1 | From biowaste to public space!

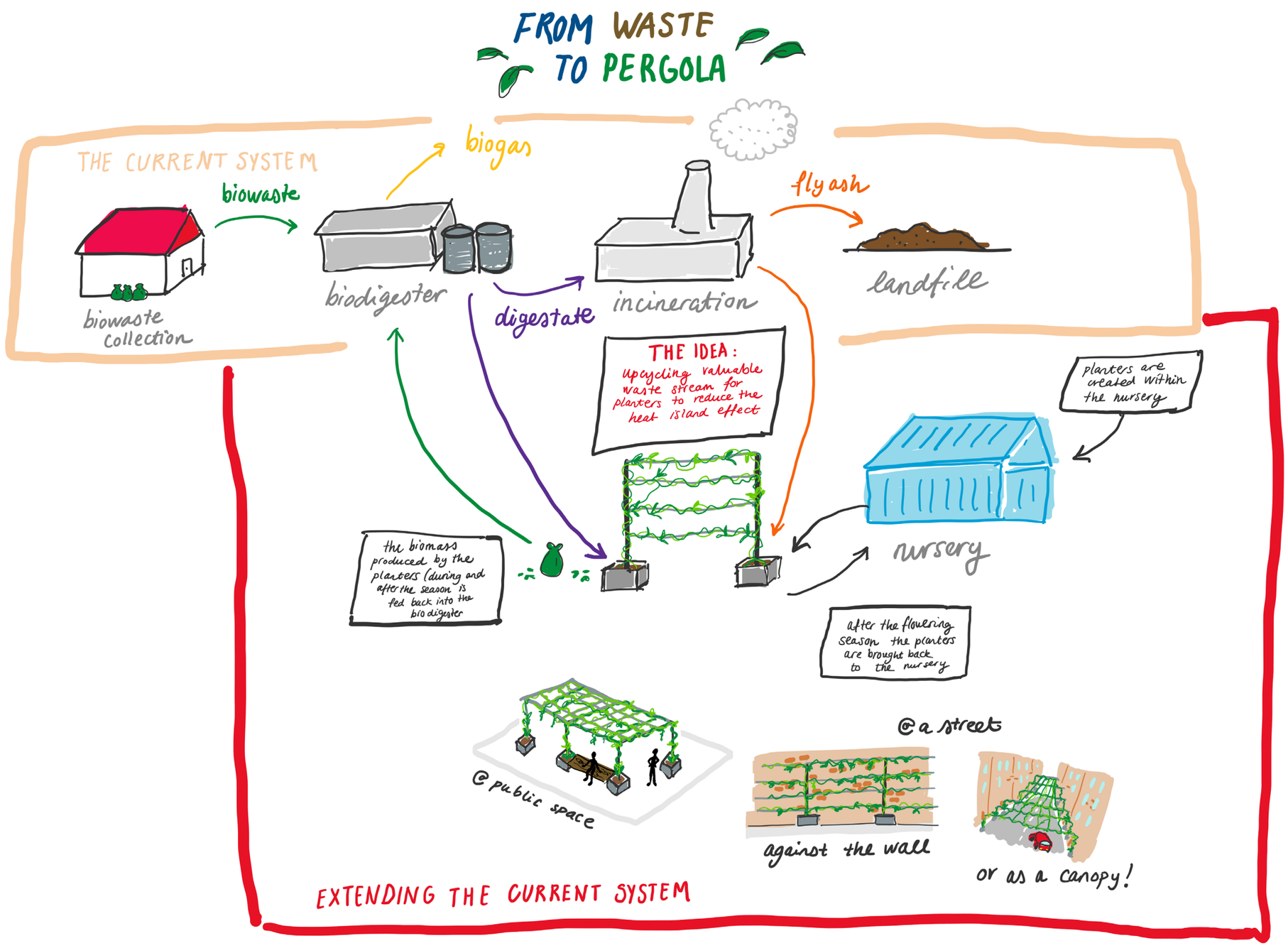


Figure 1.1) Schematic diagram showing the principle of converting biowaste into planters

To which flow does the idea belong?
WASTE SCAPES

To which challenge does the idea belong?
Upcycling waste streams

Identify which place does it take in the challenge tree:

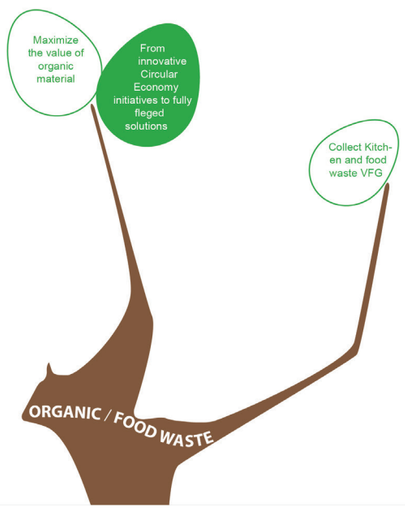


Figure 1.2) Challenge tree showing the challenge in which the idea belongs

Sources:

Maiheu, B., Van den Berghe, K., Boelens, L., De Ridder, K. & Lauwaet D. (2013). Opmaak van een hittekaart en analyse van het stedelijk hitte-eiland effect voor Gent. University of Ghent

What is the goal of the idea?

The primary aim is to mitigate the heat island effect in the city of Ghent by creating shade with greenery. Researchers of the University of Gent have measured that on average there is a 3 °C difference in temperature between the historic city centre and the outskirts of the city (Maiheu et al., 2013). This is a vast difference in temperature considering this is not even 10 km apart from each other. The reason: the urban heat island effect causes the city to cool down slower than in the surrounding lands. Due to largely paved surfaces in the city centre, heat is accumulated during days where the sun is shining throughout the day.

How will we reduce the heat island effect?

By suspending modular pergolas over public squares and streets a shade coverage will be created. So the amount of solar radiation reaching the paved surfaces will be reduced. With a minimum amount of material we create a modular pergolas that can easily connect with each other to create a greater plant coverage. To reduce the heat island effect, these installations would be placed at areas where the heat island effect is the strongest, namely the city centre.

What will be the benefits?

The idea is to provide a product service systems instead of a product only, this will make the pergolas more accessible for different parties, like the municipality and tenants that can both rent the pergolas for a monthly fee. Maintenance is included in the monthly fee, however to foster communal gardening tenants can opt for a lower fee if they maintain the pergolas themselves. For people the benefits will be more shade in the city, less heat, aesthetic upgrade of the urban image and a pleasant meeting point for recreation.

What does a modular pergola consists of?

A modular pergola consists of eight poles connected by cables. Each pole is installed in a planter boxes. The planter box is 50x50x50 cm. For pergolas crossing a street the poles are 500 cm in height. The poles will have hooks at every 50 cm so that cables can be attached to them. The cables can vary in length, dependent on the customer wishes and can be attached to hooks of other poles. Additionally, a grid of cables can made to intensify the hanging plant coverage. The vines will grow in the planters at the base of the poles and climb towards and on the suspended cables. As a result the greenery can be horizontal (but hanging) and/or in vertical direction. The connection between poles can be in any direction so imagination is the limit!

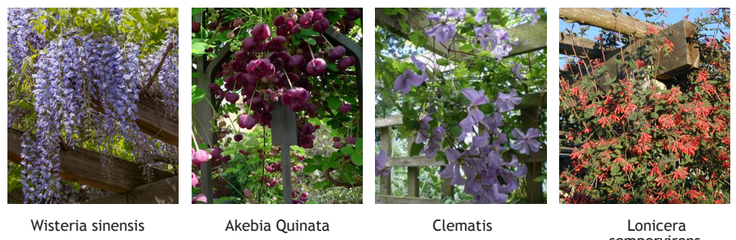
Where will the pergolas be made?

A nursery will be required to grow the plants and to build/ assemble the poles. This location can create opportunities for employment and social inclusion and can be allocated in land that is unused within the municipality of Ghent.

What will the modular pergolas be made off?

The pergolas will be made out of by-products from the biodigestion and incineration processes that are part of the existing VGF waste management in Ghent. Some fly ashes from the incineration plant will be used to construct the planter boxes. The plant boxes consist of pervious concrete with fly ashes. The soil for the planters will consist of a mix of compost from the biogestion plant. Plants that survive during winter (i.e. “winterharde planten”) and do not need much maintenance. Good climbing plants for pergolas are: Wisteria sinensis, Akebia Quinata, Clematis or Lonicera sempervirens. These plants are displayed in Figure 1.3.

Figure 1.3) Overview of climbing plants



Wisteria sinensis | Akebia Quinata | Clematis | Lonicera sempervirens

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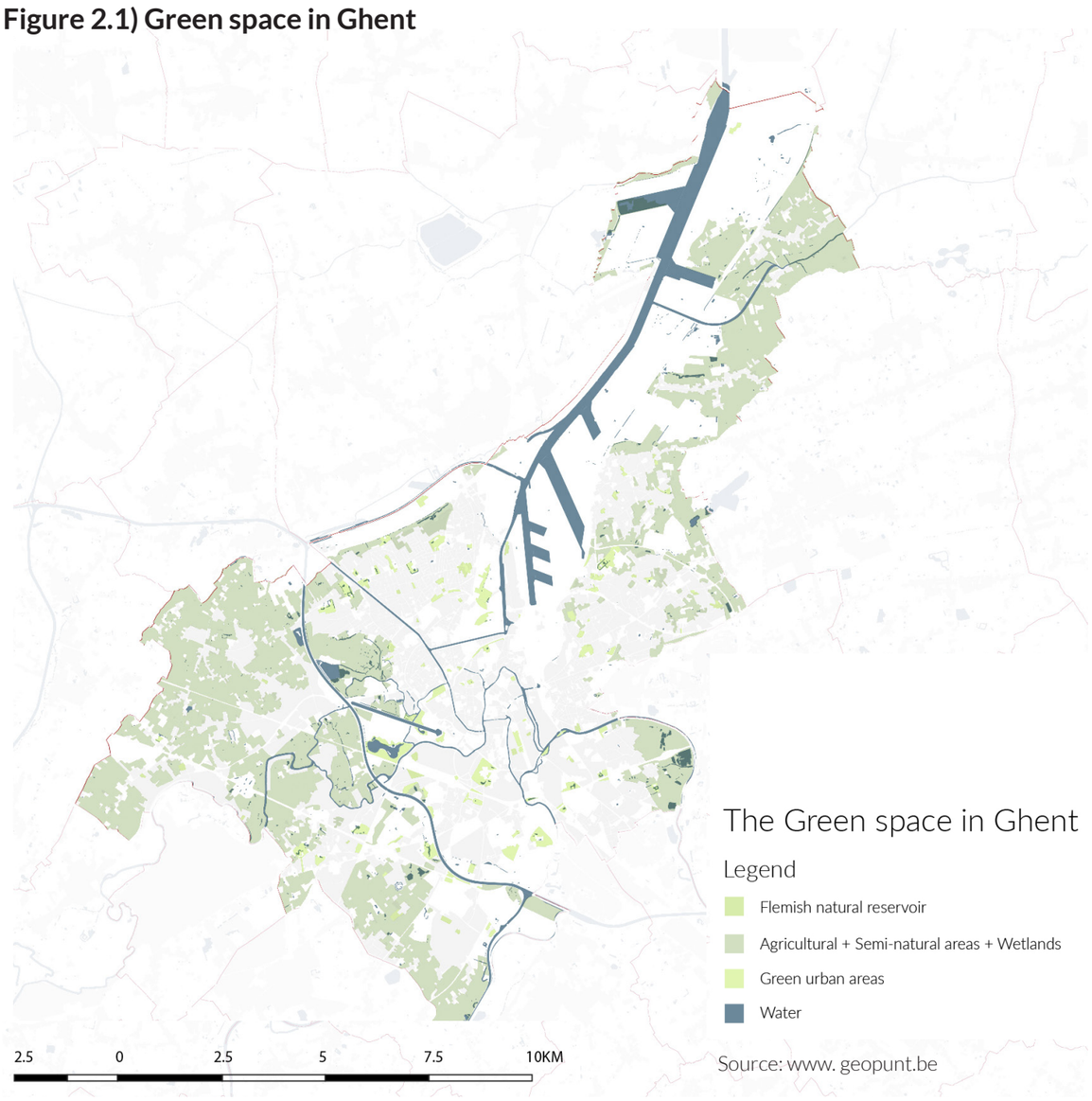
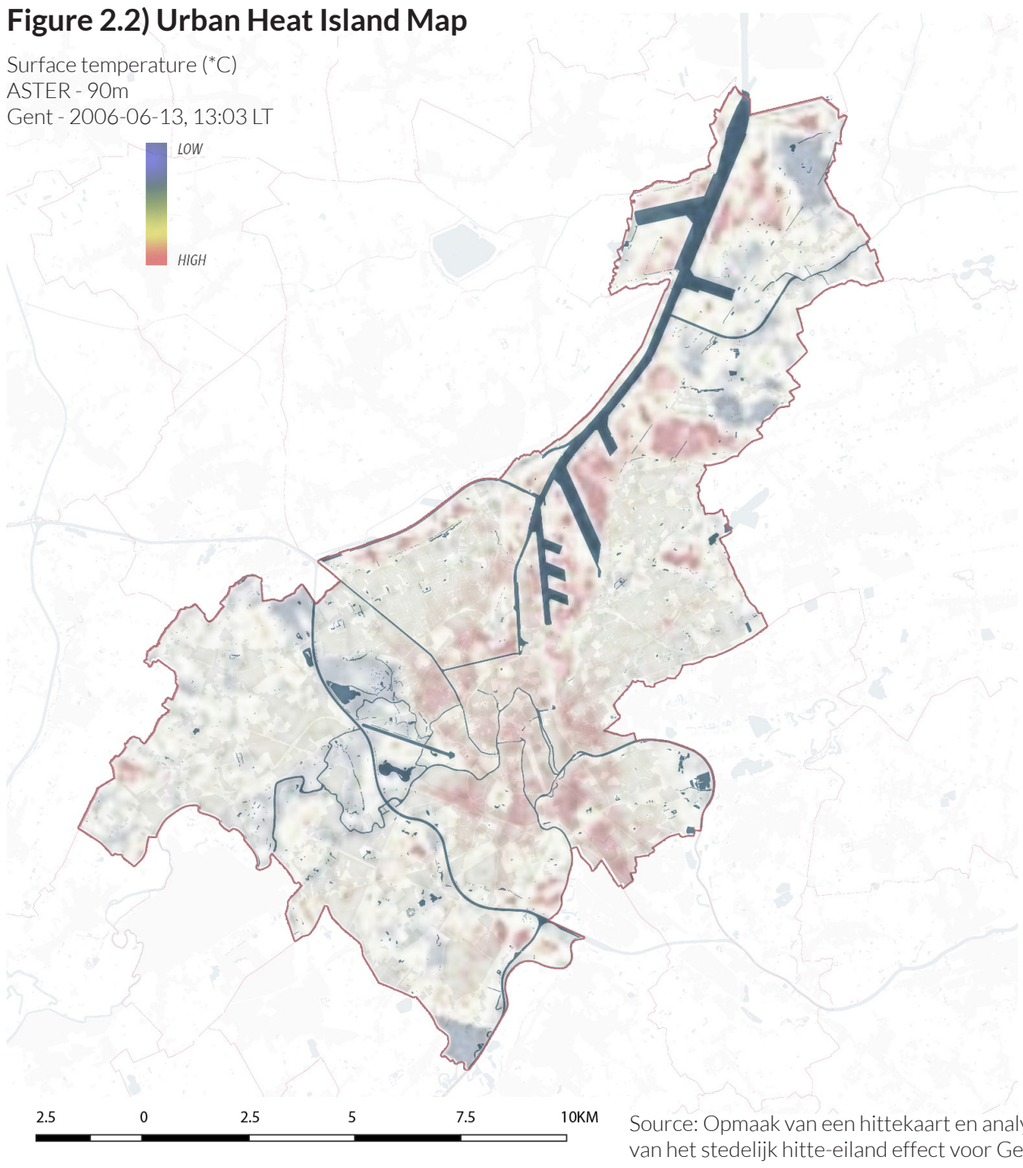
2.1 | Representation model

Figure 2.1) Green space in Ghent



Source: www. geopunt.be

Figure 2.2) Urban Heat Island Map



Source: Opmaak van een hittekaart en analyse van het stedelijk hitte-eiland effect voor Gent

Representation

This poster demonstrates the current situation of Ghent. Figure 2.1 displays the existing green spaces in the municipality of Ghent on a map. Figure 2.2 demonstrates a map of surface temperatures of the municipality; this indicates the locations that are more prone to heat stress. Finally, Figure 2.3 shows the location of the existing organic waste processing facilities, residential areas and the main roads of the city from which one can interpret the logistics of organic waste collection through the city. These maps will be used to support the decisions on which locations are the most suitable to install the pergolas to maximize their impact; also to identify the logistics related to the pergola product service system.

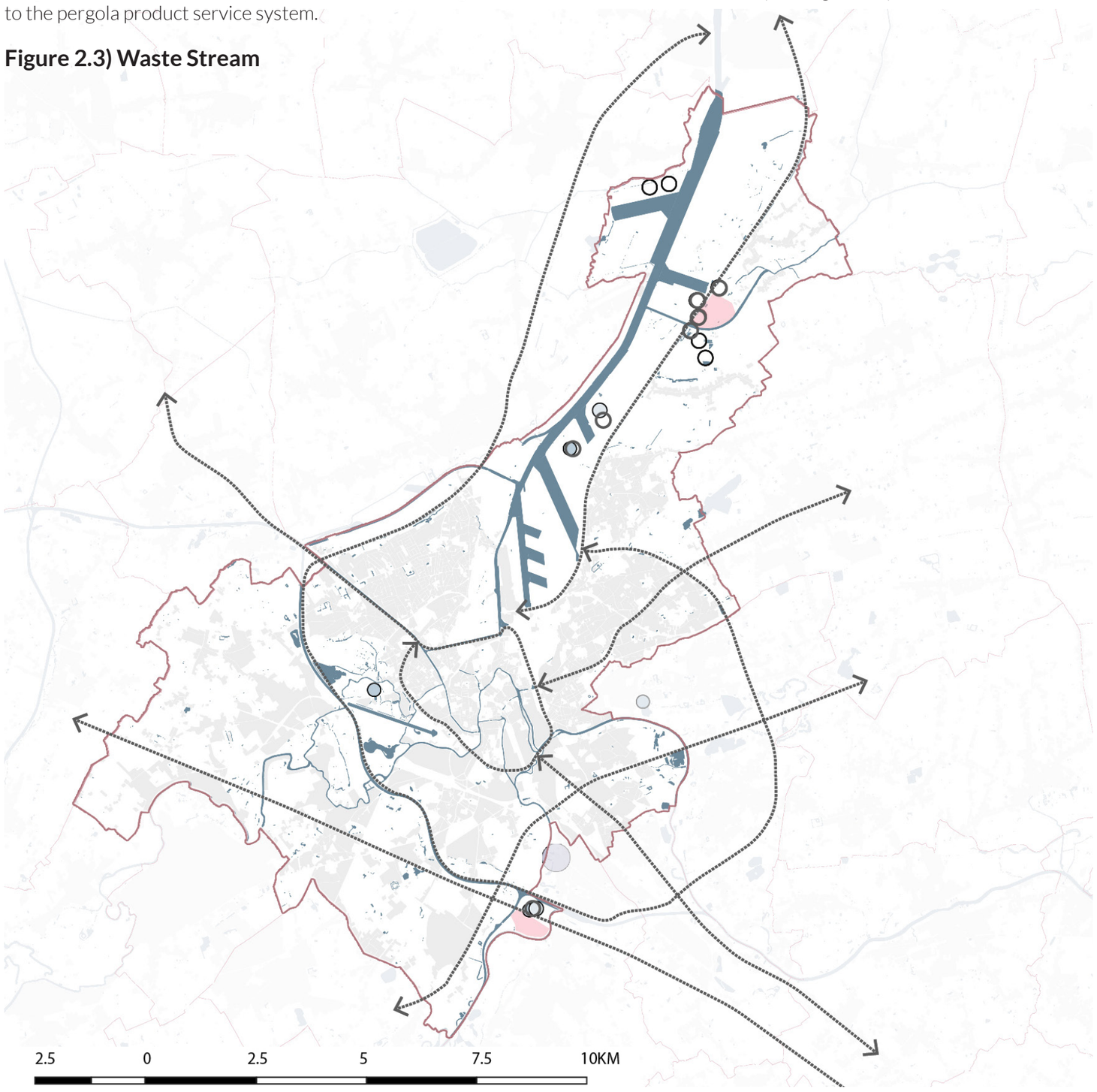
Urban stress and greenery condition

While observing Figure 2.1 one can observe that where there is little or no greenery in the historic city centre of Ghent and on the harbour industrial sites along the canal. This lack of green spaces coincides with the density of locations with high surface temperature, as can be observed in Figure 2.2. . Also, the residential area overlaps with the city centre. With the aforementioned it can be concluded that the city centre is where the citizens are most likely to be exposed to urban heat stress and shortage of greenery. The consequence of a shortage of greenery is the lack of shadow which as a result heats up the paved surfaces of the city during the day.

Suitable locations for pergolas

In order to decrease the urban heat island effect in Ghent and improve the quality of public space, the location of the pergolas is chosen by overlapping the major public space and residential area with the map of urban heat island. For the selection of the plots, we chose areas that in and surround city center. We did not include industrial areas in our analysis because they are not the major places for human activities. The red spots are places which are defined as problematic: these are public or residential areas that already suffer most from the heat island effect.

Figure 2.3) Waste Stream



Source: Geoportal flemish region https://download.vlaanderen. be/Catalogus; Urban Atlas,European Environmental Agency,

Waste streams

In figure 2.3 one can observe that the waste incineration plants, digestion plants are located next to a main road near the harbour on the North side of the city. In terms of logistics and traffic movements, it would be most convenient to place the organisation that will produce the pergolas near the biowaste processing facilities (biodigester and incinerator)

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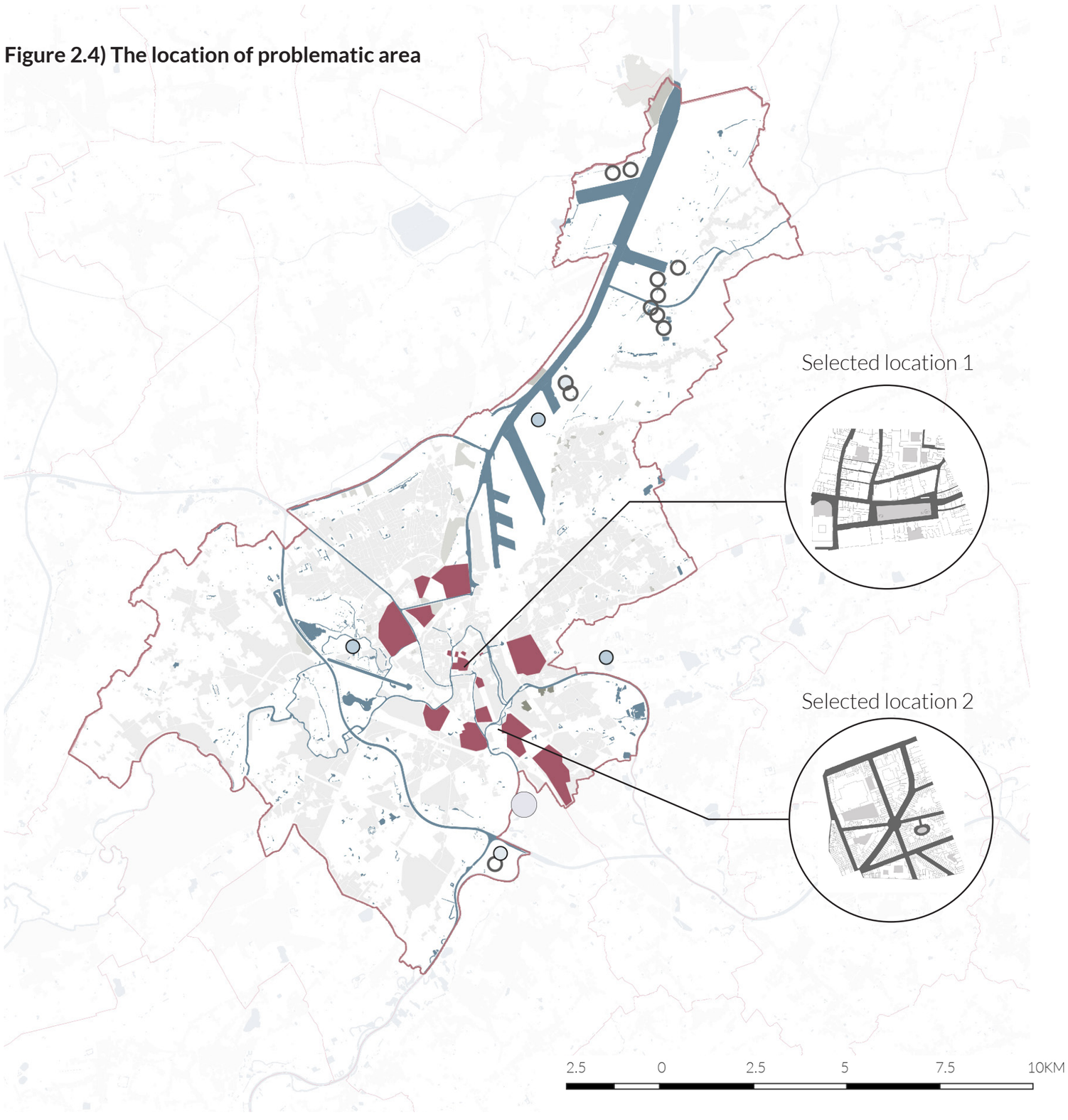
2.2 | Representation model

Figure 2.4) The location of problematic area



Source: Geoportal flemish region https://download.vlaanderen. be/Catalogus; Urban Atlas,European Environmental Agency,

Two sample plots

Out of the problematic areas we selected two case-study plots to illustrate the amount of greenery on a smaller scale level. It was beyond the scope of this research to estimate optimal placing for the whole area of Ghent. To get a detailed view of greenery in squares and streets where the pergolas could, potentially, be installed we took two sample plots: one in the city center (Figure 2.5) and one in a residential place (Figure 2.6). To give an impression of the built environment in the plots, a sketch of a square in location 1 is provided in Figure 2.7 and a sketch of a streetview is provided in Figure 2.8.

In the two plots, we calculated the public space into two categories: street and square because that the placement of pergola would be very different in these two kinds of area. And we calculated the percentage of green area in these two. From the result, we can see the percentage of green area in square is similar in these two cases, all around 25%. The greenery in the street is little. One is around 6%. Another one is less than 1%.

Figure 2.5) Selected location 1

Figure 2.6) Selected location 2

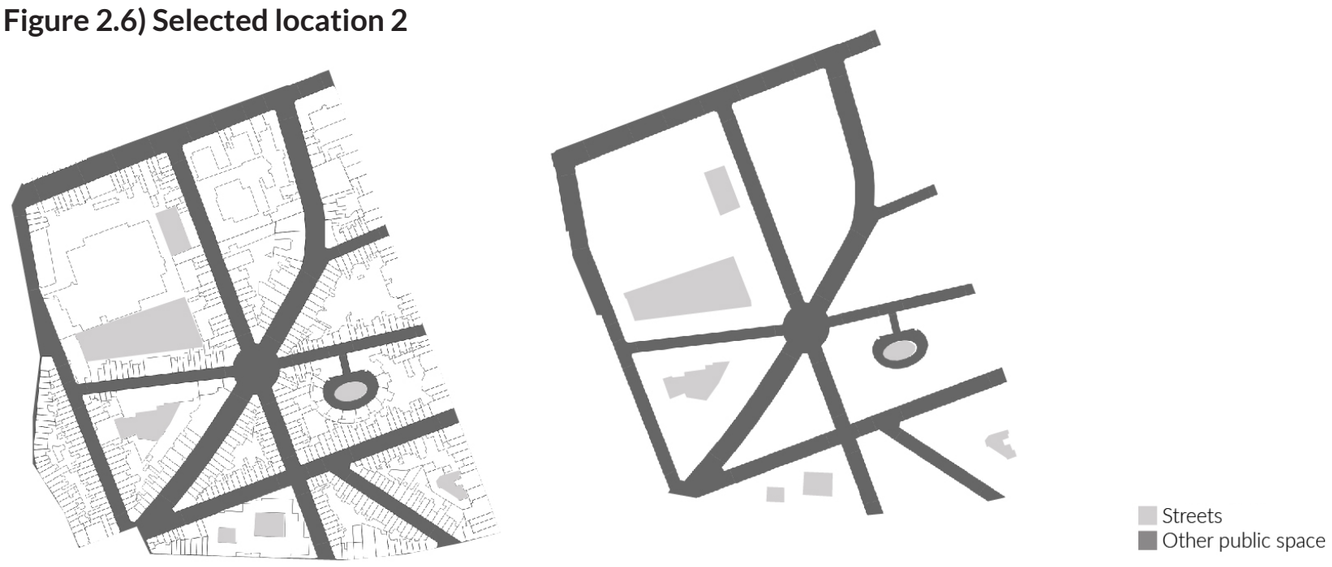


Figure 2.7) Visualization of current situation market squares

Figure 2.8) Visualization of current situation streets

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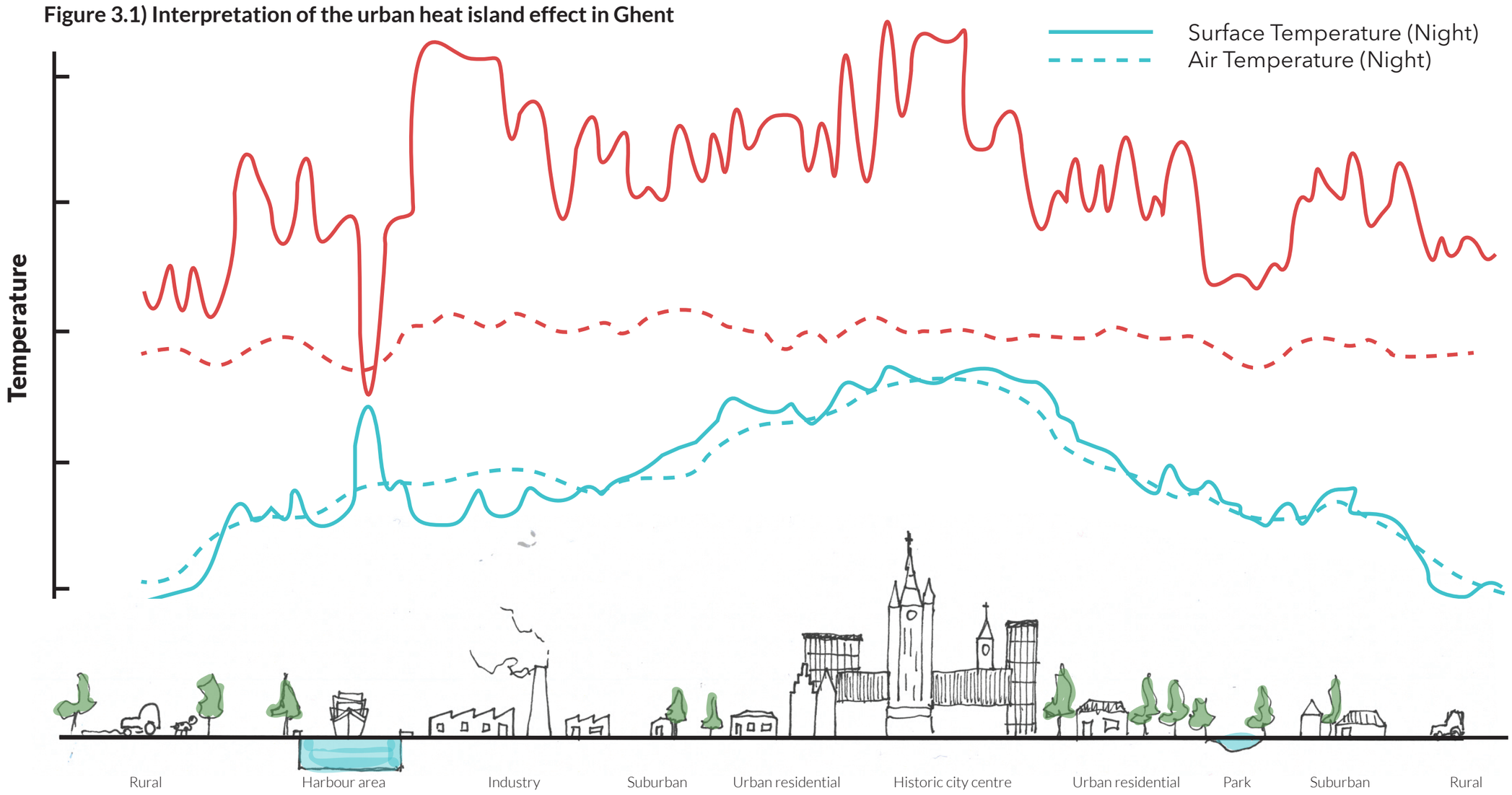
3.1 | Process model

Urban Heat Island effect

Figure 3.1) Interpretation of the urban heat island effect in Ghent



What is the urban heat island effect?

An urban heat island is a metropolitan area which is significantly warmer than the surrounding rural areas (as represented Figure 3.1). The temperature difference is usually larger at night than during the day, and is most perceptible when winds are weak. One of the main causes of the urban heat island is the fact that there is that paved surfaces heat up due to solar radiation and emanate the heat continuously during the day by convection and radiation (see Figure 3.2 a) and Figure 3.3 a)). Also, insufficient vegetation that can absorb and retain the energy from the sun aggravate the effect. During the night, although the solar radiation is not present any longer the paved surfaces still release heat continuously (see Figure 3.2 b) and 3.3 b))

There are many other factors that influence the urban temperature considerably. Some of them are wind speed, air humidity, urban landscape (see Figure 3.3), evapotranspiration of vegetation and heat generated from human activities.

Why is it important to reduce the urban heat island effect?

The most important reason to address the issue of heat island effect is safety. This is particularly the case for elderly and children as they are more vulnerable to heat illnesses. Secondly, is because this phenomenon the liveability of the urban space is decreased; it is noticeable in the sleep, work and recreation of citizens. Also, it causes an increased use of energy for energy applications and thus more carbon emissions.

Where is the urban heat island effect most noticeable?

The urban heat island effect is most prominent in urban and industrial areas which are characterized by considerable paved areas, little vegetation and no proximity to large water bodies. As you can see in figure 3.2a and figure 3.3a, the historic city centre is lacking in greenery on squares and in the streets. As a result, the surface temperature is high and the air temperature increases during the night.

Figure 3.2a) Marketplaces during daytime

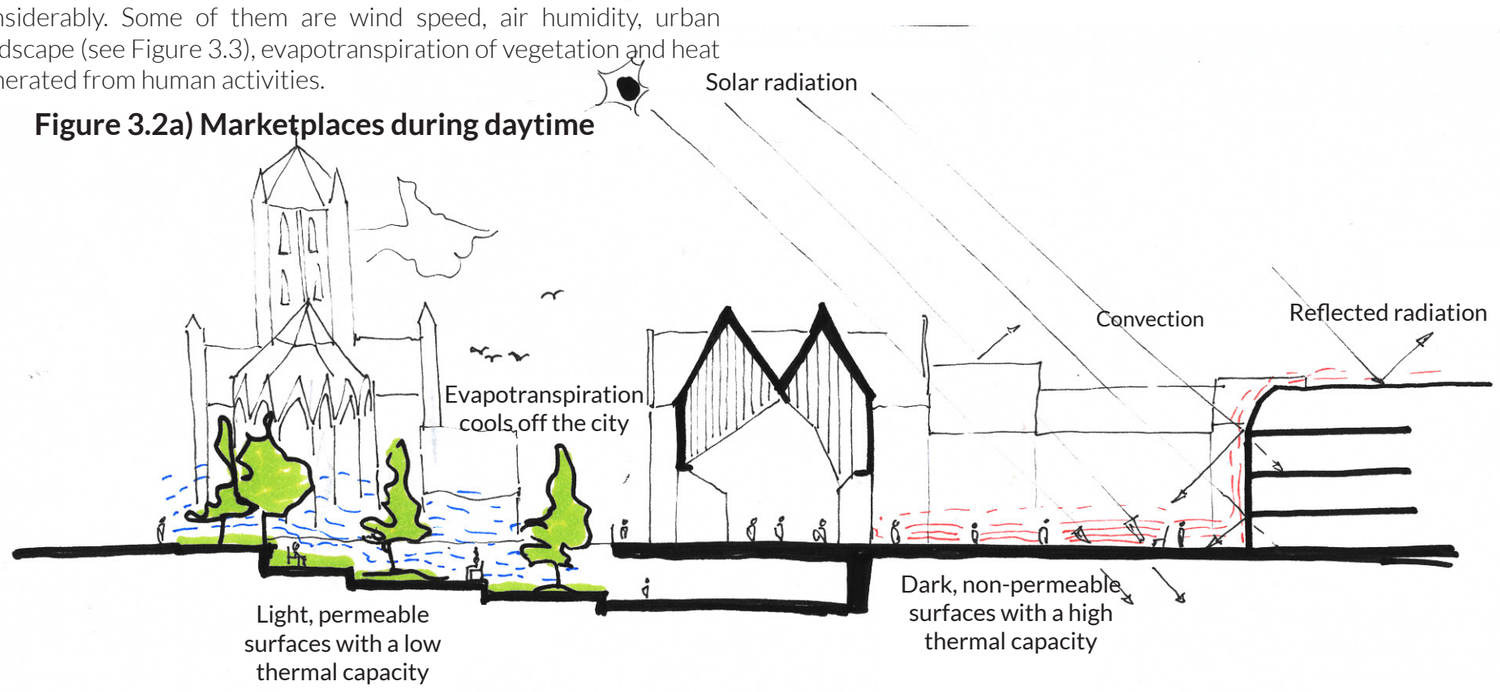


Figure 3.2b) Marketplaces during nighttime

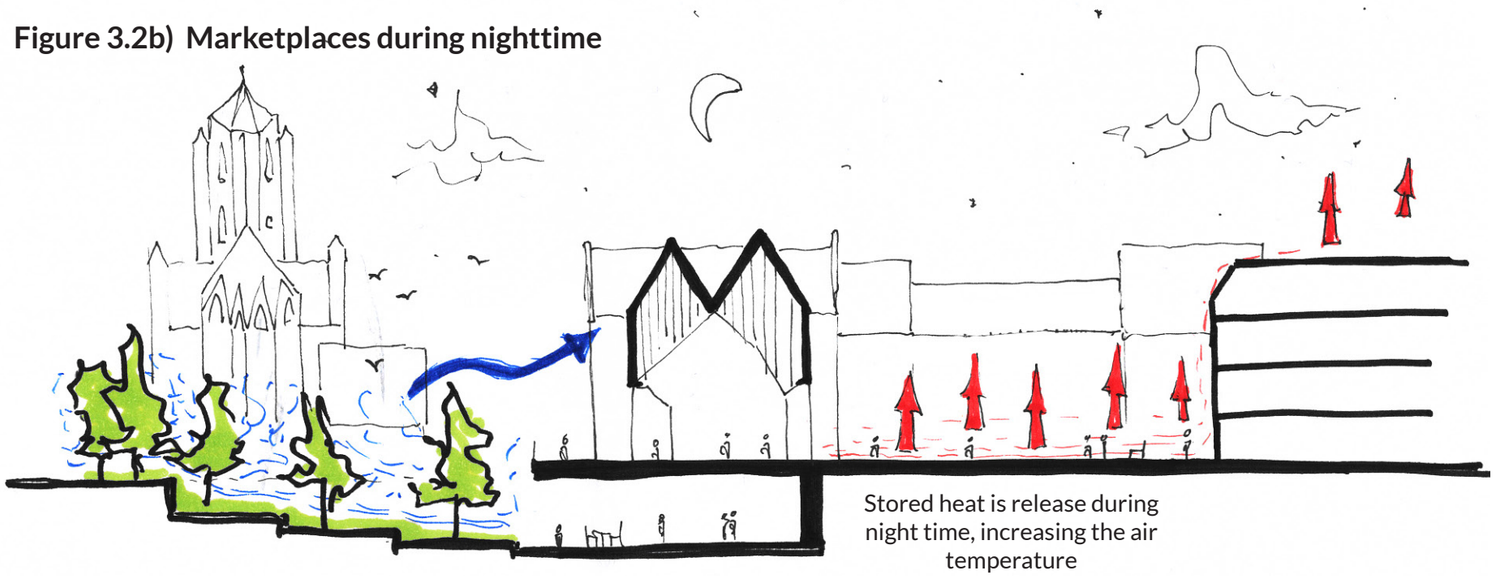


Figure 3.3a) Streets during daytime

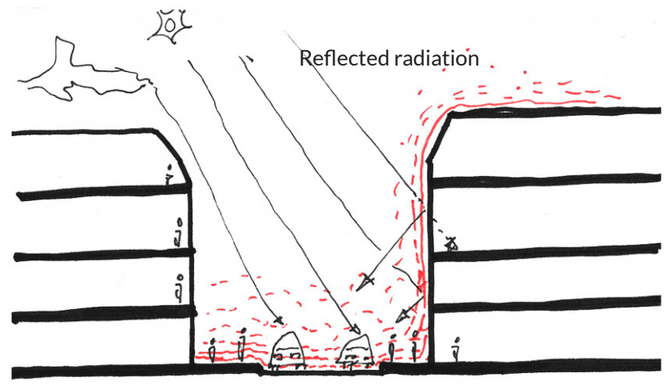
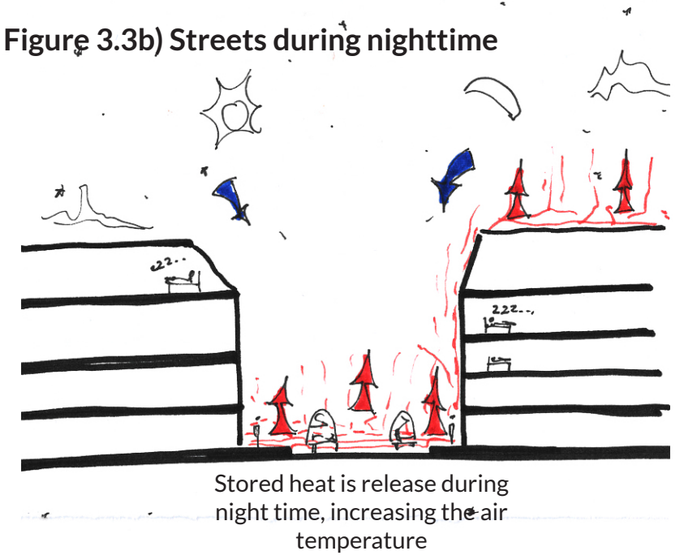


Figure 3.3b) Streets during nighttime



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3.2 | Process model

Waste management system

Figure 3.4) Overview current stakeholders VFG waste chain

Citizens of Ghent

- Responsible for seperating garbage properly
- Responsible for bringing out garbage at the appropiate times

IVVO, Yper

- Currently the organization that transports seperately collected VFG
- Currently the company for treatment of seperately collected VFG

Regional agriculture

- Currently the only client for the compost produced

Municipality of Ghent

- Responsible for informing citizens about proper garbage seperation
- Organizes the waste management process

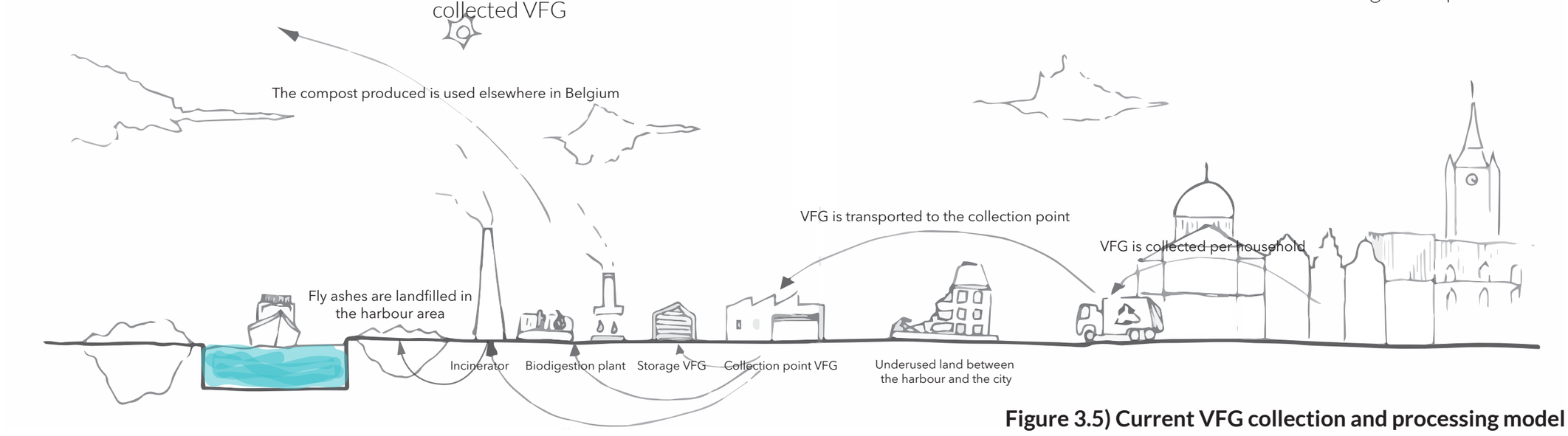

Figure 3.5) Current VFG collection and processing model

What is the process behind the waste management system?

The scheme in Figure 3.5 is a visual scheme that shows the current waste management system. Currently, SC-VFG waste in the city centre is collected individually per household by IVAGO. IVAGO transports all of the collected SC-VFG waste to a central collection point, from where there are three main streams distinguished. The first is the storage of SC-VFG, as there is a surplus of waste collected. Secondly, SC-VFG is transported to a biodigestion plant, from which biogas and compost is obtained. The compost that is produced is then used for agricultural functions elsewhere in Flanders. The last stream is the stream for the incineration plant which produces fly ashes. This is a rather linear process as can be observed from the waste flow diagram of VGT waste (Figure 3.6).

Who are the stakeholders?

The stakeholders are all who are involved in the waste management system (Figure 3.4). Of course, the start of the waste process are the producers, in this case being the citizens of Ghent. Citizens are able to first of all reduce their waste production by reducing their footprint. Secondly, they are responsible for separating their waste correctly to guarantee a higher quality waste stream. This of course benefits the

quality of recycled streams and reduces the amount of effort needed to treat the waste. The second stakeholder is the company responsible for the collection and treatment of waste, being IVVO and Yper. They are responsible for waste collection at the scheduled periods and for efficient treatment of the waste. Thirdly, the regional agricultural

sector is the only client for the produced compost. This means that they are part of the final stage of the waste management process. Lastly, there is the municipality of Ghent. They are responsible for providing the budget for proper waste collection, as well as informing citizens about separating waste.

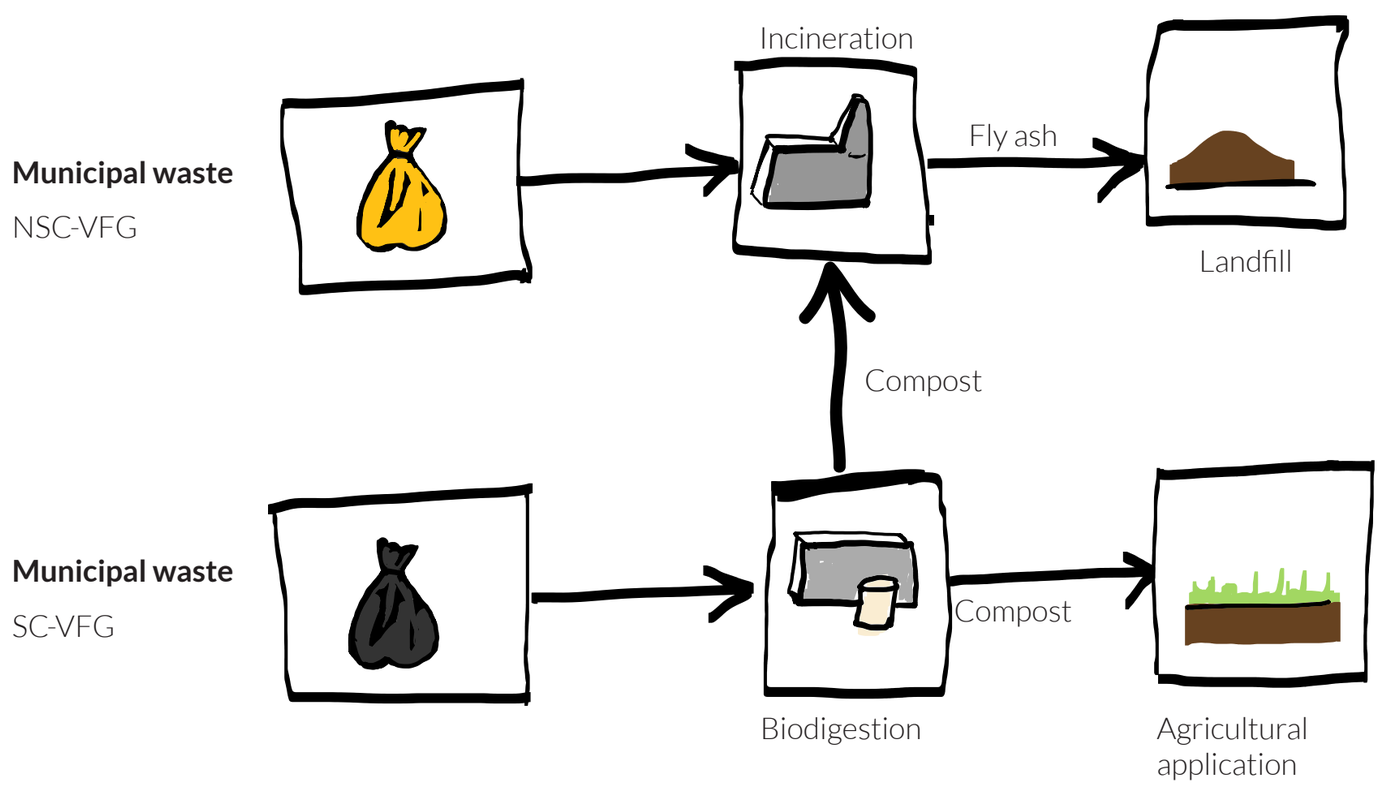

Figure 3.6) Current VFG waste flows in Ghent

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4 | EVALUATION MODEL

Shade as a product service system

The main idea is to provide a product service system instead of a product. Meaning that shading is what is being leased instead of selling pergolas. Offering shading as a service would be particularly of interest to the municipality of Ghent as it improves the urban image with the greenery of the pergolas and reduces the heat island effect without having to take responsibility for the maintenance, installation or removal. However the possibility of acquiring the pergolas as a product should not be dismissed as private organisations, such as restaurants, might be interested in owning the product.

Impact of the system

The possible beneficial impacts of implementing the pergolas in the city are:

- a decrease in air temperature in heat prone public spaces during summer (i.e. reducing the heat island effect)
- employment opportunities at the nursery and for the installment/ maintenance of the pergolas
- upcycling of residual waste from the biodigester (e.g. compost and ashes) which is currently incinerated or landfilled.
- creating awareness about the value of biowaste and the importance to separate it.

Possible unwanted impacts may be:

- generation of waste from the plant in the planters
- complicated logistics (e.g. delivery and maintenance)

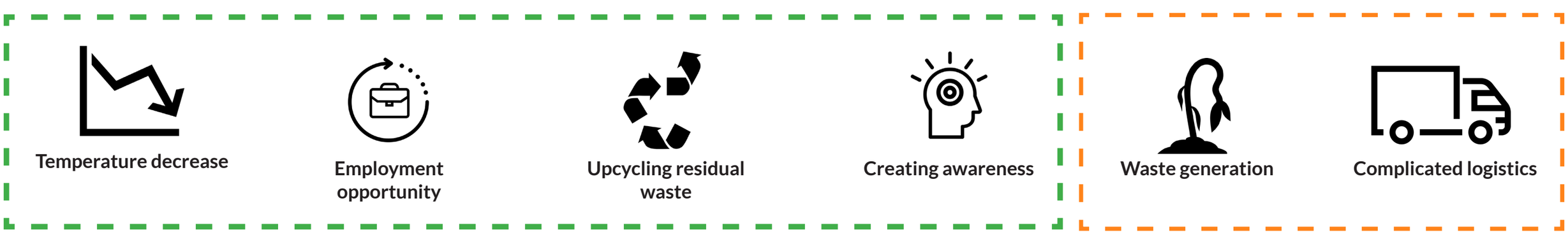


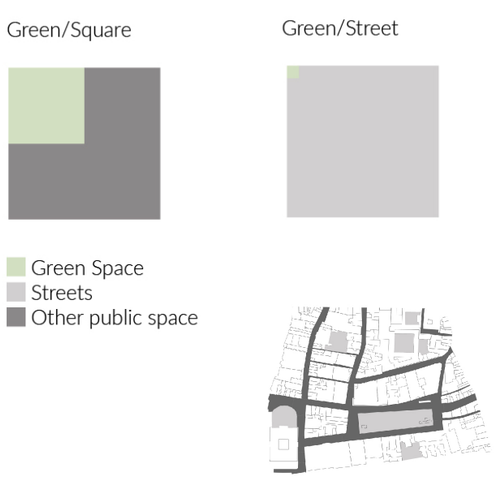
Figure 4.1) The impacts of the proposal

Indicators

Socio-spatial: increase urban greenery area (in %)

The area covered by the greenery of the pergolas is most simple manner to measure the impact of the implementation. The pergolas can to reduce the heat island effect by providing sun deflection and moisture release by their vegetation cover. The amount of extra vegetation cover, vertical and horizontal is measured as a percentage of added m2 greenery . This is, indirectly, proportional to the improvement of aesthetics of the city, the liveability of the public spaces and, most importantly the reduction of health risks related to heat stress.

Square: 15101m2
Street: 17635 m2
Greenery in Public Space: 4270 m2
Greenery in Street: 141m2



Square: 8750 m2
Street: 26542 m2
Greenery in Square: 2170 m2
Greenery in Street: 1215 m2

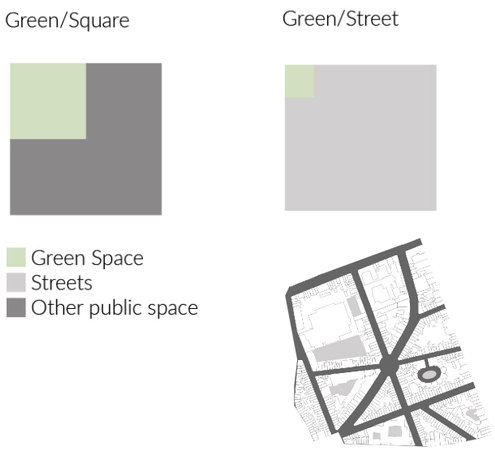


Figure 4.2) Calculation of the current amount of greenery

Environmental: volume of biowaste used (m3)

The current waste management of Ghent consists of the collection of vegetable, fruit and garden and then waste treatment with bio-digestion. Biogas and compost (also called digestate) are by-products from the biodigestion process. As of now, the compost is incinerated in a furnace from which heat and fly ashes are obtained. Each of the by-products from the digestion and incineration process can potentially be used in the production of the modular pergolas. The fly ashes can, potentially, be used as a material to manufacture the planters in which the soil and plant will be placed. The soil of the planters will be a mix of compost (from the bio-digester) and other material (e.g. sand).

Current amount of compost and fly ashes produced per year

Researchers from the Repair report (2016) conduct an material flow analysis of the VFG waste chain (i.e. this chain involved separated and non-separated collection of VFG waste) in Ghent. The mass and energy balances were established for the collection and treatment of 1 kg of VFG as generated by households in the focus area. The focus area consists out of Ghent and Destelbergen, which are neighboring communities in East-Flanders, a province in the Flemish region of Belgium. The amount non separated VFG waste collection was estimated, in that study, at 6,238 ton/year and the separated VFG waste at 10,062 ton/year; which is roughly 16,500 tons of VFG per year in total. For every kilogram of VFG waste 2.72E-04 kilogram of fly ash and 1.34E-03 kilogram of compost are generated. These ratios imply that the output of fly ashes is, approximately, of 4.5 ton/year and the amount of compost produced is 22.1 ton/year. The current application of the compost is not specified.

Economic indicator: exempted working time due to heat stress (hours)

It is mandatory, by Belgian law, to reduce the amount of working hours in a day when heat stress is significant (Urban Climate Service Center, 2016). This phenomenon occurs due to environmental climate conditions and is already measured and compared for certain range of years. It would be relevant to continue with such measurements to evaluate whether the implementation of greenery in the urban areas can attenuate the effect of heat stress on working forces.

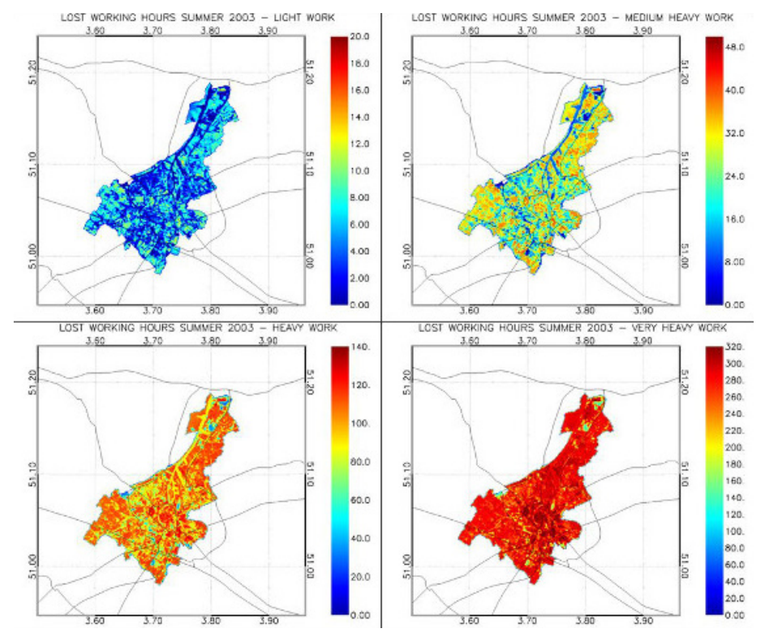


Figure 4.3) Lost working hours during the summer of 2003. (Flemish Thinktank Climate Adaptation, 2016)

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5 | Change model

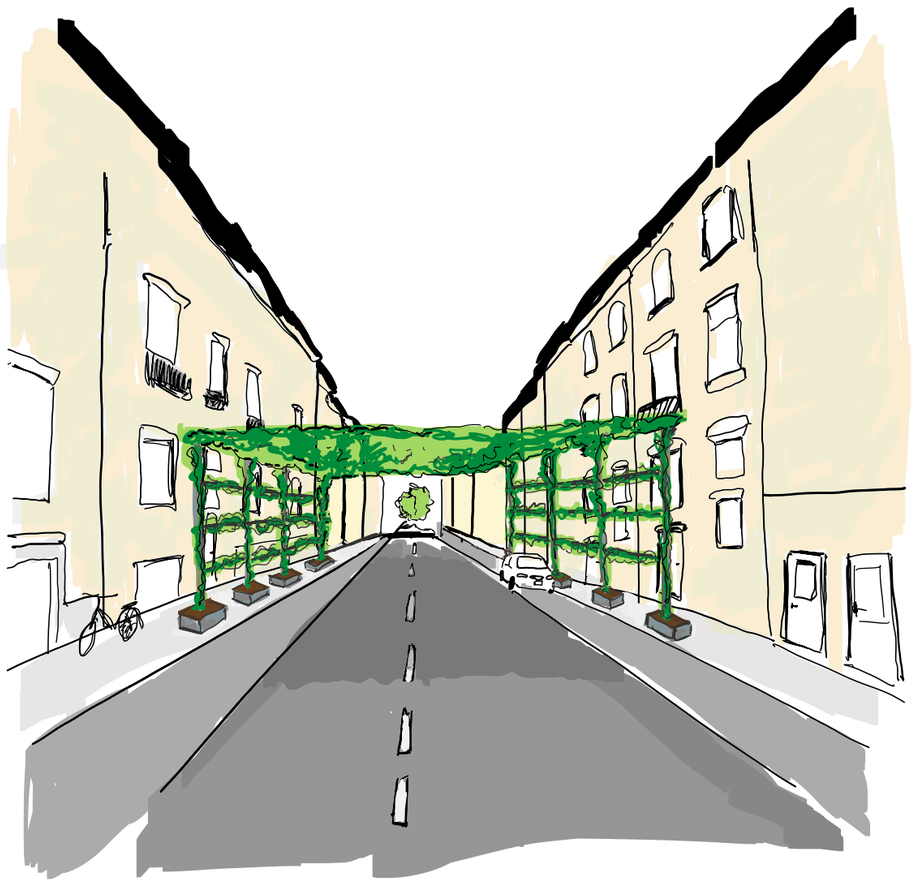

Figure 5.1) Impression of pergolas in streets

Figure 5.2) Impression of pergolas in public space

Expected changes from the pergolas

Bringing the pergolas to Ghent city is expected to trigger some changes for the tenants and visitors of the public squares and streets and for the tenants who are renting the pergolas. We expect some changes in liveability and the VGF waste stream cycle by using by-products of biodigestion that would not be used otherwise. The design of the pergolas with the dimensions is displayed in Figure 5.3.

Change in liveability

There is a small amount of greenery in streets and about one-fourth in public squares in the city of Ghent. With our pergolas aim to increase the amount of greenery in public spaces and residential areas. An impression of the pergolas in streets and in public spaces are provided in Figure 5.1 and Figure 5.2. As shown in these figures the pergolas will create shade and a nice place for people to escape direct sunlight and enjoy some shade.

Change in wastestreams

The pergolas will be made using compost and fly ashes; which are normally by-products that are incinerated and landfilled. By creating the pergolas the amount of these by-products that are incinerated and landfilled will decrease.

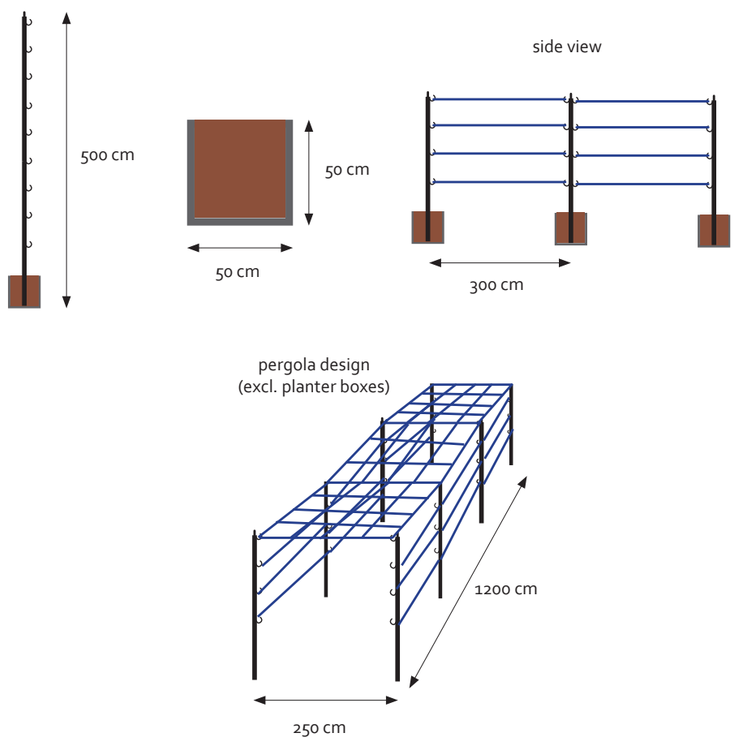

Figure 5.3) Design of the pergolas with dimensions

To foster cohesion, tenants can opt for a lower monthly fee if they maintain the rented pergolas themselves. This might create a more community feeling because of the community gardening that this will entail. Furthermore, many studies show a positive relationship between greenery and subjective well-being (Tsurumi, Imauji & Managi, 2018). So, the pergolas will also attribute to the general subjective feeling of well-being. Figure 5.4. displays all the possible positive benefits that are expected for the tenants and visitors of Ghent.

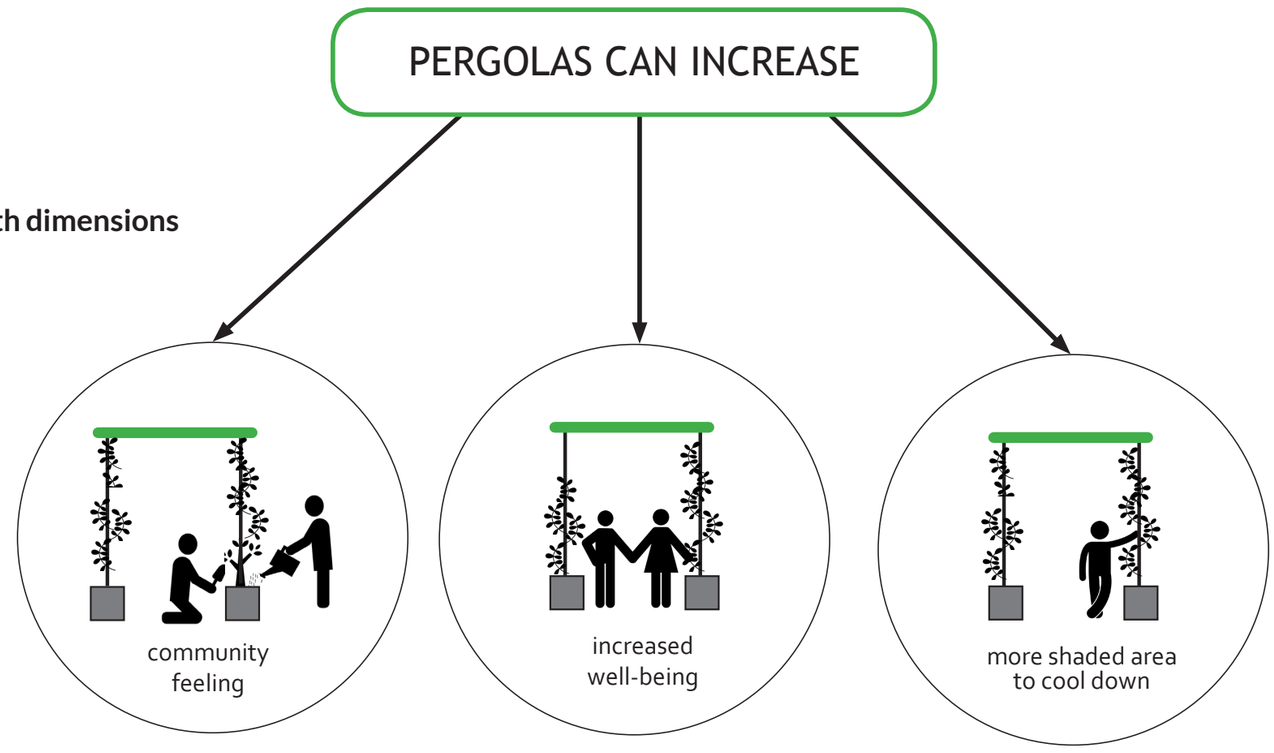

Figure 5.4) Expected changes by adding the pergolas for the tenants of Ghent

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6.1| Impact model

Urban Heat Island (UHI) effect.

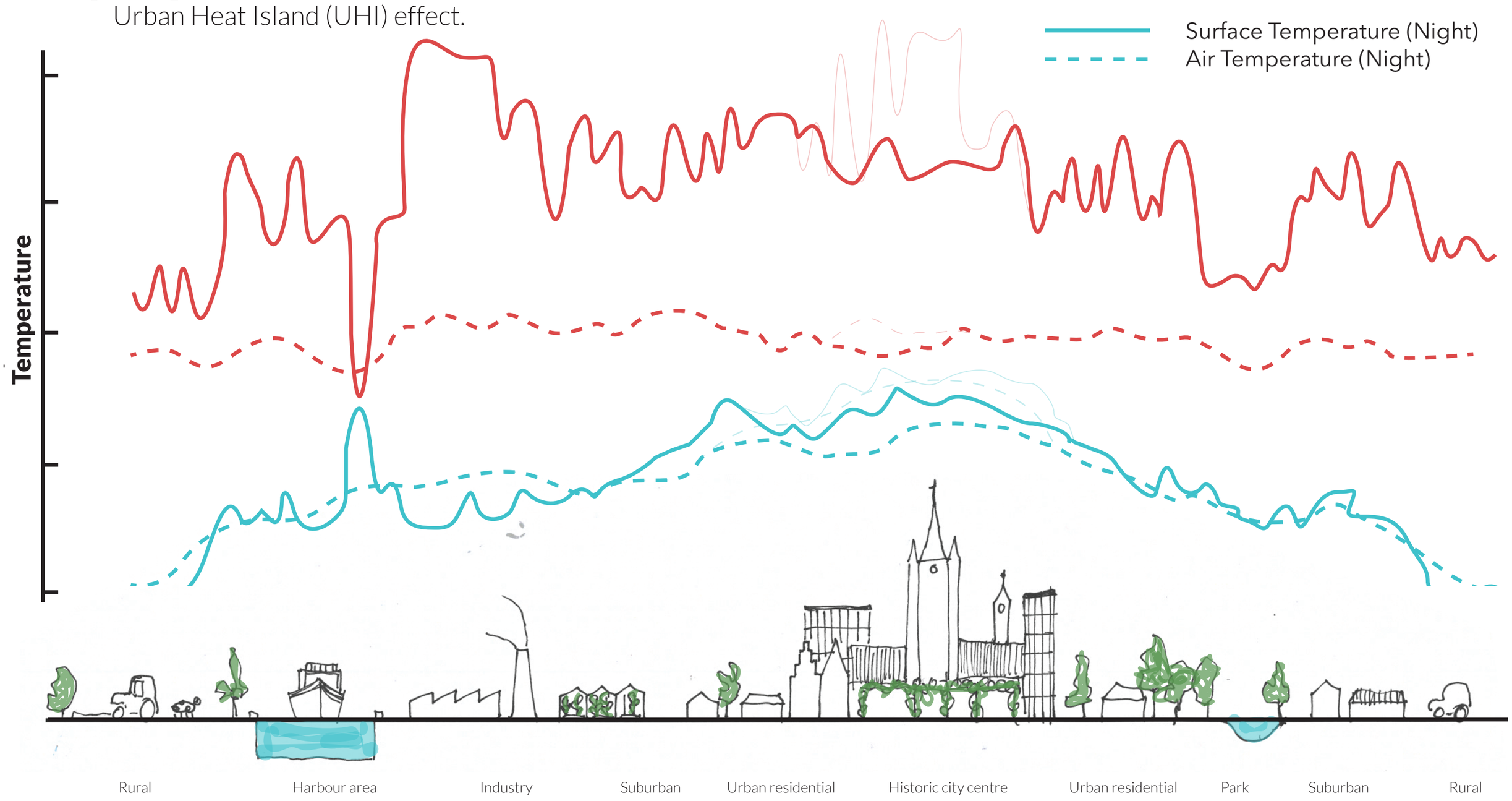


Figure 6.1) Predicted consequence on the Urban Heat Island effect in Ghent

How has the implementation of the planters reduced the Urban Heat Island?

As mentioned, the urban heat island effect is caused by impermeable surfaces storing and emanating heat of solar radiation. Our planters provide a barrier between the impermeable surface and the sun thus reducing the influx of solar radiation (see Figure 6.2 a) and 6.3 a)). This translated to a decrease in air temperature during the night, as there is less stored heat to be released (Figure 6.2 b) and Figure 6.3 b)). Not only shade, but also evapotranspiration will make up for a more pleasant ambience in the historic city centre.

What are the positive benefits of the implementation of the planters?

First of all, the urban heat island effect is reduced. This means that air temperatures in the city will be cooler during the day and night (Figure 6.1). This means that there will be a reduction in energy consumption for cooling appliances during summer. Decreased daytime surface temperatures, reduced nighttime cooling, and lower air pollution levels associated with urban heat islands can also affect human health by contributing to general comfort, as there will be a decrease in respiratory difficulties, heat cramps and exhaustion, non-fatal heat stroke, and heat-related mortality.

Figure 6.2a) Market places during daytime

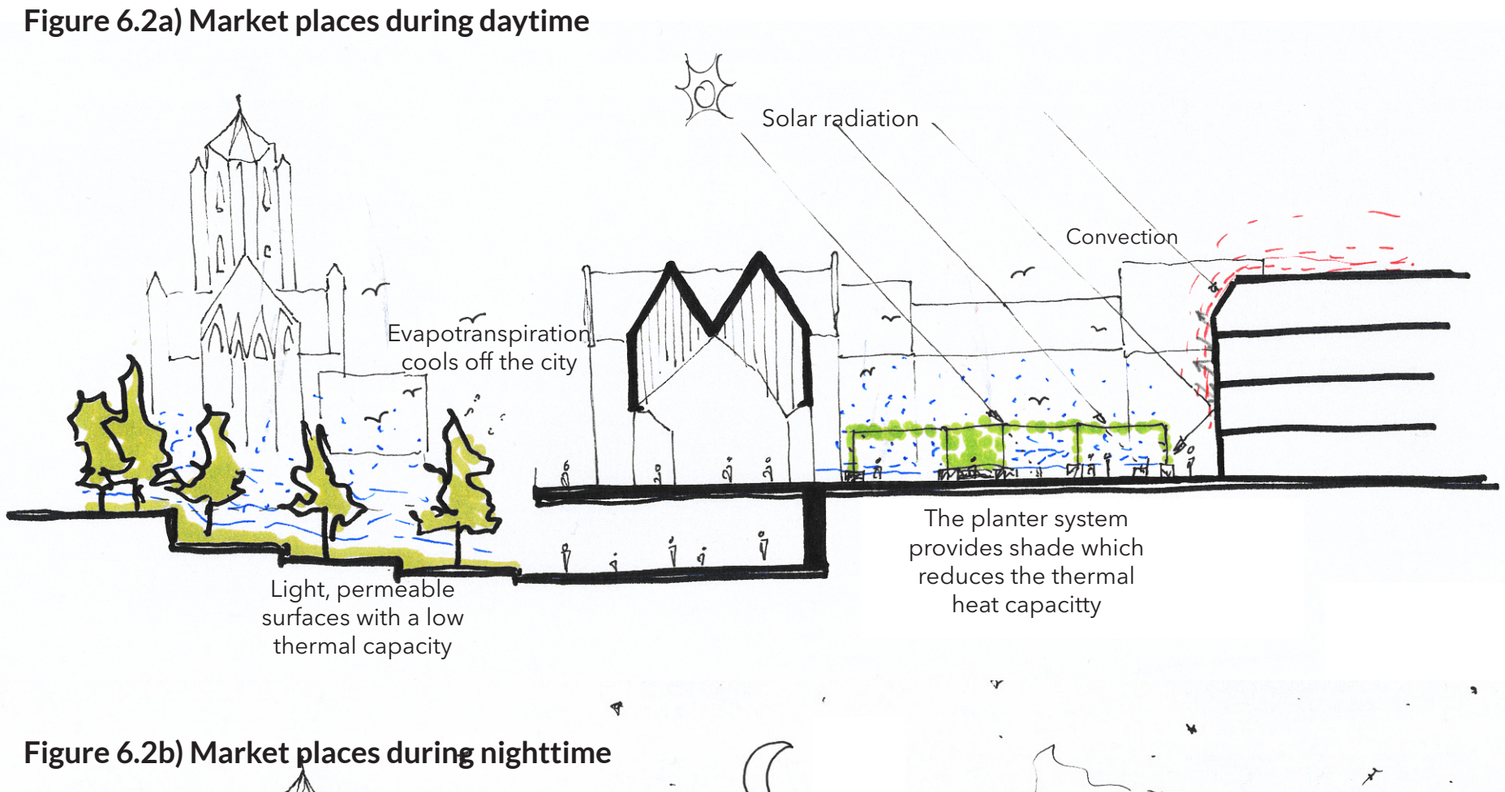


Figure 6.2b) Market places during nighttime

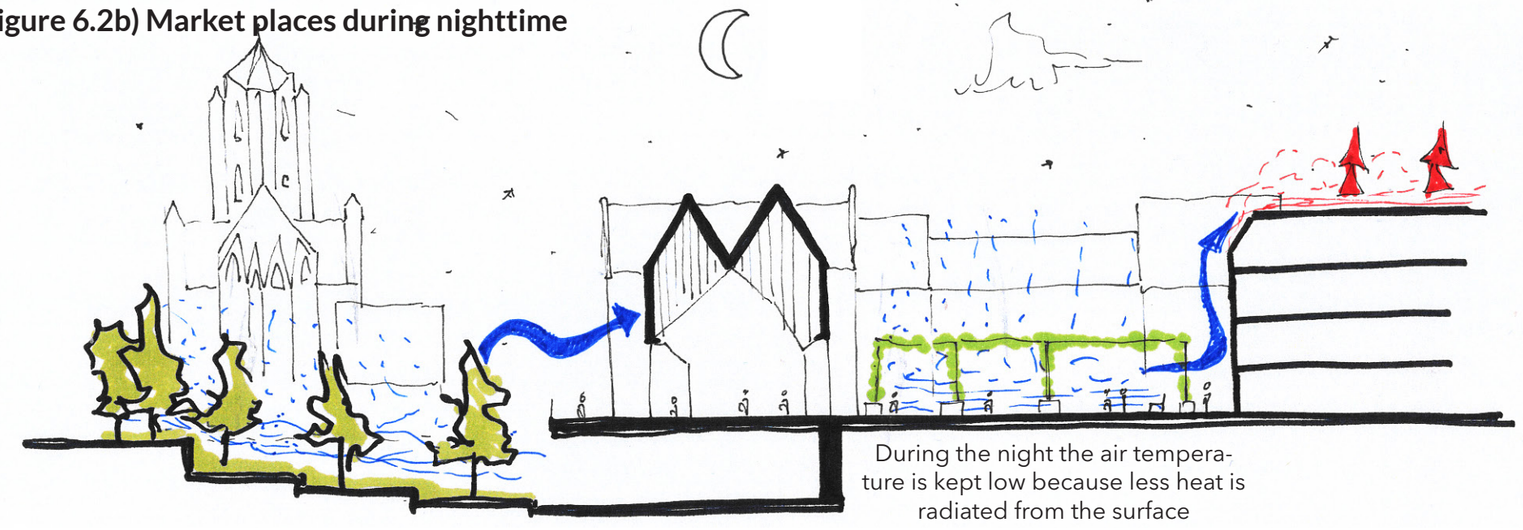


Figure 6.3a) Streets during daytime

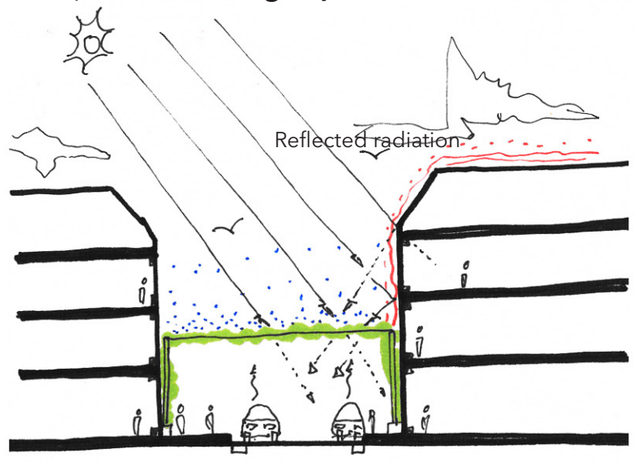
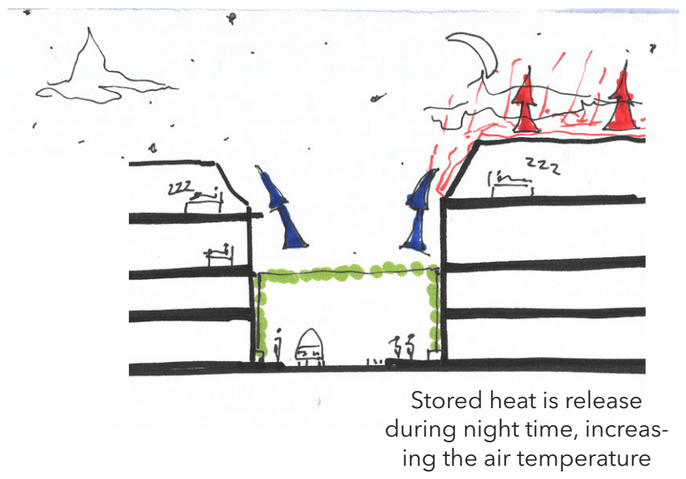


Figure 6.3b) Streets during nighttime



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6.2 | Impact model

Waste management system

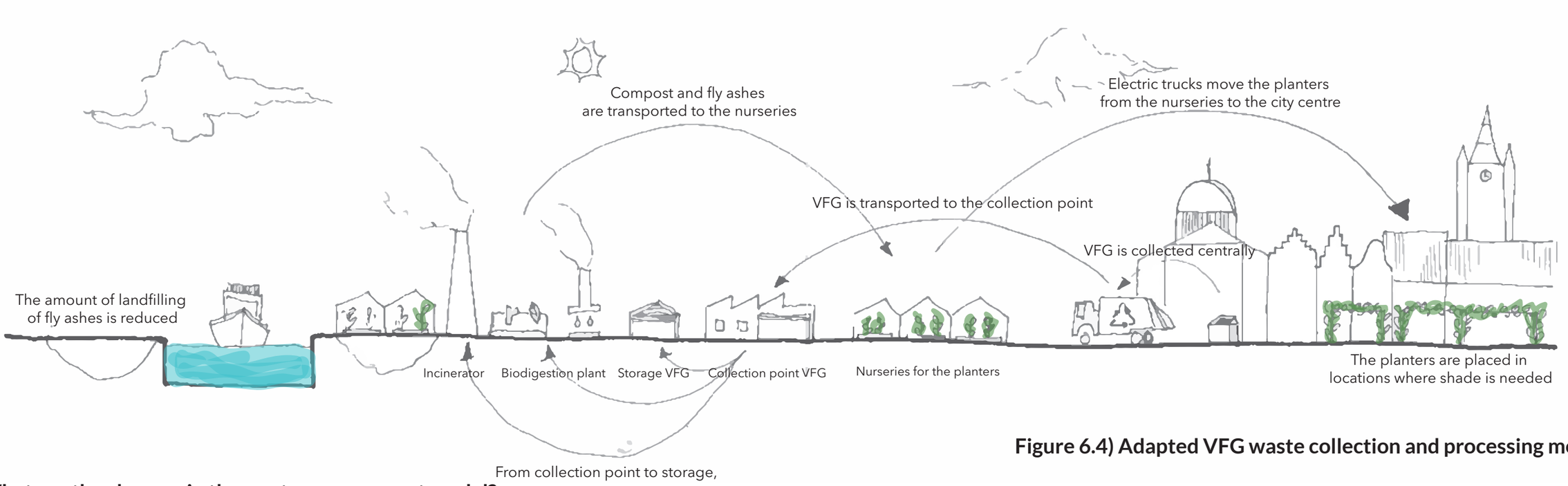

Figure 6.4) Adapted VFG waste collection and processing model

What are the changes in the waste management model?

Figure 6.4 shows the adapted waste management system. Naturally, the chain of this wasteflow starts at the households. Instead of individual pick-ups at each households, we propose that VFG is collected centrally in larger containers. This makes waste collection easier and more efficient, however it has some impact on the daily patterns of households. After the waste has been collected, it is transported to the collection point and is then again moved to either the storage, biodigestion plant or the incinerator. From this point on, the process changes. Instead of being landfilled, a portion of the fly ashes are transported to the nurseries, where there is also a production plant to make planter boxes with fly ashes as a component, as can be appreciated in Figure 6.5. The compost that is produced by the biodigestion plant is also transported to the nurseries and is used to help grow the plants. After the plants in the planters have grown to a desirable size, they are transported by electric trucks to the city centre. There, they are placed in locations where the urban heat island effect is the most significant. These locations mostly include marketplaces, squares and streets

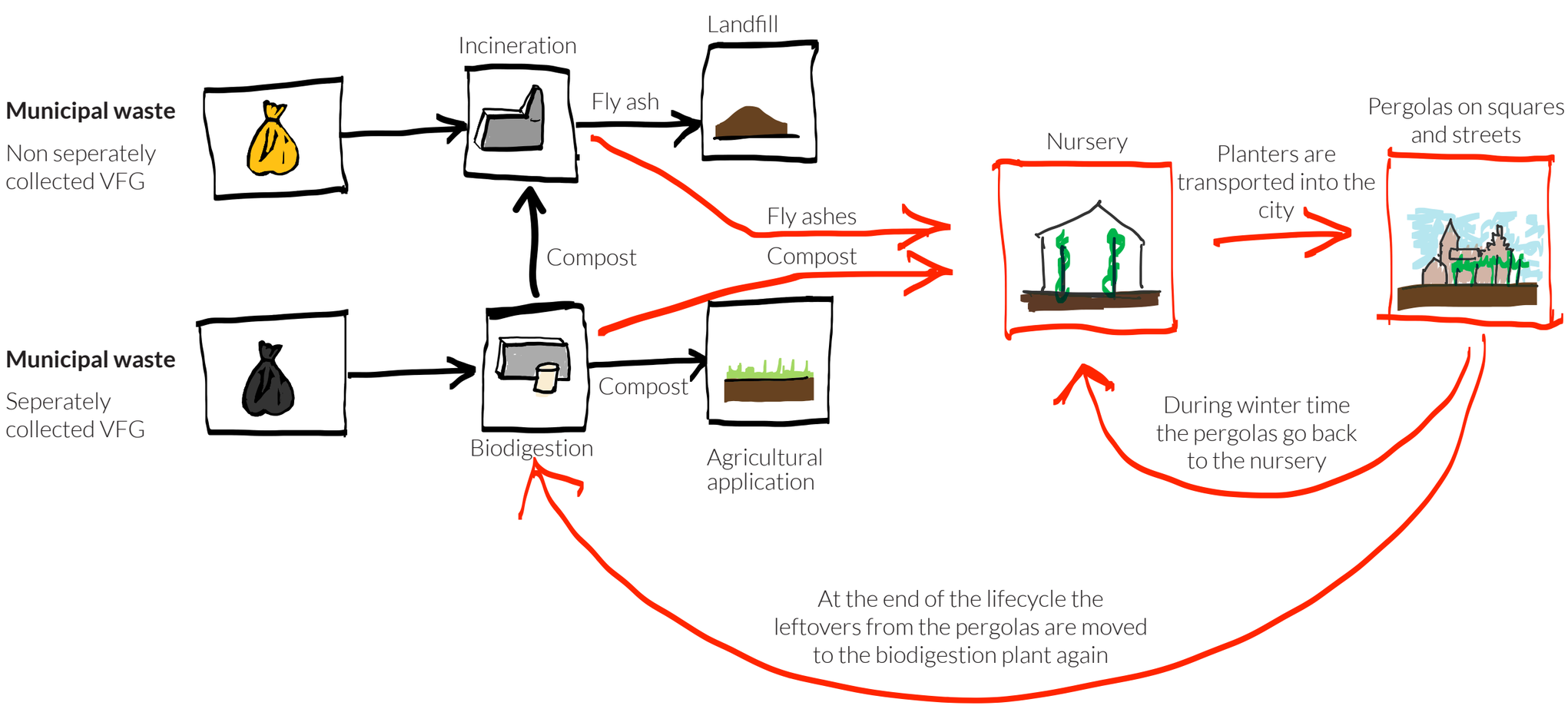

Figure 6.5) Adapted VFG waste flows in Ghent

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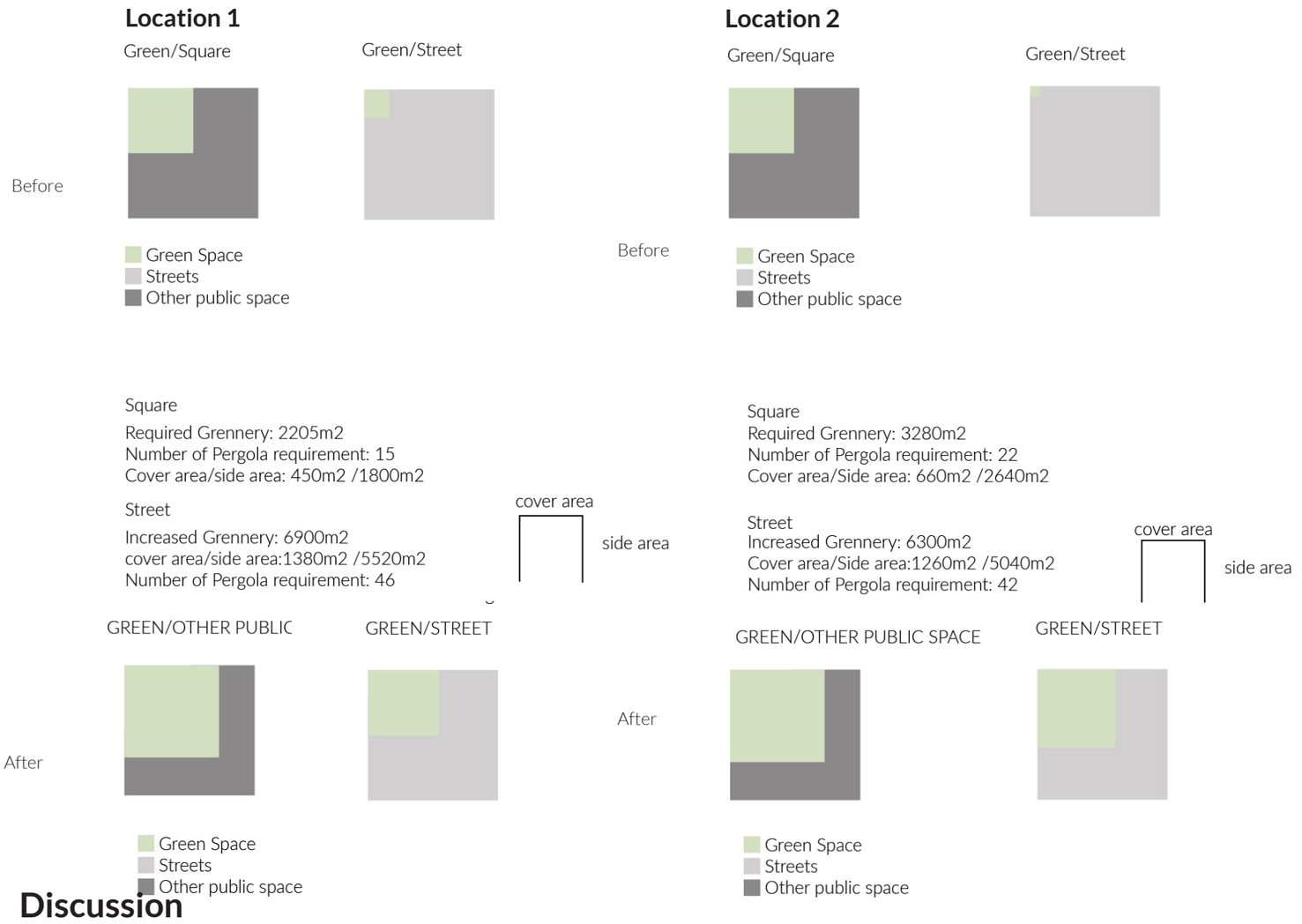
7 | Decision model

Socio-spatial: The percentage of greenery

One indicator of our project is about the amount of greenery we can increase in these two area. we also have different calculation between square and street because the objective of greenery they can reach is different and the way to put pergola is different.
In the street part, we mainly take account the length of the street. We keep 28m or 14m between two pergola and align them along the street and see how many pergola we can put totally. When we calculate the green it could increase, we take both the cover area(30m2 per pergola) and side area(120m2 for two sides). In the location 1, the greenery we could increase in the street in 6900m2 in total and in the location 2, the greenery we could increase is also 6300m2. In the square part, because that the placement pergola could be varies so the percentage of greenery is not decided by how many pergola we could put in the square. We set the objective we wanna reach, 50%, because we want the percentage of greenery be higher in the square. And we can get the greenery we need to provide by our pergola by using the total area multiple 50% and minus the existing greenery. Then we calculate the amount of pergola we need. In the first location is 15, in the second is 22.



Discussion

There are some opportunities that, consequently, come along with this project. That is the creation of habitat for biodiversity, particularly insects, and also using abandoned land plots to place the nursery.

Site suitability for nurseries:

There are multiple unused spaces in the municipality of Ghent which could be used to place the nursery and assembly line of the product. Ideally the plant nursery should be located between the city centre (where the pergolas will be installed) and the waste treatment facilities (where the materials should come from). In this way the logistics of the pergolas would be unidirectional; from the fly ashes and compost go from the waste treatment plants to the nurseries, the product is assembled and then installed in the city centre. This is a realistic option as there are currently unused plots in the harbour region, in the region of interest.

Biodiversity:

Also there are benefits for the local biodiversity, since the planter will be provide an environment for mating, feeding and shelter for insects. Since insects are important because they are the cornerstone of the food chain of an ecosystem this should be considered as a really valuable aspect of the pergola.

Collaboration of stakeholders:

So far the concept has been explored in terms of site suitability, on how to implement and what its positive impacts are. Nonetheless, one aspect has not been considered so far which is the collaboration of multiple stakeholders that is necessary to execute this idea. First of all, the municipality should assist in the land acquisition for the nursery on abandoned land. Secondly, the municipality is the most relevant client and thus their judgement on how the product should be design has to be taken into account. In many cases it would be in the interest of citizen or private organisations to lease or purchase a pergola; in this situation it will often require the permission of the municipality to place them. So for consistency the municipality should also stimulate and allow the use of pergolas. Furthermore, stakeholder involved in the funding of the project are also crucial. The organisation, profitable or non-profitable, that will produce the pergolas should collaborate with stakeholder who are willing to finance the project. The municipality could provide a subsidy, for instance, or the bank it could a loan. Project developer Sogent, an autonomous municipal company, can be an interesting partner to find potential partners for collaboration. For example, the maintenance of the gardening can be done by Groendienst that is already providing gardening services to for municipal greenery (Sogent, 2019).

Environmental: Volume of biowaste used (m3)

According to empirical knowledge of gardening, a 5 cm layer of compost is needed in the planters, which is approximately 10% of the planter box volume. The fly-ash content in the planter boxes is assumed to be 50% (Thomas, 2007). With these assumptions, one pergola (i.e. one pergola contains 8 planter boxes) would require approximately 0.2 m3 of fly ashes and 0.1 m3 of compost. So, to install 3160 m2 of greenery in a square it would require approximately 22 pergolas which is 2.2 m3 and 4.4 m3 of compost and fly ashes respectively. To install 6900 m2 of greenery in streets we need 46 pergolas, this means 4.6 m3 and 9.2 m3 of compost and fly ashes respectively.

Costs of the service

The price to lease shade in the city would be attractive for the client, particularly the municipality, if it is lower than owning it. The lease price would be based on the costs of raw materials, transport, energy and labour. Ideally the leasing costs will per year as the pergolas will be installed when spring arrives until the summer ends. The benefits that this product service will have will not be reflected in the price as its impact on urban temperature and liveability is difficult to estimate. Furthermore, an opportunity would be to incorporate personeel to the production of the pergolas who have a disadvantage in the working market. The price can be also optimised by utilising plants that require little maintenance.

So, the potential client should not only consider the economic aspect but also the return of human capital, return of inspiration and the value of creating a worthy product from waste streams when choosing this concept.

Spatial considerations

There some streets in the centre of Ghent which are even too narrow for waste bins to be placed in. For this situations a pergola system has to be defined in such a way that the planters do not intrude in the functionality of the public space.

Other practical considerations:

The timing of the growth of the plants must be in such a way that they at their best growing stage when brought to the city and installed. Also to have an immediate effect, the plants will be nursed even on the cables in the nursery.

Logistics and maintenance considerations:

If the pergolas are installed at once in spring and removed at the end of summer it will require a sudden logistic challenge which will influence the costs largely. Thus, a logistical plan is crucial for this product service system. Also, watering and maintenance of the plants have to thought off in the design of the planters. An opportunity would be to store water from rain in the planters to reduce the need of watering.

Future opportunity

Urban farming is an emerging trend in many cities and there is a possibility to combine this concept with the pergolas. It is a step that has to be thought through as food production has to comply with regulations and requires a controlled environment. Therefore its feasibility should be explored after the implementation of the pergolas has been successful.

Economic: Exempted working time due to heat stress (hours)

One pergola gives about 35 m3 (12m x 2.5m) shade. Installing 22 pergolas to enhance greenery in a square would give approximately 770 m2 of shade. Installing 46 pergolas to enhance greenery in streets, will give about 1610 m2 of shade. Furthermore, the vegetation cover of the pergolas will reduce the heat island effect by reducing the average day and night temperature. However, we cannot estimate the amount of days saved due to lack of data and time availability.

Figure 7.1) Overview of stakeholders for applying pergolas in Ghent

Evaluating results of this research

Usage of by-product waste flows

One of the most noticeable findings of this project is that the amounts of fly ashes and compost that are required for the pergolas will not have a impact on the total amounts that are generated in the city. But the value of this idea lies in the value that one can generate from a material flow that is considered a waste.

Impact of pergolas on the heat island effect

Evaluating the influence of greenery on the average surface temperature of the city is not straight forward, because the heat island effect depends other factors than greenery only. To create more insight in how different factors affect the city of Ghent and what the role of greenery can be, we recommend further research. However, with respect to this research, this does not take away the fact that the pergolas will provide more locations for citizens and visitors of the city to recreate in a pleasant environment.

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