The Urban Harvest Approach in North-West Europe

A case study on policy and implementation

Sjoerd Duim (s3581896)
May 2021

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Summary

European cities keep expanding and resources are becoming scarcer (Eurostat, EC, 2019). Some North European cities hope to counter this by creating policy documents that help to create a circular economy. The Urban Harvest Approach (UHA) is an approach that offers a method to establish circularity within cities. This approach is characterized by three indicators: minimizing demand, minimizing output and multisourcing. Research about the UHA is limited, while the potency is high. This research aims to find out to what extent cities use the UHA in their policies and how the implementation of the policies worked out. This is done by a policy analysis of a policy document (to discover what the policies comprise) and a monitoring document (to find out how the implementation of the policies worked out) of three European cities: Amsterdam, Brussels and London. The presence of the UHA indicators has been established in every document and it appeared that the cities actually used the UHA in their policies, but the scores on the monitoring document lay apart. Brussels, the only city that scored high on both documents, had a unilateral view on circularity and focused on administrative aspects, whereas London and Amsterdam had a more multilateral view.

This research has shown that cities in Europe are creating good policies and plans to become circular, but that there is certainly still a step to be taken for a number of cities to achieve the optimal form of circularity, especially in the implementation of the policies. The way in which Brussels is tackling the road to circularity, using the UHA and the right focus, can be seen as an example for other cities that include too many other aspects in their policies.

Introduction

By 2050, two thirds of humanity will live in urban areas; cities keep on expanding and especially in the developing world, slums become more frequent and living circumstances deteriorate (UN, 2020). Nevertheless, not only cities in third world countries, but also cities in the more developed parts of the world suffer from the big influx of people and growth of the population. West-European cities are plagued by housing shortages, rising temperatures (heat islands) and even the threat of water scarcity (Barnett et al., 2020). To ensure that living conditions do not continue to become worse, the UN has drawn up sustainable development goals (SDG's) that encourage governments to adhere to certain standards. The SDG that is important for cities is SDG 11. It aims to make cities inclusive, safe, resilient and sustainable. Because all countries in the world are affiliated with the UN, all countries will also have to adhere to the goals.

There is great freedom for countries to determine how this SDG is implemented. Science is looking for all kinds of new techniques to improve cities and make them sustainable and climate-friendly. Many new techniques are already being applied in cities to ensure that the quality of life is guaranteed. Urban planning plays a major role in this. In order to make and keep cities sustainable, cities will have to undergo changes, both at a policy level and at a physical level.

Several initiatives and ways to implement these applications are known. Many cities plan to become circular, because applying the circular economy is a way to emit less and be more sustainable with resources. However, the way in which cities implement circular economy policies differs. Several academic writers have done research on the circular economy and tried, on the basis of their research, to construct a strategy or approach that would work best to become circular. Consensus about the best approach has never been reached and literature on the evaluation of the circular economy and the approaches towards it are not well developed yet (Heshmati, 2018). Next to that, almost no academic literature about the relation between approach, policy and implementation of the circular economy in developed western Europe exists. Therefore it is important to continue research on the strategies and approaches that are used to reach circularity.

An approach that cities can use is the Urban Harvest Approach (UHA) (Agudelo-Vera et al., 2012). This approach describes a way to achieve circularity by means of three steps and a baseline assessment. However, little research has been done on this approach. Heshmati (2018) did report on several Chinese cities that use an almost equal approach, but did not evaluate the implementation. Petit-Boix & Leipold (2018) studied the different strategies and focuses towards circular economies on a global scale and found that the main focus was on infrastructural measures, whereas a study on circularity in historic port cities in Europe noticed the focus on cooperation in policies (Angrisano et al., 2019).

Next to the fact that research on the approaches towards circularity has to continue, it is important that cities apply these approaches in their policy documents in such a way that there are actually gains to be made. That is why this research will examine to what extent cities apply the UHA in their policy documents and what effect this has on the actual progress of circularity. Because of the

mentioned problematique in the European cities, it will analyse three developed North-West European cities on the basis of the following main question and sub-questions:

To what extent do policies and regulations in European cities make use of the Urban Harvest Approach and do these policies and regulations that make use of this approach contribute to the actual implementation of measures regarding the Urban Harvest Approach?

The accompanying secondary questions are the following:
1. What are indicators that are representative of the Urban Harvest Approach in policy?
2. What sorts of policies and regulations exist in European cities that make use of the Urban Harvest Approach?
3. What are the differences between the European cities in terms of policy and implementation regarding the Urban Harvest Approach?
4. In what way do the different levels of attention to the Urban Harvest Approach in policies contribute to the actual implementation of urban harvest initiatives?

First, this thesis will dive into the theoretical background of the concept of urban harvesting. The indicators that are introduced in this chapter (secondary question 1.) will be used for the policy analysis, which is explained in the methodology chapter that follows the theoretical framework. This methodology also elaborates on the structure and design of the research. Hereafter the results of the other secondary questions are presented, which will provide the basis for answering the main question in the subsequent conclusion. The discussion interprets the results and conclusions and mentions factors that might have had an influence on the outcomes of the research.

Theoretical Framework

This framework will try to provide a description and explanation about the most important concepts for this research and show them in a conceptual model. Besides, it will also present an answer to the first subquestion and thus present the indicators of the UHA.

A concept that strongly relates to this research and to a great extent forms the basis for sustainable change, is the Sustainable Development Goal 11. This goal has been defined by the United Nations as “Make cities and human settlements inclusive, safe, resilient and sustainable” (UN, 2015). The Sustainable Development Goals (SDG’s) have been voted in favor for by the General Assembly of the UN, which means that they are globally accepted by all countries. All countries should try to reach these goals by 2030.

There are some discussions about whether the indicators are good enough to analyse the outcomes of the measures that are taken to reach the SDG (Klopp & Petretta, 2017). Also, there are no universal definitions that are known to everyone around the world about for example ‘sustainability’ or ‘inclusivity’, which may result in different measures and outcomes in cities all over the world. Standardization of ‘the sustainable city’ would be an outcome, but would be hard to actually accomplish (Caprotti et al., 2017).

The Urban Harvest Approach can be helpful to take away some of the discussions about the SDG 11. Although little research has been done about the UHA, the concept has been established well by several authors.

The UHA is a concept that functions as an aid for sustainable city planning. It assumes that cities can become (almost) self-sufficient and aims to reach this by improving the circularity of cities. Guidelines for cities are provided for managing the material flows in a more advantageous way by the implementation of innovative technologies and integration with urban planning (Agudelo-Vera et al., 2012).

The UHA works with three steps: demand minimization, output minimization, and multisourcing. These three steps, that will function as the main indicators in this research, happen after a baseline assessment of the material flows of all geographical scales in a city (Rosanne Wielemaker et al., 2018). This gives an idea about the urban metabolism (explained later on in this chapter) of the city. This baseline assessment shows what the quantities of the inputs (such as raw materials, water and energy) and outputs (waste) are. In a linear form of urban metabolism, all materials come from outside the city, none of those materials are reused and a lot of waste comes out, while in a completely circular urban metabolism, the city is self-sufficient and reuses all materials (Bunje et al., 2011).

After the baseline assessment, the first of three steps commences, the demand minimization. The gigantic input of resources is a consequence of the demand that exists. By using technology and

trying to change human behaviour, the total demand can be brought down (Agudelo-Vera et al., 2012).

The second step is the output minimization, the harvesting. Agudelo-Vera et al. (2012) describe three categories within this step:

- Cascading (Figure 1A): the reuse of outputs, which means using a resource with a reduced quality (The exergy principle: outgoing flows are not waste, but rather flows with reduced quality (Leduc & Van Kann, 2010));
- Recycling (Figure 1A): the reuse of resources after quality upgrading. This costs energy, so feasibility is important to pay attention to;
- Recovering (Figure 1B): extraction of useful substances from waste. This costs energy as well, so feasibility is important to pay attention to.

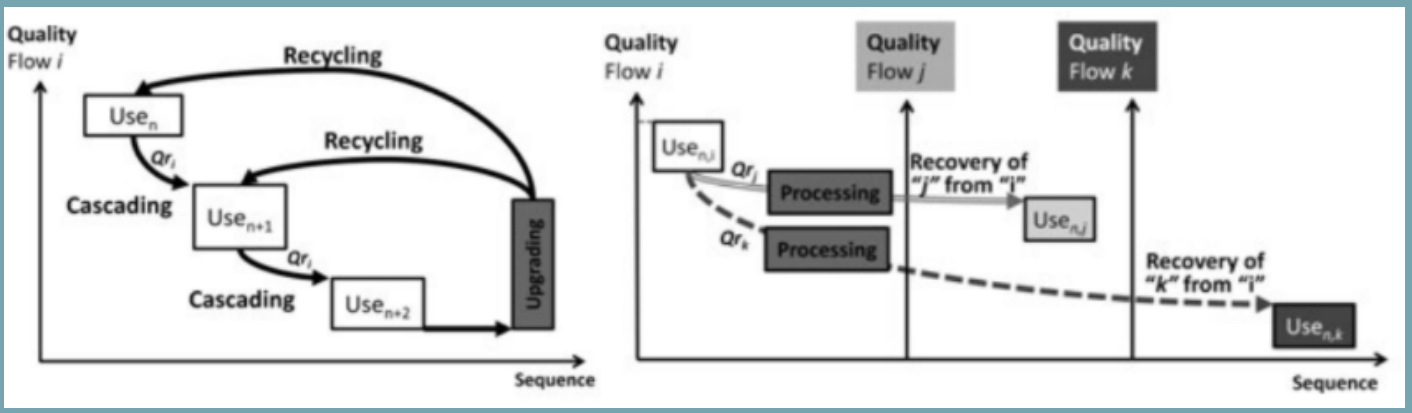

Figure 1 A (left): The process of cascading and recycling. Figure 1B (right): the process of recovering (Agudelo-Vera et al., 2012).

The third and final step, multisourcing, is used to meet the remaining demand. Local and renewable sources are used to fill this demand gap. This approach minimizes the transport costs and the external dependence of cities (Agudelo-Vera et al., 2012).

In order to evaluate which policies will help cities to become self-sufficient, an Urban Metabolic Profile (UMP) can be set up (Kalmykova et al, 2016). The flows shown in figure 2 are all incorporated in such a UMP. It can be hard for cities to know exactly what the inputs and outputs of their city are, because they might not have all the data available. Knowing exactly what resources are recycled and to what extent is not easy to find out. Smart cities could play a role in this; cities that use technologies and the internet to collect data in order to make the city operate more efficiently (Poslad et al., 2015).

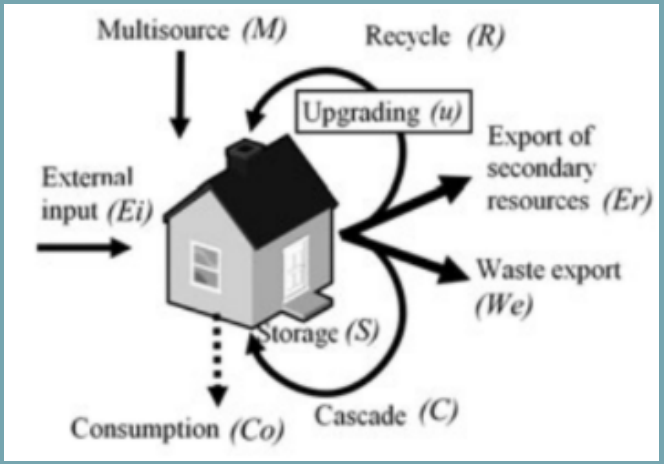

Figure 2. All variables of the UMP (Agudelo-Vera et al., 2012).

A concept that forms the basis for the UHA is urban metabolism. This industrial ecological concept relies on systems theory as it sees the city as a system, a unified whole. The urban metabolism model aims to analyse the input, throughput and output of flows and materials in cities (Daly, 1996). The urban metabolism model can be drawn up by all the raw materials that go into the city, the products that are made with these materials (such as products, energy and drinking water) and the residue or waste that comes out after the production (that may harm the environment) (Ferrao et al., 2009).

Two main schools of urban metabolism exist (Bunje et al., 2011). The first approach mostly focuses on the energy flows that exist and the energy that is needed and that is left by doing an activity or making a product (Odum, 1996). The second school uses the Material Flow Analysis (MFA), which not specifically focuses on energy, but more on the mass. What goes into the system must come out of the system in the form of products or residue/waste (Bunje et al., 2011). Both schools can co-exist, so both of them are taken into account.

The concept of urban metabolism and the UHA are often used to reach a circular economy. Circular economy is a concept that has been widely studied, which also means there are a lot of definitions in use. Hekkert et al. (2017) have researched 144 different definitions of circular economy to see what the most common parts of the definitions are. A circular economy is mostly defined as a combination of reduce, reuse and recycle activities, the linkages with sustainability are not as strong as the focus on economic prosperity (Hekkert et al., 2017). The circular economy is closely related to the UHA, but the UHA has a very evident link to urban planning, whereas the circular economy might lack this strong link. The scope of the circular economy can also vary from the UHA. The circular economy can be focused on higher geographical scales than cities, whereas the highest scale for the UHA is the city scale. Circular economy often also includes the job economy and the financial economy, while the UHA does not.

Conceptual Model

The rising environmental awareness has resulted in the establishment of the SDG 11. Governments take measures in the form of policies and strategies to reach the objectives of the SDG. These

policies are influenced by scientific models, concepts and other ideas, like in this case the circular economy, urban metabolism and UHA. In this case, the circular economy and urban metabolism also have had an influence on the UHA, because strong elements from both concepts are taken up in the concept of UHA. After the decision making process on the policy and strategy on the basis of the scientific concepts, the policies and strategies have an influence on the real world. The level of stringency of the policies and strategies might have an impact on the actual implementation of the projects.

This model (Figure 3) is used to create awareness of the pitfalls that can exist. In order to research the policies regarding the UHA, the line between circular economy, urban metabolism and UHA can become blurry. It must be clear that there is a difference and that other factors may play a fading role.

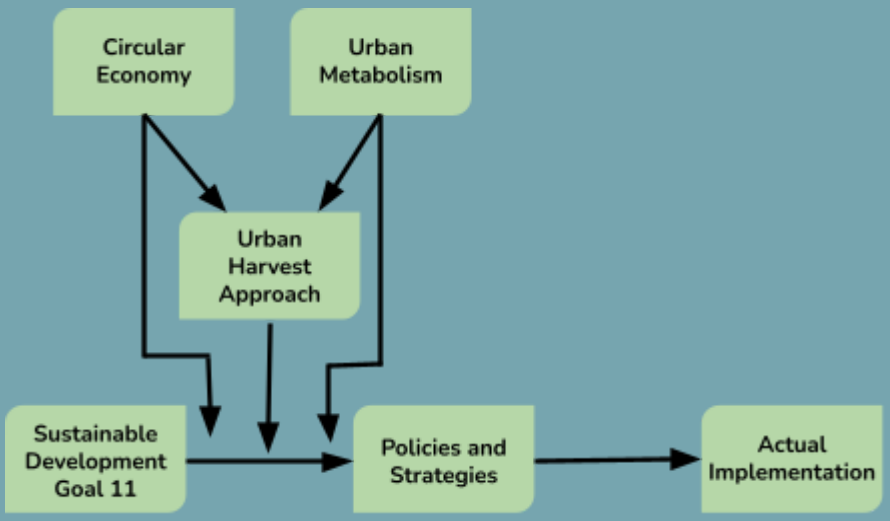

Figure 3: Conceptual Model.

Methodology

This research is a qualitative policy analysis and it consists of two parts. The first step will be to analyse policy documents of the three selected cities: Amsterdam, Brussels and London. After this step, monitoring documents will be analysed in order to find out if the proposed measures of the policy documents really had an impact. The monitoring documents often use quantitative data to see whether improvements have been made over time. The analysis of the monitoring documents will however not only be on the basis of these numbers, but also on the text accompanying the data.

The three cities mentioned above are a selection of cities in North-West Europe that are representative for the cities in the area. All three cities are situated in a different country and thus include different governance cultures. These cities also suffer from the same problems mentioned before: housing shortages, rising temperatures and water scarcity (Greater London Authority, 2020; Clarke et al., 2015; Cooper, 2019; Gemeente Amsterdam, 2021; Van der Hoeven & Wandl, 2015; KNMI, 2018; Porotto & Ledent, 2021; Brouyaux et al, 2021). Therefore, this set of cities is representative of the state of cities in North-West Europe.
The following policy documents will be analysed:

- Amsterdam, The Netherlands
  Policy: Gemeente Amsterdam, 2015. *Amsterdam Circulair: een visie en routekaart voor de stad en regio*
  Monitor: Gemeente Amsterdam, 2020. *Amsterdam Circulair Monitor*
  Amsterdam aspires to be a fully circular city by the year 2050. Therefore it has constructed a strategy with some progressive goals. For example, the city wants to use 50% less new materials in 2030 than they do now. The documents that will be analysed have been established in 2020 and illustrate the path towards circularity until the year 2025.
  Some notable environment-friendly aspirations that the municipality has are for instance the closing off of the city from the natural gas network and from 2030 onward, they will only allow electric cars to enter the city (Gemeente Amsterdam, 2020)
- Brussels, Belgium
  Policy: be.brussels, 2016. *Gewestelijk Programma voor Circulaire Economie*
  Monitor: be.brussels, 2020. *Tussentijds Activiteitenrapport*
  The city of Brussels struggles with a wide range of socioeconomic diversity, which has resulted in polarisation, even on the level of the climate. Poor people suffer the most from for example the air pollution. Brussels has set progressive goals in order to fix this and to become a circular and sustainable city.
- London, Great Britain
  Policy: Greater London Authority, 2016: *The London Plan: the spatial development strategy consolidated with alterations since 2011*
  Monitor: Greater London Authority, 2021: *London Plan Annual Monitoring Report 16*
  The region of Greater London has composed “The London Plan” in order to create guidance for planning in the region of London. It aims to improve the health of the people of London, create equal opportunities for the inhabitants and tries to contribute to sustainable development.

Now the cases have been established, the indicators that will be used on the policy documents will be introduced.

As mentioned before in the theoretical framework, the UHA uses three strategies in order to make the linear material flows more circular:

- Minimizing demand;
- Minimizing outputs;
- Multisourcing.

Therefore, the indicators that will be used to analyse the policy documents on the presence of UHA will be the following (These indicators will be elaborated upon in the thesis (subquestion 1)):

1. The presence of a phrase, sentence or text element that describes the desire of decreasing the demand of raw materials;
2. The presence of a phrase, sentence or text element that describes the desire of decreasing the output waste materials;
3. The presence of a phrase, sentence or text element that describes the desire of increasing the use of resources that are produced in the area of the city itself.

A value will be attached to all of these text elements, sorted per indicator and per policy document, ranging from -- (almost no actual presence of a UHA element) to ++ (a very clear presence of a UHA element). A short explanation with a reference to the text will be provided next to the value. After the analysis of a complete document, a summary of the level of UHA presence will also be written. When all relevant elements have been analysed, a short summary with the key differences between cities will be written including a ranking of the cities on the basis of the level of attention to the UHA. This will eventually result in an answer to sub questions 2 and partly sub question 3.

The scheme that will be used is the following:

Policy document analysis scheme	UHA indicator 1	UHA indicator 2	UHA indicator 3	Summary
Amsterdam				
Rotterdam				
London				

In the columns under the indicators, the pluses and minuses will be written with an explanation and a reference to the textelement. When the document has been analysed, a summary of the level of attention to the UHA in the policy can be put in the column underneath “Summary”.

The rest of sub question 3 and sub question 4 will be answered by looking at documents that have monitored the path towards sustainability and/or circularity. These documents will be ranked on the basis of the extent to which the cities use initiatives that relate to the indicators that are also used for the analysis of the policy documents.

Monitor document analysis scheme	UHA indicator 1	UHA indicator 2	UHA indicator 3	Summary
Amsterdam				
Rotterdam				
London				

The same analysis scheme will be used for the monitoring documents. The pluses and minuses can once again be written in the columns of the indicators with a reference and summary. The column with “Summary” will be used for an overall summary of the monitoring policy document.

After both schemes have been finished, conclusions can be drawn from the summaries. First, the differences within cities will be pointed out. This means that a look will be taken at the balance between the level of attention to UHA in the policy document and the level of attention to UHA in the monitoring document.
Secondly, the studied cities will be compared to each other to find out which approach is the most helpful to establish measures concerning UHA.

The data analysis scheme of this methodology can be found below in figure 4.

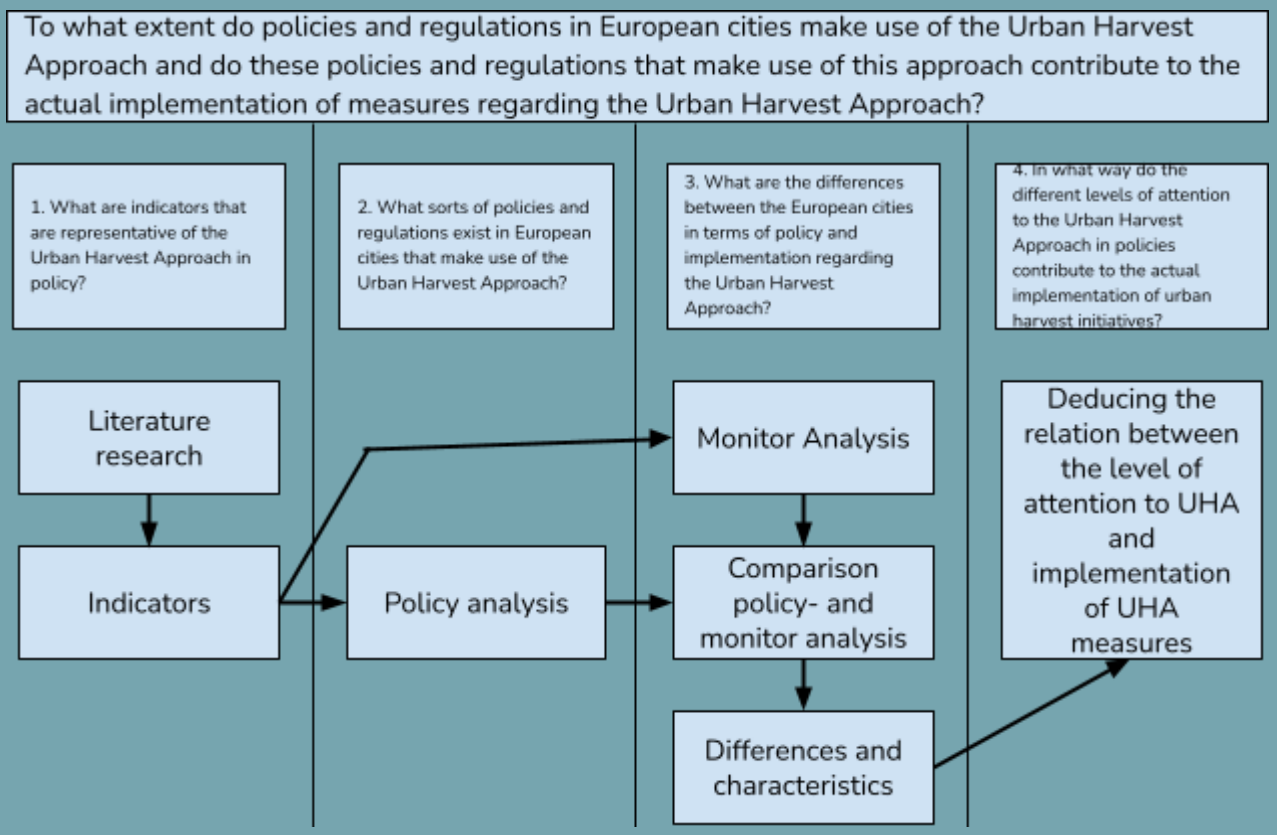

Figure 4: Data analysis scheme.

Results

Existing Policies and Regulations

Amsterdam

The municipality of Amsterdam has recently (2020) adopted a strategy document that determines the new vision on circularity. However, there was no monitoring document yet that was based on the policies of this document, because the strategy has only just gone into effect. That is why for this research the 2015 document will be used: *Amsterdam Circulair: een visie en routekaart voor de stad en regio, 2015.*

Amsterdam starts their policy document with a "Circle Scan Study" in order to find out what the material flows are within the city and to what extent the city is circular. The UHA endorses the importance of such a baseline assessment in which all flows are pointed out. However, the Circle Scan Study does not only offer the material flows, but also many social aspects of the circular economy, which sets the standard for the rest of the policy document: there is a clear focus on the social aspects of the circular economy. The UHA does not explicitly or implicitly mention a role for the social side of the circular economy, which sometimes distracts Amsterdam's policy from the focus of the UHA; becoming circular in terms of resources.

The strategy document proposes a reasonable amount of policies that relate to the UHA. For example:

- The obligation to reuse components of buildings that will be torn down on new construction sites;
- Organic residual flows will be optimally cascaded;
- All new energy that is produced must be renewable (at the time, the strategy also included biomass as a renewable source, while this is now excluded)

The measures above relate to the two indicators of minimizing the output and multisourcing. Although these indicators might have an indirect effect on the demand minimization, Amsterdam does not have a single policy that directly relates to the minimization of demand. However, it does encourage technological innovation, which often comes with more effectiveness and efficiency. This will eventually lower the demand and input. Changing the behaviour of Amsterdam's citizens is not discussed.

Brussels

The policy document for Brussels is not a municipal strategy, but a strategy for the region ("gewest") of Brussels: *Gewestelijk Programma voor Circulaire Economie, 2016.*

The Brussels document starts off with a baseline assessment of the urban metabolism of the city, including a SWOT-analysis. The baseline assessment even includes several geographical scales,

exactly like the UHA prescribes. Various (scholared) actors have been inquired about where the improvements can be made.

The focus of Brussels is on the administrative side. The city aims to bring several parties together in order to educate each other and to encourage start-ups and other initiatives. Funds are spent in order to educate students about the circular economy. Brussel's prospect is that due to the improvement of the circularity, more jobs will become available in this field. The document states that the city wants to be prepared and therefore improves the level of education about circularity. The UHA, however, does not mention that the level of education or the focus on the administrative side are the most important. There are many steps that can be taken without all the arrangements proposed in the document, especially at the lowest geographical scales.

Some unique policies that the document mentions are:

- Education will play a role in teaching people how to be more economical about the products they buy and use;
- Waste will be separated and collected in more categories;
- Logistics from outside the Brussels region must be decreased, more production from Brussels itself. One of the chapters is completely dedicated to the local economy and being more self-sufficient.

Brussels addresses all three indicators, with most of the policies being dedicated to output minimization. A strong presence of UHA elements can be observed in the document.

London

The policy document of London that will be reviewed is: *The London Plan, 2016.* This vision has been written for Greater London. This is one of the nine regions of Great-Britain. This region includes London and its surrounding boroughs. The London Plan is a rather big document and addresses several themes from a sustainability-perspective. This document is updated every five years.

The city of London does make clear with its policy that it aims to become more circular, but doesn't set the bar as high as some other cities that aim to become fully circular. Nevertheless, London addresses a great amount of themes in its document with matching policies.

A baseline assessment prior to the policy document is lacking, but there is data available on all the indicators that are used in order to monitor the progress. Although the UHA says that a baseline assessment is crucial in order to find out where the strengths and weaknesses of the city are concerning circularity, the data could work as a substitute.

London worked out which goals they wanted to reach and on the basis of those goals, policies were produced. What is striking is the fact that the focus of most measures relates to the (financial) economy or the creation of jobs. London is eager to keep their spot in the world economy and expand the wellbeing of the core of the city to the boroughs on the outskirts of the city and are trying to do so by implementing planning and sustainability policies. This focus on the economy could cause a lesser focus on the essence of the UHA.

Some of the goals that London is trying to reach are the following:

- Zero percent of biodegradable or recyclable waste to landfill by 2026;
- Zero car traffic growth for London as a whole;
- Production of 8550 GWh of energy from renewable sources by 2026.

All three indicators are present in the strategy document and are equally represented.

Differences between the cities

All cities have their unique characteristics in their way of policymaking. The differences become even more clear after the analysis of the monitoring document

After analyzing the policy documents of the cities on the basis of the methodology explained earlier, several scores became clear, as can be seen in table 1 and table 2. The percentage of pluses tells us something about the dispersion of the scores that have been assigned.

	Average score	Percentage of pluses
Amsterdam	6,3	66%
Brussels	7	62%
London	6,7	72%

Table 1: Scores of the policy documents

	Average score	Percentage of pluses
Amsterdam	4,8	33%
Brussels	7,5	91%
London	4,1	38%

Table 2: Scores for the monitoring documents.

Amsterdam

The monitoring document that has been used is: *Amsterdam Circulair Monitor, 2020.*

As mentioned before, Amsterdam has a focus on the social side of circularity. The city feels that the inhabitants have to benefit from the shift towards circularity and therefore it incorporates a lot of social policies in their strategy. This focus led to a score of 6,3, the lowest of the three cities concerning the policy document.

The UHA measures that have been proposed in the strategy did not completely work out as planned, as the score for the monitoring document is only 4,8.

For instance, the city of Amsterdam wanted to organize an optimal form of cascading all organic waste flows. However, according to the monitoring document, large amounts of organic waste are not yet cascaded, which is partly due to a lack of data. The city still needs to improve its “smartness”, in this case: being able to detect which flows are of a quality that is still usable, in order to actually reach their own goals. This knowledge gap is a reason that is frequently mentioned in order to explain the backlog. It would be hard for Amsterdam to create a complete Urban Metabolic Profile (UMP) when not all data is available, although this would give a better insight in the achievements.

Brussels
The monitoring document is: *Tussentijds Activiteitenrapport, 2020.*

Brussels scored a 7 on its policy document and a 7,5 on its monitoring document, both highest numbers in their categories. The administrative focus of the policy document has paid off in the sense that most of the UHA related goals that have been proposed in the policy document are being worked on or are already achieved (the average execution rate was 67% according to the monitor). The monitor mentioned that the bringing together of all kinds of actors created a synergy in which initiatives started that would not have happened otherwise.

London
The monitoring document that has been used is: *London Plan Annual Monitoring Report, 2021.*

The focus of the policy document of London was on the side of the financial economy and the creation of jobs. The document, *The London Plan*, did not only focus on cities becoming more circular, but also on other aspects of society. The proposed plans and measures that did relate to the UHA, often also had a link to the creation of jobs. It seemed like the city always had the profit motive in mind.

The approach that London followed did not prove to be successful: out of the three cities, London showed the biggest decrease when the scores of the policy and the monitor are compared.

Differences & Similarities
What becomes clear, is that all cities followed their own approach in setting up and executing their policies regarding the UHA. All cities scored sufficiently on their policy document, but only Brussels scored higher on its monitoring document. Amsterdam and London scored significantly lower on their monitoring documents.

Amsterdam had a clear focus on the social aspects of society when composing their UHA policies. Quite some policies included an explanation of how the inhabitants of Amsterdam would benefit from the measure. Although London had a more financial focus, it also slightly focused on the social parts because the policy often mentioned the need for more jobs in areas of the city that now suffer

a lack of jobs. London tried to create UHA policies that would increase employment opportunities in boroughs on the outskirts of the city.

Brussels had a completely different focus than the other two cities. In its policy document, it worked out how the structures of administrative units and initiative groups should be organized and how this would work in making the city more circular. Education of students was also a focal point of the policy document, which the other two cities did not explicitly address. These specific policies were easier to execute in Brussels than in London because of the scope of the area. The London Plan is a document that applies to all boroughs of Greater-London and all governments that house here. The London Plan must therefore be less specific and more general in their policies and measures and therefore this may have caused the score in the monitoring document.

A last unique feature is that Amsterdam, more than the other two cities, shows what they need to improve to reach their goals that have not been accomplished yet. Its monitoring document regularly states that there is not enough data about a certain theme and that the city will have to become a smart(er) city in order to find out the actual progress. London also mentions new policies in its monitor to improve the level of goals that have not been reached yet, but only sporadically.

Relation between policies and outcomes

What can be observed is that Brussels scored highest on both the policy document (7) and on the monitoring document (7,5). The city has used an approach towards the UHA that focused on administration, governance and education, which was a different approach than the two other cities took. The policy document also used all three indicators of the UHA, with a focus on output minimization. It also included more multisourcing policies than the other two cities. This method has led to a good score on the monitoring document. UHA policies and measures that were meant to happen, often really happened or were at least well on the way to be reached.

When this connection between policy- and monitoring document is compared to that of the other two cities, a big difference can be observed. The policies of London and Amsterdam both scored relatively close (6,3 and 6,7) to the score of Brussels. This means that the policies offer quite some attention to the UHA; there were more positive linkages to the UHA than negative linkages. However, the monitoring scores of London and Amsterdam made a vast decrease, which means that although these cities were scoring sufficiently on their plans to implement UHA measures, they did not manage to actually implement these UHA measures to the extent that they had described in their policies. One might argue that the policies of Amsterdam and London were harder to reach, on a larger scale. This is, however, not the case as the policies of the two cities were in essence a lot like the policies of Brussels.

The approach that the three cities used, differed from each other. Amsterdam not only focuses on the circular economy but also on the social aspects of life in the city and London incorporates financial aspects and the job economy in their UHA measures. Brussels has a more unilateral view: it focuses

only on the circular economy and thinks about the way in which this could be reached best. It put on paper the way in which initiative groups and governments should be organized and that students should be educated in the circular economy.

A factor that might have influenced the score of London is the level of influence that the paper has on the city. A considerable number of different bodies of government were addressed in the policy document, which does not make it easier for the city to be decisive and to execute plans fast. Next to that, the plans of London were the plans that were the most vaguely written of the three cities.

Conclusion

This research has tried to answer the research question: “To what extent do policies and regulations in European cities make use of the Urban Harvest Approach and do these policies and regulations that make use of this approach contribute to the actual implementation of measures regarding the Urban Harvest Approach?”. Policy analyses of three cities’ policy- and monitoring documents on sustainability and/or circularity have been conducted in order to find an answer to the aforementioned research question.

The three indicators that imply the presence of the UHA in policy (minimization of input, minimization of output and multisourcing) helped to find out what UHA policies existed in cities in North-West Europe. It appeared from the results that cities do in fact use policies that relate to the UHA. The policies that were mentioned differed per city. London included all three indicators on the same scale, whereas Brussels had a slight focus on the minimization of the output and Amsterdam did not include policies about minimizing input. Several UHA policies were present in all three policy documents, for example policies about local renewable energy production and the separation of waste.

After the policies and monitoring documents are compared it becomes clear that the studied cities all score sufficiently on the presence of the UHA in their policy document, which means that all cities use the UHA in their policy documents to a certain extent. However, only Brussels scored a sufficient score on the monitoring document. Amsterdam and London both scored relatively low on their monitoring documents, which means that too many aspects in these documents had a negative connotation regarding the UHA. What was observed as well, is that all cities took a specific approach towards the composing of policies. Amsterdam took a social approach, London a more financial approach and Brussels an administrative one. Amsterdam and London both had a more holistic view on sustainability, circular economy and society; these cities tried to incorporate different goals in the same policies, whereas Brussels had a focus on the aspects with which the rolling out of a circular economy comes, the administrative and educational side of becoming circular. Although differences in the scores for the policy document can barely be observed, they do become clear in the monitoring document. Brussels, which had a more specific view on the circular economy, scored high on the presence of UHA elements, whereas Amsterdam and London scored low on UHA elements with their multilateral focus on becoming more sustainable and circular.

The UHA is an approach that has been proven to be helpful for cities to become circular (Agudelo-Vera et al., 2012). In order to actually use this approach and make it work, it would be advised to create policies that are purely focused on the city becoming circular and not have any ulterior motives. The focus of Brussels on the administrative arrangements for the UHA and the circular economy has proven to be successful in contrast to the multilateral views of Amsterdam and London.

Discussion

The results of this research show that cities actually use the UHA in their policies, although they do not explicitly mention this. In the light of the current state of the climate crisis and the lack of resources that is becoming increasingly apparent (Soleimani, 2018), it is remarkable that cities do not achieve the goals relating to the UHA that they have set in their circular economy policy documents. This means that there is still progress to be made in terms of circularity in cities. The multilateral focus towards circularity that some cities in North-West Europe apply does not seem to work well, while the approach of Brussels does pay off. The previously described urban metabolism that still works too linear in some cities can be improved and made more circular by applying the administrative focused unilateral approach on the UHA that has worked in Brussels. However, the approach might be time and place specific. Path dependency might play an important role, because the history of Brussels has contributed to the way the policies are presented and implemented. This means that it will not be easy to copy and implement the same structures and approaches in other cities.

Additionally, some explanation and nuance should be made on certain elements in this research.

Firstly, the concepts “circular economy” and “renewable” are relative and subjective. Many researchers have tried to write up a definition of these concepts, however cities are free to bring in their own ideas in their policies. For example, the city of Amsterdam proposed a biomass power plant in their policy document (2015), but nowadays biomass is not considered to be good for the environment (Middelkamp & De Kleuver, 2019). Another example is the fact that London is trying to be more sustainable by improving the gas network, while Amsterdam is trying to disconnect from the gas network. This shows that cities are at different levels of sustainability and have contrasting views on the concepts. Such discrepancies might have had influence on the policies that have been published.

Secondly, the monitoring documents of the cities have different structures. While one monitoring document shows all the exact numbers with the accompanying policy, the other document gives a recapitulatory overview about what has happened in the past years. This makes it harder to give scores to the text elements and the comparison is therefore harder to establish.

Thirdly, the cities differ in government structure. The policies that have been adopted by the regional government authority are sometimes still open for the interpretation of lower bodies of government that on their turn have to decide on how to implement the policies. It differs per city, one might be more direct than the other and cities might keep this in mind while writing the policy documents. An interesting subject for further research would therefore be the question what influence the government structure has on the implementation of UHA policies and what structure would be most effective to create circular cities.

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Appendices

1. Analysis of Amsterdam's policy document

General/Other	UHA 1 Input	UHA 2 Output	UHA 3 Multisource
The "Management Samenvatting" speaks about the goal of Amsterdam to improve circularity. This is seen as the main driver behind improving the durable and sustainable city. Circularity is related to the idea of UHA. (+)	There are no main principles that the municipality uses that relate to the minimization of demand, while this is an important part of the UHA (--)	One of the three main principles for circularity of construction chains that is mentioned in the first chapter is the "storage of raw materials" (++)	One of the 7 principles the municipality works with, introduced in the introduction, is "All energy is renewable" (+)
A 'Circle Scan Study' has been done in order to have a baseline assessment for the report at several geographic scales and a clear urban metabolistic profile has been illustrated (+)		One of the three main principles for circularity of construction chains that is mentioned in the first chapter is the "stimulating high-quality reuse" and "stimulating resource-passports" (advice or obligation on reuse for buildings) (++)	Biomass should be produced regionally (+) (Biomass is not considered durable anymore but wasn't known at the time)
On the basis of the base assessment, a detailed analysis has been done on a few subjects and not on all aspects of a circular city, not the UHA approach (-)		One of the 7 principles the municipality works with, introduced in the introduction, is "Resources are used to create other forms of value" (+)	The strategy mentions that there should also be regional and national production methods, while the UHA is an advocate of local production. (-)
In the first part of the document, the amount of jobs that could be created seem to be very important, while the economic aspects do not (per se) always contribute to the UHA (-)		Planning has an essential role in the reuse of materials. The demolition and construction of buildings must be done in such a way that materials of demolished houses can be used in the new buildings (+)	Local food production is preferred and even stimulated by the municipality. (++)
One of the 7 principles the municipality works with, introduced in the introduction, is "There is no waste" (+)		Creating a "Marktplaats" for used materials to build with and this same idea for food that is still edible but eg expired. (+)	
The strategy mentions that there is a valuable role for the government as companies need the right regulations to improve the circularity. (+)		Organic residual flows are being optimally cascaded. (+)	
There is a strong aversion of linear economies and after every chapter, the strategy looks at how the plan will impact current linear flows. (+)			
Within each theme, the circular economy has been visualised with all actors in			

these themes, but the themes do not cover all sectors (energy, quite important theme, misses for example) (=)			
There is a focus on technological innovation. Every chapter needs “smart” technology that still needs to be developed. This is a good perspective, but brings uncertainty and might even cause losing attention to the UHA. (=)			
The barriers are made clear after every chapter, which is good to know when people start working with this strategy (=).			
The three indicators that are used to measure circularity are: value retention, economic impact and ecological impact. these differ slightly from the main points that the UHA uses, but the municipality is open to find new and more indicators to be able to do better research in their circularity (-).			

2. Analysis of Amsterdam's monitoring document

General/Other	UHA 1 Input	UHA 2 Output	UHA 3 Multisource
Due to the lack of data, a part of the waste materials is lost and is not (re)used. (-)	Information is lacking to make a connection between the input materials and the output.(-)	It is unknown how different products are used and reused. In the future, the municipality would like to have a better insight in order to find out what products keep on being reused in the economy of Amsterdam. (=)	Waste is processed more and more in the region itself and less outside Amsterdam, almost no import from abroad (food). (+)
The largest amount of consumption goods is still burned instead of reused. (-)	The monitor states: "focussing too much on the input causes a lesser focus on the output flows" (=)	Public-private partnerships seem to help really well in order to monitor the effectiveness of the policy. (+)	
Sorting and separating are increasing in every chain, which is a good thing according to the UHA if these goods are reused. Although there is not enough data to confirm this, the municipality is almost sure that this has increased. (+)	The level of the input is only accomplished in the city of Amsterdam, but not in the entire region; this still has to happen (administrative boundaries). (-)	The chain of consumption goods and the chain of organic goods are lagging behind other chains (-)	
	In order to do better in the future, the monitor advises to get more data from the inputs (Schiphol, Douane and the Havenbedrijf). (+)	Waste is separated well, but there is no data on the actual recycling of waste (=)	
De monitor benoemt dat heel veel nog onbekend of onzeker is. Verder is de perceptie van burgers erg belangrijk. Niet per se de doelstellingen die gesteld zijn in het rapport.			

3. Analysis of Brussels' policy document

General/Other	UHA 1	UHA 2	UHA 3
The document addresses different spatial scales, which is good to consider in a baseline assessment according to the UHA (+)	Consumption should be lowered according to the introduction, however in the main strategic points of the document, there is not so much attention to the lowering of consumption (=)	*Het regeerakkoord van de Brusselse Hoofdstedelijke Regering bepaalt dat "onze lineaire economie (delven-produceren-consumeren-weggooien) wordt omgevormd tot een kringloopeconomie (recupereren-produceren-consumeren-hergebruiken)"* (++)	Local economy is a vital part in the strategy document and is one of the four main chapters ("territoriaal") which is elaborated upon (+)
The strategy aims to be holistic and wants to include all flows of resources (unlike Amsterdam) (++)	In one of the policies (3.10), innovation and technology is encouraged to be used to help the city in the future to reduce demand. It seems like there is no smart infrastructure in place to already help the Brussels circular economy to monitor and no technology to reduce the demand. An innovation strategy was still worked on when the report was published (=).	Waste is prevented by several actions, such as recycling and recuperation (++)	Decrease logistics from outside the Brussels region, more production from Brussels itself. (+)
Brussels wants to be famous for their circular city actions and show what it does to their (job) economy. The main focus points are about economic prosperity and creation of more jobs. This economic focus might distract from the goals of the UHA. (-)	Education plays a role (3.19) in stimulating people to be more economical with the products they own and buy.(+)	A considerable part of the funds that have been made available goes to projects that educate and stimulate companies to reuse materials. (+)	
However, there are new jobs needed in order to reach circularity. The sorts of jobs that are needed are explored. (=)	The strategy states that the construction sector will need less raw materials, the demand decreases (3.23) (+)	Policy: "*Ze zal een kader ontwikkelen dat gunstig is voor de Brusselse economische activiteiten van inzameling, herstelling, hergebruik en voorbereiding op hergebruik van een maximaal aantal afvalstromen waarvoor een herziene uitgebreide producentenverantwoordelijkheid zal gelden.*" (+)	
A big part of the strategy is dedicated to the administrative changes that should happen in order to make the holistic approach viable. (=)		Education plays a role (3.19) in stimulating people to reuse products.(+)	
Apart from a holistic view, there are all sorts of sectoral measures mentioned in the strategy. (=)		Waste recycling increase (4.2). (+)	
A baseline assessment has been done in the form of a study of the urban			

metabolism of Brussels together with a SWOT-analysis. (++)			
Several actors have been asked to give an opinion about what the region should do to become more circular (=)			
The establishment of a “Coordination platform for guidance on the circular economy”. Not per se UHA, but helps in the process (=)			
A lot of measures have an administrative focus, helpful for the UHA, but this focus on creating the right circumstances for circularity might decrease attention on actually getting circular. (=)			
Several spatial scales are taken into account in a whole chapter, which is vital for the UHA. (++)			
“In 2019 zal het Brussels Hoofdstedelijk Gewest beschikken over een economisch activiteitenpark dat specifiek in het teken staat van de circulaire economie. De samenwerkingsverbanden tussen de bedrijven zullen worden aangemoedigd, zodat het afval van een bedrijf de grondstof van een andere zal worden of bepaalde kosten onderling worden gedeeld met het oog op een efficiënt hulpbronnenbeheer. De lokale initiatieven zullen zijn uitgebreid en er zal zich een kritische massa hebben ontwikkeld op gewestelijk niveau. Alle actoren van het grondgebied zullen tot slot de concepten van de circulaire economie hebben aanvaard”(+)			

4. Analysis of Brussels' monitoring document

General/Other	UHA 1 Input	UHA 2 Output	UHA 3 Multisource
Half of all measures that were presented in the strategy have been executed for 80-100%, the average execution rate is 67%. (=)	"Box 3, een moduleerbaar verblijf", a project in which the homeless can stay, but it is easily transformable to any other purpose (+)	The development of a website to teach people and companies which parts of houses can be reused. (+)	Beachwood from a forest near brussels that was first exported to other places is now used only in Brussels (+)
New partnerships have been established between public and private organizations that strive to improve the circularity in Brussels. (+)		One partnership gives subsidies to companies that address *"reparatie, hergebruik en recyclage (de 3 R'en) ongeacht de sector" (++)*	One partnership gives subsidies to companies that address the sustainable production of food (+)
Start-up incubation programmes have been established to help start-ups define their goals and contribute to the circular economy (+)		Standard 18650 tries to reuse batteries of electric scooters in phones and tablets. (+)	
Entrepreneurs in Brussels are not familiar with the circular economy, education should play a vital role. Guidance is provided in the form of clusters and cooperations . (+)		The construction industry is reusing parts of old buildings due to the BEFIMMO cooperation. (+)	
Focus op bedrijven onderwijzen en studenten onderwijs aanbieden "sensibiliseringsacties" (=)			

5. Analysis of London's policy document

General/Other	UHA 1 Input	UHA 2 Output	UHA 3 Multisource
Economy is an important part of this strategy. Competitiveness is more important than climate in some policy points. (-)	Benefits of infrastructure must be maximized in order to decrease the demand for new infra. (+)	"minimising the generation of waste and maximising reuse or recycling" (++)	The strategy aims to relocate some big companies to the periphery of London in order to secure the people living in the outskirts with jobs. This trend might cause an increased demand for materials and decrease local-ness of the city, whereas the UHA advocates a local closed system to reach circularity. (-)
Cities experience sustainable energy sources differently. London wants to increase the use of gas, whereas Amsterdam wants to disconnect from the gas network. (=)	London wants to use less energy "Be lean" (++)	"develop energy master plans for specific decentralised energy opportunities which identify possible opportunities to utilise energy from waste" (++)	London wants to use renewable energy "Be green" (++)
Policies are all quite superficial, not very in depth. "lowering carbondioxide". This approach does not really implicitly contribute to the UHA. The policies are more like frameworks for the real measures that lower parts of government have to fill in. This can cause different focusses and different outcomes. stringency is not high (--).	Supply of energy must go efficiently "Be clean" (+)	"Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems, and where a new CHP system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites." (++)	"securing sustainable procurement of materials, using local supplies where feasible" (+)
The strategy aims to be very progressive and climate friendly, while it is also clear that London wants to keep its position as a leader in the world economy. Most policies describe a certain climate friendly goal, but also note that they want to ensure the economic position of the actors that are involved. (--)	"efficient use of natural resources (including water), including making the most of natural systems both within and around buildings" (+)	"Reuse of parts of deconstructed buildings" (+)	Boroughs are encouraged to find energy opportunities within the boroughs, 25% of the energy should be produced locally by 2025 (+)
The policies are not per se all focused on circularity, but more to sustainability. The chapters that are about circularity also encourage things that do not align with the ideas of the UHA. There is for example no focus on getting all resources from the London area (-)	Implementing a lot of green spaces in order to reduce the demand for energy (+)		"store rainwater for later use" (++)

6. Analysis of London's monitoring document

General/Other	UHA 1 Input	UHA 2 Output	UHA 3 Multisource
The Monitor focuses on 24 indicators that measure the progression of the strategy document. The Indicators that are important for the UHA are: 13 (Use of public transport per head grows faster than use of the private car per head), 14 (Zero car traffic growth for London as a whole), 15 (Increase the share of all trips by bicycle from 2 per cent in 2009 to 5 per cent by 2026), 19 (At least 45 percent of waste recycled/composted by 2015 an 0 percent of biodegradable or recyclable waste to landfill by 2026), 21 (Production of 8550 GWh of energy from renewable sources by 2026), 22 (Increase the total area of green roofs in the CAZ).	**13: Use of public transport per head grows faster than use of the private car per head** Since the strategy report was published in 2016, the amount of people travelling by public transport has decreased by 1.4 index points, although an increase since 2001 can be seen of 30%. Private car transport has decreased with 1.3 index points compared to 2016. This goal has not been met yet, as a bigger decrease can be seen in the public transport compared to the private cars. This means that UHA measures to decrease the demand of fuel and cars have not been properly conducted. (--)	**19: At least 45 percent of waste recycled / composted by 2015 an 0 percent of biodegradable or recyclable waste to landfill by 2026** The waste going to a landfill is decreasing at a nice pace, so that goal is on track to be reached. However, the goal of recycling 45% of waste by 2015 is still not reached, so the UHA measures of the plan do not work (it is not increasing, nor decreasing) (--).	**21: Production of 8550 GWh of energy from renewable sources by 2026)** The production has increased by 38 GWh to 1084 GWh since the introduction of the London Plan 2016. This is well below the 2026 target, so more UHA approaches should be taken in order to reach the goal. (-)
	14: Zero car traffic growth for London as a whole Although there is a decrease in car usage since 2001, the line stagnates after the introduction of the strategy document. Levels have stayed the same as the levels in 2016. The decrease of earlier years does not continue. Although the goal is still met, there is no decrease which means that UHA measures to decrease the demand of fuel and cars have not been properly conducted. (-)	**19: At least 45 percent of waste recycled / composted by 2015 an 0 percent of biodegradable or recyclable waste to landfill by 2026** The monitor points out that there are new measures in a draft London Plan that address the goal of recycling 45% of the waste. (+)	"However, there are other initiatives being introduced to increase renewable energy generation, such as the Mayor's Solar Action Plan." (+)
	15: Increase the share of all trips by bicycle from 2 per cent in 2009 to 5 per cent by 2026 The goal in 2016 was to reach a modal split of 5% bicycle trips. Since 2016 it has increased by 0.1% (from 2.3% to 2.4%). By 2026, the goal is to make it grow to 5%, which means that London is not on schedule to reach that goal. Catching-up is possible, but		

	5% seems to be hard to reach. UHA measures have not been conducted properly yet (-)		
	22: Increase the total area of green roofs in the CAZ This target is going really well. Currently there is 290.000m2 of green roofs in London. In 2013, this was 175.000m2. Green roofs cool the city, less electricity for cooling is needed. (++)		

7. The pluses and minuses per document

Policy document

	Amsterdam	Brussels	London
--	1	0	2
-	4	1	3
=	2	8	0
+	11	10	7
++	3	5	6

Monitoring document

	Amsterdam	Brussels	London
--	0	0	2
-	5	0	3
=	3	1	0
+	4	9	2
++	0	1	1

The values of the signs

--	0
-	2,5
=	5
+	7,5
++	10

Scores Amsterdam

Policy document: (1x0+4x2,5+2x5+11x7,5+3x10)/21= 6,3

Monitoring document: (5x2,5+3x5+4x7,5)/12=4,8

Scores Brussels

Policy document: (1x2,5+8x5+10x7,5+5x10)/24=7

Monitoring document: (1x5+9x7,5+1x10)/11=7,5

Scores London

Policy document: (2x0+3x2,5+7x7,5+6x10)/18=6,7

Monitoring document: (2x0+3x2,5+2x7,5+1x10)/8=4,1