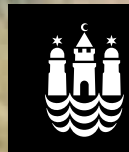


CPH 2025 Climate Plan

Roadmap 2017–2020









CPH 2025 Climate Plan

Roadmap 2017–2020

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CPH 2025 CLIMATE PLAN

Toward a carbon neutral capital

The CPH 2025 Climate Plan was adopted by the City Council on 23 August 2012. It reflects the decision to make the city carbon neutral by 2025. The City Administration will pursue the goal of making Copenhagen the world's first carbon neutral capital. The first of the three implementation phases is now drawing to a close. The purpose of this roadmap is to set out the parameters and work to be done in phase two, 2017–2020, and show how Copenhagen will reach its goal of carbon neutrality by 2025.

Cutting CO₂ emissions

The city has cut its CO₂ emissions by 38% since 2005. In other words, progress has been made, and initiatives that have already been pencilled in are also expected to reduce the emissions by a considerable amount in the run-up to 2025.

Progress during phase one was, however, slightly slower than expected, partly due to the fact that the energy being replaced by green energy from Copenhagen has turned out not to pollute quite as much as originally thought.

If the City Council were to call a halt to all efforts to reduce CO₂ emissions today, the emissions would continue to fall thanks to the national transition to renewable energy, but the City of Copenhagen would still emit of approx. 900,000 tonnes of CO₂ in 2025. The initiatives contained in the plan will make Copenhagen carbon neutral by the target date.

Co-operation and innovation are the keys to the transition

New solutions will need to be devised along the way if Copenhagen is to be the world's first carbon neutral capital. This will only happen if the City of Copenhagen works closely with experts partners from the business community, the world of research and the Copenhageners who use the city on a day-to-day basis.

As well as the contribution that they make to the transition, these new solutions will also help generate green growth in the city and in Greater Copenhagen. In fact, experience shows that the efforts to create a carbon neutral, green city fit to face the challenges posed by climate change helps open doors for local companies abroad.

During phase one – 2013-2016 – several types of partnerships have facilitated both research and development and the implementation of new solutions, e.g. the projects Energy-Lab Nordhavn, the new LED street lighting in Copenhagen, Intelligent Transport Systems and the roll-out of hydrogen-powered cars. As part of the CPH 2025 Climate Plan, the City of Copenhagen invites all parties to play a part in making Copenhagen carbon neutral.

Investments with added value

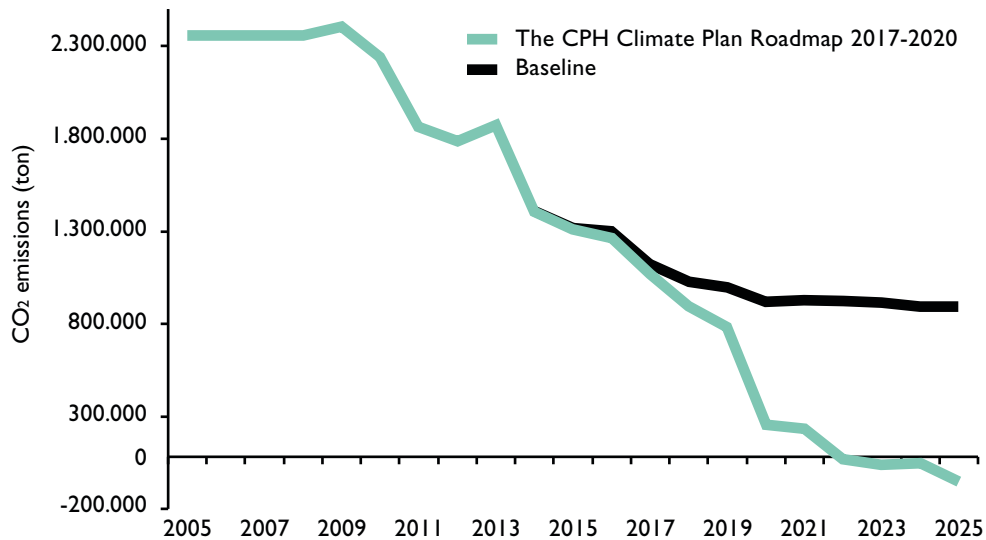
The CPH 2025 Climate Plan forecasts a need for investments of more than DKK 200 billion, much of it due to incorporating thinking about the climate and energy when planning new buildings, renovating old ones and updating modes of transport. DKK 15-20 billion will be directly invested in renewable energy supply from various forms of power stations plants by 2025. The City of Copenhagen is expected to invest a total of DKK 2.0 billion by the target date.

The cheap and easy options for cutting CO₂ emissions are all but exhausted, pushing the cost per tonne up bit by bit the closer the city gets to the target of carbon neutrality.

As part of the effort, the City of Copenhagen will provide direct and indirect support for massive investments in green growth between now and 2025. These investments will fund innovation projects in the city and create a large number of jobs in the green sector. Implementation of the Climate Plan is expected to generate more than 30,000 full-time job equivalents by 2025, mainly in the construction industry.

CO₂ emissions in City of Copenhagen 2005-2025

The figure shows CO₂ emissions since 2005, plus projections with and without the initiatives outlined in the roadmap



How does the Climate Plan work?

The CPH 2025 Climate Plan is based on four pillars:

- Energy Consumption
- Energy Production
- Mobility
- City Administration Initiatives

The targets set for all four pillars are critical to the overall objective of carbon neutrality.

The CPH 2025 Climate Plan is being implemented in three phases, the first of which comes to an end in 2016. After each phase, an evaluation will be conducted, the results of which will determine what is done in the following period.

The overall objectives will remain the same, however, and this new roadmap outlines what will happen in the second phase, from 2017 to 2020. The roadmap describes 60 initiatives which correspond with the main priorities for the four pillars.



Cities crucial to the climate

The agreement reached at the climate summit in Paris in December 2015 has put climate front and centre of the global agenda for the first time. It calls for the global temperature increase to be kept below 2° Celsius, preferably to a maximum of 1.5°, and for every nation in the world to play its part.

The battle will be won in towns and cities.

By 2050, 2/3 of the world's population is expected to be living in cities, up from just over half at the moment. Most of the growth will be in the developing countries, especially South-east Asia, Africa and South America. The global middle class is also expected to grow from 1.8 billion people in 2010 to 4.9 billion in 2030.

This will put greater pressure on resources, so it is absolutely imperative that the expected growth and development of infrastructure is based on sustainable principles. Otherwise, the targets in the Paris Agreement will be unrealistic.

The picture in a number of towns and cities all over the world is already positive and many international organisations support the trend, e.g. C40 (Climate Cities Leadership Group), Carbon Neutral Cities Alliance (CNCA) and International Council for Local Environmental Initiatives (ICLEI). The results of the international climate negotiations will mean a shift in focus in the international funding programmes supported by bodies like the UN and the EU.

Status check

The most recent CO₂ accounts show emissions of 1.45 million tonnes of CO₂ in Copenhagen in 2015, down 38% since 2005 and 11% since 2014. At 2.5 tonnes per capita, it is one of the lowest figures for a European capital.

This reduction took place during a period (2005-2015) of 16% population growth, and was mainly attributable to the increased use of biomass in combined heat and power production, including in the Greater Copenhagen area, increased use of wind power to generate energy, and implementing initiatives outlined in the Climate Plan.

The activities already planned for the period leading up to 2025 are expected to cut CO₂ emissions significantly, for example from greater use of renewable energy in the Danish energy system and the conversion of the combined heat and power plant Amagerværket to biomass.

However, none of this alters the fact that the transition to green energy will not come about automatically. Projections for future CO₂ emissions and evaluations of current initiatives show that Copenhagen will not achieve the goal of carbon neutrality in 2025 unless the roadmap triggers new initiatives on top of those already planned.

Evaluation 2013–2016

The City of Copenhagen has conducted an internal evaluation of the climate work to date. The main conclusion is that additional initiatives are called for to cut a further 286,000 tonnes of CO₂ emissions in order to reach the 2025 target. This corresponds to 12% of the 2,358,000 tonnes of CO₂ emissions in 2005. Particular challenges are faced when it comes to traffic congestion, converting vehicles to new types of fuel, reducing energy consumption in the city and achieving the targets for sorting plastic and organic waste. The transition has been slower than expected, with national measures such as the congestion zone and changes to energy taxes failing to materialise.

Another factor is the fact that progress at national level on wind power and biomass in the electricity sector has been considerably faster than expected in the CPH 2025 Climate Plan. The CO₂ content per kWh in 2025 is now expected to be half of what was expected in 2011. As a result, the work that the City of Copenhagen is doing in the electricity sector is replacing fewer tonnes of CO₂ than originally foreseen.

Initiatives 2013–2016

The vast majority of the 66 initiatives in the first CPH 2025 Climate Plan Roadmap have been implemented and significant results achieved.

For example, the programme of converting combined heat and power plants from coal to sustainable biomass is well underway and is expected to be completed by the end of 2020. The majority of Copenhagen refuse collection vehicles run

on gas, and 64% of the City of Copenhagen's own vehicles already run on electricity or hydrogen. The replacement of 20,000 streetlamps with LED is expected to be completed in 2016, resulting in a total energy saving of at least 57% compared to 2010. New buildings will have to comply with the energy parameters laid down in the 2015 and 2020 building regulations, renovation projects have also focused on energy retrofitting, and new cycle lanes and walkways have been built over the harbour area to provide better links between parts of the city. This work has often been done in close co-operation with other stakeholders in the various sectors, and a great deal of useful experience has been gained, which will be deployed in the city and by companies around Denmark and the rest of the world.

Finances 2013–2016

The budget for 2013–2016 is approximately DKK 810 million, mainly for replacement street lighting, new and improved cycle paths and lanes, new traffic signals and the renovation of municipal properties. Only limited resources have been devoted to encouraging energy retrofitting of the remainder of the building stock in the city and to promoting the use of new types of fuels in the transport sector.

The changing face of Copenhagen

Copenhagen is growing. The population will increase by 80,000 between 2016 and 2025, a 14% growth rate, which will have an impact on the whole of the surrounding region. The demographics, the uses to which buildings and urban spaces are put and the functionality people expect of their city will change as well. This will place demands on how the city is developed, the investments made in infrastructure, and how Copenhagen's attractive characteristics are preserved and enhanced.

In the transport sector, innovative thinking and major investments will be needed to produce the Copenhagen of the future. More Copenhageners and more people living in the region will mean more traffic. There will be more cycles and more cars. In 2025, cycle usage is expected to be up 27%, and there are will be 20% more cars. Congestion is expected to be twice as bad in and around the capital. The number of kilometres per person by public transport is expected to increase by 66%.

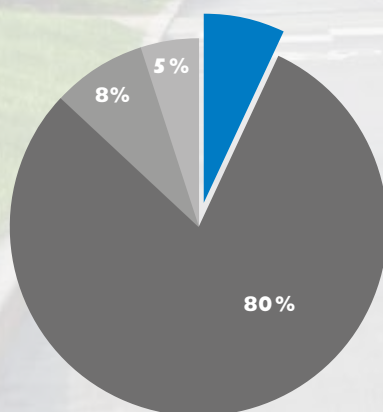
By 2025, the amount of land available for property development is expected to grow by 12% and many existing buildings will be renovated. The new and renovated buildings will all be energy-efficient and supplied with heat and electricity from a flexible system fuelled by renewable sources.

ENERGY CONSUMPTION

Partnerships are the key

CO₂ reductions from energy consumption in 2025

Total Energy Consumption
7%



Energy savings make good financial sense

Energy savings are an important part of the CPH 2025 Climate Plan. Energy consumption will only account for 7% of the total CO₂ reduction but, from an overall economic perspective, energy savings are the cheapest way to cut emissions.

Copenhageners could save approx. DKK 500 million p.a. on heating bills, if all of the potential heat savings were realised. If they fail to make those savings on heating, investment will be needed in new production capacity and ultimately they – the consumers – will foot the bill.

There are plenty of other good reasons to encourage energy savings as well. Energy retrofitting can improve the indoor climate and comfort in homes. It is important that energy retrofittings is made at the same time as standard renovations, so that the total investment provides the best possible return.

The City of Copenhagen will try to realise the potential for energy savings in the city and prepare the building stock for the future.

Current status and results 2013–2016

Consumption of district heating (weather corrected) in Copenhagen in 2015 was more or less the same level as 2010 – despite population growth of 9% and approx. one million square meters extra being used for housing. However, if its targets are to be met, Copenhagen needs to be even better at saving on heating. It is positive that electricity consumption in the capital fell by 7% during the same period, partly due to households installing more energy-efficient appliances.

Many owners and tenants still lack knowledge of how to keep energy consumption as low as possible in their buildings. Many constructing companies and building owners also lack sufficient knowledge of the technical options and attractive financial packages available for renovation and building projects. There is considerable potential for making savings by co-ordinating the design and construction phases with operations to ensure that the proposed savings are actually made in reality and result in lower energy consumption.

It is worth noting that several of the initiatives during the first implementation period from 2013–2016 have already led to positive results.

The city's district heating supplier, HOFOR, has made major energy savings by replacing steam with hot water in its system and by reducing the supply-pipe temperature. It has also developed and tested a new business model over the last couple of years, which improves the efficiency of the many district heating units in the city. In addition, several private providers now also help district heating customers operate

their units more effectively. It may be important to operate district heating units effectively but more initiatives are required, and the appliances, windows, roofs and façades in buildings also need to be renovated.

For years, urban-renewal and renovation projects in the social housing sector have driven the improvements in flats around the city. Financial support and advice have helped provide Copenhageners with bright, well insulated flats fit for the future, inspired other building owners and encouraged innovation and the use of new products. Private stakeholders have also retrofitted their properties, but there is still a need to renovate significantly more buildings by 2025.

Commercial and service companies used more or less the same amount of electricity in 2015 as 2010, despite an increase in the number of them and longer opening hours in general. However, the target is to cut the use of electricity by 20% in 2025, so there is still a long way to go. Companies need better incentives to save energy. During the first implementation phase, work started on new business models to encourage the 13,000 commercial and service companies in the city to use less electricity. Again, this is another area where more work needs to be done to improve incentives and attract the interest of the many small and medium-sized enterprises – and to achieve the target of 20% electricity savings by 2025.

Targets for Energy Consumption in Copenhagen by 2025

- **20% reduction in heat consumption**
- **20% reduction of electricity consumption in commercial and service companies**
- **10% reduction of electricity consumption in households**
- **Installation of solar panels corresponding to 1% of electricity consumption in 2025**

Baseline 2010.

CO₂ reductions in Energy Consumption by 2025 Targets per main initiatives

TOTAL CONSUMPTION (TONNES CO ₂)		66,000
Energy-efficient operations and appliances - Efficient operation of district heating units - Electricity savings by commercial and service companies - The Copenhagen Package for residents - Energy Leap – voluntary agreements with owners of buildings	35,000	
Renovating building envelopes - Energy savings in properties involved in urban-renewal projects - Energy savings in social housing - Improvements to properties with a poor energy-label ratings - Dialogue when requests are submitted for renovation projects	13,000	
Flexible energy consumption - Data-driven flexibility in buildings		18,000
New areas - Organic solvents - Space management		

Trends in energy consumption

Over the next few years, many of the new, data-based, intelligent solutions will be brought into use. Remote-reading of meters provides opportunities to automate, monitor and control the use of energy. This is necessary in order to facilitate co-ordination with producers, so that energy is used when it is cheap and green – from day-to-day and from one hour to the next – and to communicate digitally with the energy market.

In the last couple of years, solutions have also been launched that make it easier for building owners to prepare their properties for the future. Companies offer renovation “packages” that focus on energy and provide attractive financing options.

A number of initiatives have emerged from the national energy-retrofit strategy, e.g. the stricter energy requirements in the revised Building Regulations from 2016. In general, energy companies have met their savings requirements, but their focus is still on industry rather than housing. Greater financial incentives are still needed to encourage more energy retrofitting projects.

The period 2017–2020

Copenhagen is still some way from achieving its energy-saving targets, and there is still huge untapped potential in the building stock.

Flagships 2017–2020

Efficient operations

If the district heating unit in every property in Copenhagen was operated efficiently, the city would use up to 10% less heat. With this in mind, the Climate Plan includes several initiatives to encourage building owners to use more efficient heating, and optimise at least half of the district heating units in the city by 2020.

Energy Leap

As part of the “Energy Leap” project, the City of Copenhagen will enter into voluntary agreements with large building owners. The target is to sign up at least 40-50 of the biggest owners, e.g. the City of Copenhagen itself, to show the way for others and make big energy savings

Improvements to E, F and G energy-label ratings

The thousands of homes in Copenhagen with energy-label ratings E, F and G are in great need of renovation. About half of them also suffer from severe noise pollution. When renovating properties, especially when installing new windows, it is possible to improve the comfort of homes, save energy and reduce the noise from road traffic. The City of Copenhagen will make an effort to improve properties in these categories, so that energy use and noise are reduced.

The City of Copenhagen is not in a position to optimise the energy efficiency in buildings on its own. The owners need to play their part. In the period up to 2020, the municipality will, therefore, enter into partnerships with the many stakeholders in the building sector. Efforts will be targeted on the buildings with the highest energy consumption and the poorest energy-label ratings. The City of Copenhagen will also improve dialogue on energy savings whenever it receives enquiries and applications for renovation projects.

“Environmental Considerations in the Construction Sector 2016”, which the City Council adopted at the start of 2016, places the requirement on the social-housing sector, urban-renewal projects and the City of Copenhagen’s own building projects that new buildings must comply with Building Class 2020 and that major renovation projects must improve buildings’ energy-label ratings.

Energy-efficient operations and appliances

In partnership with product suppliers and others, the City of Copenhagen will offer “one-stop-shop” energy-saving packages to commercial and service companies to make it easier and financially attractive for them to save energy. The focus will be on the parts of the business property rental sector that use most energy: offices, restaurants, wholesale and retail. Positive results will be shared with other sectors in order to spread best practice.

Energy-efficient solutions will also be made available to the ordinary people of the city in their homes. The City of Copenhagen will enter into partnerships with energy companies and others to provide a “Copenhagen Package” consisting of LED lighting, energy-saving devices and digital information tools to manage consumption, e.g. modern and intelligent thermostats in apartments.

Renovating the building envelope

A significant step toward reducing energy use in Copenhagen will be to improve the building envelope – roof, gable and façades – on the building stock, while maintaining respect for architectural values.

Urban renewal has a significant role to play in this. For urban-renewal projects, the target is that all properties – depending on preservation value – must achieve a 20-30% energy saving. If the number of urban-renewal projects continues unabated, approximately 1,500 homes p.a. will be energy retrofitted.

The agreement between the City of Copenhagen and BL–Danish Social Housing revolves around a vision of reducing heat consumption by 30%/m² by 2025. The interim target in 2020 is 20%, and will be achieved by energy retrofitting and making heating systems more efficient. The social housing sector makes up 20% of housing in Copenhagen, so a considerable reduction in consumption will make a significant contribution toward the city’s energy targets.

The experience gained in this process will be deployed in renovation projects and innovative demonstration projects in social housing and urban renewal in order to inspire others in the social housing sector as well as the thousands of homeowners.

Flexible energy consumption

The energy system of the future will, to a great extent, be based on renewable sources, e.g. wind power. The energy itself will have to be stored and consumption flexible enough so that electricity can be used when there is plenty of wind power in the grid, e.g. by companies that do a lot of refrigeration, freezing and ventilation. Another form of flexibility consists of exploiting the ability of older buildings to store heat in order to avoid resorting to peak-load facilities using fossil fuels to produce heating.

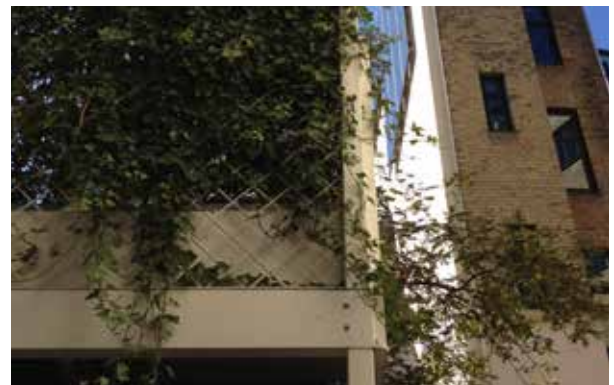
Further studies will be made of the potential for storing heat in buildings, including short-term scaling down on district-heating production. Projects will also generate knowledge about the potential to store electricity in batteries and electric cars as well as the use of heat pumps.

Access to real-time data is a key concept, as the data about the current level of production of electricity and heat is designed to ensure the right mix and give consumers the chance to manage their own consumption better and make savings. Innovative solutions will be tested in new buildings in Nordhavn and, if relevant, in older buildings.

New areas

According to national data, Copenhagen emits 20,000 tonnes of CO₂ from organic solvents but the City of Copenhagen has no information about the sources or the exact nature of the emissions. The national data is based on the populations in local authority areas, and therefore says nothing about actual emissions in Copenhagen. During phase two of the CPH 2025 Climate Plan these sources will be identified and mapped, and measures introduced to reduce emissions, possibly in partnership with other stakeholders.

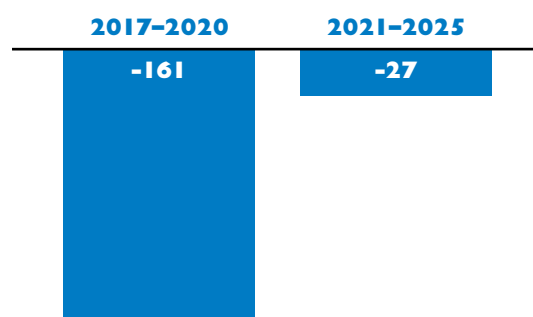
Space management to help cut CO₂ emissions is another area that deserves greater attention. Optimisation includes using the building stock more effectively, e.g. by sharing offices or using schools in the evening.



Finances

During the period covered by this Roadmap, the City of Copenhagen has budgeted with expenditure on energy efficiency in the building stock of DKK 161 million, rising to a total of DKK 188 million by 2025. Investments in cutting energy consumption will reduce the need for investments in greater heating capacity in the long term. In addition to CO₂ reductions, these investments can improve the indoor climate and reduce traffic noise in apartments in Copenhagen.

The City of Copenhagen budget: Energy Consumption (DKK million)



Improvements to E, F and G-labelled properties

Energy labels by percentage of the area of private apartment blocks.

Low consumption

A 2 % = 35 apartment blocks



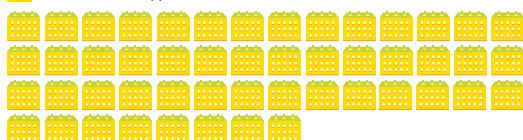
B 8 % = 200 apartment blocks



C 25 % = 1.250 apartment blocks



D 50 % = 3.100 apartment blocks



E 13 % = 925 apartment blocks



F 1,5 % = 145 apartment blocks



G 0,5 % = 50 apartment blocks



High consumption

National framework conditions

National framework conditions can help the City of Copenhagen achieve the targets laid down in the CPH 2025 Climate Plan. The City of Copenhagen will do what it can to push for improvements, e.g. by lobbying the government on the following:

- Focusing on “performance” when handing over construction projects – both new buildings and renovation projects, i.e. whether the building performs optimally within the parameters set by the Building Regulations
- Further developing the energy labelling scheme to enhance quality and make it possible to upgrade energy-label ratings after energy retrofitting without incurring excessive costs. This will improve incentives for homeowners to renovate and pave the way for energy labelling to be a factor in property valuations
- Introducing legislation to ensure efficient operation of district heating units and follow-up on actual energy consumption, e.g. with an annual “heating label” as well as flexible energy consumption and more daylight in homes
- Creating better financial incentives for comprehensive renovations. This could be done in several ways, e.g. by imposing stricter obligations on energy companies to save energy in residential properties
- Addressing what is known as the “owner/tenant” paradox, i.e. that neither have any great incentive to pay for energy-retrofitting.

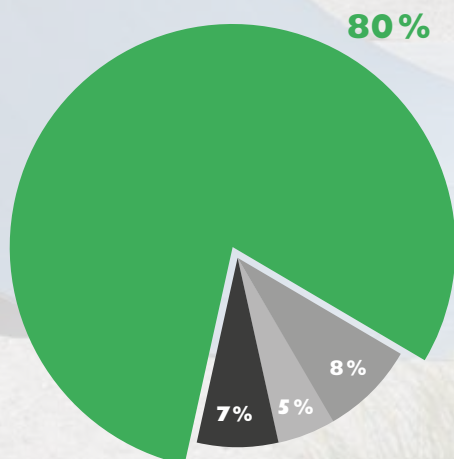


ENERGY PRODUCTION

Flexibility is key

**CO₂ reduction from
energy production
by 2025**

**Total
Energy Production**



Green energy from wind and biomass

The production of electricity and heat for Copenhageners is currently the biggest source of CO₂ emissions, and it is absolutely critical that coal, oil and natural gas are replaced in the production process by wind power, biomass, geothermal energy and solar power. This conversion to green energy also has to be as inexpensive as possible in order to keep costs down for the people of the city but security of supply must be maintained. Efforts in this pillar will account for 80% of the total reduction in 2025.

Greater use of wind power will make its mark on the energy system in Copenhagen and place greater demands on how electricity, gas and the district heating system are integrated. The aim is to make the system as flexible as possible and less dependent on individual sources. Many of these solutions are currently at the development and testing stage and will be rolled out over the next few years.

Waste incineration is, and will remain a key source of heating and electricity generation in Copenhagen. However, to make a production of green energy, plastic has to be sorted out of the waste because it is made from crude oil and generates CO₂ when incinerated. The organic part of the waste also needs to be exploited better. It will be used to produce biogas and help make other parts of the energy and transport sectors green.

The City of Copenhagen and its partners will work together on ensuring that the supply of town gas, district cooling and water, as well as waste-water treatment, are carbon neutral, so all supplies to the city are carbon neutral by 2025.

Current status and results 2013–2016

Copenhagen has taken a number of important steps toward a green energy system since 2013.

The conversion of the combined heat and power plant, Avedøreværket from coal to biomass means that half of the district heating produced for Greater Copenhagen will be from carbon neutral fuels at the end of 2016. HOFOR, the district heating supplier, is also setting up a new biomass-based combined heat and power unit to ensure that all electricity and heat from Amagerværket will be generated from sustainable biomass from 2020.

HOFOR currently operates 23 wind turbines with a total capacity of 64 MW. The company is also involved in a consortia with a number of companies from other countries to bid for government tenders for near-shore wind farms and the offshore wind farm at Kriegers Flak. To lower the cost of the PSO tariff, revenue from which finances the green transition in Denmark, the government presented a proposal in spring 2016 to cancel, postpone or put a price ceiling on the national tenders.

At the time of writing, it is still not clear whether the proposal will have consequences for the CPH 2025 Climate Plan.

In 2016, sorting of rigid plastic has been introduced for apartment blocks and houses. REnescience technology, which produces biogas from organic waste, has been tested in a small demonstration plant since 2012, and will make it possible to produce biogas from residual waste. However, the organic output generated by this process is not recyclable in its current form, and the technology needs to be developed and improved.

Trends in energy production

Europe and Denmark have set ambitious climate and energy targets. However, the requisite national framework conditions outlining the path to the energy system of the future have not yet been defined and implemented. Uncertainty also reigns about how the subsidy and tax system will be used to promote the production of renewable energy. In this area, the trend appears to be toward instruments covering the whole EU rather than individual countries.

Better utilisation of the energy will play a key role in the energy production and consumption of the future. Energy sources with fluctuating levels of production (e.g. wind turbines) are being increasingly integrated into the Danish energy system. This increases the need to develop a flexible system that uses or stores energy when it is generated. It will also call for an integration of electricity, gas, heating systems and modes of electric transport, and for consumption to be aligned with when the energy is produced.

Targets for Energy Production 2025

- **District heating in Copenhagen is carbon neutral**
- **Electricity production is based on wind and biomass and exceeds total electricity consumption in Copenhagen**
- **Plastic waste from households and businesses is separated**
- **Biogasification of organic waste**

CO₂ reductions in Energy Production by 2025 Targets per main initiatives

TOTAL ENERGY PRODUCTION (TONNES OF CO ₂)		741,000
Biomass in combined heat and power units - Building a new combined heat and power unit for biomass at Amagerværket - Using sustainable biomass in the district heating system	249,000	
Flexible energy technology - Action plan for utilisation of surplus heat - Basis for decision-making regarding large scale heat pumps based on demo projects - Setting up heat-storage units - Testing low-temperature district heating in Nordhavn	15,000	
Carbon neutral supply - Strategy for the conversion of peak-load and reserve units for district heating - Green town gas - Greater use of district cooling - Carbon neutral waste-water system and treatment - Carbon neutral water supply	89,000	
Solar panels - Possibilities for investment in large-scale solar-power units	15,000	
Wind turbines - Wind turbines on land in Copenhagen - Wind turbines on land outside the City of Copenhagen - Setting up near-shore wind farms - The government's offshore wind project at Kriegers Flak - Possibilities for an additional 100 MW of wind turbines	314,000	
Resources and waste - Developing up a biogas strategy for Copenhagen - Establishing waste-based biogas production - Collecting more plastic - Evaluating the potential for a material recovery facility	59,000	
Analysis - Fossil fuel-free Copenhagen in 2050	-	

Waste imports into Denmark have doubled in just two years. The imported waste suitable for incineration usually has a high plastic content. Due to a political agreement, Amager Resource Centre, which processes much of the City of Copenhagen's waste suitable for incineration, does not import waste at the moment. If this situation changes, Copenhagen's total CO₂ emissions from waste incineration

may increase. Liberalisation of the market could also have consequences for the City of Copenhagen's CO₂ accounts. Conversely, closer focus on the circular economy may lead to a long-term reduction in the volume of waste, better use of resources and lower CO₂ emissions.

The period 2017–2020

By 2020, Copenhagen will launch a range of types of initiatives designed to produce a greater volume of renewable energy, make the energy system more flexible and make waste treatment more climate-friendly.

Combined heat and power plants on biomass

The biggest CO₂ reduction by 2020 will be caused by the new biomass-based combined heat and power unit at Amagerværket. The new unit will replace the existing coal-fired unit 3, meaning that all combined heat and power units supplying district heating to Copenhagen will use biomass. HOFOR and the other companies that supply heat to the district heating system in Copenhagen, have signed up to the industry agreement on sustainable biomass. In parallel, work will continue on drawing up EU sustainability requirements.

New windmills and solar panels

HOFOR's wind-power strategy is based on installing 360 MW turbines by 2025 to help make Copenhagen's electricity consumption carbon neutral. By the end of 2016, the company will learn the result of the tendering process for near-shore wind farms and the offshore farm at Kriegers Flak. If it wins one of these contracts, the target will be to bring the new turbines online in 2021. If it does not win either of the tenders, HOFOR will look at alternative offshore locations

for wind turbines. In parallel with the work on offshore wind farms HOFOR continues to look for suitable sites on land, both within the City of Copenhagen boundaries and in other local authorities. In the period up to 2020, HOFOR will also look into the possibility of adding a further 100 MW to its wind-power strategy.

Solar-power technology has improved considerably in recent years. HOFOR and the City of Copenhagen are following this development and will build large-scale units if stable political framework conditions are established and large-scale units become profitable in the long term.

Carbon neutral supply

Alongside all of the other initiatives, work is also being done to reduce CO₂ emissions from the water-supply system, district cooling systems, town gas and waste-water treatment. This will be achieved through energy-efficiency measures in the supply systems and through the production of biogas from waste-water treatment, which will be mixed into the town-gas network instead of natural gas. HOFOR and the Danish Nature Agency will also plant approx. 80 hectares of forest p.a. in water catchment areas. The CO₂ captured by the trees in the course of their lifetime will be offset in the City of Copenhagen's green account.

Flagships 2017–2020

BIO4

BIO4, the new, biomass-fired combined power and heating unit at Amagerværket, will replace the coal-fired unit 3, and mean that all heating produced by the main combined heat and power plants in the capital will be from renewable fuels. This will make more than 80% of the production for the district heating system carbon neutral by 2020. The remaining emissions will be from plastic waste incineration and peak-load production based on fossil fuels.

BIO4 will be one of the most efficient and modern combined heat and power units in the world, which means that it also has export potential. The technology makes it possible to stop generating electricity and only produce heat when electricity prices are low and the system needs it. The new unit will help make the energy system flexible, and its ability exclusively to produce heat will help cut CO₂ emissions because it reduces the need to fire up the peak-load boilers, which use fossil fuels.

Windmills at sea and on land

Autumn 2016 will be a crucial juncture in relation to the target set by HOFOR and the City of Copenhagen to bring wind turbines that generate at least 360 MW online by 2025. The government will announce which consortia have won the tenders for the 350 MW near-shore wind farm and the 600 MW Kriegers Flak in September and November 2016. The HOFOR consortia pre-qualified to bid for both tenders. Future initiatives will depend on the outcome of these tenders. If the HOFOR consortia fail to win either of them, a revised plan will be drawn up for meeting the 360 MW target.

Options include more wind turbines on land outside the City of Copenhagen and using the Energy Agency's open-door procedure to set up offshore wind farms. Both of these solutions may make it necessary to revise the current risk and return-on-investment requirements for wind-turbine projects.

When it is particularly cold, or one of the big power stations is offline, the peak-load and reserve units are brought into use. Currently, they use fossil fuels. By 2020, HOFOR will present an action plan to convert all of these units to fossil-free energy sources by 2025. The plan will be drawn up along with the companies that provide peak-load supplies to the district heating system.

Flexible energy production

The energy system of the future will have to deal with the fact that periods of strong wind generate a surplus of energy, other periods do not generate enough. This will require greater flexibility between production and consumption as well as between our electricity, gas and district heating.

The City of Copenhagen, HOFOR and other external parties will work on a wide range of test and demonstration projects in the period up to 2020, e.g. with heat pumps and surplus heat, to make the system more flexible and make more efficient use of the energy generated. HOFOR will also establish a heat storage unit to make better use of the heat produced and help replace some of the fossil-based peak-load production. However, this will require a positive business case. During CPH 2025 Climate Plan Phase Two, HOFOR will look at the potential for improving the technology

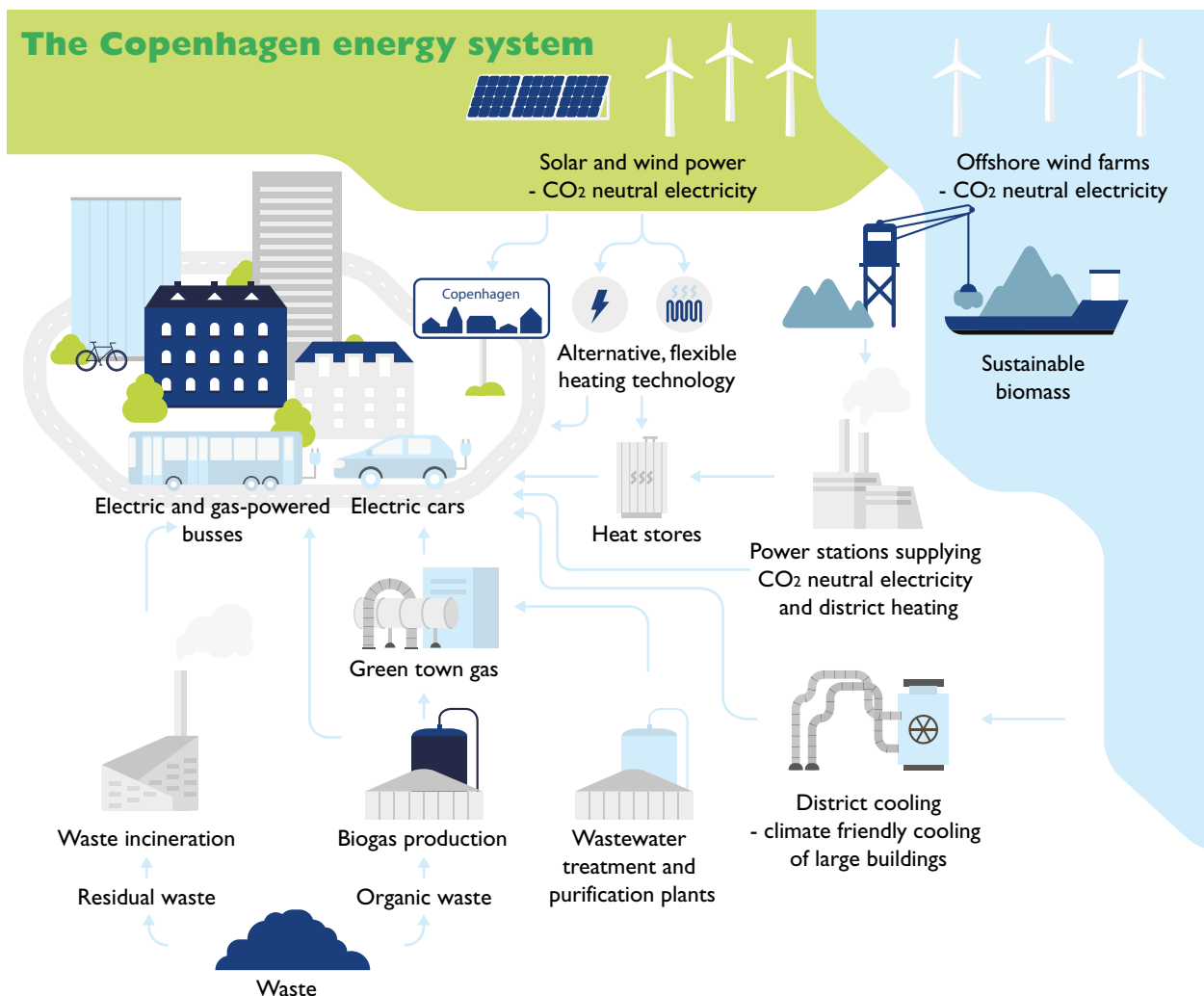
for geothermal energy, lowering its cost and exploiting its economic potential.

Maintaining a close dialogue about energy plants between the City of Copenhagen and the utility companies is of paramount importance. This applies to current and future energy units. The purpose is to ensure that land is reserved for energy production in district plans.

Waste and resources

In 2020, when coal has been phased out of combined heat and power plants in Copenhagen, incineration of plastics will be the biggest source of CO₂ in heat production. The City of Copenhagen will, therefore, promote the recycling of plastic, e.g. via information campaigns, supervision and guidance for companies in the city. The current collection scheme for rigid plastic will also be extended to cover plastic foils as well. Work will continue on technology for sorting and recycling plastic.

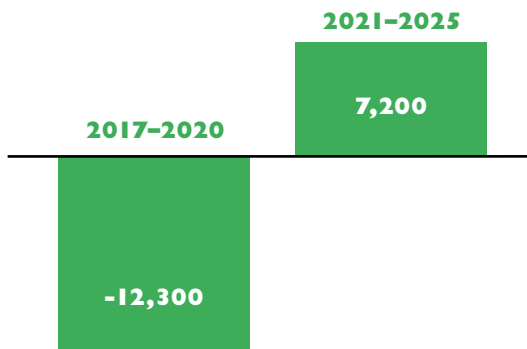
The organic part of the waste will be used to produce biogas in future. To facilitate this, the City of Copenhagen proposes an innovative treatment plant producing biogas from 50,000 tonnes of household waste, which corresponds to a third of total household waste in the city. This plant will also be used



Finances

The initiatives listed under Energy Production are financed by City of Copenhagen utility companies and by waste tariffs. The commercial investments during period covered by this roadmap amount to DKK 12.3 billion, partly due to major investments in a new unit at Amagerværket and in wind turbines. During the third implementation phase (2021-2025), the remaining working life of the units and ongoing operating revenue will provide a profitable return on invested capital.

Commercial investments: Energy production (DKK million)



to develop methods of recycling the nutrients contained in the residual product. As biogas production increases, a strategy will be drawn up for the best way to use the gas to convert fuel use in the Copenhagen energy and transport systems, e.g. for heavy transport or in the town-gas system.

These initiatives will not exhaust the total potential for reducing CO₂ emissions from waste. In its Resource and Waste plan (2019–2024), the City of Copenhagen will present a plan to achieve the targets set in the Climate Plan for biogasification of organic waste and sorting plastic from domestic and commercial waste.

Analysis

Copenhagen is looking to the future. It is only nine years until 2025, and most of the investments made before then will be of long-term importance. In order to provide the best possible basis for decisions about these investments, the City of Copenhagen will conduct analyses and draw up a plan for making the city fossil-free – i.e. completely free of coal, oil and gas – by 2050. The results of this analysis will be presented in 2018.

National framework conditions

National framework conditions may help the City of Copenhagen achieve the targets laid down in the CPH 2025 Climate Plan. The City of Copenhagen will do what it can to push for improvements, e.g. by lobbying the government on the following:

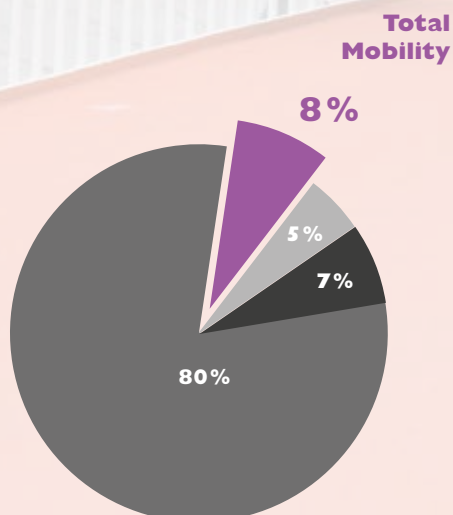
- Supporting government tenders for wind farms, security of investment and funding models that facilitate the establishment of new wind turbines in Denmark. At the time of writing, negotiations about future funding models are as yet unfinished, so it is impossible to evaluate the consequences for the Climate Plan.
- Maintaining tax exemptions for biomass or matching any tax increases with similar increases for fossil-fuel alternatives. This has to be done while maintaining the combined heat and power requirement in the short term. If the combined heat and power requirement is abolished, changes to subsidies and taxes must be used to provide an incentive for the co-production of electricity and heat based on biomass.
- Adapting the combined heat and power requirement in the longer term to enhance the potential for flexible use of electricity for heat generation, e.g. by geothermal energy and large-scale heat pumps. However, these technologies need to mature first.
- Making it possible to use biomass for peak-load production.



MOBILITY

Out of your car, onto your cycle

CO₂ reduction from mobility by 2025



Green mobility connecting Copenhagen

Getting around Copenhagen should be easy, healthy and efficient, and connect up the different parts of the city. It is not without its challenges, however, and most of the CO₂ emissions from transport comes from road traffic. 68% of the CO₂ emissions generated by road traffic, originate from cars with vans and trucks accounting for another 25%. This makes optimisation and restructuring of road transport necessary components of efforts to cut emissions.

To make the transport as smoothly as possible and optimise the use of urban space as well as possible, cyclists and pedestrians need to enjoy the best conditions and public transport needs to provide a high level of service. The interactions between green means of transport also has to be better co-ordinated so that the different parts of the city are interconnected by trains, buses, cycles, public bicycle schemes, and car-sharing clubs.

The remaining “necessary” car journeys and van deliveries, must use the cleanest possible vehicles to reduce air and noise pollution and reach the target of carbon neutrality.

Current status and results 2013–2016

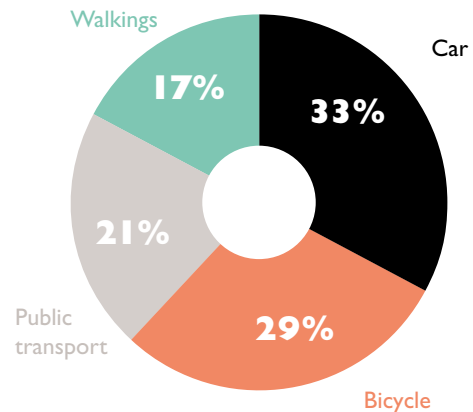
A whole series of initiatives designed to improve green mobility has already been launched. Development of the “world's best city for cyclists” concept and the introduction of intelligent traffic control and information systems are particularly important, as are expansion of the public transport system and support for the use of electricity and hydrogen-powered cars. These efforts to promote green mobility have led to lower CO₂ emissions, more cyclists and a small decrease in the number of kilometres driven by car.

Since 2010, CO₂ emissions from transport have fallen by 9%, car traffic (number of kilometres driven on the road network in Copenhagen) has fallen by 3% and cycle traffic has risen by 12%. Nevertheless, the fall in the share of trips made by car was not as big as expected and the share was still 33% in 2015. In other words, the target of max. 25% of trips made by car was not met.

Despite the reduction in CO₂ emissions from transport, the sector's share of the city's total emissions has increased from 24% in 2010 to 34% in 2015. This is because it takes longer time to limit emissions in the transport sector than in other sectors.

Trips to and from work or education accounted for 41% of journeys by bicycle in the city in 2015, although the figure for Copenhageners was 56%. More bicycles make the traffic flow more freely on the roads because they save space but also leads to capacity problems on cycle lanes, especially at junctions.

All journeys in Copenhagen in 2015



Targets for Mobility in Copenhagen by 2025

- **75% of all trips in Copenhagen are on foot, by bike or public transport**
- **50% of all trips to work or school in Copenhagen are by bike**
- **20% more passengers use public transport compared to 2009**
- **Public transport is carbon neutral**
- **20-30% of all light vehicles run on new fuels**
- **30-40% of all heavy vehicles run on new fuels**

Baseline 2010.

CO₂ reductions in Mobility by 2025 Targets per main initiatives

MOBILITY IN TOTAL	78,000
World's Best City for Cyclists 20.000 - Attractive travel time for all - Safety and sense of security for cyclists - Bicycle parking	
Public transport 45.000 - Carbon neutral bus services - "Mobility as a Service" - Multimodal station	
Traffic 5.000 - Integration of car-sharing into urban spaces - Regional collaboration on commuter traffic - ECO-driving for heavy traffic and municipal vehicles - Optimisation of traffic lights	
New fuels in light vehicles 1.000 - E-mobility – infrastructure and partnerships - Large-scale experiment and collaboration on hydrogen-powered cars and infrastructure	
Heavy transport 3.000 - Efficient delivery of online purchases - Freight network for large fleet owners, including the use of new fuels	
Shipping 4.000 - Land-based electricity to cruise ships - Environmental zone in the Inner Harbour	

When it comes to new fuels, Copenhagen leads the world in the introduction of hydrogen-powered cars. Copenhagen has played a role in making Denmark the first country in the world with a nationwide infrastructure for hydrogen-powered vehicles, and the city has the necessary infrastructure for both hydrogen-powered and electric vehicles. But the number of cars running on either electricity or hydrogen is still low. In 2015 and 2016, Arriva and Green Motion introduced car sharing for electric vehicles in Copenhagen, so more Copenhageners can try them and think about their overall mobility needs. Along with ordinary car-sharing they provide an opportunity to reduce the need for privately owned cars.

The first call for tenders for carbon neutral buses has been issued and the route 5A will run on gas from 2017. The new buses will make it possible to reduce CO₂ emissions from bus operations in the city by approximately 20%. Buses also have their own lane in the middle of the road on the stretch

between Nørre Campus and Nørreport, which has cut travel time by 16% during the rush hours, and made room for about 4,000 extra passengers a day.

A public-private partnership set up to look at intelligent transportation systems has already resulted in test runs of brand new ideas, e.g. the traffic lights on H.C. Andersens Boulevard have been optimised, and 'ECO-driving' has been introduced at 12 junctions on Folehaven, which uses signals to lorries to make it easier to choose the optimal speed.

Trends in mobility

An even better mix and spread of modes of transport is needed, if Copenhagen is to remain a city in which it is easy to get around. More Danes will own cars in the future, and even though only a marginal increase is expected in car ownership in Copenhagen, the rate of population growth may increase the number of cars in the city by almost 20%.

Although bicycles and public transport are used in the city centre, it is also clear that the car remains the preferred mode of transport outside the densely populated parts of the city. Of the traffic that crosses the municipal boundaries, 57% is by car, compared to only 16% of journeys within the boundaries. In other words, the position of a city that likes to cycle in the middle of a region that likes to drive calls for innovative thinking.

There is good reason to believe that the arrival of the sharing economy may affect the desire of Copenhageners to own their own cars, and it is already possible to choose between several car-sharing clubs, car-pooling, etc. Further into the future, driverless vehicles could help replace the need to own your own car and save space and resources.

The increase in the number of vehicles running on alternative fuels has been slower than expected – in Denmark as well as Europe. However, the technology is being developed all the time and as their range increases electric cars are becoming more interesting to the ordinary consumer.

The period 2017–2020

The key challenge will be to make conditions right for more people to drop the car in favour of walking, cycling and public transport. If journeys by car are unavoidable, then as many of them as possible should be in vehicles powered by alternative fuels.

This main thrust will be on improving conditions for cyclists and public transport. However, experience in Copenhagen and comparable cities reveals a need to regulate car use in order to encourage more people to cycle and use public transport.

World's Best City for Cyclists

During the period 2017–2020, Copenhagen will improve capacity on the bicycle network. Bicycle tracks will be expanded, and cycle corridors and regional Super Cycle Highways will be upgraded to accommodate more cyclists.

Space will also be needed for parking the increased numbers of bicycles, e.g. by upgrading bicycle parking at traffic hubs and in shopping areas. Parking facilities will also be located where they provide easy access to public transport.

Safety is also a crucial factor when it comes to encouraging more people to use their bicycles, regardless of whether they are children, young people, former commuters or newcomers to the city. The special focus on safety solutions will also include Green Cycle Routes and safe routes to schools. These activities will be combined with information campaigns to influence behaviour, e.g. the campaign “Cycle to work” and cycling education for children, young people, newcomers and immigrants.

Public transport

The public transport system will receive a major boost when the Metro's City Ring opens in 2019. This will vastly improve transport in the city centre, and the City Ring will also be supplemented with other initiatives that make it even easier for Copenhageners to choose alternatives to the car.

To help in this, a digital platform will help the users find, buy and pay for transport by different modes of transport – trains, buses, the Metro, car-sharing clubs, public bicycles and taxis.

The multimodal station will also be built, i.e. public bicycles, car-sharing, bicycle parking and other services, e.g. toilets and online information systems, will be placed beside a station. Initially it will be an experiment but if it is a success it may be rolled out to other parts of the city. More and more older buses will be replaced by new models powered by electricity and biogas so that Copenhagen is able to achieve its target of a carbon neutral bus service by 2025.

Traffic

It will only be possible to improve traffic flow and deploy resources where the potential is greatest to get people to drop the car and use bicycles and public transport instead, if analyses are conducted to ascertain exactly which car journeys are actually necessary.

To illustrate the advantages of car-sharing over car ownership, the City of Copenhagen will run a pilot project to integrate car-sharing vehicles into local streets and urban spaces. The project will also show what streets can be used for whenever there is less need for parking.

To address the issue of the traffic that crosses the municipal boundary, of which cars constitute 57%, the City of Copenhagen will enter into a regional partnership on commuting with companies and other local authorities.

To ensure that the remaining car and lorry traffic runs as smoothly as possible, work will be done on traffic control and optimisation on main roads and at traffic lights all over the city. This traffic control will include intelligent bus prioritisation and green waves for cyclists. A special initiative encouraging ECO-driving for heavy vehicles on Ring 2 will mean fewer stops and starts by lorries.

New fuels in light vehicles

There will still be large numbers of cars in Copenhagen in 2020 and in 2025. The City of Copenhagen will encourage electric and hydrogen-powered vehicles by expanding the infrastructure – charging stations, reserved parking, hydrogen pumps, etc. In particular, the City of Copenhagen will try to encourage people to adopt electric and hydrogen-powered cars through partnerships and pilot projects and by offering environmental discounts for parking them.

Heavy transport

Vans and heavy traffic are responsible for 25% of CO₂ emissions in the transport sector, and it is harder to convert lorries to alternative fuels, so new initiatives are needed to reduce CO₂ emissions.

Working hand in hand with stakeholders in this area, the City of Copenhagen has set up a freight network for owners of large fleets and will enter into a range of partnerships designed to cut the number of kilometres driven by large vehicles and conduct experiments with alternative fuels for lorries, especially biofuels.

The rise of online shopping also makes delivery vans a growing problem. The City of Copenhagen will invite appropriate stakeholders to develop and test a new concept involving

them sharing local collection points and co-ordinating deliveries to parts of the city.

Shipping

Cruise ships moored in the Port of Copenhagen, emit CO₂ and particles from diesel generators. Providing the ships with access to onshore electricity points would cut CO₂ emissions, reduce air pollution and facilitate urban development closer to the terminals. Studies will also be conducted of whether it would be possible to establish an environmental zone like the one in Amsterdam in the Inner Harbour, and restrict access to ships powered by electricity.

Flagships 2017–2020

Mobility as a Service

It should be easier and more attractive to use other modes of transport than the car in the city and to choose the most appropriate means of transport for each journey in daily life.

The Mobility as a Service (MaaS) initiative will introduce a subscription scheme to provide residents and visitors with easy access to ordering and paying for their daily transport by bus, train, car-sharing, public bicycle and taxi as a flexible alternative to private cars.

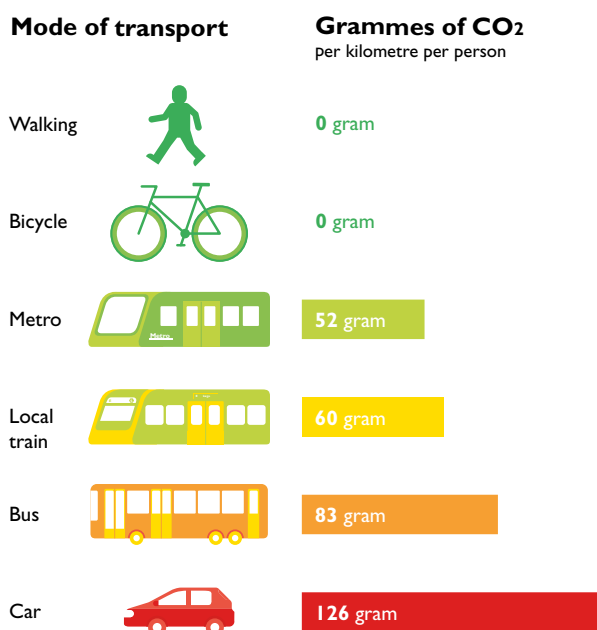
Experience from tests abroad suggest great potential. A pilot scheme will involve 200 families. If it is a success, the concept will be developed into an actual platform, where people in Copenhagen and the region around it can register.

Carbon neutral buses

Copenhagen buses run mainly on diesel. Despite measures to limit their impact on the environment they discharge CO₂ and particles. Making bus services carbon neutral will cut emissions by approx. 16,000 tonnes. Running them on electricity will also eliminate particle emissions.

The City of Copenhagen will work with Movia to make alternative fuels a requirement when bus routes are put out to tender. As well as environmental improvements, greater demand for alternatives to diesel buses will help develop the market.

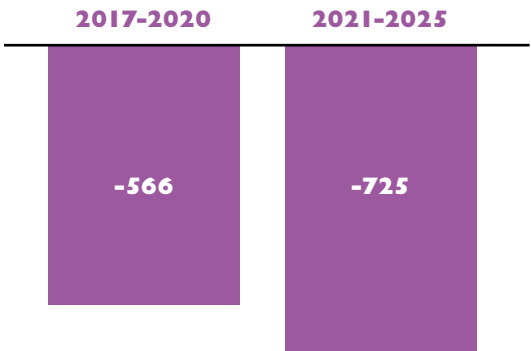
More walking, more cycling



Finances

During the period covered by this roadmap, the City of Copenhagen has budgeted with expenditure of DKK 566 million on green mobility rising to DDK 1,3 billion by 2025, mainly to improve conditions for cyclists. As well as CO₂ reductions the mobility initiatives will have a number of positive side effects in the form of better health, smoother traffic in the city and development opportunities for urban spaces.

The City of Copenhagen budget: Mobility (DKK million)



National framework conditions

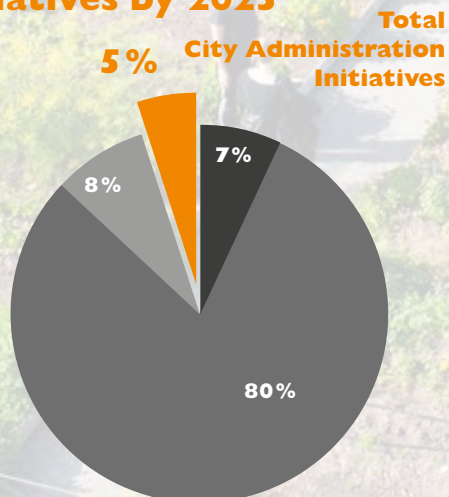
National framework conditions can help the City of Copenhagen achieve the targets laid down in the CPH 2025 Climate Plan. The City of Copenhagen will do what it can to push for improvements e.g. by lobbying the government on the following:

- National legislation does not allow stricter requirements in environmental zones, congestion pricing, road pricing or environmental parking fees (the Roads Act).
- From 2016 electric cars will no longer be 100% exempt from tax, and taxes on more expensive and often bigger cars will also be lowered.
- The electricity tax on cars and buses is three times as high as the energy tax on diesel. This means, for example, that if Copenhagen wanted all buses to run on electricity, almost three-quarters of the cost would consist of extra electricity tax.
- Electric vans are usually heavier than traditional vans and weigh over 3.500 kg. This means that drivers need a heavy goods license and totally different driving rules apply, both of which prevent electric vans being more widespread.
- The Roads Act was amended late in 2014 and environmental parking charges are now allowed, e.g. exempting electric cars from parking fees. However, the executive order accompanying the Act narrowed this option down so that it more or less only covers residents parking near their homes.

CITY ADMINISTRATION INITIATIVES

A good example

**CO₂ reduction from
city administration
initiatives by 2025**



Carbon neutrality starts with a good role model

The work put in by the city administration may only represent a small proportion of the total CO₂ reduction but it has huge significance as a source of inspiration for others. Leading the way in cutting energy use and running vehicles powered by alternative fuels enhances the City of Copenhagen's credibility. This is an important factor when working with the many private stakeholders who will have to help if the City of Copenhagen is to achieve carbon neutrality by making heavy investments in buildings and modes of transport.

The City of Copenhagen leads the way by energy retrofitting its own buildings, enforcing environment and energy requirements when putting projects out to tender and buying electric and hydrogen-powered cars. Its efforts show that a city the size of Copenhagen can push the limits for CO₂ reductions and energy optimisation.

Current status and results 2013–2016

Progress has already been made in municipal buildings, with energy consumption down 10% since 2010, mainly due to more efficient operations. For example, in 100 buildings which account for 30% of the City of Copenhagen's total district heating – the meters are now remote-read.

A range of energy savings with short payback times have been made, and money has been earmarked for the complete renovation of 41 schools, ten of which have already been completed. Total renovation comprises modernisation, energy retrofitting, indoor climate, accessibility and climate-change adaptation. Until 2016, newly built municipal buildings had to comply with the criteria for low-energy class 2015. Since February 2016, they have had to comply with the stricter requirements in building class 2020. By the end of 2015, City of Copenhagen had, as planned, installed 40 solar power units (approx. 5,000 m²) on municipal buildings.

In November 2015, 62% of the City of Copenhagen's entire fleet of cars ran on either electricity or hydrogen, and the infrastructure, in the form of charging stations, etc. – has been expanded bit by bit. The way the city collects waste is also helping it make progress toward carbon neutrality, and it is now a compulsory criterion in the tenders it issues that refuse collection vehicles must run on gas. By the end of 2016, 20,000 street lamps will use LED, and the target of halving the amount of energy used on street lighting will be reached – savings of up to 57% compared to 2010 are expected.

Copenhagen's procurement policy plays a key role in encouraging energy-efficient technology. All of the City of Copenhagen's departments are obliged to include environmental and climate requirements in their calls for tenders whenever appropriate. In several cases, these have already led to reductions in energy use, better sorting of waste and recycling as well as less noise and air pollution.

Trends

Local authorities face constant demands for greater efficiency. However, financial efficiency and climate and energy initiatives are not necessarily mutually exclusive. For example, life-cycle costings show that the most energy-friendly products are also the least expensive once the cost of electricity during their life time is factored in.

In general, it also has a positive impact on Copenhagen's climate work that more and more emphasis is placed on dialogue with suppliers about environmental considerations before goods and services are put out to tender. It will make it possible to place stricter requirements on the function as well as the environmental and climate characteristics of the goods and services in question.

In the last couple of years, the city administration has focused on digitisation its services, e.g. processing building permits. The digitisation process will continue and will help make the City's commercial activities more efficient, e.g. in the transport sector.

Changes to how local authority solar panels are regulated mean that each installation has to be run by a separate company. Only solar power units that comply with the requirement for building class 2020 will be exempt from this requirement. In reality, this will put a stop to additional installations on existing buildings.

Targets for the City Administration Initiatives in Copenhagen by 2025

- **Reduce energy consumption in municipal buildings by 40%**
- **Municipal new build up to 2015 meets the requirements of the 2015 classification and up to 2020 meets the requirements of 2020 classification**
- **The City of Copenhagen's vehicles run on electricity, hydrogen or biofuels**
- **The energy consumption for street lighting in Copenhagen is halved**
- **A total of 60,000 m² of solar panels on existing municipal buildings and municipal new build is installed**

Baseline 2010.

CO₂ reductions from City Administration initiatives by 2025 Targets per main initiatives

CITY ADMINISTRATION INITIATIVES - TOTAL		43,000
Municipal buildings - Energy-efficient operations - Energy retrofitting with short payback times - Total renovations - New buildings will comply with building class 2020	4,000	
Municipal transport - Efficient transport and vehicles run on electricity and hydrogen	2,000	
Municipal procurement - Green procurement - Life-cycle costings when buying products that use energy - Including requirements for alternative fuels when putting transport services out for tender - Requirements will be placed on non-road mobile machinery used in building and construction projects		37,000
Teaching and outreach - Climate ambassadors - Showroom for climate work		-



The period 2017–2020

The focus will be on the City of Copenhagen's options for placing requirements that can reduce CO₂ emissions on future invitations to tender. Significant investments will also be made in municipally-owned buildings, so schools and other buildings can be energy retrofitted.

Municipal buildings

At present, 30% of water and heating meters (100 properties) are remote read. The target is remote reading of water and heating meters in all municipal buildings in 2017 and of all electricity meters in 2020. Data from the meters will be used to monitor trends, so that changes can be made to operations and other improvements made whenever necessary. The users of municipal properties will play an important role in this and will receive support, training and information on energy-friendly behaviour. Work will also continue to identify energy retrofitting projects with short payback periods (under six years) in municipal buildings. A major ESCO project in 23 properties with a savings potential of 28% will be completed by 2020. Heating and ventilation systems will also be renovated, and lighting in municipal buildings will be replaced with LED lighting by 2020.

To achieve the targets in the Climate Plan the majority of municipal buildings will have to undergo an energy retrofit by 2025. It is expected that all schools will be totally renovated or at least have the budget to do so by 2020. In other properties tenders will target energy retrofitting of technical installations. Continued funding is needed in order to reach the target of a 40% reduction in energy consumption in 2025.

Municipal transport

The City of Copenhagen will seek the best possible utilisation and systematic replacement of its fleet of vehicles, so that employee transport during working hours is as green as possible.

The city administration has already replaced much of its fleet of passenger vehicles with electricity and hydrogen-powered cars. It will now concentrate on using and managing the vehicles as well as possible. In future, the city administration will systematically register its fleet of vehicles and establish a better overview of how they are used. This will make it possible for different departments to share cars and materials. The municipality will continue to purchase electricity and hydrogen-powered cars and to identify alternative fuels, where it is not possible to use electricity or hydrogen. Due to the life cycle of the vehicles, only ones running on alternative fuels have to be considered from now on so that the City of Copenhagen is able to reach its target of all of its vehicles running on electricity, hydrogen and biofuels by 2025.

Municipal procurement

The City of Copenhagen procurement budget is DKK 11 billion p.a. The sheer volume of its purchases means that the City of Copenhagen can help move the market in a more environmentally friendly and climate-friendly direction. Some 12,000 goods and services have recognised eco-labels like the Nordic Swan label and the EU Flower, but the municipality places very few requirements for eco-labels. In future, the City of Copenhagen will make better use of the potential offered by the new Public Procurement Act to demand products with recognised eco-labels when it puts products and services out to tender. It will also strive for both financial and energy savings by using life-cycle costings when purchasing products that use energy, i.e. including both purchase price and operating costs in its considerations before deciding which products to buy.

The City of Copenhagen will also study the potential for including requirements for alternative fuels such as electricity, hydrogen and biogas when it puts transport contracts out to tender, e.g. transporting disabled people or taking children to and from outdoor kindergartens. Experience gained from this work will be used to place demands on the use of alternative fuels for delivery services as well.

Teaching and outreach

Since 2009, the City of Copenhagen has trained climate ambassadors from 7th grade classes in its schools as part of their education in sustainable development. So far, 250 pupils have been trained to spread knowledge of climate challenges in their own schools. Every year, 100,000 children also use the Environment Service and its environment schools. All of this helps increase knowledge about climate challenges and prepare future generations to tackle it. The City of Copenhagen will train another 250 climate ambassadors by 2020.

Copenhagen is conscious of its role as an international pioneer in developing solutions to urban climate challenges. The capital is already widely recognised abroad for its climate initiatives, and a large number of delegations visit the city every year to study its solutions. During the next programme period, the City of Copenhagen will open a proper showroom, which will describe the city's path toward carbon neutrality in the Copenhagen Narrative. The showroom will be part of the Environment Service's "ENERGY & WATER Greater Copenhagen Living Lab" and will have facilities for professional audiovisual communications.



Flagships 2017–2020

Requirements placed on non-road mobile machinery

While car and van engines are made more efficient all the time or converted to alternative fuels such as electricity, progress has been slower for non-road mobile machinery, e.g. machines used for building and construction projects such as cranes, excavators and generators.

The City of Copenhagen is directly or indirectly involved in 40–60% of all building and construction projects in Copenhagen, and therefore would lead the way in reducing CO₂ emissions from non-road mobile machinery. Initially, the City of Copenhagen will map the use of non-road mobile machinery and identify what is technically possible. This may be done in collaboration with other cities, as this category of vehicle is attracting increasing international interest. After that, the City of Copenhagen will use alternative fuels in its own non-road mobile machinery and, by 2019 at the latest include requirements for alternative fuels in non-road mobile machinery in tenders for construction work.

Finances

During the period covered by this roadmap, the City of Copenhagen has budgeted with expenditure of DKK 291 million for work on its own conversion, mainly for the replacement of light sources and energy retrofitting of schools. Lower energy use in the period 2021–2025 will lead to operational savings.

The City of Copenhagen budget: City Administration Initiatives (DKK million)

2017–2020	2021–2025
-291	21

National framework conditions

National framework conditions may help the City of Copenhagen achieve the targets laid down in the CPH 2025 Climate Plan. The City of Copenhagen will do what it can to push for improvements e.g. by lobbying the government on the following:

- Amendments to the Solar Panels Act have made installing new panels administratively difficult for local authorities. If this work is to resume, the rules will have to change to make it possible for municipalities to invest in solar power.
- The government could also do more to support green procurement by local authorities, e.g. by setting binding targets for national, regional and local procurement of environmentally friendly products and services.
- The government should draw up tools and instructions to encourage local authorities to use life-cycle costings, eco-labels and environmental requirements on the transport of people and goods, etc.





CPH 2025

Implementation of the Climate Plan



The key conversion mechanisms

When breaking new ground, new solutions need to be developed along the way. In other words, it will require innovative thinking, a willingness to take risks and flexibility if Copenhagen is to be the world's first carbon neutral capital.

It is not something the City of Copenhagen can achieve on its own, but will take close collaboration between private and public-sector stakeholders and the involvement of the local population. It will also require keeping a close eye on technological progress and new solutions so that it is always the smartest and best solutions that are used.

The initiatives in the CPH 2025 Climate Plan can be divided into three phases:

- Analyses
- Tests and demonstrations
- Implementation

Analyses

Since Copenhagen is at the forefront of work on the climate, it is only natural that the many initiatives are preceded by in-depth analyses both of the problem and the solutions that will be most effective, financially beneficial and reduce CO₂ emissions.

Often, it will be necessary to collate data, look at experiences in other towns and cities and map needs before taking action. This Roadmap 2017–2020 contains several initiatives in each of the pillars, which will require further analyses before they are implemented either before 2020 or in the next roadmap for 2021–2025, e.g. energy consumption in buildings needs to be mapped and aligned with the information in the Building and Housing Register, so that energy efficiency projects are able to target the buildings with the highest energy consumption and greatest energy-savings potential.

During the roadmap period, Copenhagen will also map the extent of the CO₂ emissions from organic solvents, non-road mobile machinery, etc. where the data is currently national and allocated to local authorities on a per capita basis, or on the amount of land designated for commercial purposes and growth.

The City of Copenhagen will conduct many of these analyses itself, but often they will be done in collaboration with stakeholders such as knowledge institutions, companies and other interested parties, so that the analyses are as valid as possible and provide a good basis for decisions on specific initiatives.

Major analyses conducted in the period 2017–2020 will include:

- Organic solvents
- Non-road mobile machinery
- The "necessary" motor-vehicle traffic
- Heavy transport in Copenhagen
- Fossil fuel-free Copenhagen in 2050

Tests and demonstrations

Some solutions to climate challenges have been tested so often that there is no need to do so again before putting them into production, e.g. installing double glazing when renovating buildings, or introducing new bicycle lanes. However, in a wide range of other areas the solutions are not yet ready to be deployed. Technological progress and collaboration will be needed to identify the best possible solutions.

The roadmap for The CPH 2025 Climate Plan 2017–2020 contains several initiatives for energy consumption, energy production and mobility, where the main emphasis is on testing a range of different solutions on a smaller scale in order to gain experience and adjust them before rolling them out on a larger scale.

Opening Copenhagen up to partners who want to test and demonstrate new technology will help test solutions before implementing them, which will benefit Copenhagen and the city's users. In the energy sector, for example, where flexible technologies could be a part of the solution to exploiting wind power. Collaboration and partnerships will also help to stimulate employment, generate green growth and create new export opportunities. The City of Copenhagen will create a platform to discuss challenges, solutions, products and partners. Companies will be able to mature their products and create know-how, which can be exported later on.

The tests and demonstrations carried out in the period 2017–2020 will include:

- Solutions that make it more attractive for building owners to optimise energy use
- Local Smart Grids for electricity and heat production, storage and consumption
- The use of large-scale heat pumps
- Tests of low-temperature district heating
- Flexible energy consumption in buildings
- Optimisation of goods delivery in the Inner City
- Mobility as a Service (MaaS), if the initial analyses reveal a satisfactory outlook
- Further sorting and recycling of plastic and residual waste

Implementation

But it is not enough just to test new solutions. To reach the CO₂ targets, it is essential that the best solutions tested are afterwards implemented on a large scale.

The key is, of course, that the solutions make it easier for the Copenhageners, for companies and the other users of the city to make the right, environmental and climate-friendly choices. Many already do. Just look at a bicycle lane during the morning rush hour. Or at 'swap markets', sharing schemes or food co-operatives. The solutions that attract greatest involvement are those that are financially attractive, effective and easy to use – and, of course, the local population and companies need to know about the climate and environmentally friendly alternatives.

The City of Copenhagen is responsible for implementing many of the initiatives itself, while others, e.g. the Energy Leap project, involve building owners in partnerships with the municipality, and are implemented in tandem with other stakeholders. The big HOFOR energy-production projects will also help reduce CO₂ emissions in Copenhagen.

The initiatives implemented during the period 2017–2020 will include the following:

- Energy optimisation of buildings
- Combined heat and power plant on biomass
- Establishment of wind turbines
- Voluntary agreements with major building owners
- Better flow on bicycle lanes
- Municipal procurement of electric and hydrogen-powered cars
- Carbon neutral buses

Working with the rest of the world

Work on the climate challenges faced by the city will be done by both the public and private sectors, and at both national and international level. The City of Copenhagen is seeing growing interest in collaboration from other towns and cities around the world and many companies want to trial their products in Copenhagen.

In recent years, a number of projects in the city have included a significant test and demonstration element, e.g. the conversion of refuse collection vehicles to gas, the programme for hydrogen-powered cars, the replacement of street lighting, EnergyLab Nordhavn, new solutions in the building sector etc.

Copenhagen has a collaboration agreement with Beijing, comprising water and sustainable urban development, including district heating. Collaboration has also started with New York on climate adaption, and an agreement on energy and climate change adaptation is being discussed with Washington. A number of other towns and cities have expressed an interest in similar agreements.

In order to play a part in these partnerships, it is important that the City of Copenhagen is also able play a part in existing platforms that support developments in Copenhagen and abroad, e.g. Climate-KIC and State of Green, which the City of Copenhagen thinks is important for the implementation of the Climate Plan.

Energy Lab Nordhavn

Energy Lab Nordhavn is partnership between CPH City & Port Development, DTU, Danfoss, HOFOR, DONG Energy, Balslev, and, the Metro Therm, ABB, Glen Dimplex Nordic, Power Lab DK and the City of Copenhagen.

They all work together testing and demonstrating solutions and products that integrate energy production and use in buildings and in the transport sector in the new part of the city being developed in Nordhavn.

Using real-time data, the projects will deliver intelligent control of subsystems and components, leading to the requisite level of energy flexibility so that renewable sources are used effectively.

The project is expected to generate important knowledge about how energy production and use will interact in the carbon neutral Copenhagen of the future.

Car pools and car-sharing clubs

It is possible to live in Copenhagen without owning a car. As part of a demonstration project, the residents of an area will voluntarily give up their cars. Bicycles, public transport and car-sharing will be made available instead.

The aim is to show how much space parking takes up and to test the functionality of a single, integrated network of alternative modes of transport.

Hopefully, the test will help convert traffic to more environmentally friendly modes of transport, as the local residents see the alternative options available. It will also let the City of Copenhagen test the coherence and potential of the flexible transport system of the future.

In terms of CO₂, the effect will be limited (at 50 households about 15 to 20 tonnes p.a.) but it would be possible to upscale the experiment. Debate about the modes of transport will also be encouraged.

CO₂ AND THE ECONOMY

A responsible city

Copenhagen will reach its target

Overall, the initiatives contained in the roadmap 2017–2020 will result in reductions of a little more than 900,000 tonnes of CO₂ in 2025. The portfolio of initiatives will help reach the goal of carbon neutrality in 2025.

The largest reduction, just over 60%, will be from the conversion to sustainable sources in energy production, in particular the conversion to biomass at Amagerværket and the establishment of inshore, near-shore and offshore wind farms.

On the other pillars, the CO₂ reductions generated by the conversion to green mobility will make up 8% of the total reductions in 2025, energy consumption 7% and the city administration initiatives 5%.

There may also be potential to reduce CO₂ emissions from a number of 'new' sources, including organic solvents, non-road mobile machinery and shipping, which will account for a growing share of total CO₂ emissions in Copenhagen in 2025, as well initiatives for removal of plastic from the incineration process will be included in a new resource and waste plan.

How are CO₂ emissions in Copenhagen calculated?

The City of Copenhagen uses the CO₂ calculator, developed jointly in 2008 by the Ministry of Climate and Energy and Local Government Denmark, to calculate greenhouse gas emissions from the city. The calculator is based on methods used at national level under the UN Climate Convention.

In general, all greenhouse gas emissions within the municipal boundaries are included in the accounts, as well as emissions generated by municipally-owned companies outside those boundaries. Similarly, energy generated from renewable sources in the City, and renewable energy produced by City of Copenhagen utility companies outside the boundaries are also deducted.

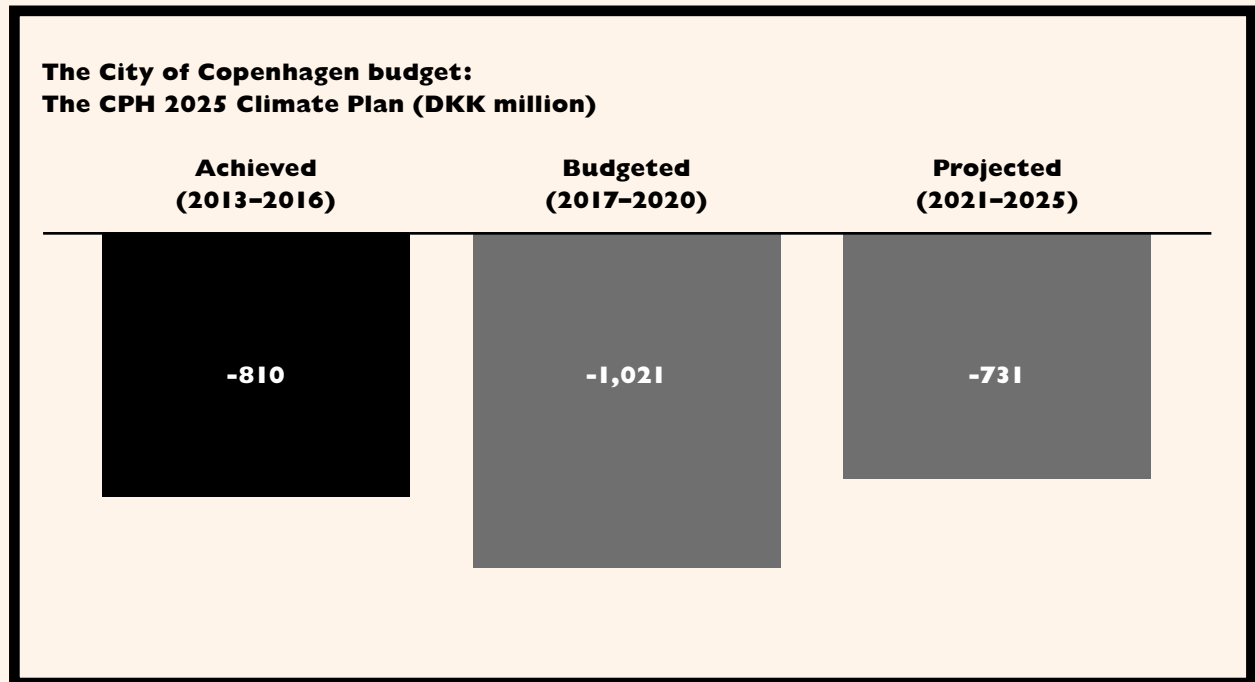
This means that Copenhagen's electricity use is carbon neutral when it generates just as much electricity from renewable sources as it uses. If more electricity is generated from renewable sources than Copenhageners use, it displaces fossil-based power generated elsewhere, and helps compensate for CO₂ emissions from traffic, etc.

Carbon neutrality in Copenhagen is based on activities in the city and the activities of utility companies owned by the City of Copenhagen. Thus quotas are not used to control emissions in Copenhagen.

CO₂ reductions in 2025 By pillar

CPH 2025 TOTAL (TONNES OF CO ₂)		928,000
Energy Consumption (7%)	66,000	
Energy Production (80%)	741,000	
Mobility (8%)	78,000	
City Administration Initiatives (5%)	43,000	

Finances



Investments in carbon neutrality

Investments under the CPH 2025 Climate Plan are made by the City of Copenhagen, in particular by municipally-owned utilities companies involved in converting energy production to renewable energy sources and by private individuals who build and renovate their homes, invest in vehicles that run on alternative fuels and invest in solar panels.

As well as reducing CO₂ many of the investments also have other positive effects. Investments to improve conditions for cyclists make the traffic flow more freely and have significant benefits in terms of health and personal finance. The transition from cars to bicycles also reduces emission of CO₂, NO_x and particles. Investments in energy-efficient operation and energy retrofitting of the building stock will help cut heat bills for Copenhageners and the better indoor climate has documented effects on health and productivity. If the improvements are big enough over a long enough period, they may also help reduce the need for new combined heat and power capacity as units reach the end of their productive life.

City of Copenhagen budget

Overall, the plan is expected to lead to a funding requirement of DKK 2,6 billion over the whole period from 2013 to 2025. This is DKK 100 million lower than estimated before the first implementation period started in 2013. The decrease includes changes to the municipal budget in each of the pillars of the Climate Plan. The City of Copenhagen is for instance expected to run its own buildings more economically than estimated in 2012.

The total expenditure is expected to be spread over the next two phases as shown in the figure. Amounts have not been

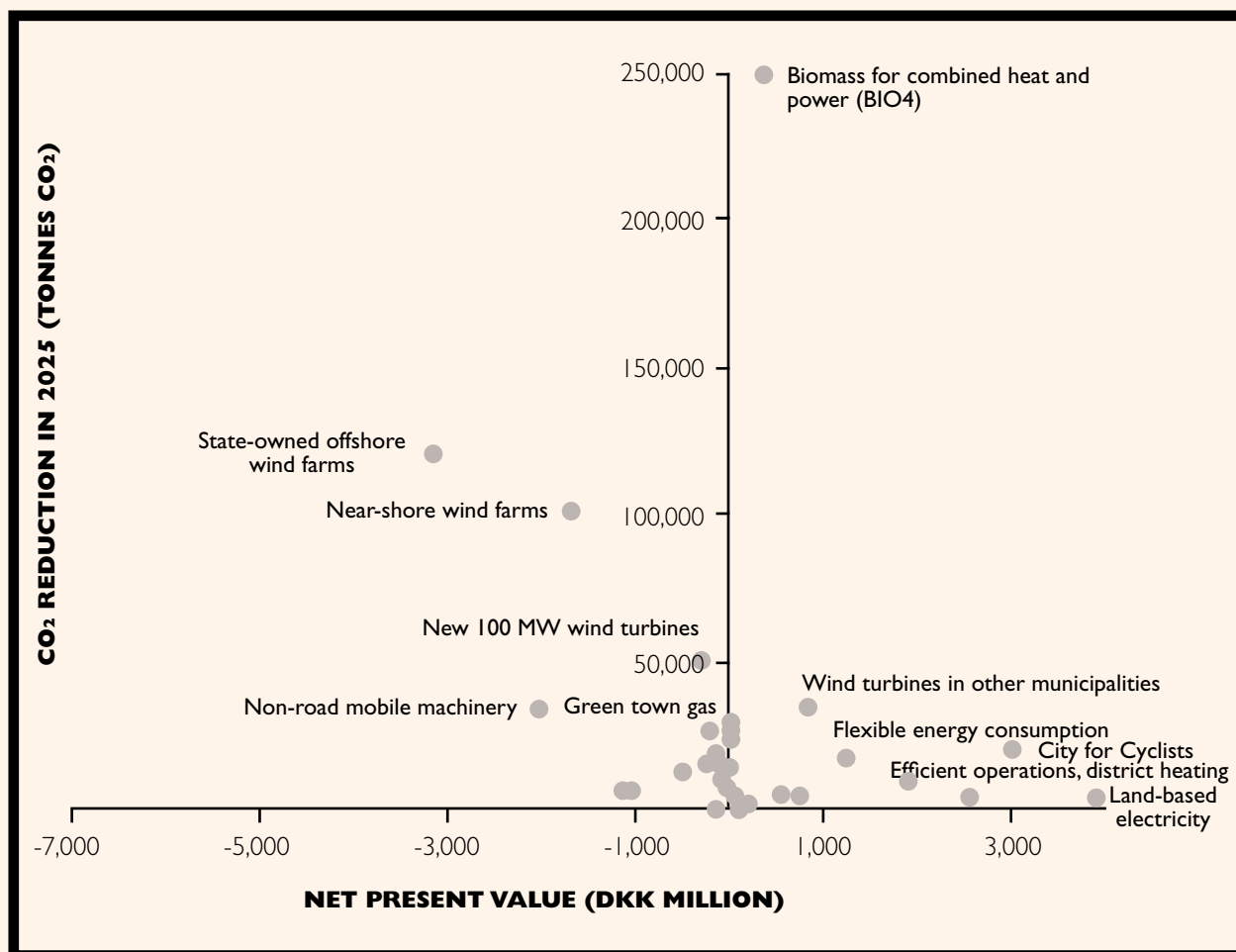
earmarked in the budget for the various activities included in the plan. Initiatives will be funded and launched, when and if possible, by means of budget agreements or other forms of decision making.

The City of Copenhagen will increasingly seek out, develop and participate in public private partnerships in order to achieve the targets in the Climate Plan for CO₂ reductions and 'green' growth. The City of Copenhagen's investments will help develop and test new solutions, which it will then be possible to scale up and export. In other words, they will contribute to research and development and to green growth.

Definitions of:

- The municipal budget
 - The budget shows the direct expenditure and savings made by financing the initiatives in the phases from 2021-2025 and 2017-2020.
- Commercial investments
 - Commercial investments show the investments made by municipal utility companies and the return of the investments in the phases from 2017-2020 and 2021-2025.
- Economic costs
 - The economic costs show the overall cost to Denmark. They do not include cash flows between the various parties, e.g., subsidies and taxes, which only serve to redistribute money between them.

CO₂ reductions and economics cost in 2025



Commercial investments

Municipally-owned utility companies are expected to invest DKK 12.3 billion during the period 2017-2020. The main investments will be in the new unit at Amagerværket and in wind turbines on land and at sea. A significant return on these investments is expected during the period 2021-2025, mainly from wind power and district cooling.

Economic costs

The overall plan shows an economic surplus of DKK 7 billion over the lifetime of the initiatives. This amount covers over considerable variations between initiatives, as illustrated by the figure.

The projections must be treated with a certain degree of caution due to the many and complex rules surrounding tax and subsidies, which affect evaluations and can only be evaluated for individual initiatives to a limited extent.

Example: CO₂ emissions from domestic electricity



Population in the municipality



Electricity consumption per capita (kWh per capita)



CO₂ emissions per kWh



Total CO₂ emissions from domestic electricity

Determining the financial consequences of the CPH 2025 Climate Plan

For use on the CPH 2025 Climate Plan Roadmap 2017–2020, the City of Copenhagen developed a new model called CONNIE (Carbon neutrality, New initiatives and Evaluation), which evaluates initiatives on a consistent basis in terms of CO₂ reductions and financial consequences. The evaluations of initiatives conducted by CONNIE form the basis for the projections in the Roadmap 2017–2020.

The approach in CONNIE is:

- Economic evaluation, integrating climate accounts, projections and CO₂ reductions with the financial consequences on a consistent basis (net present value etc.)
- The emissions from each sector are calculated on the basis of drivers, activities and emission factors
- The effects of initiatives are calculated by looking at changed activities and emission factors
- The model includes the effects of interaction between initiatives
- Selected side-effects are included in the evaluation of some initiatives (time/traffic flow, air pollution/health) and are reflected in the plan's economic consequences





Roadmap 2017-2020

MAIN INITIATIVES TO 2025	INITIATIVES	Analysis and strategy	Tests and demonstrations	Implementation
ENERGY CONSUMPTION				
Efficient operation and installations	Efficient operation of district heating units		x	x
	Electricity savings by commercial and service companies		x	x
	The Copenhagen Package for residents		x	x
	Energy Leap – voluntary agreement with large building owners			x
Renovation of building envelopes	Energy savings properties involved in urban renewal projects		x	x
	Energy savings in social housing		x	x
	Improvements to properties with poor energy-label ratings		x	x
	Dialogue when requests are submitted for building renovation			x
Flexible energy use	Data-driven flexibility in buildings		x	
New areas	Organic solvents	x		
	Space management	x		
ENERGY PRODUCTION				
Biomass in combined heat and power	Building a new heat and power unit for biomass at Amagerværket			x
	Using sustainable biomass in the district heating system			x
Flexible energy technology	Action plan for utilisation of surplus heat	x		x
	Basis for decision-making regarding large scale heat pumps based on demo projects	x	x	
	Setting up heat-storage units	x		x
	Testing low-temperature district heating in Nordhavn		x	
Carbon neutral supply	Strategy for the conversion of peak-load and reserve units for district heating	x	x	
	Green town gas	x		x
	Greater use of district cooling			x
	Carbon neutral waste-water system and treatment			x
	Carbon neutral water supply			x

MAIN INITIATIVES TO 2025	INITIATIVES	Analysis and strategy	Tests and demonstrations	Implementation
ENERGY PRODUCTION ... continued				
Solar panels	Possibilities for investment in large-scale solar-power units	x		
Wind turbines	Wind turbines on land in Copenhagen			x
	Wind turbines on land outside the City of Copenhagen			x
	Setting up near-shore wind farms			x
	The government's offshore wind project at Kriegers Flak			x
	Possibilities for an additional 100 MW of wind turbines	x		
Resources and waste	Developing a biogas strategy for Copenhagen	x		
	Establishing waste-based biogas production	x	x	x
	Collecting more plastic	x	x	
	Evaluating the potential for a material recovery facility	x		
Analysis	Fossil fuel-free Copenhagen in 2050	x		
MOBILITY				
World's Best City for Cyclists	Attractive travel time for all	x	x	x
	Safety and sense of security for cyclists	x	x	x
	Bicycle parking	x	x	x
Public transport	Carbon neutral bus services		x	x
	"Mobility as a Service"	x	x	
	Multimodal station	x	x	
Traffic	Integration of car-sharing into urban spaces	x	x	x
	Regional collaboration on commuter traffic	x		x
	ECO driving for heavy traffic and municipal vehicles		x	x
	Optimisation of traffic lights			x

MAIN INITIATIVES TO 2025	INITIATIVES	Analysis and strategy	Tests and demonstrations	Implementation
MOBILITY ... continued				
New fuels in light vehicles	E-mobility – infrastructure and partnerships		x	x
	Large-scale experiment and collaboration on hydrogen-powered cars and infrastructure		x	x
Heavy transport	Efficient delivery of online purchases		x	
	Freight network for large fleet owners, including the use of new fuels		x	
Shipping	Land-based electricity to cruise ships		x	x
	Environmental zone in the Inner Harbour	x		
CITY ADMINISTRATION INITIATIVES				
Municipal buildings	Energy-efficient operations			x
	Energy retrofitting with short payback times		x	x
	Total renovations			x
	New buildings will comply with building class 2020			x
Municipal transport	Efficient transport and vehicles running on electricity and hydrogen		x	x
Municipal procurement	Green procurement	x	x	x
	Life-cycle costings when buying products that use energy		x	
	Including requirements for alternative fuels when putting transport services out for tender	x	x	
	Requirements will be placed on non-road mobile machinery used in building and construction projects	x	x	
Teaching and outreach	Climate ambassadors			x
	Showroom for climate work	x		x

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TMF Design
Photos: Ursula Bach, City of Copenhagen, June 2016