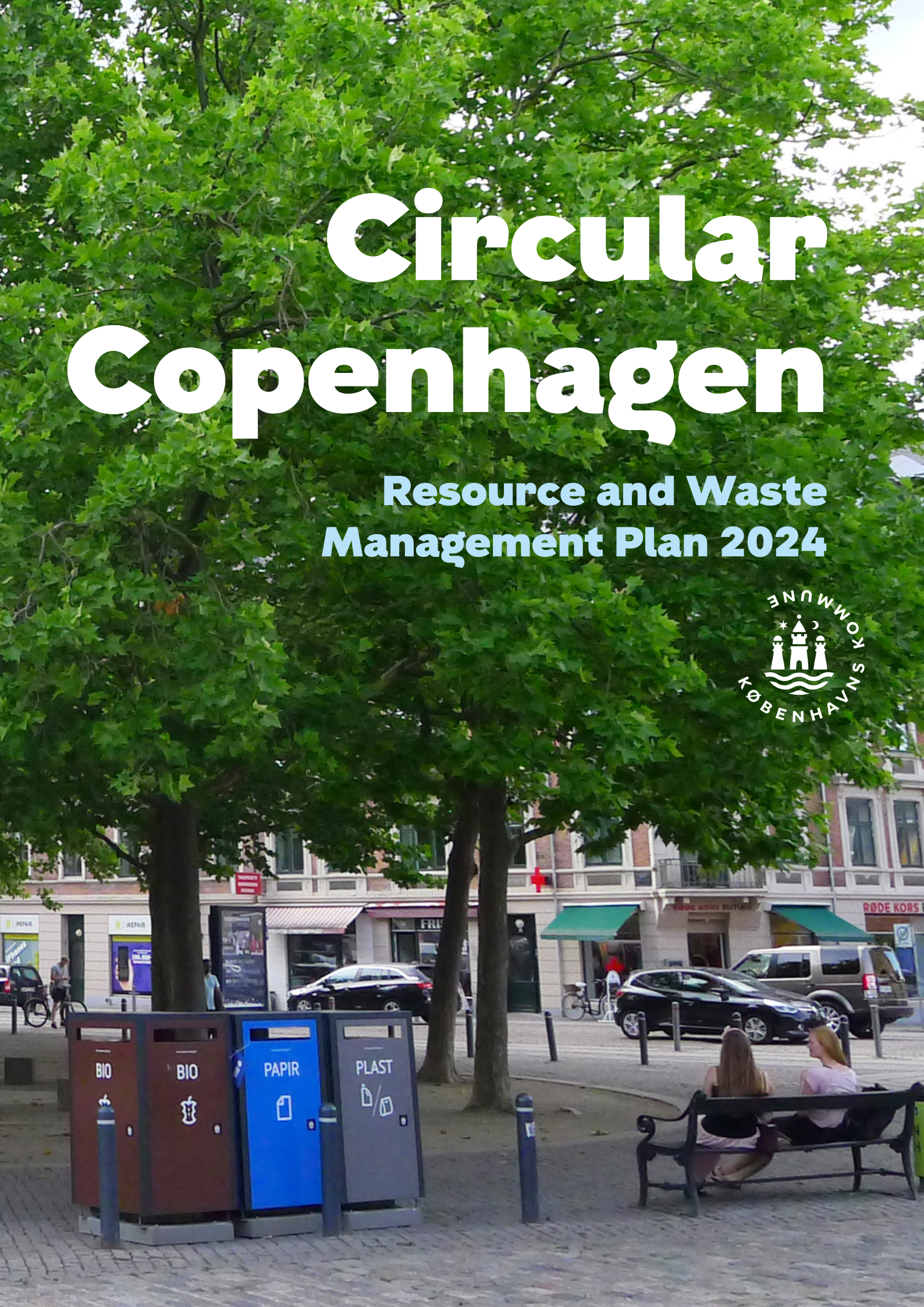
Circular Copenhagen

Resource and Waste Management Plan 2024



Front page photo: PeoplePeoplePeople Studio

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Preface

Circular economy, recycling of resources, reuse. We use many different terms, but all of them reflect the same: Much of what we call waste is actually resources. Furthermore, it is resources that we cannot afford just to discard and destroy.

For we do discard a lot. According to Eurostat, Denmark and Copenhagen are ranked twice as high as the EU average when it comes to resource consumption per capita.

This means that we use enormous amounts of raw materials and energy to produce a lot of products that end up as waste far too fast. It also means that in reality we take more from the Earth than most people. And it means that we lose resources that we could have used.

This is not sustainable. All of us - businesses, the City, Copenhageners - must change attitudes in terms of what we discard. Or rather, how we discard it.

The fact is that it is not the first time we need to change our attitude towards the bin. Today, very few people would throw their waste batteries in the bin. Most people know that glass and bottles go to a separate container. And lately, we see that source-separation of plastics and biowaste is a habit that Copenhageners like to adopt when given the option.

This is the aim of this Plan: to give the option to all Copenhageners to act in a resource-aware manner, turning it into a natural everyday habit.

The Plan will make it possible to sort your waste at source, whether you live in a flat, own a business, or work in a day-care institution. It is to make it easier to choose products that are made from e.g. recycled resources. And it is to make it possible to share and swap items far more than today. The Plan will set high requirements for treatment plants in order to ensure that Copenhageners' resources get back into the loop as new products. It is to inspire into recycling concrete and construction materials in new buildings.

In brief, behind this Plan stands a comprehensive vision. A vision of a future in which we get more out of what we produce and consume, and where waste is not just waste. The circular economy is not just a buzzword. It is the way forward to a really sustainable society in which we do not just incinerate all sorts of waste, but where we keep materials and resources in the loop. This is common sense, and it is the pathway to a better Copenhagen, a better Denmark, and a better world.

There are high requirements on all of us, and it is not an easy task. But we have shown before that we can make it. And we will show it again.

For if we can do it, we can all save CO_2 and resources and have a cleaner conscience in the long run. It will not only create a better city; it will also show the rest of the world that it is possible.

Ninna Hedeager Olsen
Mayor of the Technical and
Environmental Administration

Introduction

With Circular Copenhagen the City of Copenhagen further develops the work launched with Resource and Waste Management Plan 2018. Over the last six years new schemes have been introduced and source-separation is now available to most Copenhageners, so they can sort their waste into cardboard, paper, glass, metal, plastic, bio, and small electronics. Copenhageners are good at sorting and with Resource and Waste Management Plan 2018 the rate of recycling has moved from 27% in 2010 up to 45% in 2018.

With Circular Copenhagen, Copenhagen is taking the next large steps towards even more sustainability in a circular economy, using resources again and again. Circular economy moves away from the linear economy, which rests on a production-consumption-throwaway culture.

A fully implemented circular economy has evident environmental and economic advantages: materials can circulate for decades and centuries - and thanks to renewable energy this can happen without emitting more CO_2. It also leads to a reduction of CO_2 emitted from incineration. Carbon neutrality is an integral part of the circular economy.

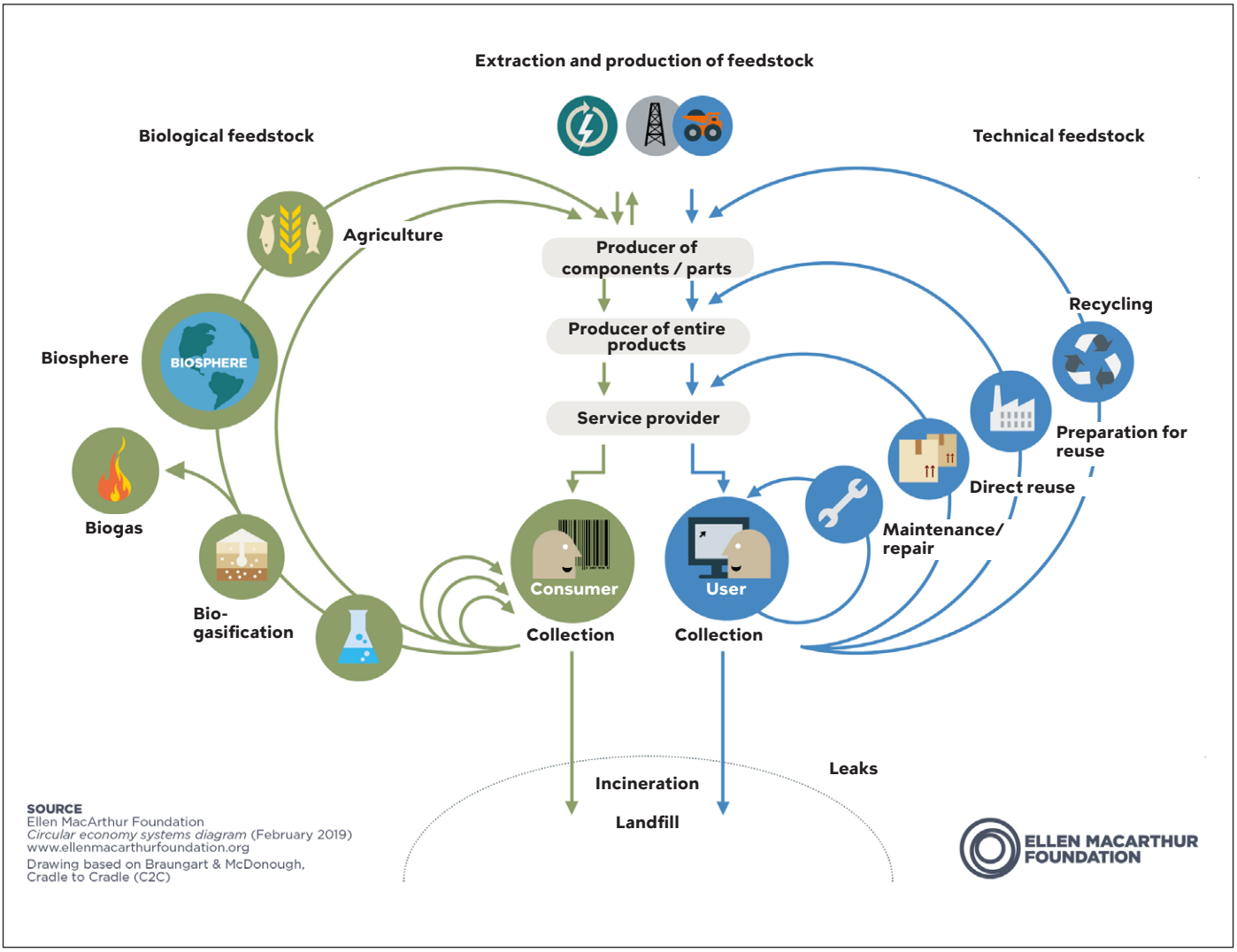
Here Copenhagen may be the driving force in the development towards a more circular economy, thereby taking responsibility for a sustainable development of our society.

We need constantly to be at the cutting edge of technological developments to ensure the best possible treatment of resources, while it must also be simple for Copenhageners to adopt sustainable habits in their daily lives. Therefore, the City constantly contributes to testing and developing future solutions regarding collection, sorting, and treatment of resources. This is done in close collaboration with the most innovative players from industry and Denmark's leading knowledge environments.

Circular Copenhagen contains the politically adopted objectives for development of the resource and waste field in the period 2019-24. The Plan contains a number of concrete measures gathered under six topics. The measures ensure that Copenhagen will comply with the objectives during the planning period.

In an appendix to the Plan waste arisings since 2001 are described along with a forecast for the coming years. The appendix also gives a description of the present waste management system and the associated economy. The appendix can be found on *www.kk.dk/artikel/ressource-og-affaldsplan*.

The figure shows how materials and products can be kept in a loop with the highest possible value as long as possible. The figure is divided into the technical loop on the right hand side and the biological loop to the left. Circular economy disrupts the concept where we have a linear value chain beginning with the extraction of resources and ending with waste generation. The resources that would otherwise end up as waste, can take one or several steps back in the value chain thus entering production again. Or they can serve as an input to an entirely new loop.



Objectives for Circular Copenhagen

Circular Copenhagen contains three concrete targets. Together the targets will contribute to Copenhagen becoming a leader within circular economy as described in the vision Co-Create Copenhagen, and being carbon neutral by 2025 as described in the CPH 2025 Climate Plan.

Objectives

70%

of household waste and light industrial and commercial waste to be collected for recycling

- The resources contained in household waste and light industrial and commercial waste are to be recycled. Light industrial and commercial waste also covers waste from the City of Copenhagen's own institutions.
- The quality of collected resources in the waste must be high, since this allows for recycling in new products.

59,000

tonnes CO_2 reduction

Reducing CO_2 emissions in 2024 with a focus on utilising biowaste for biogas and having plastics diverted from incineration. This target is to contribute to Copenhagen being carbon neutral in 2025 as part of the CPH 2025 Climate Plan. Measures aimed at both commercial waste and household waste will contribute to meeting the target.

3

...tripling of reuse

Reuse is to be tripled in the municipal swap and reuse facilities from 2,000 tonnes in 2016 with a further 6,000 tonnes in 2024. The majority of Copenhageners are to use the sharing, swap, or reuse schemes (22% in 2015).

Sydhavn Recycling Centre will contribute to attaining the target of a tripling of reuse, among others by giving entrepreneurs access to materials at the recycling centre, so they can turn them into new products.

Basic principles in Circular Copenhagen

The City of Copenhagen has four general principles for the management of waste :

Recognisability
Copenhageners are to sort their waste in the same manner, whether at home, at the public pools, or at school.

Easy and logical
Source-separation must be comprehensible and easy for all Copenhageners.

Accessible
Copenhageners must be able to source-separate as close to their home as possible.

Growth
Waste is a resource that may contribute to green growth and innovation.

Waste hierarchy
In Denmark waste is treated according to the waste hierarchy. The higher up the hierarchy, the better utilisation of resources.

Waste prevention and direct reuse
Avoid waste, buy less. Direct reuse, e.g. book from swap shelf.

Preparation for reuse
E.g. cleaning of bricks from demolished buildings.

Recycling
E.g. plastics are shredded to enter into new products.

Other recovery
E.g. incineration of waste with energy recovery.

Incineration or landfill
E.g. asbestos.

Direct reuse, here at the Enghave local recycling hub.

Facts on waste management system in Copenhagen

In Copenhagen household waste is collected in source-separated materials in view of securing high-quality recycling. At present, source-separation is the technology giving the best quality resources from waste. The higher quality of the resources, the better options for using them again. Resources contained in waste are treated in companies producing new products from the materials. The City makes a distinction between Copenhageners and commercial businesses.

Copenhageners' options
As a general rule waste is collected from containers located in the yard or at the house, so they are close to the Copenhagener. Waste in the yard is source-separated into the fractions of cardboard, paper, plastics, metal, glass, bio, residual waste/domestic waste, electronics, batteries, hazardous waste, garden waste, and bulky waste. Collection takes place primarily with collection vehicles fuelled with natural gas or biogas, which cause less pollution than diesel. The waste is compacted in the vehicles, and for this purpose electricity is used in order to reduce noise and exhaust emissions as much as possible.

It is also possible for Copenhageners to take their waste to a recycling centre where it can be sorted into more than 35 different fractions. Waste delivered to recycling centres is primarily large quantities from cleaning, refurbishments, new building, and renovation. In Copenhagen we have five large recycling centres with access for Copenhageners and companies, and eight smaller local recycling hubs with fewer sorting options and without access by car.

The city's recycling centres contribute significantly to the high recycling rate of the City's household waste. The recycling centres are a service provided to Copenhageners and companies, and approximately 45,000 tonnes of waste is delivered here on an annual basis.

Throughout the years a number of measures have been launched to ensure that 90% of the waste received is recycled, which also means approx. 11,000 tonnes of CO_2 saved.

In Copenhagen focus is on preventing waste and giving items such as furniture, toys, clothes, or kitchenware a new life through swap facilities - at the recycling centres or in swap centres in the urban space.

Waste generated in the households has decreased by just below 10% during the past ten years despite a population growth of 20% in the same period. Waste arisings are decreasing, but still waste amounts per capita for Danes and Copenhageners are high compared with other countries. Therefore, the need for recycling the resources contained in waste is very real.

Companies' options
Companies are obliged to source-separate their waste in compliance with the Statutory Order on waste. The management of recyclable industrial and commercial waste takes place in an open market. This means that every company must enter an agreement with a waste collector to pick up and find an outlet for this type of waste.

Industrial and commercial waste can be divided into two types: waste from construction and demolition and light wastes (offices, shops, production, and similar).

In 2015[1] construction and demolition activities in Copenhagen had a waste generation of 196,000 tonnes. Of this 80% was recycled, 15% was incinerated, and 5% was landfilled. Other companies generated 218,000 tonnes of waste. Of this 38% was recycled, 58% was incinerated, and 4% was landfilled or led to special treatment.

[1] Latest data from the Danish Environmental Protection Agency

Framework for waste management system

Statutory framework
According to the Statutory Order on waste local authorities are obliged to prepare a waste management plan every six years. In the Danish Environmental Protection Agency work is ongoing on a new national waste management plan, expected to be adopted in 2020. This plan will reflect the EU targets for Denmark regarding circular economy and it will set out the targets from the national Utilities Strategy.

The EU circular economy package from 2018 comprises new binding targets at national level for municipal waste. The package has high targets for recycling, more focus on waste prevention and sorting, as well as enhanced methods for the calculation of recycling rates. The Danish Environmental Protection Agency is working on the Danish implementation of the requirements. The definition of municipal waste and the way in which recycling rates are to be calculated in the future have not yet been decided. The targets for recycling are 55% in 2025, 60% in 2030, and 65% in 2035.

In 2023 it will be mandatory to separately collect biowaste, in 2025 the same applies to textiles, and the target for recycling of plastic packaging is 50% in 2025 and 55% in 2030.

Correlation with other plans and strategies of the City
The resource and waste management system interplays with transportation, mobility, the energy system, soil management, urban planning, the public space, etc. Circular Copenhagen therefore correlates with other plans and visions of the City. These are, for instance, Municipal plan 2015, the Purchasing policy and the Agenda 25 strategy Sustainable relations . In particular, the Plan is to comply with and support the vision of Co-Create Copenhagen to become a front-runner within circular economy by 2025 as well as the target of CPH 2025 Climate Plan to ensure a carbon neutral Copenhagen by 2025.

This will be done through sorting out plastics from waste for incineration as well as biogasification, which is a natural decomposition of biowaste.

UN Global Goals in Circular Copenhagen
In 2015 the UN adopted 17 global goals for a sustainable development aimed at solving many of the world's major problems by 2030. The targets have focus, among others, on ending extreme poverty and hunger, reducing inequalities, and putting an end to climate change. The UN Global Goals are also known as the Sustainable Development Goals (SDG).

Circular Copenhagen will contribute in these ways:
- Ensuring more sustainable energy (SDG no. 7)
- Promoting innovation in the treatment of recyclable resources and circular economy in procurement (SDG no. 9)
- Making the city more robust and sustainable (SDG no. 11)
- Ensuring more sustainable consumption and production (SDG no. 12)
- Integrating CO_2 mitigating measures against climate change (SDG no. 13)
- Supporting sustainable agriculture by bringing back biowaste to organic farms (SDG no. 15).

Waste type	Household waste	Industrial and commercial waste	Street waste
Definition	Waste generated in Copenhageners' homes.	Waste generated by companies. Industrial and commercial waste can be divided into two types: waste from construction and demolition and light wastes from offices, shops, production, and similar.	Waste generated in the public space.
Financing	Household fee	Taxes	Taxes

Topics and measures

To comply with the three general targets for recycling, CO_2 reduction, and reuse set out in Circular Copenhagen a number of measures organised under six topics will be implemented.

Some measures are interlinked, and the effect of one measure may depend on the implementation of other measures. The measures differ much in relation to maturity of the solutions. Some measures are well tested and are an upscaling of already known solutions. For other measures completely new solutions must be developed. Some measures have a tangible effect here and now, others are an investment in the future, so part of the effect will not be seen in the planning period, but only after 2024.

CO_2
CO_2 is the direct effect, i.e. measurements are made on the reduced CO_2 volumes emitted from the incineration plant.

Recycling
When resources are recycled measurements are made on collected quantities of waste from Copenhageners sent to treatment plants.

Reuse
Reuse covers direct reuse and preparation for reuse. The quantities passing through municipal schemes are measured.

Topic Outline

Topic 01
Copenhageners sorting more waste

Objectives	Economy - DKK million		
	Investment	Derived operation in planning period[1]	Total costs
• 14% increase in collection of household waste for recycling (approx. 30,260 tonnes). • Approx. 8,025 tonnes CO_2 reduction.	390*	143*	534*

Topic 02
Development of existing and future collection schemes

Objectives	Economy - DKK million		
	Investment	Derived operation in planning period[1]	Total costs
• 3% increase in collection of household waste for recycling (approx. 6,665 tonnes). • Approx. 2,250 tonnes CO_2 reduction. • Approx. 800 tonnes of waste for reuse.	69	14	83

Topic 03
More swap and reuse options

Objectives	Economy - DKK million		
	Investment	Derived operation in planning period[1]	Total costs
• Approx. 240 tonnes CO_2 reduction. • Approx. 5,880 tonnes of waste for reuse.	59	12	71

* rounded figures

Topic 04

Copenhagen promoting circular economy

Objectives	Economy - DKK million		
	Investment	Derived operation in planning period[1]	Total costs
• 6% increase in collection of household waste for recycling (approx. 13,040 tonnes). • Approx. 3,410 tonnes CO_2 reduction.	74	15	89

Topic 05

Increased recycling of industrial and commercial waste

Objectives	Economy - DKK million		
	Investment	Derived operation in planning period[1]	Total costs
• 15% increase in collection of industrial and commercial waste for recycling (approx. 25,700 tonnes of waste). • Approx. 9,600 tonnes CO_2 reduction.	35	0	35

Topic 06

New technological solutions for waste treatment [2]

Objectives	Economy - DKK million		
	Investment	Derived operation in planning period[1]	Total costs
• 6% post-sorting of household waste for recycling (approx. 14,055 tonnes), and 1% post-sorting of industrial and commercial waste for recycling (approx. 2,175 tonnes). • Approx. 25,150 tonnes CO_2 reduction.	1	36	37

Total

Objectives	Economy - DKK million		
	Investment	Derived operation in planning period[1]	Total costs
• Increase in recycling of household waste of approx. 63,320 tonnes - corresponding to target compliance of 70% recycling. • Increased recycling of industrial and commercial waste from offices and shops of approx. 27,875 tonnes. • CO_2 reduction of approx. 48,675 tonnes as well as contribution from present level (2018) gives total target compliance of climate plan of 59,000 tonnes CO_2. • Reuse increases by approx. 8,680 tonnes, which means that the target for reuse is met.	630*	220*	851*

1 Costs for derived operation are to be used to increase the operating budget in the planning period. The estimates comprise savings further to reduction of quantities for incineration. The operating budget will continue to be higher compared with the present level when the planning period ends, since a number of new operational measures of Circular Copenhagen will continue after the end of the planning period.

2 The establishment of a post-sorting plant for residual waste and a biogas plant is expected to be financed by a loan over 20 years. The costs of debt financing are covered by current operating expenses and are therefore included under permanent operation.

* rounded figures

Topic 01
Copenhageners sorting more waste

Copenhageners have welcomed the possibility of sorting more waste provided by Resource and Waste Management Plan 2018. Many Copenhageners have started sorting their waste as part of their daily routines. There are still minor adjustments to be made to Copenhageners' present waste management system in order that the basis for the best possible source-separation is in place.

A number of measures from Resource and Waste Management Plan 2018 have produced useful knowledge about how to support a better sorting practice among Copenhageners. This knowledge forms the basis for the measures in Circular Copenhagen where focus is on supporting more Copenhageners in sorting more.

Good waste sorting rests on three necessary elements:

- **Physical conditions:** It must be possible to sort in the right fractions in a sorting system in the kitchen and in containers in the yard or at the house. It must be easy to use, it must be located nearby, and it must be fast to see what goes into which containers.
- **Motivation:** Copenhageners state that they sort their waste in respect of the environment and of the wider common agenda for a sustainable world. Copenhageners must be able to identify themselves with this agenda, seeing that they play an important role.
- **Knowledge:** Copenhageners must know how to sort, what happens to the waste afterwards, and how this is beneficial to the environment.

Measures Topic 01

The topic covers the following measures:

1.1 Anchoring the resource agenda
1.2 Data as a motivator
1.3 Optimisation of sorting options in block's of flats
1.4 Waste solutions in streets and other public areas
1.5 Waste sorting in all citizen-focused institutions of City of Copenhagen

Effect and economy

The measures will in particular increase the recycling of household waste and lead to CO_2 reductions.

Topic 01 **Copenhageners sorting more waste** **Objectives**	**Economy - DKK million**		
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* rounded figures

1.1 ANCHORING THE RESOURCE AGENDA

Challenge

The challenge consists in having all Copenhageners sort as much waste as possible. Today we see people sorting all they can, people sorting a little, and people not yet having started to sort their waste. Some of the barriers are lack of space in the kitchen and doubts about how to sort composite products. An example of this is the window envelope as it has both paper and plastics in it. When in doubt most people discard the item as residual waste for incineration instead of recycling. Copenhageners express a wish of having more help as to sorting at home. They want knowledge and guidance about sorting, but also about how to minimise their waste generation by avoiding food waste, among others. They welcome the possibility of getting involved in the agenda. Waste sorting is an agenda that is often ignored in a busy daily life. Therefore, Copenhageners' motivation must be nurtured and enhanced.

Solution

Information to Copenhageners must be systematic in order that waste sorting becomes simpler for everybody. Annual questionnaire surveys are conducted regarding the number of Copenhageners that sort their waste and into which fractions they do it. The questionnaire survey will also cover a clarification of the challenges that Copenhageners meet in their waste sorting as well as who requests which knowledge. Against this background focused measures will be prepared meeting the needs of Copenhageners.

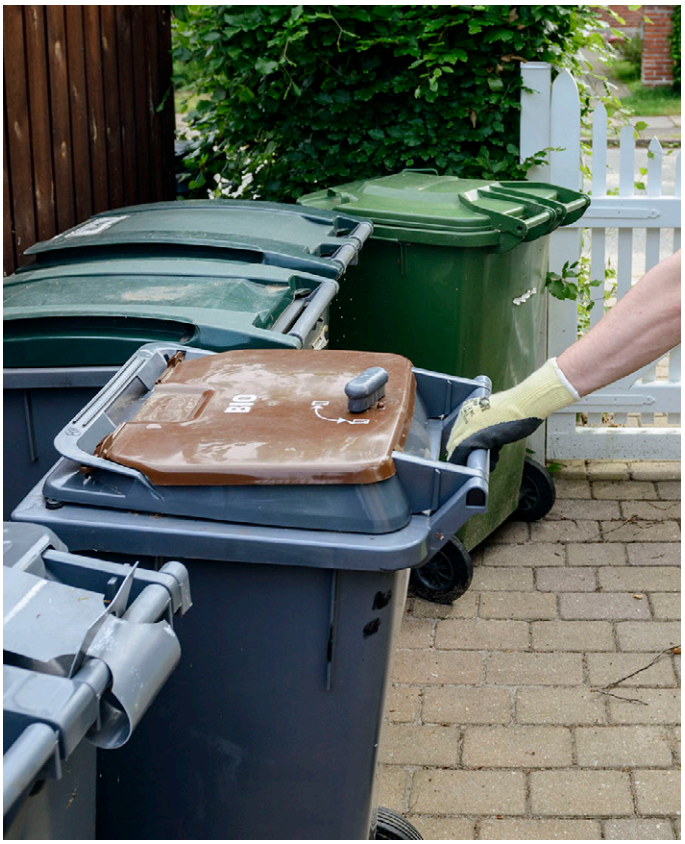
The questionnaire survey must continuously show developments. The target is to have all Copenhageners sort all waste. The initiatives will use various channels, for example direct communication to Copenhageners in their homes, digital courses, use of professionals as ambassadors, and cooperation with subsidised housing associations. The different projects are first tested in small scale after which they can be upscaled. The target is that Copenhageners know how to sort their waste and in what way this is beneficial to the environment.

Knowledge about reduction of avoidable food waste and information about the option of swapping items must be part of the general waste communication along with knowledge about sorting in the different waste containers. The target is to increase Copenhageners' overall waste awareness and thereby affect waste prevention and waste sorting in a positive direction.

Copenhageners must be given greater opportunity to commit to the resource agenda. Measures should enhance local communities regarding waste separation and a pool should be established for trials with Copenhageners' own ideas.

Effect

This measure along with other information efforts will increase quantities of waste sorted and recycled. With increased recycling rates CO_2 emissions are reduced, since lower amounts of plastics are incinerated.



1.2 DATA AS A MOTIVATOR

Challenge
Good sorting for recycling presupposes that each Copenhagener is motivated to sort his waste. The waste system is seen as a "black box" - you discard something but have no clear picture of what happens to it afterwards. For that reason it must be clearer to Copenhageners that they make a difference for the environment when sorting their waste. A study has shown that a large proportion of Copenhageners are interested in knowing their own waste quantities compared with other Copenhageners.

Solution
Strategic work on waste data is to be launched and a system is to be established for automatic registration of quantities in the waste containers when emptied. For example, it may be in the form of development of methods giving feedback to Copenhageners about how much is sorted in their neighbourhood, and which effect this has on the environment. It may be feedback at the same level as what we get from our power company: *"You have sorted xx kg of plastics, thereby saving xx kg of CO2".*

This information can be supplemented with data on sorting progress, rating compared with the average, and similar information that Copenhageners are interested in having about themselves. Precisely which data will have the largest relevance to Copenhageners must be studied in more detail and in collaboration with Copenhageners. Data may be disseminated on a digital self-service solution or other methods and channels that prove relevant in the planning period. The target is that Copenhageners can follow their contribution and maintain the motivation for sorting.

In the planning period automatic registration of container emptying will be introduced.

Effect
The measure contributes to increasing recycling and reducing CO_2 emissions as more plastics will be sorted out.

1.3 OPTIMISATION OF SORTING OPTIONS IN BLOCK'S OF FLATS

Challenge
Copenhageners' motivation for waste sorting is affected by the physical framework. The barriers to Copenhageners not sorting their waste may be that the containers are not easily accessible, that it is unclear which type of waste goes into the container, or that the containers are overfilled and dirty. The solutions available must support the natural behaviour of Copenhageners and give caretakers and others the best possible working conditions. In recent years containers for new types of waste have been placed at blocks of flats, and this has gradually changed the need for volume in the containers for the different waste fractions. It has not been possible to place all containers for the different fractions in all blocks of flats, and in some places the containers will be located inexpediently with regard to supporting waste sorting.

Solution
During the planning period a continuous and systematic work will be done in relation to Copenhagen's more than 8,000 blocks of flats in order to adjust the system so that everybody has access to sorting in all fractions.

This work presupposes:
- that the container volume is adjusted to the actual need in a 70% recycling scenario,
- that the containers are located so that everybody can access them,
- that signs or similar information are in place to support that residents know how to sort their waste in the containers.

The measure will engage relevant parties supporting a better sorting of waste.

The target is that all Copenhageners have the optimum physical framework for sorting their waste. During the review information will be given about the possible establishment of a swap scheme in the block and residents will be urged to introduce such scheme.

Effect
This measure along with other information efforts is expected to increase the rate of recycling. With increased recycling rates CO_2 emissions are reduced, since lower amounts of plastics are incinerated.

1.4 WASTE SOLUTIONS IN STREETS AND OTHER PUBLIC AREAS

Challenge
Today some 34,000 homes in Copenhagen do not have room for the different waste fractions in their yard. So these Copenhageners do not have a direct possibility of sorting their waste, and thereby all potential recyclable materials are not sorted for recycling.

Sorting of household waste today is something that mostly takes place in the yard, not in the public space. Experience from abroad, among others Barcelona and Ljubljana - the latter being the European metropolis in 2018 with the highest rate of recycling - shows that it has a positive effect on people's behaviour when we see other people sort out waste. This is a possible effect that is not attained in Copenhagen today.

Solution
Everybody must have the possibility of sorting waste, and it is necessary to establish solutions in public spaces to arrive at this target. In the past, trials of sorting of household waste in public spaces have been carried out at the squares of Kultorvet and Sankt Pauls Plads. The trials show that Copenhageners do not mind using solutions in public spaces.

Today there are approx. 500 public containers in the urban space, where Copenhageners can drop off glass. Under this measure approx. 750 sorting points will be established. The sorting points will make it possible to drop off more fractions in the public space. Whenever possible, they will be located where there are containers for glass today (approx. 50 sorting points will be located in Inner City, corresponding in number to the existing containers for glass). They will be located in a way that everybody has a short distance to drop off waste. The sorting points will be developed, planned, and adjusted to the different neighbourhoods, either as underground containers or a kind of igloo/container solution, and a new Copenhagen design will be developed. Copenhageners will be engaged continuously, so the solution is adapted to each neighbourhood. Roll-out will be stepwise from one district to the next.

Effect
The measure contributes to increasing recycling and CO_2 reduction as larger volumes of plastics and biowaste can be source-separated. All Copenhageners will be given the option to sort out all fractions, and in addition all Copenhageners are offered an extra service and flexibility in their daily lives, as they can drop off their source-separated waste at more locations. This is done to ease the daily lives of Copenhageners and to attain the rub-off effect that comes from seeing other people sort out their waste.

1.5 WASTE SORTING IN ALL CITIZEN-FOCUSED INSTITUTIONS OF CITY OF COPENHAGEN

Challenge
Many Copenhageners are daily visitors at the City's schools, exhibition centres, culture centres, libraries, and other citizen-focused institutions. In these places they do not see the same source-separation as they have in their homes. By not source-separating in the institutions we miss out on the positive behaviour effect that it would have if Copenhageners were to source-separate their waste in the same way, whether at home, at the library, or in the kindergarten. By contrast, it may have a negative effect on Copenhageners' source-separation at home if they meet different requirements for waste sorting.

Solution
The daily contact between the facilities of the City and Copenhageners must contribute to supporting resource-awareness and enhancing source-separation.

Placing correct sorting equipment in the City's institutions in concurrence with communication measures will contribute to Copenhageners getting the routine that is a precondition for having source-separation integrated in the daily lives. The City's institutions will thus become an asset in communication campaigns.

Copenhageners must know why and how to sort - and why it makes a difference. The measure must be locally anchored, adapted to the different municipal institutions, and rolled out as a trial with continuous evaluation.

Based on data on waste quantities and recycling a trial will be made with award of gold, silver, and bronze medals to those institutions that attain the best source-separation. If it turns out to be a method that leads to better source-separation it may be expanded to other places such as housing associations.

This measure builds on experience from Resource and Waste Management Plan 2018 and experience and communication tools developed for, among others, schools. The implementation of this initiative is closely linked to measure 4.5 Learning for children and young people and participation in waste prevention and waste management.

Effect
When the municipal institutions are used as a basis for communication on source-separation of waste it is expected to have an impact on users and staff members in relation to more recycling at home. The increased recycling will lead to CO_2 reductions due to diversion of plastics from incineration.

In the future, Copenhageners will meet the same source-separation in the City of Copenhagen's citizen-focused institutions as the one they have at home.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Topic 02
Development of existing and future collection schemes

In Topic 2, focus is on developing the service experienced by Copenhageners. The measures under this topic are to ensure that already existing waste solutions are optimised and made more user-friendly.

An analysis of the composition of waste for incineration (autumn 2016) shows that more than 80% of the resources are recyclable. To get closer to full recycling focus must be on the materials that are not sorted out in the homes today, such as textiles and nappies. The measures are to contribute to the development of new options for sorting without entailing a need for more containers in the yards.

The measures also focus on some of the collection schemes where recycling can be improved by changing the collection method for, for instance, bulky waste and electronics.

Measures Topic 02

The topic covers the following measures:

2.1 Technological development of waste collection
2.2 New and flexible fractions
2.3 Bulky waste: Development of collection and robotic sorting
2.4 Increased reuse and recycling of textiles
2.5 Preparation of scheme for recycling of nappies
2.6 Increased collection of electronics and more reuse
2.7 Development of concept for sorting in bins of the City

Effect and economy

The measures will in particular increase the recycling of household waste and lead to CO_2 reductions.

Topic 02 **Development of existing and future collection schemes** **Objectives**	**Economy - DKK million**		
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• 3% increase in collection of household waste for recycling (approx. 6,665 tonnes). • Approx. 2,250 tonnes CO_2 reduction. • Approx. 800 tonnes of waste for reuse.	69	14	83

2.1 TECHNOLOGICAL DEVELOPMENT OF WASTE COLLECTION

Challenge
Waste solutions in Copenhagen are known and well-established solutions resting basically on the principle of collecting waste in a container that is manually transported to a waste collection vehicle or lifted with a crane. This is a solution that is inflexible and not based on smart technology.

Solution
New and more up-to-date solutions for Copenhageners, caretakers, and waste collectors will be investigated. The City will gather inspiration from other sectors and investigate the possibilities of using new technology within self-driving vehicles and small electric cars. It may also be tested whether robot arms can contribute to a substantial citizen-focused service improvement.

In the planning period electric collection vehicles are to be introduced to reduce noise and CO_2 emissions.

When new technologies are coupled to new perspectives of the waste management system solutions may arise that contribute to more sustainability, urban life, efficiency, and service for the entire waste management system. During the planning period relevant technologies and system solutions that can be "copenhagenised" and in a long-term perspective be introduced as part of the new waste management system will be identified through focused knowledge-gathering and market dialogue.

Effect
In a long-term perspective the measure is to ensure that technologies used in the waste management system make room for the recreational urban space by minimising the space taken up by waste containers.

2.2 NEW AND FLEXIBLE FRACTIONS

Challenge
As a general rule, blocks of flats have today waste containers for the fractions of residual waste, biowaste, paper, plastics, small electronics, metal, and cardboard. This takes up space in the yards, and increased sorting of, for instance, plastics presupposes more containers or more frequent emptying. Studies show that it may be difficult for Copenhageners to find space in the yards, and it may be difficult to introduce new fractions, since the space is already exhausted.

Solution
In the City, waste sorting is based on source-separation since to date this gives the best quality of the sorted waste fractions. It will be investigated how to introduce new fractions without taking up more space in the yards. Trials will be conducted to supplement, but not be in contrast with the general extension of source-separation as a principle for waste sorting in Copenhagen.

It will also be investigated whether there are new technologies and collection options on the market that can ensure the same good quality of the sorted waste as we know from source-separation. An analysis will be made to see whether it is possible to attain positive effects from commingling of new fractions (i.e. when several fractions are collected in the same container). Focus of the study should in particular be on seeing whether the sorted materials have the desired quality with regard to recycling of the waste.

New possibilities for collection and recycling of new waste fractions such as styrofoam, textiles, and food cartons should be studied.

To get closer to the climate target collection of biowaste becomes mandatory, and two-compartment containers for biowaste and residual waste will be placed at all single-family homes.

Effect
The measure is to ensure that solutions are found for supplementing source-separation in a long-term perspective without taking up more space in the yards.

Waste takes up space, but technologies of the future may provide new solutions that can free up space for life in the yards in a long-term perspective.

2.3 BULKY WASTE: DEVELOPMENT OF COLLECTION AND ROBOTIC SORTING

Challenge
Much of the bulky waste collected in Copenhagen today consists of materials that can be recycled, in particular wood. Some wood is already sorted out, but much of it still ends up for incineration. Bulky waste also contains many items that may be reused if sorting and collection is optimised.

Solution
Through trials the City will develop and investigate alternative methods for organising the bulky waste scheme. The following will be tested:

- special collection scheme for items for direct reuse
- collaboration with voluntary organisations
- collaboration with waste collectors to optimise the collection scheme for wood
- investigation of the use of exoskeletons
- replacement of the entire bulky waste scheme/parts of it, referring people to recycling centres and local recycling hubs; transportation assistance may be considered
- investigation of experience with robotic sorting of mixed bulky waste
- replacement of compaction collector vehicles with compartmentalised pickup trucks allowing for reuse of parts of the bulky waste
- test of bulky waste scheme as a voluntary subscription scheme instead of a regular scheme.

All surveys and trials are conducted and evaluated in the first half of the planning period. In this way the basis is established to choose that or those bulky waste solution/-s that give the best opportunities for recycling and reusing the waste. In addition it will be ensured that all Copenhageners have access to discarding bulky waste.

Effect
The measure contributes to increasing quantities for reuse and recycling.

2.4 INCREASED REUSE AND RECYCLING OF TEXTILES

Challenge
The Danish consumption of clothing, footwear, and other textiles is increasing. Textiles manufacture is a burden on the environment and climate, and it is crucial that a larger share of Copenhageners' textiles is reused or recycled. The City collects textiles primarily together with charities or other professional players. The major part of collected quantities are sold and exported, but still every year approx. 6,000 tonnes of textiles end up in residual waste for incineration. This corresponds to 3.8% of all household waste sent to incineration. Studies show that 60% of the incinerated textiles are of such a quality that they can be reused directly as clothing, towels, tablecloths, etc. Almost 30% of the textiles can be reprocessed into new raw materials, such as for production of materials that are not woven, for instance felt, yarn, furniture filling, and heat/sound insulation.

Solution
The City will invite relevant players in the textiles sector and charities to collaborate and expand the knowledge of existing collection schemes for textiles in the city. New collection models will be tested. This may be, for instance, kerbside collection of textiles or placing of collection containers in connection with swap meets and flea markets. A third option is to drop waste textiles in the same container as other recyclable fractions and subsequently sort out textiles using optical sorting.

An overview of types and flows of textiles must be established. Recyclable quantities of textiles must be registered to gain insight into the fate of Copenhageners' textiles, including what happens with the share that is not sold for direct reuse. Also, work is to be done to ensure that larger quantities of textiles are prepared for reuse or recycled locally; therefore, development collaborations will be entered with companies in view of creating closed resource loops for the recyclable textiles.

Effect
The activities will contribute to increasing the rate of recycling for textiles and ensure that a larger share of textiles is reused. The activities are to contribute to the circular economy through growth and job creation, and the total environmental pressure from textiles will be reduced. When a larger part of textile waste does not end up in residual waste for incineration, the activities contribute to a CO_2 reduction since a significant part of the textiles is made of fossil materials such as polyester and similar.

Collaborations are to ensure that more textiles are reused - like in this example where entrepreneurs show Copenhageners how to easily cover small holes and stains so the clothes can be used again.

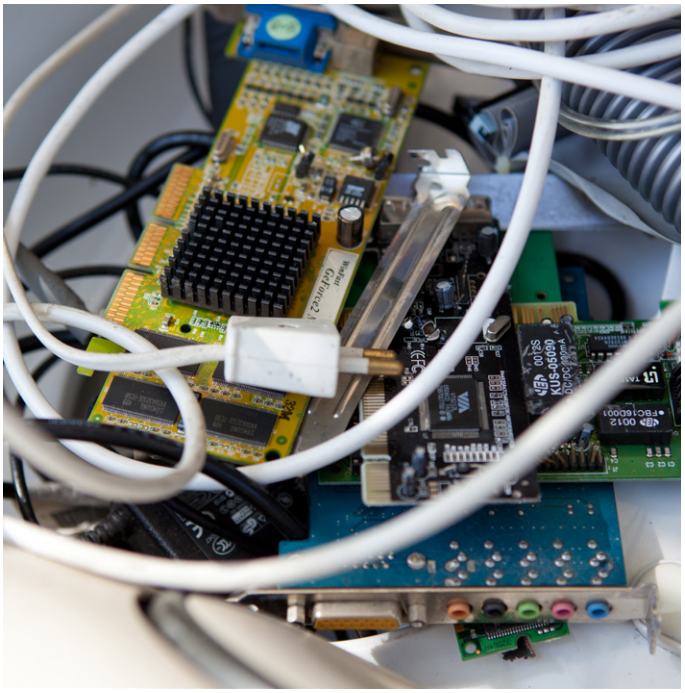
2.5 PREPARATION OF SCHEME FOR RECYCLING OF NAPPIES

Challenge
Every year more than 8,600 tonnes of nappies and other so-called absorbent hygiene waste end up in residual waste for incineration. Abroad, a number of established solutions exist for sorting and recycling of this fraction, which primarily consists of fibres and plastics. In Wales, an objective of 70% recycling of household waste is being attained, among others, by recycling the absorbent hygiene waste products. The resources contained in the absorbent hygiene waste can be used, among others, in the production of a large number of plastic products, roofing boards, and carton tubes for industrial use.

Solution
In the planning period the City will conduct an analysis of the possibilities of reducing the volume and recycling the resources contained in absorbent hygiene waste products. The analysis will result in a business case for the most promising solution and proposals for further co-operation and development projects. Against this background it will be assessed whether to launch a public-private cooperation in view of establishing solutions that can enhance recycling and/or reduce this waste fraction, for instance through reuse.

The solution must be scalable to allow for treatment of hygiene waste from commercial baby nurseries and nursing homes for the elderly. These stakeholders will be involved in the development work.

Effect
The measure will contribute to increased recycling by introducing a new waste fraction.



2.6 INCREASED COLLECTION OF ELECTRONICS AND MORE REUSE

Challenge
The collection of waste electronics is facing four general challenges today. First of all, losses from the municipal containers are huge and illegal. It is difficult to trace how this waste is managed and where it ends up. The Danish Environmental Protection Agency estimates losses of approx. 110 tonnes of small waste electronics a year from blocks of flats in Copenhagen. Secondly, a large proportion of waste electronics are still functional and can be reused, but today all collected WEEE from Copenhageners is led to disassembly before recycling. A small part of metals and other materials are used in new products. Thirdly, electronics are collected in such a way that much of it breaks during collection, and this is a barrier to reuse. Fourthly, some 600 tonnes of electronics and batteries end up in residual waste for incineration; thereby resources are lost and this waste contaminates the residues from incineration.

Solution
Through partnerships it will be investigated how to reuse more electronics through better and gentler collection from yards and recycling centres.

Based on previous measures in Copenhagen and inspired by industrial organisations and other local authorities the possibilities of establishing public-private partnerships on the repair and sale of electronics from recycling centres will be tested.

Anti-theft collection solutions for waste electronics in Copenhagen will be tested. This is to increase the legal and correct handling and treatment of WEEE in terms of the environment and health. These systems may be containers with a locking device or underground containers. After the trials the solutions will be expanded to give all citizens the option of sorting WEEE.

This measure is to prevent losses from the municipal schemes and create more confidence in and knowledge about the options for delivering end-of-life electronic equipment for recycling and reuse.

Effect
The measure contributes with increased recycling and CO_2 reductions, since electronics often contain plastics.

Many electronic products contain valuable metals that can be recycled.

2.7 DEVELOPMENT OF CONCEPT FOR SORTING IN BINS OF THE CITY

Challenge
The implementation of Circular Copenhagen will mean that Copenhageners can drop off their household waste at sorting points in the urban space. Already today bins for street waste are found all over Copenhagen. Once the sorting points have been established it is unknown how much of the waste delivered to these points will be street waste. Also, it is unknown how the two types of waste containers will supplement each other.

Solution
A study will be made to clarify the distribution between household waste and street waste in the bins and the sorting points. This will be done through sorting trials in densely populated areas. The aim is to obtain information about the waste composition and on this background prepare a total concept for waste solutions in the urban space. The concept will be tested to ensure that it interplays with the sorting points in the intended way.

The vision is that Copenhagen is a living and attractive city. This presupposes better solutions for Copenhageners so that also in the future the city will appear clean and beautiful and that in any part of their daily lives Copenhageners can show respect for the environment.

The actual implementation of a final concept for street waste is not part of the measure.

Effect
The measure does not comprise a full implementation in the entire city, but a proposal for a new concept for later political decision. The communication related to the visibility of sorting options as a natural and integral part of life in Copenhagen is an important effect of this measure.

Previous studies have shown that recyclables end up in the waste bins of the city. In the planning period it will be investigated whether solutions exist to remedy this situation.

Topic 03
More swap and reuse options

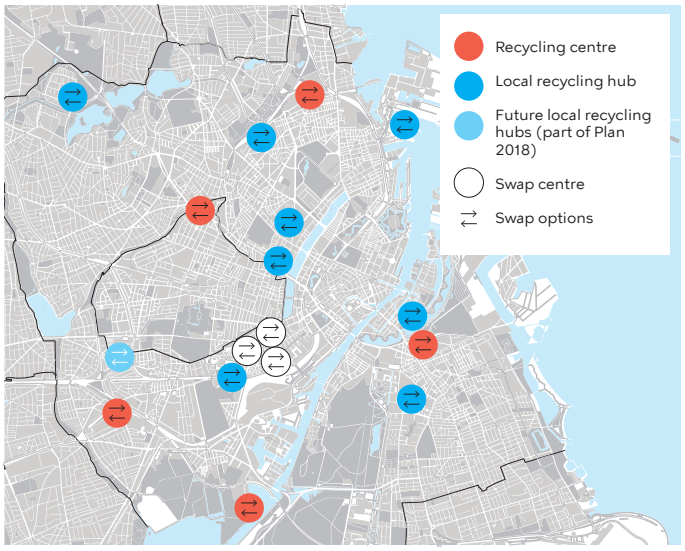
When Copenhageners reuse instead of buying new, resources for the manufacture of new products are saved and less CO_2 is emitted. Buying and selling second-hand items is popular and takes many forms today: Websites, apps, swap meets, swap shelves, swap centres, and similar.

The City will support Copenhageners and companies in swapping even more, sharing and passing on items they do not use themselves any more. A study shows that many Copenhageners are motivated by passing on items to others so that their fellow citizens can enjoy things they do not use themselves any more.

Recycling centres and local recycling hubs play an important role in attaining the Plan's ambitious objective of more reuse. The same study shows that four of five Copenhageners visit the local recycling hubs primarily to use the swap options.

A large part of the waste received at the recycling centres and local recycling hubs consists of usable products or materials that can be reused directly or repaired and then reused.

Today a number of swap schemes exist, and in the planning period they will be optimised and extended; also new measures will be launched to support reuse.



Map of existing publicly accessible swap options as well as present and future recycling centres and local recycling hubs. Three new local recycling hubs have been planned, but not yet located.

Measures Topic 03

The topic covers the following measures:

3.1 Recycling centres as reuse centres
3.2 Establishment of new local recycling hubs and supplementing with temporary local recycling hubs
3.3 More swap options for Copenhageners
3.4 Establishment of resource lab in Sydhavn Recycling Centre

Effect and economy

The measures will in particular increase the reuse of household waste.

Topic 03 **More swap and reuse options** **Objectives**	**Economy - DKK million**		
	Investment	Derived operation in planning period	Total costs
• Approx. 240 tonnes CO_2 reduction. • Approx. 5,880 tonnes of waste for reuse.	59	12	71

3.1 RECYCLING CENTRES AS REUSE CENTRES

Challenge
Around 42,000 tonnes of waste are dropped at the municipal recycling centres every year. The major part is recycled, but a large share of the waste is of such a quality that it can be reused directly or it can be repaired and reused. The potential for moving large volumes of waste up the waste hierarchy is large. Today Copenhageners have only limited access to these resources. There are swap options at the City's recycling centres and Copenhageners use them eagerly. The items delivered are often small articles for everyday use such as clothing, toys, books, and kitchenware. Copenhageners demand such swap options at the recycling centres. The same applies to some of the construction materials that are dropped off for recycling, such as bathroom tiles or a wood strip for repairing the rabbit house.

By far most of what is delivered to the recycling centres today is recycled, but still 3,500 tonnes of the fraction 'small burnable' was led to incineration in 2017. A study shows that 40% of this waste fraction can be reused or recycled.

Solution
The City will study the possibilities of expanding the existing reuse schemes in order that large items such as construction materials, furniture, wood, and similar are accessible to Copenhageners. A prototype will be developed making it easy and safe for Copenhageners to access the materials; this prototype must be replicable at all of the City's recycling centres.

Resident-operated repair and workshop facilities are requested at the City's recycling centres and local recycling hubs. Workshop facilities contribute to a better utilisation of resources, they prevent waste arisings and contribute to positive behavioural changes.

At the recycling centres trials must be made with removing the container for 'small burnable' in view of phasing out this fraction in the planning period, so that 40% of the items in these containers can be reused or recycled. The trials are to clarify the composition of the remaining 60% and what it takes to have this proportion managed correctly by recycling.

Effect
The measure will increase reuse by one third of the overall target. There will also be a reduction of CO_2 emissions, since part of the items that are diverted from incineration to reuse will contain plastics.

3.2 ESTABLISHING NEW LOCAL RECYCLING HUBS AND SUPPLEMENTING WITH TEMPORARY LOCAL RECYCLING HUBS

Challenge
The local recycling hubs supplement the existing collection schemes and they allow for sorting into more fractions. They also have a larger capacity in cases where Copenhageners are to discard larger quantities of waste than what can be put in the containers in the yard. At the same time the swap options at the local recycling hubs contribute to the reuse of suitable items and materials, and the hubs provide information about the City's waste solutions.

At the existing local recycling hubs 1,000 tonnes of waste are recycled every year, while more than 120 tonnes of waste are reused. There are still large areas in the city that do not have a local recycling hub. These local recycling hubs are in high demand, but it is a challenge to find suitable areas for them. In addition, repair facilities are in demand, and people want the local recycling hubs to be a social hub on the resource agenda in the neighbourhood.

Solution
Three new local recycling hubs will be established in the planning period, as far as possible constructed with reused construction materials. It is not a given fact that all the city's districts will get a stationary, manned local recycling hub, so concepts for alternative local recycling hubs are to be tested. Since the demand for local recycling hubs is large, temporary hubs will be established in the planning period to cover part of the need. In addition, it will be clarified where it is most relevant to locate future local recycling hubs.

The local recycling hubs can do more than just receive waste and offer swap options. The social recycling hub in the residential area of Hørgården has shown that the local recycling hubs can be used as a local gathering point for community activities. Experience from here must be expanded to the other local recycling hubs and the large recycling centres. In the planning period the options will be screened, collaborators will be identified, and relevant measures at the existing recycling centres and hubs will be launched in order to expand these functions to existing and future centres and hubs. The aim is to increase the knowledge and use of the local recycling hubs so that more items are reused and recycled.

Effect
The measure contributes to increased recycling by giving more Copenhageners the option for sorting larger quantities of waste along with swapping and reusing. The local recycling hubs are a gathering point creating communities and putting waste and reuse on the agenda.

3.3 MORE SWAP OPTIONS FOR COPENHAGENERS

Challenge
Most Copenhageners have clothes and other stuff they no longer use. Not all items have a sale value, but may still have a service value. Instead of discarding such items they can be swapped among Copenhageners to the benefit of resource utilisation and the environment.

Experience is already available on the development and testing of different forms of swap centres in public areas (districts of Vesterbro and Vanløse) and on establishing swap shelves/cabinets in blocks of flats. There is a high demand for establishing and expanding swap options.

Solution
The City will support the development of swap options and make it easier for Copenhageners to swap items. This will increase the share of reusable products. Experience from already existing swap options in public areas will feed into the further work. In the coming planning period different types of initiatives will be launched and implemented with a view to enhancing and expanding swap options in Copenhagen - in the urban space, in the homes, in companies, and in institutions. It will be studied whether swap shelves can be incorporated into multifunctional urban equipment. The aim is to have Copenhageners swap more and get a feeling of improved service through nearby swap options.

Effect
The measure will contribute to attaining the target of a tripling of reuse as well as reducing CO_2 emissions, since some of the swapped items diverted from incineration contain plastics.

It will be investigated how to make it possible for Copenhageners to access those materials and items that are dropped off at the recycling centres while still being usable. For instance flower pots for your balcony.

3.4 ESTABLISHMENT OF RESOURCE LAB IN SYDHAVN RECYCLING CENTRE

Challenge
Today the City can reuse around 4% of the waste received at the municipal recycling centres. This corresponds to approx. 1,800 tonnes of waste. The remaining part of the waste goes through processes deteriorating the quality, such as wood used for chipboard. The materials dropped off at the municipal recycling centres today are delivered to companies able to manage and recycle large quantities of waste. Not many companies can receive materials for direct reuse on a regular basis, thereby ensuring that this waste moves up the waste hierarchy. It is difficult to start new companies with a focus on reuse. This is due to the fact that companies must have sufficient capacity for handling large quantities of waste before they can receive materials from the recycling centres. Today's market is geared for recycling, not reuse.

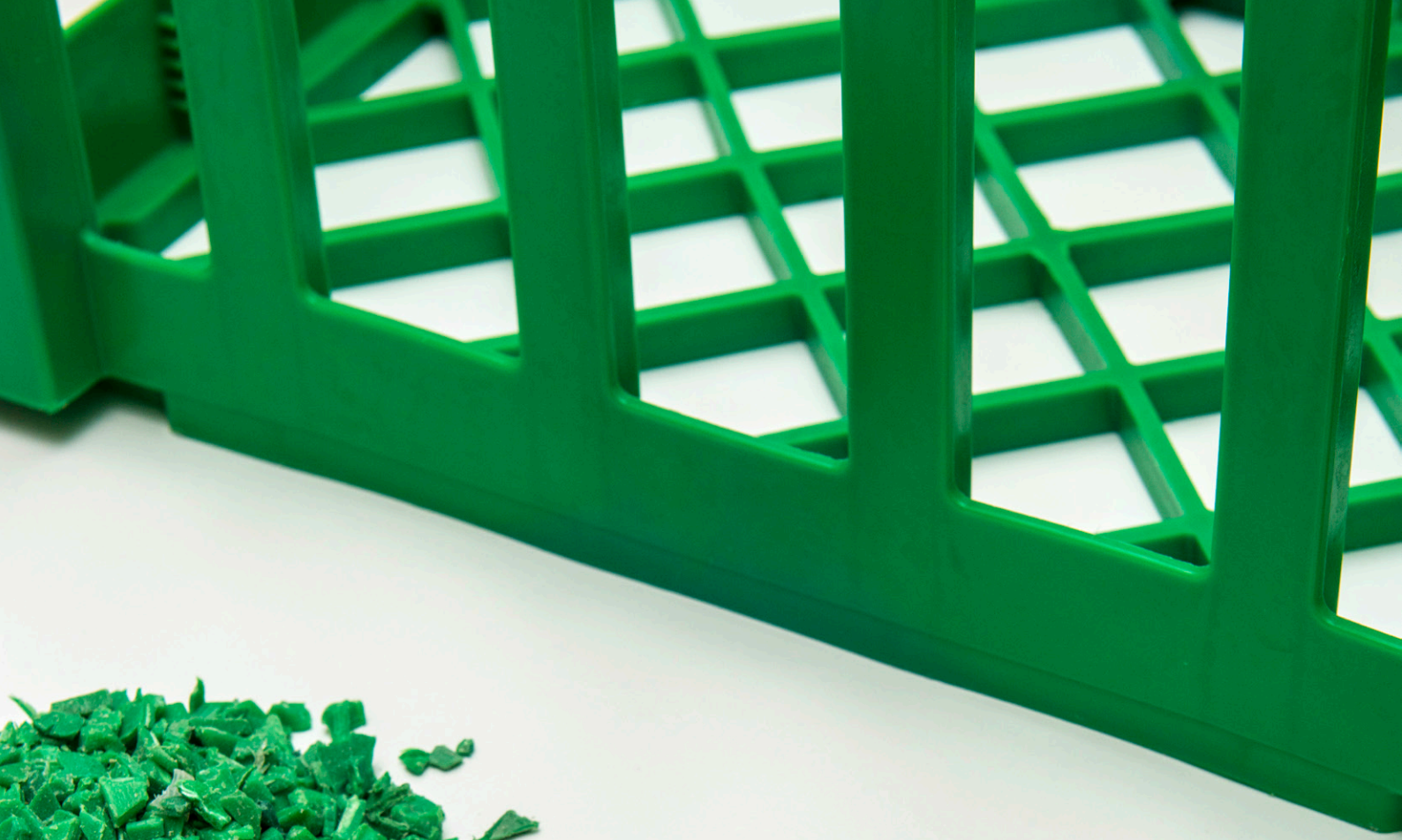
Solution
The purpose of Sydhavn Recycling Centre is to ensure that new innovative solutions are developed in Copenhagen, leading to higher rates of reuse at the recycling centres. Sydhavn Recycling Centre comprises a recycling centre operated by Amager Resource Centre and a resource lab operated by the City of Copenhagen.

The resource lab aims to establish methods for developing new business concepts and partnerships promoting reuse from the recycling centres and among companies. New value chains are to be developed for the reuse market in the same manner as the existing established outlets for recycling. This presupposes tests and experiments on how to split up fractions in a new way and in smaller quantities.

It must be possible for start-ups to grow along with the market and have access to market maturing and testing. Through these partnerships companies are to develop solutions in a long-term perspective leading to job creation and green growth. Experience is to be shared with Copenhageners through workshops and educational curricula for children. The solutions are to be implemented at the other recycling centres of the City.

The target is that 20% of the resources delivered to Sydhavn Recycling Centre are reused directly.

Effect
This measure contributes with more than one third of the reuse target. In addition, it contributes to the transition to a circular economy, job creation, and green growth.

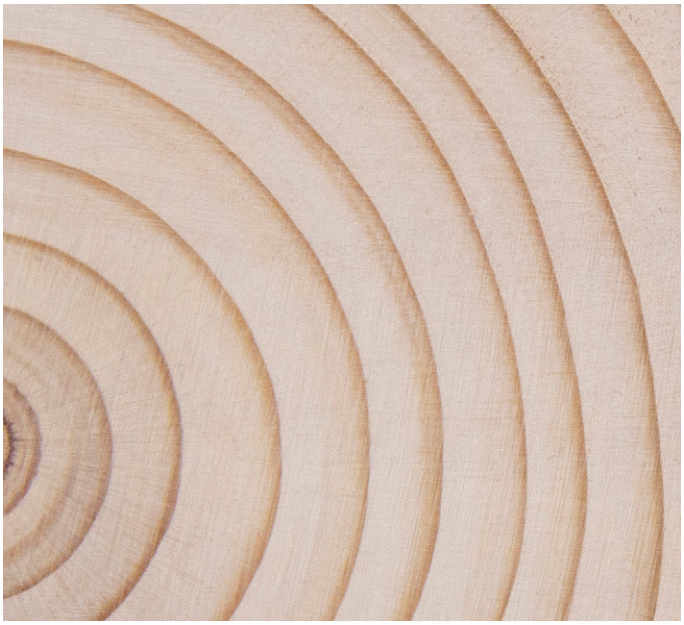


Topic 04
Copenhagen promoting circular economy

The measures of Topic 4 are to create the framework for the innovation needed for replacing the linear economy with the circular economy.

The solutions known today contribute to a large extent to meeting the City's ambitious objectives in the field of resources and waste. During the planning period it is necessary to develop new solutions for what cannot be recycled today. New solutions must be created to replace virgin raw materials with recycled resources. These are solutions that are not known today.

The topic supports the target of 70% recycling by developing new solutions ensuring a larger rate of recycling. At the same time the topic supports the vision that Copenhagen is to be a frontrunner within circular economy as described in Co-Create Copenhagen. The effect of the topic goes beyond the planning period since the new solutions will only reach their full capacity after 2024.



Measures Topic 04

The topic covers the following measures:

4.1 Innovation platform Circular Copenhagen
4.2 Reuse of construction materials from the City's properties
4.3 Ensuring development of circular material flows of high quality
4.4 Increasing quality and value of plastics
4.5 Learning for children and young people and participation in waste prevention and waste management
4.6 Copenhageners as circular consumers
4.7 Development of logistics for repair of furniture and longer life of electronics

Effect and economy

The measures will in particular increase the recycling of household waste and lead to CO_2 reductions.

Topic 04 **Copenhagen promoting circular economy** **Objectives**	**Economy - DKK million**		
	Investment	Derived operation in planning period	Total costs
• 6% increase in collection of household waste for recycling (approx. 13,040 tonnes). • Approx. 3,410 tonnes CO_2 reduction.	74	15	89

4.1 INNOVATION PLATFORM CIRCULAR COPENHAGEN

Challenge
Circular economy is in rapid development. New technologies, solutions, and knowledge are generated rapidly, and companies need to cooperate with the cities in order to meet the needs, test their solutions, and have them adjusted to the market.

Recycling solutions are still outstanding for many material types. An analysis of waste sent to incineration in 2016 shows that approx. 20% cannot be recycled with the technologies and solutions available today.

Solution
In order to ensure that work under Circular Copenhagen continuously reflects technological developments and the latest knowledge, the innovation platform Circular Copenhagen will be established. The innovation platform is to form the basis for radical innovation of new solutions for selected problems in the waste and resource field. This will be done in close interplay with innovative companies and knowledge institutions.

Circular Copenhagen has to aims. Firstly, an organisational setup with external experts will be developed and established. They are to channel the latest knowledge about technological development and innovative solutions from all over the world into the implementation of Circular Copenhagen .

Secondly, the external experts are to qualify tendering of a number of concrete innovation collaborations. The aim is to launch and complete three to five open innovation collaborations with Danish and foreign companies, research institutions, etc. The collaboration projects aim to develop new, circular solutions for management of selected resource flows in close collaboration with the most innovative parts of industry. Focus will be on those residual wastes for which we have no recycling solutions today.

Effect
The measure will increase recycling by developing and implementing new solutions. The transition to a circular economy is supported.

4.2 REUSE OF CONSTRUCTION MATERIALS FROM THE CITY'S PROPERTIES

Challenge
The City of Copenhagen owns a large number of properties that are regularly renovated while other properties are obsolete, needing demolition and replacement. The buildings that are demolished often contain many materials that can be reused in new buildings. One of the major barriers for this to happen is timing. Rarely, a building is demolished and a new one is constructed needing exactly those materials that are demolished here and now.

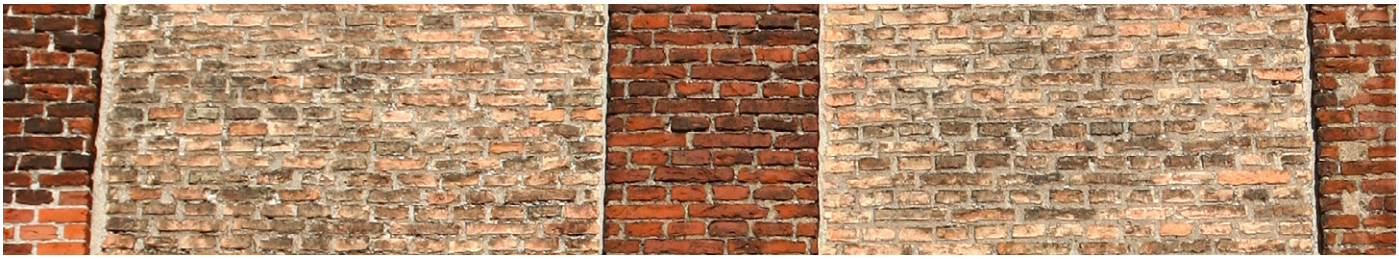
Solution
In view of increasing the reuse of construction materials in municipal buildings reuse and recycling of construction materials will be included as a criterion/requirement in tender documents; in this way the City will obtain knowledge and experience in using tendering as a tool to promote recycling.

During a two-year period it will be investigated whether a physical materials yard for storage of construction materials until their reuse in new buildings or renovation of the City's other properties has the intended effect. In addition, it will be investigated whether a digital solution can be established using information available today in existing private apps and websites. The digital solution can be a supplement or an alternative to a materials yard.

It is not possible to finance this measure through household or commercial fees. The development of requirements for recycling of construction materials and the associated testing must be financed through budget negotiations and within the budgetary framework of building project appropriations. In addition, there will be a synergy effect with the EU project CIRCuIT concerning knowledge-building about inclusion of requirements in tender documents and concerning the suitability for recycling of different construction materials. The physical materials yard must be financed through budget negotiations.

In a long-term perspective experience from tendering will be incorporated into the City of Copenhagen's requirements for building and construction *Environment in Building & Construction*.

Effect
The measure supports the transition to a circular economy.



4.3 ENSURING DEVELOPMENT OF CIRCULAR MATERIAL FLOWS OF HIGH QUALITY

Challenge
In the transition to a circular value chain in which resources are reused and recycled again and again, one link in the value chain is often missing: the value-creating link. This means that the necessary treatment (such as collection at source, storage, sorting, preparation, and management in small or standardised categories of materials) may be a prerequisite for resources to go back and be recycled in the production line at the highest possible quality. When the circular value chain has been established, it is necessary to ensure treatment of high quality in all the links in the value chain in order to uphold the value of the resources. A higher value than what is often possible today.

Solution
The City will support and facilitate meetings between the players in the entire value chain and knowledge institutions in order to establish the basis for jointly creating new solutions. The aim is to create sustainable business models so the resources collected by the City can be used as valuable materials on a market, thereby being turned into new products. In addition, the City will investigate in which value chains it is possible to improve the quality of collected resources so that they can be recycled at a high quality and thereby get a higher value for the City and Copenhageners. Together with relevant players from the value chain the City will demand and support the development of solutions so the value contained in the resources can be upheld throughout the recycling process. This includes the way in which the design of products can be adjusted in view of attaining high-quality recycling, such as designing the products in view of easier sorting.

It may also be possible across the value chain to establish entirely new systems, such as a take-back system for take-away packaging from the city's coffee and food shops.

Effect
Solutions will be created so that in the future the rate of recycling will be higher, of a higher quality and thereby of higher value. Knowledge will be shared across value chains creating an understanding of the market, which can lead to new business models and potentials. Hereby, the transition to a circular economy is supported.

4.4 INCREASING QUALITY AND VALUE OF PLASTICS

Challenge
Today, most of the separately collected plastics are recycled into new products. However, the quality of the products produced from the plastics varies much. A large part of the plastics can become products of an even better quality. When the quality of the produced plastic products is not sufficiently high, this is a barrier to having the materials recycled over and over again. The City wishes to ensure the best possible utilisation of the large volume of plastic resources and to have as high a quality as possible. If plastics are to be recycled at a higher quality it is necessary to disassemble, fine-sort, and reprocess waste plastics into a valuable raw material. Methods must be developed across the value chain until this is achieved at the best possible level with focus on the value-creating link.

Solution
The City is operating a test plant for the sorting of plastics and will continue to be a key contributor in the value chain based development of solutions of the future (sorting, washing, and reprocessing of post-consumer plastics). Thanks to the test plant it is possible to develop solutions in practice and to demonstrate how the different plastic resources can be converted to raw materials in demand. We have already succeeded in developing new saleable products together with a number of companies. This work is to be developed further in the planning period, and in collaboration with companies recycling solutions will be developed bringing down the costs associated with the management of plastics. This will result in secondary raw materials of high quality. Companies will be able to test their products at the plant, and thereby the City can support good design practices and enhance strategic partnerships with the retail trade.

In addition, the plant is to be used as a testing platform for new technologies such as robotic sorting. It will be investigated whether this can increase the quality of recycling.

Effect
Solutions for the management of collected plastics will be developed to ensure that more items can be recycled at a higher quality. This may be, for instance, to ensure that food-approved plastics can be recycled into food-approved plastics. Hereby, the transition to a circular economy is supported.

4.5 LEARNING FOR CHILDREN AND YOUNG PEOPLE AND PARTICIPATION IN WASTE PREVENTION AND WASTE MANAGEMENT

Challenge

Children and young people make up a considerable proportion of the population in Copenhagen, and also in the future they must contribute to attaining the targets for recycling, CO_2 reduction, and reuse. There are around 70,000 children in Copenhagen's institutions, and they will be the users of the waste management system in the future. It is important that they learn to sort their waste at school and at home, so in the future they can manage waste correctly and act as waste ambassadors.

Solution

The aim is to bring about a basic resource-awareness among all children and young people in the schools and institutions of the city. This will be done through learning in curricula regarding waste sorting and circular economy. A curriculum is to be developed transferring knowledge and behaviour from teaching to everyday routines at home. Activities will be based on the good experience gathered under Resource and Waste Management Plan 2018. Against the background of this experience activities will be further developed to ensure that the teaching curricula are anchored as a regular and integral part of the overall curricula of the schools. Experience shows that knowledge about waste and sorting must be maintained among children and adults; therefore, the curricula are planned as recurrent and integral parts of the annual programme of schools and day-care institutions. The measure must be based locally and adapted to the daily life of each school and institution. The aim is that resource-awareness and sorting of waste is a subject children discuss with their parents and friends, thereby giving it an awareness-raising impact.

This will be a measurement parameter in the continuous effect measurement of the activity.

The activities are interlinked with measure 1.5 Waste sorting in all citizen-focused institutions of City of Copenhagen, since this measure covers organisation and implementation of the practical collection in the institutions, with measure 3.1 Recycling centres as reuse centres, and with measure 1.4 Waste solutions in streets and other public areas. The measures are used as the starting point of curricula where pupils act as local waste ambassadors and contribute with ideas for how to increase recycling. The measure is supported by educational activities at Amager Resource Centre and Vestforbrænding.

Effect

It is expected that Copenhagen's children and future generations acquire good sorting habits through current education regarding waste sorting at institutions and schools, along with knowledge about the correlation between resource and energy consumption. This will increase the rate of recycling along with a reduction of CO_2 emissions. The activities also support more reuse and provide the children with an insight into circular economy. The children will gain insight and knowledge that is supported, among others, by visits to waste treatment facilities. This will contribute to putting an end to myths and prejudices about the waste management sector.

4.6 COPENHAGENERS AS CIRCULAR CONSUMERS

Challenge
When a Copenhagener wishes to buy products that are more circular it is difficult to identify the right product today. There is no labelling system, and circular criteria only just start being incorporated into eco-labels such as the Nordic Swan. This means that far more items than necessary are discarded today, because they are not designed and produced in view of the circular economy.

Solution
It must become easier to choose circular products. Either because they are produced from recycled materials, or because the business model supports a long useful life. This may be, for instance, leasing under which the repair is part of the agreement, or by taking into account that the product must be recyclable after its useful life.

The City must inform Copenhageners about what should be considered when a consumer wants to consume in a circular manner. This information will be made available to Copenhageners in order to make it easier for them to choose circular products, should they so wish.

Effect
The measure will promote the circular economy by promoting the market for circular products and by reducing volumes of waste that the City is to manage. When more products are designed for recycling the quality of recycling and thereby also the overall recycling improves. The vision for the circular economy is a carbon neutral economy, and therefore higher demand for circular products and services will lead to lower CO_2 emissions.

Copenhageners should be supported in choosing circular products, for instance such where the repair is included as part of the business model.

4.7 DEVELOPMENT OF LOGISTICS FOR REPAIR OF FURNITURE AND LONGER LIFE OF ELECTRONICS

Challenge

The City's equipment and furniture is expensive and many resources and much energy are used for manufacture and procurement. Most staff members are aware of this fact, and therefore it is important that the municipal institutions ensure repair and thereby a longer life of equipment and furniture. Also, it is important that the institutions demonstrate that the use and discard culture is not ideal for Copenhagen, but that second-hand equipment and furniture have a value by themselves along with a history that supports the Plan's objective of more reuse. In addition, it is beneficial for the City both in terms of the economy and the environment to make reuse in the City's institutions more efficient. The existing website Genbrugsportalen (the reuse portal) has been established with the aim of passing on items across administrations and institutions of the City. The challenge of an online portal is that the timing is not always right when someone needs to pass on second-hand items and others need them. There is a major potential in communicating to the staff members of the City about the environmental and economic benefits from reuse.

Solution

Trials are to be made with the establishment of logistics that can match the need for outlets and procurement of items. This may be, for instance, through the establishment of a storage facility for temporary storage.

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A chair with a hole in the cover that the after-school care will no longer use will in future be repaired and given a new life, e.g. at the library.

Trials will also be made with repair of equipment and furniture, IT equipment, etc. in order to increase reuse and the useful life of products. It will be investigated whether parts of the staffing needed for the storage facility and management of the web portal can take the form of inclusion of unemployed Copenhageners into the labour market. In this way this measure can contribute to the City's Social Strategy. The storage facility will act as a showcase demonstrating how to make reuse and employment go hand in hand.

The activities as well as the economic and environmental effects will be communicated to Copenhageners at schools, day-care institutions, and others locations where many Copenhageners are in contact with the City's institutions. In addition, the results will be communicated internally in the City's institutions in view of disseminating the options for reuse and of informing the many staff members that are also citizens in Copenhagen about the options for reuse.

Effect

When Copenhageners and City employees see that the City reuses and extends the useful life of equipment and furniture this is expected to affect Copenhageners' own behaviour. When furniture and other items get a longer useful life this is waste minimisation, and thereby the total costs of waste management in Copenhagen will be reduced. The activities will increase reuse and thereby reduce waste arisings in the municipal institutions. Very often, equipment and furniture that the institutions no longer use will be discarded as bulky waste.

The measure cannot be financed from the waste fee, and financing must be found elsewhere.

Topic 05
Increased recycling of industrial and commercial waste

More than half of the city's commercial waste from offices and shops is sent to incineration, which causes an extensive loss of resources. Often, the reason is lack of knowledge among companies about what can be recycled and how the company establishes a scheme for the collection of recyclable wastes. Businesses located in buildings with a mix of residential and commercial use can use the municipal containers for residual waste, if an agreement has been entered to this effect. But we often see conflicts of interest when businesses share waste containers with residents, just as it may be difficult to find space for additional containers for correct sorting.

The management of recyclable industrial and commercial waste takes place in an open market, so businesses themselves must ensure correct management and disposal. The City will focus on two measures offering dialogue and collaboration to support the business community in waste sorting cf. the Statutory Order on waste.

Potentially, construction waste contains many resources for recycling and reuse, but also substances of concern that may be harmful to humans, animals, and vegetation. It is essential to introduce measures ensuring that the potential for recycling is utilised and that buildings are cleaned correctly before demolition.

The three measures together are to increase reuse and recycling of industrial and commercial waste and construction waste. The measures support the target of recycling of 70% of industrial and commercial waste by 2024. In addition, the measures contribute to complying with the Climate Plan by reducing CO_2 emissions from waste management and bringing down environmental burdens associated with the disposal of xenobiotic substances.

Facts
The City of Copenhagen's waste arisings are distributed on household waste, industrial and commercial waste, and construction waste. Waste arisings are distributed as follows: one third household waste, one third industrial and commercial waste, and one third construction waste - approx. 600,000 tonnes in total. In the construction sector the rate of recycling is very high - approx. 80%, while the remaining industrial and commercial waste reaches a rate of recycling of 38% (2015 data).

Measures Topic 05

The topic covers the following measures:

5.1. Increased recycling of industrial and commercial waste
5.2. Industrial and commercial waste in mixed residential and commercial buildings - better solutions
5.3. Cleaner recycling of resources in construction and demolition waste

Effect and economy

The measures will in particular increase the recycling of industrial and commercial waste and lead to CO_2 reductions. The measures are to be financed through taxes. 25% of measure 5.2 will be financed through the fee on household waste.

Topic 05 **Increased recycling of industrial and commercial waste** **Objectives**	**Economy - DKK million**		
	Investment	Derived operation in planning period	Total costs
• 15% increase in collection of industrial and commercial waste for recycling (approx. 25,700 tonnes of waste). • Approx. 9,600 tonnes CO_2 reduction.	35	0	35

5.1. INCREASED RECYCLING OF INDUSTRIAL AND COMMERCIAL WASTE

Challenge
Industrial and commercial waste accounts for 218,000 tonnes or approx. one third of waste in the City of Copenhagen, distributed on some 30,000 waste generating businesses. More than half of the waste sent to incineration from these businesses is suitable for recycling. Businesses must source-separate their waste and enter agreements with waste collectors on management of their waste. Most businesses want to comply with the requirements for source-separation, and many businesses see economic savings through their source-separation. But many businesses need knowledge and guidance about the possibilities.

Solution
The aim of the measure is to inform Copenhagen's businesses about recycling and waste management. There will be a special focus on challenges relating to those waste fractions for which companies have difficulties in finding a recycling option despite the fact that technically they can be recycled.

A task force will be established with experts in the field of industrial and commercial waste taking contact to sectors with the largest potential for increasing the rate of recycling and having focus on public events in Copenhagen.

Through dialogue and information materials on recyclable waste the task force will support companies in finding better sorting and waste prevention solutions. Through collaboration with industry associations, trade associations, waste collectors etc. the barriers to increased recycling will be investigated. It will also be investigated whether there are any openings for industrial symbiosis. We see a large potential from collaboration with neighbouring municipalities and the national environmental authorities on a harmonisation of guidelines across the country - both relating to companies and waste treatment facilities.

This measure builds on experience gained from Resource and Waste Management Plan 2018. The task force has visited more than 2,500 businesses of which 90% found the information and guidance on correct source-separation very useful.

Effect
The measure is expected to contribute extensively to a higher rate of recycling of waste from businesses in Copenhagen. The higher rate of recycling will also lead to a significant reduction of CO_2 emissions.

Where commercial businesses and private homes share a yard guidance should be offered in the best possible design of waste sorting.

5.2. INDUSTRIAL AND COMMERCIAL WASTE IN MIXED RESIDENTIAL AND COMMERCIAL BUILDINGS – BETTER SOLUTIONS

Challenge
Today householders can sort their waste for recycling in many fractions. Most waste fractions can be dropped off at the home. One and the same block can have commercial leases with different types of companies. Some companies generate a lot of domestic waste and waste for recycling. When households and businesses have different schemes it is necessary to keep containers apart, making it clear which ones are for residents and which ones are for businesses. The location of several containers at common areas may create space problems and uncertainties about their use, and in the last resort this may lead to dissatisfaction and complaints between residents and businesses.

Solution
The aim is to prepare and test a new model for guidance for businesses and residents in the yard. The guidance will take its starting point in present legislation and issues concerning the use of containers. A new guidance will serve as a support for dialogue with the relevant parties: administrators, owners, residents' associations, residents, institutions, and companies. The guidance is to inform about rules and requirements for waste sorting for businesses and present proposals for how to deal with dialogue and lay-out of common spaces in view of waste sorting and correct waste management.

Effect
The measure will contribute to increased recycling and CO_2 reductions. Better solutions in the different yards will lead to a better yard environment and collaboration among the parties.

5.3. CLEANER RECYCLING OF RESOURCES IN CONSTRUCTION AND DEMOLITION WASTE

Challenge
Construction and demolition waste accounts for approx. one third of all waste in the City of Copenhagen. The rate of recycling of construction waste is high, but the quality of this recycling is generally low. The major part of renovated and demolished buildings that are the sources of this construction waste contains substances of concern. These substances make it difficult to enhance the quality of recycling and to have reuse integrated in the construction sector.

Solution
If reuse and circular economy in the construction sector is to increase it is important to map and, wherever possible, remove the substances of concern and to make a selective demolition in view of keeping the building parts intact as far as possible.

In a selective demolition the building is demolished carefully so the materials making up the house can subsequently be used as close to their original purpose and thereby as high up the waste hierarchy as possible. Along with this, the materials containing problematic quantities of xenobiotic substances must be sorted out for disposal.

In the initial design phase the City will assist private and municipal developers in conducting a selective demolition. The developer himself must make environmental screenings and clearance of buildings so the materials to be reused or recycled do not constitute a risk for human health and the environment.

In collaboration with developers and demolition companies the City will draw up a report of experience explaining how selective demolition can be conducted from a civil engineering point of view. It will describe how to ensure that materials can be recycled and reused, including requirements for cleaning and thermal treatment. Experience with selective demolition will be gathered in view of dissemination and guidance. The City will facilitate a dialogue between developers and the construction sector.

The City will stop considering buildings for demolition or renovation as construction waste and instead see them as material banks, i.e. deposits where materials have been stored in the building. In demolitions and renovations materials are moved so they can be used again in another place.

To support this work the City will draw up a number of archetypes for buildings helping to screen which materials and problematic substances a building may contain. The archetypes may be structured as follows: houses from the 70s often contain this type of windows, in homes from before 1960 a type of mortar has been used that can be removed so the bricks can be reused, etc.

Effect
The effect of the initiative will be more construction waste for reuse and recycling of high quality and more construction waste being cleaner, thereby reducing the environmental risks. In addition, heavy traffic through the city may be reduced in some cases, since parts of the construction waste/construction materials can be reused in the new building at the same location.

The old stack at the HOFOR Amager power station is demolished and the concrete is reused in the construction of Sydhavn Recycling Centre.


STILL

Topic 06
New technological solutions for waste treatment

Copenhageners constantly become better at sorting their waste, and thereby important resources are diverted from incineration to recycling. Studies conducted by the City show that the residual waste - despite thorough sorting in the Copenhagen homes - still holds many fractions that may be recycled. In several places in Europe different treatment plants have been established such as central sorting plants sorting the residual waste in order to arrive at a higher rate of recycling. Inspired from such plants and by incorporating the most recent technologies in the coming sorting plant this plant can sort out recyclable resources from the residual waste before incineration.

The work covers new technical solutions at a central sorting plant sorting the last tonnes out of the residual waste as well as the establishment of a biogas plant producing biogas and fertiliser. In addition work is being done on refining solutions for biowaste in connection with biogasification. Biowaste contains valuable materials such as succinic acid, lactic acid, and proteins that can be sold as a raw material in a large number of industries. These raw materials can enhance the competitiveness of Danish companies in the future circular economy.

By introducing new treatment solutions even larger volumes of waste can be diverted from incineration to recycling than today. This is a contribution to attaining the target of 70% recycling of Copenhageners' waste and the target of a carbon neutral capital by 2025 - as well as to promoting circular economy in Copenhagen.

Measures Topic 06

The topic covers the following measures:

6.1. Post-sorting of residual waste at sorting plant

6.2. Establishment of biogas plant close to the city and development cooperation on biorefining

Effect and economy

Topic 06 **New technological solutions for waste treatment** [2] **Objectives**	**Economy - DKK million**		
	Investment	Derived operation in planning period	Total costs
• 6% post-sorting of household waste for recycling (approx. 14,055 tonnes), and 1% post-sorting of industrial and commercial waste for recycling (approx. 2,175 tonnes). • Approx. 25,150 tonnes CO_2 reduction.	1	36	37

2 The establishment of a post-sorting plant for residual waste and a biogas plant is expected to be financed by a loan over 20 years. The costs of debt financing are covered by current operating expenses and are therefore included under permanent operation.

6.1 POST-SORTING OF RESIDUAL WASTE AT SORTING PLANT

Challenge

The City has made an analysis of household waste sent to incineration. The analysis shows that the majority of this waste is recyclable. A large part of this will be source-separated through the measures of Circular Copenhagen, but it is not expected that all Copenhageners in all situations source-separate everything. Therefore, part of the waste for incineration will contain resources suitable for recycling. Automatic sorting plants that can sort part of these resources out of the residual waste already exist. Materials sorted in this type of sorting plant are not of the same high quality as when source-separated by Copenhageners. This means that the value of the waste presumably will be lower and recycling options not the same.

For example, biowaste will be contaminated with other wastes, and therefore biowaste sorted from residual waste cannot be used as a fertiliser on agricultural land - by contrast to source-separated biowaste.

Solution

The sorting of residual waste at a sorting plant must be seen as a supplement to source-separation in the Copenhagen homes, not a replacement. A sorting plant for residual waste from households is to sort out metal and plastics from the residual waste before incineration. The City will contribute to the plant by supporting the development of a technology that can increase the recycling of resources. The sorting plant can sort out the major part of metal and plastics still contained in the residual waste. The plant will be prepared for sorting out other fractions from the residual waste, for instance cardboard and paper. The establishment of the sorting plant is part of Amager Resource Centre's plan for recycling and CO_2 reductions.

Effect

The establishment of a sorting plant will increase the rate of recycling. Since the plant will sort out plastics, among others, from the residual waste it will also contribute to CO_2 reductions.

6.2 ESTABLISHMENT OF BIOGAS PLANT CLOSE TO THE CITY AND DEVELOPMENT COOPERATION ON BIOREFINING

Challenge

In 2015 Copenhageners in single-family homes started to sort out biowaste for recycling, and in 2017 blocks of flats were included in the scheme. Biowaste is converted to biogas and fertiliser at existing biogas plants on the island of Zealand. To minimise transport distances and ensure an optimum utilisation of the collected biowaste with respect to a circular bioeconomy a new biogas plant close to the city will be established in collaboration with Amager Resource Centre.

The Government's panel for Circular Economy and the National Bioeconomy Panel have pointed out that Denmark has special expertise and prerequisites for developing the technologies of the future within the circular bioeconomy.

Biowaste from the city can form the basis for collaboration with universities and the business community on promoting these technologies that, among others, can convert bioresources to products of high value. The figure overleaf illustrates how bioplastics, proteins, and animal feed have a higher value than e.g. biofuels for vehicles. These development projects can be conducted as trials and as a supplement to the production of biogas and fertiliser for agriculture.

Solution

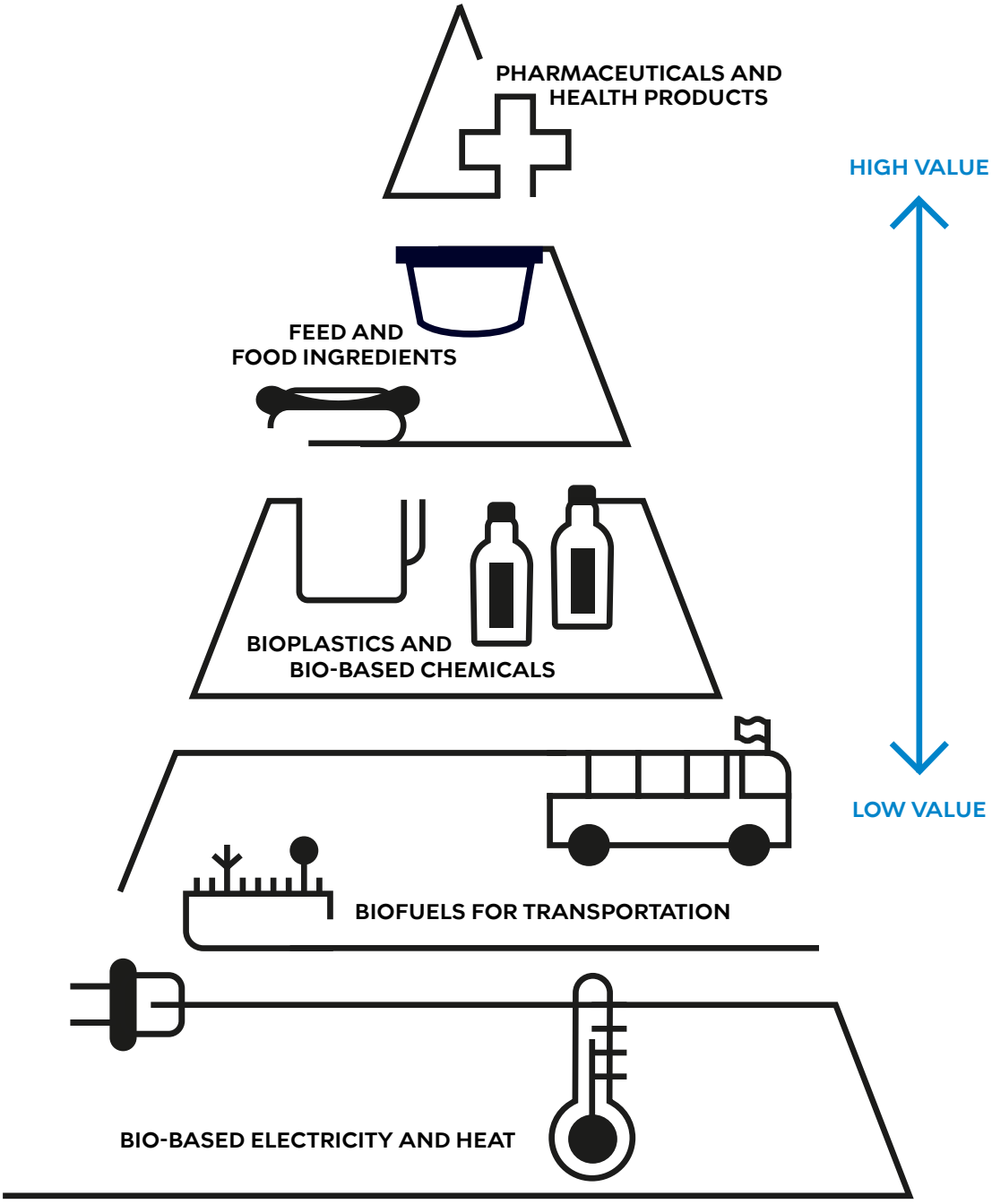
A biogas plant will be established using the most recent technology to optimise the production and utilisation of the biogas. Also, it will be ensured that the resulting fertiliser is clean enough for use at organic farms. A biogas plant close to the city will ensure that the biogas can contribute to a more carbon neutral capital through its use in the natural gas grid, such as in buses and trucks in Copenhagen.

Through collaboration with universities, companies, and other private and public collaborators development projects will be launched in view of maturing new technologies to becoming sustainable businesses. The aim is to establish a test plant for biorefining in view of utilising the biowaste as high up the hierarchy as possible.

Effect

The establishment of a biogas plant close to the city will contribute to a reduction of Copenhagen's CO_2 emissions, since the gas can be upgraded to natural gas quality, thereby replacing fossil gas. In a longer term perspective the development projects on biorefining can potentially contribute to a circular economy. This can be attained, for example, by producing oil-based plastic products from biowaste , and the biogas can form the basis for the production of proteins.

HIERARCHY FOR BIORESOURCES



Bioresources from, among others, biowaste in households are to be converted to new products of as high a value as possible. The higher up the hierarchy, the better.

"Circular Copenhagen" is the City of Copenhagen's resource and waste management plan for 2019-2024. It contains objectives and descriptions of measures to be implemented to get closer to the target of a zero waste city.

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