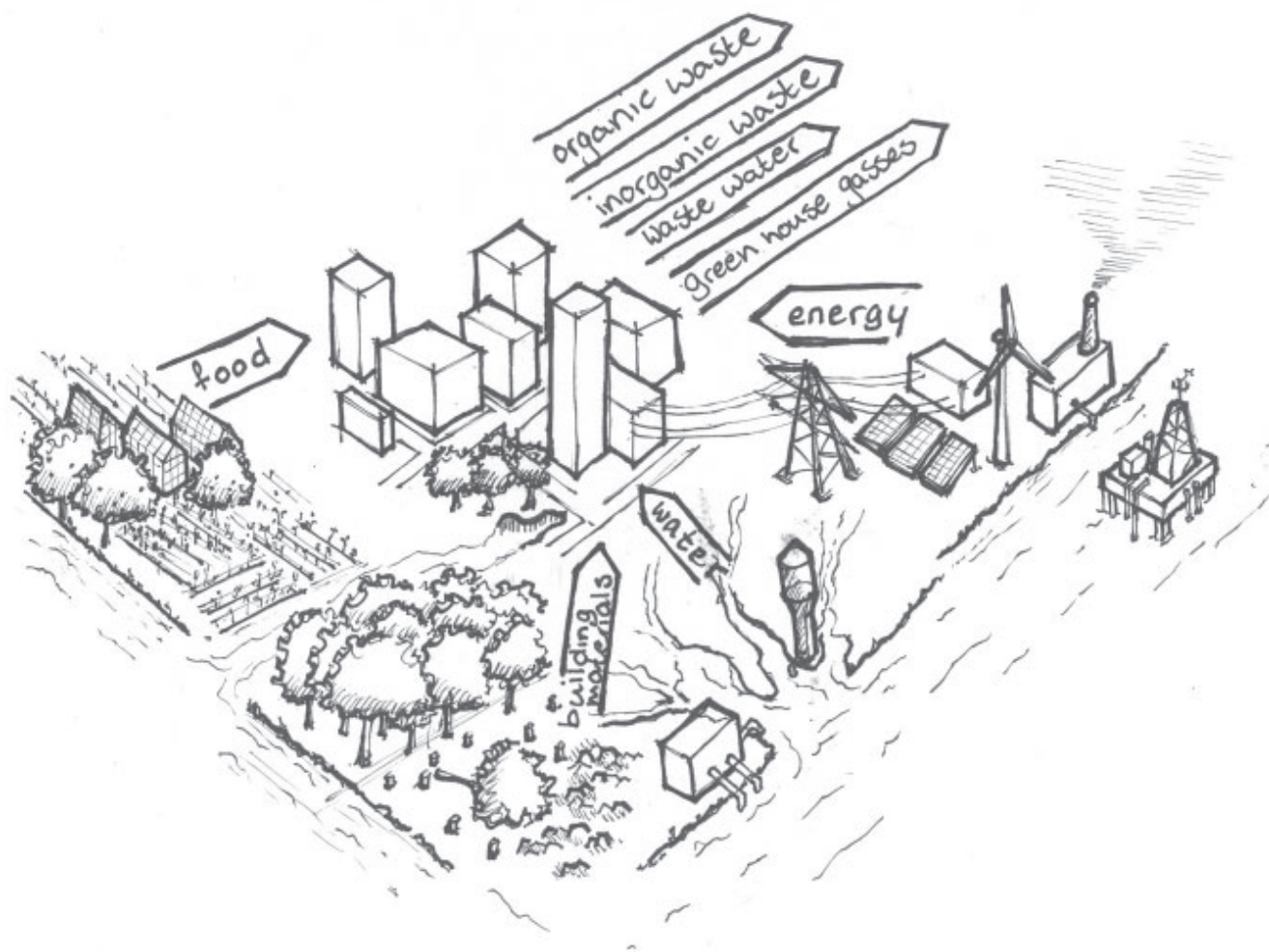


# How will we live together?

A transformation framework for symbiotic urban metabolism



Adapting 20th Century Heritage  
Vacant Police Real Estate  
2021/2022  
Arne Boenders

## Preface

### *How will we live together?*

An intriguing question which formed the central theme for this year's architectural Biennale in Venice. When visiting this Biennale, I walked through countless pavilions and saw many exhibitions, all about how humans could live together with each other, but almost more importantly, also how humans could live together with nature. There was one exhibition which especially attracted my attention. It was a large table, full of small living trees between which architectural models of ecological ways of living were displayed (see pictures below). Accompanied with this installation was this quote, which from the moment that I have read it, stayed with me:

*"By applying natural principles in design, humans can strive to close the gap that currently exists between built and natural environments, for the mutual benefit of both human and nonhuman life."*

Lynge, S. & Hesselberg Foged, T. (2021)



Venice Biennale 2021 - by EFFEKT - own picture



Urban Village - EFFEKT - own picture



***By applying natural principles in design, ...***

This first part of the quote immediately touches upon a personal fascination that started a long time ago and probably has its roots in my personal experience and memories of encounters with nature, like many camping trips, and walks. A fascination for nature originating from my childhood, but still something that greatly interests me and has been a recurring topic throughout my architecture education.

***... the gap that currently exists between built and natural environments, ...***

This section of the quote addresses the problem, or better formulated; the challenge that we currently face as humans. A disconnection between nature and humans of which the built environment forms the ultimate representation. The natural environment exists of a complex of ecosystems all interdependent and in balance with each other. Then there is the built environment, where the open-ended cycles use resources

from the natural environment but create waste unsuitable for reuse by the ecological cycles. This imbalance and disconnection have caused climate change, destruction of the natural environment, and reduction in biodiversity. This will, in the long term, not only impact the natural environment, but also the built environment.

***... for the mutual benefit of both human and nonhuman life.***

The ending of the quote illustrates the relevance of this challenge, as it has not only an impact on the biodiversity of nature but also on humans themselves. If we continue living how we currently are and ignore this challenge, then it will no longer be human life and nonhuman life on this planet, it will just be nonhuman life. This has to do with the fact that currently, humans are indeed a danger for all forms of nonhuman life, but at one point the destruction of that life will become a danger for human life itself as we will make this planet inhabitable for ourselves.

With this research plan, during this graduation project and possibly even in the future of my career I will try to find possible solutions for this challenge. I will be trying to find new ways of living together.



## Introduction

### *Disconnection between nature and humans*

The history of the natural environment<sup>1</sup> and the built environment<sup>2</sup> goes far back. The natural environment has already existed for around 3.7 billion years, while the built environment exists for around 12 thousand years. For a long time, these two entities were in some sort of balance. But something happened, a disconnection between nature and humans emerged, the relationship between them had changed.

The main reason for this change in the relationship is the change of cycles. The natural environment consists of ecological<sup>3</sup> cycles, which form a balanced, connected, and interdependent system of closed cycles. With the industrial revolution, a new cycle emerged in the built environment; the technological cycle. This cycle had one main difference to its ecological predecessor, it was not a cycle, as it had waste at the end which could not be used anymore by the ecological cycles. In this way, a different relationship between the natural environment and the built environment was created, as the former would be exploited for resources used by the latter and disposed in the form of waste not useful for the natural environment again (Van Dijk, Tenpierik & Van den Dobbelsteen, 2014). These technological cycles are causing climate change, loss of biodiversity, shortage of resources, and abundance of waste; ultimately leading to an inhabitable planet for a great part of living species including humans.

### *Minimizing negative environmental impact*

In current articles, policy documents, but also in academic debates about sustainability strategies, the main focus lies on the reduction and minimization of the negative environmental impact (Van Dijk, Tenpierik & Van den Dobbelsteen, 2014). With this research, I hope to contribute to the shift of this focus towards creating a positive impact on the environment. The way how the built environment currently functions needs to be transformed in order to create this positive environmental impact.

### *Built environment as an ecosystem*

A method for guiding this transformation can be urban metabolism<sup>7</sup>. This term was first used by Wolman in his book *The metabolism of cities* (1965). It presents the built environment as an ecosystem<sup>4</sup> with flows and processes. The concept of metabolism<sup>6</sup> is used to analyse the interactions and flows of materials and energy in an urban region (Broto, Allen & Rapoport, 2012). Based on urban metabolism, interventions can be designed to create symbiotic<sup>5</sup> relationships. In this way transforming the built environment in a way so it has a positive impact on its environment.

### *Importance of transformation*

As explained before, most of the societal and ecological issues arose in the built environment, but it is also there where most possibilities for change and improvement are. The open-ended technological cycles are taking place in an existing built environment and in order to control and alter these cycles, transformation of existing buildings and infrastructures is needed. A question that might arise is if the current built environment causes all these problems, then why not demolish it and start over again? In other words;

#### *Why should we transform?*

The reason for transformation over demolishing and new built is related to sustainability aspects of embodied energy and material waste, but also to the preservation of heritage values as buildings are the embodiment of cultural values and historical memories (Van Hees, Naldini, & Roos; 2014). The next question could then be:

#### *How should a building be transformed?*

The heritage department has developed a value assessment tool with which a transformation framework can be created (Kuipers & De Jonge, 2017). These values are however a social construct created by humans and are mostly subjective based on the different perceptions of the stakeholders. I believe that another

**1. Natural environment:** The natural environment encompasses all living and non-living things occurring naturally on Earth. Consisting of ecosystems including all living species, universal natural resources, and physical phenomena. (Johnson et al., 1997)

**2. Built environment:** an environment consisting of all manmade structures to support human activity (Portella, 2014).

**3. Ecology:** *oekologie* introduced by Ernst Haeckel from the Greek word *oikos* (home). It stands for the study of the interrelationships of organisms with their environment and each other. (Pimm & Smith, 2019)

**4. Ecosystem:** a dynamic complex of plant, animal and micro-organism communities, and their non-living environment interacting as a functional unit (CBD, 2010).



tool is additionally needed to help guide an architect with the transformation of a building. This research will by no means ignore or reject the heritage value method of guiding the transformation, but rather seeks an extra tool that does not only focus on the human needs and values of the building but a tool that tries to include the needs and wishes of nonhuman actors. In this way designing a transformation that not only positively contributes to humans but also to its environment, in an effort to try and find a way of living together.

### ***Spatial Building Typology***

These two transformation tools are two different ways of analysing and guiding the design. A third method is the spatial building typology research which will be performed by the entire graduation group. The spatial aspects of the different buildings will be compared in order to formulate different building typologies. The output of this analysis will form input for the two transformation tools, both the heritage value assessment and the urban metabolism transformation tool. At the end of the studio, the re-designs of the different typologies will be compared to research the relation between the building typology and the re-design solutions.

### ***Vacant heritage police building***

The urban metabolism transformation tool will be researched and developed during the Vacant Heritage graduation studio, which focuses on vacant police buildings. The goal of this studio is to create a re-design strategy for these vacant police buildings, which can be used as input on the discussion about the future of these buildings.

### ***Eenheidsbureau - The Hague***

The Eenheidsbureau in The Hague was chosen as case study, mainly because of its large scale and character. When visiting the building it felt like a fortress, a safe place in which you are protected, but also like a complete village inside of a building. The large scale can be used as a way to imitate the urban scale inside of a building and apply urban metabolism on a building scale.

### ***Research & Design***

The goal of both the research and the design is to find new ways of living together with a transformation of a building that has a positive impact on both humans and their surroundings. Therefore the following questions are formulated:

#### ***Research question & Subquestions***

***How can an architect transform the Eenheidsbureau in order to create a symbiotic urban metabolism in the neighborhood?***

How can an urban metabolism transformation framework be created?

How did the urban metabolic relationship between the natural environment and the built environment develop over time?

What are the current urban metabolic flows on different scales of the Eenheidsbureau in The Hague in relation to the spatial impact?

#### ***Design questions***

How can these current urban metabolic flows be transformed in order to create closed cycles and mutually beneficial relationships, while taking the heritage values into account?

What program benefits from other program inside a building and in its surroundings in order to create symbiotic relationships?

How can the heritage value framework and the urban metabolism transformation framework be combined in order to guide the design?

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**5. Symbiosis:** from the Greek words *sýn* (together) and *biósis* (living). It means a close connection between two entities that have a mutually beneficial relationship. (The Editors of Encyclopaedia Britannica, 2020)

**6. Metabolism:** the sum of the chemical reactions that take place within each cell of a living organism and that provide energy for vital processes and for synthesizing new organic material (Kornberg, 2021).

**7. Urban metabolism:** the sum total of the technical and socio-economic processes that occur in cities, resulting in growth, production of energy, and elimination of waste. Also the study of quantification of the inputs, outputs, and storage of energy, water, nutrients, materials, and wastes for an urban region. (Kennedy, Pincetl, & Bunje, 2011)

## Theoretical Framework

In this chapter important literature sources are selected and positioned on a timeline to show the relation between the literature and the development of the relationship between the natural and built environment (see image below). These literature sources were chosen as they present a clear overview of certain academic debates by reviewing the previous articles on a specific topic.

### Ecological design

For the development of ecological design, an article by Lydia Kallipoliti (2018) will be used as she created a framework on the history of ecological design. It reflects on the different theories in this field and positions them in her framework, concluding that ecological design developed towards systems theories.

### Systems theories

These so-called systems theories are further researched by Van Dijk, Tenpierik, & Van den Dobbelsteen (2014) in an article where they compare cradle-to-cradle with six different systems theories; laws of ecology, looped economy, regenerative design, industrial ecology, biomimicry, and blue economy.

### Urban metabolism

Urban metabolism is further set apart in two articles written by Beloin-Saint-Pierre et al. (2016) and Kennedy, Pincetl, & Bunje (2011) which both review over 50 urban metabolism studies. The articles come to different outcomes,

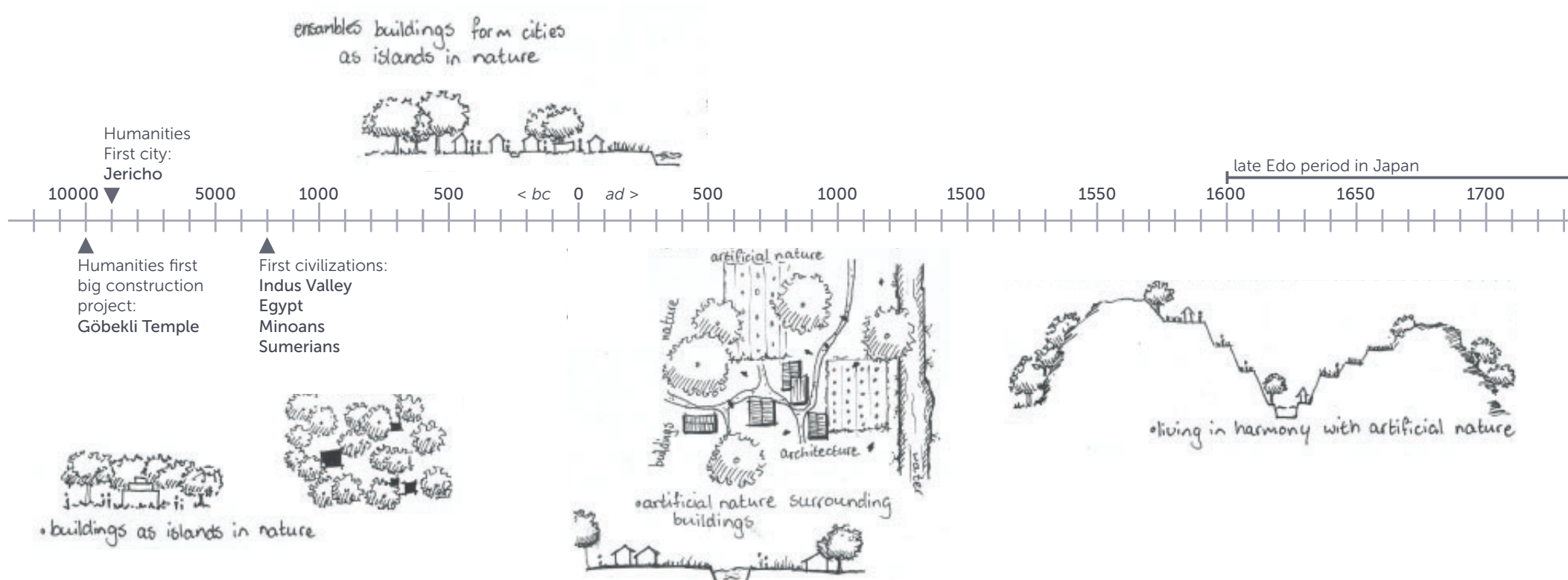
which is why these two studies were chosen in order to compare the different interpretations of urban metabolism.

### Heritage value assessment

The heritage value assessment framework is a combination of the shearing layers by Brand and the Rieglian values Kuipers & De Jonge, (2017) and will be used to create a transformation framework with possibilities for change while respecting the heritage values.

### Spatial building typology framework

Another framework developed by the heritage department is the spatial typology framework which exists of four scales with each several spatial aspects. This framework will be used to analyse and compare these spatial aspects of the different police stations in order to define several building typologies.



Theoretical Framework as it places the different articles and frameworks on a time line - own drawing

## Relevance

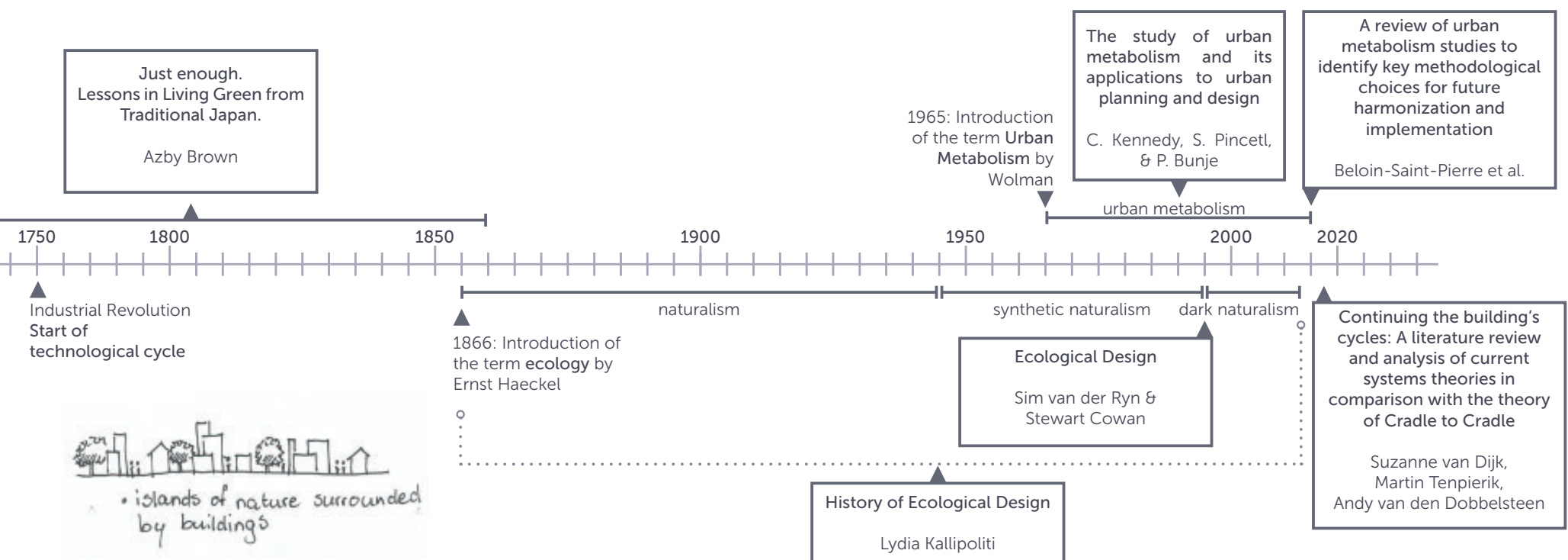
A great part of the relevance of this research is already discussed in the introduction, but a brief summary of the relevance will be given in this chapter.

### Societal context

The societal challenges that are addressed with this research are related to the disconnection between humans and nature and the therefrom arising problems, like climate change, decrease of biodiversity, shortage of resources, and abundance of waste; all ultimately leading to an inhabitable planet for humans and many other species. This research and the design aim to shift the focus of the current sustainability strategies from minimizing the negative environmental impact towards creating a positive impact on the environment.

### Professional context

The relevance of this research for the profession as an architect is related to the additional urban metabolism transformation tool which will be developed during the course of this research. It will add to the heritage value transformation framework in order to guide an architect during the design of a transformation of a building. This extra framework will attempt to help an architect to, next to the human values, also take nonhuman values and the environment into account while transforming a building in an effort to find ways of living together.



Theoretical Framework as it places the different articles and frameworks on a time line - own drawing



## Methodology

The different components of the methodology are explained below and illustrated in the diagrams on the next pages.

### Literature research

Different literature sources about ecological design, systems theories, and urban metabolism will be compared. These literature sources are further defined in the Theoretical framework. Based on the existing frameworks of these topics a new framework will be made (a first version of this framework is shown on the next page).

**Outcome:** An urban metabolism framework to analyse the metabolic flows and cycles on different scales categorized in water, energy, materials, and food.

**Reflection:** The creation of a new framework out of existing literature is in a way a subjective, as certain elements from existing frameworks are chosen, while others are left out. These choices will be supported with literature in order to create a logical tracable process, but will contain a form of subjectivity.

### Case studies

Three different case studies are analysed that are examples of symbiotic urban metabolism. The case studies are chosen in different times in order to research how the relationship between humans and nature changed over time and if the methods that were used to create symbiosis have developed (see images on right):

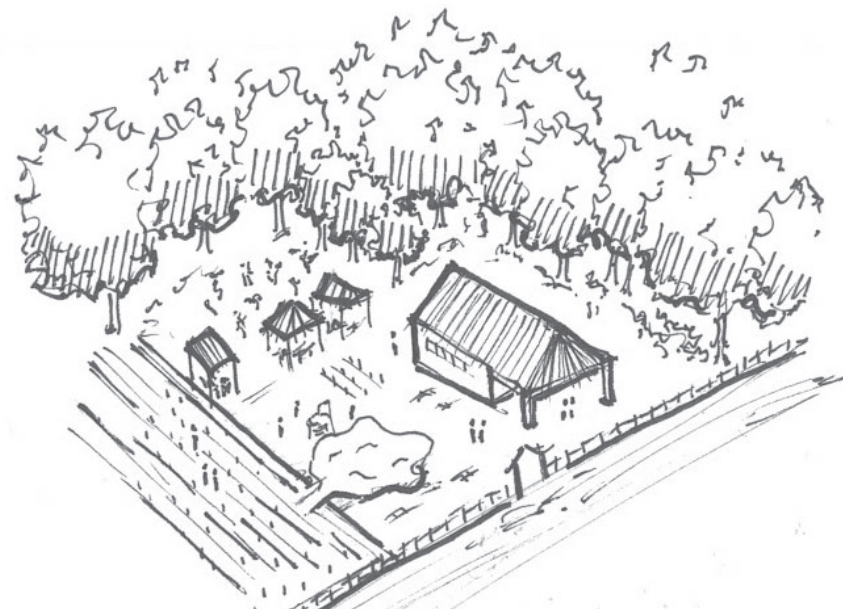
- Past: Edo period 1600-1850 in Japan with research of Azby Brown (2012)
- Present: Schoonschip - 2020 - Amsterdam
- Future: ReGen Village - Oosterwold

The analysis will be performed with the developed urban metabolism framework.

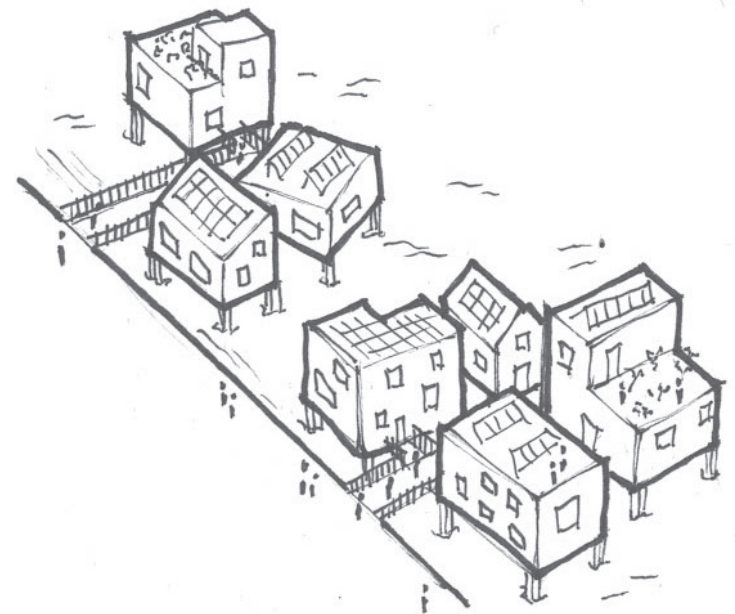
**Outcome:** Input to improve the urban metabolism framework and design guidelines and possible interventions to create symbiotic urban metabolism.

### Urban metabolism analysis Archipelbuurt

The urban metabolism framework developed in the previous step will be applied to the Eenheidsbureau and the Archipelbuurt. Previous metabolic research of The Hague will be combined with GIS data (Geographic Information System) to analyse and map the different existing metabolic flows of the



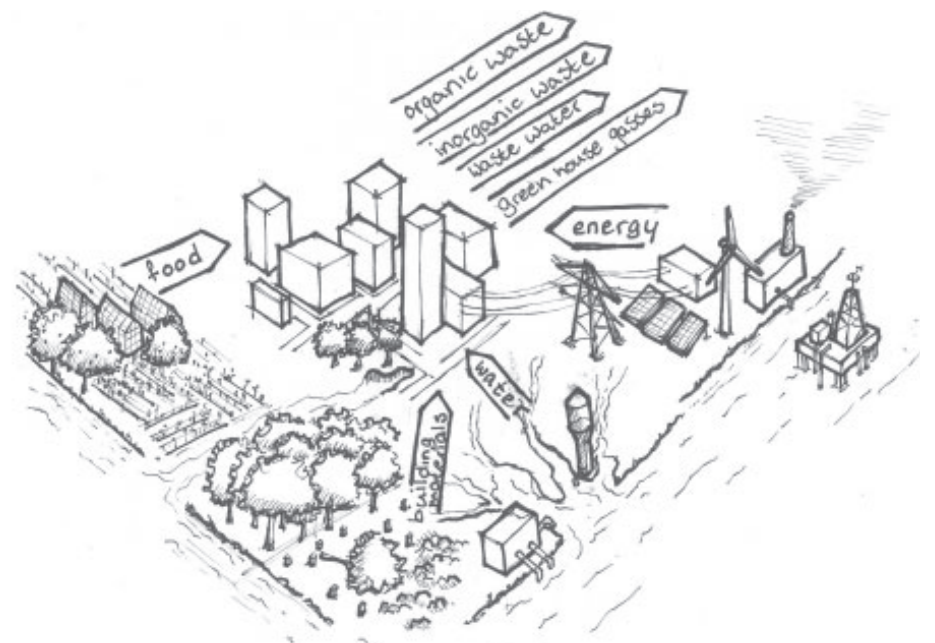
Edo period 1600-1850 in Japan - own drawing



Schoonschip Amsterdam - own drawing



ReGen Village Oosterwold - own drawing



Sketch of Urban Metabolism - own drawing



neighborhood Archipelbuurt. The flows will be analysed on different scales, but the emphasis will be on the building scale and its immediate surroundings. The analysis will be categorized into water, energy, materials, and food (for a first sketch example see diagrams on the next page).

**Outcome:** A framework of urban metabolic cycles that are currently present around the Eenheidsbureau.

**Reflection:** The urban metabolism analysis will be selectively performed in order to not get overloaded with data. The primary focus of this research lays on the possible interventions on the building scale and the data will be accordingly selected. In order to have a reproducible analysis, open source data (QGIS) and public available sources are used for the urban metabolism analysis. The depth and scope of this analysis will greatly depend on the availability of data and is therefore at this point still a bit uncertain.

**Value assessment**

The existing building will be mapped and assessed based on the heritage values framework.

**Outcome:** A framework of what should stay and why and at the same time a framework of what can be changed.

**Spatial building typology analysis**

The eight case study police buildings will be analysed and compared on 4 scale levels with each several spatial aspects.

**Outcome:** A comparison and conclusion of different building typologies and their influence on the re-design solutions.

**Design toolbox**

Experiments with different interventions will be done in order to create a design toolbox to create symbiotic cycles. The interventions themselves will all be on the building scale, but the impact on the other scales will be researched. The interventions will be assessed on three aspects; social (values), spatial, ecological.

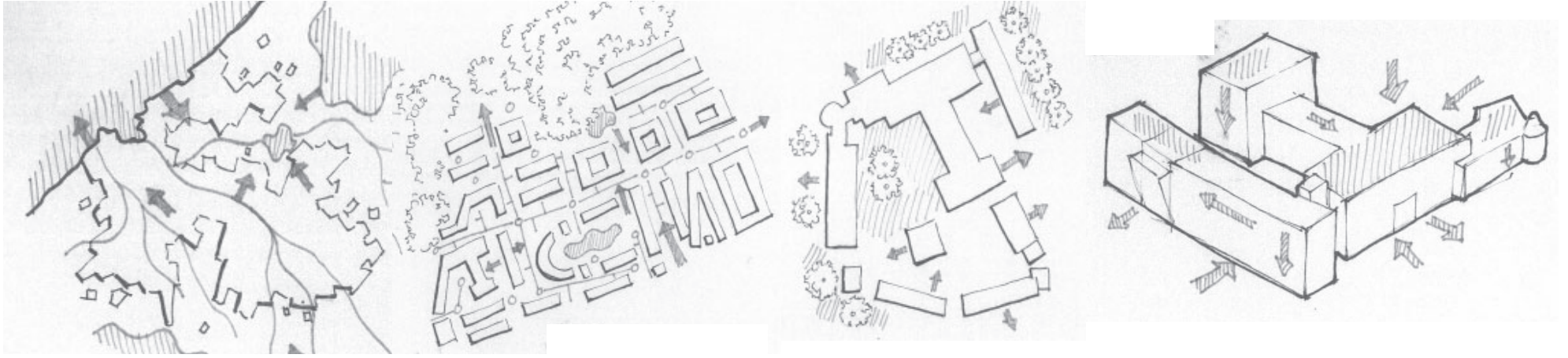
**Outcome:** A design toolbox with different interventions to create symbiotic cycles. These interventions can be applied in the re-design of the Eenheidsbureau.

	Water	Energy	Materials	Biotic factors
<b>Urban Metabolism Analysis</b>	groundwater surface water rain water drinking water grey water black water	electricity heat cold greenhouse gasses	biobased non-biobased organic waste inorganic waste	soil plants animals food
City scale	sources of drinking water & waste water treatment for Eenheidsbureau	sources of electricity production & presence of heat network	waste treatment of waste from Eenheidsbureau	connection of Archipelbuurt green networks in relation to larger green networks
Neighborhood scale	drink water and waste water networks & estimation of water usage and waste water	estimation of electricity usage and related greenhouse gass emmissions	waste collection points & estimation of the amount of waste	green networks & presence of plants and animals & presence of food production
Urban block	amount of rain water and infiltration in soil or hard surface	need or abundance of heat or cold based on function	estimation of the amount of waste categorized	green networks & presence of plants and animals & presence of food production
Building object	amount of water used and waste water produced & current water system	electricity usage & heating and cooling demand & current climate systems	estimation of the amount of waste categorized	relation with surrounding nature
Building envelope	amount of rain water & catchement or removal	thermal properties & thermal mass of envelope		

First draft Urban Metabolism analysis - own drawing



Water



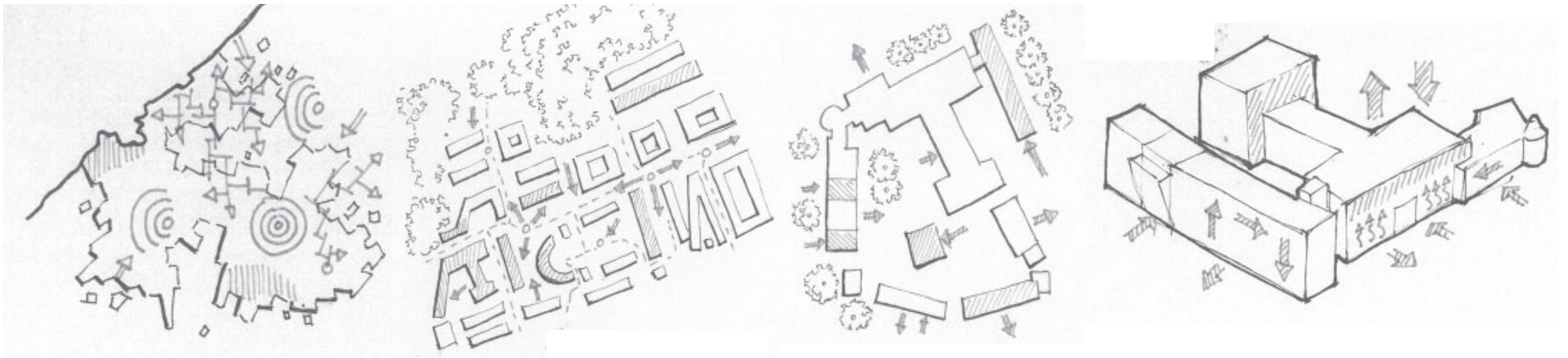
City scale

Neighborhood

Urban block

Building object / Building Envelop

Energy



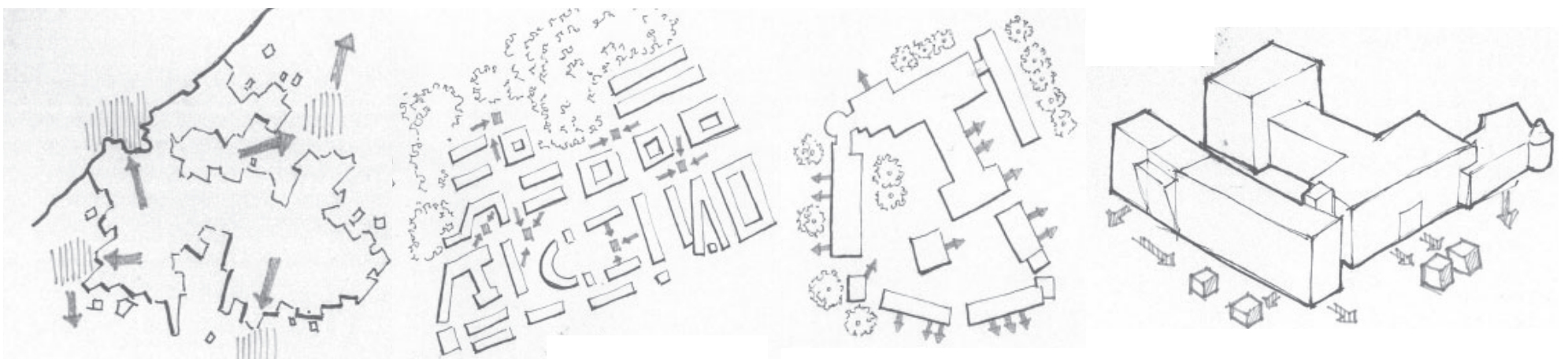
City scale

Neighborhood

Urban block

Building object / Building Envelop

Materials



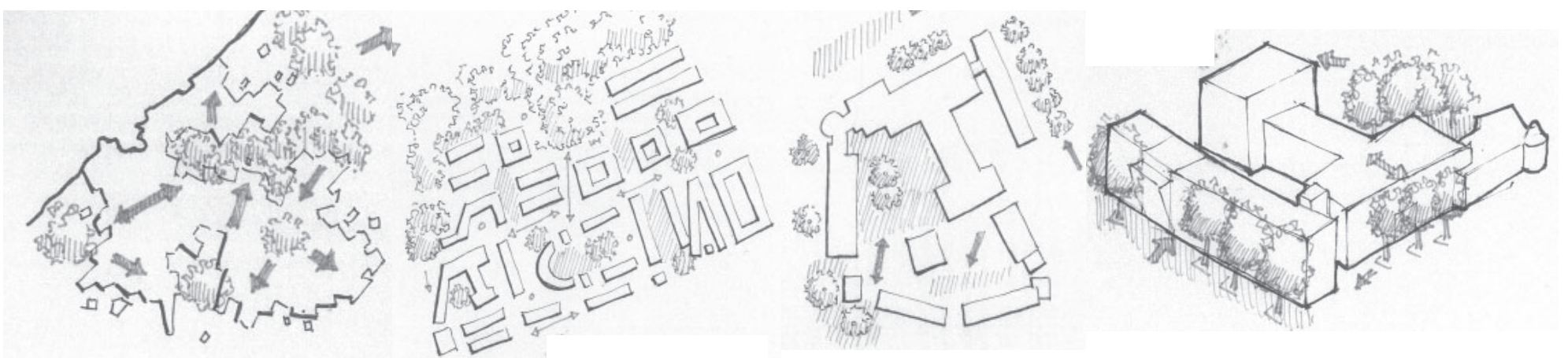
City scale

Neighborhood

Urban block

Building object / Building Envelop

Biotic factors



City scale

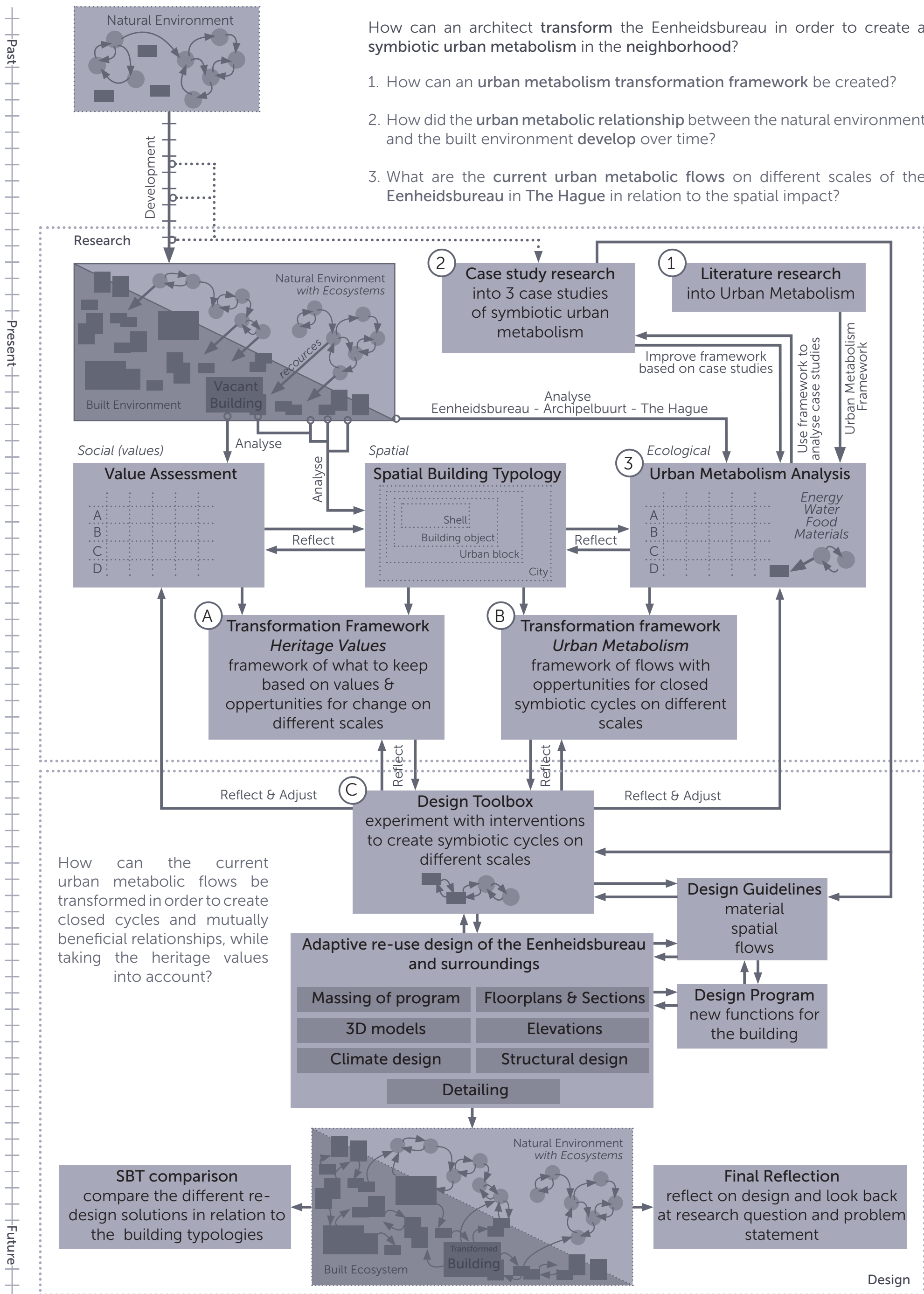
Neighborhood

Urban block

Building object / Building Envelop

Sketches of urban metabolism analysis on different scales and categories





Research & Design Methodology diagram - own drawing

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