KAS

the ClimateActive City

TOWARD A CLIMATE-ACTIVE CITY

HOW URBAN WATER CAN CONTRIBUTE TO A CIRCULAR CITY

THIS IS A PUBLICATION BY

stowa

2016-08


WOUTER TER WEE

CLIMATE-ACTIVE CITY: CITY OF THE FUTURE

IS THE CITY THE PROBLEM? THE CITY IS THE SOLUTION!

More than half of the world's population lives in cities. Cities are large-scale consumers of water, resources and food and they produce enormous amounts of waste, air pollution and CO_2.

Cities produce a large share of all greenhouse gases. These greenhouse gases are the main cause of climate change. The same cities in turn are possibly confronted with even more consequences of climate change than rural areas: extreme weather including flooding, water shortages, heat stress and subsidence.

FROM PROBLEM TO SOLUTION

Luckily cities are also breeding grounds for new developments. There are plenty of new social initiatives in the social, economic and ecologic fields that reduce our impact on the environment and promote a healthy and attractive city. Examples include urban architecture, energy co-operatives, water boards' energy and raw materials factories, car sharing and initiatives to make the city greener.

NOT ONLY TECHNOLOGY

Cities are faced with enormous challenges in the 21st century. We will need to design them more efficiently with regard to the use of natural resources and energy. We need to find ways to adapt them to climate change and we must find a way – in spite of the effects of climate change – to keep them attractive and healthy. This transformation is not purely technical. It will need the commitment and creativity of people who work and live in the city and urban development professionals. New cooperation is also necessary between diverse parties such as water boards, municipalities, businesses, co-ops and citizens. Only together will we be able to make the transformation successful. This requires new forms of organizing and managing.

A LARGE PART OF ALL GREENHOUSE GASES IS PRODUCED IN CITIES

WATER BOARDS

Together with other parties, water boards search for solution in the urban setting to absorb the consequences of climate change and to realise more efficient use of energy and resources. Water boards, for example, are working on producing energy and extracting raw materials from wastewater, thereby transforming wastewater treatment plants into factories for energy and raw materials. Possible cooperation between citizens and businesses in the urban setting is also being examined, with the objective of a liveable city which can cope well with water and climate. The water boards called this approach the Climate-active City (KAS in Dutch).

Within the climate-active city water is considered one of the structuring principles in the city and one of the natural facilitators for closing the urban cycles: the circular city.

With this poster we would like to inspire water boards, designers, municipalities, developers, businesses and residents to work together on new solutions for the Climate-active City. We demonstrate how the urban water system can easily be combined with elements such as recreation, biodiversity, cyclists and pedestrians, energy and heat generation and the production of raw materials.

ONLY TOGETHER CAN WE MAKE A SUCCESSFUL TRANSFORMATION

GREEN & BLUE: THE BASIS FOR A CLIMATE-ACTIVE CITY

In the ideal city there should be an interlacing with green-blue networks in addition to ‘grey networks’. The urban water system and the urban green areas are then connected. These green-blue networks offer an excellent base for the realization of a Climate-Active City.

Green-blue networks can facilitate a variety of functions: water storage and treatment, urban lungs, district cooling, biomass production, nature development, food production, recreation and an attractive and safe route for cyclists and pedestrians. The urban wastewater chain – as part of the grey network - can also produce energy, heat and resources.

Combining functions locally on a district or block level allows for synergy and saves space, making the city more efficient. Examples of synergy are:

CLIMATE ADAPTATION
Measures for rainwater buffering – for example less paving and more vegetation – contributes to cooling in the city and offers opportunities for citizen participation (for example replacing paving in urban gardens).

BIODIVERSITY
Urban water systems and green networks linked together offer many opportunities for plants and animals but also for recreation and cycling and pedestrian routes.

ENERGY
We can extract heat from wastewater and make biogas from sewage sludge fermentation, which can then be used to produce electricity and heat. Heat can be extracted from surface water and in the production of drinking water to heat buildings.

RAW MATERIALS FROM WASTEWATER
Valuable raw materials can be extracted from wastewater, such as cellulose and phosphate. Phosphate can be used as fertilizer in agriculture.

PARTICIPATION
Providing city residents with opportunities to participate in the design, construction and maintenance of green spaces creates more engagement and it may be possible to save on costs of installation and management. City residents can actively contribute to making the city more climate-resilient by making their gardens and roofs more green.

FOOD PRODUCTION
Public and private vegetable gardens can be planted in the city and professional urban agriculture can be encouraged. Organic fertilizers from wastewater and green management can be used for urban agricultural businesses, as long as it is done in a hygienically-responsible way. Every square metre of green surface of a vegetable garden or urban agricultural business contributes to more natural urban water management. Roofs can also be used for food production.

BETER QUALITY OF LIFE
Green areas and bodies of water are places where people can enjoy outdoor recreation. This benefits health and wellness and reduces stress among citizens. More nature in the city in the form of vegetation and water can thereby reduce health costs.
Creative play opportunities in a natural setting are important for children because it increases their social skills and ability to concentrate. More nature can increase the attractiveness of the compact city as a place for businesses and individuals to settle. This is reflected in higher property values for homes located on water or green areas compared to homes not located there.

HEAT CAN BE EXTRACTED FROM WASTEWATER

HEAT PREVENTION
Every measure that contributes to more natural urban water management, such as unpaved gardens, areas with vegetation, green roofs, vegetable gardens and urban agriculture, also contributes to limiting the heat in the city.

SINGAPORE
REPUBLIC OF SINGAPORE

Singapore strives to be a climate-resilient and circular city because it has no hinterland and wants to be self-sufficient in drinking water production and wastewater treatment.

Despite the high concentration of buildings, city authorities would like to use vegetation to reduce heat and attractive businesses. Singapore buffers all of its rainwater in a reservoir and processes it for use as drinking water. All of its wastewater is treated using membrane filtration and reused for industry. Singapore is making the city as green as possible by applying green roofs and facades, half-paved parking spaces, green rainwater discharge, compact parks and adding vegetation to the streets scene.

ALL RAINWATER IS TREATED AND REUSED AS PROCESS WATER

GREEN SOLUTIONS FOR RETAINING RAINWATER

PORTLAND
OREGON, USA

Portland’s primary motivation to work on a Climate-active City is to improve the quality of life and increase local employment opportunities. Portland has an extensive green and sustainable urban development concept. Many green solutions have been conceived of for retaining rainwater on streets and squares.

But they are also working on making the city more sustainable, for example with urban agriculture, sustainable energy generation and green local employment opportunities. Additionally, use of the car is discouraged and cycling encouraged. This creates more space for green, less CO2 emissions and lower energy use.

LONDEN
GREAT BRITAIN

London regularly suffers from flooding and heat stress, causing for example computer systems in the city to break down. London is working hard to prevent flooding and heat stress according to the principles of the London Green Grid. This dictates that during restructuring projects the possibilities for water storage, greening, development of biodiversity, travel routes for cyclists and pedestrians and recreation must be considered.


HENRI CORMONT

THE CLIMATE-ACTIVE DISTRICT

The district is the perfect scale at which urban cycles can be closed. In the district consumers and producers are close together. The waste heat from a business can be used to warm buildings. Rainwater can be buffered in the district, thereby increasing its attractiveness.

An example is the ecologic district EVA-Lanxmeer in Culemborg (eva-lanxmeer.nl), where all the rainwater is buffered. Greywater is treated locally and added to the district water. The Waterschoon project in Sneek (waterschoon.nl) takes it one step further. In the new district Noorderhoek energy and raw materials are produced from wastewater.

Although vegetable gardens and urban agricultural businesses in the district provide but a small portion of the food for a district, they do bring us back in touch with food production, thereby increasing awareness. An extra advantage is short transport routes. Urban agricultural businesses and vegetable gardens also provide social meeting points.

WATER

There are many opportunities for a climate-resilient approach at the district and street level. The starting point here is retaining rainwater locally. This can be done with less paved surfaces, installing green roofs, infiltration of water and the realisation of water storage in the district. Rainwater can also be buffered and used for toilet flushing.

ENERGY

Wastewater is usually treated in a central wastewater treatment plant. In a more decentralised approach, local energy and resources can be reclaimed. In the Waterschoon project in Sneek and the Jenfelder Au project in Hamburg, the water system is a large energy provider for the district. Heat can also be recovered from surface water, from the air and from the ground with a water pump. Heat can also be recovered from wastewater and treated wastewater for use in buildings.

WASTE

At the district level many waste cycles can be closed using decentralised facilities. For example, the wastewater and organic waste from the district, including household organic waste, can be used in an energy and raw materials factory to produce energy and heat for the district. Raw materials such as phosphate, which is released during wastewater treatment, can be used as fertilizer in urban agriculture. Organic waste can be used for compost.

PEOPLE WHO LIVE IN A GREEN ENVIRONMENT ARE IN GENERAL MORE HEALTHY

FOOD

In many cities local food production is being developed in many forms: from private vegetable gardens, roof gardening and community gardens to professional urban farms. The advantage of these initiatives is that they bring the urban resident back into contact with food production. A decentralised energy and raw materials factory (such as in Jenfelder Au) in combination with an urban agriculture business is ideal for the Climate-active city; the treated wastewater and the raw materials released (such as phosphate) can be used for local fruit and vegetable cultivation.

GREEN-BLUE NETWORKS

Green-blue networks can benefit residents particularly at the district level. Green roofs, bioswales, parks, community gardens and natural playgrounds are all part of the Climate-active city. They make the district healthier, more attractive and climate-resilient. People who live in a green environment are in general less stressed. Children can play outside, which can reduce the number of overweight children.


SIGRUN LOBST

SNEEK, FRIESLAND, THE NETHERLANDS

WATERSCHOON

A sustainable and innovative water treatment system has been installed by several local entities (Wetterskip Fryslân (water board), Woningstichting de Wieren (social housing agency), STOWA (Foundation for Applied Water Research), the municipality of Súdwest-Fryslân and DeSaH bv (consultancy) in the Noorderhoek district of Sneek. Wastewater from 232 new homes is collected separately at the source and cleaned in a small treatment facility in the district. The Waterschoon project is the first in the world on this scale.

SEPARATE AT THE SOURCE

In this district organic waste together with water from toilets (blackwater) is collected through a vacuum system. The special vacuum toilets need only 1 litre of water per flush, while a standard toilet uses 7 - 8 litres per flush. Household wastewater (greywater) is discharged from the home. The blackwater and the greywater are treated separately in a local wastewater treatment plant in the district itself. The greywater is then discharged into the rainwater sewer system. The greywater from showers and washing machines is less dirty but has much more volume than the blackwater. By treating them separately the treatment is simpler and uses less energy. In regions with water shortages the treated greywater could be used for toilet flushing or horticultural businesses.

BIOGAS PRODUCTION

Blackwater from all connected homes comes together in a fermentation installation in the energy building. During fermentation biogas is released which is partly used for heating homes and tap water. Around 12 percent of the total gas demand in the district is produced in this way.

HEAT EXTRACTION

The greywater, coming from the washing machine, dishwasher, bath and shower is also treated in the energy building. Most of this water is heated and still has – even after transport – a high temperature. This heat is extracted and used to heat homes in the district.

ENERGY AND WATER CONSERVATION

A savings of 10 percent can realised on heating the houses by extracting heat from the sewer water. Producing biogas from sewer water means an extra savings of 10 percent. This is combined with a thermal energy storage installation and a heat pump located in the energy building. Further advantages include:

- Water conservation by households (25-50%)
- Removal of harmful substances (more than 90%) from the wastewater, such as nitrogen, phosphate and drug waste
- Reduction of polluted by-product streams (sewage sludge)
- Generation of energy from wastewater, and therefore savings on space heating and with that a reduction of CO_2 emission.
- Conversion of chemical elements such as phosphate into fertilizer


WATERSCHOON

ECF FARMERS MARKET

BERLIJN

ECF URBAN FARMING

In the ECF Urban farming project in Berlin fresh water fish (perch) is cultivated in collected rainwater in an old factory building. The water, enriched with fish excretion, is then used for vegetable growing in the greenhouses. The advantage of this system is that it is almost a closed water cycle: the production takes place close to the consumer and that there is hardly a need for transport. The waste product of the fish production is also used as fertilizer to grow the vegetables. The company occupies around 1800 m² and delivers 30 tons of fish and 35 tons of vegetables per year.

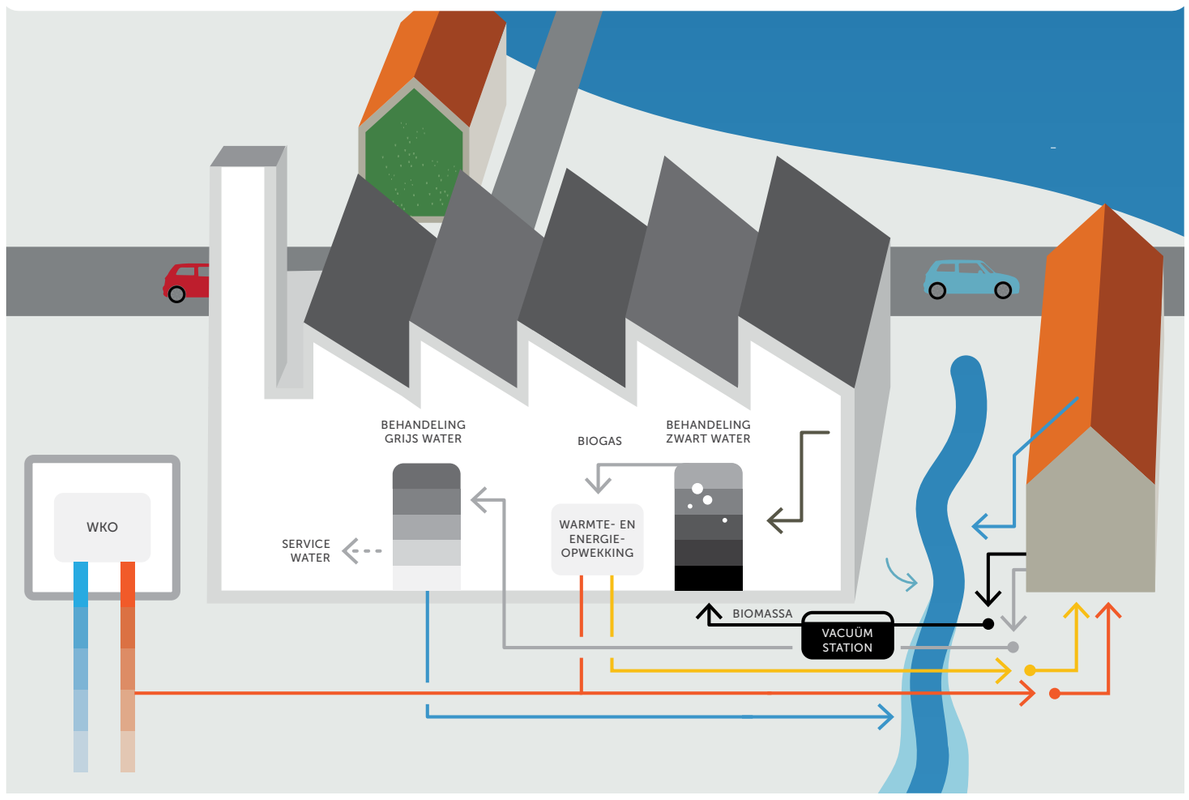
HAMBURG

JENFELDER AU

The Jenfelder Au project is, through its use of public green for rainwater retention and through its advanced wastewater concept, a good example of what green-blue networks can do for a climate-active city.
A former army barracks complex totalling 35 ha in Hamburg Wandsbek is being restructured and converted into a modern climate-neutral district with around 770 homes. In addition to new homes, homes are being built in a few of the old barrack blocks. The new homes are being built in accordance with the low-energy standards or in compliance with the passive home standard (max. 50-15 kWh/m³ use). The idea from Sneek is being applied here on a larger scale and in combination with green-blue networks. The blackwater, greywater and rainwater are processed separately. After treatment the greywater is added to the district water system. It can be used in regions with water shortages for toilet flushing or horticultural businesses. In Jenfelder Au biogas is used in a CHP installation for electricity and heat production. This provides 40 to 50 percent of the electricity and heat energy supply for the district.
The rainwater is buffered in a retention pond which is part of the district water system. Here the water can infiltrate and evaporate. The pond is also part of the district's green network.


ATELIER GROENBLAUW

ENERGY AND RAW MATERIALS FACTORY



OPTIGROEN

THE CLIMATE-ACTIVE BUILDING

Not only at a city and district level can we work on the circular city, but also at the building level.

WATER

At the moment households use drinking water for showering, washing, cleaning, watering the garden and preparing food. Ideally the greywater from the shower and washing machine and blackwater from the toilet can be treated in a helophyte filter and be made suitable for reuse. Clean rainwater from roofs often ends up in the sewer system. In general rainwater can be used again without being treated for the washing machine, the garden or for toilet flushing. This is already quite common in Belgium and Germany.

Because gardens continue to become more compact and paved, more and more rainwater from gardens must be discharged through the sewer system. Paving surfaces is bad for soil life and for the water table; it speeds up the water discharge, intensifies the strain on the sewer system and increases heat stress. By not paving gardens the rainwater can drain into the ground. In addition to retaining rainwater, unpaved gardens also keep the surroundings cooler through evaporation. Other options for retaining rainwater include installing a green roof, a ditch or a rainwater retention pond.

80% SAVINGS ON DRINKING WATER BY 100% REUSE OF TREATED WASTEWATER

ENERGY

It is important to insulate a house well in order to reduce the demand for heat. Applying sustainable energy sources, such as solar collectors and PV cells, heat recovery from shower water and the use of ambient heat is an important second step.

FOOD

Part of our own fruit and vegetable needs can be met by planting a vegetable garden with a fruit tree, berry bushes, nut trees and a small greenhouse. For complete self-sufficiency, including potatoes and grains, around 170 m² per person is needed. Organic waste can be composted in the garden and used again as fertilizer.

WASTE

Fifteen percent of the weight of household waste can be saved by composting organic waste. Separating waste to make reuse possible and limiting residual waste is of course important.

MORE VEGETATION

More vegetation on and around the home is good for retaining rainwater, keeping the living environment cool, for biodiversity and for our general wellness. An unpaved garden and a green roof buffer rainwater, thereby helping prevent flooding during heavy rainfall. Vegetation evaporates water and keeps the immediate living environment cooler. A green garden offers a habitat for all sorts of small animals and insects: bees, butterflies, beetles, birds, etc.
A combination with water, such as a retention pond, attracts even more plants and animals.

BEELDBANK RWS.NL
RIJKSWATERSTAAT / JAN VAN DEN BROEKE

TERNEUZEN

RIJKSWATERSTAAT OFFICES

THE BUILDING IS HEATED WITH HEAT FROM THE CANAL WATER

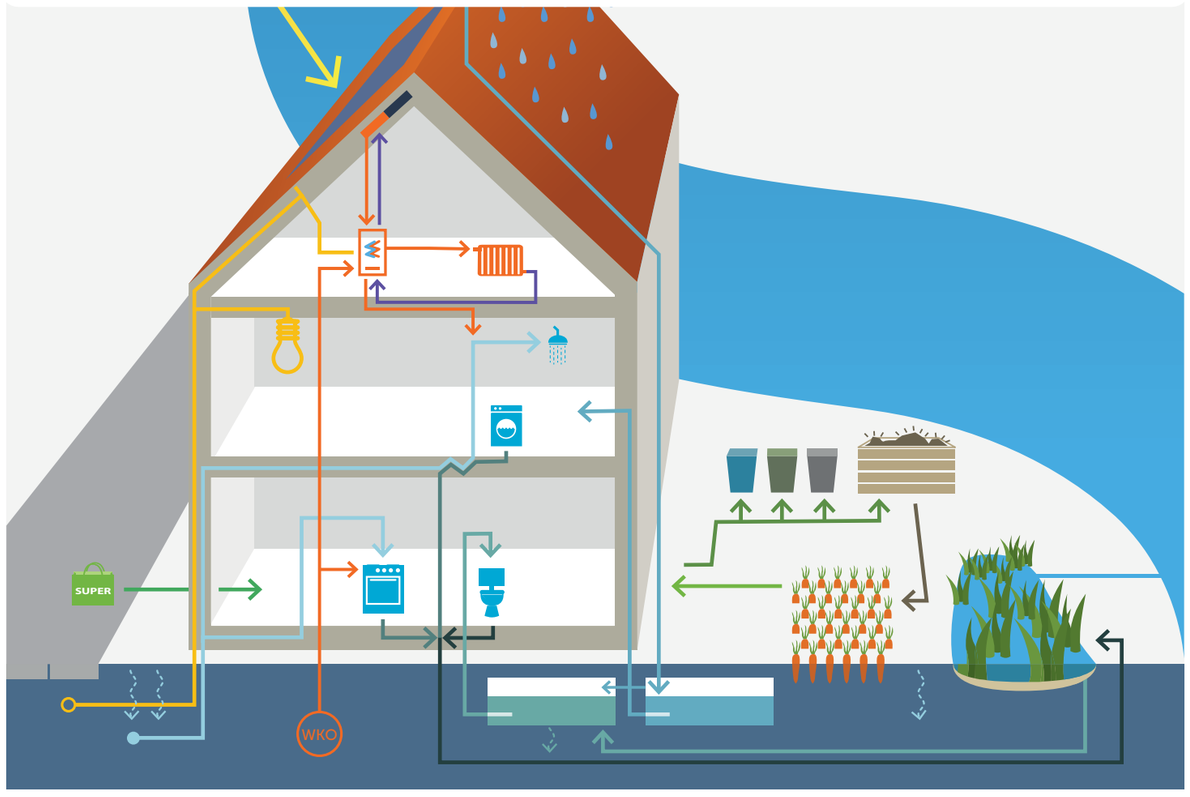
An extremely sustainable office building for the Dutch Rijkswaterstaat agency, part of the Ministry of Infrastructure and the Environment, was built in 2000 at the locks complex near Terneuzen. It was designed entirely according to the green-blue and circular principles. The building houses 60 employees.

The building has a green roof which holds most of the rainwater. The remainder flows into a ditch. There is very little paving around the building. Where it is necessary, there is half-paving. This makes rainwater discharge unnecessary. All the wastewater from the toilets, showers and sinks are treated in a field of reeds and used again for toilet flushing. There is a buffer for the treated wastewater, incorporated into artwork. Connection to the sewer system is not necessary. A water pump that extracts heat from the canal water in the Ghent-Terneuzen canal is used to heat the building. Solar collectors on the atrium provide part of the building's electricity.

Material from the agency itself was used in the construction of the building. For example bollards were sawed into wooden shingles for the façade and indoor galleries. Old clinkers and basalt blocks were reused for both the exterior and interior. The inner walls are made of sustainable limestone and only natural paint was used.

MADELEINE DERSU

CIRCULAR HOUSE



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THE CLIMATE-ACTIVE BUILDING

Not only at a city and district level can we work on the Climate-active city, but also at the building level. Consider for example disconnecting rainwater to use for toilet flushing or the washing machine.

COLOPHON
Amersfoort, April 2016

PUBLICATION
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STOWA NUMBER
2016-08

stowa

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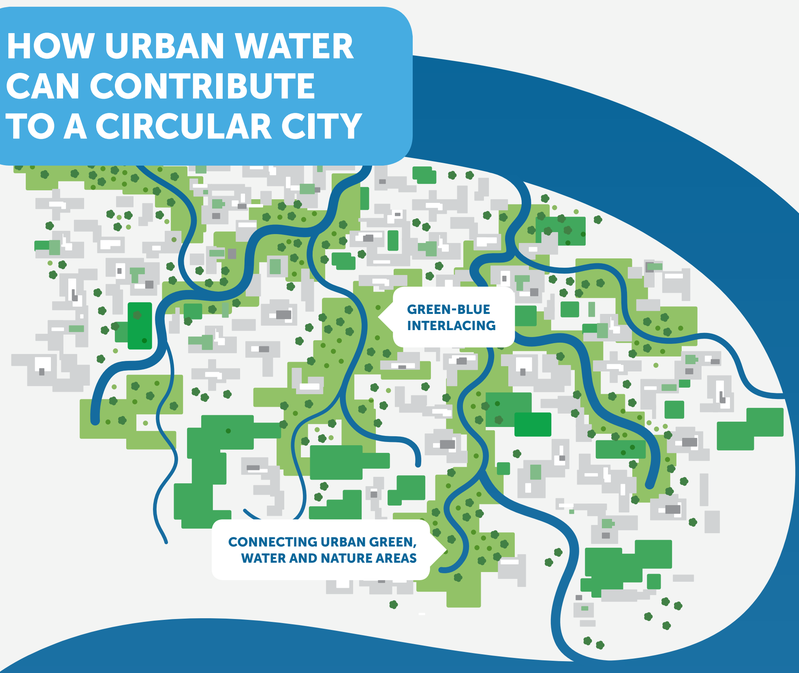


GREEN-BLUE ARTERIES THROUGH THE CITY

LESS PARTICULATE MATTER (PM)
MORE GREEN REDUCES PM IN THE AIR

LESS FLOODING
LESS PAVING AND MORE ROOM FOR SURFACE WATER CREATES MORE OPTIONS FOR RETAINING AND STORING WATER TEMPORARILY

MORE BIODIVERSITY
CONNECTING URBAN GREEN AND BLUE ENSURES MORE PLANTS AND ANIMALS

BETTER QUALITY OF LIFE
MORE BLUE AND GREEN MEANS A BETTER QUALITY OF LIFE, A HEALTHIER ENVIRONMENT AND LESS HEAT STRESS

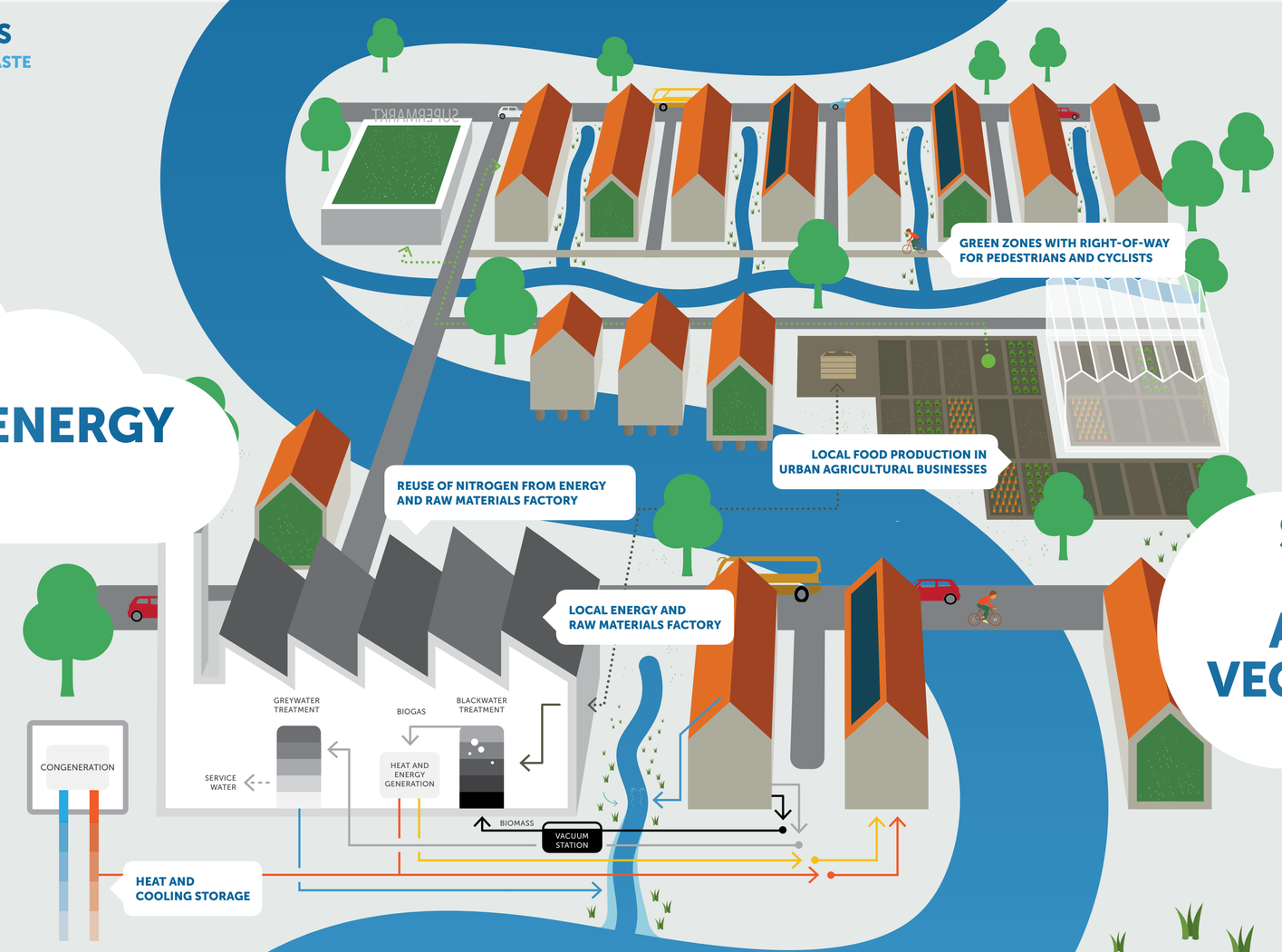
PRIORITY FOR PEDESTRIANS AND CYCLISTS
USE GREEN-BLUE STRUCTRUES FOR WALKING AND CYCLING ROUTES AND FOR RECREATION

EXTRACTING, RECLAIMING AND REUSING MATERIALS LOCALLY

RAW MATERIALS FROM WASTEWATER
RECLAIMING PHOSPHATE, NITROGEN AND CELLULOSE FROM WASTEWATER

CLOSE RECYCLING LOOPS
COMPOSTING AND REUSING ORGANIC WASTE

HEAT & ENERGY
HEAT AND ENERGY EXTRACTION THROUGH FERMENTATION OF ORGANIC MATERIAL FROM WASTEWATER



LOCAL AND SUSTAINABLE ENERGY PRODUCTION

GEO-THERMAL HEAT AND AMBIENT HEAT
USE THIS HEAT TO COOL AND HEAT BUILDINGS

HEAT FROM SURFACE WATER
USE TO COOL AND/OR HEAT BUILDINGS

RESIDUAL HEAT
USE RESIDUAL HEAT FROM INDUSTRY TO HEAT HOMES AND BUILDINGS

SOLAR PANNELS
GENERATE SUSTAINABLE ENERGY ON UNUSED SURFACES SUCH AS ROOFS

SELF-SUFFICIENCY THROUGH URBAN AGRICULTURE AND VEGETABLE GARDENS

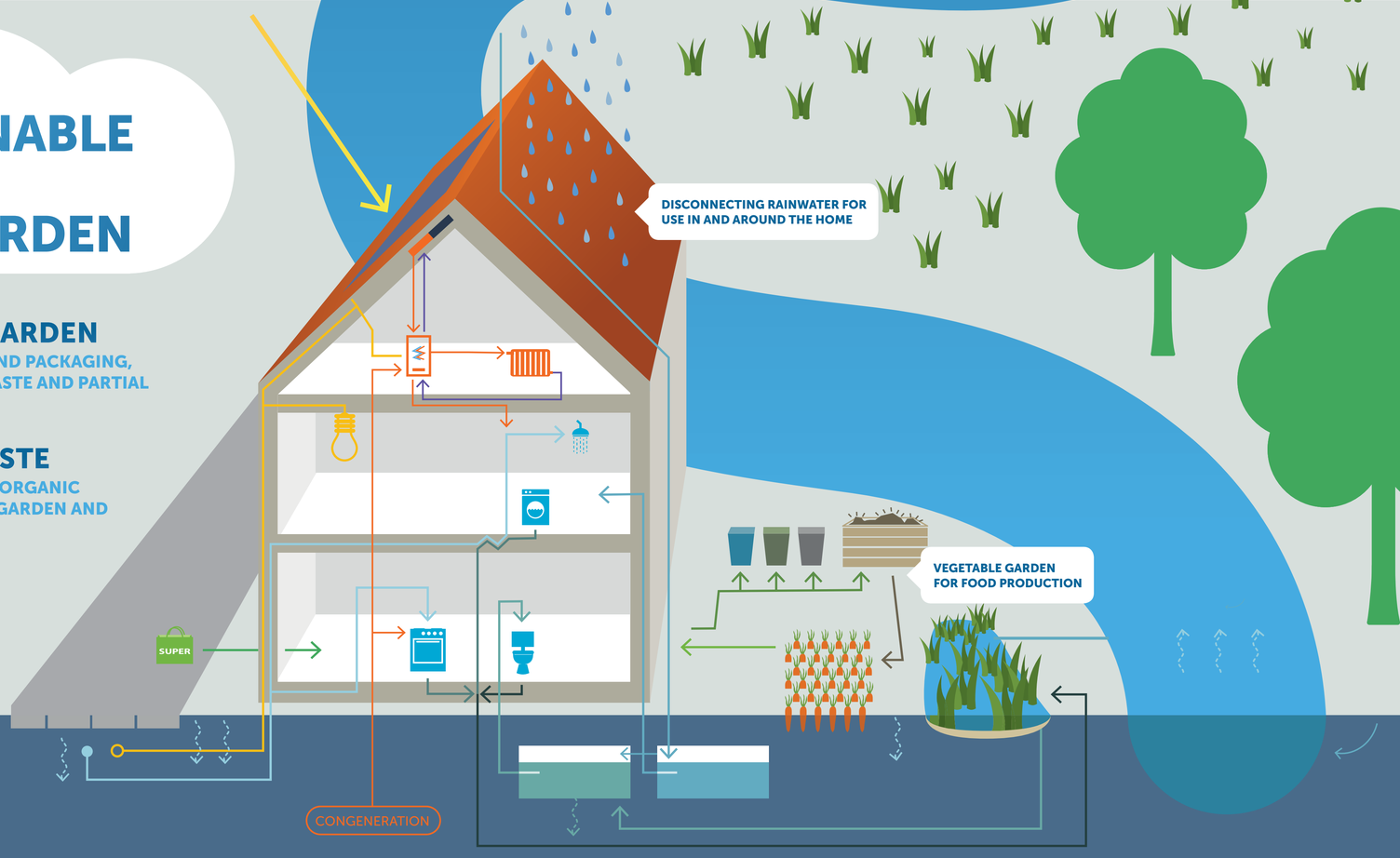
URBAN AGRICULTURE
USE LOCALLY-RECLAIMED FERTILIZER FROM THE ENERGY AND RAW MATERIALS FACTORY IN URBAN AGRICULTURE

PARTICIPATION BY RESIDENTS
LOCAL RESIDENTS MAINTAIN THE NEIGHBOURHOOD'S VEGETATION

SUSTAINABLE HOME AND GARDEN

VEGETABLE GARDEN
LESS CO_2 EMISSIONS AND PACKAGING, REUSING ORGANIC WASTE AND PARTIAL SELF-SUFFICIENCY

ORGANIC WASTE
COMPOST AND REUSE ORGANIC WASTE IN YOUR OWN GARDEN AND VEGETABLE GARDEN



DISCONNECT RAINWATER FROM THE SEWER SYSTEM

REMOVE PAVING
REMOVING PAVING AND ADDING VEGETATION TO THE GARDEN CONTRIBUTES TO WATER RETENTION, THEREBY RELIEVING THE SEWER SYSTEM. THIS MEANS LESS WATER IN THE STREET

RAINWATER USE
RAINWATER CAN BE CONTAINED AND USED FOR RINSE WATER, THE WASHING MACHINE AND THE GARDEN

MORE INFO AND INSPIRATION AT GROENBLAUWENETWERKEN.NL AND HUISJEBOOMPJEBETER.NL

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