



# Schieoeever-Noord Re-Development Project Brief

## Delft, The Netherlands.

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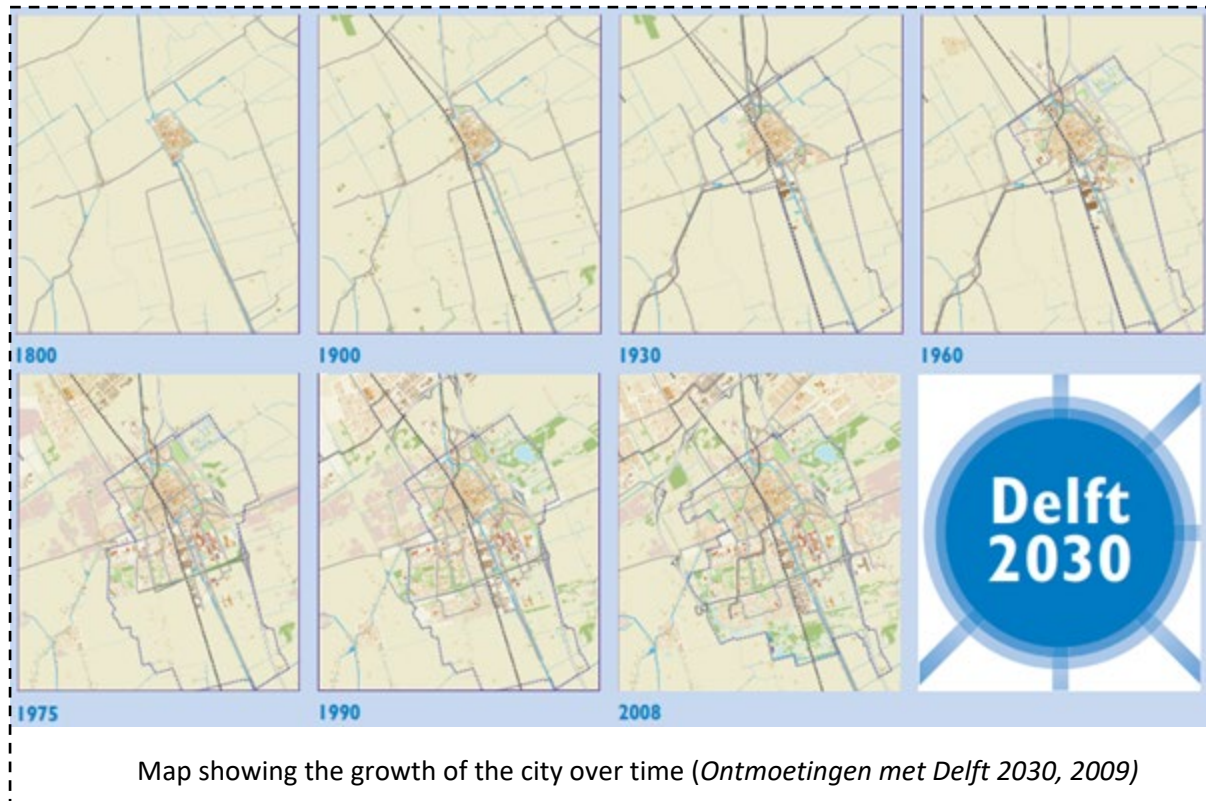
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## Chapter 1: Introduction:

Due to the growing demand for housing in Delft and the municipalities has vision for transforming the area of Nieuwe Haven, Schiehallen and Stationsomgeving in Delft into a work come living sustainable and healthy area. This PvE focuses on the housing and residential functions in accordance with the visions of the municipality of Delft, while targeting a specific target group for the year 2030.



### **1.1 Context of the Location:**

Delft is a city located in the Netherlands in a province called South Holland that exists between the two metropolitan cities of Rotterdam and Den Hague. Delft is a city that is known for its rich maritime history, ceramic products, diverse culture, the technical university and for its associations with the royal family.

In 1900 due to the upcoming maritime trade in the country the port of Delfshaven formed and became a leading area for the Dutch East Indies Company, in matters of trade and industrial developments<sup>2</sup>. Since then to the late 17<sup>th</sup> Century Delft was one of the major cities in the Netherlands and at the same time the introduction of Delft Blauw ceramic products were being made in the city<sup>3</sup>. With the arrival of transportation via the railway network in 1847, Delft became an active place and by 1842 the Royal Academy (now known as the Delft University of Technology) and in 1842 the research institute of TNO was formed<sup>2</sup>.

Since the 60's after the "rampjaar" the area saw less economic growth and by the late 70's major companies and manufacturing industries moved their operations to the newly formed ports of Rotterdam South and much of the legal and administrative tasks of running the city moved to Den Hague<sup>2, 4</sup>.

This research paper focus on the areas of Nieuwe Haven, Schiehallen and Stationsomgeving Delft Zuid located within the city of Delft in the Netherlands. Where later during this paper we will be focusing our research on the area of Schiehallen.

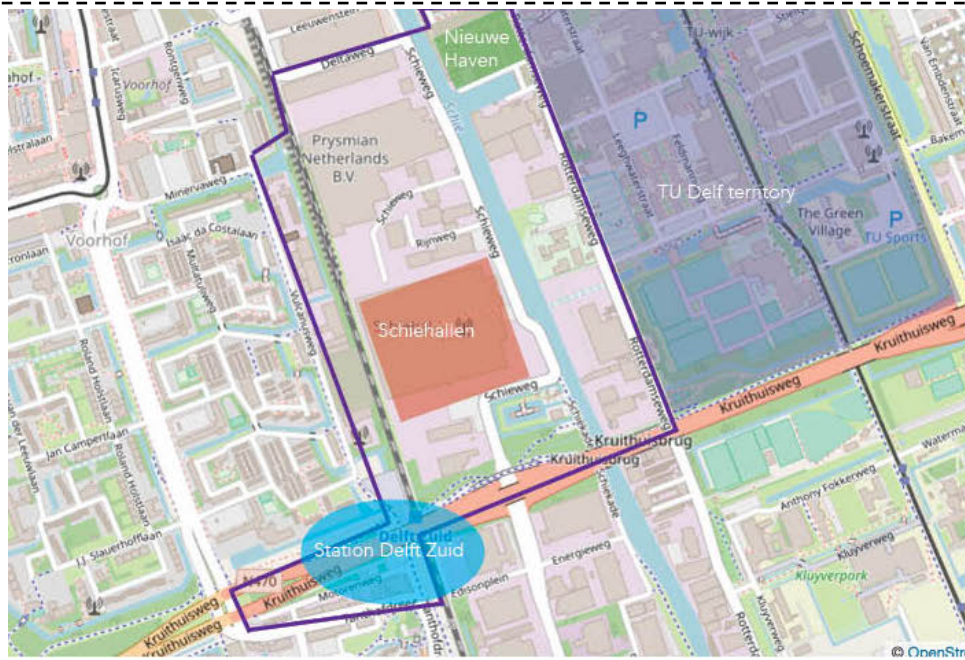


Figure showing the areas of study for our research project where we will be mainly focusing on the area of Schiehallen.

## **1.2 Current Housing Situation in Delft and the Municipality Housing Plan in Nieuwe Haven, Schiehallen and Stationsomgeving Delft Zuid:**

Schieoovers Noord is a quiet of an industrial area with its factory and company terrains and ports. Those factories are especially concentrated at Schiehallen and the shore of Rotterdamseweg. As a result, the area doesn't have many housings or parks. Nevertheless it is also possible to see historical and recreational areas like Kruithuis which is in surroundings of Delft Zuid.

The Municipality of Delft has the ambition to gradually transform the industrial terrain of Schieoovers Noord into a unique mixed residential terrain. The area is quite important in sense of its bridge role between the two main stations: Delft Main and Delft Zuid stations. And at the east side, it has borders with TU Delft institution (Concept Notitie Reikwijdte en Detailniveau Schieoovers Noord). Therefore, it can be concluded that this area has a great potential of recreation and transformation for new functions. A good example is to be seen by the Schiehal, the factory which is transformed for different functions. It contains storage places, Delftse Blauw Bouldering Center, restaurants, bars, small businesses etc.

The terrain is quite big and has enough space for also other functions like residence or different activities. Since there is a shortage of housing and space for other functional buildings in Delft, Schieoovers Noord can be a really good solution to this problem.

## **1.3 Resolving the problem in the housing market of Delft:**

To understand the ways in which the problem of the housing market for this area can be resolved we first need to identify our projects target audience and take into consideration their needs financially, culturally and environmentally, while reflecting to the current situation of the area and how we can re-develop it to meet the needs of the future. For this we plan on making the current industrial area into a work come living and recreational area. The area seems to be a very attractive are for redevelopment for it is well connected by rail, tram, bus and road and is located right next to the Delft University of Tehnology, Technoplios, TNO and

other business districts along with it overlooking a water-front. In addition, Delft situated between two major metropolitan growing cities; Rotterdam and Den Hague and the area of Schiehallen within walking distance to the cosset train station Delft Zuid and within cycling distance to Delft Central Station and the historically and culturally rich city centre<sup>5</sup>.

#### **1.4 Research Question:**

It is important to first understand what the current situation and possible redevelopment opportunities exist in Schiehallen and then ask how the supply and demand can be optimally aligned for the housing market in this area (. For this it is important to ask what the actual demand for housing is in the area and who are the potential residents who desire to move into Schiehallen (target audience). Then it is also important to ask what aspects of sustainability, healthy living, public outdoor spaces and facilities and be incorporated into the hosing or developmental plans for the area. Such the housing and developmental plans can be made to meet the needs and budget of the target audience while also meeting the municipalities demands in terms of housing type, price/rental price and type of ownership <sup>5</sup>. This in turn will lead us to the main research question:

**What redevelopment opportunities exist in Schiehallen such that our target audience can meet their needs financially while focusing on a sustainable and healthy living environment?**

Where to help us answer this main research question we need to first answer the sub-research questions for the redevelopment of the area <sup>5</sup>:

- What is the target audience for the redevelopment of Schiehallen?
- What functions and facilities are needed for the target audience?
- How does the target audience influence functions and facilities?
- How can we redevelop the area in a sustainable way while promoting healthy living conditions?
- Is the plan financially achievable for the selected target audience?

#### **1.5 Method:**

First, we'll start by looking at the population of Delft and zoom in on Nieuwe Haven, Schiehallen and Stationsomgeving Delft Zuid located. We will look at which group of people (demographically) are looking for housing and are failing in finding what they want. Then we will look at the current housing market of Delft. With these two factors we will focus on Schiehallen and look at the possible housing types that fit the living requirements of the target audience and see if they are competitive with what exists in the housing market. We will also look at how the planning and redevelopment of the area should look like. Finally, we will answer all the sub-research questions using all the information and knowledge we have gained through the writing of this research paper and use this knowledge to formulate an answer to the main research question, which will be used to develop a vision for the redevelopment of the area of Schiehallen.<sup>5</sup>

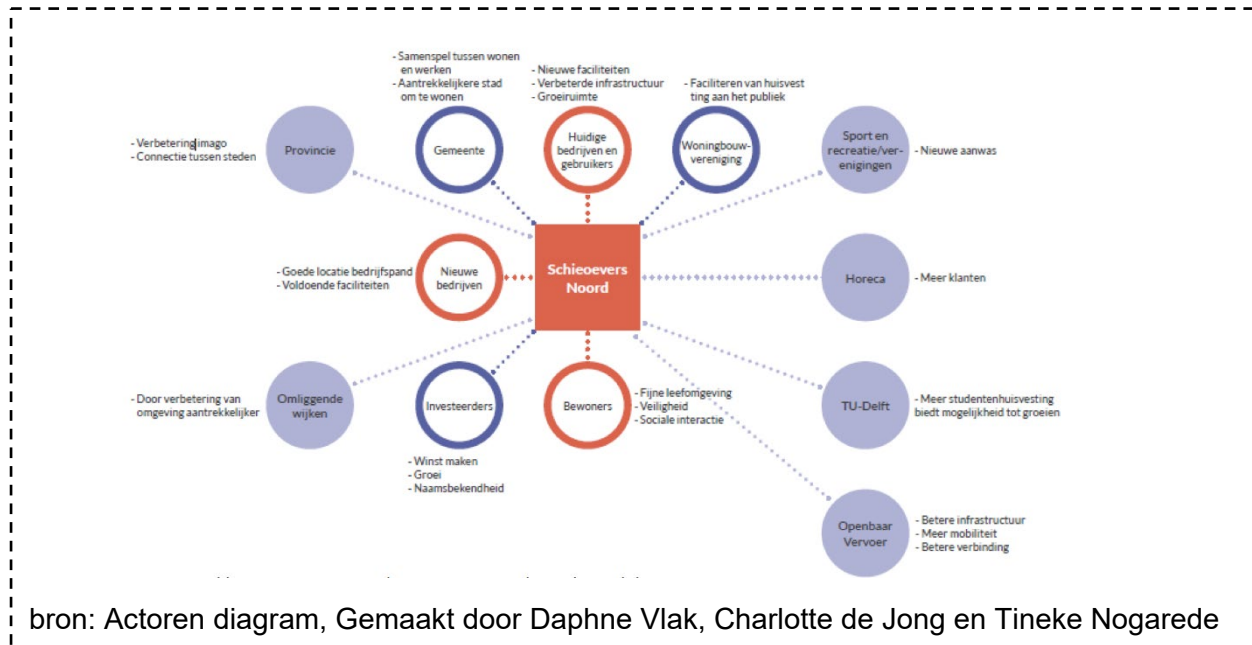
#### **1.6 Research Goal:**

The goal of this PvE is to formulate a redevelopment vision for the area of Schiehallen that meets the needs of the target audience in a sustainable and financially achievable way. This will be done by comparing inquiries into the target audience and considering how the needs following from the comparison could be realized in a redevelopment while still meeting the above-mentioned research goals of being sustainable and financially achievable.<sup>5</sup>



## 1.7 Actors:

Different parties take parts during the development of a project such as Schieoevers Noord. Those parties include the current and future residents, but also TU Delft, NS, established companies and investors who all have their own interests. All those parties have different influences over the project and the area. Therefore before plans can be made, it is important to analyse which actors are involved in the project and what are their interest. This analyse is shown in the schema below.



## 1.8 Reading Guide:

This PvE consists of five chapters and an infographic A3 poster summarizing the conclusion of this research paper <sup>5</sup>.

- In chapter 1 the location will be introduced. Along with the introduction of our main research question and its subsequent sub-research questions.
- In chapter 2 we will look at the current housing market, demographic and population of Delft and specifically Schiehallen while comparing it to that of Nieuwe Haven and Stationsomgeving Delft Zuid. We will also define a target audience and look into housing types and investigate possibilities of redeveloping the area for a sustainable, healthy lifestyle.
- In chapter 3 we will describe the location in greater detail. Next, we will look at the boundary conditions of the available building plots in Schiehallen and define the living environment there. Finally, we will also look at the living requirements of the target audience and what sustainable solutions can be implemented and formulate a vision for the area.
- In chapter 4 we will see if the redevelopment vision for the area is achievable and competitive on the housing market. We will also look at the different aspects that are important when planning a redevelopment project.
- In chapter 5 we will answer all the sub-research questions. After which we will formulate an answer to the main research question and give our concluding thoughts and state what the final re-development vision for the area of Schiehallen should be.



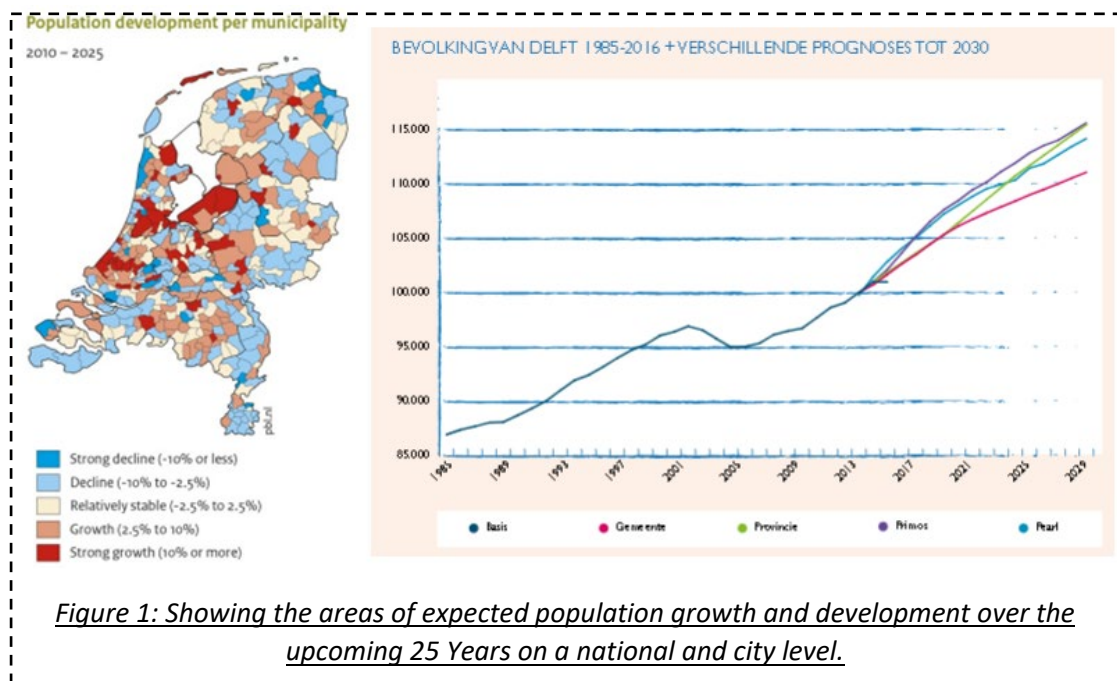
- Finally, in the infographic A3 poster summarizing the conclusion of this research paper (PvE) and indicate as to what are visions are for the area of Schiehallen.

## Chapter 2: Identifying the Target Audience and their Preferences:

In this chapter we will first try and understand the current population structure of Delft in relation to where they are currently staying in the city. Through this we will try and determine a potential target audience that meet the needs of the municipality while taking into consideration the needs and wants of the target audience and finally we will see if the area of Schiehallen is best suited for the specified target groups.

### 2.1 Population Structure of Delft (whole).

The number of residents in Delft have been steadily growing and is expected to grow for the next 25 years. Where the population of Delft between 1960 and 2017 has increased by 61.23% (see Table 1). It is expected by 2023, 12,000 new individuals that form 9,000 extra households are expected to come to the city. From which 4,000 are Students and 5,000 are regular households (Woonvisie Delft 2016-2023). Since Delft contains one of the three Technical Universities in Netherlands (TU Delft, TU/e and TU Twente), the student population is quite high when compared to other cities without universities or research centres. Hence 12.7% of the residents of Delft are students under the age group of 30 years and have a low income (Studiekeuze 123,2018). Also, as much as 62% of the housing market in Delft is composed of rental properties, this is especially attractive for students and individuals below the age of 30 and above the age of 65 with low income or who are on pension and are looking for dwellings in Delft (WoON 2015/OBT). Where current statistics from the Municipality of Delft (2016) suggest that from 50,000 dwellings in Delft where 66% are for multi-individual households and 34% are for single-individual dwellings.



If we look at the current age demographic of Delft (see Appendix) we see that a peak is immediately noticeable for the age group 20 to 29. This can easily be explained as much of this peak consists of students (from which 23% WO, 12% HBO students continue to stay in Delft after their study) where most of the students come from outside the city or country to stay, study and work in Delft (Woonvisie Delft 2016-2023) where 3,500 HBO students are also

living in the city and 56% of WO (University Students) who are currently studying in Delft are also living in Delft.

For when we investigate the student population of TU Delft closely we see that from a total of 23,461 students in 2017, 52% were Bachelor students and 45% were Master Students. From which 20% of the Bachelor Students were International Students and 79% of Master Students were also International Students <sup>9</sup>. When we look at the teaching and research staff of TU Delft closely we see that from a total of 5189 employees, 10.83% are Professors, 22.31% are PhD Researchers, 0.75% are Student Assistance, 17.44% are Scientific Staff, 40.12% are Management Staff. Where 94% of the research staff and 6% of the management staff are international <sup>10</sup>. This hence tells us that much of the TU Delft is composed of an international population.

When we compare the current population demographics to that of the future as predicted by the municipality of Delft we see the following:

Table 1: Shows the future predicted demographics for different age groups in Delft (Woonvisie Delft 2016-2023):

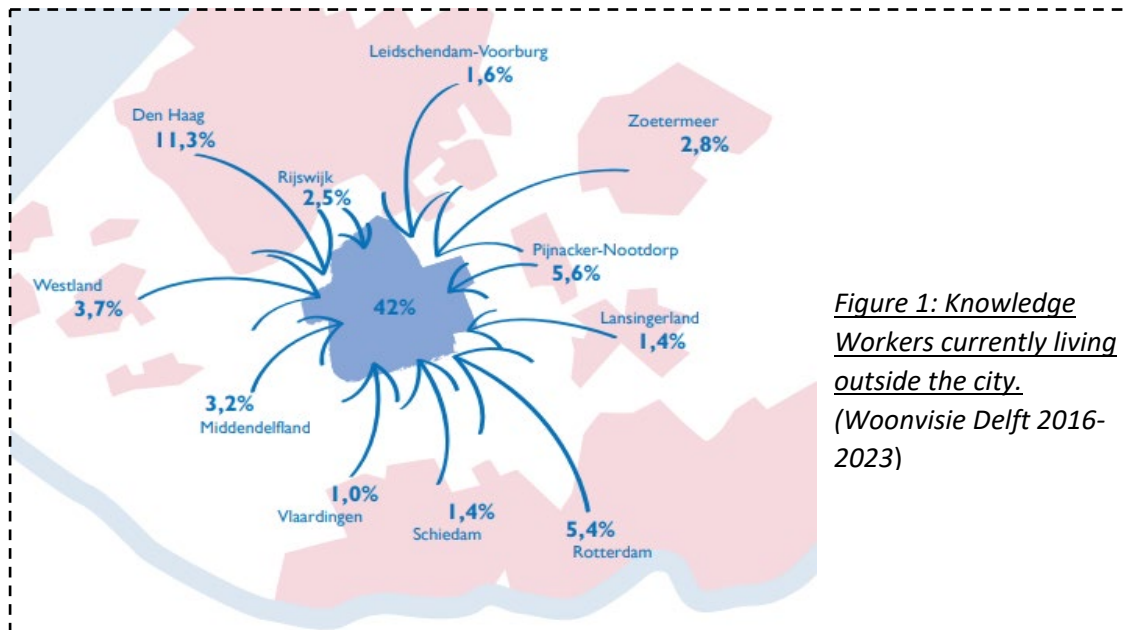
Demographics (1 to 2 people)	2020	2023	2025	2030
14-24 years old	12228	12468	12445	12160
25-54 years old	20046	20333	20563	21037
55-74 years old	12053	12009	12022	12024
75+ years old	5162	5921	6392	7371
Total	49489	50731	51422	52592

The municipality future predicted demographics tells us that a 94% decrease is expected for 14-24 years old, 87.66% increase for 25-54 years old, 93.17% for 55-74 years old and 64.44% increase for 75+ year old individuals. Where an increase of 85.68% is expected for families from 2020 to 2030. This all suggests to us that a growing demand of dwellings and functionality is required to support the predicted growth. To tackle this predicted demand, over the past couple of years an average of around 400 regular dwellings for self-employed individuals (*excluding students*) have been created. Where future short term plans include the construction of 7,500 dwellings and by 2023 around 2,700 new regular dwellings need to be created and 1,100 new dwellings for students (*Woonvisie Delft 2016-2023*).

## **2.2 Delft the Knowledge-Hub.**

Delft with the help of TNO, Yes! Delft and the Technical University is seen as a city that promotes knowledge workers and knowledge companies. It wants to place itself as a major competitor that attracts knowledge workers and companies from the surrounding regions. Where it is commonly seen that many start-ups are a spin-off from the university and research institutes, where they often attract companies or start their own. The province of Zuid-Holland has three main goals that it wishes to achieve: The Main-Port (*the industrial port of Rotterdam*), the Green-Port (*Historical-Cultural sectors of the province*) and the Knowledge-Port. From which the Leiden Bio Science Park and the Technological Innovation Campus (TIC) in Delft and Leiden are the current knowledge hubs of the province (*Woonvisie Delft 2016-2023*). Hence Delft has the aim and vision of making the city all out pooling knowledge together in one area and with the help of regional parties is looking at ways by which it can improve connectivity and housing for knowledge workers and its infrastructure, while

promote its historical, cultural, urban living environments. The city participates in competitions with other knowledge cities but with also other universities.



*Figure 1: Knowledge Workers currently living outside the city. (Woonvisie Delft 2016-2023)*

TU Delft is regional, national and internationally an important player and for Delft one of the biggest employers within the city. Established names like Deltares, VSL, DSM, Fox-IT, OGD are emerging start-ups form YES! Delft. Hence employment in the region is set to steadily increase from 1 to 2% per year (*gemeente Delft, 2011*). Where it is expected that 41.2% of the future employment will be that of knowledge workers in the city and many will seek accommodation in the city. At present though an estimated half of the population of knowledge works currently don't live in the city and stay in neighbouring cities. Due to the predicted growth rate and demand the city wants to create a mid-rental housing and buying market that is aimed towards knowledge-workers, where variety of housing typology and environments is key such that the needs and wants of the knowledge-workers are met (*Bind de Kenniswerker, 2014*).

While in other cities students are dependent on the private housing market, most student accommodations in Delft belong to the social sector. Where DUWO is the largest student housing provider followed by smaller organizations such as SHS and as more students are expected want accommodations within the city it is also expected that more student residences are also required.

### **2.3 How do you define a Knowledge Worker?**

In Delft there are relatively more knowledge workers 30% when compared to the rest of the Netherlands 12% (Nyfer, 2010). A knowledge worker is typically in the age group of 23-35 years old (WoON, 2012) who has completed a higher professional education or university education where in Delft the size of this group is 11,500 individuals (WoON, 2012). In Delft there are approximately 100,000 residents from which 30,000 are of the age group of 23-35 (*Bind de Kenniswerker, 2014*).

Knowledge workers of the age 28-30 years old earn 766 to 1666 euros per month more than the age group 15-25 years old, in Delft. Knowledge workers till the age of 28 years have a net income up to 2,500 Euros per month, where most live-in residential areas with apartments and single-family dwellings. In most cases they like to live in quite urban or lively urban living



environments single compartment dwelling apartments. Currently most of the knowledge works prefer look of new rental properties but hope to later-on purchase a new dwelling within the price category of 190,000 to 350,000 Euros. Ease of accessibility to the public transport is very important to them. 37% of these knowledge workers plan to move within two years, whereas 61% wish to continue to stay in Delft (*Bind de Kenniswerker, 2014*).

Knowledge workers of the age 28 to 30 years old have an average net income up to 2,500 Euros per month, where most live-in apartments located in quite urban or lively living environments, but want to live in a terraced house, where many prefer to purchase existing buildings instead of dwellings within the price category of 190,000 to 350,000 Euros. Ease of accessibility to the public transport is very important to them, but also which to have a place for parking. 47% of these knowledge works plan to move within two years, whereas 53% wish to continue to stay in Delft (*Bind de Kenniswerker, 2014*).

Knowledge workers aged 30 and above that have an average monthly disposable income up to 4,324 euros per month. These individuals are considered mid income individuals that like to live in detached dwellings and that prefer a monthly rent above 400 euros (*Rendament.nl, 2017*).

The number of students in Delft is expected to increase over the coming years, hence the number of knowledge workers will also increase. Hence due to shortages in preferred dwellings 23% of knowledge works currently live in Delft whereas nearly 50% of students continue to live in the city for 1.5 years after graduation. Where most knowledge workers live in Apartments (up to 28 years) but would like to move to single-family dwellings (28-35 years old) and would like to purchase a dwelling in the long run. (*Bind de Kenniswerker, 2014*).

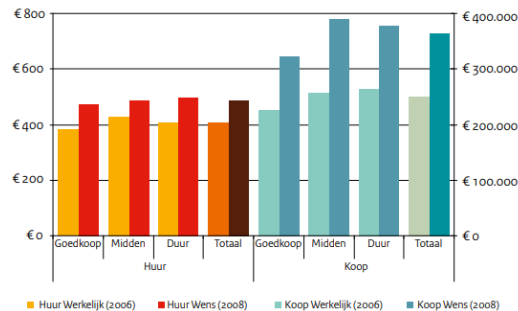
## **2.4 More about Living Preferences?**

The age group 23-28 seem to be a crucial stage for the age group of 23-35 when student, leave their “student residences” and move to find a stable job in the age group of 28-35. For knowledge workers looking to buy a house in Delft, it is extremely difficult due to the lack of supply of houses in the current housing market in Delft. Even for students who wish to return to the city after their studies find it difficult to find a house and that too to their preferences, resources and expectations. To tackle the issue of less supply of housing for students the TU has a leasing agreement with the students which requires them to leave after six months of completing their studies. Where student rental accommodations generally tend to be priced at: 400 euros per month for one individual or 800 euros per month for two individuals. Where for this target audience (students) the price, area and location are less important since they need a dwelling to move in quickly. Master Students (aka. Future Knowledge Workers) prefer to live in an apartment (400 to 500 euros for individuals and 800 to 900 for two individuals) than a regular dwelling that exist in lively popular environments. Whereas for young knowledge workers of the age group 28-35 like to live in regular dwellings and those who can purchase a dwelling often look for dwelling in the areas of: Westerkwartier, Hof van Delft (Agnetapark), Binnenstad (Verwersdijk, Schutterstraat, Nieuw Plantage), TU Noord, Oude Bibliotheek TU, Proffessorenwijk, de Indische Buurt. Areas of dwellings next to the train station are also very attractive locations within Delft as they not only feel that the quality of the dwelling will be quite high but also fear their prices but is rather still quite attractive to them. (*Bind de Kenniswerker, 2014*).

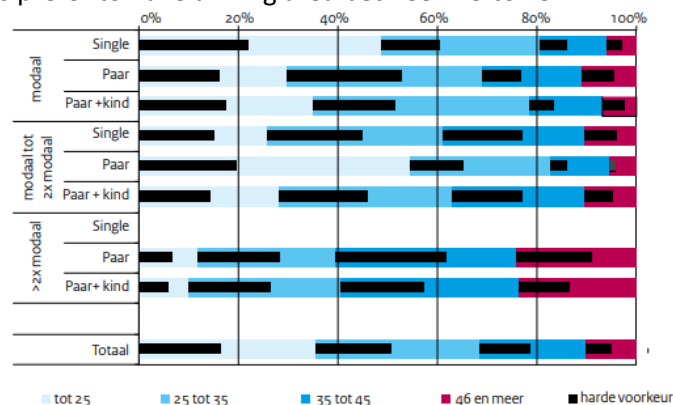
## 2.5 Living Preferences for Knowledge Workers and Students?

In reference to “Het inkleuren van voorkeuren de woonconsument bekend” a research done on the housing preference of select target groups based upon their age and income by WoON 2009 we see the following results:

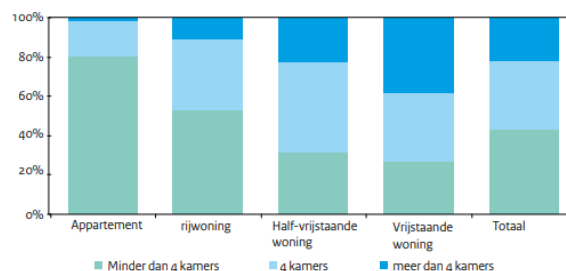
- The “Desired monthly rent and cost price per dwelling, per price region”, from this we see that rent is around 400 euros per month (average). Whereas for the for individual who wish to buy a dwelling the price is around 250,000 euros (average).



- The “Desired minimum size of the living room with regards to household composition and income”, shows us that for single individuals with a modaal income they prefer a living area up to 25m<sup>2</sup>, for duos they prefer a living area of 25-35m<sup>2</sup> and for duos with children they prefer a living area of 25-35m<sup>2</sup>. For singles with double the modaal income they prefer a living area of 25 to 45m<sup>2</sup>, for duos they prefer a living area of 25-35m<sup>2</sup> and for duos with children they prefer a living area of 25-35m<sup>2</sup>. For duos with an income below the modaal income its preferred to have a living area of 35-45m<sup>2</sup> and for duos with children they prefer a living area of 35-45m<sup>2</sup>. Hence in general individuals prefer to have a living area between 25 to 45m<sup>2</sup>.



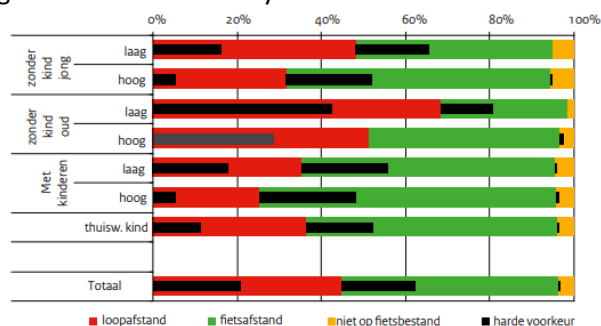
- The “Relationship between desired housing typology and number of rooms”, tells us that for apartments it is preferred less than 4 rooms, for individual dwellings it is preferred more than 4 rooms.



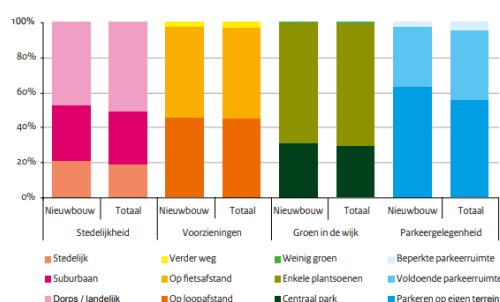
- The “Desired housing typology with regards to household composition and price segment”, tells us that for young individuals (with a low income) and without children it is preferred to either live in apartments or in detached dwellings, for those (with a high income) it is preferred to live in detached dwellings. For older individuals (with a low income) and without children it is prepared to live in apartments and for those (with a high income) it is preferred to live in detached dwellings. For individuals with children (with a low income) it is preferred to live in semi-detached dwellings and for those (with a high income) it is preferred to live in detached dwellings. Where in general it can be said that individuals want to live in a detached dwelling.



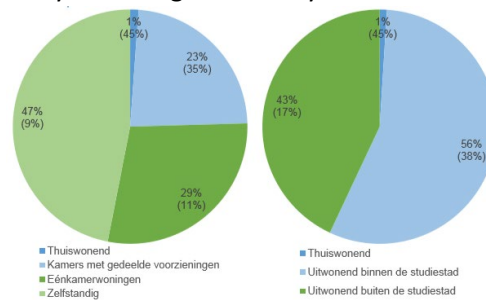
- The “Desired closeness to daily necessities with regards to household composition and price segment”, for young individuals without children (with a low income) prefer to be within either walking or cycling distance to daily necessities whereas those (with a high income) prefer to be within cycling distance. For older individuals without children (with a high and low income) prefer to be within walking distance to daily necessities. For individuals with children (with a high and low income) prefer to be within cycling distance to daily necessities. In general individuals like to be within cycling or walking distance to their daily necessities.



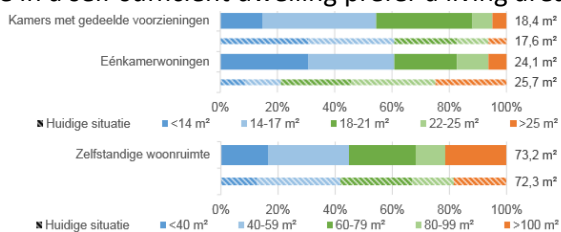
- The “Preferred living environment for households with a preference for new buildings” tells us that, individuals like to have a dwelling that is surrounded by similar vegetation, has access to parking on their own plot, is within cycling or walking distance to daily necessities and like to live in a “city-environment” that is on the border of the city.



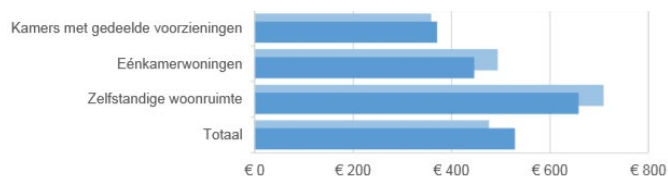
- The “Percentage of students (in the year of 2015-2016) that like to either live at home, have a self-sufficient studio, individual room or shared facilities” tells us that the majority 47% like to live-in self-sufficient dwellings from with 56% prefer to live in the city that they are currently following their study.



- The “Desired living area for students (in the year 2015-2016)”, tells us that students that live in an environment with shared facilities prefer a living area of 14-17m<sup>2</sup>, individuals that live in a one room dwelling prefer a living area of 14-17m<sup>2</sup> and individuals that live in a self-sufficient dwelling prefer a living area of 40-59m<sup>2</sup>.



- The “Desired living costs including additional expenses and before housing allowance for Students for the year 2015-2016”, tells us that student with shared facilities prefer to have a monthly rent of less than 400 euros, for those that live in a one room dwelling prefer to have a rent that around 450 euros per month and for those that live in a self-sufficient dwelling it is preferred to have a rent that is around 650 euros per month.



In general, from these graphs and figures it can be said that students prefer to live in the city that they follow a study and like to live in a self-sufficient dwelling that has a rent around 650 euros per month. Whereas for non-student individuals a preferred monthly rent of 400 euros is desired and for non-student individuals who wish to purchase a dwelling they prefer to purchase it for 250,000 euros. Where the dwelling has a size between 25-45m<sup>2</sup> and has more than 4 rooms and is a detached dwelling that is within cycling or walking distance to daily necessities have a similar type of vegetation and has direct access to parking. Where the surrounding environment gives a city like vibe but that the dwelling is situated on the border of the city.



## **2.4 Housing availability for target groups in Schiehallen and comparing it with that of Nieuwe Haven, Stationsomgeving Delft Zuid and Delft as a whole.**

In this part, the paper will focus on Schieoever-Noord area and its possibilities for developing into an attractive living and working environment.

The location of the Schieoever-Noord is quite eligible for further developments considering that it is in an industrial area across TU Delft campus, on the other side of the Schie and next to the rail line, just in between two stations: Delft Zuid and Delft Main Stations. Also, another attractive part of it is that it is very close to the center. Nowadays, interesting urban living environments started becoming popular as a solution to the shortage of space and housing in cities. Former business and office areas are transforming into integrated working and living environments within cycling distance to each other but also close to the center and main roads, easily accessible by public transport. Therefore, Schieover Noord provides a perfect environment for this kind of a transformation. It is a place where employees of knowledge - intensive companies, PhD and graduated students can both live and work, hence makes it quite attractive to this target group. For all those reasons, Schieoever-Noord has a very important role to create an environment with functions of work, culture, breeding creative economy ground, sports, leisure, meeting places and living.

## **2.5 Probability of finding housing for starters and young professionals.**

Delft is a student city. Every year more and more (inter)national students and PhDs students are moving to Delft to study in TU Delft. In the academic year 2015/16, the intake of students grew by 33% percent compared to the previous year. The number of students at TU Delft is expected to grow to more than 25,000 over the next ten years (source: TU Delft policy). According to Delft Municipality, students consciously chose to live in Delft: not only because of the educational offer and the excellent educational facilities, but especially for the historic center, the small scale and the vibrant student life. Students - both Dutch and international - seek accommodation in Delft itself. The 'Bind de Kenniswerker' report (2014) shows that students who wish to stay in Delft after graduation cannot find a suitable home. The campus contract expires and there is often no suitable rental property available anymore. Buying also is not usually an option. Labour relations change (fewer permanent contracts) and flexibility is a great asset for this target group. This means that many students leave Delft after graduation. They go to Amsterdam, Rotterdam, The Hague or elsewhere.

Most of the student housing in Delft belongs to social sector. Housing corporation DUWO is the largest student housing provider, but there are also smaller organizations such as SHS (foundation housing students). But to meet the growing demand, more student housing is needed.

Also, to improve the knowledge-economy, it is desirable to keep the graduated students in the city and therefor it should be eligible for them to keep living here in Delft. This is well arranged for Dutch students. They find accommodation in the city via DUWO's Student Housing Web and through smaller organizations such as SHS or the private market. The experience of TU Delft shows that this is more difficult for international students and PhD students. Graduates and Delft knowledge workers are often still unaware of the opportunities to live in the various neighbourhoods in Delft, according to the research 'Bind the Knowledge Worker'. They mainly search in the center, where the supply is scarce. Home providers,

brokers, employers and the municipality can help to find a better way to other suitable offers. A good example to that various neighbourhoods could be Shieoever-Noord.

## **2.6 Identifying the target audience in Schiehallen.**

According to analyses from the Delft Municipality's Woonvisie, there are more cheap houses than the size of the target group that has been designated. Given the need, Delft housing market has shortage in middle and expensive segment. For a better balance in supply and demand, more middle-expensive and expensive housings are needed. Therefore, we can conclude one of our target groups is middle- and high-income people. Because of the logistic of Schieoever Noord and also for the Municipality's ambition to turn Delft into a sustainable knowledge cantered city, the group fits there the best among this target group can be defined as knowledge workers.

The second most eligible target group is students. TU Delft is growing every year more and more with bachelor and master students coming from all around the world. However, the housing supply doesn't meet the needs of this large number of students and therefore, there is high shortage for student housing, especially for international students. For the Delft Municipality who wants to keep Delft growing in knowledge sector, it is vital and one of the priorities to provide housing also for this low-income and potential knowledge worker of future.

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## **2.7 Confrontation:**

Schiehallen is an urban area close by the TU Delft campus which makes is quite favourable for our target group but also for the same reason it has a high land price. Target group of knowledge workers often prefer semi-detached or detached houses; however due to the relatively high land prize, limited area and high demand, those type of houses can't be realized. Considering current condition of Schiehallen, there must be some other attractions in order to attract this target group to the area. For example: green areas and parks, supermarket, sport attractions like the already existing Delftse Blauw Bouldering Centre and rowing clubs...

As mentioned earlier, Delft Municipality wants to make Delft a knowledge city, so they aim to attract knowledge workers. In addition, they want to ensure that more graduate and PhD students keep living in Delft after graduation (Delft Municipality, 2016). However, the percentage of students keep living in Delft after graduation is quite low compared to the other student cities because demand is high, but supply is low.

## Chapter 3: The Housing Market:

In the previous chapter we tried to define the needs and requirements of the municipality of Delft with regards to the selected target audience of students and knowledge workers. From this we were able to define our target group and investigate their housing preferences. We also investigated the future demand for the area and how the municipality wishes to tackle this issue. In this chapter we will see what type of dwelling is the most attractive to our selected target group and if their needs and wants can be met financially.

### 3.1 Current Housing Market of Delft:

In Delft at this moment there are more low-income dwellings that do not match the future demands of the target-audience and the requirements of the municipality. This currently concerns 26,000 households of which approximately half are target towards students and the other towards regular households who are entitled to the housing allowance and other forms of governmental subsidies and tax benefits. In Delft the current market structure is leaning towards the social rental sector where the rent asked for this sector is to a maximum of 710 euros and for individuals who wish to buy these dwelling it comes to a maximum of 265,000 euros. Where in average a price of 2.844 euros is asked per m<sup>2</sup> of residential area in Delft. Currently in Delft there are approximately 19,000 social rental dwellings, where the municipality believes that for low income households there are approximately 16,000 dwellings in the city (*Woonvisie Delft 2016-2023*).

In the upcoming years the municipality would like to reduce the current 19,000 of social rental dwellings to a figure between 16,000 and 17,000 dwellings. Where it is believed that a figure between this range is enough to accommodate people of low-income when considering the future and current demand for such dwellings and the cities vision for the city. Where the city has set a target that by 2023, 1,200 to 1,800 new dwellings will be realized for non-students (*Woonvisie Delft 2016-2023*).

Currently at present there is a shortage of rental dwellings for Master-students (pre-knowledge workers) and Knowledge workers as see in the previous chapter.

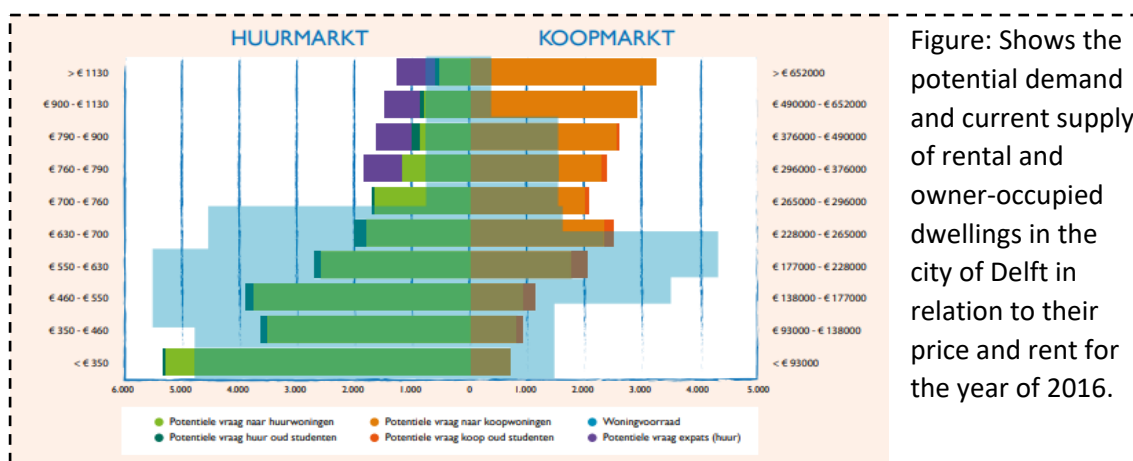


Figure: Shows the potential demand and current supply of rental and owner-occupied dwellings in the city of Delft in relation to their price and rent for the year of 2016.

Woningvoorraad Delft (afgerond op 100/totalen op 1000)	2016	2023		2030	
	voorraad	TS	PS	TS	PS
sociale huur	19100	17700	18100	16200	17000
vrije sectorhuur	3600	4900	5200	6300	6500
koopwoningen	19100	22800	23800	26100	26700
studenteneenheden	12800	13800	15700	14800	18600
overige	4000	3800	3800	3200	3200
<b>totaal</b>	<b>59000</b>	<b>63000</b>	<b>67000</b>	<b>67000</b>	<b>72000</b>

Tabel 2: Ontwikkelingsrichting woningvoorraad

(af rondingsverschillen)

TS = Trendskenario (doortrekken ontwikkeling 2006-2015)

PS = Prognosekenario (groei volgens prognose Primos + prognose ABF/Apollo-TUD 2016)

Verwachte ontwikkeling vergeleken met planvoorraad	Voorraad	Verandering 2016-2023		Harde plannen	
	2016	TS	PS	WBM	WBM+T
sociale huur	19100	-1400	-1000	65	-980
vrije sector huur	3600	1300	1600	260	1050
koop	19100	3700	4700	1980	1980
nog te bepalen huur/koop				650	650
studenten	12800	1000	2900		1120
overig	4000	-200	-200		
<b>totaal</b>	<b>59000</b>	<b>4400</b>	<b>8000</b>	<b>3000</b>	<b>3800</b>

Tabel 3: Groei aantal woningen per segment 2016-2023

WBM = harde plannen zoals opgenomen in de woningbouwmonitor 2016. Dit betreft nieuw toe te voegen woningen door marktpartijen t/m 2021

WBM + T = harde plannen uit WBM, aangevuld met de bij de gemeente per 1-6-2016 bekende bouw- en (per saldo) transformatieplannen van corporaties en marktpartijen t/m 2023.

Bron scenario's:

1. Ontwikkeling huishoudens volgens Primos

2. Toegevoegd: ontwikkeling studentenaantallen volgens onderzoek ABF in opdracht van TU Delft (Apollo, 2016). Is aanvulling/verbetering op ABF/Apollo "landelijke monitor studentenhuizing 2015".

3. Voor ontwikkeling sociale voorraad ontwikkeling doelgroep volgens Primos aangehouden.

4. Trend passend toewijzen en liberalisering woningmarkt doorgetrokken, resulteert in zeer geleidelijke afname aandeel sociale voorraad richting 2030.

5. Kwalitatieve verdeling over segmenten op basis van STEC Marktruimte model en WoON 2015.

6. Woningbouwmonitor 2016 en bronbestanden gemeente Delft

7. De categorie Overig; dit zijn alle ander wooneenheden die niet in voorgaande categorieën zijn in te delen. Te denken valt aan bijvoorbeeld intramurale verzorgingshuisenheden.

Figure: Shows the current supply and projected development of the housing stock by tenure in the year 2016 and for the future.

Where the municipality vision for Delft in the year of 2030 is that 33% of the housing market will be for social dwellings, 13% for rental dwellings and 53% for non-rental dwellings. Where the above figures show that there are more low-income dwellings than the number of individuals in the target group that it has been designated for. Where the Delft housing market currently has a shortage in the middle and high-income segment and to create a balance in the housing market between the high-low and mid-income dwellings a strong shift to mid and high-income dwellings is required (*Woonvisie Delft 2016-2023*).

Where the trend scenarios show, that 320 high-income and 400 mid-income rental dwellings are required to be created annually to meet the predicted demands for our selected target audience. In addition to this another 330 to 460 high-income non-rental dwellings are required to be created annually (*Woonvisie Delft 2016-2023*).

Form the figures the distribution over rent and non-rental dwellings for the mid-income market segment is difficult to predict. Reduction of social rented dwellings along with a flexible work come living dwellings along with high-interest rates from banks will increase the demand for rental housing and the re-development rate of the area. In contrast, a low-interest rate will lead to an increasing in demand non-rental dwellings. Hence in the long run it is expected that the demand for non-rental dwellings will increase and a shift from rental to non-rental dwellings is expected to occur as mentioned in Chapter 2 under the topic of living preferences for Students and Knowledge-Workers. Where a distribution between 25 to 75 is set to exist between rental and non-rental dwellings (*Woonvisie Delft 2016-2023*).



### **3.2 Categorizing the Target Group into High, Mid and Low-Income Individuals:**

After identifying our target group in chapter two we now split them into two categories, low income and medium-high income individuals. Where the split between low and medium-high income individuals occurs at a gross income of 36,500 euros per year. For individual who earn less than 36,500 euros per year are considered low income individuals and individuals who earn between 36,500 to 70,000 euros per year are considered mid income individuals and those who earn more than 70,000 euros per year are considered high income individuals. For individuals who have a yearly income of 36,500 euros are qualified for social rental housing, where the rent per month cannot exceed 710.68 euros (*huurwoningen.nl*, 2018). Where this categorization of individuals based upon their income is in accordance to the Centraal Planbureau for modaal income individuals for the year 2017 (*CPB*, 2017).

For individuals who have a low-income can buy a dwelling up to 150,000 euros, whereas individuals who have a mid-income can buy a dwelling between 150,000 to 375,000 euros and individuals who have a high-income can buy a dwelling that is higher than 375,000 euros. Since student and some knowledge workers have an average disposable income of less than 22,100 euros they are hence entitled for social housing and housing subsidies if their monthly rent is between 231.87 to 710.68 Euros (Belastingdienst, 2016).

### **3.3 Living Requirements of Target Audience:**

Following the research of Chapter 2 (Housing Market Analysis and Target Audience), there are three target groups that we would like to focus on as we see them as the prime potential individuals that would be the most interested in living within the area of Schiehallen.

The first target audience is that for Students between the age of 18 to 25 that have an average monthly disposable income of less than 833.33 Euros per month (low income individuals) that like to live in self-sufficient dwelling (studios) that have a rent around 400 euros per month and have a living space equal to or less than 25m<sup>2</sup>. Master Students (aka. Future Knowledge Workers) also fall into the same income class and prefer to live in self-sufficient apartments (400 to 500 euros per month for individuals and 800 to 900 euros per month for duos) that exist in lively popular environment and which have a living space between 25-45m<sup>2</sup>.

The second target audience are that of Knowledge workers between the age of 25 to 30 that have an average monthly disposable income of 2,500 Euros (low income individuals) that like to live in detached dwelling that prefer a monthly rent of 400 euros (*Bind de Kenniswerker*, 2014).

The third target audience are that of Knowledge workers aged 30 and above that have an average monthly disposable income up to 4,324 euros per month. These individuals are considered mid income individuals that like to live in detached dwellings and that prefer a monthly rent above 400 euros (*Rendament.nl*, 2017).

Currently most of the knowledge works prefer look of new rental properties but hope to later-on purchase a new dwelling within the price category of 190,000 to 350,000 Euros. Where the dwelling has a size between 40-59m<sup>2</sup> and has more than 4 rooms and is a detached dwelling that is within cycling or walking distance to daily necessities have a similar type of vegetation and has direct access to parking. Where the surrounding environment gives a city like vibe but that the dwelling is situated on the border of the city.

Most low-income individuals in this target group due to their income are also eligible for housing subsidies hence reducing their rent and hence increasing their disposable income.

Doelgroep	2009	2012	2015
Huurtoeslag doelgroep* student	11.300	10.600	13.200
Huurtoeslag doelgroep overig	11.500	12.400	12.800
geen huurtoeslag doelgroep	29.300	31.700	30.800
<b>Totaal</b>	<b>52.200</b>	<b>54.600</b>	<b>56.800</b>
<b>Aandeel HT-doelgroep</b>	<b>44%</b>	<b>42%</b>	<b>46%</b>
<b>Aandeel exclusief studenten</b>	<b>28%</b>	<b>28%</b>	<b>29%</b>

Figure: Indicates the number of individuals that receive housing subsidies.

### **3.4 Selecting the Target Group based upon the supply and demand of Dwellings**

As discussed in Chapter 2, our target groups consist of knowledge workers with middle and high income and students with low-income. This first group knowledge workers prefer a 1 or 2 people households or a family size households. In both case, they prefer to live in a spacious house or apartment with outdoor space. This type of houses fall under the medium expensive purchase/ rental housing. From the previously mentioned data at the beginning of the chapter, we can conclude that there is a shortage in this type of housing so within the Delft housing stock there is room for more of this type of housing. Especially the Schieoevers Noord area is particularly suitable. The second target group is students. Students don't have as high standards as the knowledge workers who have a higher income. Students mainly focus on location (close to the university), functionality and accessibility. Schieoever Noord meets all those wishes of our second target group as well. By meeting the wishes of both target group, the gap in the housing market will also be filled.

### **3.5 Economic attainability for selected Target Group to get their desired Dwelling:**

From the examination of the housing market in Delft and requirements of intended target group, it can be concluded that the most suitable housing types for Schieoever Noord are spacious terraced houses or apartments. However, there is still a factor left untreated and that is whether this type of housing at this location is economically feasible for the intended target groups, this is also to be discussed in this section.

The first target audience is the students between the age of 18 to 25. Students income consist of student loans and any side jobs they have. As a result, that have rather a low income, an average income of less than 1000 Euros per month and therefor a maximum rental price that this group can afford is 450 euros per month average.

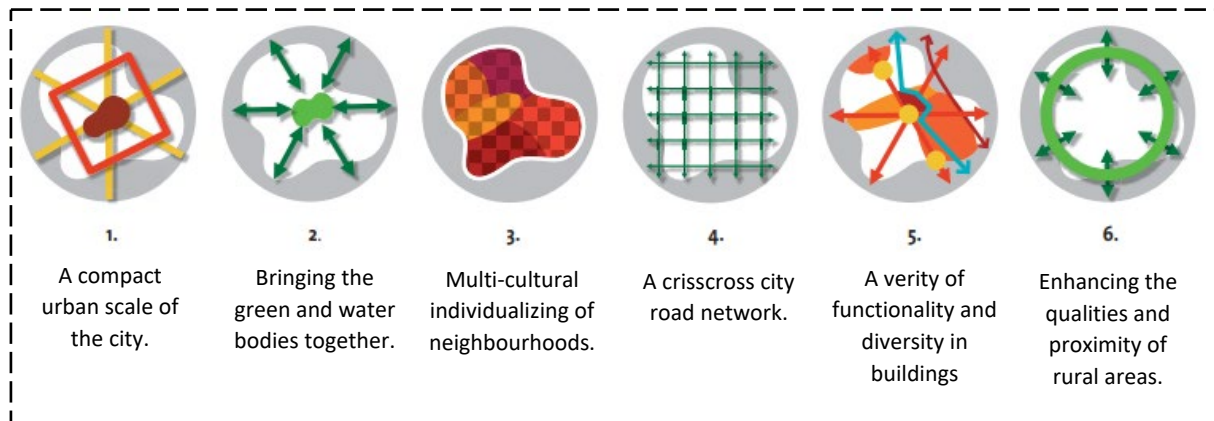
The second target group is the knowledge workers under the age of 26 with a 1 or 2 people household and they have a relative lower middle income which is around 27,500 euro per year due to their new start in the labour market. So the maximum rental price for this target group is approximately 1000 euro per month. Knowledge workers in age range 30-60 with a family household has a middle or higher income (4000-4000 euros per month average) which means they can afford so much higher priced houses to rent or purchase.

It can be concluded that spacious terraced houses and apartments that are to be realized in Schieoever Noord has to cost between 177,000 and 490,000 euro to attract our target group.

## Chapter 4: Sustainability:

This chapter will discuss sustainability aspects and possibilities regarding the target area Schieoevers Noord. So that the policy of the Delft Municipality and what has been done so far regarding sustainability will be reviewed. Furthermore, it will also be discussed what are other possibilities to make this area more sustainable. Finally, it will be concluded which sustainable solution is more favourable regarding the municipal, economic and residential requirements of the target groups.

Where the city aims to develop a dynamic, sustainable city that is closely bound together. By enhancing the spatial core qualities of the city, being (*Ontmoeting met Delft 2030, 2009*):



### 4.1. Policy of Delft Municipality regarding Sustainability

In Netherlands, municipalities such as that of Delft wants to build climate-friendly and sustainable buildings/living environments that eliminate the dependence on fossil fuels by 2050. We can list the achievements that Delft Municipality wants to reach in the following topics:

1. Milieueffectreportage (MER) “Transformatie Schieoevers-Noord gemeente Delft”.
2. Energy-neutral and innovative city in sustainable knowledge.
3. Green city with nature and water around.
4. Mobility (Sustainable Delft, 2018).

Hence, we will examine, what are the possible ways by which we can achieve the targets of the municipality.

### 4.2. Milieueffectreportage (MER) “Transformatie Schieoevers-Noord gemeente Delft, 2018”

The municipality of Delft aims to gradually transform the present business and industrial area of Schieoevers Noord (62ha) into an urban residential area where a focus is given to sustainability (green living). The transformation of this area is intended to infill the housing shortage and development goals that the municipality has set out for the area, which is also expected to contribute towards the creation of additional jobs in the area. The redevelopment of the area aims to create an urban area with spaces form working, living and recreation in a sustainable living environment.

The MER report intends to create a description of the municipalities ambitions, legal requirements and urban policies that need to be translated into the redevelopment project for the area of Schieoevers Noord. In doing so the MER report intends to create a d distinction between hard and soft guidelines. The report also intends to show how the distribution of the space (62ha) regarding functional qualities is supposed to take place and investigates how the

redevelopment of the area will affect the environment in the future (in terms of noise pollution and environmental management).

Via the MER we see that the municipality intends to;

1. Transform the area into a mixed urban residential area.
2. Create spaces for businesses that fits the characteristics of the area.
3. Make the area accessible via road and railway, while limiting traffic in the area.
4. Create more cycle paths and wider pedestrian walkways.
5. Increase accessibility via public transportation.
6. Create ways by which traffic can be managed in and around the area.
7. Introducing Climate Adaptation, Energy Transformation and Circular Economy Policies.
8. Create Soft and Hard regulations, that will become the framework to the redevelopment of the area.
9. Develop more parking storage facilities.
10. Increase Road Safety.
11. Optimal safe and liveable Noise and Air Quality.
12. Increase recreational activities in the area.
13. Healthy mobility (walking and cycling), an attractive public (green) space, quiet (indoor) areas, avoiding wind nuisance and heat islands, creating shadow spots, limiting nuisance for sensitive groups (children, elderly, sick) and promoting social safety and liveliness.

Hence via the policies of the MER the city intends the develop the area in a sustainable way.

#### **4.3. Energy-neutral and innovative-knowledge city:**

The port of Rotterdam (also known as the “Energy Port”) is an attractive location as it produces a lot of energy in the form of Biomass, CO<sup>2</sup> (Capture, Storage and Reuse), Steam, Wind and Solar Energy. These forms of energy are produced by the large industrial plants and processes that take place in the port<sup>5</sup>.

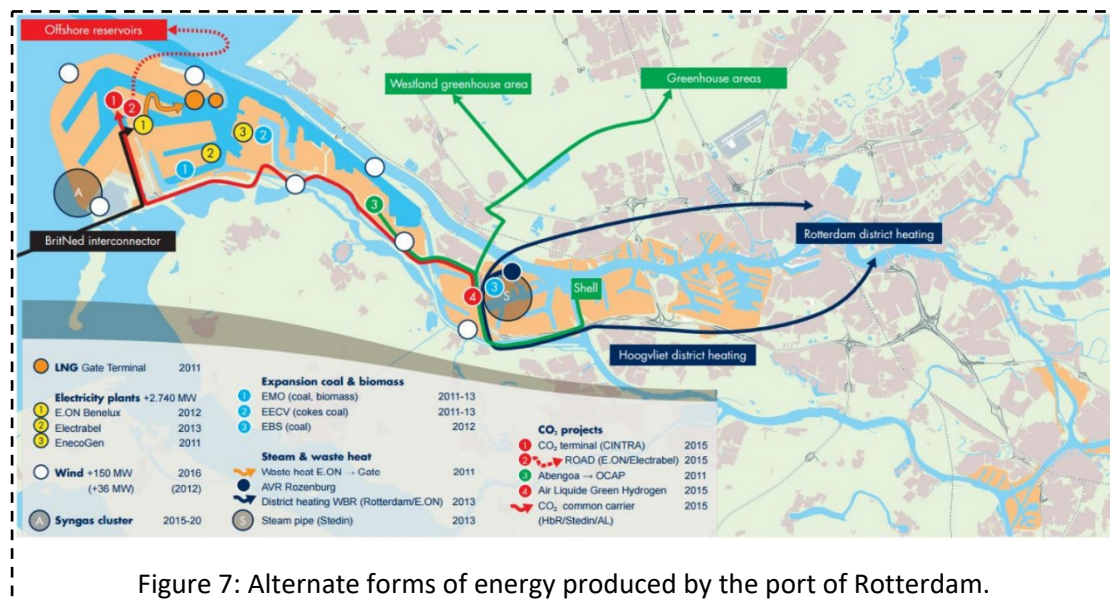
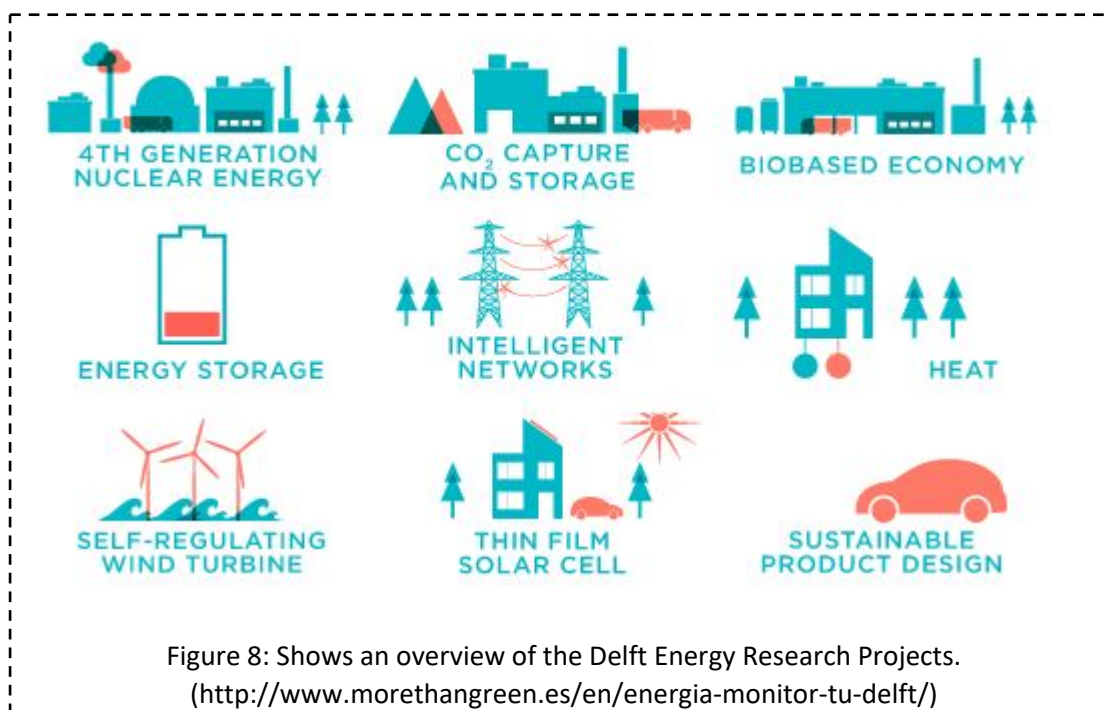


Figure 7: Alternate forms of energy produced by the port of Rotterdam.

From all the above-mentioned forms of energy; Steam, Wind and Solar Energy infrastructures are the most promising for the area of Schiehallen, as they require the least amount of resources. Where Steam Energy is readily available in the Rotterdam port as it is produced as a by-product by the industries in the port area and is currently being supplying heating for

dwelling and businesses in Rotterdam and Den-Hague. For us to make use of this by-product for the area of Schiehallen, a steam pipe network would have to be created and linked to the current steam-pipe network between Den-Hague and Rotterdam. This infrastructure is currently unavailable for the location but due to the current trends of global energy usage and lack of resources to meet the growing demands of the population it would be a wise investment, that will secure the future energy demands of Schiehallen and possibly even for the city of Delft <sup>5</sup>.

Where the TU Delft campus has a goal set that by 2035 all buildings on the campus will be energy neutral <sup>17</sup>. For the campus currently has 4000 solar panels that in the life-time have produced 2641 MWh and has helped reduce the carbon footprint of the campus by 1,388,982 Kg<sup>18</sup>. The campus is also running a “Delft Energy Initiative” that is the gateway to energy research in the fields of Urban Energy, Wind Energy, Smart Energy, e-Refinery, Solar Energy, Ocean Energy, Energy from Hydrogen and the storage of Thermal Energy <sup>19</sup>.



Future plans of the campus involve connecting themselves to a geothermal heat source, where through the help of market parties the campus plans on starting the 16 Million Euro project. Where the campus plans on further halving their Carbon Footprint by half by 2020 in relation to 2012, where the campus plans on achieving this by joining the steam-pipe network between Den-Hague and Rotterdam<sup>20</sup>. The campus is also conducting research on a green village that investigates how they can create a sustainable group of row houses, that will be energy neutral with more comfort<sup>21</sup>.

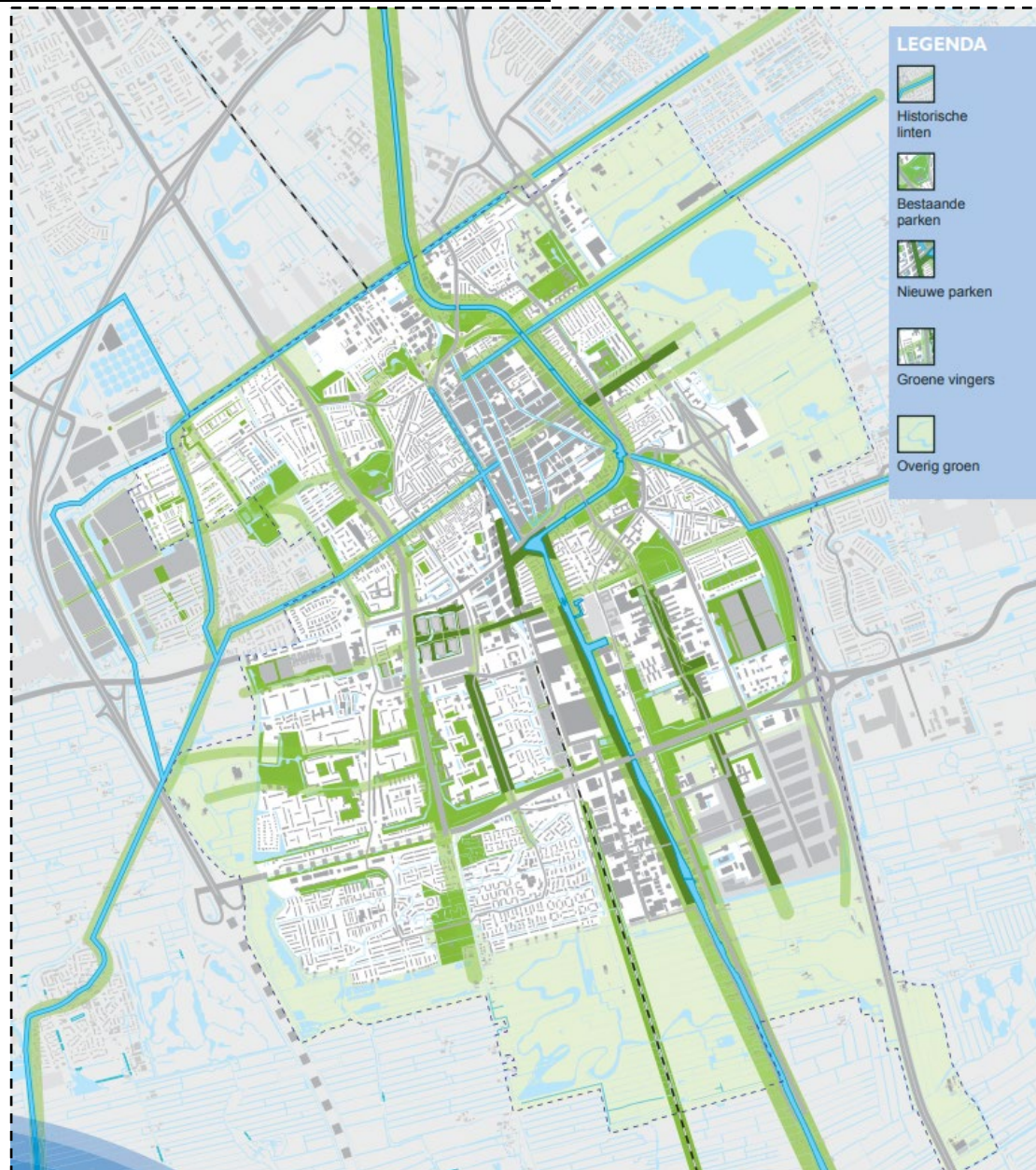
Hence having a steam energy network will not only reduce the energy consumption costs for households and will also help them and the city to reduce upon their carbon footprint and will help in replacing CV gas boilers that are currently used in the Netherlands to heat up dwellings. Where the buildings of the area of Schiehallen can be made even more energy efficient by connecting them to the solar and wind energy grid. Where companies such as Eon are currently providing Wind, Solar and Steam Energy to buildings. This will hence help in creating a situation where gas is replaced by steam and cars running on electricity from solar and wind



energy. While further developments into the production of energy storage and energy production form Hydrogen can lead to public busses in the city running on electricity produced by hydrogen or that form the solar grid.

These energy initiatives will also help in promoting the vision of EPBD (Energy Performance Building Directive) as signed by EU member states that “ensures that by 31 December 2020 all buildings are nearly zero-energy buildings; after 31 December 2018; new building occupied and owned by public authorities are nearly zero-energy buildings”. (Directive 2010/31/EU)<sup>5</sup>.

#### **4.4. Green City with Nature and Water around:**



Map showing the green and water infrastructures around the city of Delft (*Ontmoeting met Delft 2030, 2009*).

Nature and water areas in and around the city contribute significantly to a pleasant living environment. The municipality therefore encourages optimal implementation of these elements (Duurzaam Delft, 2018).



Currently Schieoever Noord is an industrial terrain with little green around. With its transformation to a living-working area, it is crucial to make this area healthy and comfortable place for people. This can be achieved through greening the area. Green has many positive effects on people's well-being: it relaxes people, provides cooling in the summer and creates a more biodiverse environment. Schie is really eligible to have a green boulevard through Schieweg, especially with the water element: Schieoever which is located right next to it. Therefore, it creates an environment that people can take a break from work, walk around, relax and that kids can play.

#### **4.5. Mobility:**



Map showing the crisscross mobility infrastructures around the city of Delft (*Ontmoeting met Delft 2030, 2009*).

For the moment, a big route, approximately 60 km, goes through Schieoever: Schieweg with a small bike lane. But if it were for more people to start living and working in the area as planned in the Delft Municipality's Woonvisie, there will be more working and residential traffic which requires the road to meet some regulations. In that case, road has to be extended and there has to be clear division between car, bicycle and pedestrian traffic because of the safety reasons. Furthermore, bicycle usage should be encouraged in order to free the living

space from car traffic and make it a healthier environment. Therefore, a big bicycle network and also bridges connecting the Schieoever Noord with the other parts of the city is needed. As much as the bicycle network, also the public transportation should be stimulated. Especially considering with the new targeted functions of Scieoever Noord, the area becomes more attractive and crowded so it has to be connected to the city center with transportation for the group of people starting to live there. Connection over the Schie is also important to improve. A pedestrian bicycle bridge across the Schie will connect the TU district via the Schiehallen with the stations.

#### **4.6 What requirements do Mobility, Green, Water and Energy have for the location:**

From the policies set out by the MER report and by the various goals that the Technical University of Delft and the municipality of Delft plans on achieving we can say that a lot of changes need to take place within the location in the form of rules and infrastructural projects to bring out the vision of the city and its stakeholders. For the requirements of Mobility, Green, Water and Energy to be met, the following need to occur:

1. Introduction of car free zones in green (recreational) environments and prevent large vehicles from entering some parts of the living environment.
2. Creating green facades, energy neutral buildings, green roofs (to help reduce the heat island effect of the city) to help reduce the carbon footprint of the area.
3. Introduction of green energy in the area from solar panels, windmills and the steam network.
4. Redevelop the current area into a mixed urban residential and work area sustainable living environment.
5. Make the area accessible by introducing paved roads (for public and private transportation, where some roads are only accessible by public transportation and pedestrian/cycling paths hence promoting the use of public transportation and healthy mobility within the area), pedestrian walkways, cycling paths which in turn will help reduce traffic but increase mobility within the area.
6. Introduce policies that prevent noise and air pollution in the area by limiting industrial activities and by introducing noise buffer zones (such as parks) within the area.
7. Introducing Climate Adaptation, Energy Transformation and Circular Economy Policies.
8. Create Soft and Hard regulations, that will become the framework to the redevelopment of the area.
9. Develop more parking storage facilities underground where residents of the area can have direct access to the underground parking through close access points on the surface that is near their living or work environment.
10. Increase recreational activities in the area, such as parks, sports activities (bowling, film, clubs), street furniture (such as benches, fountains etc to help promote public gathering spots), restaurants, bars, hotels, schools, day-care centres, shopping centres within the area.
11. Create a bridge that connects Schieoevers-Noord to the Technical University of Delft and Technopolis which is accessible for pedestrians and cyclists.
12. Creating shadow spots, limiting nuisance for sensitive groups (children, elderly, sick) and promoting social safety and liveliness.
13. Introduce waterways to help cool the area and promote the living and work environment within the area.
14. Introduce a lot of vegetation within the area in the form of trees, bushes, public gardens etc to help reduce noise pollution but to also help promote a healthy sustainable living environment.

15. Promote the area for knowledge workers, experts, students of multi-cultural backgrounds by introducing cultural and technological innovation festivals in the area.
16. Waste Segregation Units that can be accessed at any time.

Through the help of introducing the above-mentioned policies, activities and features we not only hope to promote the vision of the city and its stakeholders but to also help promote the needs and requirements for a green, sustainable healthy living environment within the area of Schieoevers, which in turn meets the requirements for sustainable; mobility, green, water and energy in the area.

#### **4.7 How do we make the Dwellings for the area sustainable:**

We believe that we can achieve sustainable dwellings by having slanting green roofs with solar panels attached to the top of it to help meet some of the energy requirements of the dwelling. Where the remaining energy demands can be supplied from companies such as “essent” that in recent periods has moved towards a 100% green energy initiative that sees its customers receive green energy from sustainable green means. The collection of rain water from the roof of the dwellings can also be used for the surrounding vegetation. Heat produced from the Rotterdam Port can be transported via the steam network to help produce energy friendly heating for the dwellings, where the steam can then be let to condense within a condensing unit in the house to produce water for plumbing or even for showering. Where via the help of WTW units the hot water from the steam network can also be used to heat up water used for showering and drinking in the house. Geo thermal energy can also be used to heat and cool the building due to transferring the heat in the building to the ground during summer and from the ground to the building during winter. The use of Natural Ventilation and WTW in central HVAC units for multiple dwellings can also help reduce energy requirements of the dwelling. The introduction of green facades and roof can also help in insulating the building but will also help in reducing the heat island effect and hence reduce the overall air temperature of the area. All these processes and more can help in making a sustainable energy neutral dwelling that will not only meet the municipalities energy neutral goals for new buildings for the year 2020 but will also pave the way for a sustainable healthy living environment for the residents of the neighbourhood.

#### **4.8 Sustainable Preference for the Target Group:**

Our selected target group for the area of our study are low-income (master) students, low-income knowledge workers and mid-income knowledge workers. These individuals don't have a lot of financial resources hence it will be extremely difficult for us to expect the owners of the dwellings to invest into creating a sustainable healthy living environment. Nevertheless, multiple solutions can be found to this issue and can hence help the development of sustainable healthy living environments for the area. These solutions are as follows:

1. Investment from energy companies such as; eon, essent, eneco etc. into solar and wind energy can see the construction of solar panels on roofs of dwellings and wind-mill farms on the suburb rural farm areas surround Delft.
2. Subsidies and tax benefits for tenants and owners from the municipality can help in promoting the area and increasing demand for owning a building within the area.
3. Stakeholders such as TU Delft, Essent and the Delft municipality can also invest into the steam network pipeline which in turn will help to benefit the city in the long run.

4. International and Local Companies driven towards sustainable living and energy friendly mobility can also take place in the re-development of the area by proving their technology to help promote a sustainable healthy living environment, in doing so not only will these companies advertise their products successfully within the area but will also create an initial testing and cheap consumer acquisition for residents in the area.

Much of these initial investments are too large for our target audience to finance hence by following the above-mentioned steps owners of the building can not only feel motivated the live in the area, but inventions also can profit from this investment in the long run by getting a return on their investment in the form of slightly increased service costs that home owners would have to pay back to the investors over a long period of time (hence crating brand loyalty and a market that would be difficult to influence via external parties at a later period in time). By following this approach, the initial investments required for a sustainable living can be repaid and the vision of the city for the year 2030 can be achieved successfully.

#### **4.9 Conclusion:**

In conclusion it can be said that a lot of sustainable innovations and approaches can be taken via the help of local and global stakeholders to help provide for a sustainable healthy living in Schiehallen. That will meet the sustainable needs and requirements of the municipality of Delft for the year 2030 and will also help in attracting owners and tenants for our specified target group as they will be able to afford such sustainable approaches over the long run.

### **Chapter 5: Conclusion:**

#### **5.1 Answer Sub Research Questions and Research Questions:**

In order to answer to the main question and sub-questions, the paper is divided in different chapters and studied and researched through those chapters. In chapter 2, it's been focused on possible target groups and their preferences in order to set requirements. In chapter 3, living environment and housing market and financial feasibility in Delft is studied on basis of the possible target group and their preferences which was discussed in chapter 2. In chapter 4, sustainable aspects and how they can be integrated in Schieoever Noord is discussed.

There is a shortage of houses in Delft and especially an imbalance between low and high priced housings but Delft Municipality has a "Woonvisie", a redevelopment project to solve this problem by transforming industrial area Schieoever Noord into a living and working environment. But what groups would be suitable in this area to live? Now again considering Municipality's another ambition, to make Delft the city of innovation and knowledge, it makes knowledge workers an important target group for Schieoever Noord which is located next to the city centre, TU Delft campus and all the knowledge based companies around it. We also found that students should be given a place in this district, because the location is ideal and those students are also potential knowledge workers that might remain in Delft if they have the possibility. Therefore the target groups are decided. On the basis of the housing requirements of those target groups, there are 2 types of housing desired: apartments/studios and terraced houses. Spacious terraced houses are for the middle/high income knowledge workers who requires more space, comfort and luxury. Apartment and studios are for students and low income knowledge workers whose desire is mostly location and accessibility. Those segment of houses also fit well with the location and the possibilities it offers. Furthermore, it is also feasible by the target group and brings a balance to the housing market.

In order to achieve sustainability and also to follow Delft Municipality's Woonvisie, some sustainability aspects have to be taken into account like energy, mobility, green and Delft's choice of sustainable way. A solution offered by our side for energy-sustainable wise is to use steamed pipe network from Rotterdam (not only for Schieoever Noord but also for whole Delft in long term) but also use of wind and water power. Also a sustainable city means also sustainable environment with water and green around, offering people a place to relax and enjoy, increase the bio-diversity... Mobility-sustainability wise, the best solution is to create a bicycle network and keep the living area, aside from the main road, as much car-free as possible.

## **5.2 Our vision for the location:**

From our research into the PvE (Programma van Eisen) for the area of Schiehallen in Delft we see that municipality has the following vision for the area:

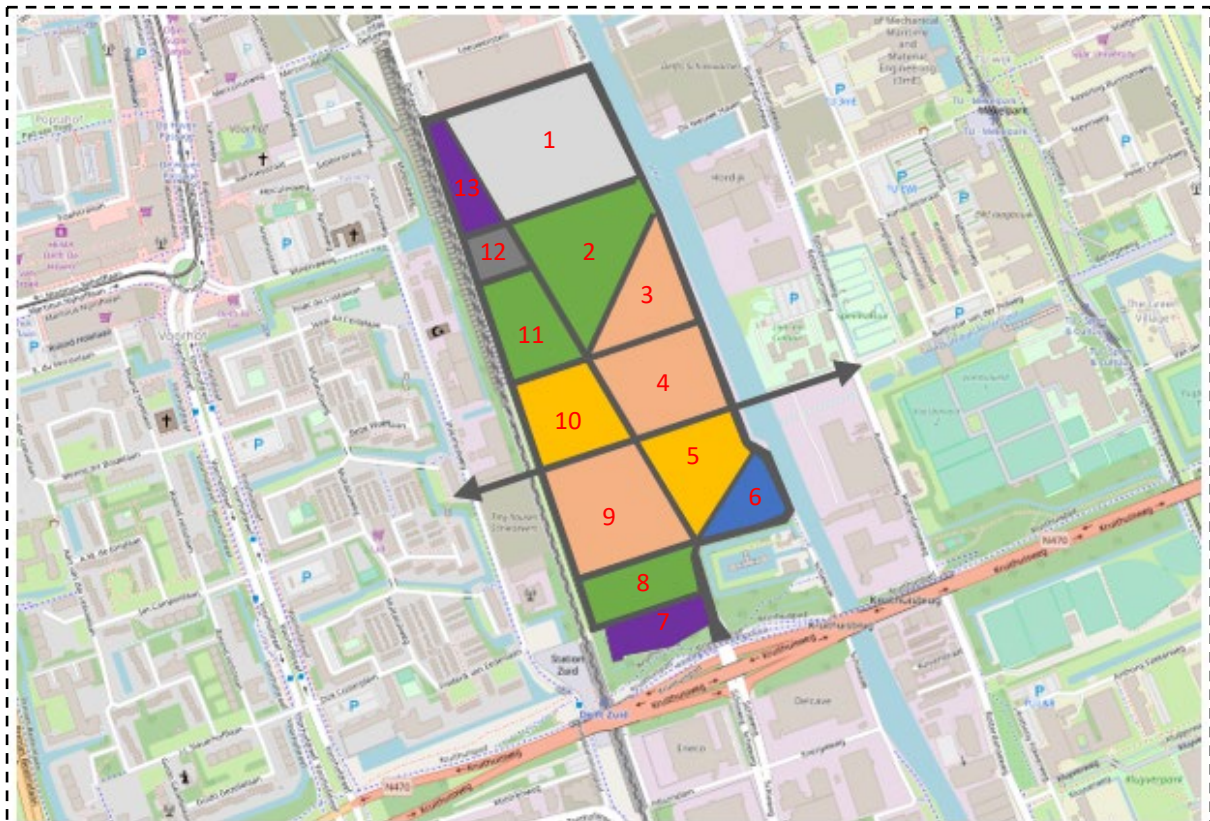
1. Making the city all out pooling knowledge together in one area and with the help of regional parties is looking at ways by which it can improve connectivity and housing for knowledge workers and its infrastructure, while promote its historical, cultural, urban living environments. The city participates in competitions with other knowledge cities but with also other universities.
2. By 2030 33% of the housing market will be for social dwellings, 13% for rental dwellings and 53% for non-rental dwellings. Where the Delft housing market currently has a shortage in the middle and high-income segment and to create a balance in the housing market between the high-low and mid-income dwellings a strong shift to mid and high-income dwellings is required.
3. Creating a healthy sustainable living environment for students and knowledge workers.

Hence to tackle the vision set out by the municipality of Delft we decided to have the following for our vision:

1. We decided to target low-income students aged 18-25, low-income knowledge workers aged 25-30 and mid income (knowledge workers) aged 30 and above. Where we decided to focus upon this target group after thoroughly investigating the current housing market in Delft and its predicted demand and supply for the future. Where the details to this was mainly analysed in chapter 2 and 3.
2. Due to the income status of our target audience we decided to create apartment complexes for low-income knowledge workers, self-sufficient units (studios) for low-income students and terraced and detached houses for mid-income knowledge workers. Those details were mainly analysed in Chapter 3.
3. In order to meet the healthy sustainable living environment requirements for students and knowledge workers we decided on following policies and investment guidelines that would help to attract demand for dwelling in the area for our target group as discussed in chapter 4, where these policies tackle energy, water, mobility and wind sustainable requirements for the area along with ways by which we can make the dwellings more sustainable.

From our research so far, we hence decided to come up with the following functional plan for the area:





**Legend:**

1. Industrial Terrain (For low noise and air pollution industries).
2. Recreational Park with water ways connecting the canal.
3. Low-Income Student self-sufficient dwellings, with underground parking.
4. High- and low-rise apartment complexes for low income- knowledge workers, with underground parking.
5. Recreational zone containing restaurants, bars, cultural centres etc.
6. Mini CBD (Central Business District) containing shops and supermarkets.
7. Office Area with underground parking.
8. Recreational Park with water ways connecting the canal.
9. Detached dwellings for mid-income knowledge workers.
10. Recreational zone containing sporting complexes, communal centres etc.
11. Recreational Park with water ways connecting the canal.
12. Parking Garage.
13. Office Area with underground parking.



Target Groups	Income range	Number Dwellings	Type	Area (m <sup>2</sup> )	Price (€)
Students	€ 800- € 1000	400	Apartments/ Studios	25-60	350-500 (rent)
Knowledge workers (1 to 2 households) low income	€3000- €3,600	600	Apartments/ Studios	80	800-1000 (rent)
Knowledge workers (1 to 2 households or family households) middle-/high income	€3,600-...	400	Terraced or detached houses	100	200,000-450,000 (purchase)

*Table: Possible distribution of house types depending on target groups*

### **5.3 Social Consequences of our vision**

One of the social consequences for our vision is that we plan on connecting the Technical University of Delft and Technopolis to that of Voorhof and Delft Zuid by creating two bridges that connect both areas to Schiehallen. The next major consequence is that each neighbourhood within Schiehallen will be based upon the target group this may either be a positive consequence as neighbours of the same target can better socialize amongst themselves but may result in a negative consequence if neighbourhoods with Schiehallen then create segregation or social divisions based upon income, dwelling typology and target group. The introduction of a mini-CBD is very promising for the area as currently Delft Zuid doesn't have a CBD, this could hence not only help in increasing the demand for dwelling for the area but also for businesses. Since Schiehallen is extremely close to the central station of Delft and Delft Zuid it acts as a critical point of connectivity for knowledge workers and students who live and travel to the other cities. The introduction of underground parking will also help in reducing traffic on the surface of the city and will also help in promoting a healthy living environment.

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## Appendix:

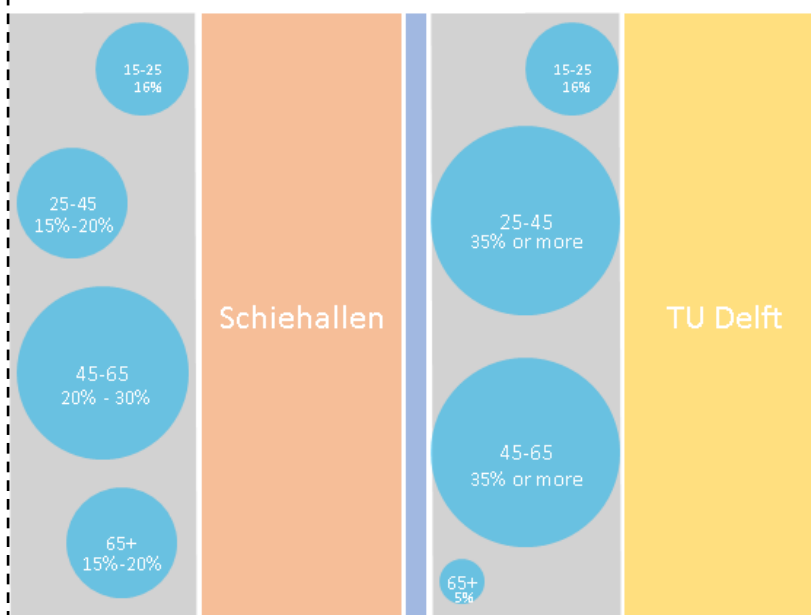
### Age-Groups currently living in neighbourhoods of Delft.

To help us later understand how to place the different target audience within Schiehallen we investigate the % of individuals currently living around the area of Schiehallen in relation to their age group:



*Figure 1: Showing the % of individuals in relation to their age-group currently living in different neighbourhoods of Delft.*

Where the above maps and observations can hence be summarized as follows:



*Figure 2: Summary showing the % of individuals in relation to their age-group currently living in different neighbourhoods of Delft.*

This hence tells us that individuals aged 25 and younger live in the area as long their needs and preferences are reached. While the age group of 25-45 and 45-65 is split into two groups one that lives close to the TU Delft Campus and the other that lives further away for the campus but close to the Delft Zuid Station. Elderly individuals on the other hand don't live next to the TU Delft campus but rather live further away from the campus.

## Market Value of Buildings in different neighbourhood of Delft and the Household Disposable Income.

Most buildings in Delft have a market value (WOZ value) of 150,000 Euros to 300,000 Euros. Where the bellow map indicates exactly as to which neighbourhoods have what WOZ value:

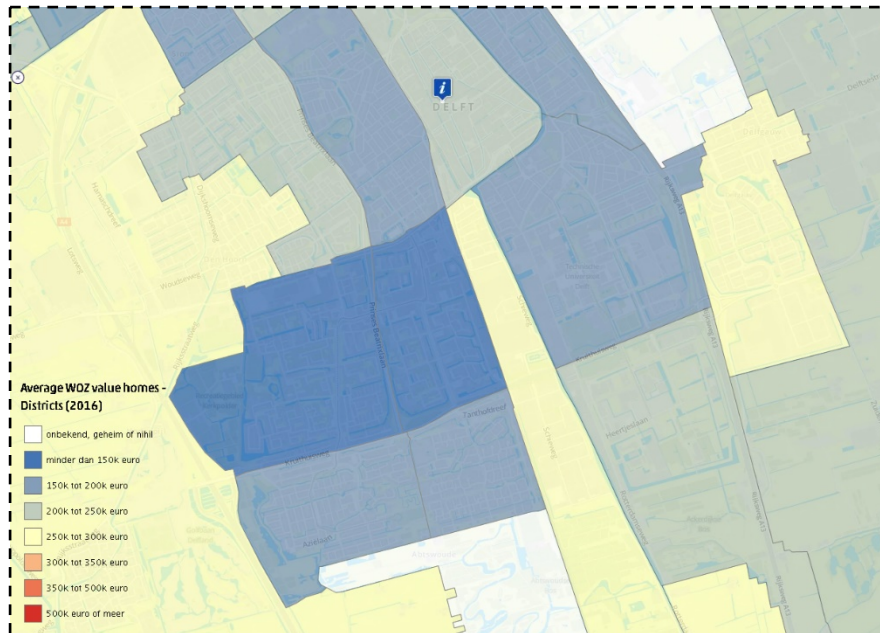


Figure 3: Average land value of homes (WOZ Value) in and around the district of Delft.

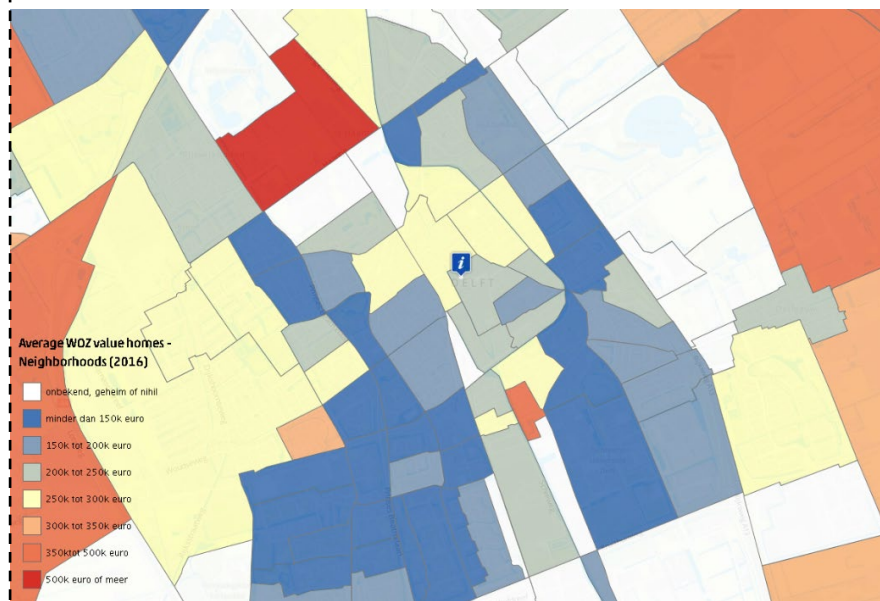


Figure 4: Average land value of homes (WOZ Value) in and around the neighbourhood of Delft.

From this map we can see that:

- In Nieuw Haven the average land value is between 150,000 Euros to 200,000 Euros.
- In Schiehallen the average land value is between 200,000 Euros to 250,000 Euros.
- In Stationsomgeving Delft Zuid the average land value is between 150,000 Euros to 200,000 Euros.

Where from the maps we can see that the area of Haantje is the most expensive in Delft with an average land value of 500,000 Euros or more.

## Average Disposable Income of various age groups of individuals living in Delft.



*Table 2 showing the number of individuals in Delft with an average yearly disposable income compared to their age and age category:*

<b>Income for 2016</b>	<b>Age Group (Male and Female)</b>				
	<b>0-15</b>	<b>15-25</b>	<b>25-45</b>	<b>45-65</b>	<b>65+</b>
<b>Less than 10,000 Euros</b>	97.60	1151.90	336.20	339.80	135.30
<b>10,000 to 20,000 Euros</b>	0.20	357.10	761.90	816.50	1519.10
<b>20,000 to 30,000 Euros</b>	0.00	194.00	792.00	753.10	638.80
<b>30,000 to 40,000 Euros</b>	0.00	82.50	764.90	717.60	323.70
<b>40,000 to 50,000 Euros</b>	0.00	19.30	527.20	562.80	151.00
<b>50,000 to 100,000 Euros</b>	0.00	7.30	669.10	941.20	159.40
<b>100,000 to 200,000 Euros</b>	0.00	0.80	83.90	162.00	22.10
<b>Above 200,000 Euros</b>	0.00	0.40	11.60	33.60	3.00

From the above tables we see that for the following age categories have the following disposable income per year:

- Children (Aged 0 to 15): Have a disposable income of less than 10,000 Euros.
- Students (Aged 15 to 25): Have a disposable income of less than 10,000 Euros.
- Knowledge Workers/Young Professionals (Aged 25 to 45): Have a disposable income between 20,000 Euros to 30,000 Euros.
- Researchers/Professors/Professional Workers (Aged 45 to 65): Have a disposable income between 50,000 Euros to 100,000 Euros.
- Pensioners/Elderly (Aged 65+): Have a disposable income between 10,000 Euros to 20,000 Euros.

It is also seen that for households with:

- One individual the average yearly income is 19,600 Euros.
- Multiple individuals the average yearly income is 42,700 Euros.
- Couples the average yearly income is 44,300 Euros.
- Single parents the average yearly income is 28,300 Euros.
- Other multiple individuals the yearly income is 48,200 Euros.

## Variations of Housing available in Delft.

Upon studying the available housing typology in the city of Delft, it seems that over the past years there has been a steady increase in the construction of new residential complexes and houses throughout the city.

Table 3: Where in Delft the following areas have seen land development for the year 2010:

Neighbourhoods	New Public Transport	New Build Area	New Semi-Built Area	New Recreational Area
Stationsbuurt	1	5	0	0
Schieweg Noord	4	37	0	0
TU Noord	3	20	5	2
Rotterdamseweg -Noord	1	16	0	0
TU Campus	5	55	0	16
Technopolis	13	44	28	12

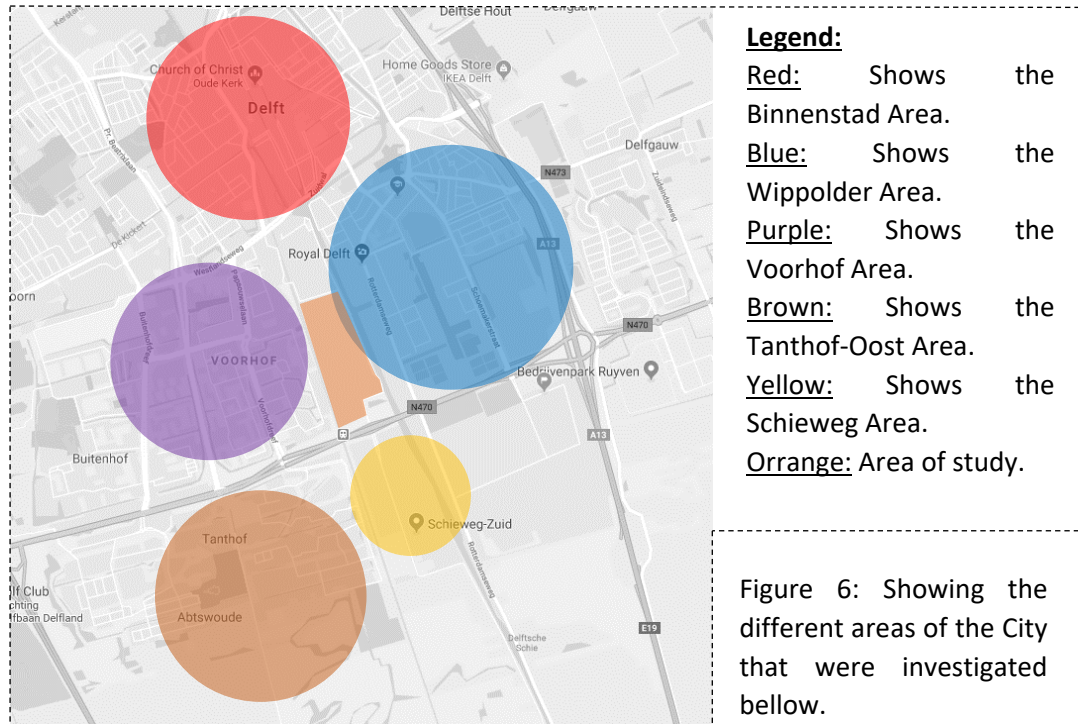
From the table we see that major development has taken place in Schieweg Noord in Schiehallen and further developments have taken place in the TU Delft Campus Area and Technopolis Area.



Figure 5: Shows the type of housing available in the year 2017 for the area of Delft

The housing-market of Delft contains 50,000 dwellings from which 66% are multi-individual households and 34% are single-individual households that were constructed from 1965 to 1974. In the past couple of years 400 new self-sufficient dwellings have been constructed, where future plans for see the construction of 7,500 dwellings, from which 2,700 are for regular households and 1,100 student dwellings. (Woon Visie)

When we investigate the household demographics of some neighbourhoods around Schiehallen and compare it to the population demographics we see the following:



Neighbourhood	Single	without Children	with Children
<b>Binnenstad</b>	68%	20%	12%
<b>Wippolder</b>	65%	20%	15%
<b>Voorhof</b>	65%	18%	17%
<b>Tanthof-Oost</b>	45%	30%	25%
<b>Schieweg</b>	47%	30%	24%

Age	Binnenstad	Wippolder	Voorhof	Tanthof-Oost	Schieweg
<b>0-15</b>	8%	10%	11%	12%	13%
<b>15-25</b>	25%	27%	26%	12%	12%
<b>25-45</b>	33%	32%	29%	24%	23%
<b>45-65</b>	22%	19%	17%	31%	32%
<b>65+</b>	12%	12%	16%	21%	20%

From the investigation we see that approximately 58% of the individuals like to live in single household homes while 23.6% like to live in households without children and 18.6% like to live in households with children. We also see that individuals of the age 15-45 like to live in

the binnenstad, wippolder and voorhof. While individuals of the age 45-65+ like to live in Tanthof-Oost and Schieweg.

This hence suggests that the age groups of 15-45 like to live closer towards the city centre, the TU Delft Campus and Technopolis while the age groups of 45-65+ like to live further away from these areas.



## PvE Poster:

