, hydrogen cars are coming 'at full speed', and other hydrogen vehicles will follow suit. Major investments are being made in facilitating more cycling, and new car-sharing initiatives are being introduced at the same time as the use of established schemes like the car-sharing network *Bildelingen* is increasing.

The business sector and research communities are also changing. The willingness to invest in renewable energy and climate-friendly technology is increasing and shifting away from oil. Western

Norway and the Bergen region are in a special position because of the ability to use the expertise gained in the oil industry to develop new technology for a more sustainable society.

Consumer power is starting to make its mark on Bergen. New attractive initiatives such as swap markets, food cooperatives and equipment sharing have been established in several places.

3.2. Heading towards 2050 – the city accepts the challenge

The goals that have been set for Bergen to be able to realise the green shift are realistic and feasible but also ambitious and challenging. At present, fossil cars take up most of the space on the roads of Bergen. Cyclists and pedestrians only account for 29% of all passenger transport. Most public transport is currently also based on fossil fuel. There are great challenges ahead, but measures can be implemented so that we achieve our goals.

Cities account for 70% of global greenhouse gas emissions– and the cities are growing. Therefore, they play a decisive role in reducing greenhouse gas emissions. Internationally, we see that more and more cities and urban networks are playing ambitious roles, assuming obligations and cutting emissions.

Bergen is part of ZERO's Urban Forum. ZERO is an independent environmental foundation that works to promote zero-emission solutions. Together with other cities, Bergen will be a spearhead in the climate work.

Bergen can reduce its emissions in a number of areas. The most important are heating, transport, construction machinery and waste management. Bergen plays a key role as service provider by virtue of its role as an infrastructure developer and planning authority. The city has great purchasing power that can be used to promote climate-friendly solutions. The authorities of Bergen shall inform the city's inhabitants about their possibilities of contributing, and facilitate cuts in their emissions.

Even if Bergen becomes fossil-free in 2030, we have a long way to go before we reach the goal of maximum 1.5 tonnes CO₂ emissions per person per year. The emergence of a sharing culture will lead to less waste being produced. Agriculture must use less resources to cultivate food. Consumption in general must be reduced, for example by choosing quality over quantity and by making products that can be repaired.

3.3. Broad cooperation with other parties

Well over 20% of Norway's total greenhouse gas emissions can be reduced with the help of policy instruments at municipal and county level. Many different parties are working on reducing greenhouse gas emissions and making energy consumption more efficient. The City of Bergen takes a positive view of participating in collaborations that contribute to achieving the goals of the Climate and Energy Action Plan. The following collaboration projects have been initiated:

1. **Energy consumption:** The Urban Forum for zero-emission solutions – collaboration with Zero and other Norwegian cities. The City of Bergen also takes part in a Smart City project in cooperation with the private sector.
2. **Wood Programme:** Collaboration with the university colleges in Bergen, research institutions, the Norwegian State Housing Bank and Nordic Wooden Cities.
3. **Mobility:** Collaboration with the county authority, government agencies and the inter-regional project SHARE North.
4. **Consumption and waste:** Collaboration with BIR, the Vil Vite science centre and the university colleges in Bergen.
5. **Adaptation to climate change:** Collaboration with the Norwegian Environment Agency, KS (the Association of Local and Regional Authorities), Hordaland County Council, research institutions and the inter-regional project BEGIN.
6. **Collaboration with the business sector and research community:** the Climate Forum and the Energy Forum. The Climate Forum is a collaboration between the City of Bergen, Bergen Chamber of Commerce and Industry and the Bjerknes Centre for Climate Research. The Energy Forum is a collaboration between the City of Bergen, Hordaland County Council, BKK, the Norwegian School of Economics (NHH) and the University of Bergen.
7. **Collaboration with Space Lab and a number of players at UiB** in their initiative for climate and energy transition research from a social science perspective.
8. **The municipality as a workplace:** Cooperation with Climate Partners with a goal of reducing greenhouse gas emissions from the municipality's operations.
9. **Participation in various EU projects:** For example Eurocities (network for the biggest cities in Europe), ICLEI (international municipal network) and the Global Climate Network (international forum for research, the business sector and organisations).
10. Bergen is one of over 4,000 municipalities in Europe that have signed the Covenant of Mayors, which aims to reduce greenhouse gas emissions. 'Mayors Adapt' is a new initiative that was launched in connection with the EU strategy on adaptation to climate change. The municipality will also endorse this part of the Covenant of Mayors.



4. Green business

SECTOR GOALS

The City of Bergen will work to put the city's business community at the forefront of a renewable society.

- N1 Efforts shall be made to encourage green business development.
- N2 The City of Bergen shall work to promote fossil-free agriculture in terms of transport of feed, fibres and food.
- N3 The City of Bergen shall promote a transition to more organic agriculture and encourage the use of agronomic methods that circulate nutrients and store carbon in soil and forests in a good way.
- N4 The City of Bergen shall not invest in fossil energy.

Green business is about making the business sector in Bergen greener, which includes industry and agriculture. Green business development, green growth, sustainability and the environment are important topics in the development work, which includes solutions for reduced emissions, purification technology, energy efficiency, resource utilisation and waste management.

In autumn 2015, the Climate Section and the Business Development Section were organised under the same municipal department. The goal is to coordinate the work in the sections and better facilitate green business development. Furthermore, the City Government's proposal to reorganise the municipality's business-related work may also strengthen opportunities for an increased focus on green business development.

Goals

The municipality sees great potential in helping to develop new, more energy-efficient industries, including contributing to innovation and the development of new businesses. Existing enterprises in Bergen can also become greener.

By using new knowledge and technology, we can live well off nature's resources without destroying it for future generations. The interdisciplinary *Bioverdi* project points out that agriculture, aquaculture, health and industry can be important sectors in the green shift. The Norwegian Farmers' Union has set a goal that states that agriculture shall be fossil-free by 2030. This forms the basis for goal N2.

A food strategy has been developed for Hordaland county that emphasises three development trends:

- strengthening Hordaland's identity as a food region;
- increasing potential consumers' know-how about the region's food products and food experiences;
- strengthening the basis for growth and value-adding innovation.

Through cooperation and joint development projects, the 'blue-green' food cluster in Hordaland shall cultivate a clear food identity, increase people's knowledge about the region's raw materials and food traditions, and strengthen the basis for business development in the region.

In December 2015, UNESCO awarded Bergen the status of City of Gastronomy, and the Bergen region became a member of UNESCO's Creative Cities Network. This will give Bergen a stronger connection to UNESCO. Bergen was already a UNESCO World Heritage Site through Bryggen and included in UNESCO's Memory of the World Register through the Leprosy Archive. In addition, Bergen has a UNESCO professorship at the University of Bergen.

An important goal of UNESCO's Creative Cities Network is to use food and creativity to contribute to sustainable urban development, among other things with regards to the climate, environment and creative use of urban areas.

Inclusion in the network provides opportunities for expanding the collaboration to include a number of other cities all over the world in gastronomy and other creative industries.

The businesses of the future must be green, smart and innovative. The goal is for Norwegian business and industry to contribute to developing good solutions that can lead to reduced greenhouse gas emissions, both in Norway and abroad, and to make the competitiveness of the business sector gradually greener. This is the background for the government-appointed expert committee on green competitiveness. The expert committee is tasked with helping the Government to draw up a strategy for the field. The committee is to submit and present its work to the Government in October 2016.

Do we have the policy instruments we need?

A number of policy instruments have been established to help new enterprises get started. This will also contribute to new, green enterprises being established. Bergen is at the forefront of research in areas that can provide fertile ground for green businesses.

The new state investment fund – Fornybar AS – is an important step on the way towards the green shift. The purpose of Fornybar AS, which aims to raise NOK 20 billion in the long term, is to invest in renewable energy and environmental technology. The fund shall contribute risk capital to big pilot projects aiming to develop renewable energy, and assist in realising an upscaling and full-scale development of new technology. The City of Bergen is working to get the fund to be based in Bergen.

The City of Bergen will act as a driving force and partner in developing green businesses, for example by using existing policy instruments such as green public procurement and corporate governance.

The City of Bergen is part of the Climate Partners Hordaland network, a public-private partnership that works to reduce greenhouse gas emissions and encourage green social and business development. The network shall disseminate knowledge about climate change, develop and promote green business ideas, create arenas for climate debate and cooperate at the regional, national and international level.

The City of Bergen grants support to organisations, business clusters and events in the fields of business, sports and culture. In its award letters, the municipality may set requirements for or

encourage the recipient to focus on more climate and environmentally friendly solutions. In connection with major events, the City of Bergen may also encourage the use of locally produced food and a local food profile and emphasise that the events shall be certified as 'green events'.

4.1. Status

Emissions from industry and agriculture in Bergen are relatively low. Emissions from the business sector as a whole come from transport, the operation of buildings and waste management. It is a major task for the business sector to become as climate-efficient as possible. The municipality therefore encourages enterprises in Bergen to improve their practices so as to achieve the goal of a fossil-free city by 2030.

In the statistics that show greenhouse gas emissions by municipality, it is impossible to isolate the business sector's share of emissions, and no figures are therefore presented that show direct greenhouse gas emissions here.

The construction and property industry is identified as a sector with a great potential for energy efficiency and more sustainable solutions. Both in Norway and abroad, clear political ambitions and goals have been defined for reduced emissions and energy consumption in this sector. This allows for the possibility of Norway offering its expertise, services and products relating to climate-friendly buildings internationally.

Treet ('the Tree') is an example of an innovative project in Bergen that shows that it is possible to build modern high-rise buildings using environmentally friendly materials. It was decided early on in the process that the building would be made from wood, with the load-bearing structure in laminated wood and prefabricated massive wood modules.

The municipality aims to be an active partner and will facilitate in making the business sector in Bergen as green as possible.



4.2. *Innovation and the development of green business*

Bergen shall be a natural hub for strategic development and innovation. It is therefore important that companies that offer strong technology and service products with a green profile set up their head office in Bergen. The City of Bergen will make strategic, targeted efforts to ensure this.

Bergen is a knowledge city, and the municipality shall do its best to facilitate more business start-ups, new industry, green growth and greater pace of house-building. It is especially important to facilitate new start-ups and innovation, and schemes that encourage such developments shall be given priority.

Steps shall be taken to facilitate further growth in knowledge and technology-based industries, travel and tourism, and culture and media enterprises. Bergen shall be a good host municipality for higher education institutions and research communities, and it is desirable to strengthen cooperation between these environments and the public sector.

The green shift requires new expertise in technology, systems and interdisciplinary cooperation. This represents new challenges for educational institutions at all levels. The City of Bergen will further develop the interaction between different public sector agencies, educational institutions and the private sector, with the goal of creating dynamics that provide fertile ground for fresh thinking, greater expertise and innovation for the purpose of increased business development. It is important to cultivate activities and projects with concrete, measurable goals that can demonstrate progress. Measures that encourage green growth in Bergen shall be prioritised.

Entrepreneurship is an essential part of the green shift. A high degree of innovation is important to ensure that new ideas provide the basis for new enterprises with a growth potential.

The research communities in Bergen are strong in their respective areas. The municipality wants to help to achieve even more strategic cooperation between the communities and the public sector. Among other things, it is important that more research programmes organised by the Research Council of Norway and other parts of the public funding agencies are located in Bergen.

Bergen and Western Norway have natural advantages that make the region well equipped to make the transition that must take place if we are to become a zero-emission society. Investment funds for renewable energy shall be considered, and measures that encourage green growth in Bergen shall be prioritised. Steps shall be taken to facilitate business clusters, start-ups and partnerships.

The petroleum sector represents great value creation and many jobs in Bergen, and many people's work identity is linked to this industry. The municipality will help to ensure that the expertise and technology accumulated in the oil and gas sector can be transferred to new industries.

Greater focus on the climate in business and industry means that policy instruments and projects to a greater extent are assessed from an overall perspective. Active cooperation with the municipality's entrepreneur communities (the 'Nyskapingsparken' incubator, HUB, Connect Western Norway etc.) can be expedient in this field. One example can be to test different methods for involving social

entrepreneurs at an early stage when forward-looking, green solutions and projects are to be defined.

MEASURES TO START IN 2016

- Organise the Innovation Camp
- Encourage the development of new, innovative solutions, for example in the area of mobility, inspired by Helsinki's 'Mobility as a Service' initiative
- Consider an investment fund for renewable energy
- Cooperate internally in the municipality and with the business sector on promoting green business development
- Participate in the Norwegian EU Network on Smart Cities and Communities – a project funded by the Research Council of Norway's ENERGIX programme for the period 2016–2018
- Innovation week in connection with the Global Entrepreneurship Week in November, a broadly-based partnership between members of the region's innovation and entrepreneurship network
- Entrepreneurship course organised by the Business Startup Centre (Etablerersenteret)
- Entrepreneurship for immigrants – start-up autumn 2016.

4.3. Agriculture

An agriculture plan for Bergen is being prepared and is scheduled to be ready in 2016. Topics such as soil protection, drainage, increased food production, less food waste etc. will be discussed in more detail in the plan.

Among other things, the agriculture plan will describe agriculture as land management and as protection of the environment needed for food production and forestry, and, thus, it emphasises that sustainable agriculture is part of the solution to the climate problem.

Green plants absorb CO₂ and convert it into fibre and energy. Green plants also absorb NO_x to a certain extent and thereby contribute to reducing air pollution in the city. Wooded hills, green areas, green ground cover and intact natural vegetation help to retain the increased amounts of precipitation that follow from climate change, and also help to prevent landslides and floods.

Green areas and urban agriculture, whereby food is grown in the city where people live, thereby contribute to reducing the effects of greenhouse gas emissions in the city and to reducing the need for transport. Urban development and densification must go hand in hand with allocating land for allotment gardens, school gardens, urban agriculture and green areas. Several public and private schools have established school gardens.

The City of Bergen will support local associations and clubs that want to generate knowledge about urban agriculture, grow food on available cultivable land in the city and investigate opportunities for more allotment gardens etc. The *Matkollektivet* food cooperative, which was established by the *Bærekraftige liv* (Sustainable Lives) organisation in 2014, is an example of how demand for local food has developed.

Cooperative farming contributes overall to broad value creation in agriculture because it promotes environmental, financial, social and cultural sustainability and value creation, according to the 2014 report from the Telemark Research Institute – TF report No 341. There is land available on farms in Bergen. Innovation Norway has awarded a start-up grant to a farmer in Bergen to look into the possibility of cooperative farming, where three farms work together on the production of allotments. Work is also under way on establishing cooperative farming, where a hired gardener is responsible for the organisation and local farmers hire out the land.

The project Urban Agriculture has been initiated in Bergen, with support from the County Governor's agriculture department. The project includes cooperative farming, allotment gardens and school gardens, provision of available acreage, and green meeting places and learning arenas for children and adults in the city districts.

MEASURES TO START IN 2016

- Preparing an action plan for agriculture in Bergen, emphasising soil protection and increased food production
- Facilitating more school gardens, organising school garden seminars
- Facilitating cultivation in the city
- Urban Agriculture project – establishing cooperative farming on farms in Bergen

4.4. Green public procurement and corporate governance

The green shift requires huge investments in infrastructure, renewable energy, environmentally friendly urban development, and increased energy efficiency. Corporate governance in municipally owned enterprises and the municipality's other investments shall have a clear climate profile in order to achieve forward-looking and attractive enterprises. The City of Bergen will not make new investments in fossil energy companies, and will discontinue its existing investments in such companies by 2018.

The City of Bergen will take advantage of its position as owner and procurer and act as a demanding, green customer that calls for forward-looking solutions and products. Through green public procurement, the municipality shall promote business development and new green jobs.

This point will be further developed in a separate Climate and Environmental Plan for the municipality's own activities.

The following amendments to the Public Procurement Act are set to enter into force on 1 July 2016:

- New rules that safeguard the environment, human rights and requirements for the use of apprentices.
- Restrictions on the number of links in the supplier chain.
- The Norwegian Complaints Board for Public Procurement (KOFA) will be allowed to issue fines for illegal direct procurements.
- Based on the Simplification Committee's report and three new EU directives.
- Make overall requirements for the whole procurement process.

5. Transport and mobility

SECTOR GOALS

The transport sector must reduce its greenhouse gas emissions by 30% by 2020 and be fossil-free by 2030. In order to reach this goal, all fuel must be renewable by 2030. Until then, the scope of transport that emits greenhouse gases must be reduced.

Reduce the scope of transport that emits greenhouse gases

- T1 Reduce passenger car traffic in Bergen by at least 10% by 2020 and 20% by 2030 compared with 2013.
- T2 Introduce zero-emission zones in parts of Bergen city centre by 2020 and make the whole city centre a zero-emission zone by 2030.
- T3 All growth in passenger traffic is to be in the form of walking, cycling, public transport and the use of unoccupied car seats.
- T4 The City of Bergen shall support public transport by means of an active polity to improve traffic conditions for public transport and facilitate park-and-ride facilities for cars and bicycles.
- T5 The capacity of vehicles on the roads shall be better utilised. The goal is to double the number of passengers per car during rush hours by 2020.
- T6 Bergen shall promote shared mobility. One goal is to reduce the number of cars per household in Bergen – from 1.35 to 1 car per household by 2025.

Promote renewable fuel in the transport sector

- T7 Bergen shall provide good access to renewable fuel (charging stations, hydrogen filling stations and biofuel filling stations) for vehicles and machinery in the city.
- T8 The City of Bergen shall encourage people to choose environmentally friendly vehicles. Zero-emission vehicles shall always have more favourable conditions than other vehicles.
- T9 All new passenger cars shall be fossil-free as of 2025.
- T10 The City of Bergen shall promote fossil-free public transport by 2020.
- T11 All goods transport by light commercial vehicles shall be fossil-free as of 2025.
- T12 The City of Bergen shall facilitate fossil-free heavy goods vehicle traffic and construction from 2025.
- T13 A greater proportion of cargo should be moved from road transport to rail or sea. The City of Bergen shall facilitate fossil-free solutions for shipping.
- T14 The City of Bergen shall offer shoreside power to all ships by 2020.

Goals

Two main measures are needed to achieve the goals of reduced emissions in the transport sector. Zero-emission technology will not realise the climate goals alone because it takes too long to phase in, which is why we must also implement measures that reduce the scope of transport that generates greenhouse gas emissions. The goal is for all growth in transport in Bergen to be in the form of increased walking, cycling, public transport and car passengers. In addition, 20% of today's car drivers (RVU 2013) shall be shifted to other means of transport by 2030.

Achieving the goal of reduced traffic will also be beneficial in relation to noise, air quality and local blue-green qualities.

It is important for Bergen to contribute to reduced emissions from air travel and make the railway more competitive.

- The City of Bergen will play an active role in making the train service to Oslo a real alternative for people who currently travel this distance by plane.
- The City of Bergen will work to cut the travel time on the Bergen Railway, especially between Voss and Bergen.
- The City of Bergen will support measures that reduce the use of fossil fuel in aviation.

These items are not defined as separate, quantified targets because the municipality to a lesser extent has relevant policy instruments at its disposal. In these cases, the municipality must act as a driving force in relation to the relevant government authorities and agencies.

Do we have the policy instruments we need?

In order to achieve the goals and implement all the proposed measures, the municipality will need legal authority for implementing additional regulatory measures. This issue is raised at the national level. The following policy instruments are necessary:

- Legal authority for environmentally differentiated road tolls, and zero and low-emission zones
- Regulation of autonomous vehicles
- Regulation of carpooling and new, shared mobility, including questions concerning privacy and payment

In order to reach its goals for the transport sector, Bergen is dependent on ambitious policies for zero-emission solutions and emission cuts at the central government and county level.

Conflict between goals

Increased capacity on the main road network around Bergen

Major development projects on the main road network around Bergen result in increased capacity for car traffic and also challenges in relation to achieving the goals of reduced car traffic and greenhouse gas emissions. The City of Bergen must find ways of dealing with these challenges, together with its partners in the Bergen Programme. Establishing bus and taxi lanes or high-occupancy vehicle (HOV) lanes on these roads are among the solutions that have been discussed.

Plans for further development of Flesland airport

Greenhouse gas emissions from air traffic at Flesland are not included in the municipal emissions. The environmental impact assessment (September 2015) projects an increase in greenhouse gas emissions of between 40 and 70 thousand tonnes of CO₂ per year by 2065 if a second runway is built. The wide estimate is due to uncertainty about how much biofuel is expected to be phased into aviation. The assessments concerning a second runway should be seen in conjunction with the main goals of the Green Strategy.

The plans for further development are addressed in the land-use part of the municipal master plan, which is to be reviewed in 2016.

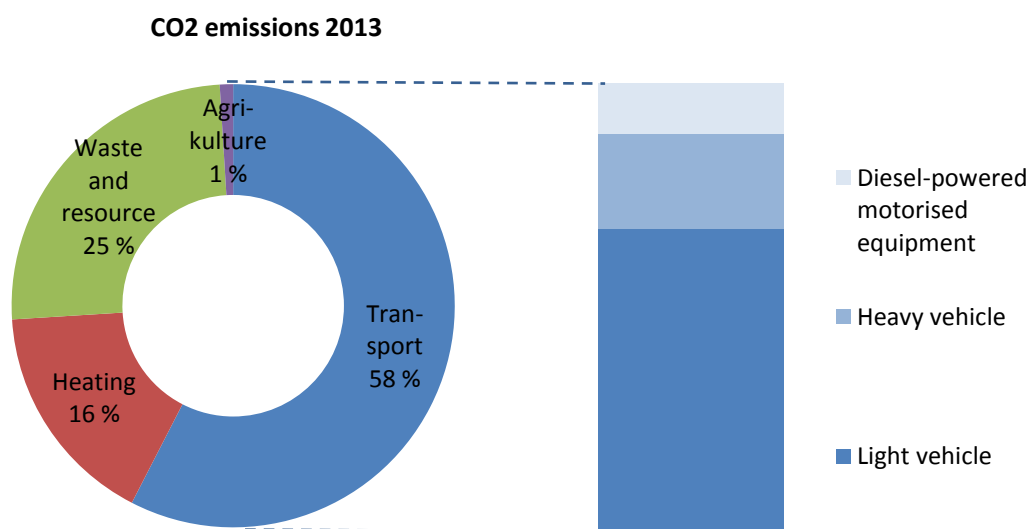
These conflicts between goals are examples of greater societal challenges that affect most urban areas.

5.1. Status and challenges

Achieving major reductions in greenhouse gas emissions in the transport sector is demanding. All prognoses point to increased transport demand. The reasons are population growth, settlement patterns, consumer habits and increased trading in goods.

Transport accounts for 58% of Bergen's total greenhouse gas emissions, according to Statistics Norway's most recent statistics. Road traffic is the number one source of emissions. Great emphasis has therefore be given to this area in the plan.

Figure 5.1 Mobile emissions by source. Collated figures from Statistics Norway. See Annex 2



Source: Statistics Norway, BKK

Results of densification policy

The City of Bergen received the Urban Environment Award in 2013. The grounds for the award emphasised the targeted densification policy the city has pursued for many years in the city centre and near transport hubs, especially along the Bergen Light Rail corridor.

The most recent travel habits survey (2013) shows that there has been a change in the people of Bergen's travel habits. The number of car journeys is on its way down, and the number of public transport users and pedestrians is increasing, compared with the last survey from 2008. The change is especially visible in the Bergen Light Rail area, and less visible in other areas of the city. This may indicate that the densification policy is producing results.

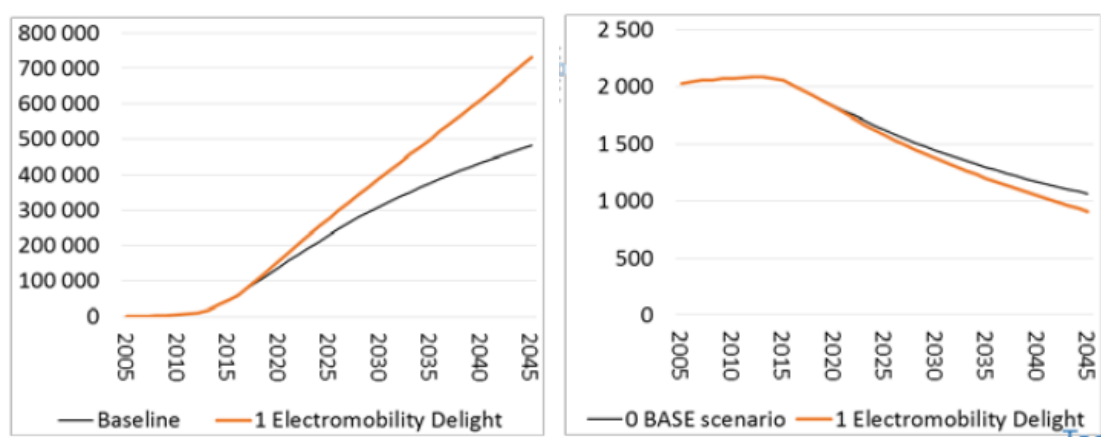
The average number of cars per household is 1.35 in the Bergen area. The figure has not increased since 2008. There are big difference between the central areas of Bergenhus and Årstad (0.75 cars per household) and the districts further away from the city centre (between 1.3 and 1.6 cars per household). Car-sharing networks are growing fast, and it is expected that a greater focus on sharing solutions can reduce the number of cars per household.

Decrease in emissions from vehicles

The sale of electric cars and plug-in hybrid cars in Bergen has increased greatly from 2010 until today. In 2010, electric cars accounted for 0.2% of new car sales. In 2015, the proportion of electric cars and plug-in hybrid cars was more than 30% (Source: the Information Council for Road Traffic – OFV). It will nonetheless take a long time before such cars make up a great proportion of the total car fleet.

The Institute of Transport Economics (TØI) has prepared different projection scenarios that show how the number of zero-emission vehicles affect greenhouse gas emissions from the vehicle fleet.

Figure 5.2. Projected growth in electric cars and consequences for the sale of fossil cars



Source: TØI: 1422/2015

The figure on the left shows a modelling of the growth in the number of electric cars, given the most optimistic scenario that involves strong incentives and fast technological developments, in relation to both range and the selection of models. The figure on the right shows the consequences of this development for the sale of fossil fuel and thereby greenhouse gas emissions.

We expect an even quicker transition to zero-emission vehicles than shown on the graph, and see that hydrogen-powered vehicles will play a bigger role in the near future, which will result in a wider range of options for zero-emission vehicles.

At the same time, the goal is for the transport sector in Bergen to be fossil-free in 2030, and renewal of the car fleet alone will not be sufficient to achieve this goal. Car traffic must therefore be reduced by approximately 20%, at the same time as biofuel of the right quantity and quality is available for the remaining internal combustion engines.



PHOTO: Christine Hvidsten

5.2. Strategies

Introduction

A good mixture of policy instruments is decisive in order to be able to handle the challenges caused by population growth. The strategies described here are therefore closely interconnected. Effective measures in all four areas are needed to achieve the goals of reduced emissions, and the measures must be combined in order to have the greatest effect. The goal that all growth in transport is to be in the form of walking, cycling, public transport and the use of unoccupied car seats must form the basis for land-use and transport planning and infrastructure investments.

- 1. Coordinated and climate-friendly land-use and transport planning***
- 2. Climate-friendly travel habits***
- 3. Shared mobility – mobility culture changes***
- 4. Transition to low-emission technology – phasing out fossil fuel***

Strategy 1: Coordinated and climate-friendly land-use and transport planning

The City of Bergen's land-use and transport policy is defined in the land-use part of the municipal master plan.

A number of assessments and reports form the basis for the new plan. Many key issues that have consequences for greenhouse gas emissions will be discussed in more detail here.



Strategy 2: Climate-friendly travel habits

Goals for reduction in car traffic

- T1 Reduce passenger car traffic in Bergen by at least 10% by 2020 and 20% by 2030 compared with 2013.
- T2 Introduce zero-emission zones in parts of Bergen city centre by 2020 and make the whole city centre a zero-emission zone by 2030.

Goals for changes in transport mode distribution

- T3 All growth in passenger traffic is to be in the form of walking, cycling, public transport and the use of unoccupied car seats.

National target:

The Climate Agreements of 2007 and 2012 and the National Transport Plan state that

‘The growth in passenger traffic in urban areas shall be in the form of walking, cycling and public transport.’

Local target

Bergen City Council has decided (item 297-14) that car traffic in Bergen shall be reduced by 10% by 2020, compared with the level identified in Hordaland County Council’s travel habits survey conducted by SINTEF in 2013. Traffic counts may be a more correct way of operationalising this target, instead of figures from the travel habits survey. Based on the prognoses for renewal of the car fleet, further reductions of passenger car traffic will continue up until 2030, and then by a 20% reduction in relation to 2013.

When restrictions are imposed on passenger car traffic, people must be offered good alternatives. It is therefore important to compose ‘packages’ comprising both restrictive and rewarding measures that can work together.

Important strategies to reduce car traffic include:

- To further develop a high-capacity public transport system, with a fully developed light rail network as the ‘backbone’.
- To ensure robust financing to operate a public transport system that is far more extensive and costly than the current system.
- A fully developed main and suburban network of cycling lanes.
- Make arrangements for pedestrians, especially near suburban centres and in connection with the public transport network.
- A main road/ring road network that reduces traffic to the city centre and provides the necessary freedom of action to strengthen measures that restrict passenger car transport to the city centre.

- Additional restrictive measures to reduce passenger car transport, for example environmentally differentiated road tolls, low-emission zones, zero-emission zones, fossil-free zones, parking restriction etc.
- Mobility work – advocacy work targeting the population and the business sector that leads to positive changes in travel habits.
- To facilitate shared mobility that better exploits the capacity in the transport system.

Reduction of car traffic and development of road capacity

On the main road network in the City of Bergen, new road capacity for motor vehicles must promote public transport and cars with passengers (HOV lanes). The exception can be ring roads that divert the traffic away from central areas, and that enable restrictive measures to be implemented within the ring road systems. At the same time, ring roads must be designed so that they do not contribute to an overall increase in car traffic. Good solutions for cycling, walking and public transport must be given main priority when developing and upgrading infrastructure.

Solo drivers

In and around the cities, the main challenge is all the people who drive their cars to work alone during rush hour. Cars containing only one person have the highest emissions per passenger kilometre, they take up unnecessary space on the roads (generate congestion) and demand parking space. There will always be a certain amount of solo driving, but we need to make it expensive enough to persuade sufficiently many to choose smarter ways of travelling. Various measures to get drivers to park their car and use unoccupied seats in other people's cars (who are going the same way) should therefore be given priority.

Time-differentiated road tolls

Time-differentiated road tolls were introduced in Bergen on 1 February 2016. The goal of the measure is to reduce traffic during rush hour to increase the flow of traffic and reduce emissions. It costs NOK 45 (NOK 90 for big vehicles) to drive during rush hour, Monday–Friday between 06:30 and 09:00 and between 14:30 and 16:30. Outside rush hour, the rate is NOK 19 (NOK 38 for big vehicles). Experience from other cities (Stockholm, London) shows that this type of differentiation is capable of reducing the traffic volume considerably during rush hour (Urbanet Analyse, Memo 23/2009). So far, time-differentiated road tolls in Bergen have had a good effect, resulting in both a significant reduction in traffic during rush hour and a certain reduction overall. The measure will be evaluated after a year.

Environmentally differentiated road tolls and low-emission zones

Environmental differentiation means varying charges based on the emissions from the individual vehicles, for example on the basis of Euro class or fuel type. Environmentally differentiated road tolls can be described as a type of payment that takes the road toll ring as its point of departure and charges cars based on their environmental properties. Environmentally differentiated road tolls will be an alternative to introducing low-emission zones, and these measures should be considered in conjunction with each other.

A low-emission zone is a zone where the use of cars is restricted for environmental reasons. A studded tyres fee zone is in reality also a low-emission zone. Low-emission zones are used in a number of countries to reduce pollution in congested areas, particularly from exhaust particles in city centres. There are few zones whose main purpose is to reduce greenhouse gas emissions.

Neither a low-emission zone nor environmentally differentiated road tolls have been introduced. Over several years, the City of Bergen has applied to become a pilot municipality for the introduction of a low-emission zone targeting polluting heavy vehicles.

On 3 May this year, the Storting considered an item concerning the legal authority for introducing low-emission zones, based on a proposal from a member of the Storting. The Ministry of Transport and Communications has asked the Directorate of Public Roads to draw up draft regulations on low-emission zones. The draft regulations are expected to be distributed for consultation before summer 2016.

Zero-emission zones and fossil-free zones

A zero-emission zone is a zone where only vehicles with no local emissions are allowed. It is also possible to include emissions from buildings, so that only heating with no local emissions is allowed. Fossil-free zones can be an alternative to zero-emission zones in areas where there is public transport and goods transport by heavy vehicles, as such zones can include vehicles that run on biofuel. These vehicles produce local emissions but are considered climate-neutral even if the manufacture of such vehicles in many cases generates greenhouse gas emissions. Out of consideration for the air quality, it should be considered to prohibit biodiesel vehicles in such zones, because they emit nitrogen oxides.

There are currently no zero-emission or fossil-free zones in Europe, but low-emission zones have been introduced in several places. This means that there is limited experience to build on. As a first step, zero-emission zones can be introduced in heavily trafficked city centre streets that are not part of the main road network and where there are few parking spaces for local residents. The first phase can give zero-emission vehicles better access to selected parts of the city centre, but fossil-based vehicles should not be banned from large areas at this stage. The provision should apply to private cars, utility vehicles and buses alike. In order to avoid unfortunate consequences in terms of distribution, the arrangement should first be introduced on streets with few residents. The chosen streets should also have a certain amount of goods delivery. Sustainable goods transport will provide a significant environmental benefit for the city. Zero-emission waste management is easy to achieve in areas where the underground waste collection network has been established. Alternatively, the zone can be operated by electric waste trucks. Streets used by public transport should be avoided in the initial phase.

A pedestrian-friendly city

Making Bergen a **pedestrian-friendly city** is emphasised as an important goal in the new social element of the municipal master plan:

‘In the last fifty years, urban planning in Bergen has largely been tailored to the car. Now, we will prioritise pedestrians first and then cycling and public transport. This will help us to achieve a more active and climate-friendly city. By focusing on making Bergen pedestrian-friendly, we want to encourage people to move more in their day-to-day lives and have an active, close relationship with the city and their local environment. The measure is a way of creating a more people-friendly city that contributes to better mental and physical health. At the same time, it helps to make the city more climate-friendly.’

In order to realise the ambition of Bergen as a pedestrian-friendly city, all areas of the city must be planned with pedestrians in mind. The focus must be on manageable walking distances and attractive walking paths. Streets, urban spaces and shortcuts that are conducive to good experiences and create potential meeting places are important if we are to make walking more attractive. A mixture of different functions (houses, businesses/shops, public functions) is the key to a pedestrian-friendly environment. The Norwegian Public Roads Administration has prepared a National Walking Strategy that underpins these goals.



Figure 5.3 The transport pyramid shows which means of transport are most expedient from a societal perspective

Design: Christine Hvidsten

At the top of the pyramid is walking and cycling, which shall be given priority in all planning and construction. Next we find public transport, then goods transport and carpooling, and last solo driving.

Cycling

The National Cycling Strategy (2012) sets out the following main goal:

‘Cycling shall account for 8% of all journeys in Norway by 2023’

The goal of an 8% cycling share means that cycling must at least double in scope, since the total number of journeys is expected to increase. The greatest potential is in the cities: The cycling share should be around 10–20%, depending on local conditions. The Regional Transport Plan for Hordaland

2013–2014 sets out the following goal for the Bergen area: *The proportion of journeys made by bicycle shall increase from 3 to 8%.*

The Cycling Strategy for Bergen 2010–2019 was adopted by the City Council on 26 April 2010. The cycling strategy sets out the following main goals:

- Cycling in Bergen shall be an attractive and safe option for all
- By 2019, the cycling share shall increase to at least 10% of all journeys in Bergen
- The main cycling network shall be completed by 2019

The cycling strategy envisages a cohesive cycling network consisting of main routes (main cycling network) and suburban routes, and it is followed up by a four-year action plan. The action plan specifies the cycling strategy and the City Council's decision.

Existing policy instruments and organisation

Most of the current work is based on funds granted through the Bergen Programme's cycling initiative relating to county and national roads. Approximately NOK 100–115 million is spent every year on cycling initiatives (this partially includes pertaining road improvements and pedestrian initiatives in connection with cycling initiatives). Some cycling initiatives are financed directly by the state through the National Transport Plan. The County Council part-finances bicycle parking facilities near public transport terminals. The municipality is responsible for facilitating cycling on the municipal road network, but it is also the planning authority for cycling initiatives initiated by central government and county municipal authorities. The goal is to include experience of the current organisation in the Urban Environment Agreement, in a way that ensures greater capacity for implementation of bicycle projects.

High-quality, high-capacity cycling infrastructure

A number of measures are under way to improve the infrastructure in Bergen. In order to achieve the goal of an increased cycling share, the cycling infrastructure must be attractive and encourage use by all types of cyclists. The facilities must be designed for increased use, meaning that the capacity of facilities near the city centre must be higher than facilities in the city districts because the number of users is higher. This can help to make cycling the fastest, simplest and most efficient means of transport. Cycling must be perceived as safe and comfortable, and it must also be integrated in road safety measures. A natural strategy would be to prioritise measures in the city centre. The cycling share in the city districts of Bergenhus and Årstad is already twice as high as the rest of Bergen (7–8%), but the potential for further growth is high.

A cycling-friendly city

The 'Sykkelbyen Bergen' project is a partnership between Hordaland County Council, the City of Bergen and the Norwegian Public Roads Administration and is part of the cycling initiative under the Bergen Programme.



Success criteria for achieving a high cycling share

- ✓ A coherent, well-constructed cycling network with high-quality details
- ✓ High-quality maintenance and operation of the cycling network in both summer and winter
- ✓ Cycling culture and social acceptance
- ✓ Good cycling facilities
- ✓ Long-term investment in cycling, and high level of expertise
- ✓ Focus on everyday cyclists
- ✓ Concerted effort in several fields (for example coordinated infrastructure measures and campaigns)
- ✓ Stronger focus on children and young people
- ✓ Seeing the cycling initiative in conjunction with other policy areas (for example public health)

Publictransport

Hordaland County Council is responsible for public transport in Bergen. The municipality's role in relation to public transport is first and foremost to be the planning authority for:

- densification around public transport hubs
- regulation of the Bergen Light Rail line
- measures to improve the traffic flow for public transport

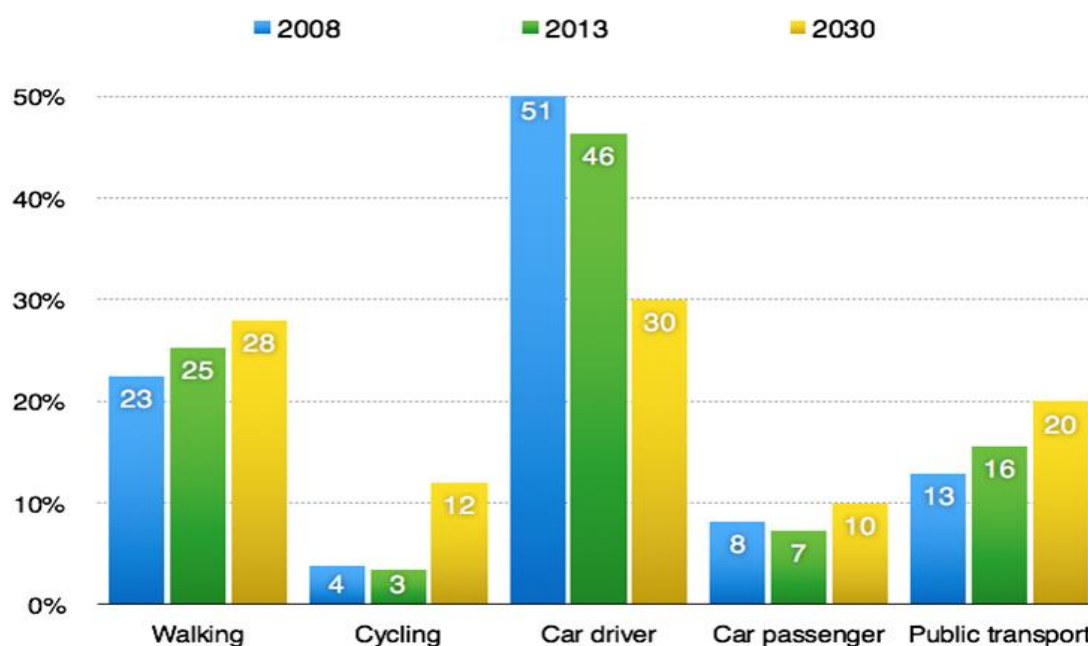
Experience and studies have shown that these factors are crucial to ensure optimum conditions for public transport. As regards the traffic flow, calculations show that an increase in speed of 10% reduces the need for operating grants by 15% (Urbanet Analyse, 50/2014).

Bergen is dependent on good cooperation with its neighbouring municipalities to ensure optimum public transport operations. This applies in particular to park-and-ride facilities, which should preferably be located in the outer transport hubs of the Bergen area to have the greatest effect. Public transport by sea, which can gradually be operated by zero-emission craft, is another important area in which Bergen must cooperate with its neighbouring municipalities.

The Public Transport Strategy for Hordaland (Skyss, 2014) sets out four main strategies:

- Best provision where most of the travellers are
- Simple travel
- Efficient travel
- Environmentally friendly operation

Figure 5.4 Travel habits survey for Bergen 2013, with breakdown in 2008 and 2013 and possible breakdown for 2030



Source: RVU 2013 (blue and green columns). Figures in percentage. Note: Of the yellow bars, only the bar for car drivers indicates a specific target in accordance with the goal of reducing car traffic. The bars for walking, cycling, car passengers and public transport only indicate one of several possible breakdowns between travel modes and are not concrete, quantified targets.

The City of Bergen supports the main points of the public transport strategy. Public transport must absorb a lot of the growth in passenger traffic in the years ahead. According to the strategy document, each new public transport user costs the authorities NOK 10. Walking and cycling are means of travel that have great socio-economic benefits. It is therefore a goal in itself to ensure that these means of travel account for as large a proportion as possible. Facilities that promote walking and cycling should be given priority on short journeys and into public transport hubs. There is also a great untapped potential for carpooling. With the right measures and minor investments, unoccupied car seats can absorb a considerable part of the growth in passenger transport. At the

same time, a high-capacity public transport system is a precondition for getting various shared mobility solutions (carpooling, car-sharing schemes) to work. The City of Bergen will prioritise measures that highlight public transport and other shared mobility as a real alternative to solo driving in your own car.

Although public transport will require substantial investments and grants to meet demand in the time ahead, calculations carried out by Urbanet suggest that it will cost twice as much to handle the growth in passenger traffic by increased car traffic and development of road capacity.

In order to reach the overriding goals for the transport sector, the people of Bergen must make as many journeys by foot as by car by 2030. To achieve zero growth in car traffic in 2030, the car share must not exceed 39%. To achieve a 20% reduction by 2030, it must be even lower, estimated at 30%. The walking share, on the other hand, must increase to 28% in 2030. (Based on figures from Urbanet Analyse – the zero growth target.)

As regards the number of journeys made in Bergen, prognoses from Urbanet show an increase from 882,000 journeys per day in 2014 to 1,012,000 journeys per day in 2030. According to these calculations, there will be an increase in daily journeys of 130,000 by 2030, to be distributed between walking, cycling, public transport and unoccupied car seats. In addition, approximately 75,000 journeys currently made by car shall be shifted to walking, cycling, public transport and unoccupied car seats. This shift may seem ambitious. On the other hand, the travel habits survey from 2013 shows a positive development in recent years.

Short car journeys

The potential for changing travel habits is great. According to the travel habits survey from 2013/14, 39% of all car journeys are shorter than 3 km. A great number of these journeys can be replaced by walking and cycling, or by public transport. For example, 6% of car journeys are shorter than 1 km. The city of Malmø has had a dedicated campaign going for several years, targeting 'ridiculous car journeys', using humour as a tactic. The campaign has been very successful. A focus on car sharing can also be effective. Investigations of car-sharing networks show that membership of such schemes drastically reduce the number of 'ridiculously short car journeys'.

Multi-modal journeys = a good transport mix

Good interoperability is essential if environmentally friendly forms of transport are to be able to compete with the car. Most journeys are multi-modal, meaning that the traveller changes between different modes of transport. Especially in relation to public transport, it is essential to facilitate walking and cycling to transport hubs and stops, including secure bicycle parking facilities.

In recent years, several apps and services have been developed that integrate travel information from different modes of transport and make multi-modal journeys easier. European surveys show that members of car-sharing networks make use of a greater part of the available means of transport than car owners do.

Dedicated mobility plan (SUMP) for Bergen?

More and more cities are drawing up their own Sustainable Urban Mobility Plan (SUMP). Dedicated networks have been established under the auspices of the EU in which these cities support each other and share their experience of the work on such plans. In Bergen's case, it must be considered whether such a comprehensive, sustainable mobility plan can coexist with plans that have already been established for the area.



OVERALL MEASURES CONSIDERED IN 2016

- Consider whether to prepare a Sustainable Urban Mobility Plan (SUMP) for Bergen

ONGOING MEASURES TO BE CONTINUED

- Supporting the development of apps and other information systems that simplify the use of different means of transport combined;
- Planning Bergen Light Rail lines that promote environmentally friendly urban development;
- Implementing measures that lead to a better traffic flow for public transport;
- Building infrastructure that makes walking and cycling in Bergen easier, for example by:
 - prioritising the development of infrastructure for walking and cycling, including a bridge for cyclists and pedestrians across the Puddefjord, the 'Småpudden', which will open on 14 June 2016;
 - building high-quality, high-capacity cycling infrastructure;
 - improving shortcuts to public transport stops.
- Introducing time-differentiated road tolls combined with better public transport services.

MEASURES TO START IN 2016

Measures targeting pedestrians and cyclists

- Promoting cycling as a means of transport and utility vehicle by:
 - allowing cyclists to travel in both directions on one-way streets;
 - establishing streets where cyclists have priority;
 - facilitating public bicycle parking facilities that offer good solutions and are located in strategic spots in the city and near public transport hubs;
 - introducing various measures to reduce accessibility for car traffic, giving cyclists competitive advantages over cars;
 - establishing sufficient, expedient bicycle parking facilities;
 - signposting cycling routes.

Measures for public transport users

- Facilitating simple transfer between means of transport with the help of good infrastructure for pedestrians and cyclists travelling towards public transport stops;
- Promoting better public transport services in line with the Public Transport Strategy for Hordaland;
- Establishing new public high-occupancy vehicle (HOV) lanes;
- Establishing sufficient park-and-ride facilities for cars and bicycles in strategically important hubs.

Measures to limit car traffic

- Looking into and preparing for the introduction of environmentally differentiated road tolls;
- Preparing for fossil-free zones in the city districts with a view to establishing the first zones by 2020;
- Preparing for zero-emission zones in the city centre with a view to establishing the first zone by 2020.

Strategy 3: Shared mobility – mobility culture changes

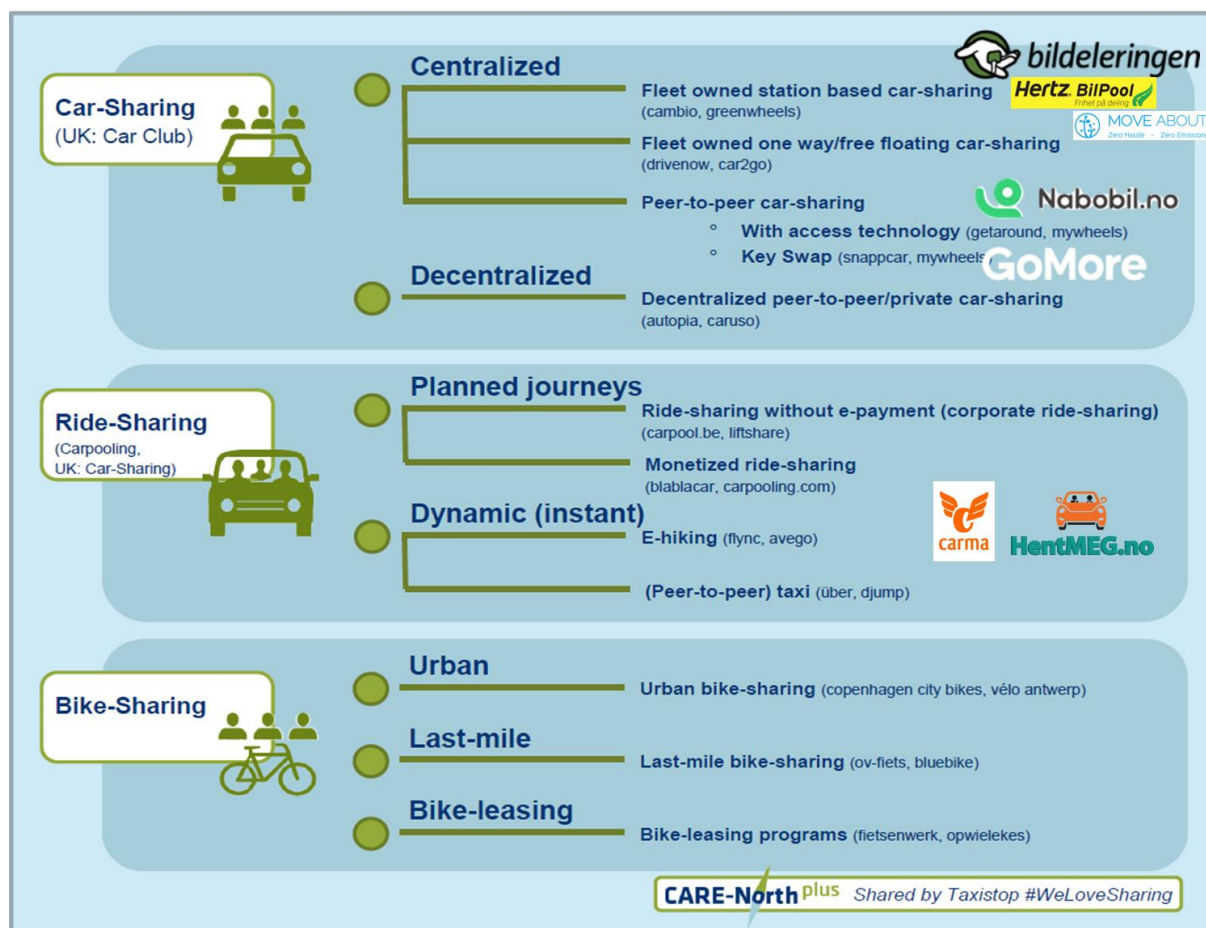
Goals for shared mobility – changes in mobility culture

- T4 The capacity of vehicles on the roads must be better utilised. The goal is to double the number of passengers per car during rush hours by 2020.
- T5 Bergen shall promote shared mobility. One goal is to reduce the number of cars per household in Bergen – from 1.35 to 1 car per household by 2025.

Would you buy a cow if you needed a glass of milk?

A sharing culture and sharing economy is about shifting the focus from ownership to access. Shared mobility is about a shift from the idea of car ownership to the concept of *access* to the means of transport you need, when you need it. This is a precondition for achieving reductions in traffic and emissions, and to free up valuable land without affecting the mobility we desire. Trend surveys shows that one in four young people do not consider owning a car to be important. On average, privately owned cars in Norway are only used for 0.5 hours a day. During rush hour, 95% of the cars' passenger seats are empty. This represents an enormous pool of available capacity, which it is almost 'free' to exploit. The barriers to realising this potential are mostly about culture and psychology. The good news is that minor changes in this area can have a huge impact on the system as a whole.

Figure 5.5 Overview of shared mobility – operators, April 2016



Car sharing – sharing of vehicles

A car-sharing network is a cooperative society that organises car sharing for private individuals and enterprises. The car-sharing network means that the members do not have to take responsibility for the upkeep of a car, while both the environment and society benefit from better utilisation of the total car fleet. The car-sharing network uses modern cars of varying sizes with a high safety standard and modern engine technology, and with low emissions. Members of car-sharing networks drive about 30% fewer kilometres than car owners. According to the Institute of Transport Economics (TØI), one shared car can replace between 5 and 15 privately owned cars.

The car-sharing network in Bergen has 150 cars. This means a reduction in the number of cars in the city of between 750 and 2,250. In 2015, the car sharing network had around 1,400 members. In recent years, commercial players have also established car-sharing schemes, targeting businesses in particular. Hertz Bilpool and Move About are two examples.

New forms of car sharing are constantly being developed. In Europe, a **car-sharing network between private individuals** has grown tremendously the last few years. The scheme is based on privately owned cars that are made available to others when the owner is not using them. Car sharing is often provided through a mediating enterprise that handles booking systems, agreements and insurance. Both the Danish company GoMore and the Norwegian Nabobil.no offer such services in Bergen. There are also simpler solutions for small-scale car sharing between families in the same neighbourhood, for example in Autopia in Belgium.

Through the Interreg project Share North, Bergen has access to experience and solutions from Europe that can be tested in Bergen. Testing these solutions requires collaboration between the municipality, the business community and local associations and teams.

Carpooling – sharing of seats

Unoccupied seats in passenger cars represent a huge spare capacity in traffic. If they can be filled by road users who would otherwise use their own car, this can lead to less traffic and less emissions. The *Spontan Samkjøring* ('Spontaneous carpooling') project is a collaboration between the NPRA, Hordaland County Council, the City of Bergen and a number of private companies. Several enterprises with many employees have participated in the project. One of the goals is to get more people to carpool to work.

Counts by the Directorate of Public Roads show that six out of seven cars that drive in and out of Norwegian cities during rush hour contain only the driver. At the same time, measurements carried out by the NPRA show that very little is required to increase the flow of traffic. If 10% more motorists carpooled every day, or if everyone carpooled twice a month, the traffic would flow smoothly without congestion. If carpooling is to have the effect we are looking for, we must ensure that it is actually motorists who carpool, and not cyclists or public transport users who get a lift in a car instead of cycling or taking the bus.

Autonomous vehicles

Technological developments in recent years show that good solutions for self-driving vehicles are not far away. Several of the world's biggest companies are investing huge sums in this technology. Viewed solely as an exciting addition to today's technology, the climate benefit of such technology is doubtful. If, on the other hand, we manage to steer the development towards a shared fleet of autonomous vehicles that deliver transport on demand, it can be hugely beneficiary for the cities. Two independent studies, based on the cases of Lisbon and Stockholm, respectively, show that such solutions are capable of meeting the current transport demand by using about 10% of the current road capacity and parking space. A precondition for achieving good results is the existence of a high-capacity public transport system. Valuable land in the cities can be freed up for other purposes and have great financial benefits. A shared fleet of vehicles can be based on zero-emission technology, and any charging or battery replacement needed can be fully automatic, as required. In this way, it is possible to envisage achieving a vision of zero greenhouse gas emissions from the transport sector, at the same time as the number of road accidents can be close to zero. It will be important to include such scenarios in all long-term planning of future land-use and transport needs.

MEASURES FOR WHICH START-UP IS PLANNED IN 2016

- Measures to promote increase carpooling:
 - o work to establish an arrangement of lower road tolls for registered carpoolers;
 - o work to establish an arrangement of lower parking fees for registered carpoolers;
 - o testing an arrangement of highly visible, strategically located 'carpooling stops' for registered carpoolers. Providing information to people who are considering carpooling.
- Measures to promote car sharing:
 - o prioritising car-sharing schemes in connection with the development of public charging infrastructure;
 - o allocating a sufficient number of parking spaces for car-sharing schemes in central areas;
 - o supporting car-sharing initiatives between private parties;
 - o utilising the possibility of synergies between cars used primarily in the daytime and car sharing with people in the local area.
- Other sharing schemes
 - o testing sharing schemes for utility and transport bicycles that can replace car journeys;
 - o supporting local initiatives for shared mobility in city districts and neighbourhoods.
- Establishing a well-functioning public city bike scheme that covers a wider area than the city centre;
- Developing 'mobility hubs' with a dedicated profile that accommodate car sharing, (covered) bicycle parking facilities, charging for electric cars, information about public transport and carpooling stops;
- Participating in EU partnerships on shared mobility.

MEASURES TO BE CONSIDERED

- Cooperating with relevant parties on a dedicated mobility initiative targeting public and private enterprises and their employees.

Strategy 4: Transition to low-emission technology

Goals for transition to low-emission technology

- T6 Bergen shall provide good access to renewable fuel (charging stations, hydrogen and biofuel filling stations) for vehicles in the city.
- T7 All new passenger cars bought in Bergen shall be fossil-free as of 2025.
- T8 The City of Bergen shall promote fossil-free public transport by 2020.
- T9 All goods transport by light commercial vehicles shall be fossil-free as of 2025.
- T10 The City of Bergen shall facilitate fossil-free heavy goods vehicle traffic and construction work from 2025.
- T11 A greater proportion of cargo shall be moved from road transport to rail or sea. The City of Bergen shall facilitate fossil-free solutions for shipping.
- T12 The City of Bergen shall offer shoreside power to all ships by 2020.

Battery-powered electric cars, hydrogen cars and plug-in hybrid cars

Electric cars are currently suitable for local transport over distances of up to 80–160 km. More than 90% of journeys made in Norway are within the range of a normal electric car. Electric cars' range can be expanded if there is a well-developed network of battery charging facilities and possibilities for quick charging. Plug-in hybrid cars can use their electric motors for short journeys (20–60 km) and switch to their internal combustion engines for longer distances, which means, in principle, that their range is unlimited. The industry expects the range of normal electric cars to double within two years.

The increase in electric cars in the Bergen area in recent years is driven by the national and local incentives targeting these vehicles. The development is the result of active policy. The incentives will continue as long as the proportion of zero-emission cars is low, but will be gradually reduced as electric and hydrogen cars become competitive and the goal of reduced emissions from the car fleet is achieved.

The transition to fossil-free vehicles requires good access to non-fossil fuel and charging stations. Most basic charging stations in Bergen are installed by private households, housing cooperatives or employers. In addition, there are 118 publicly available charging points for electric cars in Bergen. There are currently 17 quick charging points in Bergen, ten of which are located in the biggest universal quick charging station at the Danmarks plass junction. In addition, there are approximately ten 'flexi-charging points' with possibilities of semi-quick charging. These figures are expected to increase strongly in the years ahead in step with the number of rechargeable vehicles.

In order to achieve targets T6, T7 and T8, we propose using policy instruments at the municipality's disposal relating to parking, charging points, land use etc., and also establishing partnerships initiated by business and industry. The municipality shall also act as a driving force in relation to authorities that have other policy instruments at their disposal. Mobility work will be important to achieve the transition to low-emission technology.

Electric cars in the city

The increase in the number of electric cars in the municipality has concurred with an increase in electric cars travelling into the city centre. Even though electric cars generate no local emissions, they take up space on the roads and in parking facilities. At one time or another, when appropriate, electric cars will have to start paying road tolls and parking fees. Free parking on public streets is regulated at the national level. Norway's policy is based on the idea of facilitating a rapid introduction of zero-emission vehicles to the car fleet. The City of Bergen will largely continue the financial benefits for zero-emission cars at the municipality's disposal until 2020. Gradual payment may be introduced after this date in order to slow down the introduction of electric and hydrogen cars, seen in relation to the proportion of electric/hydrogen cars of the total number of cars in Hordaland.

Hydrogen vehicles

Hydrogen vehicles use hydrogen gas in a fuel cell to produce power in an electric motor. The hydrogen works as an energy carrier, corresponding to a battery in an electric car. The advantages of hydrogen over batteries are quicker filling (like fossil fuel) and longer range. It is also easier to scale up hydrogen solutions to heavier vehicles and boats. Hydrogen will be a necessary part of the fuel solution to achieve the goal of a renewable transport sector. In the last few years, technological developments have taken place that mean that several hydrogen-based models are available at competitive prices. Hydrogen filling stations are costly to establish and depend on public funding until the market matures. The City of Bergen can contribute to the phasing in of hydrogen by buying suitable cars for its own use, and by cooperating on the establishment of hydrogen filling stations. Space and necessary infrastructure have been allocated for a hydrogen filling station near the Danmarks plass junction.

Together with Oslo, Trondheim and Stavanger, the City of Bergen has collaborated with the Norwegian University of Science and Technology (NTNU)/Sintef on a report on the phasing in of hydrogen. The biggest cities and towns in Norway will play an important role in a major national initiative to make the transport sector more environmentally friendly. Cooperation between national and local authorities will be decisive in the phasing in of hydrogen for transport purposes. Targeted use of policy instruments to establish hydrogen stations can encourage increased sale of hydrogen vehicles. Local policy instruments such as zero-emission zones and public procurement policy can effectively stimulate demand.

Electrification of public transport

The public transport strategy for Hordaland sets out 'Environmentally friendly operation' as one of four main focus areas. Although the total fleet of buses and boats is not among the major contributors to emissions from transport overall, each vehicle is used much more than a private car, which results in higher emissions per vehicle. Converting buses and boats into zero-emission vehicles will therefore have a substantial, positive climate effect per vehicle.

Skyss is participating in the testing of buses based on hybrid battery/biogas technology and is in the process of preparing new bus tenders with requirements for fossil-free solutions. Electric buses and ferries are gaining ground, and Bergen and Hordaland are taking an ambitious approach to the phasing in of such technology.

Siemens and Volvo have conducted a feasibility study for future bus transport in Oslo. The study was presented in February 2016, and it concludes that Oslo can save millions on a transition to rechargeable buses and quick charging at the final stop.

Fossil-free commercial transport

Goods transport and construction machinery have different needs than passenger cars for phasing out fossil fuel. Cooperation with business and industry is of great importance. The City of Bergen will focus on influencing the business sector and cooperating with relevant partners to find good, fossil-free solutions for Bergen.

ONGOING MEASURES TO BE CONTINUED

- Cooperating with Hordaland County Council and the business sector on building quick-charging stations.
- The City of Bergen will take the initiative and test new payment solutions for charging to make it easier for private parties to develop and offer charging services.

MEASURES TO START IN 2016

- Considering environmentally differentiated road tolls and/or low-emission zones;
- Preparing the first fossil-free zone in the city centre (promote the use of emission-free vehicles), and introducing this zone by 2020;
- Facilitating charging infrastructure:
 - making requirements of developers to facilitate charging points (dimensioning of electrical systems, conduits etc.) for at least 75% of the parking spaces in connection with the establishment or upgrading of parking facilities;
 - establishing a sufficient number of publicly available basic and flexi-charging points at street level and in parking garages, in areas where it is difficult for private individuals to establish charging solutions;
- Facilitating the establishment of energy stations in cooperation with new businesses and existing petrol stations, so that we increase the supply of fossil fuel (electricity, biogas, hydrogen) pending growth in demand.

MEASURES THAT REQUIRE COOPERATION

- Together with relevant partners, the City of Bergen will carry out pilot projects to prepare for the introduction of a zero-emission zone in the city centre by 2020.
 - facilitating emission-free operation of tourist coaches in the city centre;
 - facilitating emission-free goods delivery.
- The City of Bergen will collaborate with Hordaland County Council on
 - achieving fossil-free public transport;
 - achieving fossil-free taxis.
- Together with the transport sector, the City of Bergen will consider projects and measures that can:
 - ensure fossil-free goods transport by light vehicles;
 - ensure fossil-free goods transport by heavy vehicles;
 - ensure fossil-free construction work.

- The City of Bergen will follow up the scheme of environmentally differentiated port charges (introduced at the turn of the year 2015/2016).
- The City of Bergen will be a driving force for schemes that promote the use of fossil-free solutions (e.g. biofuel) in air traffic to and from Bergen Airport (e.g. differentiated landing charges).

5.3. Policy instruments

Entering into an Urban Environment Agreement will be the most comprehensive measure, initially covering all the strategies. An Urban Environment Agreement is a way of continuing existing ‘city packages’ / road toll schemes that shall help to ensure that all growth in passenger traffic is in the form of walking, cycling, public transport and unoccupied car seats.

EXISTING POLICY INSTRUMENTS	OWNER
Coordinated land-use and transport planning at the local and regional level to reduce land use and transport demand and facilitate increased use of public transport and increased cycling.	The municipality
Development of infrastructure (for motor vehicles, bicycles and pedestrians)	The NPRA and the municipality
Parking regulations	The municipality
Urban Environment Agreement	The state, the municipality, the county authority
Environmental requirements of the taxi industry. A decision by the Storting of December 2014 enables county authorities to set requirements for emission from taxis.	The county authority
Requirement for fossil-free public transport	The county authority
Bus and taxi lanes / HOV lanes	The NPRA
Road tolls and congestion charges.\	The municipality and the county, adopted by the Storting
Responsibility for traffic signs on municipal roads. Important to the work of establishing environmental zones/low-emission zones.	The municipality, the NPRA
CO ₂ tax on diesel and petrol, and the road use tax, which is not justified by greenhouse gas reductions but contributes to more expensive fuel.	The state
Differentiation of the one-off registration fee for private cars through emphasis on the CO ₂ component.	The state
Encourage the sale of electric and hydrogen cars through exemption from the one-off registration fee, VAT, (low) annual motor vehicle tax and 50% discount on company car tax.	The state
Giving zero-emission cars access to bus and taxi lanes, free passing of toll plazas, free	The municipality, the

parking and free parking in public charging stations.	state
Charging and parking for electric cars	The municipality, the county authority
Requirement for car manufacturers that average CO ₂ emissions from new passenger cars shall not exceed 130 g/km in 2015 and 95 g/km in 2021.	The EU
Increased use of biofuel through a sales requirement and partial/full exemption from the road tax on fuel.	The state
Grants for new technology and infrastructure that help to replace fossil fuel with alternative fuels or energy carriers that lead to lower or no CO ₂ , and for measures that reduce the extent of transport.	Enova

6. Energy in buildings

SECTOR GOALS

The building sector in Bergen shall be fossil-free by 2030, and new and existing buildings and street lighting shall be more energy-efficient.

- E1 By 2020, fossil oil shall not be used in homes or be the primary source of energy in big buildings, and the use of fossil gas shall be reduced by 30%.
By 2030, no fossil energy shall be used for heating purposes in Bergen.
- E2 Seventy per cent of all buildings in Bergen shall produce energy by 2030*.
- E3 District heating in Bergen shall be fossil-free by 2025.
- E4 Solar energy production systems (solar cells and solar collectors) corresponding to 200 W per inhabitant shall be installed in Bergen by 2030 (a total of 65 MW).
- E5 Electricity consumption in Bergen shall not increase towards 2030, despite the growth in population, phasing out of fossil fuels for heating and increased use of electric vehicles. This will result in a reduction of 30% per inhabitant.
- E6 Electricity consumption from public outdoor lighting** in Bergen shall be reduced by 40% by 2020 and 80% by 2030, and all new lighting systems shall have energy management options.
- E7 Sustainable choices of materials and energy solutions shall be assessed for all big new buildings (more than 100 square metres of floor space) and areas, and greenhouse gas accounts*** and mobility plans shall be prepared. Individual buildings shall be seen in connection with their surrounding areas, for example in terms of energy solutions.
- E8 Increased use of environmental classification systems such as BREEAM for big buildings and areas.
- E9 All buildings and areas in Bergen shall be climate-neutral by 2050.

* 'Produce energy' means local production of electricity or heat in connection with the building or area, for example solar panels, solar collectors, wind or different types of heat pumps etc. Approximately one in three Norwegian households currently have a heat pump.

** Public outdoor lighting means lighting on streets, roads, in parks, public spaces, sports grounds and schools.

*** A simple, free recipe for how to prepare greenhouse gas accounts is available at Klimagassregnskap.no.

6.1. Goals

Greenhouse gas emissions from the building sector are largely generated through the use of energy and materials, both during the construction process and throughout the service life of the building. The goals are therefore to reduce energy consumption in general and the use of fossil energy in particular. The goals shall be achieved by phasing out fossil energy and promoting the production of renewable energy and the use of climate-friendly material.

The municipality's goals are governed by EU policy, government directives and the Climate Plan for Hordaland.

Do we have the policy instruments we need?

Most public policy instruments and measures in recent years have benefited the construction of new buildings, while the same cannot be said for existing buildings. We therefore need better policy instruments and more measures targeting existing buildings. Here, government agencies like Enova can be challenged to do more. Enova has a number of support schemes that the people of Bergen can use to implement energy and climate measures in their own homes, but these schemes must be improved in a number of areas.

For example, Enova can improve support schemes with a view to accelerating the replacement of oil-fired stoves that are not connected to water-borne heating systems, increasing the installation of solar panels and providing energy guidance to private individuals.

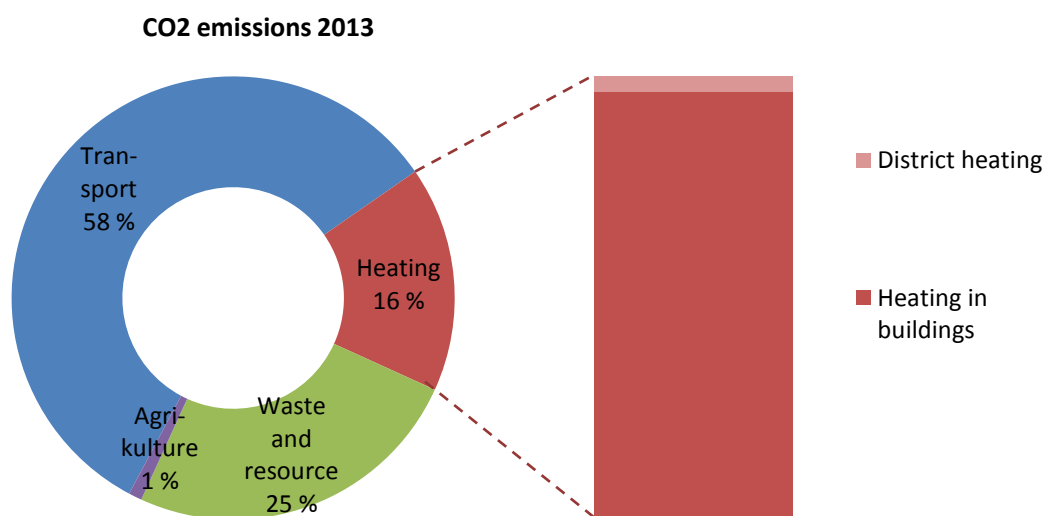
Many of the measures in the plan depend on new municipal and state policy instruments in order to produce results. The Climate Agreement announced that there will be a prohibition on using fossil oil as heating after 2020. A prohibition is decisive in achieving a quick enough transition from fossil to renewable energy for heating.

6.2. Status and challenges

New statistics from Statistics Norway of greenhouse gas emissions by municipality show that heating of buildings accounts for 16% of Bergen's direct greenhouse gas emissions.

Figure 6.1 shows that the use of fossil fuel for heating in buildings accounts for the majority of these emissions. Neither greenhouse gas emissions from the use of electricity nor indirect emissions relating to the production of building materials are included in the statistics.

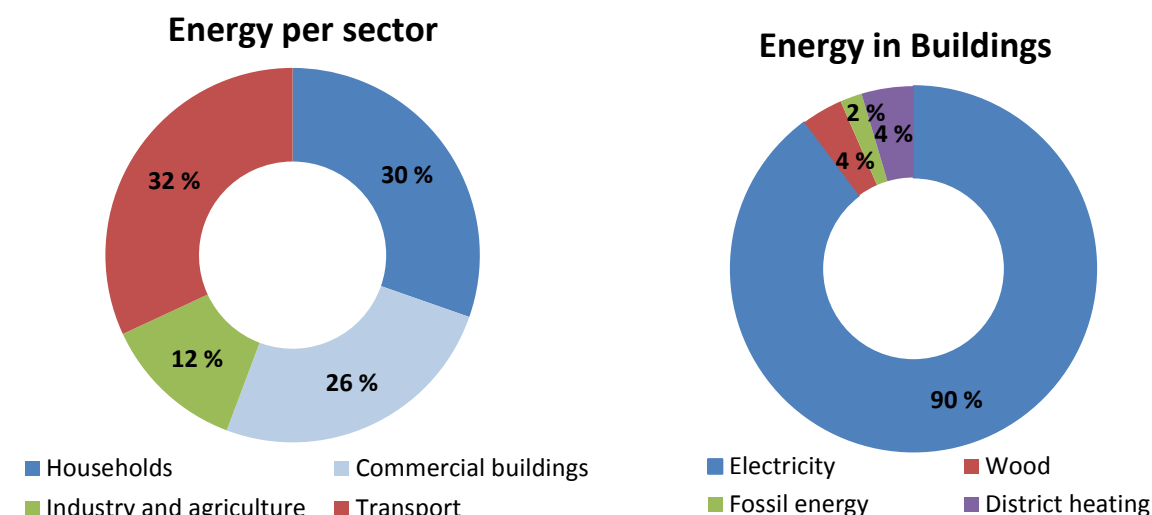
Figure 6.1 Greenhouse gas emissions in Bergen



Source: Statistics Norway, BKK

Figure 6.2 shows that energy consumption in buildings accounts for more than 60% of the energy consumption in Bergen. A total of 90% of the energy consumption comes from electricity. These figures are from 2009, because Statistics Norway has stopped publishing energy statistics by municipality, but the breakdown has probably not changed notably. It can also say something about the breakdown between households and businesses. Although greenhouse gas emissions from the use of electricity are not included in the statistics, it is nonetheless important to reduce energy consumption in buildings, among other things to free up electricity for use in the transport sector.

Figure 6.2: Energy consumption in Bergen by sector and energy carriers



Source: Statistics Norway

6.3. Overall planning leads to more climate-friendly buildings

A comprehensive approach to urban planning and development is essential in order to reduce greenhouse gas emissions. Where a building is located decides how transport to and from the building takes place. The building's design and placement on the plot lay the premises for the building's energy consumption and flexibility from a life-cycle perspective. The choice of energy solution decides the possibilities of using renewable energy and energy sharing between nearby buildings. The choice of materials generates greenhouse gas emissions in the construction process and has consequences for the energy used to operate the building once it is completed. It is therefore important to be aware of these factors at an early stage in the design process.

The pilot projects carried out under the five-year central government programme 'Cities of the Future' have given the City of Bergen valuable knowledge and experience. All the pilot projects set out to reduce greenhouse gas emissions by 50% in three areas:

- heating – by building to at least passive house standard
- building materials – by using climate-friendly materials
- traffic relating to the building – through localisation and mobility planning

Experience of the programme shows that an overall plan for an area is important, and that localisation and planning with a view to achieving climate-friendly mobility are as important as the use of materials and the choice of energy system. It is therefore very important to see the measures described in Chapters 5 and 6 on 'Transport and mobility' and 'Energy in buildings' in conjunction with each other.



6.4. Strategies

Many houses will have to be built to accommodate the population growth that is expected in the time ahead, which provides for the possibility of choosing climate-smart, energy-efficient solutions. Despite extensive construction activity and sustainable new buildings, 80% of all the buildings that will still exist in Bergen in 50 years have already been built. It is therefore important to reduce the energy consumption in existing buildings. There should be plenty of opportunities to achieve this, since many buildings built in the 1960s and 70s will need upgrading in the years ahead. At the same time, it is important to look at the whole picture and take building, land use and mobility solutions into account in connection with planning. A good living area has more to offer than the sum of its buildings.

Major changes are taking place in the construction sector. New buildings are becoming increasingly energy-efficient. People are more concerned with the building's life cycle, in terms of both energy consumption and greenhouse gases. The energy used for cooling will soon exceed the energy used for heating in new commercial buildings. Local energy production in connection with buildings is becoming increasingly common, and smart electricity meters will give people an opportunity to manage their energy consumption.

Reducing the use of direct-acting electricity for heating is a challenge. Replacing electricity with other renewable energy sources will make the energy system more robust by increasing energy flexibility, supply security, balancing out power peaks in the grid and reducing the need for developing and upgrading the grid.

The Climate and Energy Action Plan for Bergen describes the following main strategies for buildings:

1. ***From fossil to renewable energy***
2. ***Energy efficiency***
3. ***Energy and environmental qualities in buildings and areas***

Each strategy is explained and described in separate chapters. A list of measures that will be introduced to implement the strategies is included under each strategy.

Strategy 1: From fossil to renewable energy

SECTOR GOALS FOR THE TRANSITION FROM FOSSIL TO RENEWABLE ENERGY

- E1 By 2020, fossil oil shall not be used in homes or be the primary source of energy in big buildings, and the use of fossil gas shall be reduced by 30%.
By 2030, no fossil energy shall be used for heating purposes in Bergen.
- E2 Seventy per cent of all buildings in Bergen shall produce energy by 2030*.
- E3 District heating in Bergen shall be fossil-free by 2025.
- E4 Solar energy production systems (solar cells and solar collectors) corresponding to 200 W per inhabitant shall be installed in Bergen by 2030 (a total of 65 MW).

* 'Produce energy' means local production in connection with the building or area, for example solar panels, solar collectors, wind or different types of heat pumps etc. Approximately one in three Norwegian households currently have a heat pump.

The transition from fossil to renewable energy means that oil and gas shall be replaced by renewable, locally produced energy from heat pumps, solar panels and bioenergy. A prohibition against oil-fired heaters will lead to reduced greenhouse gas emissions.

It is relatively easy to reduce direct greenhouse gas emissions in buildings, as they are caused by the use of fossil energy for heating. The announced prohibition against the use of fossil energy for heating will therefore be effective. There are currently many competitive alternatives on the market, such as different types of heat pumps, solar collectors, district heating, biopellets and bio oil. The two latter reduce greenhouse gas emissions, but not emissions of particles and nitrogen oxides, and should be avoided in densely populated areas unless additional purification equipment is installed.

Bergen shall become oil-free and continue its focus on district heating

The City of Bergen helped to start up the *Oljefri* ('Oil-free') project in 2008. The website Oljefri.no provides information on how to switch from oil-fired heating to renewable energy sources. Until the prohibition enters into force in 2020, increased focus will be given to the transition from fossil to renewable energy for heating. Our focus on district heating will continue, particularly in existing buildings, where it represents a simple way to shift from the use of oil to renewable energy.

Overall planning in building areas, focusing on renewable energy

In development areas, it is important to consider the energy supply at an early stage, in the same way as other infrastructure such as roads, water and sewage. Early planning can provide for the possibility of local energy production and the development of structures for energy transmission between buildings. The City of Bergen shall encourage and facilitate local production of renewable energy in buildings and areas. Energy assessments shall be integrated in all planning.

ONGOING MEASURES TO BE CONTINUED

- Further development of the district heating network in the licence area and dialogue with BKK Varme on 100% renewable district heating.
- Focus on the Oljefri project and on providing information about the transition to renewable energy consumption.

MEASURES TO START IN 2016

- Introducing policy instruments for a speedy replacement of oil-fired stoves in both small and large buildings;
- Providing information about, facilitating and encouraging the installation and use of renewable energy production;
- Demanding energy assessments (report on energy solutions) in relevant plans, and developing functional templates for the work;
- Cooperating with relevant partners to increase the use of solar energy.

Strategy 2: Energy efficiency

SECTOR GOALS FOR ENERGY EFFICIENCY IN BUILDINGS

- E5 Electricity consumption in Bergen shall not increase towards 2020, despite the growth in population, phasing out of fossil fuels for heating and increased use of electric vehicles. This will result in a reduction of 20% per inhabitant.
- E6 Energy consumption from public outdoor lighting in Bergen shall be reduced by 40% by 2020 and 80% by 2030. All new lighting systems shall have energy management options.

** Public outdoor lighting means lighting on streets, roads, in parks, public spaces, sports grounds and schools.

Implementing energy efficiency measures in own buildings should be simple

Many of the policy instruments that aim to reduce energy consumption in buildings target new buildings. It is existing buildings that account for most of the energy consumption, however, and that have the greatest potential for reducing energy consumption. It is especially important to implement energy-saving measures when a building is being renovated, since that is when it is most profitable and easiest to achieve good results. It is also important to implement measures such as measuring energy consumption, management, regulation, heat recovery and other clean energy efficiency measures. Many energy-saving measures are profitable after only a few years.

Knowledge about energy-efficiency measures that can stimulate and guide the decision-making process is important to realise this potential. The need is especially great in the housing segment, which is characterised by many small decision makers with relatively limited knowledge.

In order to trigger the huge energy-saving potential that lies in existing buildings, we need better policy instruments at central government and municipal level.

The website 'Energiportalen' provides a tool that people can use to calculate the potential for energy saving in their own house. The website shows how much energy you can save by implementing various measures in your home. The tool will make it easier for people to decide whether and which energy-saving measures to implement.

Measuring energy consumption and showing results lead to lower electricity costs

Having an overview of energy consumption and how the energy is used makes it easier to implement measures where they will be most effective. Introducing smart electricity meters will enable better follow-up and management. Labelling and certification schemes such as Eco-Lighthouse, *Energimerket* ('the Energy Label') and BREEAM increase people's awareness about effective measures and results. Comparisons with others also work as an incentive and increase the level of knowledge.

High-quality outdoor lighting saves energy

In the 2010 Smart City report, it is estimated that simple measures can reduce the amount of energy used by street lighting by 50%. New knowledge and technology can also improve the quality of the lighting and provide an increased sense of security in public spaces and along roads. The municipality replaces old fixtures continuously and has an ambitious plan for upgrading existing lighting.

If lighting is taken into account in the preparation of plans, arrangements can be made to facilitate more efficient public lighting in the long term. The potential for saving in the form of reduced energy expenses is great. Competence-raising measures and the preparation of lighting plans are important tools for reducing energy consumption from street lighting. Work that has been carried out in, for example, Malmø has shown that the integration of a lighting plan in planning work has led to less expensive and better lighting in the city.



ONGOING MEASURES TO BE CONTINUED

- Certification of enterprises as Eco-Lighthouses
- Participation in the Klimapartner network

MEASURES TO START IN 2016

- The energy portal for houses
- Energy advice to private individuals
- Special focus on housing cooperatives in partnership with the building associations

- Introduction of smart electricity meters in Bergen (BKK). Research project on good communication platform for introducing smart meters (partnership with the University of Bergen (UiB) by application to ERA-NET)
- Focus on energy consumption in enterprises ('Catch my energy thief' etc.)
- Upgrading street lighting in Bergen.

Strategy 3: Energy and environmental qualities in large buildings and areas

SECTOR GOALS FOR BETTER ENERGY AND ENVIRONMENTAL QUALITY IN LARGE BUILDINGS AND AREAS

- E7 Environmentally friendly energy solutions shall be assessed for all new big buildings and areas, and greenhouse gas accounts*** and mobility plans shall be prepared. Individual buildings shall also be seen in connection with their surrounding areas, for example in terms of energy solutions.
- E8 Increased use of BREEAM classification system for buildings and areas.
- E9 All buildings and areas in Bergen shall be climate-neutral by 2050.

*** A simple, free recipe for how to prepare greenhouse gas accounts is available at Klimagassregnskap.no

Thinking about the whole picture when planning buildings and areas is important to achieve climate-friendly developments with low energy consumption and low emissions during the construction period, in the choice of materials and during the operating phase. In built-up areas, it is important to consider the value of the existing buildings, including materials and the energy structure.

The Technical Regulations (TEK) for buildings are continuously amended, and it is expected that the requirements in the current TEK10 are made more stringent so as to meet requirements for passive houses in 2016 and near zero-emission houses in 2020. The City of Bergen will help to ensure that the transition takes place as soon as possible.

Competence-raising for sustainable buildings and areas

Competence on the part of the construction industry and building orderers is important. Big enterprises generally have a good level of knowledge about energy-efficient buildings and building processes. We see good results from the work on pilot projects under the national programme Cities of the Future and the research programme Zero Emission Building (ZEB).

Private individuals who wish to upgrade their house with the help of skilled workers often have a great need for information.

A centre of expertise for energy-efficient, sustainable construction is currently under development at Bergen University College in cooperation with other local educational institutions and various public agencies. This is important to achieve the necessary competence-raising in the construction industry. The centre of expertise will work on energy efficiency, the use of materials, the location of new buildings and renovation of existing buildings.

Greenhouse gas accounts will contribute to more environmentally friendly choices

New building regulations and a focus on building energy-efficient buildings will lead to low energy consumption in new buildings. We see that commercial buildings increasingly need cooling. It is therefore important to take steps to reduce the need for cooling and the amount of energy used for cooling.

Preparing greenhouse gas accounts during the construction process is a good tool for reducing the overall greenhouse gas emissions from buildings. When the building itself becomes more energy efficient, other parts of the construction process will contribute more, relatively speaking, to greenhouse gas emissions and energy consumption, particularly the localisation of the building and the materials used. Greenhouse gas accounts prepared for Rådalslien residential care units, Søreide School and the ZEB project at Haakonssvern (office building) are testament to this development.

Wood buildings lead to less greenhouse gas emissions and a good indoor climate

When the energy consumed during the service life of a building is reduced to a minimum and the building also produces its own energy, the choice of materials becomes relatively more important. The projects under the Cities of the Future programme have contributed to the development of new components and new materials that give lower greenhouse gas emissions than traditional materials, for example low-carbon concrete. The use of wood as the main construction material reduces greenhouse gas emissions by at least 40%, which was demonstrated in connection with the building of Søreide School and in other pilot projects.

New technical solutions mean that urban, wooden multi-storey buildings are just as fire safe as concrete and steel buildings. The same is true for soundproofing. Research conducted in Austria and Canada shows that the use of wood on visible interior surfaces gives a healthy indoor climate and measureable health effects. Wood is used as the main construction material in an increasing number of urban buildings, which in terms of costs is on a par with traditional construction methods. Using prefabricated massive wood elements and modules can reduce the building costs.



PHOTO: Gerd Hole

Environmental classification system for buildings and areas leads to more sustainable buildings

The use of environmental classification systems for buildings has increased in recent years. BREEAM, and the Norwegian version BREEAM-Nor, has become the dominant system in Norway. There are 29 classified BREEAM-Nor buildings in Norway. Three of these buildings are in Bergen, and Søreide School is one of them. BREEAM-Nor is an environmental classification system that encourages sustainable design throughout the construction process, from the early phase, through the construction phase, to the handover of the building. It thereby contributes to the development of expedient and well thought-through environmental solutions while safeguarding the project's financial aspect. The City of Bergen encourages increased use of BREEAM.

BREEAM Communities is the same method used for areas instead of buildings. A method is being developed that is adapted to Norwegian conditions, and Bergen is participating in this development.

ONGOING MEASURES TO BE CONTINUED

- Building a centre of expertise for energy-efficient construction in cooperation with Bergen University College and other educational institutions in Bergen;
- Organising breakfast meetings on sustainable urban development;
- Getting other players to hold courses in Bergen;
- Interdisciplinary cooperation in the planning of big buildings and areas with a view to reducing the use of cars and facilitating cycling.

MEASURES TO START IN 2016

- Facilitating energy production in buildings and areas;
- Focusing on environmentally efficient and sustainable construction among developers in Bergen, among other things by organising preliminary seminars and making requirements for the preparation of energy assessments and greenhouse gas accounts;
- Participating in national and international projects to increase the level of knowledge about sustainable urban development and implementation capability;
- Contributing to raising expertise on the use of materials with a small carbon footprint, for example by developing guides and courses;
- Working in a long-term perspective to achieve zero emissions from new buildings and in connection with the development of new areas – for example by considering the climate-related and environmental consequences of investments and by facilitating emission-free transport in new projects;
- Encouraging the use of environmental classification systems, for example BREEAM, in connection with both the development of areas and the construction of individual buildings. The classification level should at least be 'Very Good';
- Considering fossil-free construction work – with regard to both buildings and transport.

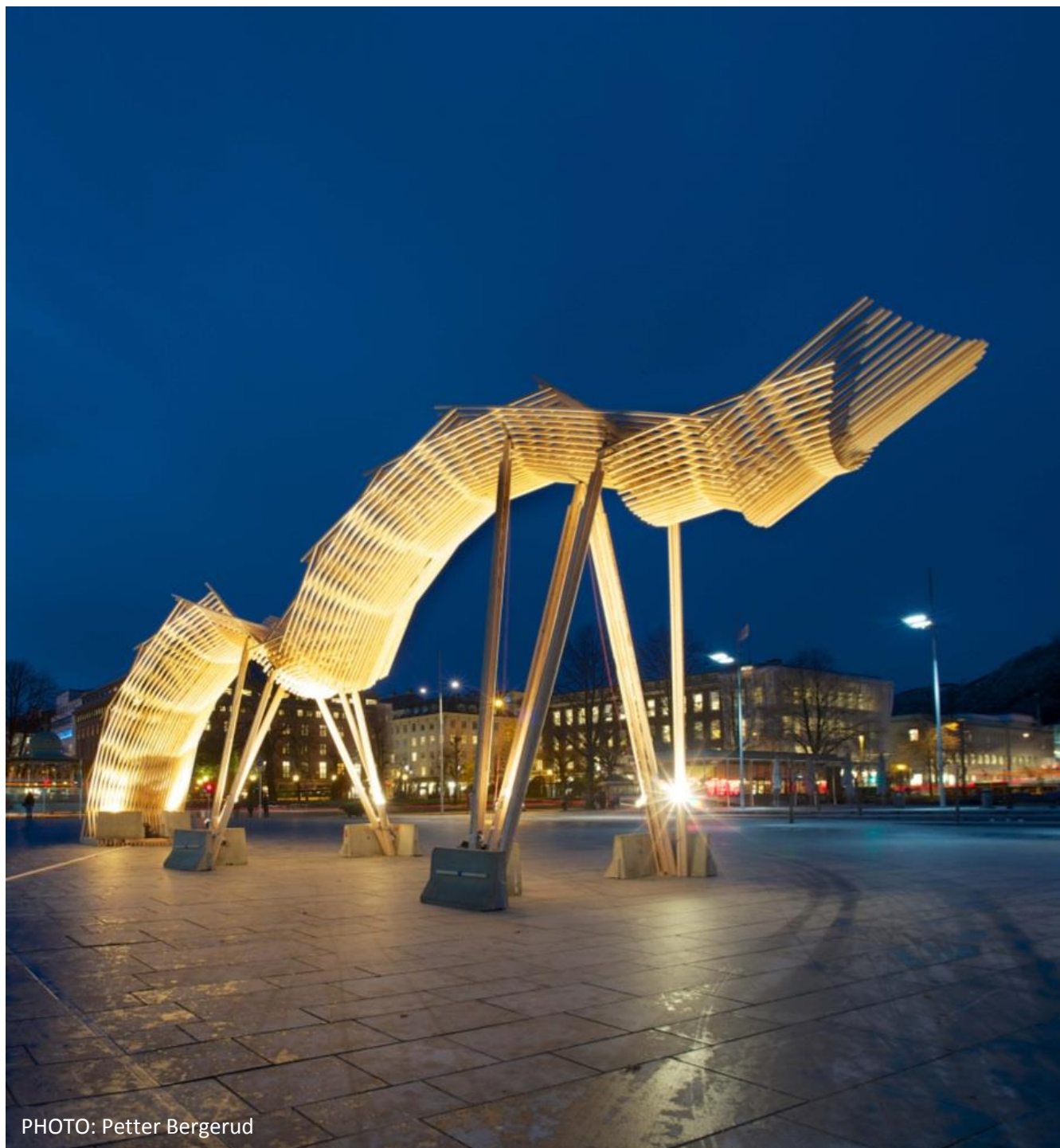


PHOTO: Petter Bergerud

6.5. Policy instruments

The right policy instruments are a precondition for implementing this plan. A number of instruments are laid down in law, and the municipality also has some policy instruments of its own. In addition, various special interest organisations and private parties are working on similar topics and projects.

EXISTING POLICY INSTRUMENTS	OWNER
The Planning and Building Act (PBL) outlines expedient processes for new buildings and restoration projects. It also provides legal authority for the Technical Regulations (TEK).	The state
TEK sets out the national requirements for buildings, including for energy quality and the use of renewable energy for heating. TEK10 sets stringent requirements at the passive house level for new buildings and major restoration projects. The announced revision in 2020 will entail a further tightening to almost zero-emission level.	The state
The purpose of regulations relating to energy labelling of buildings and energy assessments of technical systems is to highlight the energy condition of buildings and the possibility of reducing energy consumption in existing buildings. Energy labelling is mandatory for all new buildings and in connection with the sale or hiring out of private homes and commercial buildings.	The state
The installation of new advanced electricity meters (AMS) in all homes by the end of 2018 will make it easier for customers and providers to consider measures.	The state
Enova has grant schemes and advisory services for private individuals and private and public enterprises, which focus on reducing energy consumption, phasing out fossil energy and producing renewable energy.	The state
Green leases is a concept developed by the Norwegian Green Building Council in cooperation with the Norwegian Property Federation. The goal is to ensure that both the tenant and landlord benefit from upgrades.	The Norwegian Green Building Council The Norwegian Property Federation
BREEAM-Nor is an environmental classification system for large buildings that rewards taking the environment, climate and energy into consideration throughout the planning and construction process.	The Norwegian Green Building Council (NGBC)
Phasing out old wood-burning stoves in Bergen – municipal grant scheme	The municipality
Licence area for district heating	The municipality
Climate and environmental fund from which people can apply for financial support for various environmental, climate and energy measures.	The municipality
Energy portal – simplified version for private homes (terrace houses and detached houses)	The private sector
Energy Performance Contract (EPC) with guarantee	The private sector

7. Consumption patterns, waste and resources

SECTOR GOALS

The total amount of residual waste and greenhouse gas emissions from waste management shall be reduced

- A1 The people of Bergen shall know how consumption, waste and resource utilisation affect greenhouse gas emissions and how they can make climate-friendly choices.
- A2 It shall be simple and attractive for consumers in Bergen to choose products that have a long service life and the possibility of repairs and upgrades, and to gain access to products through various sharing schemes.
- A3 In Bergen, it shall be easy to sort used items and waste in an expedient manner. The amount of waste shall be reduced, and the quality of recovery shall be increased.
- A4 Waste transport in Bergen city centre shall generate zero emissions of greenhouse gases and NOx by 2020.
- A5 Arrangements shall be made to establish better solutions for handling commercial waste.
- A6 The amount of fossil fuel in waste incinerated at the waste incineration plant shall be reduced.
- A7 A carbon capture solution shall be installed at the waste incineration plant by 2025.

7.1. Goals

The national waste goals are set out in the waste strategy *Fra avfall til ressurs* ('From waste to resources' – in Norwegian only), which was adopted by the then Ministry of the Environment. The strategy states that *'the growth in the amount of waste shall be significantly lower than the economic growth'*.

The National Waste Strategy of August 2013 follows up the EU Waste Framework Directive. The focus is on waste prevention, recovery and utilisation of residual value in the waste. More re-use of textiles, increased material recovery of plastic and construction waste and less food waste are emphasised in particular. The goals for Bergen are based on the national goals.

Do we have the policy instruments we need?

The possibility of delivering sorted waste could be better in many areas of Bergen, and BIR plays a key role in this context. High-quality recovery is important to ensure that suitable waste is collected and made into new products. Deposit and return schemes must be organised well, for example by placing collection points in common areas that are easily accessible for the users. Steps can be taken

to enable people to deliver unsorted food waste for composting or other forms or recovery that do not entail incineration.

Establishing equipment libraries, 'swap shops' (where people can donate and swap usable items) etc. can make sharing and recycling easier for the people of Bergen.

More recycling and repair is desirable. The state can offer clear incentives for changed behaviour, for example in the form of reduced VAT on recycling and repair.

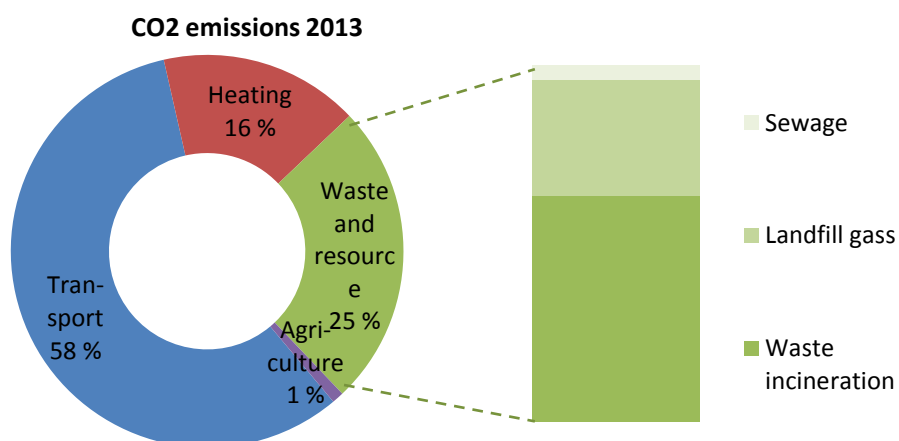
Coordinating private and public waste management, for example in the form of coordinated waste collection from households and businesses, is sometimes preferable from a climate and environmental perspective.

7.2. Status and challenges

Our consumption is closely related to the amount and type of waste we produce. The topic of consumption cannot be clearly distinguished from the other sectors described in the plan. We nonetheless choose to address it together with waste, because what we throw away largely reflects our consumption. Waste from households is called household waste. In Bergen, it is BIR that manages this waste. Waste from public and private enterprises is called commercial waste and is traded freely on the open market, mostly by private players.

The sum of our consumption and production is measured as our gross domestic product (GDP). During the period 1995–2011, the amount of waste increased by 39% and our GDP by 41%, and according to Statistics Norway, consumption in Norway has increased more than four times in the past fifty years. The national goal that the growth in waste shall be lower than the growth in GDP is therefore far from being achieved. The amount of waste has increased in step with the level of welfare and the economic development. During the financial crisis around 2009, there was a decrease in the amount of waste, but it has increased again after 2009.

Figure 7.1 Greenhouse gas emissions from waste and resource use in Bergen 2013



Source: Statistics Norway and BIR

Greenhouse gas emissions from waste treatment facilities, old landfills and sewage management in Bergen account for 28% of the municipality's greenhouse gas emissions. Waste incineration accounts for the majority of this, and demanding measures need to be put in place in order to reduce this share.

After all that can be recycled has been sorted from the household waste, the residual waste is incinerated at the facility in Rådalen. This facility also receives a lot of the commercial waste.

Improving sorting and reducing the amount of household waste and the fossil share of the waste is important, and the new waste strategy for BIR will specify what this approach entails. There is no common strategy for commercial waste, where many different players handle different types of waste. It is therefore important to take steps in relation to commercial waste, both in order to reduce the fossil share of the waste and to identify good solutions for the large quantities of material in building and construction.

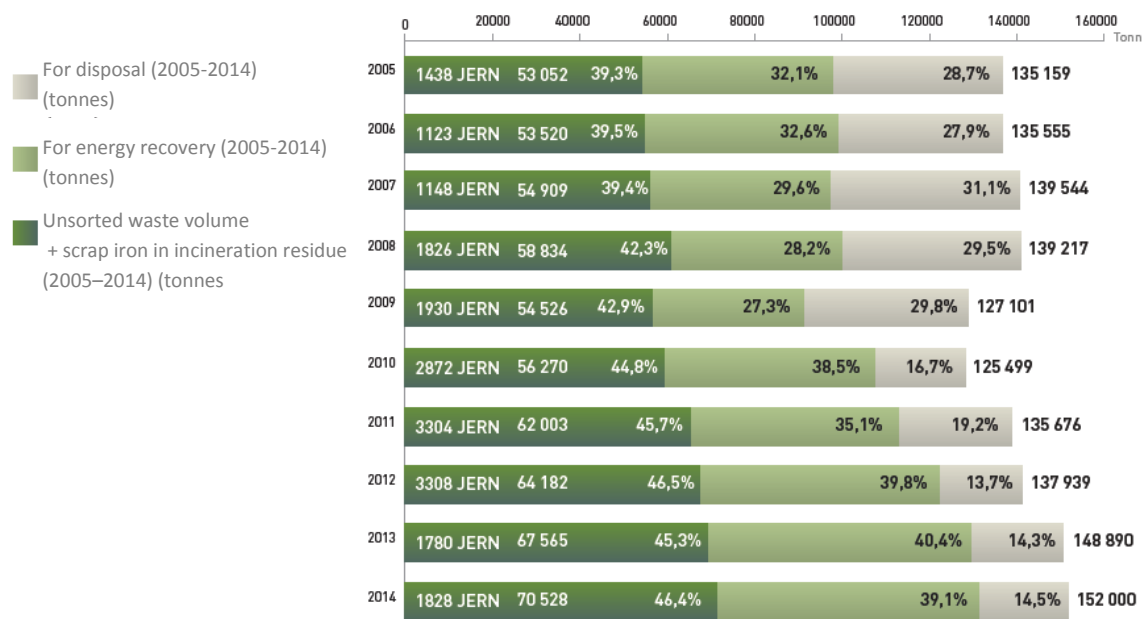
The waste consists of a number of fractions with different recycling value and with different climate impacts. In the municipalities serviced by BIR, 46.4% of the household waste was recycled in 2014. A total of 39.1% was incinerated for energy recovery. As much as 85.5% was recovered, which is higher than the national average, while 14.5% went for final processing/depository. In general, both the amount and the quality of recovery have increased more than the total amount of waste. Figure 7.2 shows the total amount of household waste and the recycled share for BIR's area.



PHOTO: Christine Hvidsten

Figure 7.2 Total amount of waste and recovery rate

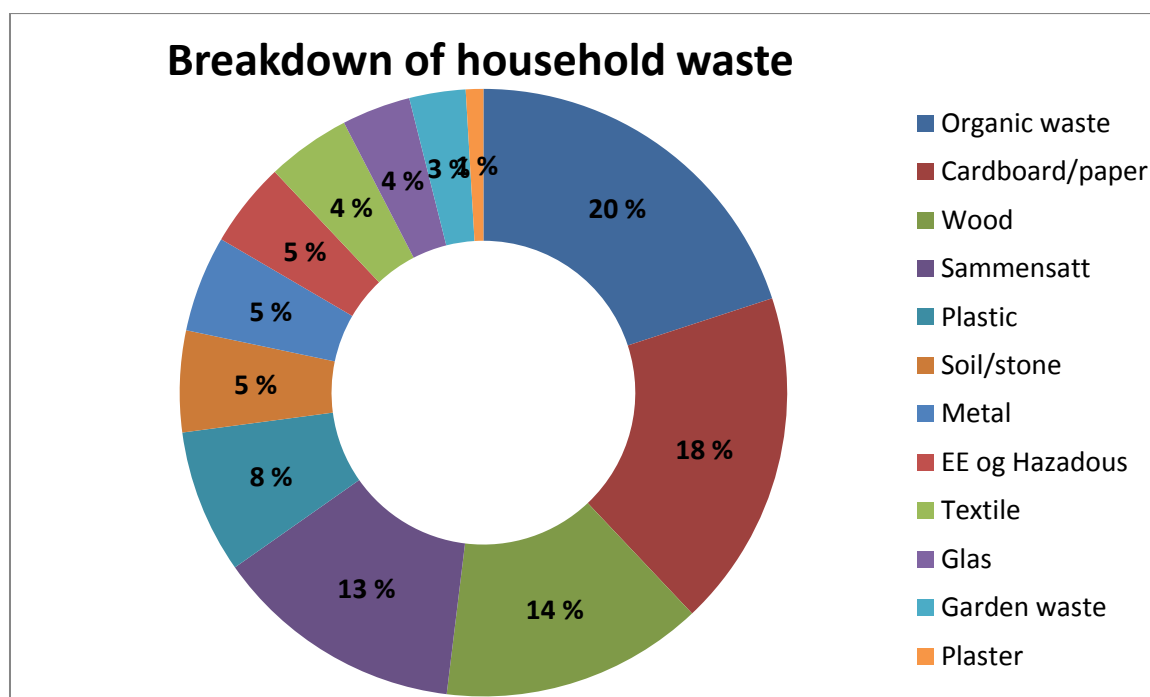
Unsorted volume (incl. scrap iron in incineration residue) for energy recovery – and disposed volume – per year



Source: BIR

Households sort their waste into several fractions at home. In addition, some fractions can be delivered to recycling stations and facilities. The breakdown between the different fractions in Bergen is shown in Figure 7.3. We see that the biggest share is food waste, which shows that there is a potential for increased sorting here, for example for composting or digestion for biogas.

Figure 7.3 Breakdown of household waste from waste collection and recycling stations



Source: BIR

7.3. The underground waste collection system will make the city tidier

In 2008, Bergen City Council decided that all waste in Bergen city centre shall be collected in an underground vacuum waste collection network. The first part of the network opened in 2015, and it will gradually be extended to cover the whole city centre.

This means that it will be easier for household customers to separate waste at source, and there will no longer be waste bins on the streets and in courtyards, which will result in improved hygiene, aesthetics and fire safety. Commercial customers will be offered to connect to the network in return for a standard fee, and may deliver their waste in bags. This will considerably reduce the need for heavy waste collection vehicles in Bergen city centre. Some driving will still be necessary, as glass and metal waste and hazardous waste will not be collected by the underground waste collection system.

The network opened in autumn 2015 and has inlets for households (bags in the small hatch) and commercial customers (bags in the big hatch). See photo below.



7.4. Strategies

Most activities in society generate greenhouse gas emissions in one form or another. We also know that indirect emissions from consumption far exceed direct emissions.

More and more people are questioning the models for increased production and economic growth. *Bærekraftige liv* ('Sustainable lives') is a people's movement based on self-sufficient, sustainable and social communities. There are similar initiatives in other countries, called 'transition towns'. The goal is a simpler and more robust way of life that is less demanding on resources and emphasises local resources and opportunities that also benefit the climate and environment.

The term 'circular economy' is a system for recreating resources and opportunities throughout the lifecycle of a product. Seeing waste as a resource instead of a problem reflects this way of thinking. In its consultation submission to the EU's circular economy strategy, the Norwegian Government pointed out that products should have a longer service life and generate a smaller carbon footprint.

The municipality has delegated responsibility for household waste to the waste collection company BIR. It will therefore be natural to cooperate closely on the climate-related ambitions set out in BIR's new Waste and Resource Strategy for 2016–2020. The possibility of achieving local goals will be enhanced by coordinating national framework conditions, municipal measures and BIR's efforts. Further development of the underground waste collection network and the introduction of fossil-free zones are examples of issues that require a concerted effort. Furthermore, it is of great importance that BIR take ambitious steps to sort out food waste and reduce CO₂ emissions from the waste incineration plant.

Commercial waste can consist of large, heavy masses, the transport of which requires extensive energy. Facilitating measures to reduce transport and achieve more expedient utilisation and management of commercial waste will have a substantial effect on the climate and environment.

The strategies chosen to reduce consumption and the climate impact of waste are as follows:

- 1 Reduce the climate impact of consumption**
- 2 Reduce the amount of waste and increase reuse**
- 3 Use waste as a resource**

Strategy 1: Reduce the climate impact of consumption**SECTOR GOALS TO REDUCE THE CLIMATE IMPACT OF CONSUMPTION**

- A1 The people of Bergen shall know how consumption, waste and resource utilisation affect greenhouse gas emissions and how they can make climate-friendly choices.
- A2 It shall be simple and attractive for consumers in Bergen to choose products that have a long service life and the possibility of repairs and upgrades, and to gain access to products through various sharing schemes.

Our own day-to-day choices affect the climate and environment; how we use our cars and travel, what we eat, how we build things, how we refurbish our houses, and how we consume. The world's resources are limited. The rate of consumption is extensive, and there are huge differences between the rich and the poor. Lower, smarter and more fair consumption is therefore necessary.

In cooperation with other parties, the municipality can encourage and assist by providing information and incentives for climate-friendly choices and actions. One example is to provide information such as this:

TIPS to reduce consumption

- ✓ Conscious purchasing. If you have to buy new, go for quality.
- ✓ Conscious choices in connection with refurbishing of private homes/holiday homes. Choose energy-efficient, durable solutions.
- ✓ Repair instead of buying a new product.
- ✓ Responsible action when products stop working.
- ✓ Conscious choice of travel and transport for both everyday tasks and leisure purposes.
- ✓ Conscious purchasing of food; quality – amount. See opportunities for using leftovers instead of throwing them away.
- ✓ Information about networks and non-profit organisations.

Sharing culture and sharing economy

The greatest challenge relating to consumption is: How can we reduce our climate footprint while maintaining consumers' level of welfare? The solution can be to think in terms of access rather than ownership. Many of the things we buy are intended to cover a special need. Many people buy a drill because they need to drill a hole in the wall. You buy a car to get where you want, when you want, and with as much cargo as you want. A sharing economy gives people access to use things when they need it, without having to buy the thing itself.

Sharing is not a new concept, but new communication technology and the use of social media allow us to build a sharing economy and culture between people in a different way than before. Sharing solutions are growing as a trend all over the Western world. Sharing culture and economy encompass a wide range of different services; some make a lot of money, others are driven by idealism and a desire to solve problems together. The accommodation service Airbnb books more overnight stays than the whole Hilton hotel chain taken together, and is a profitable business. CouchSurfing does

much of the same, but is free and based on people's inherent desire to help each other. What the services have in common is mutual trust, which is the real currency in this economy. The new social media have made it possible to gain and show trust in a way that makes it less tempting to abuse it.

The City of Bergen cannot adopt a sharing culture, but it can be a partner for its inhabitants and support initiatives that contribute to a smaller climate footprint. The municipality can help to make good initiatives known, such as local swapping and sharing networks, swap days and swap markets. Apps and services for sharing local resources can be made known to the people of Bergen.

The municipality can further develop its own recycling station, and possibly offer services and professional assistance to its inhabitants based on this activity. Various low-threshold services have developed in several countries, where neighbours help each other to fix equipment, thereby extending the service life of the items. The City of Bergen wishes to support 'repair cafes' or similar initiatives based on voluntary work.

ONGOING MEASURES TO BE CONTINUED

- Providing good communication platforms:
 - Making active use of websites and social media to spread information (BIR, the City of Bergen's website and klimahandling.no);
 - Competence-raising measures – for example organising breakfast meetings;
 - Cooperating on activities relating to consumption and the climate, for example redesign competitions, observing Earth Hour and organising the Climate Festival together with Bergen International Film Festival (BIFF);
 - Certification of enterprises as Eco-Lighthouses

MEASURES TO START IN 2016

- Facilitating local measures:
 - local sharing schemes for material and equipment;
 - local repairing initiatives;
- Further developing the municipality's recycling station into a resource centre for recycling and repair;
- Cooperating with industrial enterprises on developing models for a circular economy;
- Big events in the city that take place on municipal land, that receive financial support from the municipality or that the municipality organises shall be green events. From 2018, all such events shall have environmental certification.

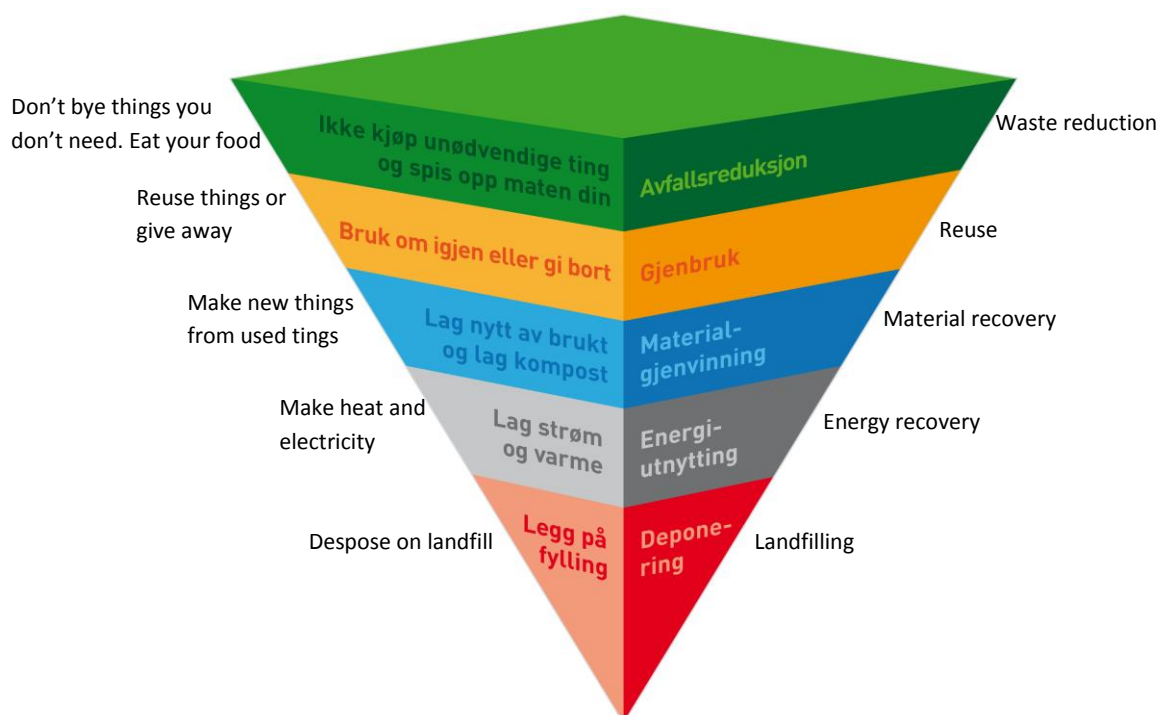
Strategy 2: – Reduce waste and increase recycling

GOALS TO REDUCE WASTE AND INCREASE RECYCLING

- A3 In Bergen, it shall be easy to sort used items and waste in an expedient manner. The amount of waste shall be reduced, and the quality of recovery shall be increased.
- A4 Waste transport in Bergen city centre shall generate zero emissions of greenhouse gases and NOx by 2020.
- A5 Arrangements shall be made to establish better solutions for handling commercial waste.

The waste hierarchy describes how we need to act to reduce the amount of waste and the environmental and climate impact of the waste. In practice, we need to consume less, and the things we buy should be of good quality and be durable, be possible to repair and to be used by others when they no longer work as intended. Then, it is considered whether the product, or parts of it, can be recycled and used for new products, and finally, whether it can be used to produce energy. This is the waste hierarchy illustrated in Figure 7.4.

Figure 7.4 The waste hierarchy visualises where we can concentrate our efforts to reduce the amount of waste



Source: The Norwegian Waste Management and Recycling Association (Avfall Norge)

To see opportunities and residual value instead of throwing away used items requires raised awareness. That is why the City of Bergen and BIR for several years have organised a redesign competition for young people between the ages of 12 and 16. The assignment given has been to make something new of things that would otherwise have been thrown away. The competition has

been popular and has generated many good products each year. Redesign has also become an elective subject at lower secondary schools in Bergen.

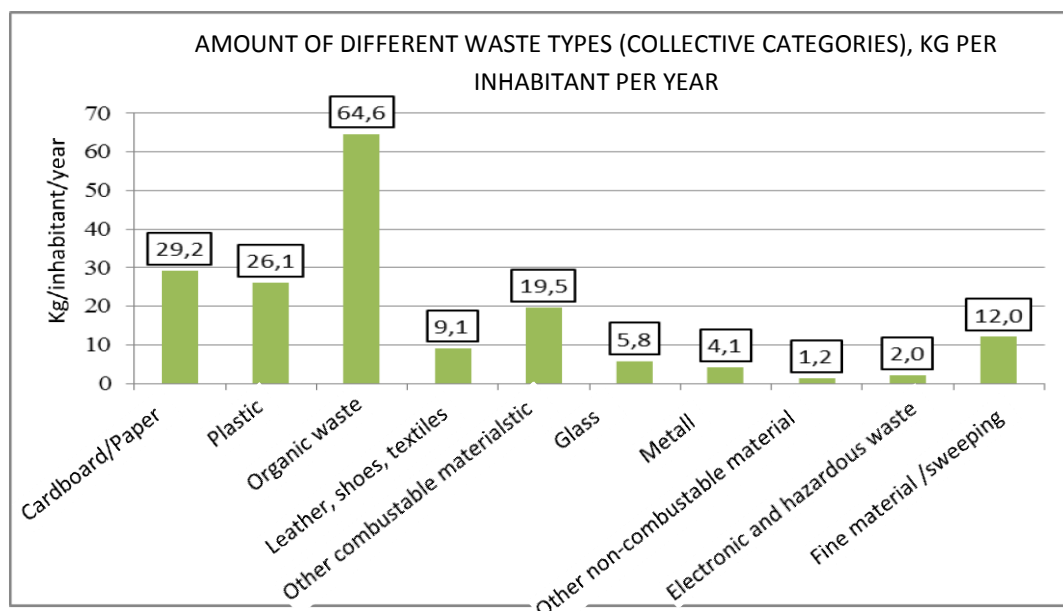
High-quality recovery

More recycling and recovery is positive with regard to both resource use and greenhouse gas emissions.

Some products and materials contain substances that can be harmful to health or the environment. This waste needs to be handled so as to avoid hazardous substances from spreading. The quality of sorted waste is as important as achieving a high recovery rate. In practice, this can mean that waste containing environmental toxins shall be sent for energy recovery rather than recycling. High-quality waste shall ensure clean raw materials, so that the material recovered from the waste is used for something useful and preferably replace virgin material.

Samples taken of residual waste from BIR customers in 2013 showed that between 21 and 34% of the residual waste could potentially be separated at source or recycled. Improved separation at source by households is positive for the climate and contributes to good resource utilisation. Foreign elements that are not suitable for incineration, like metal and gypsum, must be taken out to avoid problems at the incineration plant. The same is true for commercial waste, where the potential for further sorting is probably even greater.

Figure 7.5 Average amount of different waste types in the residual waste by each BIR customer per year



Source: BIR

Is food waste a resource?

Food waste consists of biological material and is a resource. It can be composted and turned into soil improvement agents, it can be incinerated at the waste incineration plant and generate heat, or it can be digested at a biogas plant and turned into biogas, which can power buses or heat up buildings. Biogas production also generates remaining material, or *digestate*, that contains phosphorus, a

resource that is useful in agriculture. The challenge of what to do with the digestate has not been resolved in Bergen, because there is a surplus of natural fertiliser in agriculture in Western Norway. In the years to come, various solutions will be tested on how to sort food waste from residual waste, and endeavours will be made to find commercial use for the digestate.

It is important to ensure that edible food does not become waste. A lot of the food that, for various reasons, is thrown away is perfectly fine to eat. It is important to reduce such food waste to a minimum.

ONGOING MEASURES TO BE CONTINUED

- Further development of the underground waste system in Bergen city centre
- Work to increase the waste recovery rate in Bergen
- Collecting garden waste – to be turned into compost and sold

MEASURES TO START IN 2016

- Facilitating local measures:
 - Supporting good arenas for swapping and recycling;
 - Supporting measures that reduce the amount of discarded food;
- In cooperation with BIR, considering various measures for sorting out food waste from residual waste;
- Achieve better and more coordinated handling of commercial waste.

Strategy 3: Use waste as a resource

GOAL FOR HOW TO USE WASTE AS A RESOURCE

- A6 The amount of fossil fuel in waste incinerated at the waste incineration plant shall be reduced.
- A7 A carbon capture solution shall be installed at the waste incineration plant by 2025.

In many cases, residual waste can pose great challenges, but good solutions for reducing the amount and handling the waste can be beneficial.

Utilisation of biological waste

In 2016, a new biogas plant was taken into use that produces biogas from wastewater sludge and a limited amount of other biological waste. In the long term, it will be possible to expand this plant so that it can handle all food waste in Bergen. Today, the challenge lies in the difficulty of finding use for the digestate locally, and until that problem has been solved, it is not expedient to produce huge amounts of it. Utilising the digestate is important to achieve environmental benefits of biogas production from food waste. The current solution is energy recovery through incineration.

Good management of old landfills

Old landfills are a great challenge. Old biological material leaks into the air and generates potent methane gas, with a 20 times greater environmental impact than CO₂. Correct management can help to collect some of this gas, which can then be used for energy purposes. It can produce heat, electricity or be purified and used e.g. as fuel for buses. With time, the old waste will generate less and less methane, and it will also become more and more difficult to collect the gas.

At the old landfill site in Rådalen, the gas is collected in an extensive gas well system. The gas is transported to two flares and a gas engine that generates electricity. What happens to the gas depends on the amount. In the last few years, the plant has only been in operation for part of the time because of faults and inadequate maintenance. This means that we know little about how much gas has been collected. Most of the gas has been flared.

Possibility of carbon capture and storage in Bergen

Waste incineration in Bergen generates relatively extensive CO₂ emissions. The fossil share alone accounts for about 10% of emissions in Bergen. In addition comes CO₂ from the biological material that is assumed to be renewable, which is not included in the figures. If Bergen is to attain its goal of becoming a fossil-free city, it is important to find good solutions for how to reduce these emissions.

In the Climate and Energy Strategy adopted earlier this year, the City of Oslo decided to look into the possibility of a carbon capture solution at its incineration plants. This would capture both the fossil and the biological share of CO₂, which could then be stored or used as a commercial product in greenhouses for algae production, as a coolant or similar. The City of Bergen wants BIR to play a more active role in this development work, and the municipality will monitor the work closely and consider whether the experience gained can be used to establish a similar plant in Bergen.

The potential for emission reductions at BIR's facility was approximately 233,000 tonnes of CO₂ in 2013, of which 116,000 tonnes is of fossil origin.

ONGOING MEASURES TO BE CONTINUED

- Developing a biogas plant for the utilisation of wastewater sludge for biogas;
- Improving the management of the old landfill site in Rådalen to reduce methane gas emissions;
- Utilising the landfill gas for energy purposes;
- Utilising hydroelectric energy for local power production.

MEASURES TO START IN 2016

- Working to ensure that food waste is sorted out and, if applicable, that biogas is generated;
- Cooperating with relevant parties on an idea competition for how to use digestate (from biogas production) in a profitable way that benefits society;
- Following up the Oslo project on the possibility of carbon capture at the waste incineration plant, and establishing a similar arrangement in Rådalen as soon as possible.

7.5. Policy instruments

The central government, the municipality and BIR all have a few policy instruments that are effective in this area. Each of us is both a consumer and a decision-maker. We make many choices that affect greenhouse gas emissions, developments and the prevailing policy.

EXISTING POLICY INSTRUMENTS	OWNER
The underground waste collection network in the city centre can provide simpler solutions for the delivery of cardboard and plastic for residents in the areas.	BIR
The recycling stations let people sort their waste and dispose of the most common waste fractions such as cardboard/paper, glass/metal in their local community. Plastic, garments, electric appliances, hazardous waste etc. must be taken to recycling stations for other waste.	BIR
Deposit and return schemes make it easier to recycle materials and collect products made of hazardous or valuable materials.	The state
Public procurements	The state and the municipality
The municipal Climate and Environment Fund helps organisations to implement climate measures.	The municipality

8. Adaptation to climate change

SECTOR GOALS

- K1 The municipality shall be one step ahead of developments and be optimally equipped to reduce the negative consequences of climate change to a minimum.

8.1. Background

Variations in climate have always affected nature and society, and the municipality has extensive experience of adapting to such variations. The extent of current climate change, and the speed at which it takes place, is nonetheless far greater than before. Climate change will cause rising sea levels, more precipitation and wind, and increased risk of floods and landslides. All of this must be taken into account as the city grows and changes.

What the climate will be like in the future is difficult to ascertain. Among other things, it depends on how much greenhouse gases we emit in the time ahead. Given what we know about climate change today, we must nonetheless conclude that we all need to prepare for it. Climate change will affect each and every one of us and the society we live in.

Adaptive capacity is defined as *‘the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences’* (IPCC, 2007).

In this context, the municipality is responsible for:

- Safeguarding its inhabitants’ lives, health and safety
- Preventing damage/harm
- The municipalities’ duty to ensure emergency response and preparedness

In Bergen, this is addressed through the following strategies:

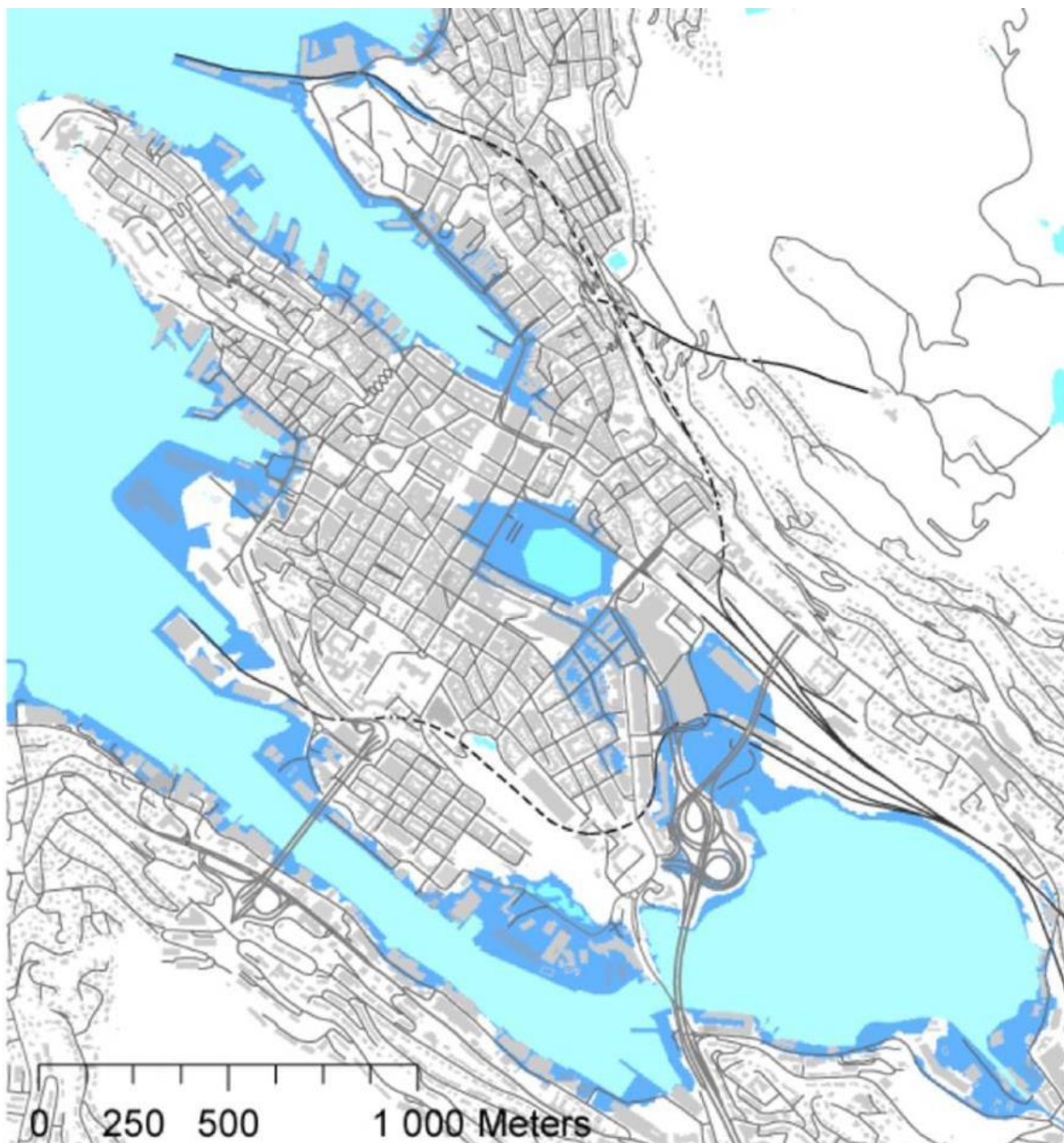
- Acquiring the best knowledge available about climate change and the impact of climate change;
- Using this knowledge to change and prepare the local community for adaptation to climate change;
- Making the work on climate change adaptation an integral part of general urban planning and area development;
- Including work on adaptation to climate change in the municipality’s work on risk and vulnerability and in other municipal planning.

8.2. Status and challenges

The 2010 Climate and Energy Action Plan lists a number of projects. The projects focus on knowledge generation that includes the preparation of climate models, registration of climate vulnerability, prognoses and scenarios. Most of the projects are under implementation or in the process of being implemented. See Annex 1, *Status of measures in the Climate and Energy Action Plan for Bergen 2010*.

The City of Bergen has previously carried out extensive surveys relating to landslide risk, wind, floods, precipitation, water levels and rising sea levels. The municipality uses the results of these surveys in the processing of building applications. Figure 8.1 shows expected flooded areas at a water level of 2.38 m above normal (0) in central areas of the city.

Figure 8.1 Flooded areas at a water level of 2.38 m above normal



Map: City of Bergen, the Agency for Planning and Geodata

The land-use part of the municipal master plan of 2010 includes considerations in the form of guidelines and provisions for a development adapted to the challenges that will arise in future. Guidelines have been drawn up for surface water handling, and a water and sewage framework plan shall be included in all zoning plans. See the list of references at the back of this document.

8.3. Strategy

The City of Bergen's main strategy is to include work on adaptation to climate change in the municipality's work on risk and vulnerability and in other municipal planning.

Bergen has started work on an overriding risk and vulnerability analysis that will include all of the municipality's activities and potential incidents within the municipal borders. An overriding risk and vulnerability analysis pursuant to the Act relating to Civil Protection can help the municipality to determine whether existing buildings are at risk.

The analysis covers all the city government departments and underlying agencies and other parties and private enterprises in Bergen. A mapping of incidents shall be carried out for schools, kindergartens, nursing homes, municipal housing, health institutions and social services, municipal facilities, institutions and municipal enterprises.

Undesirable incidents that may affect critical infrastructure and critical functions in society shall be included. The purpose is to develop a comprehensive overview of risk factors in Bergen, and to have a stronger focus on civil protection and emergency planning. The risk and vulnerability analysis shall form the basis for the revision of an overall emergency response plan for the City of Bergen.

Adaptation to climate change is part of this analysis. Extreme weather and transport accidents on land are considered the most serious incidents. For critical infrastructure, failure in ICT systems or sewage management are deemed to be the two most serious incidents. Incidents outside the municipal borders that may affect the people of Bergen include earthquakes, radioactive waste and loss of main traffic arteries. The work has been carried out pursuant to the Act relating to Municipal Duties in Respect of Emergency Preparedness.

Adaptation to climate change will be addressed in the upcoming review of the land-use part of the municipal master plan. The municipality's risk and vulnerability work is intended to form the basis for the preparation of new thematic maps/special consideration zones in the land-use part.

The soil is one of our most important carbon sinks, and moorland is the type of soil that contains the most CO₂. A good climate measure for Bergen, in a time of increased precipitation, would be to leave moorlands as untouched as possible. This is also in line with the regional climate plan for Hordaland.

Measures

Climate change adaptation shall be part of the municipality's day-to-day activities, and the municipality is seeking knowledge for the purpose of adapting to change by cooperating with other parties in society.

Acquiring new knowledge and experience through participation in collaborative projects at the national and international level will always be important. Through local, national and international collaborations, the municipality is seeking to achieve competence-raising and increased knowledge about the use of prognosis tools.

International projects also provide knowledge about expected climate change and local impacts. It leads to important exchange of experience with other cities facing similar challenges that are already in a more extreme situation than us. Examples of such projects include MARE (Managing Adaptive Responses to changing flood risk in the North Sea region) and the follow-up project CAMINO (Climate Adaptation Mainstreaming Through Innovation), which Bergen has participated in.

Among the new projects are BINGO (Bringing INnovation to onGOing water management – A better future under climate change) and BEGIN (Blue Green Infrastructure through Social Innovation). The latter is an EU project that is at the application stage, in which the City of Bergen has been invited to participate as a partner.



Streets can serve as a natural, expedient flood route. PHOTO: Ivar Kalland

Other important partners in this work are research communities, the business sector, neighbouring municipalities, county authorities and national agencies such as KS and the Norwegian Environment Agency. Through Learning and Action Alliances, the municipality is seeking to engage in dialog with

the business sector and the general public, for example through the 'HORDAKLIM' project, led by Hordaland County Council. HORDAKLIM is about downscaling and tailoring climate data to the municipalities' needs.

Green roofs absorb rainwater and enable it to evaporate, thereby slowing down the flow of runoff rainwater to the public sewage system, and relieving the wastewater system of excess water. They also prevent overflow and problems caused by water in the streets.

Green roofs also have other properties: They make the urban environment look 'greener', the vegetation has a cooling effect on hot days and provides insulation on cold days, they absorb particulate matter and the vegetation causes friction that reduces the risk of snow falling from buildings.

Bergen is currently testing out green roofs on the Agency for Water and Sewerage Works' pump station in Nygårdstangen. Steps will be taken to facilitate the use of green roofs in the time ahead.

Examples of how to use new knowledge

The City of Bergen is using newly acquired knowledge in the modelling of the sewerage network in order to identify critical points and areas where it is possible to establish new solutions or re-open former streams.

In order to gain more knowledge about precipitation, the municipality is conducting precipitation measurements, and the City of Bergen currently has four short-term gauge stations and has ordered two more.

Floods that have caused damage means that the municipality has the experience to prevent similar situations through improvement measures and preventive operational and maintenance measures, such as the establishment of flood routes and increasing the systems' capacity.

ONGOING MEASURES TO BE CONTINUED

- An overriding risk and vulnerability analysis that will include all of the municipality's activities and potential incidents within the municipal borders
- Implementing new knowledge in the municipality's work
- Participation in the EU project BINGO
- Participation in the HORDAKLIM project
- Environmental Lighthouse network for adaptation to climate change (Norwegian Environment Agency)
- The municipal network for adaptation to climate change (KS)
- Testing different types of green roofs on the pump station in Nygårdstangen

MEASURES TO START IN 2016

- Participation in the EU project BEGIN on blue-green structures;
- Including climate change adaptation in the upcoming review of the land-use part of the municipal master plan;
- Using experience gained in the pump station trial and from the establishment of other green roofs in Bergen for the purpose of achieving increased use of green roofs.

9. References and links

9.1. *References*

1. Climate and Energy Action Plan for Bergen, 2010
2. SmartCity Bergen
3. The social element of the municipal master plan, 2015
4. The land-use part of the municipal master plan, 2010
5. The Bergen Programme
6. Climate Plan for Hordaland, 2014–2030
7. Environmental Strategy for Skyss, 2013
8. Cycling Strategy for Bergen 2010–2019
9. Assessment report and action plan for improved air quality in Bergen, 2015
10. Action Plan against Noise, 2013–2018
11. Draft Waste Plan for BIR Privat, 2010–2015
12. Master plan for Wastewater and Water Environments and Master plan for Water Supply, 2015–2024
13. Public Transport Strategy for Hordaland, 2014
14. Cycling Action Plan, adopted 24 January 2011
15. Travel habits survey for Bergen, 2013 (RVU 2013)
16. Mobility guide, Cities of the Future
17. Local energy study, City of Bergen, 2014
18. The heating register in Bergen
19. Klimakost.no
20. Climate accounts for waste management, AvfallNorge, 2009

9.2. *Links*

Chapter 2. Developments since the previous Climate and Energy Action Plan

http://www3.bergen.kommune.no/BKSAK_filer/bksak/0/VEDLEGG/2015226104-5195235.pdf

Chapter 3. The green shift in Bergen

www.framtidensbyer.no

Chapter 4. Green business

Telemarksforskning 2014: TF report no 341:

<https://www.telemarksforskning.no/publikasjoner/filer/2527.pdf>

Chapter 6. Energy in buildings

Information about BREEAM: <http://www.breeam-nor.no/hva-er-breeam/>

The low-energy programme: <http://www.lavenergiprogrammet.no/>

Local energy study for Bergen: http://www.bkk.no/om_oss/anlegg-utbygging/Kraftnett/utredninger-planer/article33578.ece

Chapter 7. Consumption patterns, waste and resources

Summary of consumption of waste in Cities of the Future:

<http://www.regjeringen.no/nb/sub/framtidensbyer/forbruk-og-avfall.html?id=548118>

More information about the national waste strategy:

http://www.regjeringen.no/nb/dep/kld/dok/rapporter_planer/planer/2013/t-1531-fra-avfall-til-ressurs.html?id=733163

National Waste Strategy:

<http://www.miljodirektoratet.no/no/Nyheter/Nyheter/2013/August-2013/Nasjonal-avfallsstrategi-lagt-fram/>

Facts about the waste situation in Norway: <http://www.miljostatus.no/Tema/Avfall/>

Report: Climate accounts for waste management

http://avfallnorge.web123.no/article_docs/Avfallprosent20Norgeprosent20Rapportprosent201-09prosent20klimaregnskappresent20avfallprosent20prosent20Faseprosent201.pdf

Chapter 8. Adaptation to climate change

Risk mapping – landslides:

<https://www.bergen.kommune.no/aktuelt/tema/risikokartlegging/5503/6063>

Risk mapping – floods:

https://www.bergen.kommune.no/bk/multimedia/archive/00019/Isolinje_for_flomvan_19063a.pdf

Risk mapping – precipitation:

https://www.bergen.kommune.no/bk/multimedia/archive/00019/Temakart_for_ekstrem_19062a.pdf

Information – water:

<https://www.youtube.com/watch?gl=UG&hl=en-GB&v=pJIPNgmPUeQ>

Risk mapping – water level:

https://www.bergen.kommune.no/bk/multimedia/archive/00019/Vurdering_av_ekstrem_19064a.pdf

Risk mapping – wind:

https://www.bergen.kommune.no/bk/multimedia/archive/00019/Kartlegging_av_ekstr_19065a.pdf

Guidelines for handling surface water:

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Report: *Regional Havstigning* ('Regional sea level rise'):

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Report: *Endringer i fortidens, dagens og framtidens havnivå med spesielt fokus på vestlandskysten* ('Changes in past, present and future sea levels with particular focus on the coast of Western Norway'):

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Guidelines and provisions in the land-use part of the municipal master plan, 2010:

https://www.bergen.kommune.no/bk/multimedia/archive/00184/Bestemmelser_og_ret_184189a.pdf

Green roofs:

<https://www.bergen.kommune.no/omkommunen/avdelinger/vannog-avlopsetaten/9081/article-116976>

Climate in Norway in 2100. NCCS report 2/2015:

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10. Glossary

Airbnb and CouchSurfing	The online services Airbnb and CouchSurfing put tourists in contact with private individuals who rent out a room, apartment or house
Bioenergy	Energy released from the utilisation of biomass. In solid, liquid or gas form. Bioenergy is assumed to be renewable
CO₂	Carbon dioxide is a naturally occurring greenhouse gas in the atmosphere. Today, however, human activity causes huge amounts of CO ₂ to be released into the atmosphere, which warms up the Earth and changes the climate. CO ₂ does not have an impact on local air quality
Output	The output from an energy system is the amount of energy delivered per second
Energy	Energy is defined as the capacity to perform mechanical work or generate heat
Energy consumption	The use of different types of energy, such as electricity, district heating, oil, gas etc.
Energy carrier	A mechanism or substance that has the ability to retain energy and then use it later in another place. Examples include electricity and district heating
Renewable energy	Energy sources that are part of the natural cycle and that are renewed in less than a 100 years. Examples include wind power, hydropower, solar energy, biofuel etc.
Fossil energy	Energy that comes from oil, gas, coal and coke that we have retrieved from the Earth. Oil includes all oil-based products such as petrol, diesel, and light and heavy oils. Unlike bioenergy, fossil energy is not renewable
Fossil-free zone	A geographically limited area where no fossil energy sources are used
Free cooling	<p>Free cooling means the cooling of a medium with the sole use of pump energy. This means that no energy is transmitted to the medium with the help of electric power. Free cooling can be achieved by retrieving energy from energy wells, or with the help of seawater pumps</p> <p>Free cooling entails that the low temperature in the energy well or groundwater is exchanged with the cooling system in the building without having to use the heat pump as a cooler, which means that the need for electrical energy is reduced to a minimum</p>

HFK	Hordaland County Council
Climate footprint	A city's climate footprint comprises all anthropogenic greenhouse gas emissions caused by direct and indirect emissions by the city's inhabitants and enterprises
Greenhouse gases	Gases that affect the climate by interfering with the Earth and atmosphere's radiation balance. The gases either absorb or reflect/spread short-wave solar radiation and/or absorb long-wave solar radiation. The gases absorb specific wavelengths in the radiation spectrums of the sun and the Earth
KPA	The land-use part of the municipal master plan
KPS	The social element of the municipal master plan
Low-emission zone	A geographically limited area where the local authorities seek to improve the air quality with the help of instruments targeting the emission properties of vehicles
Environmentally differentiated road tolls	That some vehicles pay more to pass through the road toll ring, based on the vehicle's emission level
Environmental policy	Policy for how to achieve a better and healthier natural environment and reduce greenhouse gas emissions
Zero-emission zone	A geographically limited area with no local emissions (nitrogen oxides and particulate matter) and no greenhouse gas emissions (carbon dioxide).
Peerby and Streetbank	Websites for the sharing of tools etc.
RVU	Travel habits survey
Solo driving	Vehicles containing only the driver, i.e. no passengers
NPRA	The Norwegian Public Roads Administration
Time-differentiated road tolls	Road toll system where the prices are high during rush hours and lower during the rest of the day
The two-degree target	Through international climate negotiations (COP 21, Paris 2015), the countries of the world have agreed to limit global warming to an average of 1.5 °C (previously 2 °C). It entails a commitment to pursue the goal of a maximum temperature increase of 1.5 °C above pre-industrial levels.

The UN Intergovernmental Panel on Climate Change states that an increase of 2 °C is the tipping point for when climate change becomes catastrophic and irreversible.

The target largely entails:

- Limiting drought during the southern hemisphere warm season
 - Limiting global sea level rise
 - Limiting the possibility of amplifying feedback processes in the northern hemisphere, for example relating to the thawing of the permafrost in the High North
 - Preventing increased frequency of extensive, harmful extreme weather
- Substantial cuts in global greenhouse gas emissions are necessary to achieve this goal

Peak load The output that an ordinary energy system is unable to deliver on days when the energy need is exceptionally high

1.5-degree city The climate footprint of the municipality's people and enterprises shall not exceed the city's climate quota. The goal is a maximum global temperature increase of 1.5 degrees. At the 2015 United Nations Climate Change Conference in Paris, the countries adopted an agreement to limit global warming to 2 °C by 2100 – and preferably to 1.5 °C.