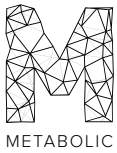
EXECUTIVE SUMMARY

Transitioning
Amsterdam
to a Circular City

CIRCULAR BUIKSLOTERHAM

Vision & Ambition


METABOLIC


DELVA Landscape Architects


Studioninedots


amsterdam
smart
city


new
energy
docks


BSH


PAKHUIS DE ZWIJGER*


de Alliantie
hart voor wonen


waternet


Gemeente Amsterdam
Ontwikkelingsbedrijf

Cities are a key leverage point for transitioning the global economy to a sustainable state

As human impact on the environment accelerates and we continue to make very uneven progress on achieving most of the United Nations' Millennium Development Goals,[1] cities have come into sharp focus as a key intervention point for change. We must re-imagine how cities function. While they occupy only 3% of global land surface, cities consume 75% of global resources and produce 60 - 80% of global greenhouse gas emissions.[2] Cities must transition from their status as "global resource drains" to circular, biobased, smart, productive, ecologically- and socially-integrated hubs. This is arguably one of the most essential steps in transitioning the broader human economy to a more sustainable state.

Buiksloterham is a unique neighbourhood within Amsterdam that can serve as a living lab for Circular, Smart, and Biobased development

By most quantitative measures, Amsterdam is a small city in a small country. Though it is the largest city in the Netherlands, its municipal population numbers only around 813.000 residents, placing it in 432nd place of the world's largest urban agglomerations.[3] Despite its small size, Amsterdam is global in character. Its role in shaping history through the development of international markets and trade, its contribution to innovation, its creative sector, and its progressive social policy have solidified it as a historical and cultural landmark, attracting almost 13 million tourists per year.[4] Amsterdam is looked to internationally as a positive example for urban governance, development, and policy.

Buiksloterham, a neighborhood in the north of Amsterdam, is in a unique position to serve as both a living test bed and catalyst for Amsterdam's broader transition to becoming a circular, smart, and biobased city. Within Amsterdam, Buiksloterham is a rare case: though it has been treated as a functionally peripheral district because of its industrial past, it is located just five minutes from the old center of Amsterdam across the IJ river. Unlike most other centrally-located neighborhoods, Buiksloterham is a comparative blank slate with many empty plots and almost no monumental buildings. This status creates space and flexibility for new development.

Buiksloterham shares many features with other post-industrial neighbourhoods worldwide

Though Buiksloterham is unique in Amsterdam, it also has many features that make it a good case study for the transformation of other post-industrial neighborhoods in cities around the world. It is near to, but somewhat physically and socially disconnected from, an old city center. It has scattered property ownership. Many of its plots are highly polluted, creating prohibitive cost barriers to development. These are common features of many areas that were once peripheral to city centers, but have grown closer through the process of urban expansion.

In the vision and Action Plan presented in this report, we conceive of Buiksloterham as an engine for the broader transition of Amsterdam. Its polluted lands and open spaces can become the center of the implementation of new clean technologies and a hub for the closure of urban material cycles. The activities needed to close these local material flows can be used as a driver for local industry and the strengthening of local social networks. IT-based interventions can smartly connect local residents with one another and boost the efficiency of resource flows. Urban biodiver-

1) The Millennium Development Goals are a set of targets published by the international community for global sustainable development. Recent progress reports indicate uneven progress on the MDGs, particularly on environmental sustainability targets.

2)United Nations Development Programme Statistics

3) 2013 Population Statistics

4) Amsterdam Economic Board tourism figures

sity and climate adaptation measures are conceived as a core strategy to bring long-term local resilience to the area. As such, Buiksloterham can serve as a blueprint and live experiment for how such formerly peripheral areas worldwide can be transformed into a motor for change and regeneration in cities.

Intervening in the development of Buiksloterham to realize sustainability objectives is urgent

Buiksloterham is part of a larger re-development plan of the northern banks of the IJ river. Though sustainability has been mentioned as an ambition for the re-development of the area and has been used as a performance metric in some tendering procedures, there is no central sustainability plan or directive. This poses the risk that sustainability as a development objective will be de-prioritized because of the unusually market-driven and bottom-up approach the municipality has taken with the area's redevelopment.

Not taking advantage of the transformational potential of neighborhoods like Buiksloterham would be a massive missed opportunity. New construction offers much more flexibility and lower costs for sustainable design than retrofitting. In order to move towards a more sustainable state, these former industrial areas need dedicated creative thinking, investment, and vision as they are redeveloped.

Buiksloterham is now on the cusp of a rapid transformation. In the coming three years alone, around 84.000 m2 of new residential construction is scheduled, representing an increase of almost 30% over the current built area in the neighborhood. Recognizing the urgency for a clear strategy, stakeholders including the development office of Amsterdam's Municipality, Grond & Ontwikkeling, the local water utility, Waternet, and an important local developer, social housing corporation De Alliantie, pooled together resources to make the development of this vision and Action Plan for Buiksloterham possible.

An Urban Metabolism Scan was the foundation for co-creating a future vision and shaping interventions for a Circular Buiksloterham

The foundation of this report is an Urban Metabolism Scan, which was used to understand the full workings of Buiksloterham from an integrated, systemic perspective. The topics investigated as part of the study included energy and material flows, biodiversity, environmental conditions, socio-economic data, an assessment of local stakeholders, policies and strategic plans, and factors that may influence the health and wellness of individuals living in the area.

Insights developed during the analysis were used as input to the co-creation of the Circular Buiksloterham Vision with a group of key stakeholders at a session in mid-September 2014. This session resulted in several hundred proposed interventions for transitioning Buiksloterham towards a "circular state." These interventions were refined and evaluated using the material flow model that was built as part of the metabolism analysis. The intervention options form the basis for both the vision and the exemplary Action Plan for the area.

A second stakeholder session in early October 2014 brought together key decision-makers to commit to further supporting and implementing the Action Plan that has been developed on the basis of the vision and interventions.

Circular, Biobased, & Smart are core underlying paradigms for the Circular Buiksloterham Vision

Over the last decade, the terms "circular," "smart," and "biobased," have begun to frame a new paradigm for urban and, more broadly, economic development. These three terms refer to complementary trends in sustainability practice, and form the basis for the vision and approach we have crafted for Buiksloterham.

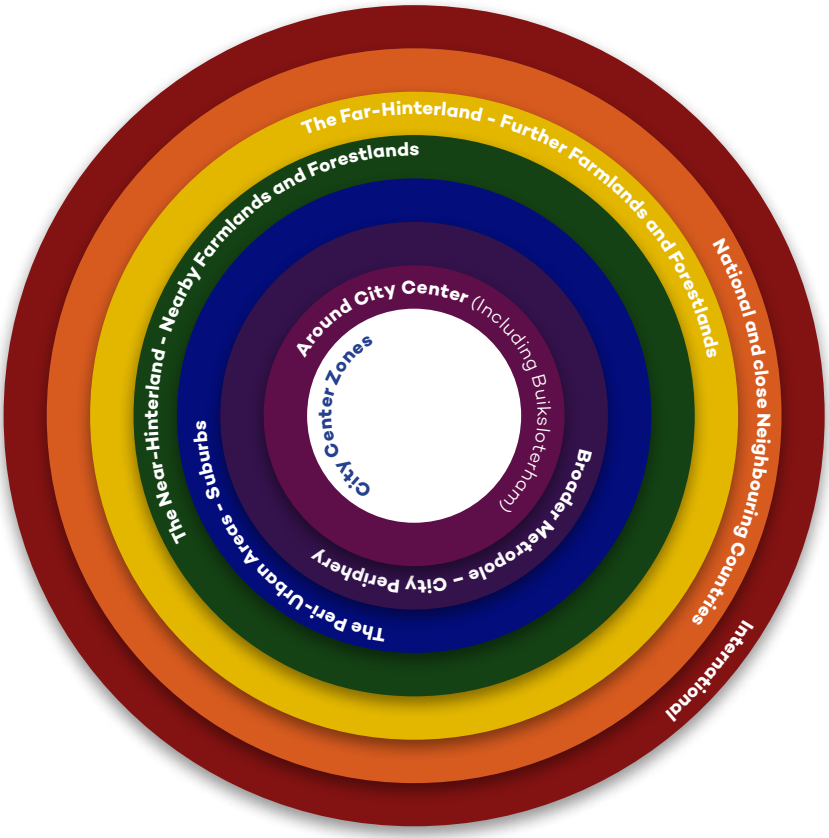
A Circular Economy is one that is "regenerative and waste-free by design." In a Circular Economy, materials are indefinitely cycled at high quality, all energy is derived from renewable or otherwise sustainable sources, and natural and human capital are structurally supported rather than degraded through economic activities. Though it may appear that the primary focus of this philosophy is on material recycling and an energy transition, achieving a Circular Economy requires systemic redesign of our modern industrial system with a great deal of focus on how it relates to both ecological and human systems.

The overarching concept of the Circular Economy is well complimented by the development goals of "biobased" and "smart" cities. The shift towards biobased resources, when executed properly, can reduce our dependency on non-renewable sources of value. A primary objective in transitioning to a biobased economy is the beneficial reuse of biological waste streams (e.g., nutrient recovery from organic wastes) and the use of bioprocessing to replace conventional industrial functions (e.g., soil phytoremediation instead of standard mechanical-chemical cleansing).

Smart Cities are those that maximize social and environmental capital in the competitiveness of urban areas through the use of modern infrastructure, highly efficient resource management, and active citizen participation. One of the drivers behind the Smart City concept is to move away from viewing the development of cities as a purely hardware-related activity to recognizing the importance of "software" elements within the city context: people, knowledge, data flows, and civic engagement. The human and programmatic elements of an urban development stand central in successfully achieving any more technically-oriented goals.

Even within a perfect "Circular Economy," not all resource flows should be closed on all spatial scales of development. The Circular City Model, as developed by Metabolic, translates how Circular Economy objectives should be applied in physical space, particularly in relation to cities. The schematic model provides rule of thumb guidelines for where certain flow types should optimally be closed.

The more costly it is to move a flow (losses, expense around transport) and the more spatially ubiquitous that flow is (for example, energy and water in the form of sunlight and rain), the higher the priority for closing that flow locally. The specific scale at which flows should be closed is based partly on calculations of density of resource demand versus density of availability. For that reason, energy and water are the two top priorities for local flow closure or supply. This is not possible in city centers, but becomes increasingly possible in areas just outside city centers like Buiksloterham. After energy and water, the next priority targets for local material cycle closure are



Circular City Framework

The Circular City Model provided guidelines for which material flows should be preferentially closed within the geographic borders of Buiksloterham

fast cycling and high volume material streams like food waste and other local organic wastes from which nutrients can be recovered. The more complex or scarce a material, the less of a priority there is on closing that material cycle locally.

The intervention options and exemplary Action Plan for Circular Buiksloterham have been developed with this schematic model in mind and based on the following general order of action priorities for managing local resources:

- Reducing the volume of local flows (demand-side management)
- Finding local supply synergies (heat cascades, material cascades)
- Supplying local flows in a renewable fashion

Based on this approach, our priorities for Buiksloterham on the level of managing physical flows have been to focus on the energy, water, and nutrient cycles (in that order of priority).

Results: Circular Buiksloterham Study

The primary outcomes of this work include:

- an Urban Metabolism Scan of Buiksloterham;
- a Vision and Ambition for a Circular Buiksloterham;
- an exemplary Action Plan & roadmaps;
- a list of possible interventions;
- commitment from key parties.

These outcomes are briefly described in the following sections.

Urban Metabolism Scan results

The Urban Metabolism Scan consists of three components: a context, stakeholder, and metabolism analysis. A detailed overview of the results can be found in the Urban Metabolism Analysis chapters at the end of the full Circular Buiksloterham report.

Physical Metabolism

Buiksloterham's current material metabolism is still dominated by its industrial character. This is readily evident in the local distribution of energy and material demand. Because there are currently only 252 registered residents in Buiksloterham, typical domestic material flows (food, household products, water, and wastes) are still relatively low. The majority of these residents is young (under 40), non-immigrant, and low-income. The development plan for Buiksloterham includes a scheduled increase of 700.000 square meters of usable space over the current 300.000, with primarily residential and office functions in the planned expansion. When all of the area's development plans are complete, the number of residents is projected to go up by approximately 25-fold and the number of offices is projected to go up by over four-fold. This will dramatically change the resource demand profile of the neighborhood and reduce the dominance of industry.

If Buiksloterham continues on a "Business as Usual" path, our model concludes that despite projected improvements, Buiksloterham will follow the typical pattern of an urban "resource drain." Below is an overview of how some key parameters may look in Buiksloterham under this BAU path.

Energy:

- The total energy demand will be 992 million MJ (or 992 Terajoules) per year, largely resulting from the area's heat demand (32%), followed by energy for mobility (21%), and operational energy for remaining industrial activities (13%);
- By 2020, the electric grid is projected to supply 12-14% renewable energy to Buiksloterham, little of which little will be generated locally;

Infrastructure & mobility:

- In 20 years, the district heat network will be the primary source of supply for the area's large heat demand. This heat will mostly be produced by the incineration of municipal waste at the waste-to-energy plant;
- The area will have an additional 5.000 parking spaces based on the parking standard of one

spot per household and 1/125th parking spot per m^2 office space;
- The fuel use for vehicles (residents, commuters, transport of goods) will result in 14.016 tonnes of CO_2 emissions per year (23% of total projected CO_2 emissions for Buiksloterham) and significant NO_x and PM emissions.

Water & nutrient cycle:

- Stormwater will be traditionally managed through underground stormwater sewers. The neighborhood will have a dominant percentage of non-permeable surfaces. Most rainwater will not be usefully applied or buffered;
- There will be no recovery of nutrients like nitrogen and limited phosphate recovery (10-20%) at the waste water treatment plant (WWTP) in West Amsterdam.

Material cycle:

- 3.500 tons of municipal and commercial waste will be incinerated annually in the waste-to-energy plant; only 14% of the municipal solid waste will be separately collected and recycled;
- Excluding industrial inputs, construction materials will be by far the largest material flow by mass (490.000 tonnes) into Buiksloterham over the coming twenty years. This flow will be dominated by reinforced concrete, a traditional building material with only low-quality recycling options.

Ecosystems and biodiversity:

- The polluted plots in Buiksloterham cover over 15 hectares, or around 15% of the total area.
- Under a standard approach (ex situ mechanical remediation), these soils would cost up to an estimated 20 million euros to remediate;
- As a result of the high projected cost, most of the polluted grounds will remain empty and fenced off for the coming years.

Socio-economic:

- Buiksloterham runs the risk of becoming a standardized and monofunctional neighborhood. This can be avoided if sufficient room is given to organic development and explicit steps are made towards integration with existing users and neighboring areas, as well as a planned diversification of functions.

Health & wellbeing:

- As a result of increasing mobility and remaining industrial functions, local emissions may pose a risk to healthy air quality. Noise and odor pollution will be a continued nuisance.

Snapshot overview: Current vs. +20 projections for Buiksloterham

- Overall energy demand will increase almost 3-fold;
- Heating demand will increase 5-fold;
- Electricity demand will increase almost 2-fold;
- Vehicle fuel demand will increase almost 6-fold;
- Water demand will increase almost 4-fold;
- Food demand will increase 9-fold;
- Waste production will increase almost 3-fold;
- Household good demand will increase by 170-fold.

Circular Buiksloterham Vision and Ambition

The vision of a Circular Buiksloterham is of a neighborhood with exemplary performance on a set of systemic measures of urban and environmental quality. It is an area of continuous innovation and experimentation. It is a neighborhood with a tight-knit local community, strong civic engagement, and a resilient local economy. All energy comes from renewable sources. All products and materials are recovered for reuse, repair, and recycling. The area is biodiverse and features attractive and human-scale streets and buildings. These holistic performance criteria for a Circular Buiksloterham have been summarized in eight overarching goals for the neighborhood's development.

The results of this modelling have informed the development of the Circular Buiksloterham Vision and the proposed Action Plan.

Overarching Ambitions for Circular Buiksloterham in 2034:

A more detailed description can be found in the Vision and Ambition chapter of the full report.

- Energy: Buiksloterham is energy self-sufficient with a fully renewable energy supply
- Materials & products: Buiksloterham is a zero waste neighbourhood that with a near 100% circular material flow
- Water: Buiksloterham is rainproof and has near 100% resource recovery from waste water
- Ecosystems and biodiversity: Buiksloterham's ecosystems are regenerated and its base of natural capital is self-renewing
- Infrastructure & mobility: infrastructure is maximally-used and local mobility has zero emissions
- Socio-cultural: Buiksloterham has a diverse and inclusive culture, and a high quality, livable environment
- Economy: Buiksloterham has a strong local economy that stimulates entrepreneurship and encourages the creation and exchange of multiple kinds of value (social, environmental, cultural)
- Health & wellbeing: Buiksloterham is a healthy, safe and attractive environment with recreational activity space for all residents

Proposed Action Plan

The high-level performance ambitions for Buiksloterham as a circular neighborhood could apply to most urban developments worldwide because they represent generic standards for a "circular neighborhood" or city. The challenge lies in designing an Action Plan that translates these ambitionss to the context, challenges, and opportunities of a specific area. Some of the unique features of Buiksloterham include: a rapid increase of new housing developments, a rapid increase in mobility and energy demand, large amounts of surface water and rainfall, and a high percentage of polluted grounds (15%).

The proposed Action Plan for a Circular Buiksloterham is where these and other contextual features are translated into an approach for achieving the higher-level ambitions in Buiksloterham. This plan was developed by prioritizing interventions based on their urgency, the magnitude of

their impact, and their specificity to the context of Buiksloterham. Our understanding of magnitude, urgency, and contextual relevance was shaped by the Urban Metabolism Analysis.

Because of the long-term scope of this project, it is not advisable or possible to propose specific technical interventions for fully achieving each goal over the coming 20+ years. New technologies will emerge, the price of existing technologies will change, and the range of opportunities and solutions will evolve over time. Specific technical recommendations risk becoming outdated in even short time-spans. For this reason, it is essential to have mechanisms in place to continue steering towards the desired outcomes (the goals), while leaving the specific means of achieving the goals flexible to maintain optimal efficiency and reduce bureaucracy.

That said, because Buiksloterham is developing quickly, with a great deal of construction planned in the upcoming few years or already underway, there are some technical interventions that need to be made now, based on our current understanding of the situation.

The need for both near- and short-term actions has resulted in an Action Plan that identifies two types of interventions: systemic and technical. The systemic interventions are process-oriented and the technical interventions are focused on more immediate actions that are prerequisites for reaching certain milestones. They are summarized below, and further detailed in the Action Plan chapter of the full report.

Systemic Interventions options

The proposed systemic interventions will create the necessary structures to sustain a long-term transition process in Buiksloterham. We have identified five types of such interventions that we see as prerequisites for further development. There are five primary systemic intervention categories proposed in the Action Plan:

Designate Buiksloterham as an official experimental zone or Living Lab.

A Living Lab status is necessary for establishing the overall character of the neighborhood as a place where new technologies and management approaches can be applied and learned from. It is also instrumental in releasing developers and residents in the area from some legal restrictions that currently prevent the use of new materials and clean technologies in construction.

Develop an inclusive governance and management structure for Buiksloterham.

A local governance structure should give responsibility and authority to local stakeholders in collectively managing and enforcing progress towards the long-term goals. Such a structure will be essential for implementing the Circular Buiksloterham vision while giving citizens and other stakeholder groups a consistent and significant voice in the process.

Create new incentive structures and financial vehicles. The transition plan to a Circular Buiksloterham requires sufficient capital for investment and appropriate incentive structures (such as tax or credit schemes) that will provide guidance and enforcement of key directives. New vehicles for investment that take into account the broader ambitions of the area in addition to considering financial returns are a prerequisite for successfully achieving the vision. Several options for such financial vehicles exist, such as a rotating “Circular Investment Fund.”

Build capacity for urban sensing and open data. Urban sensing and open data infrastructure are critical for monitoring progress towards the goals, enforcing key directives, and for purposes of research and communication. Investments in the data infrastructure should be made early on in the process to create visibility and buy-in for the local activities, and facilitate the communication of results.

Implement a Circular Neighborhood Action Plan. The Circular Neighborhood Action Plan is a set of resources for local residents and developers that is needed to provide the translation of higher-level goals into everyday activities. This Action Plan will provide up-to-date guidelines for all residents, developers, and other local stakeholders active in the area and provide a vehicle for internal communication. The Action Plan can include a community web portal, household purchasing guidelines, developers guidelines, and other accessible resources.

All of these proposed systemic actions are urgent; they provide the fundamental infrastructure for the execution of the long-term vision.

Technical Interventions

The overarching Circular Buiksloterham ambitions have been translated into five urgent areas for technical intervention focused around: local renewable energy production, natural water management, soil remediation, smart mobility, and local material cycling. Under each of these categories, we have detailed additional specific action points.

Fully Renewable Energy Supply: To achieve the first of the technical objectives proposed for Buiksloterham, urgent action needs to be taken around the construction of new buildings. Instituting Passive House construction as a standard in new buildings and an electric efficiency guideline are essential pre-requisites for supplying the area with locally-generated renewable energy.

Water Innovation: This objective includes two primary elements: making Buiksloterham stormwater-sewer- free through natural rainwater management, and recovering nutrients and resources from wastewater.

Alternative Mobility. To reduce local emissions, energy use and the need for parking spots, an alternative mobility plan should be introduced. The focus should be on reducing passenger miles overall, facilitating low-energy, zero emissions alternative modes, and increasing shared use of vehicles.

Soil as Natural Capital. Many of the plots in Buiksloterham are polluted and require intensive and costly remediation. Bioremediation combined with temporary use can transform these areas into an societal asset while progressively rebuilding local biodiversity.

Close the Loop. Closing the loop revolves around making Buiksloterham's short, medium and long term materials recoverable and reusable in their highest quality form possible. Setting up source separation programs and circular building principles are most crucial first steps.

The most urgent actions in these categories are those which directly impact new development and infrastructure investments. The most important of these include:

- Reducing the structural energy demand of new buildings by implementing stringent energy and insulation standards, such as the Passive House standard and energy efficiency plans in all

new constructions;

- Designing roof real estate in all new buildings to handle access and extra weight for water collection and buffering, green roofs, and solar infrastructure;
- Building flexible infrastructure capacity in both buildings and underground, which should include a range of connection options for future expansion. This should ideally include different sewer lines for different water quality types (grey, yellow, and brown water). It should also include both AC and DC lines for in-building electric grids. Underground infrastructure should be collectively planned and coordinated between a number of utility partners for optimized installation cycles. A district heat network should be installed, but the requirement for new constructions to connect to it should be dropped, allowing for developers to solve supply side issues using a broader range of energy technologies;
- Reducing mobility demand by releasing developers from the high parking requirements currently in the area, and investing in additional alternative and shared mobility;
- Planning for and executing natural and above-ground water management techniques.

In addition to these most immediate areas of intervention, some others that should ideally take place over the coming 1 - 5 years are included in the plan. These action points are further detailed in the examplary Action Plan and Interventions sections of the full report.

Research Areas

It is clear that many additional research areas remain to work out further long-term aspects of the development plan. Some of the most urgent ones include questions around water infrastructure and separate piping, above ground rainwater management, optimized use of underground infrastructure, nutrient recovery systems from wastewater (local biorefinery), and optimized grid management (AC and DC combined smart grids).

Because some technical decisions need to be taken before full clarity is available on key research questions, we propose erring on the side of designing for flexibility. Though this may lead to some overcapacity of infrastructure in the near-term, it will also preserve essential opportunities for transition to other types of technological solutions as they become available in the future.

Conclusions and Next Steps

In the Vision and Action Plan presented in this report, we conceive of Buiksloterham as an engine for the broader transition of Amsterdam.

A unique development like the one proposed for Circular Buiksloterham requires continuous effort and support from all stakeholders: from residents to research institutes, utilities to developers. Political support and commitment for the ambitions will create a guiding framework for all individuals and organizations active in Buiksloterham; to this end a signing moment with Amsterdam's aldermen and other decision makers will be organized in March 2015. A governance structure should be created as soon as possible to ensure continuous development of the project. Bridge financing will need to be secured from local parties to support the process until larger amounts of funding are secured. A communication plan and online website will help generate traction and transparency about the development. Research and development agendas of stakeholders and institutions like AMS (Amsterdam Institute for Advanced Metropolitan Solutions) should be connected to leverage knowledge and research. Attracting additional funding for the process and interventions will be key to the success of Buiksloterham.

COLOPHON

This document is the executive summary of the Circular Buiksloterham report. The full report can be requested from the projectteam.

Commissioned by
De Alliantie
Waternet
Ontwikkelingsbedrijf Gemeente Amsterdam (OGA)

Project team
Metabolic, DELVA Landscape Architects, Studioninedots, Frank Alsema, Peter Dortwegt, Saskia Müller (Amsterdam Smart City).

Overall project management
Sanderine van Odijk (Metabolic)

Authors
Eva Gladek (Metabolic)
Sanderine van Odijk (Metabolic)
Pieter Theuws (DELVA Landscape Architects)
Albert Herder (Studioninedots)

Graphic Design
Rui Lira (Metabolic)

Research team and text contributors
Sanderine van Odijk, Eva Gladek, Anastasios Kokkos, Barend Donkers, Chris Monaghan, Luuk de Klijn, Frances Rompas, Dániel Jaczkó, Rachael Hamann, Erin Kennedy, Kevin Gooley, Albert Herder, Steffan Dannel, Monika Pieroth, Steven Delva, Pieter Theuws, Jens Jorritsma, Peter Dortwegt.
Interviews were performed by Saskia Müller, Frank Alsema, Peter Dortwegt and Sanderine van Odijk