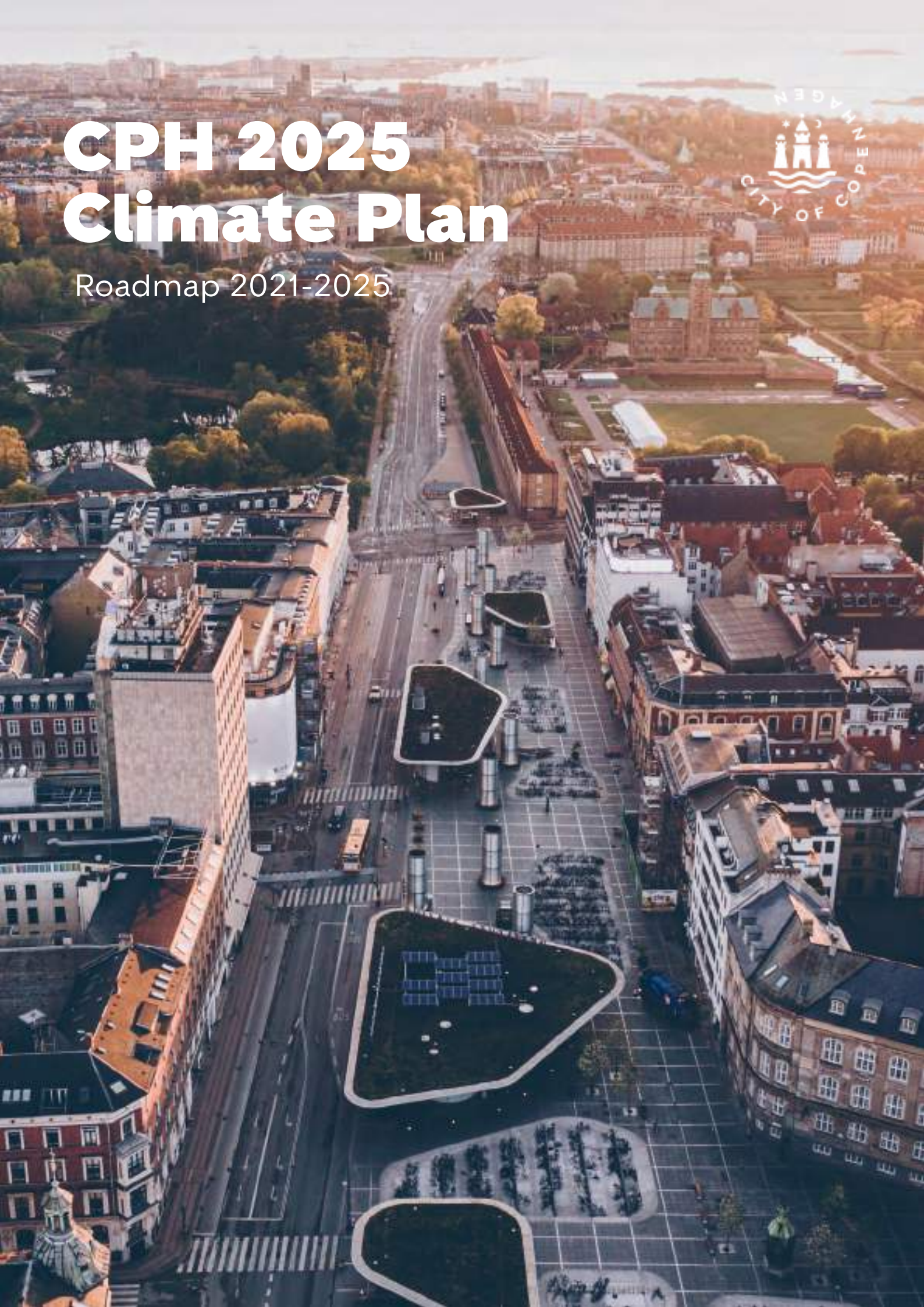
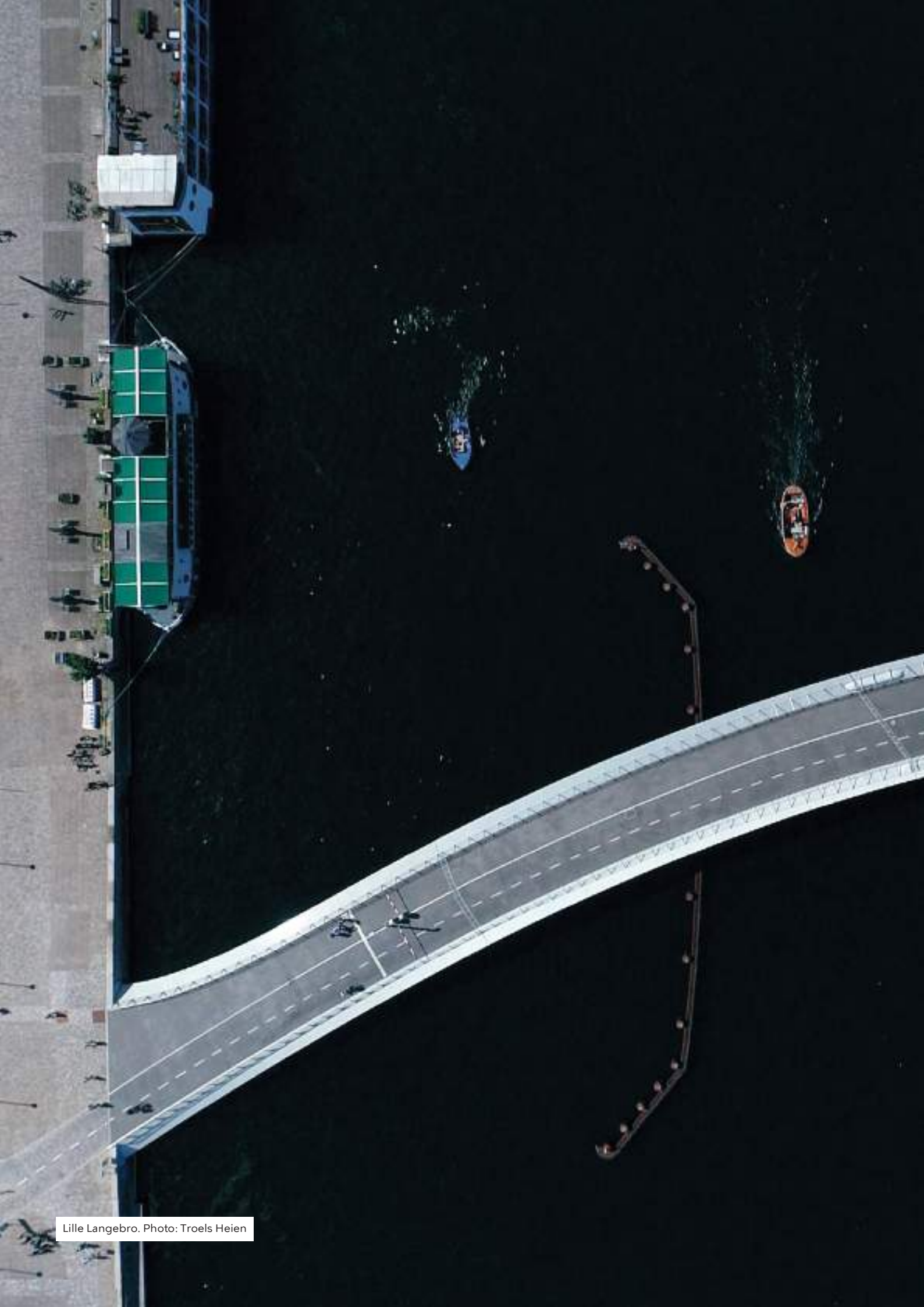


CPH 2025 Climate Plan

Roadmap 2021-2025

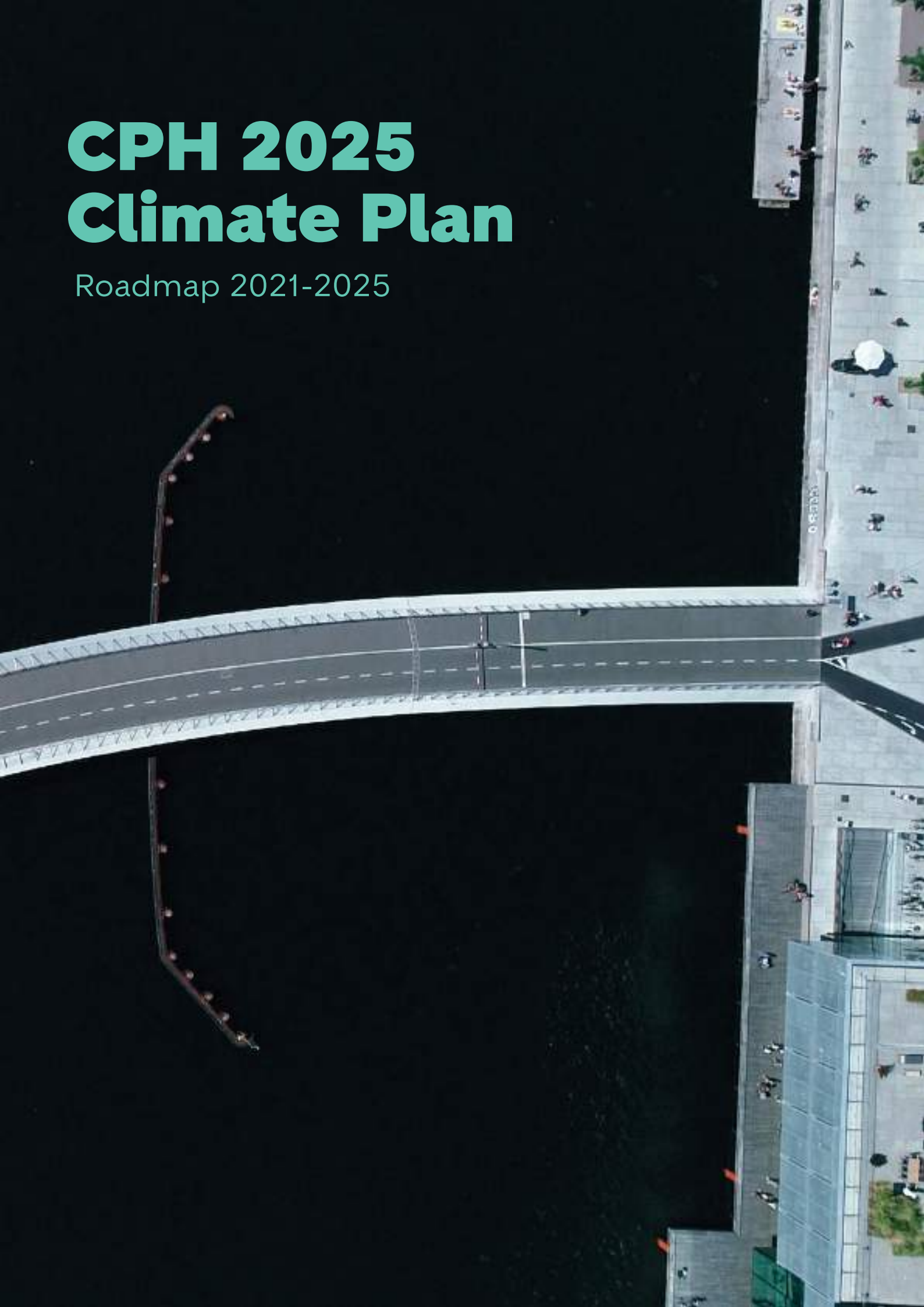




Lille Langebro. Photo: Troels Heien

CPH 2025 Climate Plan

Roadmap 2021-2025



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The Circle Bridge between Islands Brygge and Christianshavn. Photo: Astrid Maria Rasmussen

Reading guide

This document contains the Roadmap 2021–2025 for the CPH 2025 Climate Plan. The Roadmap describes the status of the four pillars of the Climate Plan, based on the plan's 18 launched actions and indicates what is required to achieve the goal of carbon neutrality by 2025.

Chapter 1 presents how the City of Copenhagen is working on the green transition and describes the status of these efforts up to the present.

Chapters 2–5 describe the City's green transition through the four pillars of the Climate Plan. Chapter 2 describes the Energy Consumption pillar focusing on reducing the energy consumed in Copenhagen's building stock. Chapter 3 describes the Energy Production pillar focused on the green transition of power generation, district heating and town gas. Chapter 4 describes the Mobility pillar by focusing on initiatives that ensure the transition to green fuels and encourage switching from cars to green modes of transport. The Climate Plan's fourth and final pillar is described in chapter 5 and deals with City Administration Initiatives. This chapter is focused on how the City of Copenhagen can lead the way in the future as well, by investing in retrofitting buildings, green modes of transport and greener procurement.

Chapter 6 outlines a number of crosscutting considerations on implementing the Climate Plan's initiatives, analyses, carbon accounting and investments up to 2025.

Chapter 7, the document's final section, sums up the initiatives in Roadmap 2021–2025 and the perspectives for the period after 2025.

KEY CONCEPTS IN ROADMAP 2021–2025

Carbon Neutrality

The City of Copenhagen will be carbon neutral if the carbon emissions from the city are offset by activities that reduce emissions, such as renewable energy production or the planting of trees.

Fossil free

Fossil free means that fossil fuels – such as coal, oil and natural gas – are no longer used to generate electricity or district heating nor in transportation and building projects.

The City of Copenhagen's envisions that Copenhagen must be fossil-free by 2050 (see 'Fællesskab København' (Co-Crete Copenhagen)).

Greenhouse Gases

Greenhouses gases include carbon dioxide (CO₂), as well as methane (CH₄), nitrous oxid (N₂O) and fluorinated gases (F-gases). The impact of these gases is far more profound than CO₂, which is why they are usually converted into CO₂ equivalents. For instance, the impact of methane is 28 times greater than that of CO₂.



Amager Slope (Copenhill). Photo: Astrid Maria Rasmussen / Copenhagen Media Center

1. Introduction

1.1 ROADMAP 2021-2025

The City Council adopted the CPH 2025 Climate Plan on 23 August 2012 with the goal that Copenhagen must become carbon neutral by 2025. To make it possible to adapt the plan's initiatives on an ongoing basis and provide politicians and partners with the status of the climate actions, the Climate Plan is to be implemented in three subsidiary phases. Each sub-phase is described in more detail in separate roadmaps describing the status of climate efforts and defining the focus of initiatives over the next four years. The planning of the CPH 2025 Climate Plan's actions and initiatives parallels their development and implementation. This means that the plan is developed in step with the emergence of new knowledge and technology, as lessons learnt shows what works and as framework conditions change.

The CPH 2025 Climate Plan includes the first roadmap for the period 2013-2016. Roadmap 2017-2020 was adopted by the City Council on 25 August 2016 with 60 initiatives that continued and supplemented the actions of the first subsidiary period. Several of these have been implemented and now contribute significant reductions to reaching the 2025 target, exemplified by BIO4 (Unit 4, Amager Power Station).

The anticipated level of carbon emissions in 2025 is calculated on the basis of expected societal developments and the expected effects of the previously implemented initiatives in the CPH 2025 Climate Plan. This is done to enable the management of climate actions towards the goal of carbon neutrality by 2025, and to evaluate the effects in terms of a reference without a new roadmap. Based on the most recent specification, the baseline projection shows that carbon emissions will be to 630,000 tonnes in 2025. The 47 initiatives presented in Roadmap 2021-2025 are expected to reduce carbon emissions by slightly more than 200,000 tonnes by 2025. Thus, anticipated residual carbon emissions of almost 430,000 tonnes will remain in 2025.

This roadmap does not include initiatives aimed at reducing these residual emissions. A reduction of this dimension requires the city to work on analysing and developing new actions and initiatives in the year ahead.

By virtue of the 2020 Budget, the City Council has decided to initiate two mobility analyses that must define the actions in the transport area, as well as to expand wind-turbine efforts and ARC's examination of carbon capture. These new actions and initiatives will be presented as a supplement to Roadmap 2021-2025 in 2021.

1.2 THE CPH 2025 CLIMATE PLAN

Copenhagen's goal of carbon neutrality by 2025 means that the city aims to become the first carbon neutral capital in the world. Politically, the city aims to demonstrate how it is possible for big cities to create green growth and development, while reducing carbon emissions at the same time. This aim is one reason why Copenhagen is an international frontrunner in the climate area.

At the same time, the CPH 2025 Climate Plan seeks to enhance Copenhageners' quality of life by, among other means, using the carbon neutrality goal as a lever to change behaviour, stimulate innovation, job creation and investments. Accordingly, it is crucial to achieve the Climate Plan goal by collaborating with and entering into strategic partnerships with authorities, universities and companies. For the same reason, Copenhagen makes it possible for Danish and international operators to try out new solutions and technologies in the city.

Copenhageners play a natural part in the green transition, which is why the plan gives Copenhageners an opportunity to contribute to and get involved in the climate efforts, e.g. by cycling and walking more, separating waste (plastic, biowaste, etc.), saving energy in dwellings and at workplaces, and by investing in PV modules.

1.3 STATUS

The baseline for the CPH 2025 Climate Plan is Copenhagen's carbon emissions in 2005, when Copenhagen emitted 2.3 tonnes of CO₂. Up to 2018, carbon emissions were reduced by almost 1.2 million tonnes, mostly due to the green conversion of power-generation and district heating systems. This is true of both the conversion process at national level and in Copenhagen – with the conversion of combined heat and power plants from coal to biomass and the erection of wind turbines – and efforts made to reduce energy consumption both nationally and locally.

The reduction was achieved while the population of Copenhagen grew by roughly 22% to more than 620,000 at the same time. Juxtaposing Copenhagen's reduced carbon emissions from 2005 to 2018 with the population growth in the same period shows that per capita emissions fell by roughly 57%.

Copenhagen faces a number of challenges in relation to implementation of the Roadmap's initiatives up to 2025. This is especially due to the concerns of utilising the effect of the initiatives aimed at reducing carbon emissions from road traffic by converting motorised traffic to new fuels, and reducing energy consumption in buildings.

The carbon emission trend from 2005 to 2018 is illustrated in the top figure on p. 12. The figure shows both the projection up to 2025 if no further action is taken (baseline projection) and projection if the 47 initiatives can be implemented via Roadmap 2021–2025. As the graph shows, and as mentioned in the introduction, we clearly still have a way to go to achieve carbon neutrality. These residual emissions must be covered by new actions and initiatives not included in Roadmap 2021–2025. The actions and initiatives will need to be further illuminated, and they will be presented in a supplement to the Roadmap that will be politically processed in 2021.

NATIONAL FOCUS ON CLIMATE CHANGE

The Paris Agreement of December 2015, places an obligation on 171 countries, including Denmark, to keep the global temperature rise well below 2°C, and to pursue efforts to limit the temperature increase even further to 1.5°C. The Agreement entered into effect in 2020. In December 2019, an almost unanimous Danish Parliament passed the first Climate Act stipulating that Denmark must actively pursue the targets of the Paris Agreement. At the same time, the Climate Act sets a target of reducing the emission of greenhouse gases in Denmark by 70% by 2030 compared to 1990 and a long-term goal of climate neutrality by 2050. The Climate Act stipulates that Denmark must be a pioneering country in the global transition that can inspire and influence the rest of the world.

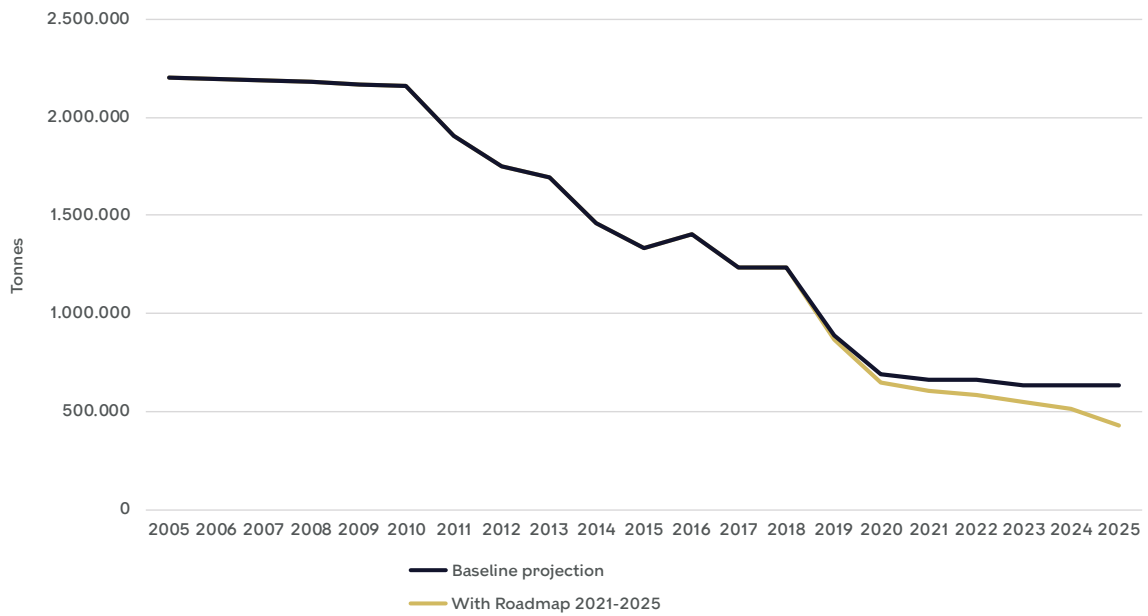
Even before the Climate Act was adopted, the government launched thirteen climate partnerships in November 2019. The partnerships are based on the sectors of the Danish business community, as the government seeks close collaboration with the business community on how the business community can contribute to addressing the climate challenges. The results of the partnerships' analyses and recommendations were published in March 2020. If the partnerships' recommendations and proposed actions are adopted in the upcoming Climate Action Plan for Denmark, the City of Copenhagen anticipates that these will be able to support several of the CPH 2025 Climate Plan's initiatives and actions areas, if they are launched without delay. For instance, this could intensify focus on saving energy and increasing renewable energy production.



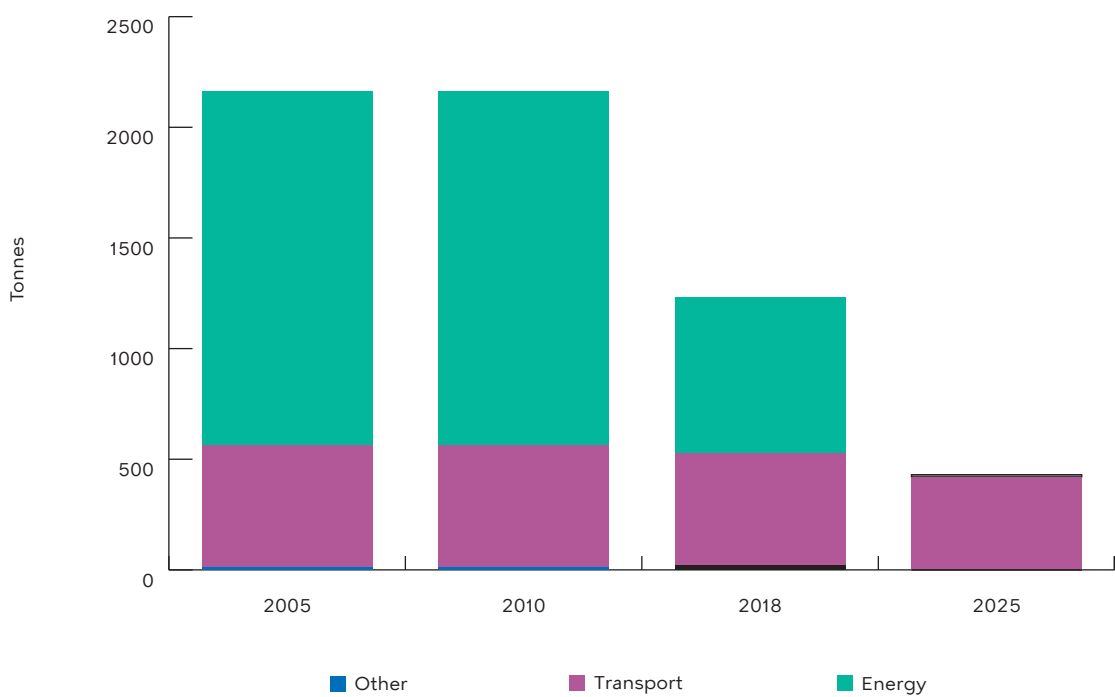
ROLE OF THE CITIES

Urbanisation means that almost two-thirds of the world population are expected to be living in cities by 2050, compared to just over half today. Cities are already responsible for a large share of the world's total carbon emissions, so in light of the rising population, it will only be possible to achieve the climate targets if cities grow and develop according to sustainability principles. Therefore, the world needs good examples of how to reduce cities' greenhouse gas emissions while creating green growth and higher quality of life at the same time. As a frontrunner in terms of climate action, Copenhagen can develop solutions with the business community and financial services sector that can inspire other cities around the world, thus helping to globally develop the sustainable cities of the future.

Carbon emissions, Copenhagen 2005-2025



Carbon emissions, Copenhagen, 2005-2025, by category



1.4 THE FOUR PILLARS OF THE CPH 2025 CLIMATE PLAN

The CPH 2025 Climate Plan's specific actions are distributed across the four pillars:

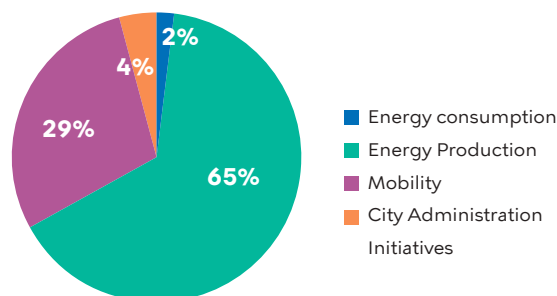
Energy Consumption: The actions under the Energy Consumption pillar work to reduce energy consumption in Copenhagen and achieve energy efficiency by streamlining operations of district heating units and other installations and by promoting energy efficiency in refurbishment and new construction projects. This is supplemented by installing PV modules on buildings and retrofitting buildings currently heated by oil to e.g. district heating. These efforts are carried out in the Energy Leap partnership, in which the City of Copenhagen collaborates with major building owners in Copenhagen on the efficient management of their properties by monitoring energy consumption and optimising building operations. In 2020, the partnership represents 20% of Copenhagen's combined building stock

Energi Production: The actions taken under the Energy Production pillar focus on converting the city's supplies of district heat, town gas and district cooling, as well as water and waste-water including waste-water treatment, to carbon neutrality and energy efficiency. Moreover, efforts to convert the electricity system – by erecting wind turbines and photovoltaic systems, reducing greenhouse gases from the waste management sector and the production of biogas – are ongoing. The Energy Production pillar can be exemplified by wind-turbine actions implemented by HOFOR which also includes photovoltaic systems. These efforts aim to erect a wind-turbine capacity of at least 460 MW by 2025.

Mobility: Actions under the Mobility pillar focus on reducing greenhouse gas emissions from the transport sector, generally divided into two groups: One comprising road traffic and the other comprising other modes of transport, such as maritime traffic. The conversion of buses and harbour buses exemplify this effort. This effort involves the conversion – wherever possible and by no later than 2025 – of bus lines that are wholly or partly financed by the City of Copenhagen to electric buses or to other buses with the same positive effects as electric buses in terms of zero carbon emissions, significantly less street noise and reduced local air pollution. The initiatives for reducing carbon emissions from road traffic will be included in the supplement to Roadmap 2021–2025 on the basis of the mobility analyses launched under the 2020 Budget. These analyses investigate the possibility of reducing carbon emissions from road traffic by 50,000, 75,000 and 100,000 tonnes, respectively.

City Administration Initiatives: The actions under the City Administration Initiatives pillar focus on areas where the city can lead the way by demonstrating how green solutions can be implemented. The actions involve the city's buildings, vehicles and procurement, as well as actions focused on afforestation outside Copenhagen and building up climate-related knowledge and resourcefulness, particularly among children and young people. The city's efforts involving energy-efficient operation of energy systems in its own buildings exemplify these ongoing efforts.

Carbon emission reductions in Roadmap 2021–2025 across the four pillars of the CPH 2025 Climate Plan



1.5 CLIMATE ACTION PERSPECTIVES AFTER 2025

Achieving the goal of carbon neutrality by 2025 will make Copenhagen a city with cleaner air, less noise, energy-efficient dwellings and greener mobility. Yet even if Copenhagen does achieve carbon neutrality by 2025, the green transition will not be over. For this reason Copenhagen's Municipal Plan 2019 stipulates that a new climate agreement must be entered into by the City Council no later than 2023 to determine the line of action to be taken once Copenhagen achieves carbon neutrality by setting specific objectives and targets for 2030 and 2035.

Specifically, Copenhagen will still have residual carbon emissions, particularly from road traffic. Moreover, the electricity system and, in part the district heating system, will still be based on waste incineration, etc., with a few fossil fuel-based systems on standby. Carbon emissions in Copenhagen will derive from the consumption of goods and services that is beyond the scope of the Climate Plan, and there may be a need to determine how scarce resources should be sustainably consumed. Thus, the perspectives for climate-related actions after 2025 can include the following:

- continue retrofitting and implementing energy efficiency measures in Copenhagen's building stock, while developing new solutions that generate a greater amount of decentralised energy in Copenhagen, where buildings' consumption is more flexible, so it can be adjusted to variations in electricity production from wind turbines and PV modules;

- continue the proliferation of electricity-based sources in the district heating system and the integration of energy systems, concurrent with the phasing out of old systems and reduction of biomass use;
- develop integrated resource systems in which the use of resources for energy production is included in sustainable, circular value chains and supports the transition to a waste-free Copenhagen;
- reduce and convert motorised transport to fossil-free fuels;
- enter into collaborations aimed at developing new supply systems based on carbon capture and Power-to-X, that utilise wind power for the production of sustainable fuels.

To follow up on Copenhagen's Municipal Plan 2019, the city will present a plan for the period up to 2023 outlining Copenhagen's climate actions after 2025, covering the areas focused on in the Climate Plan, and outline new visions for the transition to a fossil-free Copenhagen.



Cherry trees, Superkilen Park, Nørrebro district. Photo: Ursula Bach



Copenhagen seen from Christiansborg Palace. Photo: CAECA COPENHAGEN, Copenhagen Media Center





Photovoltaic project at A/B Landsdommergården, supported by urban renewal funds. Photo: Martin Dietz

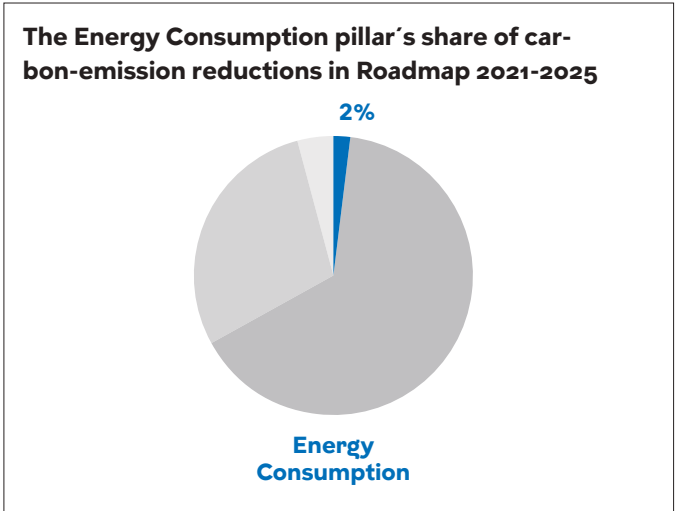
2. Energy Consumption

2.1 INTRODUCTION

The Energy Consumption pillar involves efforts to reduce the energy consumed by Copenhagen's buildings. The actions planned are expected to help reduce carbon emissions by roughly 4,000 tonnes in 2025 compared to 2018.

The efforts to reduce and optimise the energy consumed by Copenhagen's building stock are crucial for the long-term development of the energy infrastructure and the production of energy for the city. By reducing energy consumption, we can reduce the fuel consumption and eventually the need to expand production capacity. This will become increasingly relevant when future production capacity comprises new technologies that have yet to be fully developed. This is why reducing energy consumption and optimising the building stock are crucial aspects of the long-term transition.

Buildings generally have a long lifespan, which is why many years often pass between major refurbishing and rebuilding projects. At the same time, the construction industry is characterised by a widely diverse group of actors, from building owners and developers to suppliers and builders, all of whom must actively participate in the solution if the energy consumption in the building stock is to be reduced and optimised.



TARGETS FOR ENERGY CONSUMPTION IN COPENHAGEN BY 2025*

- 20% reduction in heat consumption.
- 20% reduction in the electricity consumed by commercial and service companies.
- 10% reduction in household energy consumption.
- Installation of PV modules equating to 1% of electricity consumption.

*All targets are relative to 2010.

PILLAR	MAIN ACTIONS	INITIATIVES
Energy Consumption The Energy Consumption pillar in Roadmap 2021-2025 includes ten initiatives distributed across four main action areas, with a total reduction of carbon emissions of 4,000 tonnes of CO ₂ .	Energy-efficient operations	Energy-efficient operation of district heating units
		Electricity savings
		Energy Leap partnering with professional building owners
		Social housing associations
		Property administrators - offers to cooperative and homeowner associations
	Refurbishment and new build	Energy retrofitting in the renewal of urban areas and buildings
		Energy-efficient focus in building permits
		Sustainability tool for local planning
	Conversion	Conversion of individually oil-heated buildings
	Photovoltaic modules	PV Action Plan

Overview of main actions and initiatives in the Energy Consumption pillar

Reducing carbon emissions attributable to the city's buildings requires collaboration with a number of actors. Based on the city's own buildings, the City of Copenhagen wants to launch actions and drive partnerships involving the actors needed to collaborate to achieve the energy savings.

The actions up to 2025 aim to reduce energy consumption and implement new technology.

2.2 STATUS AND MAIN CHALLENGES

In order to reduce the consumption of district heating and electricity in publicly and privately owned buildings, the City of Copenhagen's actions and initiatives focus on retrofitting the building stock and the operation of energy systems.

Copenhagen's consumption of district heating (adjusted for degree days) has stabilised since 2010 while the individual resident's district heating consumption has declined since 2010. The unchanged total heat consumption is due to the growth (2.6 million m²) of the built-up area of Copenhagen, equating to roughly 5% of the building stock in 2019.

One reason that heat consumption has not increased is due to a series of initiatives implemented by HOFOR since 2010 to optimise district heating units and streamline the district heating system. This has helped stabilise consumption. This includes HOFOR's efforts to convert the steam-powered segment of the district heating grid to water-based heat to reduce heat loss from the grid. This project is expected to be completed in 2021. Also, efforts are being made in urban development areas to reduce the flow temperature of the district-heating supply. These initiatives, combined with day-to-day efforts to optimise the temperature in the combined district heating grid reduce the need for heat production and thus reduce carbon emissions.

Electricity consumption has declined in Copenhagen since 2010, but it has been unchanged or slightly increased in recent years. Generally speaking, the city has limited mechanisms for reducing electricity consumption, and several key initiatives in Roadmap 2017–2020 had to be abandoned for lack of data and means.

2.2.1. Energy retrofitting is the main challenge

The biggest challenge to achieving the Climate Plan's goal to reduce energy consumption in city buildings is that the City of Copenhagen has very few options for supporting energy retrofitting. In practice, the city is only able to support energy retrofitting in buildings that is owned by the city (5% of Copenhagen's building stock), support refurbishment in the social housing sector (10% of Copenhagen's building stock), and by supporting the refurbishment of privately owned buildings through urban

renewal funds. 18% of Copenhagen's building stock is still energy-labelled E, F or G, which equates to about 7,600 buildings. To ensure the necessary energy retrofitting without incurring disproportionately high housing costs, new financing models and new business models, such as energy cooperatives, are needed to render the solutions less costly and more efficient. At the same time, the decision-making processes need to be simplified for the many small cooperative and homeowner associations, as well as the social housing sector, which have a large backlog of refurbishment projects. In addition, the conflict of interest between landlord and tenant for investments in energy retrofitting of rental properties needs to be resolved.

Another challenge is that the many new buildings being built in Copenhagen frequently use more energy in practice than stipulated in the energy requirements of the Building Code. As Copenhagen is experiencing substantial growth in new square metres, the city's energy consumption will be profoundly affected if new builds have a higher consumption of electricity and heat than stipulated in the Building Code. Consequently, the city is reviewing its options for ensuring the newly constructed buildings do not use more energy than they are rated for.

FRAMEWORK CONDITIONS

The City of Copenhagen will work to improve the conditions for energy-optimising the building stock in the following areas:

- Statutory requirements for mandatory energy labelling of all buildings erected before 2000 and for upgrading their energy label to a specific minimum over a number of years.
- A new agreement for energy savings after 2020 (when the energy companies' current obligation to implement energy-efficiency measures expires), and the development of new business models and financing solutions that can enhance the financial incentives to save energy.
- Remove barriers and establish conditions for investments in energy retrofitting, while taking account of architecture, indoor climate and enhanced daylight
- Enhanced financial incentives to invest in PV modules, particularly in the existing building stock.
- Ensure better compliance with the building code.

2.2.2. Great potential in optimising operations

Regardless of whether a building is retrofitted, there is a large potential for savings by optimising the operation of district heating and ventilation systems. This is also true for newly constructed buildings. In these instances, HOFOR can deduce from the actual heat consumption, that more than half of newly constructed buildings use substantially more heat than stipulated in the Building Code. For the same reason, HOFOR implemented a comprehensive action from 2016 to 2020 aimed at optimising the city's many district heating units that with transfers heat from the district heating system to building radiators. The result of this estimated savings of 52 GWh a year, by means of agreements to use smart energy-management systems and advisory services for 3,700 out of potentially 10,000 major heating customers in Copenhagen.

2.2.3. Rising electricity consumption

During the period 2017–2019, electricity consumption rose by 4% in Copenhagen, a trend that is expected to continue to 2025 due to population growth and the increasing use of electrical devices. At the same time, the enlargement of the metro network and electrification of transport and heat production will increase electricity consumption further, which also needs to be met.

In the two previous roadmaps, the City of Copenhagen has launched development partnerships to implement energy savings in the retail and service sectors, most recently the project 'Bæredygtig Bundlinje' (Sustainable Bottom Line). Upscaling these actions has turned out to be difficult, however, and the city generally lacks mechanisms to influence electricity consumption in companies and housing units in Copenhagen.

2.2.4. Photovoltaic modules on the way towards the Climate Plan's goals

By the end of 2019, photovoltaic capacity of 15 MW had been installed in Copenhagen, primarily on city roofs, and these modules generated more than 12,000 MWh of electricity, equating to 0.5% of Copenhagen's electricity consumption that year. Based on present initiatives, the City of Copenhagen expects to achieve the Climate Plan's goal that photovoltaic energy must cover 1% of electricity consumption by 2025.

FLAGSHIP PROJECTS 2021-2025

Urban renewal projects with demonstration value

At present, urban renewal projects are pioneering ventures with a positive impact on the building stock, by providing well-lit, well-insulated dwellings focused on quality of life, architectural values and attractive outdoor spaces.

Urban renewal in the City of Copenhagen annually supports energy retrofitting of roughly 1,000 privately owned housing units.

In 2019, grants were issued to support 16 properties containing 907 housing units, with expected average energy savings of 23% per property. Support in years 2018–2020 particularly focused on replacing windows with energy-efficient, noise-insulating windows. In this same period, support was granted to more than 2,000 housing units.

Energy Leap

Energy Leap, a partnership comprising the City of Copenhagen, HOFOR and more than 40 private and public-sector property owners and administrators, supports the energy optimisation of the city's buildings. The partners collaborate on energy savings in housing units and offices representing 20% of Copenhagen's total building stock. A similar partnership with social housing associations was launched in 2019. Both partnerships are expected to make noticeable contributions towards reducing the city's energy consumption up to 2025.

Energy-efficient operation of district heating units

If all Copenhagen properties run their district heating units efficiently, this could reduce the city's heat consumption by up to 10%. This is why the Climate Plan must focus on multiple actions, including the roll-out of efficient operation of up to half of Copenhagen's district heating units

2.3 ACTIONS IN 2021-2025

Copenhagen continues to grow, as does the need for energy. Up to 2025, actions aimed at reducing energy consumption in Copenhagen need to be intensified through energy-efficient operation of district heating units and electricity savings at major consumers, energy retrofitting through urban renewal funds, implementation of the City of Copenhagen's PV Action Plan and the replacement of oil furnaces. The content of the upcoming national Climate Action Plan can also significantly impact actions in Copenhagen up to 2025. Additional initiatives under the Energy Consumption pillar may be included in the supplement to Roadmap 2021-2025, which will be presented in 2021.

2.3.1. Energy-efficient operations

The action 'Efficient operation' of district heating units will be disseminated throughout the city in the period towards 2025. Specifically, this means that the initiative to reduce heat consumption through intelligent energy management systems will be further disseminated, and HOFOR's initiative to train operating staff in collaboration with the HVAC sector will be continued. The City of Copenhagen supports the effort through the Energy Leap partnership and by partnering with the social housing sector. Also, the City of Copenhagen will initiate collaboration with property administrators aimed at reaching cooperative and homeowner associations with offers on energy-efficiency initiatives.

In the period 2021-2025, energy savings will focus on major consumers of electricity and their possibility of reducing consumption. This is why efforts are focused on optimising the electricity consumption of major building owners in the Energy Leap partnership, which includes managing electricity used for ventilation and in large-scale catering establishments. In addition, the action will target the reduction of electricity consumption at the city's utility companies. In this context, BIOFOS is expected to contribute with electricity savings in its waste-water treatment processes, while HOFOR's proliferation of district cooling in Copenhagen is expected to help reduce electricity consumption, as district cooling replaces individual cooling systems that traditionally use more electricity than district cooling.

2.3.2. Refurbishment and new build

Towards 2025, urban renewal in the City of Copenhagen will continue to lead the way with ambitious energy retrofitting projects. The aim of urban renewal projects is that every property, depending on preservation value, must reduce its energy consumption by at least 20-30%

and increase its energy labelling rating by two categories. Urban renewal is expected to support the energy retrofitting of some 800 housing units a year, thus supporting the retrofitting of 4,000 housing units in the period 2021 to 2025.

The lessons learnt from retrofitting the City of Copenhagen's own buildings through urban renewal projects and in the social housing sector will be used to inspire other building owners - in the public sector, the social housing sector and among private owners - to see the value of energy retrofitting to meet ambitious energy targets.

The City of Copenhagen will engage in dialogue with building developers and client consultants on how they can support the City of Copenhagen's energy efficiency targets in new and existing buildings as part of the drafting of new local development plans. This will be achieved by applying a new sustainability tool in the local planning process and through dialogue and information meetings with developers and consultants.

2.3.3. PV Action Plan

Towards 2025, the City of Copenhagen will draft and implement a photovoltaic action plan aimed at describing the actions the city can implement in collaboration with building owners, contractors and suppliers of photovoltaic solutions to achieve the Climate Plan's target stipulating that 1% of the baseline 2010 electricity consumption, or 26,000 MWh, must be generated by PV modules by 2025. Efforts to install PV modules is rooted in the Energy Consumption pillar, as it is linked to Copenhagen's building stock, and, because it is assessed that PV solutions are best implemented if done in synergy with energy-efficiency measures. The PV Action Plan will utilise the specific lessons learnt from urban renewal's pilot project Solar District North-West, whose target is to install 5 MW of PV capacity in the North-West district alone by 2025.

2.3.4. Conversion of oil furnaces

Roughly 500,000 square metres in Copenhagen are not connected to the district heating grid. A substantial number of these are heated by oil furnaces. As part of Roadmap 2021-2025, the aim is to identify these properties and launch initiatives to support the conversion to renewable energy sources, district heating or town gas by 2025.

The City of Copenhagen will join forces with HOFOR to identify which properties use oil for heating and clarify which actions can be implemented to reduce this.

2.4. PERSPECTIVES

By saving energy, we can save the resources used to generate energy and reduce the energy bill paid by companies and individual households.

Efforts to reduce and optimise the energy consumed by Copenhagen's building stock are therefore crucial for the long-term development of the city's energy infrastructure and its energy-production capacity. If Copenhagen fails to reduce the energy consumed in its buildings, Copenhagen will have to invest in new production capacity to meet future needs. By reducing energy consumption and using energy more flexibly, we can reduce carbon emissions as well as the need to invest in new facilities at the same time.

Future energy systems are expected to be flexible and based on renewable energy, which is why buildings must be integrated into the energy system to a far greater

extent. In some instances, buildings will have to store energy and consume energy when green energy is present in the system. In addition to a more intelligently managed energy consumption, it is also crucial to integrate the various energy distribution systems into one combined system.

This will require a keener focus on circular economy by enhancing efforts to reduce carbon emissions generated by the production and transportation of building materials. Specifically, this will mean a keener focus on reducing the consumption of resources and recycling building materials to reduce the need to use resources and energy to manufacture new building materials. In addition, buildings could eventually become carbon sinks, e.g. by using more wood in buildings. By using wood, the city's buildings will eventually be able to not only reduce carbon emissions but also act as carbon sinks.

PROJECTS AND PARTNERSHIPS

ATELIER

ATELIER is a five-year project supported by the EU Horizon 2020 programme. The aim of the project is to work out how the building stock can be converted from only consuming energy to also producing energy. In this context, Copenhagen will work together with eight other major European cities, including Amsterdam and Bilbao, to demonstrate how authorities, residents, business/industry and knowledge institutions can work together to develop an urban infrastructure that results in the creation of energy-positive urban areas. An urban area is defined as energy positive when its buildings generate more energy annually than they consume. Levantkajen and Tunnelfabrikken in Nordhavn are included as demonstration areas. ATELIER will build on lessons learnt from EnergyLab Nordhavn with intelligent flexibility in the consumption and production of energy, as well as mobility. As part of the project, a collaboration forum is established across the cities to ensure that the cities draw on one another's resources early in the development process.

CLIMATE TASK FORCE

The Climate Task Force project aims to promote the CPH 2025 Climate Plan's action areas locally and help disseminate the lessons learnt from local projects to the rest of Copenhagen. The sustainable transition is under way in the individual urban renewal projects, and projects such as EnergiForum Sydhavn have shown the potential to focus its efforts on climate action in a specific area.

Together with Climate KIC, the City of Copenhagen has received financing from the European Institute of Innovation and Technology (EIT) to set up a task force focused on the local transition. Over the next five years, the Climate Task Force must coordinate and develop actions particularly focused on local and urban renewal efforts. The project is intended to supplement existing efforts and link strategic knowledge of climate and energy efforts closely together with the implementation of local initiatives such as PV modules, energy efficiency and car-sharing. This climate action will be decentralised and require a local approach involving owners, residents and investors.

GREEN RETROFITTING OF SOCIAL HOUSING

In May 2020, the Danish government, backed by a wide majority in the parliament, adopted an agreement to earmark DKK 30.2 billion for the green retrofitting of housing units in the social housing sector up to 2026. The agreement aims to ensure healthy, contemporary social housing for the benefit of tenants, the green transformation and the restoration of the Danish economy. DKK 18.4 billion is earmarked for projects that can be initiated in 2020 and 2021. The City of Copenhagen expects that 42 projects can be initiated with a total capital expenditure of DKK 2.5 billion in 2020 and 2021. The project will comprise 11,000 housing units in Copenhagen and provide scope for significant improvements of social housing in Copenhagen and add a green focus to the actions. Initially, projects will be put on a waiting list to undergo a green screening process. The agreement also generates additional incentives to energy-retrofit the social housing sector in the amount of DKK 6 billion because a new green guarantee is being developed.





Wind turbines in Øresund. Photo: Bhart9070/Pixabay



HOFOR's new bio incineration facility, BIO 4. Photo: HOFOR

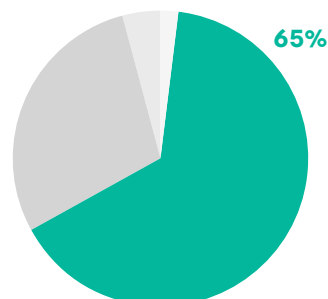
3. Energy Production

3.1 INTRODUCTION

The biggest source of carbon emissions in 2018 was the production of energy consumed in Copenhagen. In 2010, the consumption of electricity, district heat and town gas generated total carbon emissions of 1.6 million tonnes, equivalent to 76% of total emissions in Copenhagen. In 2018, carbon emissions related to energy consumption had been reduced to 723,000 tonnes, equating to 59% of Copenhagen’s carbon emissions. By 2025, carbon emissions are expected to be reduced to 112,000 tonnes, equating to 20%, when taking account of general systems developments and the impact of implemented initiatives such as BIO4 (Unit 4, Amager Power Station).

This means that the energy sector will no longer be the biggest polluter in Copenhagen, but reduceable residual emissions will remain and there will be an opportunity to become a net energy exporter thereby offsetting residual emissions that are expected particularly in the transport sector. The conversion of energy production from fossil fuels to green alternatives and better utilization of Copenhagen’s resources, such as waste, continues to be a key element in the efforts to make Copenhagen carbon neutral by 2025

The Energy Production pillar’s share of carbon emission reductions in Roadmap 2021-2025



Energy Production

TARGETS FOR ENERGY PRODUCTION IN COPENHAGEN BY 2025

- District heating in Copenhagen is carbon neutral
- Power generated on wind energy and biomass exceeds the city’s total consumption of electricity
- Plastic from households and companies will be outsourced from waste

PILLAR	MAIN ACTIONS	INITIATIVES
Energy production The Energy Production pillar in Roadmap 2021-2025 includes sixteen initiatives distributed across four main action areas, with a total reduction of carbon emissions of 130,000 tonnes.	Carbon Neutral District Heating	Continued securing of sustainable biomass
		Development of the future district-heat production
		Development of the future district-heating system
		Reducing the need for peak load production
		Converting peak and reserve load capacity
	Carbon Neutral Utilities	Green town gas
		Development of district cooling
		Carbon neutral water supplies and sewerage
		Carbon-neutral waste-water processing
	Wind and Sun	Establish onshore wind turbines
		Establish offshore wind turbines
		Establish large-scale PV systems
	Resources and Waste	Establishing materials recovery facilities (Dirty MRF)
		Implementing biogas solution for organic household waste
		Higher level of household waste sorting
		Higher level of business/industry waste sorting

The Energy Production pillar includes actions targeting energy and utility systems which supply the city with electricity, district heating, town gas, water, district cooling, etc. The two biggest action areas are the conversion of district-heating supplies and the establishment of wind turbines to meet electricity consumption in Copenhagen. However, actions to make town gas, water and sewerage systems and waste-water treatment more carbon neutral and proliferating new types of supply, such as district cooling, are also important to help Copenhagen achieve its goals. The Energy Production pillar includes actions targeting the production of solar and wind energy both within and outside Copenhagen.

To better utilise the city's waste in the future, the Energy Production pillar also includes initiatives to recover waste to make it recyclable, instead of sending it to incineration plants. Copenhagens' separation of food waste is a specific example of how to better utilise resources, because this food waste is biogasified at a biogas facility, the residual product from which is used to fertilise organic fields, etc. This exploits both the energy and the nutrients in the biodegradable waste.

3.2 STATUS AND MAIN CHALLENGES

Up to now, efforts to reduce carbon emissions from energy production for Copenhagen could generally be divided into four action areas: Carbon-neutral district heating, carbon-neutral utilities, wind and solar power, as well as resources and waste. Since the adoption of the Climate Plan, a number of initiatives have been implemented in each of these areas to make Copenhagen's energy system greener.

3.2.1. Carbon Neutral District Heating

in 2019, HOFOR's new biomass-fired power station unit, BIO4, was put into operation at Amager Power Station. BIO4 replaces the last coal-fired power station unit in Copenhagen, meaning that all heat and power production at Amager Power Station, which supplies district heating to Copenhagen, has been converted from coal to biomass. This also means that more than 80% of Copenhagen's district heating is carbon neutral. The remaining 20% of the heat is generated from the fossil fraction in waste and by the city's peak load and reserve load plants – most of which are fired with oil and natural gas – generating energy in cold weather, when consumption levels are high or in the event of breakdowns at the central CHP plants.

HOFOR partners with CTR (common district heating system of five Greater Copenhagen municipalities) and VEKS (district heating for the western part of Greater Copenhagen) to develop and demonstrate alternative sources of energy for district heating. For example, HOFOR, CTR AND VEKS jointly test the use of large heat pumps in Copenhagen that use purified waste water, seawater and groundwater, as well as surplus heat from

industrial production as heat sources that can be included in the supply of district heating. In addition, experiments involving geothermal energy which exploits subsurface heat have been conducted at Margretheholmen. In its service life up to now, the system has encountered a number of challenges, but provides valuable lessons in terms of the possibilities of establishing and operating geothermal heat production in Copenhagen. HOFOR, CTR and VEKS have previously had an exploration and extraction monopoly for geothermal energy in the capital region.

They released this monopoly in 2019, enabling private operators to bid for the contract and develop geothermal solutions in the district heating system of Greater Copenhagen. Geothermal energy is a source of heat with long-term potential to replace part of the biomass-based heat production.

FRAMEWORK CONDITIONS

The City of Copenhagen will work to ensure better framework conditions for the green conversion of the energy sector, in the following areas:

- Creating clear framework conditions for a socio-economic valuation of energy storage.
- Supporting the ongoing process to prepare national sustainability requirements for solid biomass based on new requirements stipulated in the EU Renewable Energy Directive.
- Maintaining mandatory connection to the district heating system in Copenhagen to ensure that district heating remains the primary supply of heat in Copenhagen.
- Working concurrently to urge the state to waive the CHP requirement so that district heating units without electricity generation, such as heat pumps and geothermal energy can be included in the collective heating system.
- Developing the rules for socio-economic assessment of heating projects so it will be possible to disregard fossil fuel alternatives or that carbon emissions and environmental factors are given higher priority.
- Working out a national strategy and action plan for the development of solar power and onshore wind power.

3.2.2. Carbon Neutral Utilities

Concurrent with the conversion of electricity and district heating systems, the City of Copenhagen, HOFOR and BIOFOS are working to convert other utility systems in Copenhagen so that all city utilities contribute to the carbon neutrality goal by 2025. These utilities comprise town-gas supply, district cooling, water supply, as well as sewerage and waste-water processing.

HOFOR's town-gas network is currently well on its way to becoming 40% carbon neutral. This result is achieved by replacing natural gas with biogas from waste-water treatment at two of BIOFOS' water treatment facilities. Besides the production of biogas for the town-gas network, BIOFOS also generates electricity and district heating at its facilities and has been a net energy-producing company since 2014. The BIOFOS strategy for the years 2020–2025 sets a new standard by aiming to be climate-positive by 2025. Basically, this means that BIOFOS will not burden the climate with greenhouse gases but will design and run its waste-water processing facilities so that the climate is subjected to fewer carbon emissions than if BIOFOS hadn't existed. HOFOR is working on energy-efficiency solutions for its water supply and sewer systems, installing PV modules at technical facilities and planting trees in water catchment areas. Today, HOFOR, in collaboration with the Danish Nature Agency, has planted almost 11 km² of open broadleaf woodland that binds CO₂ during its lifetime.

Finally, HOFOR has for years been working to establish and enlarge the district cooling grid, which supplies cooling to multiple commercial customers and office buildings in the inner city, Ørestad and Østerbro districts. In 2018, 70 MW of district cooling was established for commercial customers in Copenhagen. District cooling is similar to the collective supply of district heating and is an eco-friendly alternative to individual cooling systems. The primary source of district cooling in Copenhagen is free cooling based on seawater.

3.2.3. Wind and Sun

In 2017, the City Council authorised HOFOR to erect large PV facilities as part of its wind turbine strategy. In spring 2020, HOFOR has commissioned its first PV project with a total output of 20 MW. The establishment of large-scale PV systems is part of HOFOR's wind-turbine strategy, which is why it is included under the Energy Production pillar.

The establishment of PV on Copenhagen rooftops is included as an initiative under the Energy Consumption pillar, as it is associated with retrofitting and energy-efficient operation of the building stock.

By late 2019, HOFOR – which implements Copenhagen's wind-turbine actions – had established and erected wind turbines with a total output of 114 MW. HOFOR has erected wind turbines in Copenhagen and elsewhere in Denmark.



Waste sorting. Photo: Ursula Bach

In addition, HOFOR purchased Ørsted's share of wind turbines (20 MW) at Middelgrunden in 2018, with a view to renewing the turbines when their current service life runs out around 2025. Wind turbines help meet electricity consumption needs in Copenhagen by providing renewable energy, equating to a combined reduction of carbon emissions of 100,000 tonnes in 2018, from HOFOR's wind turbines and other wind turbines erected in Copenhagen, owned by among other local wind-turbine cooperatives.

Since HOFOR lost the state contracts in 2015 and 2016 for 350 MW of offshore wind turbines and withdrew from a tender for wind turbine capacity of 600 MW at Kriegers Flak, the City of Copenhagen and HOFOR have particularly focused on establishing offshore wind turbines through the Danish Energy Agency's 'Open Door' scheme whereby wind turbine projects are developed in phases with the relevant authorities. From 2019 to 2021, HOFOR and the City of Copenhagen will be looking into the possibility of erecting wind turbines in Øresund at Nordre Flint (situated off the coast of Copenhagen east of Saltholm) and at Aflandshage (south of Copenhagen).

3.2.4. Resources and Waste

In autumn 2017, it became possible for most Copenhageners to separate their biodegradable waste at source, meaning that roughly 25% of Copenhagen's biodegradable waste was collected for recycling in 2019. Currently, biodegradable waste is driven to Hashøj Biogas in central Zealand, where it is biogassified and used to generate electricity and heat, used locally.

Plastic in waste incineration is one of the remaining sources of carbon emissions in the district heating system. Since the adoption of the Climate Plan, the City of Copenhagen and ARC have actively worked to remove plastic in collaboration with Copenhageners and Copenhagen companies. For the same reason, it became possible in 2017 for Copenhageners to sort hard and soft plastic for recycling. Today, 3,700 tonnes of plastic waste is sorted for recycling in Copenhagen each year, equating to 23% of the total volume of plastic waste. The target is to sort 13,000 tonnes of plastic waste for recycling by 2025, equating to 86% of the total volume of plastic.

3.3. ACTIONS IN 2021-2025

In the period up to 2025, the City of Copenhagen will focus on action areas relating to the conversion of energy and utility systems in Copenhagen, on carbon-neutral district heating, carbon neutral utilities and on increasing the sorting of plastic and biodegradable waste. In addition, wind turbine actions will be continued and widened. Finally, Energy Production actions will be supplemented by studies of carbon capture.

3.3.1. Carbon Neutral District Heating

Up to 2025, efforts will be made to increase the proliferation of future districting-heating solutions and to reduce the residual fossil fuels currently used in the district heating system. Efforts focused on future district heating solutions involve continuing to develop and implement technologies, such as heat pumps and geothermal energy, at the same time that areas of the city will transition to low-temperature district heating, particularly in urban development areas.

Lowering the temperature in district heating is an important contribution, because it both reduces heat loss and enables better utilisation and integration of large-scale heat pumps, for instance. In addition, HOFOR and CTR will work to reduce the use of fossil fuels in peak-load production. This can be achieved by reducing the peak load need through thermal storage systems and flexible consumption, and at the same time efforts are made to convert the residual fossil peak load production into using biofuels or electricity. Successfully promoting the proliferation of more decentralised energy systems, such as heat pumps, geothermal energy, etc., in the city, requires the City of Copenhagen to focus on earmarking areas for energy purposes, so that future facilities are integrated into the planning of urban development and suitable heat sources in the city and that areas are set aside for both energy production facilities and thermal storage systems, for instance.

All CPH plants supplying heat to Copenhagen's district heating system currently use certified, sustainable biomass. Up to 2025, HOFOR is participating in efforts to develop national sustainability requirements for solid biomass based on new requirements from the Renewable Energy Directive that will replace the existing sector agreement.



Amager Bakke seen from Lynette harbour, Refshaleøen. Photo: Christoffer Regild / ARC

3.3.2. Carbon Neutral Utilities

In the period towards 2025, efforts will be made to convert HOFOR's town-gas network to exclusively use green gas. This must happen by increasing the production of biogas at waste-water treatment facilities, but this can also be achieved by investing in the production of biogas outside Copenhagen.

The district cooling system must continue to be expanded and developed with district cooling production from seawater, groundwater, etc., so it is possible to supply efficient, eco-friendly cooling of server rooms and ambient cooling for commercial customers. In addition, the possibilities of exploiting surplus heat from the production of district cooling in the district heating system will be studied.

Up to 2025, efforts will continue to focus on actions in the water and waste-water systems that help streamline energy consumption, increase the production of renewable energy from biogas, as well as continue to plant trees in water catchment areas, which both protect Greater Copenhagen's drinking water and absorb CO₂.

3.3.3. Wind and Solar Power

The City of Copenhagen's current target for its wind-turbine actions is to have erected 460 MW of wind turbine capacity by 2025. To achieve this, HOFOR continues their efforts to establish onshore wind turbines in Copenhagen and outside the city boundary. Concurrent with efforts to erect onshore wind turbines, HOFOR will work to establish large-scale photovoltaic units that are a good supplement to wind energy in the energy system of the future.

In addition, HOFOR and the City of Copenhagen continue their efforts to establish large offshore wind farms, preferably as close to Copenhagen as possible. The two areas in Øresund (Nordre Flint and Aflandshage, for which feasibility studies were conducted in 2019 and 2020) have the potential to contain 410 MW of wind turbine capacity.

Provided that HOFOR is able to erect the two planned wind farm projects in Øresund, the City Council adopted the decision (in Budget 2020) to increase the target by an additional 100 MW for a combined total of 560 MW by the end of 2025. Accordingly, it is crucial for an enlargement of the wind turbine action that it is possible to establish wind turbines in Øresund. This will be clarified before the presentation of supplements to Roadmap 2021-2025 in 2021.

At the same time, HOFOR is cooperating with other companies and operators on the development of photovoltaic power stations and wind farms (including offshore wind farms) in the rest of Denmark.

PROJECTS AND PARTNERSHIPS

Energy på Tværs

Energí på Tværs is a collaborative project between the Capital Region of Denmark, Gate 21, 11 utility companies and 33 municipalities in Greater Copenhagen. The parties collaborate through the project on specific actions supporting the transition in the Capital Region with targets for a fossil-free energy sector in 2035 and a fossil-free transport sector in 2050.

District Heating of the Future in the Capital Region 2050

'District Heating of the Future in the Capital Region 2050' is collaborative project involving the three major district heating companies in Greater Copenhagen: CTR, HOFOR and VEKS, as well as Vestforbrænding on the development of a heating vision for Greater Copenhagen's district heating system. The project aims to contribute with a common vision for developing the district heating system so it is capable of supporting the green transformation and stabilise heating prices and maintain a high reliability of supply at the same time.

Investigation project on Carbon Capture

The City of Copenhagen has just completed an investigation project on carbon capture and the part it can play in making cities carbon neutral. The project was carried out with support from the Carbon Neutral Cities Alliance (CNCA) in cooperation with NIRAS, Bellona (Norwegian NGO), as well as Amsterdam, Helsinki, Oslo and Stockholm. The lessons learnt from the project have been passed on in the partnership with ARC concerning the establishment of a carbon-capture facility at the Amager Bakke facility.

Renewable Energy Lolland

In 2016, a collaboration agreement was entered into between Lolland Municipality and HOFOR concerning the project Renewable Energy Lolland (REEL). In 2019, the agreement was extended until 2022 and SEAS-NVE entered as a third party to the agreement at the same time. The object of the agreement is to develop collaboration relating to energy systems and the resulting creation of more jobs on Lolland. Other collaboration themes are aimed at tourism, food production and marketing, regional energy conversion and the utilisation of electricity from renewables in the transport sector.

3.3.4. Resources and waste

'Circular Copenhagen: Resource and Waste Management Plan 2024', adopted by the City Council in 2019, stipulates a number of initiatives that support the CPH 2025 Climate Plan's goal to remove plastic and biodegradable waste from the rest of household waste. The actions described in the Resource and Waste Management Plan comprise initiatives involving a higher collection of plastic from households and a goal to boost removal at the source of industrial waste, which requires funds to be earmarked for this in the city budget, however. The target and expectation is to remove 13,000 tonnes of plastic waste by 2025, equating to the target of 86% of the total volume of plastic.

The Resource and Waste Management Plan includes an initiative to establish a waste sorting facility at ARC for the removal of recyclable materials such as plastic and metal from residual waste and an initiative to establish a biogas plant close to the city for biodegradable waste removed at source by Copenhageners. A decision has been made to establish a biogas plant in Solrød and put ARC in charge of establishing a pre-treatment facility intended to convert Copenhageners' biodegradable waste into green biogas. Like the waste separation facility, the biogas solution at ARC is expected to be completed by late 2021.

Altogether, the initiatives contribute to an increased production of biogas capable of replacing the use of fossil (natural) gas and to reduce the volume of plastic in waste incineration, thereby reducing carbon emissions in Copenhagen's energy systems. In a long-term perspective, the initiatives contribute to the establishment of a more circular economy, in which a larger segment of Copenhagen's resources are reused and recycled.

3.3.5. Carbon Capture

Carbon capture is a process in which carbon dioxide can be removed from an emission source, such as a chimney at a power plant or incineration plant. The captured CO₂ can subsequently be used as either a resource (carbon capture and usage, e.g. to produce fuels) or stored underground (carbon capture and storage). ARC and the City of Copenhagen have jointly prepared studies of potential solutions and technological maturity for various carbon-capture solutions.

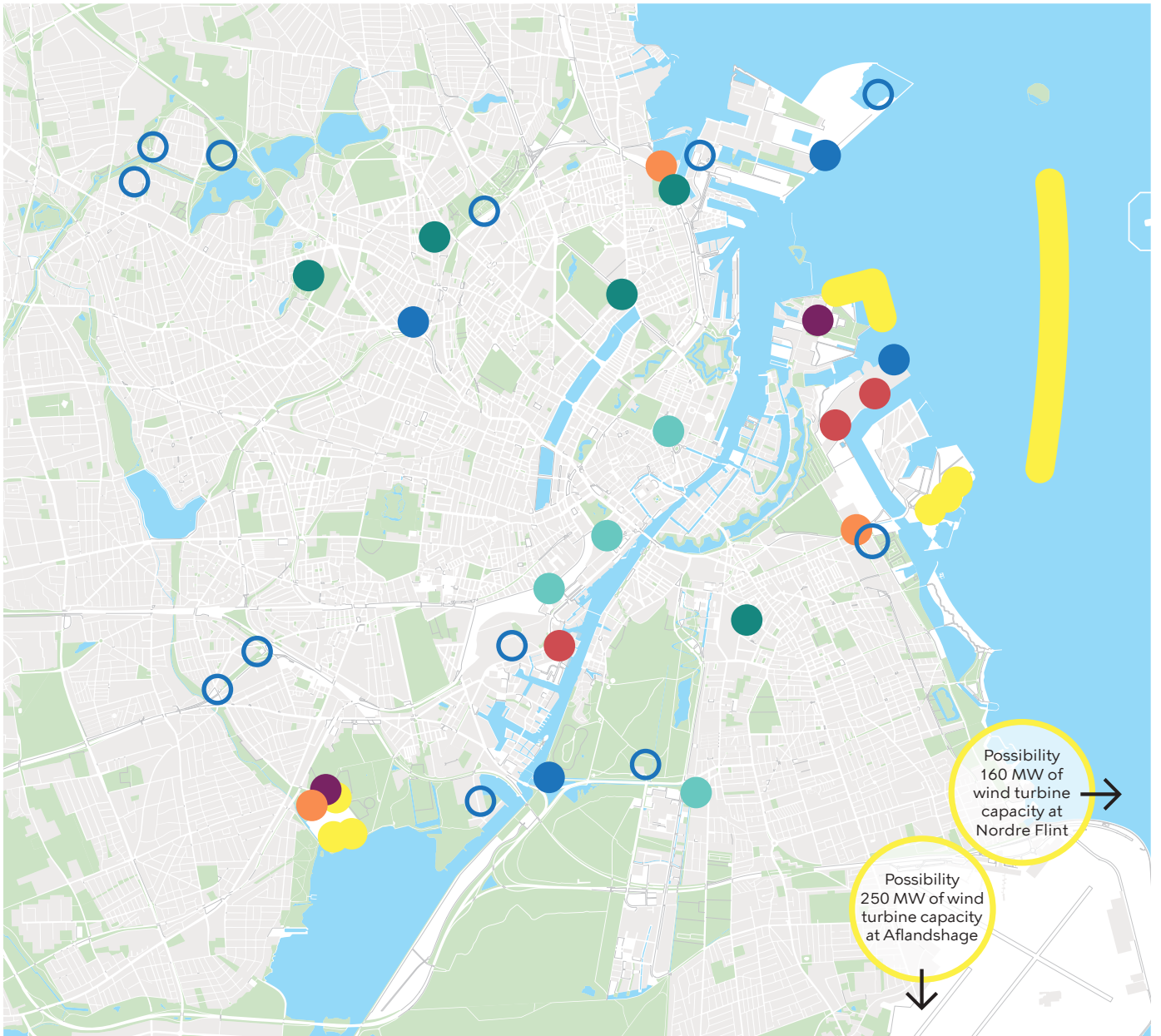
In Budget 2020, the City Council noted that ARC is working to establish a pilot facility that could pave the way for a full-scale facility at ARC. This facility could capture carbon in the future if it turns out to be a good climate investment. In its current efforts, ARC is studying how to reduce the energy consumed by the process and how to use surplus heat from the process in district heating, etc. ARC and the City of Copenhagen expect that the establishment of a large carbon capture facility will be able to render waste incineration carbon neutral by capturing the CO₂ generated by the fossil fraction of the waste.

The carbon-capture efforts at the incineration plant are not deemed an alternative to existing actions to remove fossil waste fractions, but a supplement to them.



District cooling facility, Ørestad Photo: HOFOR

Energy supply facilities in the City of Copenhagen



● Existing heat pumps/geothermal energy

○ Potential heat pumps/geothermal energy

● Waste-water treatment facilities

● Electricity production
(wind turbines and PV modules)

● Heating and power plants

● Heating plants

● District cooling plants

● Town gas plants

3.4. PERSPECTIVES

It is important to view the green transformation of Copenhagen up to 2025 as a stepping stone to developing the city further towards 2050, as efforts are being made in the energy sector to convert and develop large-scale utility systems and investments in facilities that have service lives of up to 30–50 years.

A key focus of the long-term conversion of the energy systems is to phase out all fossil energy sources at the same time as new technologies (such as surplus heat from Power-to-X facilities, large heat pumps and geothermal energy) capable of delivering the district heating of the future are implemented. These technologies can possibly be integrated to such a great extent that they can replace new combined heat and power units in the future when the service lives of existing units at Avedøre and Amager Power Stations end. The sustainable biomass currently used for combined heat and power production at these units can subsequently be used for other purposes. For instance, the biomass can be converted into synthetic and advanced fuels that can be included in the conversion of the transport sector.

In the future, it is expected that most of our energy production will be based on renewable and fluctuating resources such as wind and solar power. To maximise the use of this energy requires that the City of Copenhagen, the city's companies and partners work to integrate more renewable energy locally, such as through thermal storage systems, and exploit surplus energy whenever it is available. The district heating system of the future must

wherever possible be able to utilise all the local energy sources that are available, such as surplus heat, seawater, waste water and geothermal energy. Initiatives for the CPH 2025 Climate Plan that support the districting heating system of the future and the period after 2025 include working on low-temperature areas, developing flexible consumption solutions and using local heat sources in large heat pumps.

It is expected that new technological pilot projects such as Power-to-X can be established in or near Copenhagen as it requires the setting aside of large areas for technological purposes. This is exemplified by a hydrogen factory that a number of major Danish companies want to establish on Avedøre Holme or Amager, which is intended to supply buses, lorries, ships and aircraft with green fuels. If these facilities are placed in Greater Copenhagen, the surplus heat from the facilities can be utilised in the district heating system. Power-to-X covers a number of technologies that use surplus electricity from renewable energy sources to manufacture new products such as synthetic fuels or chemicals. Power-to-X is combinable with CO₂ from carbon-capture systems to manufacture synthetic fuels such as gas or liquid fuels. Accordingly, it could be relevant to site these technologies in Greater Copenhagen, as there would be both a demand for the product which the technology can produce, while CO₂ can possibly be supplied by a carbon capture facility. Greater Copenhagen is also the site of a large district heating system which can exploit surplus heat from Power-to-X.



Inderhavnsbro bridge between Nyhavn and Christianshavn. Photo: Troels Heien

FLAGSHIP PROJECTS 2021-2025

Offshore wind farms

Since 2011, HOFOR has used the Danish Energy Agency's 'Open Door' scheme to set aside two areas in Øresund for the establishment of offshore wind turbines. There is a potential to establish up to 410 MW of wind turbine capacity in these two areas. During 2020, HOFOR plans to conclude the technical feasibility studies and environmental impact assessments in the two areas. The tasks of subsequent phases include official processing, installation permits, design engineering, procurement, installation and grid connection. If all goes well and no undue delays occur, it will at best be possible to erect wind turbines in 2024. The wind turbines can serve as a green transformation landmark in Greater Copenhagen.

Circular Copenhagen

In 2018, the City Council adopted a Resource and Waste Management Plan for the city called 'Circular Copenhagen'. The plan focuses on promoting the circular economy, whereby we move away from a throw-away culture towards a situation in which large segments of waste flows are recycled as resources. The plan's target is to recycle 70% of Copenhagen's household waste by 2024, instead of sending it to incineration.

The Resource and Waste Management Plan helps reduce the city's carbon emissions in several areas. Part of the plan involves getting ARC to help establish a biogas plant close to the city for Copenhageners' biodegradable waste. The plan also includes a series of actions

to increase the removal of plastic. This will happen both through increased communication and providing better removal and separation options in the city. A total of 750 sorting points will be set up around the city to make it easier for the people of Copenhagen to deposit their separated household waste as part of daily routines in the city.

Climate-positive waste-water processing

BIOFOS processes wastewater from Copenhagen and 14 other municipalities. Its strategy is to become climate positive by 2025, which means that the company will generally remove more carbon dioxide than it emits. This target will be achieved by using waste-water resources to produce more biogas and district heating than is produced today, by making a targeted effort to implement energy efficiency and streamlining measures in day-to-day operations, as well as to produce and sell more green energy than the company buys. The biogas currently produced by BIOFOS' systems is e.g. used in HOFOR's town-gas network, where it helps displace the use of fossil (natural) gas and ensure that town gas used by Copenhageners and companies emits less CO₂.



Offshore wind farm. Photo: Ursula Bach



Sundby Station →

4. Mobility

4.1. INTRODUCTION

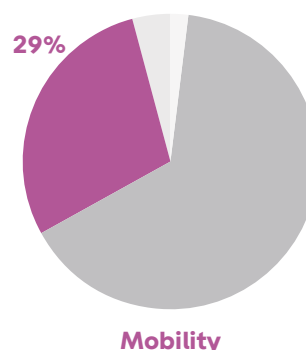
Carbon emissions from the transport sector fell from 2010 to 2018, whereas the transport sector's share of total carbon emissions in Copenhagen rose in the same period.

In 2010, total carbon emissions from the Copenhagen transport sector were 550,000 tonnes, equivalent to 25% of the city's total carbon emissions. In 2019, the Copenhagen transport sector's carbon emissions were 510,000 tonnes, equivalent to 40% of the city's total carbon emissions. The baseline projection in Roadmap 2021-2025 expects the transport sector to be the highest source of Copenhagen's carbon emissions from 2021. If the transport sector fails to substantially reduce its carbon emissions in the period 2021-2025, it may be very difficult to achieve the CPH 2025 Climate Plan's goal of carbon neutrality by 2025.

Road traffic, with an emission of 368,000 tonnes, is responsible for the vast majority of carbon emissions from the transport sector in 2018. This is also why efforts to convert road traffic to carbon neutral transport and minimise the number of kilometers driven account for the greatest potential reduction, e.g. by switching from cars to cycling, walking and public transport and by converting vehicles to fossil-free fuels.

The Mobility pillar include the areas road traffic, shipping, rail traffic, air traffic and off-road mobile machinery. Off-road mobile machinery and air traffic are included in the transport sector's carbon emissions according to percentage apportionment figures based on national values. No municipal actions for rail or air traffic are included in Roadmap 2021-2025, as this would require state actions to restrict carbon emissions from the individual sectors.

The Mobility pillar's share of carbon emission reductions in Roadmap 2021-2025



TARGETS FOR MOBILITY IN COPENHAGEN BY 2025

- 75 % of all trips in Copenhagen are on foot, by bike or public transport
 - With the municipal plan of 2019 this has been supplemented with the goal that at least 25% of the trips will be by bike, 25% will be with public transport and 25% will be on foot. Furthermore, it is explicitly stated that car traffic can take up a maximum of 25% of all trips in Copenhagen
- 50% of all trips to work or school are by bike
- 20% more passengers use public transport compared to 2009
- Public transport will be CO₂-neutral
- 20-30% of all light vehicles use new fuels
- 30-40% of all heavy vehicles use new fuels.

PILLAR	MAIN ACTIONS	INITIATIVES
Mobility The Mobility pillar in Roadmap 2021-2025 includes four initiatives distributed across three main action areas, that reduces carbon emissions by 58,000 tonnes.	Public transport	100% zero emission buses in 2025 (including harbour buses)
	Maritime traffic	Shore power for cruise ships Maritime environmental zone in Copenhagen's inner basin
	Construction machinery	Conversion of non-road machinery in the city

Overview of main action areas and initiatives in the Mobility pillar

FRAMEWORK CONDITIONS

The City of Copenhagen will work to ensure better framework conditions for the green transformation of the transport sector, in the following areas:

- The requirements in the environmental zone should be tightened and include environmental requirements for passenger cars as well as make the requirements for all types of vehicles in the law dynamic so they develop as emission requirements for vehicles are tightened. In addition, the possibility of establishing zones or streets with special requirements for vehicles should be worked into the law.
- The taxation system must be geared more towards supporting the green conversion of vehicular traffic to both emission-free cars and eco-friendly alternatives to cars. This can be done by reorganising registration fees, green motor vehicle taxes, fuel taxes, charges for liability insurance cover, as well as rules for mileage allowance, reimbursement of travel costs, company cars and the leasing of cars.
- Municipalities do not have the authority to implement road pricing or similar measures, as this would involve a new tax. Therefore, an amendment is needed to enable the City of Copenhagen to implement road pricing.
- Cities should have freer scope of action to implement initiatives that reduce traffic jams and lower carbon emissions, such as traffic calming, one-way streets and similar.
- The Planning Act lacks options to plan for shared cars and electric cars, including that these can be part of the parking norm and that it is possible to stipulate that car parks are reserved for shared cars and electric cars and that charging stations are installed.

4.2. STATUS AND MAIN CHALLENGES

The City of Copenhagen makes a targeted effort to promote green mobility by improving conditions for cyclists and pedestrians, expanding the metro and creating an interconnected green transport system for the purpose of switching from cars to green modes of transport. By means of the 2020 Budget, the City Council has decided to conduct two mobility analyses aimed at identifying the possibilities of reducing carbon-emitting traffic and making it easier to choose green traffic solutions at the same time. The results of these analyses will be included in supplements to Roadmap 2021–2025.

4.2.1. Status

Since the CPH 2025 Climate Plan was adopted in 2012, emissions from road traffic have declined by almost 3% in real numbers and roughly 16% per capita. This reduction is primarily due to declining emissions from lorries and buses in service, whereas carbon emissions from passenger car traffic have risen 10% in the period, to 255,000 tonnes in 2018. Despite a huge effort in the area of cycling and a rising number of cyclists, efforts to reduce emissions from passenger traffic from 2010 to 2018 were unsuccessful. Up to 2025, there is a need to sharply reduce carbon emissions from road traffic, particularly from passenger cars, in order for the City of Copenhagen to achieve its goal of carbon neutrality by 2025.

In the first Roadmap period (2013–2016), major efforts were made to develop Copenhagen as a cycling city, to implement intelligent traffic control and traffic information systems (ITS), better BRT (bus rapid transit), experiments with electric buses and supporting the use of hydrogen cars, including the implementation of free

parking for these cars. In addition, there are a number of other initiatives, such as ECO driving for lorries, experiments involving the interplay between shared cars and public transport and regional collaboration on influencing behaviour.

Since the City Council's adoption of Roadmap 2017–2020, the cycling infrastructure has been expanded, including the cycle-track network, Cycle Superhighways, Green Cycling Routes and bicycle parking. The expanded in the period was more limited than planned, however, particularly due to the municipal capital expenditure ceiling.

The conversion to carbon-neutral bus operation will be implemented as planned. In this context, the first electric buses were put into service in 2019. In the 2019 budget agreement for the City of Copenhagen, the City Council decided that all diesel bus lines financed wholly or partly by the City of Copenhagen, must be converted to electric buses or other buses that meet the carbon-neutral emission requirement and reduce local pollution by no later than 2025. The agreement was entered into presupposes that the temporary scheme with an exclusion of electric tax on electric buses in collective service which will expire on 31 December 2023, be extended. At the end of 2019, 15% of buses in service had been converted to electricity.

Finally, there are efforts involving initiatives such as the establishment of a freight network and partnerships on heavy transport, experiments on Mobility as a Service (MaaS), as well as experiments involving reorganisation of local car parks for shared cars and urban spaces.

4.2.2. Lessons learnt and main developmental trends up to 2025

There are different main trends in the Mobility area up to 2025. Four important trends relating to actions required to reduce carbon emissions from road traffic are described in the following.

Rising population and car ownership

Since the adoption of the CPH 2025 Climate Plan, both the population of Copenhagen and the number of car owners in Copenhagen have risen. It has been possible, however, to disconnect the growth in number of cars from the use of them. This is why car traffic has not risen correspondingly during the period and why cycling and public transport have taken market shares from car traffic. Overall, Copenhageners' per capita emissions from road traffic declined 16% from 2010 to 2018. There are still many trips by car, however, not least across the city limits, as well as recreational trips. These trips are responsible for the biggest share of road traffic's transport-related emissions.

The public transport network is expanded

The ongoing expansion of the Copenhagen metro grid is underway. In the spring of 2020, the M4 (section to Nordhavn) opened and M5 (linking Sydhavn to the metro network) will open in 2024. To achieve the city's target whereby at least 25% of all trips in, to and from the City of Copenhagen must be made using climate-friendly public transport by 2025, massive, intensified focus needs to be brought to bear on making it easier for Copenhageners and visitors to use public transport, including the City Ring, to move about in Copenhagen.

More are cycling more frequently and cycling longer

The past ten years of investments in better cycling conditions have prompted a rise in cycling trips from 26% to 28%. The cycling percentage has particularly risen for trips to and from work and place of study in Copenhagen, i.e. from 34% to 44% (2019). Looking at kilometres driven over the past ten years, car traffic has declined slightly, whereas cycling traffic has risen sharply, not least for trips in and out of the inner city. In addition, the use of electric cycles has become more widespread, enabling longer cycling trips and the extension of the regional Cycle Superhighways makes it more attractive to cycle across city boundaries. In this context the average length of a cycling trip is 11 kilometres.

Conversion of passenger cars

The government target for converting passenger cars to green fuels means that additional incentives are expected to promote a sharp rise in the percentage of electric cars in the years ahead. Taxi customers demand electric taxis and more than 100 of Copenhagen's taxis were zero-emission at the end of 2019. Up to 2025, it is expected that much of Copenhagen's fleet of taxis will be replaced with electric vehicles. There are roughly 1,000 shared cars without a regular spot (city cars such as GreenMobility and Share-

Now) and 230 shared cars with a regular spot (traditional shared cars such as LetsGo) in the City of Copenhagen. Shared cars and car pooling can reduce the number of passenger cars and car trips, particularly if owning one's own car is made more expensive at the same time. There have been attempts involving Mobility as a Service (MaaS), in which Min Rejseplan and other travel-planning apps have integrated shared cars without a regular spot in the overall transport offers. Experience indicates, however, that MaaS must be interconnected with general improvements in green transport offerings provided to users by the platform to have a genuine impact on changing people's preferred modes of transport.

4.2.3. Main challenges in the Mobility area

The main challenge in the Mobility area is that the rising number of cars and high number of kilometers driven by car in Copenhagen result in high carbon emissions. There are many factors affecting the City of Copenhagen's scope for reducing emissions from road traffic, including:

- population growth prompts more trips, intensifying the pressure on the city's infrastructure.
- lowered motor-vehicle taxes mean less expensive cars and thus more cars in Copenhagen.
- much of the carbon-emitting road traffic crosses the city boundary (both incoming and outgoing). Of this traffic, a large percentage is for recreational trips, which are often more difficult to affect than trips to and from work and place of study.
- one result of the municipal capital expenditure ceiling (temporarily suspended in 2020 and 2021, however) is that the cycling track network has not been sufficiently expanded to ensure additional switching from cars to bicycles.
- due to current rules in the area, roughly DKK 330 million from the city's parking income is offset in its block grant. Instead, these funds could have been used to promote green mobility in the city, for instance.
- the necessary functions to support green mobility, such as charging-station infrastructure, bus lanes, cycling tracks, attractive hubs and bicycle parking, require space in urban settings, which are generally pressured in Copenhagen, particularly in the inner city and "bridge" neighbourhoods (Nørrebro, Østerbro and Vesterbro).

The lessons learnt from the period 2010–2018 showed that it is difficult to achieve the desired carbon emission reductions from road traffic solely by improving conditions for green modes of transport and converting to green fuels.

4.3. ACTIONS IN 2021-2025

Based on the existing initiatives in the CPH 2025 Climate Plan's Roadmap 2017–2020, significant carbon emissions will still remain in 2025. In order for the City of Copenhagen to achieve its goal of carbon neutrality by 2025, emissions from the transport sector need to be reduced. Thus, it is necessary to change the focus of the actions from primarily on improving conditions for green alternatives to ambitiously reducing the number of kilometres driven by petrol and diesel powered cars in Copenhagen as well. This can be done by making it less attractive to drive petrol and diesel cars and thus transfer trips to greener alternatives and by supporting the choice of vehicles with alternative fuels, such as electric cars, up to 2025. In this context, it is also relevant to use urban planning tools to reduce the need to drive a car in urban development areas.

4.3.1. Road-traffic actions

Funding for mobility analyses are earmarked in the 2020 Budget. These analyses are intended to specifically define how a more rigorous mobility effort could achieve the needed reductions in carbon emissions from road traffic in terms of passenger cars, buses, delivery vans and heavy traffic. The climate impact must be achieved by means of passenger-car restrictions and by promoting green modes of transport to reduce the kilometres driven by petrol and diesel-fuelled vehicles. The analyses are in line with existing initiatives, the conversion to carbon-neutral bus service and the establishment of the M3 City Ring.

Reducing the number of cars and having greener cars can be done by making it attractive to use green shared cars rather than owning a car and by working on green goods delivery. It is also a prerequisite for conversion to electric cars that the charging infrastructure is expanded

on an ongoing basis, which is why the city specifically expects to prepare a master plan for the roll-out of a charging infrastructure for electric cars.

The actions to reduce carbon emissions from road traffic cannot be described until the mobility analyses are completed in early 2021. Therefore specific road-traffic actions are not included in Roadmap 2021–2025. These will be presented in a supplement to the Roadmap in 2021.

4.3.2. Actions for other modes of transport

The rest of the transport spectrum comprises bus traffic, maritime traffic, aviation, railway transport and off-road mobile machinery with carbon emissions of 155,000 tonnes in 2018, which must be reduced as much as possible.

There is an ongoing effort to convert all diesel bus lines financed wholly or partly by the City of Copenhagen to electric buses or to other buses that meet the carbon-neutral emission requirement and reduced local pollution by no later than 2025. 60% are expected to be converted in the existing phasing-in plan by 2023.

The City of Copenhagen works to establish shore power for cruise ships in Nordhavn and possibly at Langelinie. This ensures that cruise ships do not use diesel generators when moored quayside. In Copenhagen, cruise ships are primarily moored in Nordhavn and at Langelinie. The planning of shore power on the Nordhavn waterfront and an assessment of installing shore power at Langelinie are expected to be reported on during 2020. The establishment of shore power requires close collaboration with Copenhagen Malmö Port. In addition, Movia is converting its harbour buses (delivered by Arriva) to electricity in 2020. A conversion to green fuels for other enterprises operating in the port, such as canal tour boats, etc., will require stipulating environmental requirements within the port by implementing a maritime environmental zone.

In relation to construction machinery, the City of Copenhagen is taking the initiative to buy and transition to fossil-free fuels and eventually to zero-emission construction machinery. The municipality purchases alternative green fuels for its own road and non-road mobile machinery in 2020–2023, and in the period 2020–2022, up to ten pilot projects will be carried out that require the use of bio fuels and/or zero-emission construction machinery in the call for tenders of construction contracts. Efforts are being made to issue a general tendering requirement for this before 2025. As this is also a new area at international level, the city is collaborating on the task with a number of European cities under the auspices of C40 to influence the market to transition to zero-emission construction machinery.

FLAGSHIP PROJECTS 2021-2025

Conversion of busses

It has been decided that all bus lines, that are partially or wholly financed by the City of Copenhagen must be emission free by 2025. In January, 2019, bus lines 2A and 18 were converted to electricity (approximately 15 % of the bus operations) and the other bus lines will be converted by 2025. In 2023 Movia is expecting that 60 % of the bus operations, partially or wholly funded by the City of Copenhagen, will be emission free.

Cycle superhighways

With a vision of creating more than 750 km regional high quality routes, for the cycle pedestrians, Copenhagen has, in collaboration with the Capital Region and 27 other municipalities, established 8 cycle superhighways. The cycle superhighways effect is indicated by a 23 % rise in cyclist on the routes, of which 14 % are transitioning from car travel.

4.4. PERSPECTIVES

Both the state and the city have set ambitious carbon-reduction targets, which requires comprehensive conversion of the transport sector. This presupposes that both the state and municipal framework conditions in the area are optimised with a view to promoting the requisite conversion, to reduce the number of cars and to convert the rest of the motorised traffic to green fuels. The government's Climate Action Plan is expected to support municipal initiatives to promote the conversion of the transport sector. Copenhagen's Municipal Plan 2019 also contains multiple options for promoting green mobility, such as developing car-free urban areas relating to urban development.

With expectations of Copenhagen's continued population growth, it is essential to fully exploit these possibilities to restrict car traffic and ensure the requisite conversion to fossil-free fuels. For this reason, the green conversion of the transport sector should also support better capacity utilisation of the road grid particularly focused on promoting green space-saving modes such as public transport, cycling and walking. This applies in relation to both existing districts and the planning of new districts, which, wherever possible, must be car-free, but also by tightening the environmental zone to include passenger cars and by enabling the introduction of outright zero-emission zones in existing and new urban areas and districts. It must also be ensured that the planning of traffic electrification is coordinated with the energy system.

PROJECTS AND PARTNERSHIPS

Copenhagen Electric

The Capital Region's regional electric car secretariat, which works to implement a vision of making the Capital Region into a leading electric car region in Europe. The City of Copenhagen is represented on the advisory board, which is facilitated by Copenhagen Electric.

Cycle parking near traffic hubs

In collaboration with public transport companies, the City of Copenhagen is focused on improving the conditions for cycle parking at stations and other traffic hubs. The purpose is to increase the level of satisfaction with cycle parking in Copenhagen, enlarge capacity and support intermodal trips involving bicycle, bus, train and metro.

Movia and municipalities

The achievement of the City of Copenhagen's goal to convert all diesel buses into electric buses by no later than 2025 requires close collaboration with the other municipalities which co-finance roughly 90% of bus service in the City of Copenhagen. For the conversion to electric bus service, the City of Copenhagen collaborates with all the relevant municipalities through the public transport company Movia.



Repair station on a Cycle Superhighway Photo: City of Copenhagen



Panorama of Copenhagen from Town Hall Square. Photo: Jens Panduro





Grøndalsvængets School, winner of the City of Copenhagen Building Award 2020. Photo: Torben Eskerod

5. City Administration Initiatives

5.1. INTRODUCTION

The City of Copenhagen's own initiatives must also set an example for transitioning to carbon neutrality. By leading the way to reduce the city's energy consumption, green procurement and conversion of the city's vehicles to alternative fuels, the City of Copenhagen paves the way for the green transformation. This is important for the interplay involving a wide variety of public and private-sector operators who have to help make Copenhagen carbon neutral, such as by investing in buildings and modes of transport.

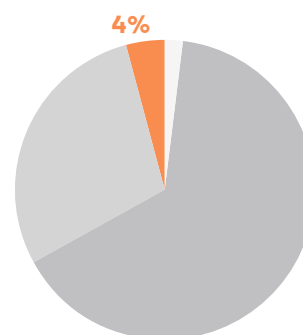
5.2. STATUS AND MAIN CHALLENGES

In the preceding two roadmap periods (2013–2016 and 2017–2020), the City of Copenhagen carried out a number of activities to use the city's administration initiatives as leverage in the green transformation process.

5.2.1. The City of Copenhagen's energy consumption

Based on existing grants, we expected to have achieved roughly half of the Climate Plan's target to reduce energy consumption by 40% by 2025, compared to 2010.

The share of carbon reductions in Roadmap 2021–2025 in the City Administration Initiatives pillar:



City Administration Initiatives

PILLAR	MAIN ACTIONS	INITIATIVES
City Administration Initiatives The City Administration Initiatives pillar in Roadmap 2021–2025 includes seventeen initiatives distributed across six main action areas, with a reduction of carbon emissions of 8,000 tonnes.	The city's energy consumption	Energy retrofitting (energy efficiency projects)
		Energy-efficient operation (streamlining and day-today operations)
		Flexible energy consumption
		The City of Copenhagen's new construction
		Street lighting
	The city's transport	Efficient transport and electric and hydrogen powered vehicles
		Requirements for non-road mobile machinery in construction projects
		Tightened requirements for supplier transport
	The city's companies	Charting of initiatives in the City of Copenhagen's companies
	The city's procurement	Ecolabelled products and services
		Electricity-saving products
		Systematic follow-up
	The city's woodlands	100,000 trees in Copenhagen
		Semi-urban tree planting
	Training and information	Climate Ambassador Training Programme
		Climate Action Showroom
		Climate Training Programme

Energy savings are achieved by focusing on energy-efficient operation of district heating and power units. Specifically, the City of Copenhagen has worked to set up remote monitoring of energy consumption in the city's buildings to establish a basis on which to optimise the facilities and advise the city's local operating staff. In addition a number of energy retrofitting projects have been carried out, such as the replacement of luminaires and modernisation of automated control systems which makes it possible to optimise energy consumption in the city's buildings.

The efforts targeting automated controls and energy monitoring have attracted international attention. The City of Copenhagen is in the process of planning pilot experiments involving energy monitoring and controls in Beijing in collaboration with C4o and in Buenos Aires. The vision is to disseminate Copenhagen solutions and show that the potential savings achieved in the city's properties have international format. Also, there is a Danish perspective in terms of developing collaboration involving multiple municipalities concerning joint property management.

In this respect, holistic retrofitting projects of Copenhagen schools have been implemented whereby a number of schools have undergone energy retrofitting that has reduced the energy consumed in the buildings. All these initiatives help save energy. For several initiatives however, the implementation has been temporarily suspended and postponed due to the capital expenditure ceiling, which is also why the expected effect was not achieved. At the same time, this effort was challenged by population growth, which requires the city to enlarge its portfolio of properties.

In addition to the energy consumed in the city's buildings, the city uses electricity for street lighting. As part of Roadmap 2013–2016, a widespread replacement of luminaires was carried out, resulting in electricity savings of 55.5% compared to baseline year 2010.

At the end of 2019, 11,200 m² of PV modules had been set up on the City of Copenhagen's properties, equating to slightly less than 20% of the target of 60,000 m² by 2025. The establishment of PV modules on city buildings is challenged by existing legislation in the area.

5.2.2. The City of Copenhagen's vehicles

For a number of years, the City of Copenhagen has been working to purchase vehicles and equipment that are powered by alternative fuels (electricity, hydrogen and biogas). This means that almost 90% of the city's passenger cars are currently electric or hydrogen vehicles. It is challenging for the market to deliver the city's heavy vehicles (such as lorries and construction machinery) with alternative fuels (such as electricity, hydrogen and biogas). This is why the city currently uses alternative

TARGETS FOR THE CITY ADMINISTRATION BY 2025*

- Energy consumption in the city's buildings is reduced by 40%
- Up to 2015, the city's new builds were constructed according to low-energy class 2015 and up to 2020 according to building class 2020.
- All of the City of Copenhagen's vehicles are powered by electricity, hydrogen or biofuels.
- Energy consumption for street lighting is reduced by 50%
- A total of 60,000 m² of PV modules have been installed on the city's new and existing buildings.

*All targets are relative to 2010.

fuels instead, such as GTL and HVO, which substantially reduce emissions of NO_x, particulates and CO₂. The municipality systematically replaces old diesel-powered vehicles and retrofits filters to meet the requirements for stricter environmental zones which impose stricter air-emission requirements (such as NO_x and particulates). Also, the city is continuously optimising the utilisation of vehicles based on GPS data and by sharing the equipment and creating an efficient fleet of vehicles.

5.2.3. The City of Copenhagen's procurement

The City of Copenhagen's procurement policy plays a central role in pushing for the development of energy-efficient technology. Today, a number of environmental and climate requirements are set in the administrations' tenders, and in several areas, this has resulted in reductions in energy consumption, increased waste sorting and reduced noise and air pollution. Among other initiatives, funds have been set aside in 2020 and 2021 for pilot projects to set requirements for construction machinery in a number of building and construction projects. These projects must provide a basis for experience in order to be able to make a general requirement for fossil-free or emission-free construction machines in the future, and preferably by 2025.

5.2.4. Training and information

In the autumn of 2020, Energy & Water will open 'The Sustainable City' showroom, which aims to demonstrate how HOFOR and the City of Copenhagen work on sustainable urban development. Energy & Water's activities have previously focused on providing information to children and young people, but the showroom target group is being widened to include professionals. This means that the showrooms is designed for urban planners, politicians, experts and students from Denmark

and abroad who want to learn about the efforts to build a sustainable Greater Copenhagen.

The Climate Ambassador Training Programme is offered to Copenhagen's 7th grade students. The programme is organised as a citizen involvement process which is tailored so that the students achieve qualifications and technical skill-sets in line with the learning targets of the lower secondary school system. At the same time, students are prepared to provide skilled advice from a teenager's perspective. Since 2009, five hundred 7th grade students have taken part in the programme, which is jointly run by the Children and Youth Administration and the Technical and Environmental Administration.

5.3 ACTIONS 2021-2025

The actions in Roadmap 2021-2025 are organised on the basis of the various sub-elements of City Administration activities. The actions targeting the city's energy consumption, transport, procurement, forestry, teaching and information services are described in the following.

5.3.1 The City of Copenhagen's energy consumption

To achieve the Climate Plan's target to reduce energy consumed in the City of Copenhagen's properties by 40%, the ongoing actions involving energy-efficient management and energy retrofitting are to be continued and strengthened. This means that efforts are being made to expand operating support, that reducing energy consumption becomes a shared target for employees and users in the city administration and that more energy retrofitting projects focused on LED lighting and heating systems can be launched. In addition, there is a need to finance energy retrofitting projects with longer repayment periods, just like the large-scale refurbishment of heating plants and ventilation systems, for instance.

Copenhagen is growing, which means that the city must construct a number of new buildings for schools, preschools, etc., in the period up to 2025. In addition to actions focused on energy retrofitting and energy-efficient

management of the city's existing properties, there is thus a need to focus on energy consumption in the city's new build projects. Lessons learnt from new builds show that it is often difficult for new buildings to live up to the energy consumption ratings they are designed for. To counteract this, the city will ensure that newly constructed buildings can be operated as energy-efficiently as possible. This will require building up the requisite expertise, collecting data on the city's new builds and systematically following up on whether the buildings meet the requirements stipulated by the city in the tenders.

In the period up to 2016, much of Copenhagen's street lighting was replaced by more energy-efficient solutions. However, there is still a potential for reduction. This is why Roadmap 2021-2025 includes an initiative to replace the remaining luminaires with new energy-efficient luminaires.

5.3.2. The City of Copenhagen's vehicles

The city will acquire vehicles and equipment that run on alternative fuels, such as electricity, hydrogen and biogas, up to 2025. Wherever this is not possible, the city will use bio-diesel (e.g. HVO) which substantially reduces emissions of NO_x, particulate and CO₂. This approach will enable the City of Copenhagen to achieve its goal of having all vehicles running on alternative fuels by 2025. In addition, the city will cooperate with external actors concerning the testing of alternative fuel technologies, including methanol. Old diesel-powered vehicles will continuously be replaced or retrofitted with particulate filters to meet the tightened environmental zones.

5.3.3. City of Copenhagen's companies

In 2020, the city is looking at the nine big companies of which the city is co-owner to map out their potential for additional initiatives and actions capable of supporting the goal of carbon neutrality by 2025. This mapping of possible initiatives will be included in the supplement to Roadmap 2021-2025, to be presented in 2021.

FRAMEWORK CONDITIONS

The City of Copenhagen will work to improve the terms for converting the City Administration:

- Requirements should be stipulated for the energy retrofitting of buildings owned by the municipalities and regions. At the same time, it should be investigated whether it is possible to exempt investments in energy efficiency and better indoor climates from the capital expenditure ceiling, provided that these investments pay for themselves within a given period
- The Photovoltaic Modules Act must be amended so it is simple to install PV modules on municipal properties
- Create better framework conditions for the dissemination of emission-free construction machinery by adapting charges and requirements in environmental zones and public tendering processes.
- The state's framework conditions must underpin municipalities' aims to promote green procurement and the procurement of energy-efficient products.

5.3.4. The City of Copenhagen's procurement

The City of Copenhagen purchases goods and services for DKK 8.2 billion p.a. It is possible, via these purchases, for the city to nudge the market in a more sustainable, climate-friendly direction. 21,500 ecolabelled products and services exist, and the City of Copenhagen continues to work to stipulate even more requirements for the ecolabelling of its purchases.

In the period up to 2025, the City of Copenhagen will stipulate additional requirements for energy efficiency and ecolabelling in its purchases and require the use of green fuels in transport services. Finally, Roadmap 2021–2025 contains a new initiative to strengthen the administration's possibility of systematically following up on whether suppliers comply with the procurement requirements to ensure that the desired effect is achieved.

The City of Copenhagen is a member of several collaboration forums and a number of international projects for the procurement of construction machinery that is either emission-free and/or capable of running on green fuels and the city collaborates with Nordic colleagues on stipulating green requirements for goods conveyance. The collaboration on construction machinery is focused on assessing when technology, reliability and financial aspects permit that general requirements be stipulated in tender documents of one's own and subsidised construction projects for fossil-free and emission-free construction machinery. The collaboration on green goods conveyance focuses on working with the market and across the Nordic countries to find ambitious, realistic requirements for delivery in large delivery vans and lorries.

5.3.5. The City of Copenhagen's woodlands

Roadmap 2021–2025 includes an enlarged and more systematic afforestation effort. Afforestation can contribute to the city's Climate Plan, as trees absorb CO₂ during the growth season which enables them to store carbon.

The City of Copenhagen will supplement its ongoing efforts to plant 100,000 trees in Copenhagen with the purchase of farmland outside the city to plant new, semi-urban woodland. This must be done in collaboration with neighbouring municipalities. The aim is for the City of Copenhagen's woodlands in and outside Copenhagen to absorb 3,000 tonnes of CO₂ in 2025, while increasing biodiversity and creating a number of recreational woodlands near Copenhagen at the same time.

In addition to the city's afforestation, HOFOR will join forces with the Danish Nature Agency to plant trees in water catchment areas in Zealand, particularly focused on the safeguarding of drinking-water wells. These efforts will continue in the period up to 2025 and will also contribute to establishing carbon sinks.

PROJECTS AND PARTNERSHIPS

Flexible Electricity Consumption

The City of Copenhagen is currently working to make it possible to remote-control electricity consumption in the city's buildings on a large scale, making it possible to upscale or downscale electricity consumption for brief periods when electricity is generated from fossil fuels or when electricity needs to be bought from the power grid. In so doing, the City of Copenhagen can contribute to the green conversion of the electricity market by regulating electricity consumption upwards or downwards. By establishing a flexibility platform, the city envisions that remotely-controlled electricity consuming systems such as ventilation can bid for on the existing market for system services. The project expands on an innovation project carried out in collaboration with market actors in 2019 and 2020. The City of Copenhagen expects to finish developing the project in 2020 and implement it in 2021.

5.3.6. Training and information

The City of Copenhagen must instil far better understanding and acceptance of and involvement in the city's green transformation among city residents, and future generations. Children and young people must be trained in climate issues through an interconnected, three-tiered effort:

- the Climate Training Programme in Copenhagen must ensure that all Copenhagen children and young people can receive climate training that provides a high level of technical climate knowledge, skill-sets for the labour market of the future and contributes to democratic formation and resourcefulness.
- the Climate Ambassador Training Programme must continue to instil students with resourcefulness and motivation to be active co-creators and communicators of a sustainable future.
- the aim of the Climate Action Showroom in Copenhagen is to inspire politicians, experts, planners, educators, citizen groups and students in a stimulating, professional setting.

The action requires broad collaboration with climate stakeholders in Copenhagen, including youth study programmes, educational institutions, the business community and many other parties.

5.4. PERSPECTIVES

By leading the way and demonstrating new sustainable solutions, the City of Copenhagen can turn its activities and large parts of the city into a living laboratory for sustainable climate solutions. It is crucial for the long-term transformation that this effort be continued. In so doing, Copenhagen can make it possible for companies to test green solutions and, through its demand for products and services, it can influence market trends. At the same time, Copenhageners and companies will be able to learn about new climate-friendly technologies in the city's operations and through the Climate Ambassador Training Programme, future generations can be equipped to take responsibility for the long-term transformation.

Eventually, the actions concerning the City Administration Initiatives will continue to serve as first movers in dialogue with the market and authorities, which requires the city to influence some of the developmental trends and meet the long-term needs outlined in the chapters on energy consumption, energy production and mobility. This involves, among other things, flexible energy consumption and working to incorporate considerations for embedded carbon emissions in the city's consumption of building materials.

FLAGSHIP PROJECTS 2021-2025

Greener transport of purchased goods

From 2020, the City of Copenhagen will stipulate stricter demands for emission-free delivery or the use of alternative fuels such as electricity, hydrogen and biogas in the city's tendering processes for contracts involving goods and services. The requirements will be initially stipulated in the following public procedures with contractual start-up in 2020: window washing, locksmith services and electrician services.

Construction machinery

Non-road mobile machinery, including construction machinery in particular, was responsible for 75,000 tonnes of carbon emissions in Copenhagen in 2018. The machinery owned by the city (or for which it is possible for the city to stipulate requirements in its own tendering processes) constitutes only a small portion of this, but the conversion of this fleet makes it possible to influence market trends in a green direction. Therefore, there is particular focus on converting the city's

own machinery and machinery used in the city's construction projects, but also on how these experiences can be upscaled and disseminated to all construction projects in cooperation with the entire industry.

Energy-efficient operation of the city's properties

In 2017, the City of Copenhagen received an international award from the C40 Cities Climate Leadership Group for its comprehensive efforts involving energy monitoring and energy management. The City of Copenhagen is the first capital in the world to have a centralised, digital energy-monitoring system to monitor the energy consumption in most of the city's buildings on an hourly basis. The systems have made it possible to take a strategic approach to energy optimisation and planning and the centralised management of the facilities, which also supports energy-efficient operation. These efforts have resulted in the City of Copenhagen developing the prototype for a platform for flexible utilisation of energy consumption. This platform will be ready for further development during 2020.



Waste collection at Nørreport. Photo: Troels Heien





WHEN WILL THE CITY OF COPENHAGEN BE CARBON NEUTRAL?

The City of Copenhagen will be carbon neutral when the city's residual carbon emissions are offset by activities that reduce emissions, such as through establishing carbon sinks (e.g. forests) or renewable energy production. For example, Copenhagen's electricity consumption is carbon neutral when the amount of electricity generated by renewable energy sources equals the electricity consumed by the city. If more electricity is produced from renewable energy sources than Copenhagensers use, this compensates for carbon emissions from other sources of emissions such as car traffic.

Søtorvet and Frederiksborggade seen from Dronning Louises Bridge. Photo: Ursula Bach

6. Implementing Roadmap 2021–2025

6.1. INTRODUCTION

This chapter describes how the City of Copenhagen will implement the actions and initiatives in Roadmap 2021–2025. In addition, the chapter describes the city's analysis and follow-up efforts, as well as the investments relating to the task.

6.2. IMPLEMENTATION

To achieve the carbon neutral goal, it is crucial to implement the Climate Plan's initiatives on a large scale. The City of Copenhagen can utilise a number of mechanisms to support the plan's implementation. The mechanisms are distributed under the following four headings:

- **City Administration Initiatives:** Through its administrative entities, the city can stipulate requirements for greenhouse gas emissions and conversion to sustainable solutions in tasks concerning everything from product delivery to construction. In addition, the city can refurbish its own buildings to use less energy and convert its own vehicles.
- **The city as an authority:** The City of Copenhagen is a planning authority in a number of crucial areas for green transformation, including heat supply, waste-management planning and physical

planning in Copenhagen. The city works in these areas through Municipal Plan 2019 and 'Circular Copenhagen – Resource and Waste Management Plan 2024' to reduce carbon emissions within the framework, permitted by the official tasks.

- **The city as a supplier:** The City of Copenhagen owns or funds a wide range of collective systems and, as co-owner of utility companies, influences the companies to work towards carbon neutral supply. This is done in utilities such as district heating, town gas, water and waste-water, as well as bus transport.
- **The city as a facilitator:** We will only achieve our goals through cooperation. This is why the city also works as a facilitator in the transformation, joining forces with residents, companies and authorities to realise the transformation. We do this in partnerships, such as the Energy Leap and Bæredygtig Bundlinje (Sustainable Bottom Line) projects and in efforts targeting the Climate Training Programme.

The City of Copenhagen does much of the green transformation in collaboration with neighbouring municipalities, the Capital Region, state authorities, utility companies, private companies and Copenhageners. This is also

COLLABORATION PROJECTS AND NETWORKS

The City of Copenhagen is part of a wide variety of networks and collaboration projects both in Denmark and abroad to develop and disseminate climate solutions, including:

C40: A global network of cities working to reduce greenhouse gas emissions. C40 is a group of the 96 of the world's biggest cities and leading cities in climate action. In total, the cities represent 1/12th of the world population and 25% of the world economy.

Carbon Neutral Cities Alliance: An association of the 22 most ambitious cities in the world in terms of climate action. All members have a goal of achieving at least 80–100% carbon neutrality before 2050 (for Copenhagen it is 2025).

Big Buyers Initiative: A platform for promoting collaboration between a number of European cities, including Oslo, Amsterdam and Helsinki, to stipulate requirements for zero-emission construction sites in the tendering process for construction contracts. The aim is to promote market development of emission-free construction machinery through joint public tendering and procurement procedures.

EnergyLab Nordhavn: A partnership of 11 operators to test and demonstrate solutions and products that integrate energy production and consumption into buildings and the transport sector in Nordhavn. Although the project ended in 2019, the EnergyLab Nordhavn Association was formed to follow up on the project results.

Energy and Carbon Calculator: An online tool that specifies and shows emissions of greenhouse gases for all municipalities in Denmark on the basis of uniform methods. The tool specifies emissions by using key, dynamic data sources so municipalities do not need to collect data to visualise their greenhouse gas emissions. The tool is still being developed in collaboration between the Danish Energy Agency, Realdania, Local Government Denmark, Gate 21 and a number of municipalities and regions across Denmark.

Big City Partnerships: Copenhagen has entered into twinning agreements with Beijing, New York, Washington, Boston and Buenos Aires aimed at increasing cooperation which, among other things, can support Danish exports to China and attract more investments to Copenhagen. As part of the agreement with Beijing, the two cities have cooperated closely on energy-efficient operation of municipal buildings, whereby Beijing will implement some of the solutions developed in Copenhagen.

why the city focuses on joining partnerships to develop and implement new solutions. The City of Copenhagen takes part in a number of collaboration projects that contribute to the transformation locally in Copenhagen and which disseminate good solutions to other cities.

6.3. FOLLOW-UP AND ANALYSIS

The City of Copenhagen conducts ongoing analyses to follow up on the targets and objectives in the CPH 2025 Climate Plan and to examine the potential for reductions in new areas.

Carbon accounts are prepared for Copenhagen each year to give an account of the city's carbon emissions. The accounts are prepared on the basis of Local Government Denmark's carbon emission calculator from 2008, which builds on methods used at national level to report emissions to the United Nations. The point of departure is that all greenhouse gas emissions within the city limits and emissions relating to the consumption of electricity and district heating are included in the accounts. In the assessment of carbon neutrality, energy production based on renewable energy in the City of Copenhagen and renewable energy produced by city-owned companies outside the city limits are itemised as deductions.

Concurrent with the City of Copenhagen's launch of new initiatives to reduce carbon emissions, a need will emerge to develop methods for specifying the emissions in Copenhagen to identify the source of the carbon emission more accurately. This is why efforts are continuously focused on further developing the carbon accounts and, as part of the development of supplements for Roadmap 2021–2025, methods relating to carbon capture, Power-to-X, etc., will be examined.

Furthermore, annual cycling accounts, specifications of energy consumption and energy production and a series of other accounts will be prepared to enable follow-up on the CPH 2025 Climate Plan's targets and objectives.

In addition to the ongoing follow up of the Climate Plan's targets and objectives, a number of analyses, tests and demonstration projects will be carried out to identify new possibilities of reducing carbon emissions. For instance, an analysis of greenhouse gas emissions from shipping and oil furnaces in Copenhagen has been carried out. In the period 2021–2025, the city expects to carry out tests and analyses of heat pumps, carbon capture, flexible energy consumption, etc. In addition, the city and the large companies co-owned by the city jointly map the possibilities for additional initiatives to reduce greenhouse gas emissions from the companies' activities.

As Copenhagen is a frontrunner in terms of climate action and as the knowledge base of these efforts does not already exist in many instances, many of the Climate Plan's initiatives require thorough preceding analyses. Up to 2025, an effort must be made to shorten the time from analysis to action to achieve the goal of carbon neutrality.

6.4. INVESTMENT AND FINANCIAL ASPECTS

In the period up to 2025, a number of investments are required to achieve the goal of carbon neutrality. A number of investments will be made by the city, but the city's utility companies in particular will be making the biggest investments in public utilities of the future.

Several of the utility companies' investments, such as in energy systems, may in some instances be made before the systems they are replacing are worn out, provided that a replacement has a positive socio-economic effect. This can be necessary to accelerate the conversion in the energy sector, which is characterised by facilities with long service lives.

The financing of municipal initiatives in Roadmap 2021–2025 for the CPH 2025 Climate Plan is done through the city's annual budgetary process and is managed by the responsible administrations and entities of the City of Copenhagen.

The municipal investments will in some instances contribute to the development and testing of new solutions that can subsequently be upscaled and used on export markets, thus contributing to research, development and green growth. Also, in the final implementation period, the City of Copenhagen will seek out, develop and take part in public and private partnerships to achieve the Climate Plan's goal to reduce carbon emissions and generate green growth.

Many of the investments have and will have positive derivative effects on Copenhageners' health and quality of life. For instance, the cycling actions will not only reduce carbon emissions but will increase accessibility, reduce air pollution and substantially benefit the health and personal financial situation of Copenhageners who switch from driving to biking. Similarly, energy retrofitting can improve indoor climates, afforestation contributes to biodiversity goals, and the conversion of individually heated dwellings to district heating can reduce air pollution in the city.

6.4.1. Financing

The transformation in Copenhagen is based on financing from a number of different sources. The transformation is financed by, among other things, the annual municipal budget negotiations, the utility companies and state budgets. In addition, some projects are funded by grants from the EU and private foundations, and finally, some of the transformation is financed directly by private individuals and companies.

The government's climate partnership for the financial sector has provided a number of recommendations and proposed actions that can support the national target of reducing carbon emissions by 70% up to 2030. Several of these are relevant across actions and tasks otherwise related to the CPH 2025 Climate Plan. The recommendations are cross-cutting in nature and will generally be able to strengthen the City of Copenhagen's own efforts.

The Climate Partnership's conclusion is that funding healthy projects is not challenging. It is challenging, however, to create framework conditions in Denmark and abroad that make the requisite investments profitable.

In terms of implementing climate projects in Copenhagen, the Partnership's following recommendations are relevant:

- A requirement for certified, energy-efficiency construction.
- Higher ESCO financing in which energy retrofitting costs are financed through the financial savings generated by the retrofitting.
- Keener focus on the overall economy in public financial controls.
- Electrification of public transport via public-private partnerships (PPP).
- Better access to sharing public data.

It is the assessment of the City of Copenhagen that certification of building projects, energy-efficient building projects and better facilities for sharing public data can be relevant for the 2025 Climate Plan.

A number of the Climate Plan's objectives in 2025, e.g. retrofitting of building, require substantial investments, which can give cause to initiate a dialogue between the city and the financial sector concerning options for and obstacles to supporting the actions in the CPH 2025 Climate Plan, e.g. focusing on the financing needs and PPP solutions that could help implement critical initiatives in the Climate Plan's goal of carbon neutrality and energy efficiency by 2025.



Wind turbines at Prøvestenen, Amager. Photo: Ursula Bach

7. Process ahead and perspectives for climate action

This concluding chapter describes the process ahead for the Roadmap 2021–2025 and climate action perspectives for the City of Copenhagen up to 2025.

Without further action, carbon emissions in Copenhagen are expected to be 630,000 tonnes (baseline projection) in 2025. Roadmap 2021–2025 contains 47 initiatives distributed over 17 main action areas which are expected to reduce carbon emissions by 200,000 tonnes up to 2025. This means that without additional initiatives, there will be residual carbon emissions of 430,000 tonnes in 2025.

7.1 THE PROCESS AHEAD FOR ROADMAP 2021–2025

To ensure that Copenhagen becomes carbon neutral by 2025, the City of Copenhagen is continuing its efforts to analyse potential actions and initiatives capable of reducing the 430,000 tonnes of residual carbon emissions. The results of these efforts will be presented as a supplement to Roadmap 2021–2025 in 2021. This process is illustrated below.



By virtue of its 2020 Budget, the City Council has decided to look into the possibilities of increasing the target for wind-turbine actions from 460 MW to 560 MW. This increase is contingent on being able to erect wind turbines in Øresund, about which greater clarity is expected in the years ahead. In addition, the city monitors ARC's efforts and the lessons it will learn from establishing a carbon capture pilot facility. The transport sector is expected to be the biggest source of carbon emissions in Copenhagen from 2021. Accordingly, the conclusions of the mobility analyses – launched by the 2020 Budget with particular focus on the scope for reducing carbon emissions from road traffic (by 50,000, 75,000 and 100,000 tonnes by 2025) – are crucial for achieving the carbon neutrality goal by 2025.

Besides the potential actions analysed in light of the 2020 budget, a number of framework conditions are being changed that could impact the target fulfilment of the

Climate Plan. The government's forthcoming Climate Action Plan is expected to include a series of actions aimed at reducing emissions at national level which could affect the City of Copenhagen's possibilities of reducing emissions at local level. In addition, COVID-19 closed down our society in the spring of 2020, and the impact of this on greenhouse gas emissions and how the city is used are still unclear. There is some uncertainty as to how reopening society will affect both the government's Climate Action Plan and the municipalities' scope for reducing carbon emissions.

In addition to the above-mentioned possible actions and initiatives, the City of Copenhagen will assess the potential for reducing carbon emissions from other emission sources in the city even more, and monitor developments in the national framework conditions, in order to create a robust basis on which to achieve the carbon neutrality goal using the initiatives that will be presented as supplements to Roadmap 2021–2025.

7.2. PERSPECTIVES FOR THE PERIOD AFTER 2025

Insofar as the period after 2025 is concerned, the City of Copenhagen is working on initiatives that will continue the actions within the CPH 2025 Climate Plan's current remit and targets, by focusing on how the city can transition from carbon neutrality to climate neutrality and a fossil free city, and perhaps become climate positive eventually.

In the period up to 2023, the city will work out specific actions, goals and visions for climate efforts up to 2030 and 2035, as well as a long-term goal for 2050. The perspectives for climate efforts after 2025 are described in brief below.

7.2.1. The Climate Plan after 2025

The conversion from carbon neutral to fossil free or climate neutral and the linking of climate actions to efficient utilisation of scarce resources is generally the next major challenge for Copenhagen's climate efforts. By leading the way in the transformation, Copenhagen can retain its leading position and take responsibility for developing new innovative solutions that can drive the green transformation forward globally.

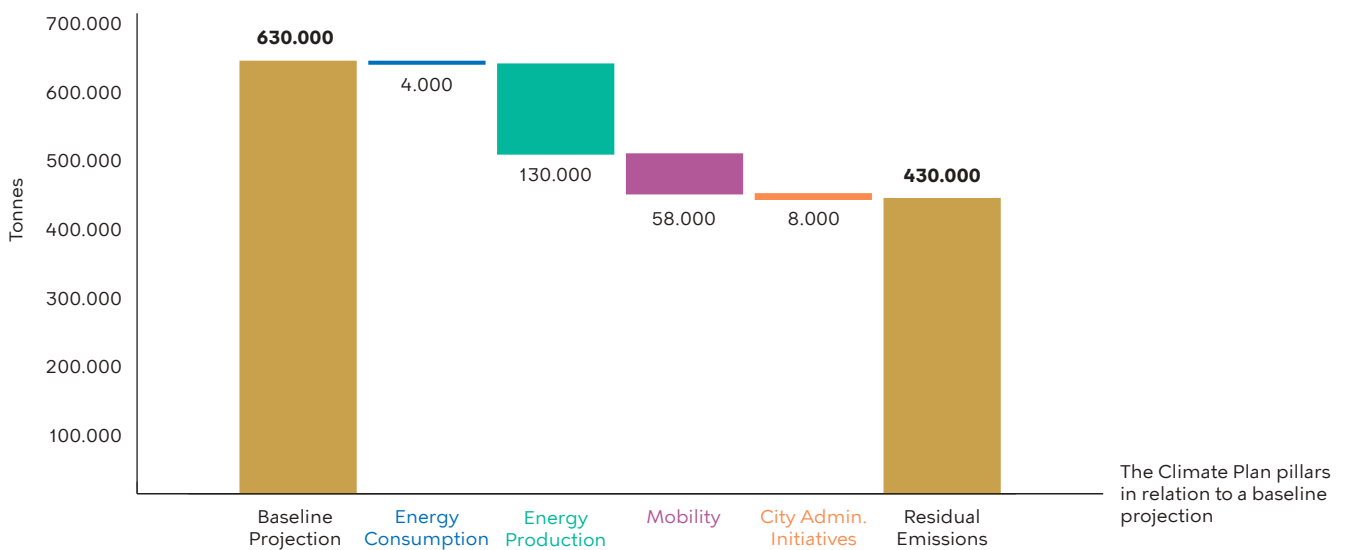
The City of Copenhagen's climate action efforts after 2025 must be based on the actions included in the CPH 2025 Climate Plan, but also consider Copenhagen's green transformation in a long-term perspective. The reason for this is that the green transformation will not have been completed in all sectors when Copenhagen becomes carbon neutral in 2025. In the period after 2025, there will still be work to do to reduce residual emissions in order for Copenhagen to become fossil free. Therefore, after 2025, climate efforts must:

- Reduce greenhouse gas emissions from the emission sources still left in the city. This will primarily be from transport and the last remaining emissions from the energy system.
- Develop mobility and transport solutions in Copenhagen so they are more energy efficient and have a greatly reduced climate and environmental impact and strain on urban spaces.

- Develop Copenhagen's utility systems so that they are better geared for the energy system of the future based on renewable energy. This requires that energy consumption in buildings is made more flexible, that the district heating system can adapt to fluctuating electricity production from wind turbines and renewable energy, and that the transport sector can be converted to electricity and other alternative energy sources based on renewable energy to a far greater extent.
- Ensure that efforts to reduce greenhouse gas emissions are supplemented by other criteria in the development of the energy system of the future, e.g. by reducing the use of biomass, developing integrated, circular resource systems and producing more energy locally from PV modules, heat pumps and possibly geothermal energy.

By leading the way in this action, Copenhagen can retain its leading position and take responsibility for developing new innovative solutions that can drive the green transformation forward globally.

CARBON REDUCTION AND RESIDUAL EMISSIONS IN 2025





Fælledparken, Østerbro district. Photo: Troels Heien



View across Kalvebod Fælled from Ørestad. Photo: Astrid Maria Rasmussen



Overview of pillars, main action areas and initiatives in Roadmap 2021–2025

PILLAR	MAIN ACTIONS	INITIATIVES
Energy Consumption The Energy Consumption in Roadmap 2021–2025 includes ten initiatives distributed across four main action areas, with a reduction of carbon emissions of 4,000 tonnes.	Energy-efficient operations	Energy-efficient operation of district heating units
		Electricity savings
		Energy Leap partnering with professional building owners
		Social housing associations
		Property administrators - offers to cooperative and homeowner associations
	Refurbishment and new build	Energy retrofitting in the renewal of urban areas and buildings
		Energy-efficient focus in building permits
		Sustainability tool for local planning
	Conversion	Conversion of individually oil-heated buildings
	Photovoltaic modules	PV Action Plan

PILLAR	MAIN ACTIONS	INITIATIVES
Energy Production The Energy Production pillar in Roadmap 2021–2025 includes sixteen initiatives distributed across four main action areas, with a reduction of carbon emissions of 130,000 tonnes.	Carbon Neutral District Heating	Continued securing of sustainable biomass
		Development of the future district-heat production
		Development of the future district-heating system
		Reducing the need for peak load production
		Converting peak and reserve load capacity
	Carbon Neutral Utilities	Green town gas
		Development of district cooling
		Carbon neutral water supplies and sewerage
		Carbon-neutral waste-water processing
	Wind and Sun	Establish onshore wind turbines
		Establish offshore wind turbines
		Establish large-scale PV systems
	Resources and Waste	Establishing materials recovery facilities (Dirty MRF)
		Implementing biogas solution for organic household waste
		Higher level of household waste sorting
		Higher level of business/industry waste sorting

PILLAR	MAIN ACTIONS	INITIATIVES
Mobility The Mobility pillar in Roadmap 2021–2025 includes four initiatives distributed across three main areas, that reduces total carbon emissions by 58,000 tonnes.	Public transport	100% zero emission buses in 2025 (including harbour buses)
	Maritime traffic	Shore power for cruise ships
		Maritime environmental zone in Copenhagen's inner basin
	Construction machinery	Conversion of non-road machinery in the city

PILLAR	MAIN ACTIONS	INITIATIVES
City Administration Initiatives The City Administration Initiatives pillar in Roadmap 2021–2025 includes seventeen initiatives distributed across six main action areas, with a reduction of carbon emissions of 8,000 tonnes.	The city's energy consumption	Energy retrofitting (energy efficiency projects)
		Energy-efficient operation (streamlining of day-to-day operations)
		Flexible energy consumption
		The City of Copenhagen's new construction
		Street lighting
	The city's transport	Efficient transport and electric and hydrogen powered vehicles
		Requirements for non-road mobile machinery in construction projects
		Tightened requirements for supplier transport
	The city's companies	Charting of initiatives in the City of Copenhagen's companies
	The city's procurement	Ecolabelled products and services
		Electricity-saving products
		Systematic follow-up
	The city's woodlands	100,000 trees in Copenhagen
		Semi-urban tree planting
	Training and information	Climate Ambassador Training Programme
		Climate Action Showroom
		Climate Training Programme

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