

MEMOIRE

Présenté en vue de l'obtention du Master en **Ingénieur de Gestion**, finalité **spécialisée**

Autonomous electric cars' profitability in Brussels based on the simulation of the daily trips

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J’autorise la consultation de ce mémoire

# Acknowledgements

# Executive summary

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# List of abbreviations

aTaxi = autonomous taxi

SAEV = Shared Autonomous Electric Vehicle

resp. = respectively

V2V = vehicle-to-vehicle

V2I = vehicle-to-infrastructure

AV = autonomous vehicle

SAV = Shared autonomous vehicle

total cost of ownership (TCO)

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# Introduction

(Litman) This indicates that it will probably be 2045 before half of new vehicles are autonomous, 2060 before half of the vehicle fleet is autonomous, and possibly longer due to technical challenges or consumer preferences. ; it will be at least 2040 before half of all new vehicles are autonomous, 2050 before half of the vehicle fleet is autonomous, and possibly longer due to technical challenges or consumer preferences

# Literature review

## Impacts of autonomous vehicles

By many people, autonomous vehicles are seen as the future of transportation. They indeed think that AVs will be safer, more convenient and cleaner. This section of the thesis gives the literature opinion on the impacts of AVs.

In 2019, there has been 3,928 accidents in Brussels including 19 fatalities. (REF IBSA 14.2.1.2). In the literature (SOURCES ?? REF), it is common to assume that this number of accidents will plummet because 95% of the accidents are caused by human error (REF <https://www.europarl.europa.eu/news/fr/headlines/society/20190410STO36615/deces-sur-les-routes-en-europe-les-chiffres-infographie>). Thus, by removing the human dimension from the driving activity, the number of accidents decreases.

With autonomous cars, passengers will not only be safer, but they will also win time since they do not need to be focus on the road during their trips. A Belgian spends in average ten hours per week in transport (REF beldam 2005 data 2E3F). They can now use this time to work, rest or do any activity feasible in a car. Nevertheless, the car design will probably be adapted to these new possibilities like shown on Figures XXX.

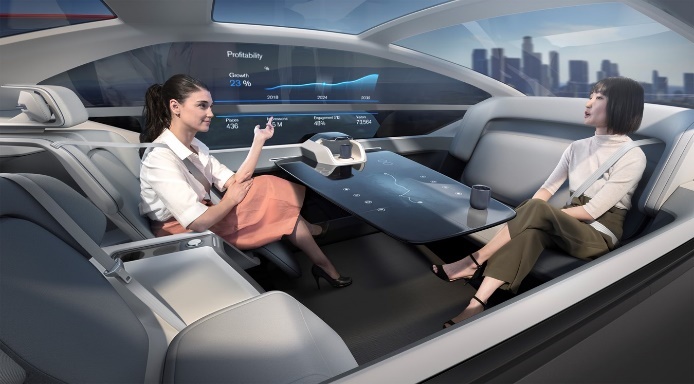


Figure 1 New autonomous car design for a meeting (Volvo 360c) Figure 2 New autonomous car design for resting (Volvo 360c)

(REF https://www.media.volvocars.com/be/fr-be/media/photos/237052/volvo-360c-interior9)

(REF https://fr.motor1.com/photo/3240235/volvo-360c-concept/)

Thanks to autonomous vehicules (AV), time spent in travel will be more efficient. However, it will also be shorter. Indeed, scientists predict a decrease of congestion thanks to AVs (REF Anderson, J.M.; Kalra, N.; Stanley, K.D.; Sorensen, P.; Samaras, C.; Oluwatola, O.A. Autonomous Vehicle Technology A Guide for Policymakers; RAND Corporation: Santa Monica, CA, USA, 2016 REF + 17 Anderson). As seen in section XXX, the number of cars required to fulfill all users need is inferior to the current number of cars on roads. Many searchers (REF ???) see the reduction of traffic jams as a consequence of less cars on the roads.

Moreover, XXX has demonstrated that congestions increase fuel consumption by 80% (<https://www.akesting.de/download/How_Much_does_Traffic_Congestion_Increase_Fuel_Con.pdf> REF). Therefore, less congestion thanks to AVs means reduction of fuel consumption and pollution. Several aspects of AVs participate in the pollution reduction. Firstly, with a centralized dispatcher, the resources are optimized. Cars are allocated to the people needing it, reducing the number of vehicles (REF <https://journals.openedition.org/factsreports/4403?lang=fr#tocto2n5>). On top of that, ride sharing allows decrease of the energy consumption per passenger (REF <https://journals.openedition.org/factsreports/4403?lang=fr#tocto2n5>) to 4.7% (REF 30). Vehicles are also more intensely used, leading to shorter lifespan (30, 19 REF). Therefore, old vehicles are substituted by new vehicles with improved technologies reducing the pollution. Automobile indeed evolves towards more sustainable vehicles (REF ??). Secondly, emissions induced by cold starts can be reduced by 85% (7 REF) to 95% (30 REF). Furthermore, by anticipating accelerations and decelerations, AV can reduce the energy consumed in acceleration and braking by 4 to 10% (REF 42 & 6). As a consequence, there is fuel saving and less brake wear (REF 6). Shared electric autonomous vehicles (SAEV) reduce even more the environmental cots especially if renewables energies are used to produce the power grid. (35 REF + Reiter and Kockelman 2016 (from 35)). Finally, smart parking decisions could also increase fuel savings by avoiding “cruising for parking”. (6 and (Bullis, 2011; Shoup, 2005) from 6 REF).

AVs will indeed have an impact on urban parking. According to 7 (REF), eights parking spots per vehicles can be saved. It is 96% of the current parking places according to 18 (REF). While 21 (REF) analyses different market penetration levels. With 50% of the vehicles fleet being autonomous, the parking space saved is insignificant while with a full market penetration, we can get rid of 85% of the parking spot.

Nevertheless, other authors are more skeptical on autonomous cars advantages. By reducing the driver burden allowing him to have efficient time while traveling, 20 (REF) thinks that traveling behavior will change, increasing the number of trip. This would have, according to him, all opposite effects to what is stated here above. 8 (REF) is also afraid that transforming vehicles’ designs such as depicted on Figures XXX, will increase vehicles’ weight and thus their energy consumption.

## Six levels of automation

You are probably already driving an autonomous car. There exists indeed several levels of automation as defined by the very cited SAE (REF) and summarized on Figure XXX. The levels are organized from the less automated vehicle (level zero) to the fully automated car (level six).

The two main categories are the vehicles still driven by the human and the one driven by the system. A level zero car has no automation at all. The driver is responsible for doing everything.

A level one car starts to have some automation such has your car probably possess. It includes cruise control and lane centering. While a level one can not both provide steering and brake / acceleration support at the same time, a level two car can.

Level three corresponds to the “real autonomous” level. The system can drive the vehicle under limited conditions such as in traffic jam. At level four, the pedals and steering may not be install letting the whole control to the system. Finally, level five vehicles can drive in all conditions and the system has whole control.

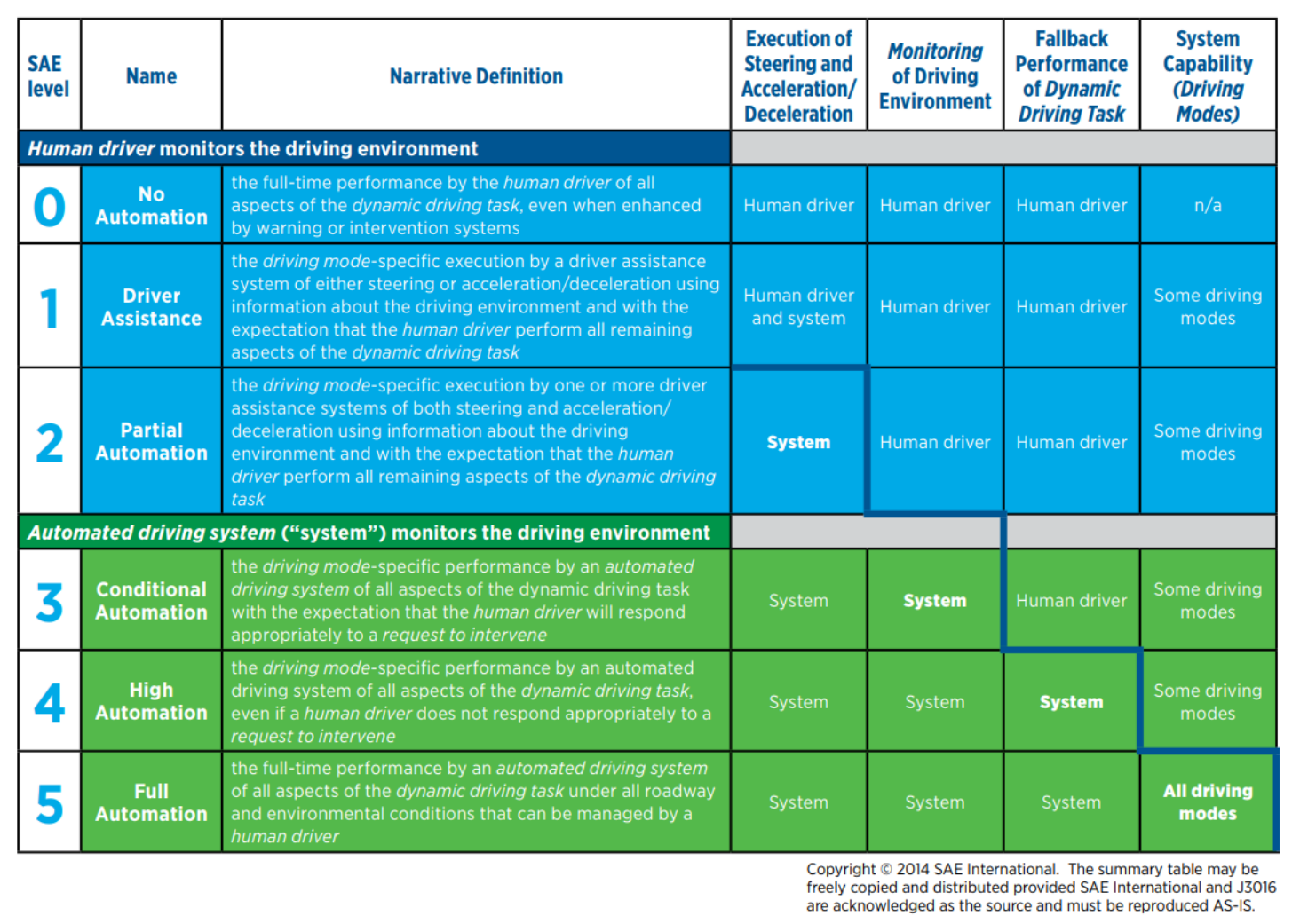
This thesis considers level five vehicles only.

Figure 3 Automation levels (REF from Berrada)

## State of the art

Several searchers have already tackled the topic of autonomous cars. Most of them focuses on the simulation of the autonomous vehicles’ fleet. However, the characteristics of their scenarios vary. Table XXX summarizes parameters of the major papers in the field.

TABLE TODO

The first parameter is the geographic region for the AVs implementation. Since a study require heavy region simulation, a few places are represented and studied by different searchers. In this way, the state of New Jersey (USA) has been simulated by Kornhauser et al (REFs, 1) based on census data and then Zachariah (2 REF) and Zhu (3 REF) went deeper on the analysis as explained below. This is called an agent-based simulation. Other agent-base simulations exist in the literature such as POLARIS used by Auld (REF 20) to model trips happening in Chicago (USA) or Stockholm (Sweden) simulated thanks to similar data (CONTRAM and REGENT REFs) by Burgohout (REF 18). Martinez and Viegas (REF 27), Viegas and Martinez (REF 28) and ITF (REF 21) also simulated the traveling demand based on a survey, but the area studies is Lisbon (Portugal). While Spierser (REF 19) and Azevedo (REF 38) analyze AVs in Singapore thanks to data from surveys and taxis’ GPS data. Spierser (REF 19) also used a non-stationary (separably) spatio-temporal Poisson process in order to model the demand.

Bosch (REF 4) was the first to introduce the use of MatSim, a “dynamic traffic simulation software” as described by Hyland and M… (REF), for AVs simulations. Bosch (REF 4) recreated the region of Zurich (Switzerland) on MatSim. While for their simulations, Fagnant and Kockelman (REF 7, 22), Loeb and Kockelman (REF 10), Chen (REF 25), Levin et al (REF 26) and Loeb et al (35 REF) used the representation of Austin, Texas (USA) on MatSim created by Liu et al (REF 11). Berlin (Germany) (Bischoff and Maciejewski 29 REF) and Rouen, Normandie (France) (REF 16) are also studied using MatSim. Gurumurthy (REF 39) uses cellphones data in order to simulate the trips happening in Orlando, Florida (USA).

Less realistically, Burns (REF 5) models the attraction to the centrum of the city and simulated the trips in three different areas: Ann Arbor, Michigan (USA) to represent a small to medium town, Babcock Ranch, Florida (USA) representing a suburban region and Manhattan, New York (USA) as urban. Leurent (REF 14) created a synthetic ring-shape city with homogeneous population density along the periphery called Orbicity and studies divers AVs scenarios happening in Orbicity.

The smaller region of Palaiseau, Saclay (France) is studied by Babicheva (REF 32) and Poulhès (REF 15). Those analyses investigate the possibility of replacing a bus with a specific itinerary by an autonomous one.

Moreover, like Spierser (REF 19), Babicheva (REF 32) uses a spatio-temporal Poisson process in order to model the demand. Babicheva works with a fixed fleet size and simulates a (dis)utility function for the waiting time. (REF 32)

The roads are generally not represented apart in Babicheva (REF 32) and Poulhès (REF 15) where a specific itinerary is studied or in Orbicity (REF 14). When using SimMobility or MatSim the actual roads are not represented but their characteristics of speed and congestion are used (REF 19 and 4, 7, 10, 11, 16, 23, 29). The road characteristics come from OpenStreetMap (REF) which is an open-source world map editable by everyone. It is a veritable database with all road and buildings characteristics. Only those papers use real position of the origins and destinations. Other studies (REFs 1, 2, 3, 15, 21, 22, 24, 25, 32, 35) aggregate the demand at a station level. The whole territory studied is divided into squares with a grid and a station is in the center of each square. The square size can vary from 0.25 miles (402 m) x 0.25 miles (REF 22) to 16 miles (25.75 km) x 16 miles (REF 24).

The third parameter is the market penetration. Only few scientists tackle the full penetration (REF 5 & REF 21). Others study penetration rates from 0.1% (REFs 25 & 35) to 90% (ITF 21). When only a percentage of the demand is simulated, it is considered as a partial market penetration with the other trips being fulfilled by non-autonomous vehicles. It is then also considered as multimodal since a commuter could take different modes to go from his origin to his desired destination given that other non-autonomous vehicles are available. This has an impact on the AVs’ fleet size needed. (REF 21)

Fourthly, several implementations exist. AVs can be owned as a private (REF 4, 6, 9) car or shared and manage by a centralized dispatcher. Among shared autonomous cars, it can include ride sharing (REFs 1, 2, 3, 4, 6, 7, 8, 10, 15, 16, 18, 21, 23, 27, 45, 46) or not (REFs 4, 5, 6, 8, 11, 14, 19, 22, 23, 24, 30, 35, 38, 46). With ride sharing, two strangers can share a SAV for a trip having closed origins and destinations. 20 (REF) tackles autonomous cars but with lowest automation level than the driverless vehicles.

The fifth classification parameters is the fuel. Some papers consider electric vehicles and the charging problems it implies. If Bosch (REF 4) and Burns (REF 5) do not simulate electric vehicles, they analyze its advantages and challenges. For the simulation of SAEVs, REFS 6, 7, 8, 10, 14, 16, 21, 22, 25, 35 are more interesting.

After the interesting characteristics of the existing analyses, this thesis summarizes some methodologies and conclusions. Kornhauser et al (REF 1) has synthetized the 9 million residents of New Jersey (USA) and their 32 million of daily trips with their origin, destination and starting time. Based on that, Zachariah (REF 2) has pixelized the region with squares of size 0.5 miles (805 m) x 0.5 miles. A taxi station is reachable in each square by walking less than five minutes. Using the Manhattan distance and a fixed travel speed, Zachariah (REF 2) simulated the taxis fleet. In his scenario, ride sharing was allowed provided that the resulting detour is inferior to 20% of the initial itinerary. He demonstrated that less vehicles are needed and the number of kilometers traveled per day decrease thanks to SAVs. Kornhauser et al (REF 1b) then analyzed the impact of the number of common destinations and of the departure delays implied by the ride sharing demonstrating that the marginal benefits in vehicle occupancy decreases while the depart delay or the number of common destinations increases. Zhu (REF 3) finally tried and compared different relocation strategies and showed that the total vehicle kilometer traveled is reduced by 43% thanks to SAVs with ride sharing.

Bosch (REF 4) follows a similar agent-based methodology using activity-based tour patterns. Nevertheless, the path and mode choices are also included in the trip simulation. When driving passengers, the aTaxi uses real roads with their characteristics such as the speed but when the AV is empty, the travel time is computed using the beeline Euclidean distance with a trip-specific correction factor multiplied by the average speed (REF 10). The ride sharing applies the first-in-last-out (FILO) rules and like Kornhauser et al (REF 1b), the simulation does not allow detours extending the trip duration by more than 20%. Ten percent of the total travel demand of Zurich (Switzerland) is simulated and the results show that one SAV does in average 10 trips per day with an average users’ waiting time of 3.11 minutes with a rejection rate of 3.8% because of waiting time higher than 10 minutes.

Burghout (REF 18) proposes a ride sharing model with a maximum allowed detour of 30% of the travel time, a maximum waiting time of 10 minutes and a first-in-first-out (FIFO) rules. His analysis is based on 498 732 trips simulated based on the home-work and work-home commuting data of Stockholm (Sweden) coming from the REGENT (REF 18 🡺 19 inside). Those data are then fitted to the morning and afternoon peaks assuming Gaussian distribution (REF 18 🡺 20 inside). Only 51% of those data are kept for the simulation by removing trips coming or going outside the studied area. Conclusions of this paper demonstrate that without ride sharing the total number of kilometers traveled increased by 24%.

Chen (REF 25) focuses on the implementation of SAEVs and the strategic question of charging infrastructure position. Her simulation is in three times: first she creates charging stations when an aTaxi needs to be charged and can not find a free charging station, then she does the simulation again knowing the position of the charging stations in order to determine the fleet size and finally she run the simulation on several days to get the final results. The simulation uses 5% of the daily 8.8 million trips happening in Austin, Texas (USA) simulated thanks to the data of Austin’s 2010 Capital Area Metropolitan Planning Organization (CAMPO) (REF ??? from 35) and of the U.S. National Household Travel Survey (NHTS) of 2009 (U.S. Department of Transportation, 2009 REF ? from 35). Since it has been assumed that only 2% of the inhabitants use the SAEVs, the final sample used is only 0.1% of all daily trips. Chen (REF 25) has been able to show that the fleet size is sensitive to the charge time and the vehicle range (meaning the total distance an electric vehicle can travel before its battery to be empty) and that the number of charging stations is dependent on this vehicle range as well.

Loeb et al. (REF 35) have then improved Chen’ analyses (REF 25). Unlike Chen (REF 25), Loeb et al. (REF 35) allows charging vehicles to accept a trip request. They assumed that all users pre-order their trip five minutes in advance. They showed that the modification of this order time does not have a significant impact on the results. Their simulation demonstrates that 19.8 % of the kilometers traveled are empty rides (meaning the aTaxi drive without any passenger) while 23% of those empty kilometers are to reach a charging station. The vehicle range affects the number of charging stations but does not improve the response time once having reached 175 km. However, reducing the charging time and mainly, as already stated by Loeb et al. 21 (2016) (REF 12), increasing the fleet size improve the response time.

16, 23, 24 and 47 (REFs) examine several relocation strategies. 16 (REF) gets to the conclusion that SAVs reache a 20% economies compared to privately owned AVs. 47 (REF) demonstrate that the assignment of the nearest taxi using the First-come-first-served (FCFS) rule is inefficient. Finally, 24 (REF) states that the best assignment strategy allows aTaxis to be diverted to a new request while booked and consider en route drop off. His scenario uses a fixed feet size, forbids rejecting requests and ignores refueling.

Next to those simulations, Bosch (REF 4) studied different economic (monopoly of aTaxis, monopoly of aRs (???) and oligopoly of aTaxis and aRS) and regulations (pricing of mit (???), subsidizing public transport and restriction on private empty rides) scenarios in order to give recommendations for politicies. 14 (REF) analyzed the medium-term supply demand equilibrium of AVs while 6 (REF) uses external costs (crash or congestion) of today private cars to asses AVs advantages.

Wadud (REF 9) inspects who will be the first adopters of AVs using a total cost of ownership (TCO) analysis in the UK. His analyses included not only private users but also taxis and freight companies. He concludes that commercial operations will be the early adopters. Concerning the private users, the households with the highest income will be the first adopters.

Finally, all researchers (REFs 19, 21, 22, 25, 30, 41) agree that SAVs will reduce the number of vehicles needed to fulfill travelers’ demand with a reduction of number of vehicles needed between 43% (REF 3) and 95% (REF 18). According to 41 (REF) SAVs do not increase the number of vehicle kilometers traveled. However, the majority of scientists (21, 22, 25 REFs) have demonstrated that the number of vehicle kilometers traveled will increase with SAVs.

# Thesis goal

This thesis studies the profitability of electric autonomous Taxis in Brussels through the simulation of the average daily trips in Brussels. The first section of this chapter depicts the major hypotheses of the scenario considered while the second section describes the methodology followed.

## Scenario analyzed

This work focuses on the Belgian region of Brussels. In Belgium, Brussels is both a region, a city and a municipality. If the region and the city refer to the same territory, the municipality is much smaller. In this paper, unless otherwise noted, the word Brussels refers to the whole region including the municipality of Brussels but also the eighteens other municipalities.

Brussels has been chosen because, until now, no paper in the literature focuses on the case study of Brussels. (UNAWARE OF ? TODO) Furthermore, Brussels is a central city in Europe (REF), being the capital of Europe, hosting the European Institutions (REF) and (???). Brussels is a capital and presents thus a dense urban population and trips habits. Nevertheless, the city is a small city compared to other European capitals. This allows to have a manageable number of residents and trips. (???) Moreover, Toyota (REF) and Aon (REF) have already conducted some tests with an AV in the streets of Brussels (REF) showing car manufacturers are willing to implement autonomous cars in this city. In addition, the author living and studying in Brussels has easier access to data about Brussels than another city.

The scenario studied in this thesis assumes a full penetration of the transportation market while only focusing on people transport (excluding thus freight transport). This scenario has been chosen to avoid the complexity created by multimodal trips and to focus on the “long term” analysis of a stable market instead of the development of this one. Moreover, this assumption is sparsely investigated in the literature. The author is indeed only aware of two papers using this hypothesis (REF 5 & 21).

Like many others (1, 2, 3, 4, 6, 7, 8, 10, 15, 16, 18, 21, 23, 27, 45, 46 REF), this paper focuses on the shared autonomous vehicles with ride sharing. Ride sharing allows two strangers to share a SAV for a trip having closed origins and destinations. It has been shown to be cheaper, more efficient and cleaner (15 & 16 REF Sohrabi, Khreis and Lord (2020) from litman). Nevertheless, unlike 18 (REF) (resp. 1, 2, 3 REF) which allows detour as long as the traveling time is not impacted by more than 30% (resp. 20%), this work forbids detour like 15 (REF). This simplification reduces the computation time of the simulation. As from this point in this paper, shared autonomous vehicles have to be understood as shared autonomous vehicles with ride sharing.

Even if it makes the simulation more complex, this simulation was not imaginable with gasoline vehicles. Brussels has indeed decided to forbid diesel cars in 2030 and gasoline cars in 2035 (<https://www.rtbf.be/info/belgique/detail_plus-de-vehicules-diesel-en-2030-et-essence-en-2035-a-bruxelles-que-feront-les-navetteurs?id=10791595> REF). This work is looking to be the more realistic possible. This assumption was thus compulsory. Furthermore, it is cleaner (REF) and follows similar investigations (refs 4, 5, 6, 7, 8, 10, 14, 16, 21, 22, 25, 35).

## Methodology

In order to assess the profitability of the scenario describe in the above section, this thesis first determines the volume, meaning the aTaxis’ fleet size. Then, the costs are summarized. To finally, assess the feasibility of the price needed for the project to be at least breakeven.

The methodology used for the fleet sizing in this thesis is an agent-based simulation similar to 1, 2, 3, 11, 19, 20,30 (REFs). This work indeed first synthetizes the population of Brussels based on very specific statistics. In this way, each resident is created with some personal attributes: an age, a gender, a place of residence, a household type, a worker type, a place of work and a daily trips pattern. Commuters and tourists are also reproduced with fewer attributes.

Based on the population simulated and thanks to statistics on the timing and length of the trips happening in Brussels, daily trips are simulated.

The aTaxis’ fleet can then be simulated. TODO

More details on the population, trips and aTaxis’ fleet simulations are specified in section XXX and all Excel Files (also including costs and profitability analysis) and Python scripts are accessible on the git : XXX.

The costs analysis corresponds to a literature review of the costs involved in the SAEVs’ fleet management. However, the cleaning costs and the administrative costs due to the management of the company as such are added compared to what exists in the literature.

Finally, the pricing and profitability assessment compares the price needed for the company to be breakeven with results stated in the literature and current travel costs in Brussels.

## Tools used

Spyder: Spyder is a free scientific development environment included in the Anaconda platform. It allows the programming of the coding language Python. All codes made and used in the simulations for this thesis were developed using Python. Several libraries have been used but most notably Pandas which permits to import data tables from csv (Comma Separated Values) files, manage and modify the data, and save them to new csv files. The random library has also been used for all random assignments.

Microsoft Excel: Excel is a spreadsheet software developed by Microsoft. It has been used for simple computations and data cleaning as well as for graphs making.

Microsoft Access: Access is database management software developed by Microsoft. It was used to handle big databases such as the matrix of workflows (REF).

Microsoft PowerPoint: PowerPoint is a presentation software developed by Microsoft. The majority of the figures in this thesis have been created with PowerPoint because it is easy to insert geometric shapes, align them and adapt their visual aspect.

Microsoft Word: Word is a text editor software developed by Microsoft. This paper has been written and formatted using Word. This software provides useful tools to create automated content table, list of figures, list of tables, list of equation and bibliography which have been used for this thesis.

GitHub: GitHub is a repository hosting service and development platform. It helps for the collaboration and updating of development projects. It has been used in this thesis in order to share the scripts and computations realized. The XXX lines of script and XXX Excel sheets are indeed shared on the repository XXX.

## Contributions

The major contribution of this thesis is the conclusion and analysis of the profitability of a company managing a centralized fleet of electric shared autonomous taxis fulfilling all trips happening in Brussels. This demonstrates the viability (???) of this system for the upcoming future with the most realistic scenario possible given the available data. Of course, it needed some simplifying hypotheses described in section XXX. (such as the prohibition of empty trips for the aTaxis. ) (???) Nevertheless, it provides a first simulation for more sophisticated ones. It also provides a worst-case scenario on the profitability.

For the analysis of the profitability, the simulation of the daily average trips was needed. Therefore, this thesis offers a Trip File for analyses or simulations other than autonomous cars.

In order to create this Trip File, it first needed to simulate the entire population living in Brussels. This simulation includes specific attributes assignments such as the work id, the workplace, the household type, the sector of residency, age and gender of individuals, … This simulation can also be used for other purposes in the future.

Finally, the cost analysis brings new specifications on the cleaning costs compared to what already exists in the literature. This work also includes administrative costs due to the management of the company. Those new costs increase the realism of autonomous vehicles profitability analyses.

# aTaxis’ fleet simulation

## Data

Most of the data is coming from the neighborhoods’ monitoring (“monitoring des quartiers” in French) (REF). It provides detailed statistics at the statistics sector level (for more information see below X.A.2.) for different years. IBSA (REF) has helped fulfill the missing data. However, IBSA’s data are only available at a municipal level. Besides mentioned otherwise, the data from the neighborhood’s monitoring is always per sectors while the data from the IBSA is always per municipality. Other sources that have been used such as ARES (REF) and Onderwijs Vlanderen Dataloep (REF) for the higher education’s data. The origin of each piece of information will be specified in the methodology.

### 2019 as a reference year

2019 has been chosen as reference year and besides it is specified all data used are 2019’s data. Even if 2019 does not represent the latest data. 2020’s data are the latest available data at the time this thesis is written. However, 2020 has be hammered by the COVID-19 pandemic (REF papa), enforcing multiple lockdowns, homeworking, closing schools, universities, … (REF papa) The travel data of 2020 have been highly affected in that regard. Therefore, 2019’s data are more representative of a normal behavior of the population of Brussels.

Since autonomous cars will not penetrate Brussels market before at least 2030 (REF), the population could have been predicted. However, it introduces additional hypotheses and inaccuracies. It has been chosen to use 2019’s data as if it was the population at the time of full penetration of the market by autonomous taxis. The reader is free to work on the prediction of 2030’s population of Brussels and repeat the process in order to compare the results. The methodology is voluntarily detailed to allow it.

### Statistics Sectors as a geographic level

Brussels is geographically divided in three different levels of details: communes, neighborhoods, and statistics sectors (REF). Figure 1 compares the three levels. Useful statistics such as the area of each part, its population density, the number of women and men (REF monitoring) are available in Appendix 1. For this work, the highest detailed level has been chosen namely the statistics sectors level. It allows the depiction of the most accurately possible detail of origin and destination for each trip. Moreover, in this simulation, there will be only one aTaxis’ station per statistics sector. It has to be small enough for users to walk to it wherever they are in the statistics sector. The average walking distance is 237 m corresponding to XXX min by walk (TODO) which is reasonable and corresponds to the pixelization used in similar studies (REF 22). Note that for simplicity, statistics sectors will be referenced to as sectors in this paper.

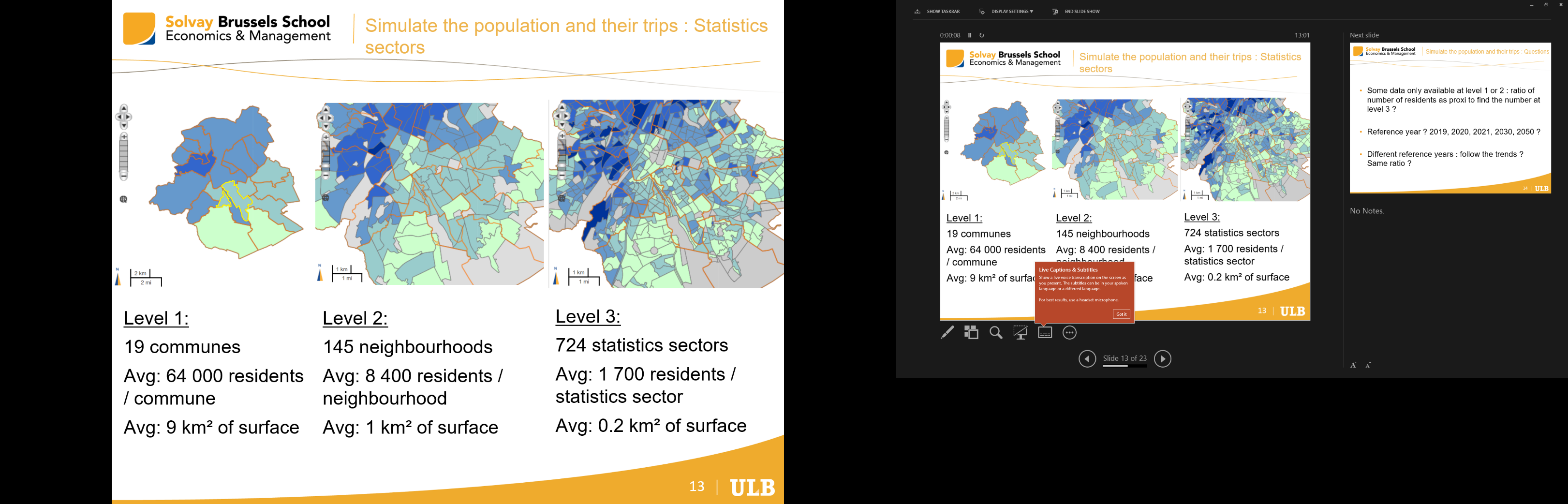


Figure 4. Levels of geographic subdivision of Brussels (REF)

## Methodology

TODO exemple

### Overview

The methodology applied for this thesis follows the process proposed by Pr. Kornhauser (REFs). However, Pr. Kornhauser’s work was based on really detailed data from the census (… nom plus precis ?) (REF) not available for Brussels (the last Belgian census dates of 2011 and is not as specific as the US one). This work follows the same methodology but is based on slightly higher-level statistics (at the sectors level as explained in IX.A.2.).

The first step is to create people (in our case living in Brussels) (section IX.B.2.) with their attributes: the sector where they are living, their id, their age, their gender, an attribute telling if they are considered as children in their household, their household type and their household id. Those attributes are allocated according to statistics about the population of Brussels (REF).

Their work id is then added (section IX.B.3.a)) also according to statistics (REF). All age - household type - work id combinations are not possible. A child of 5 years will indeed not live as a single mother and study at the university. Possible combinations are presented in the table XXX.

The third step is to determine the sector where each person works (section IX.B.3.b)). Note that in this thesis, the word “work” has to be understood at its broad sense including the place of study.

The last element allocated to each person is their trip chain type (section IX.B.4.). According to Beldam 2010 (REF), there exists 31 patterns of travels during a day in Belgium represented in Appendix 2. Based on the probability for each of hem, one specific pattern is allocated to each person.

Commuters living outside Brussels (section IX.B.3.d)) and tourists (section IX.B.3.e)) are also created with slightly less attributes but following the same logic and having their own patterns.

The trips can now be created with an origin, destination and start time for each (section IX.B.5.). The aTaxis’ fleet reaction according to those trips is then simulated in order to determine the number of aTaxis needed to fulfill the whole demand with less than 5 minutes waiting time (section IX.B.6.).

The detailed computations and process for each of these steps are presented in the rest of this section while all Excel Files and Python scripts are accessible on the git : XXX.

### Create people and households

This section will first present how the number of people in each category has been determined and then how the households have been conceived.

#### Define numbers

The first attribute to be allocated to the Brussels’ residents is the age according to their gender. The neighborhood’s monitoring offers the number of men and women per category of age (grouped by 5 years) and sector of living (REF). Those numbers have been uniformly spread among the 5 years of each category. It has been chosen that the highest possible age for a woman if 99 years. There are indeed only 225 women oldest than 100 (IBSA 1213 2020) which is negligeable in front of the 1.2 million of residents in Brussels. The number of women aged between 95 and 99 comes from the IBSA’s data (REF) and are transposed from a municipal level to the sectors’ level using the ratio of women living in a given sector to the number of women living in the corresponding commune (the population ratio). Similarly, for men, the oldest man possible in this simulation is 94 years old because there are only 500 men older than 94 years in Brussels (IBSA 1212 2020) which is also negligeable. Note that those the numbers are from 2020 and not 2019 because of availability’s problem. However, only the order of magnitude matters here, and it should not have changed between January 2019 and January 2020 (the COVID-19 pandemic has started to highly reach Belgium only as of March 2020).

The number of people for each category of age and gender in each sector have been determined, the household type repartition has now yet to be determined.

The starting point is to compute the number of couples living with at least one child is the part of women aged between 20 and 59 years living in couple with at least one child (REF). It is multiplied by the number of women aged between 20 and 59 years. Then, knowing the total number of couples living in each sector from the part of households being of this type and the total number of households, the number of women aged between 16 and 19 or between 60 and 70 can be extracted. The hypothesis that no one aged less than 16 years old can live without parent (meaning living being himself the parent in the household) is taken because before 16 years, full time school is compulsory making it impossible to manage a job paying the required rent. (REF) A second assumption is that no one lived at their parent’s home once the mother reaches 70 years. It means indeed that the child is about 38 years of age (the average age difference between a mother and his child being 32 years (REF)). IBSA (ref) states that only around 1,600 persons older than 38 years still live with their parents. Those can therefore be neglected. Those numbers date of 2020 but it is not an issue given that only the order of magnitude matters here. Finally, the number of women living in a couple with child per age category are uniformly spread among each age category.

The same logic is used for the number of couples living without child. The only difference is that the available data are for the 20-49 and 60+ age categories (REF). The difference between the number of couples without child (REF) and the sum of those two categories gives the number of women aged between 16 and 19 living in couple without child.

The same process is applied to determine the number of women living alone with at least one child. The only available data being for the age category 20-49 (Ref), the number of women aged between 16 and 19 or 50 and 70 is figured out from the total number of households being “single mother with child” (REF). The same assumptions still apply concerning mothers younger than 16 years or older than 70.

For the single fathers living with at least one child, it is more complex. There is no information about their age repartition. The only available data is the part of households being ‘single father with child” (REF). These percentages are brought back to absolute numbers thanks to the total number of households and the age of the father is randomly picked between 16 and 70 following the same assumptions as explained here above.

For the people living alone, the neighborhood’s monitoring provides the part of household being “single” per gender and per age category (18-29; 30-64; 65+). Thus, those percentages are multiplied by the total number of household and uniformly spread among the ages in each category. The assumption is taken that no one younger than 18 years lives alone. They are in fact about 240 (IBSA ref) but it can be neglected.

Finally, the number of men and women living in flatshare are provided at a municipal level by the IBSA (ref). They are spread among the sectors using the ratio of men (resp. women) living in a given sector out of the number of men (resp. women) living in the corresponding municipality.

#### Create people and households

People living alone are simply created following the numbers defined in the previous section.

To associate couples, the woman is firstly created and looks then for a man older of three years than his spouse. The average age difference in couples is indeed 3 years in Brussels (REF <https://statbel.fgov.be/fr/themes/population/partenariat/mariages#figure> doc 2019 tableau 11). If there is no such man still available in the concerned sector, the simulation looks for the first available man in the sector with the age closest to the desired one. Note that only hetero couples are created for a question of simplicity. This could be an improvement for readers interested in the household simulation. However, for the fleet sizing goal of this thesis, it does not have any impact since every household is created at a sector level and not at a real address level. It is therefore aggregated, and one could simply invert two household ids in order to create homo couples.

To create household of a single parent with at least one child, the script first determines the number of children living in the household. This number is randomly picked according to the probability distribution of number of children per household provided by Bruxelles famified (REF). This information dates of 2014. However, the average number of children per household with at least one child in 2014, 1.83 remains closed to the 2019’s one, XXX (TODO). It seems right to think that this distribution of probabilities has not changed much between 2014 and 2019. Each child is then created, receive a gender (randomly picked) and an age. The age is allocated following the probability distribution of the age difference between a mother and her child (<https://www.cepip.be/pdf/rapport_CEPIP_Bxl2019_FR_2tma.pdf> REF). For the creation of a “single father with child” household, the probability distribution is slighted with 3 years more to represent the average age difference in a couple (REF). Following the same process as for the husband explained above, if no more children with the desired age is available in the concerned sector, the first child available with the closest age to the mother age minus 32 (resp. the father age minus 36) is chosen. This 32 (resp. 36) represents the average age difference between a mother (resp. father) and her (resp. his) child <https://statbel.fgov.be/fr/themes/population/naissances-et-fecondite#news> (REF and <https://statbel.fgov.be/fr/themes/population/naissances-et-fecondite#news> 36,3 tableau 12). If it is still not possible to find such a child and that it is not the first child allocated to the household, the number of children in this household is simply scaled down.

The creation of households with a couple and children is simply a mix between the creation of a couple and the allocation of children to their mother as explained above.

The creation of shared households follows the same logic as the allocation of children to a household. A first flat mate is created, then the number of roommates in the household is randomly picked between 3 and 8. 3, itis the minimum otherwise the household would be considered as a couple without child. Next, the gender and the age (between 16 and 70) of the flat mates are randomly taken. Following the same process as for the husband and children explained above, if no more flat mates with the desired age is available in the concerned sector, the first person available with the closest age to the first flat mate created is chosen.

Finally, after the creation of all the households, the household type for the remaining people is defined as “collective”. According to the IBSA conventions (REF), this refers to people being in the hospital, in prison or in a nursing home. Those people are still and stay always at their living place. They are therefore excluded for the rest of the process because useless in order to simulate the average daily trips. They are however included in the results’ analysis.

### Allocate a work ID and a workplace

The structure of this section follows the classical study / career path in Belgium. A child can go to nursery while aged between 0 and 2 years but it is not compulsory. He could also stay at home. From 3 to 5 years old, a child goes to kindergarten before the primary school from 6 to 11. Then, the teenager is in secondary school until 17 years old. As already mentioned, full time study is compulsory until 16 years old (REF). Between 16 and 18 years, the teenager can work part-time with his study (REF). As from 18 years, adults can study or work. Studies generally last 5 years. The retirement age is at 65 years for the moment (REF).

Depending on the data, the workplace is directly allocated to each person at the same time as his work id or first the work id is assigned and in a second time, the workplace is. All work id can not be allocated to every person. It depends on the resident’s age and household type as shown on the figure REF.

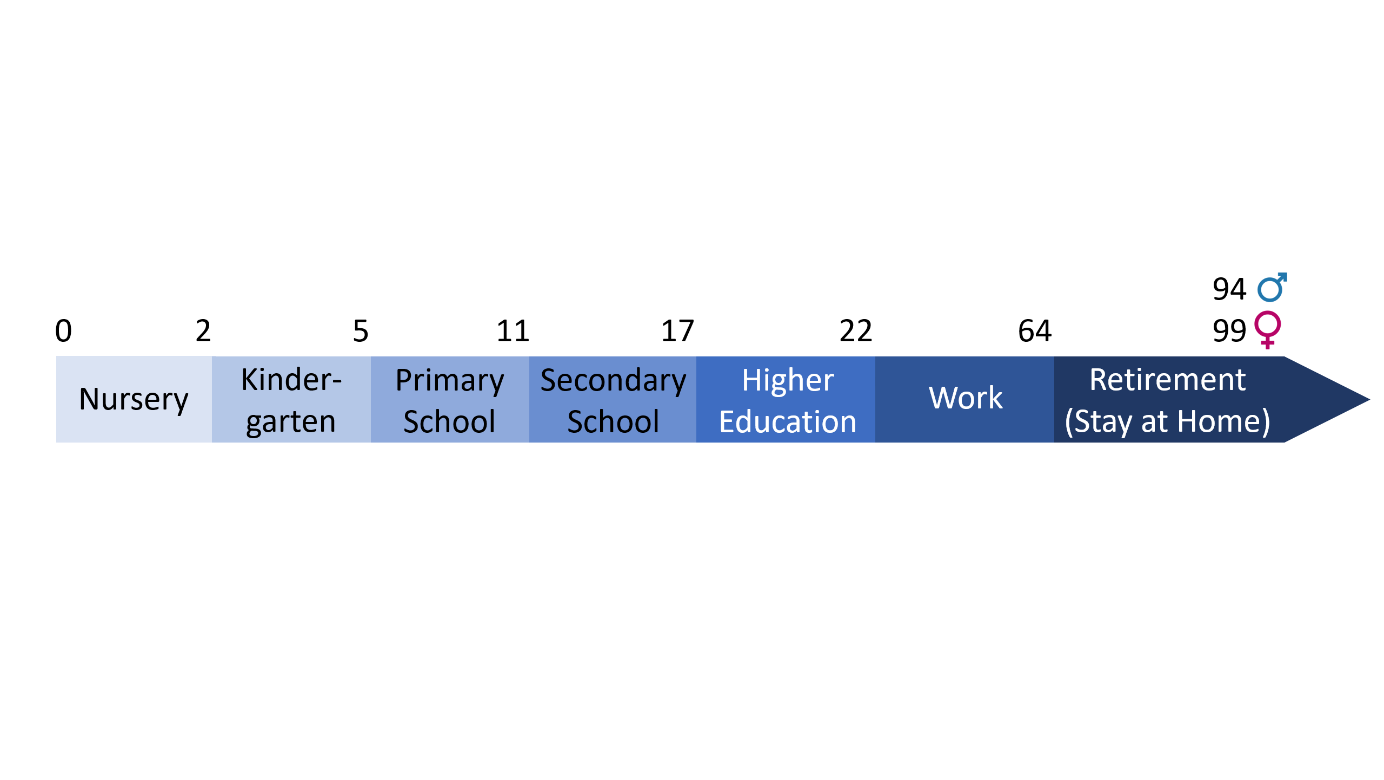


Figure 5 Classical study / work path in Belgium. The numbers above the timeline represent the ages while the word inside the arrow the study / work status corresponding to the given age class.

#### Work ID and workplace when possible

The nurseries’ capacity per sector in 2018 is available in the neighborhood’s monitoring as a ratio between the capacity and the number of children of aged below 3 living in the sector (REF). With this information, it is easy to compute the absolute capacity. No new places have been created between 2018 and 2019 (<https://lacapitale.sudinfo.be/318381/article/2018-12-08/la-creation-de-creches-bruxelles-pris-du-retard>) (REF). Therefore 2018’s numbers can be used. To assign each baby of the simulated population from section XI.B.2), the important assumption is that a baby goes to the closest nursery to his household with available places. For the babies for whom there is no places any more in any nursery, they are staying at home.

According to IBSA 6151 (REF + <http://www.enseignement.be/index.php?page=28188&navi=4580>), 275 children between 3 and 17 years study at home. They are therefore randomly picked in the simulated population from section XI.B.2.).

IBSA 6433 (REF) presents the number of children per municipality and gender being in primary school with some advance compared to the normal study path. This number has been uniformly spread among the six years of primary school. Those computations give the number of children an age of 5 years old while being already in primary school when they should be in third kindergarten. Those numbers remain low. The children have been randomly picked at a municipal level instead of breaking the numbers down to the sectors. The breaking down and the compulsory rounding (in order to have “full” children) result to only null values. On the other hand, there is no children in kindergarten with delay in their study path since the minister has decided in XXX to limit and make exceptional the grade repetition in kindergarten (REF). The chosen in advance children were assigned to the primary school work id while all the other children aged between 3 and 5 years receive the work id corresponding to kindergarten.

The same logic is applied for children being 11 years old and in advance in their study path based on the data for students in advance while in secondary school (IBSA 6437 REF). They are therefore assigned the secondary school work id instead of the primary school one. All other children aged between 6 and 11 years receive the primary school work id.

Children with one (resp. two) year of delay in primary school (IBSA 6433 REF) are also uniformly spread among the six years. However, this time the numbers are brought down to the sector level using the population ratio per gender before being randomly picked among the population of concerned children (aged of 12 (resp. 13)). Those teenagers should be in secondary school but remain in primary school. The secondary school work id is assigned to all other teenagers aged between 12 and 15 years.

Teenagers of 16 or 17 years with the status of parent in their household receive the work id corresponding to workers. Having the status of parent means indeed that they work half time and go to secondary school the other half of the time (REF). The worker profile takes over. The same logic for the youngsters of 17 years in advance in their study path is applied than earlier for children aged of 11. They are already at the university instead of still following classes in secondary school. All other adolescents between 16 and 17 are assigned to the secondary school work id.

Like for their younger counterparts, adults aged between 18 and 20 having a parent status in their household have a worker work id. The difference is that here they work full time. Such as for secondary students with some delay in their study path, the same numbers are used here to allocate some 18 and 19 years adults to the secondary school work id.

In Brussels, the higher education is organized by two different federations for the French speaking and the Dutch speaking part (REF ?). The data and methodology used are different for each federation.

Ares (REF) provides the list of campus with their geographic position (REF) as well as the number of students per municipality studying in each municipality per age and gender (REF). Unfortunately, this matrix is not available at a campus level and the number of students per campus is not available either. This last piece information has been found for the biggest campus thanks to other sources (REF). Those numbers do not always date from 2019 but only the range of magnitude matters here so those numbers can be used. For campus where the information is not available, the total number of students commuting to the municipality is simply uniformly spread among all the campus of the concerned municipality. These data have been combined with the percentage of students living in Brussels among the number of students studying in Brussels: 37% (REF). The combination of all those data results in the number of students living in a municipality studying in a specific campus in Brussels or outside Brussels per age and gender. The students have been picked from the population simulated in section XI.B.2. and assigned to the work id higher education.

Two different work ids exist for higher education students in Pr. Kornhauser methodology because their probability distribution for the trip chain type allocation is different whether they are living on campus or off campus. Unfortunately, the probability distribution for the trip chain type allocation in Brussels is not available according to the work id. This distinction therefore has no impact on the trips. However, for the readers interested in the resulting simulated population it is worth explaining. A student having a household type ‘single’ or ‘flatsharing’ and having his residence sector identical to his workplace is considered has living on campus while all the others are considered as living off campus.

Note that here, students have also already received their workplace because of the format of the data. Since this thesis only focuses on trips happening in Brussels, for people studying (or working) outside Brussels, their workplace corresponds to the closest sector being on the periphery of Brussels to their sector of residence. This corresponds to the assumption that people studying (or working) outside Brussels leave Brussels as soon as possible with the idea of reaching the fast lines as soon as possible. In the GPS’ language this corresponds to choosing the “fastest itinerary” instead of the “shortest” one.

Data from the Dutch Federation are far less specific. Dataloep (REF) only provides the number of students studying in Brussels per age and gender and the number of students living in Brussels and studying somewhere also per age and gender. By taking 37% (REF) of the people studying in Brussels, the number of students living and studying in Brussels is obtained. Next to that, the difference between this last number and the number of students living in Brussels and studying somewhere gives the number of students living in Brussels and studying outside Brussels. Those students are randomly picked from the simulated population (section XI.B.2.).

BCSS (REF www.bcss.fgov.be samilc) provides data on the worker status (independent, employee, unemployed) per municipality, age and gender. Moreover, INASTI’s data (REF <https://websta.rsvz-inasti.fgov.be/fr/statistical/insured>) state that 37% of the independents practice a liberal profession and 2% works in the agriculture sector. Those 39% of the independents on top of the number of unemployed people are broken down to the sector level using the population ratio. People are then pick from the simulated population (section XI.B.2.) and are seen has staying at home. It means that their workplace is the same as their living place.

After assigning secondary school student, higher education students and young adults staying at home because unemployed or independents, all the other people aged between 18 and 20 receive the work id corresponding to worker.

The exact same process is applied for people aged between 19 and 64 years. Some receive the higher education work id, others the “stay at home” work id and all the others are assigned to the worker work id.

For seniors older than 64 years, the same data from INASTI (<https://websta.rsvz-inasti.fgov.be/fr/statistical/insured>, REF) are used while the number of people working significantly decreased compared to the previous age category. As a result, the majority of the elderly people receive the work id “Stay at home”.

#### Workplace alone

After the assignment of the work ids, babies, students from the higher education in the francophone federation and people staying at home already have their workplace. However, it still has to be determined for all the other residents.

The neighborhoods’ monitoring provides data on the part of kindergarten students studying outside Brussels per neighborhood of residence (REF). These numbers multiplied by the number of children living in each neighborhood result in the absolute number of kindergarten students studying outside Brussels. Those children are randomly picked from the children with kindergarten work id and living in the concerned neighborhood. Those numbers are not broken down to the sectors level because too few children are concerned. As explained above, since they are studying outside Brussels, their workplace is the closest sector being on the periphery of Brussels to their sector of residence.

Furthermore, the neighborhoods’ monitoring issues the school capacity for kindergarten per neighborhood as a ratio between the number of kindergarten students studying in the neighborhood and the number of students registered to any kindergarten school (in or outside the concern neighborhood) living in the concerned neighborhood (REF). A simple multiplication with the number of of students registered to any kindergarten school (in or outside the concern neighborhood) living in the concerned neighborhood coming from the population simulation and the work id assignment gives the absolute number. It is then broken down to the sector level using the population ratio.

Another interesting statistic produced by the neighborhoods’ monitoring is the proportion of children going to a kindergarten school being in an adjacent neighborhood to their living neighborhood (REF). This number is available at a neighborhood level. Once again, a simple multiplication results in the absolute number. Children from a given neighborhood are randomly picked and allocated to a kindergarten school from an adjacent neighborhood where there is still enough places.

As a complement, the IBSA 6322 (REF), provides a matrix of the flows between the municipality of residence and the municipality of the kindergarten where the children are going. After deduction of the children already assigned to a workplace, those numbers allow the allocation of a sector in the concerned municipality as workplace for the remaining children (i.e. the children studying in a kindergarten inside Brussels but not being in an adjacent neighborhood to their living neighborhood). All children should have been allocated to a workplace. However, because of the rounding error throughout the whole simulation XXX children remains. They are henceforth randomly assigned to a workplace.

The exact same process is applied for primary school students except that the data used (REF dont IBSA 6323) are different.

The method is similar but not exactly the same for secondary students because the school capacity per neighborhood is not available. However, the school capacity is available at a municipality level. The population ratio between the number of teenagers from the simulated population (section XI.B.2) with a secondary school work id (section XIB3) living in each sector and the total number of teenagers from the simulated population (section XI.B.2) with a secondary school work id (section XIB3) living in the corresponding municipality is used to brought down the capacity at a sector level. Then, the process is exactly the same as for kindergarten and primary students with other data (REF dont 6324).

The francophone students already have their workplace but their Dutch speaking counterparts only have their work id. The campuses’ capacities have been determined thanks to different sources (REF). Those numbers do not always date from 2019 but only the range of magnitude matters here so those numbers can be used. For campus where the information is not available, the total number of students studying in Brussels is simply uniformly spread among all the campus. Like for the francophone students, these data have been combined with the percentage of students living in Brussels among the number of students studying in Brussels: 37% (REF). Since no other information about the provenance of the students per campus is available, the students have been randomly assigned to a workplace respecting the capacity computed. Of course, the distinction being students living on and off campus is respected. Therefore, people living on campus receive a workplace identical to their sector of residence. For students living in Brussels and studying outside Brussels the same methodology is still applied with the closest sector being on the periphery of Brussels to their sector of residence.

Very specific data are available for the workers commuting. The census 2011 (REF) indeed provide a matrix of the number of workers per sector of residence and sector of workplace. However, those data dates of 8 years from 2019 … Thus, they have been used in the form of ratios. For example, if there were XXX workers commuting from XXX to XXX in 2011 out of the total XXX workers living in Brussels in 2011, this ratio of XXX is applied to the total XXX workers living in Brussels in the simulated population to result in XXX workers commuting from XXX to XXX in 2019. Some data are aggregated at a neighborhood or municipality level. In those cases, the specific sector is picked randomly. The same logic is used for people living in Brussels but working outside Brussels. Once again, the closest sector being on the periphery of Brussels to their sector of residence is assigned as workplace.

#### Collective check (not ?)

#### Commuters living outside Brussels

Some people do not live in Brussels but work in it. Their trips have to be taken into account. This section focuses on them.

For babies and children below 18 years, the process is based on the remaining places in nurseries, kindergarten, primary and secondary schools. The neighborhoods’ monitoring and the IBSA indeed define the capacity as if it was fully used (REF). For each place still available, one commuter is created. Not all personal parameters (such as the age, gender, household type, …) are defined because they are useless for the trip simulation. They are nevertheless assigned to a sector of residence. Since this one should be outside Brussels, the opposite logic is applied compared to people living in Brussels and working outside Brussels: their residency sector is the closest sector being on the periphery of Brussels to their workplace.

For high education students, ARES (REF) provides the same data as presented above for students living outside Brussels and studying in Brussels. The same process is therefore used with the method to defined the residency sector just explained in the above paragraph. For their Dutch counterparts, the methodology is identical to what has been explained in section XXX but with 63% (REF), the percentage of students living in Brussels and studying outside Brussels this time.

Concerning the workers, the same 2011 census matrix is available for people working in Brussels and living outside the city. The exact same process is then applied.

#### Tourists

People making some trips inside Brussels are not only residents and commuters. Brussels also welcomes some tourists. The word tourist must be understood at a broad sense since it included all kind of travelers (business trips, people on vacation, …). In order to quantify the average number of tourists that have to be taken into account, the table 15.1.1.6 from the IBSA (REF) helps. This table indeed gives the number of arrivals per year per municipality. By dividing those numbers by 365 (2019 is not a bissextile year (REF)), the average daily number is obtained. The population ratio is useless in this case in order to break down the number of arrivals per municipality to the sector level. Indeed, more people living in a sector does not mean more tourists coming to this sector. The surface ratio between the sector and the municipality it belongs to (REF) is used as proxy in this part of the simulation. For tourists, the workplace is identical to their place of residency. This assumes that “tourists” on a business trips opt for an hotel closed (meaning in the same sector as) to their workplace. This is confirmed by XXX (REF).

### Allocate a trip chain type

When studying the mobility habits of a population, it is common to use trip chains (REF monitor, beldam, kornhauser). Trip chains are patterns representing the daily trips of a person. Those used in this thesis are the 31 ones used in Brussels in Beldam and Monitor reports (REF <file:///C:/Users/MediMonster/Downloads/les_pratiques_de_deplacement_a_bruxelles_analyses_approfondies.pdf>, p52). They are shown on figures XXX and XXX. Those trip chain types are grouped in two main categories: the ones including a workplace and the one without workplace (REF). In our case, people not having a workplace are people with “stay at home” as work id or tourists. Both categories have their own probability distribution used in order to allocate a trip chain type to each person simulated previously. In Beldam and Monitor reports (REF), trip chain types without workplace have a general leisure place instead. This is considered as the longest leisure activity of the day. However, in this thesis no difference is made between a “simple” leisure and a general leisure.

The probabilities distribution presented in Beldam and Monitor (REF <file:///C:/Users/MediMonster/Downloads/les_pratiques_de_deplacement_a_bruxelles_analyses_approfondies.pdf>, p52) date from 2011 (? CHECK). However, in sack of more recent data, this work make the assumption that Brusselers travelling behaviors have not changed significatively between 2011 and 2019. Those probabilities distributions are percentages of the mobile population. The immobile people represent 22.5% (REF). The immobile people are people not doing any trip per day in average. Those include prisoners, hospitalized people and elderlies in nursing home (having a collective household type in our simulation) but not only. There also exists people free to leave their home but not doing it in average. In order to adapt the probabilities distributions, the percentage of people with a collective household type in the simulated population (XXX %) is deduced from the 22.5% and this remaining XXX % then multiply the probabilities distributions adding the possibility to be immobile in the distribution.

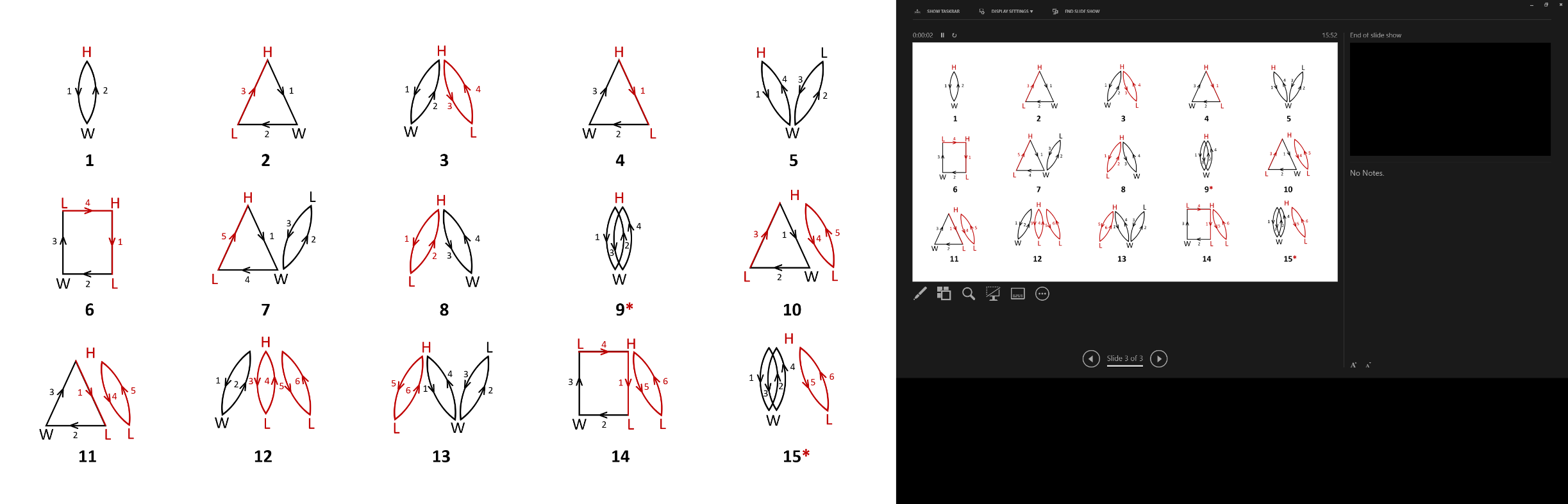


Figure 6 Trip chain types including a workplace. H stands for Home, W for Workplace and L for Leisure. The small numbers indicate the order in which the trips are done arrow represents the direction of the trip. . The bold numbers are the reference of trip chain types. The red lines are the trips not done in Brussels when the trip chain type is assigned to a commuter. Trip chain types with an asterisk are the trip chain types not considered for commuters.

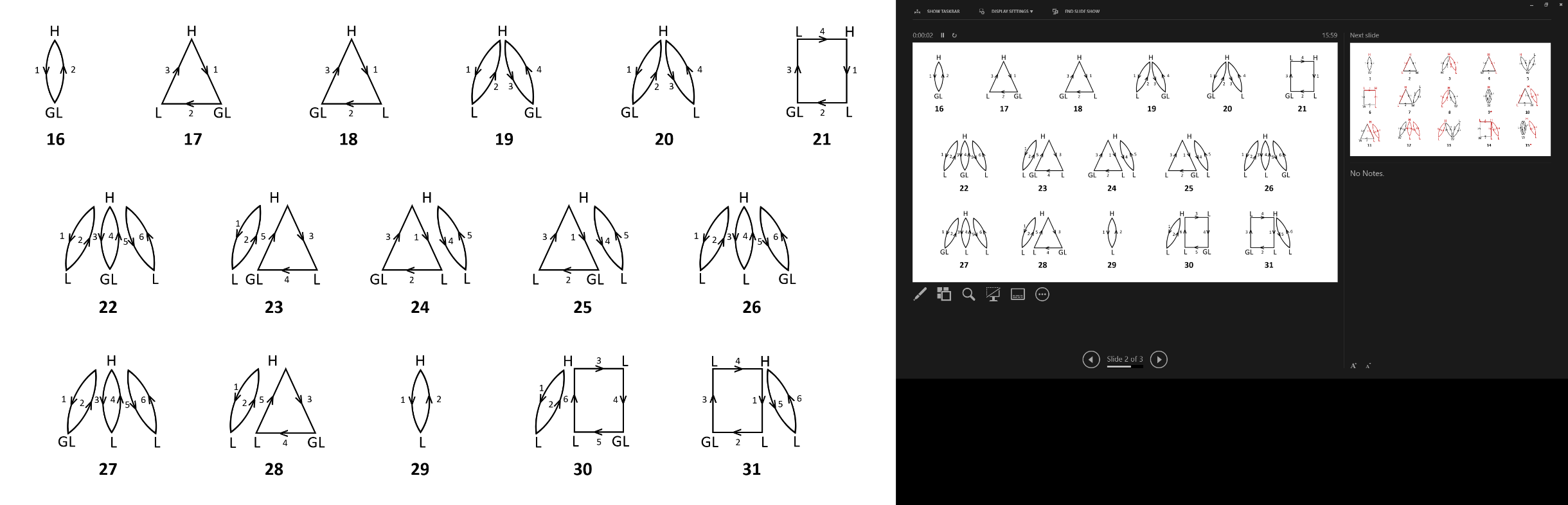


Figure 7 Trip chain types without workplace. H stands for Home, L for Leisure and GL for General Leisure. The small numbers indicate the order in which the trips are done arrow represents the direction of the trip. The bold numbers are the reference of trip chain types.

Commuters live outside Brussels. All their trips are not especially in Brussels. Monitor data (2019 REF) demonstrate that only 3% of the commuters working in Brussels while living outside Brussels practice their leisure in Brussels. In sack of simplicity, for commuters, all trips from home not being to work (in red on figure XXX) are assumed as not being in Brussels and therefore not considered in this thesis. Some trip chain types including the commuter to come back at home before going back to his workplace (trip chain type 9 and 15 on figure XXX) correspond generally to people going back home to eat. Nevertheless, it seems seldom for commuters living far from their workplace to do twice the return trips on a day. Therefore, those two trip chain types are excluded for commuters. Those assumptions change the probability distribution since some complex trip chain types now become simpler ones as depicted in the correspondence table XXX.

### Create trips

Each trip possesses a sector of origin, a sector of destination, a starting time, a duration, and a length. It is also characterized by a type: home to workplace, workplace to leisure, home to leisure and all opposite possibilities. The trip chain type assigned to each person determines the order in which trips of each type have to be created. The starting time is allocated according to the probability distribution of trips in Belgium per destination type through the time in the day (REF) at the minute precision. Here again, the hypothesis that Brusselers travelling behaviors have not changed significatively between 2011 and 2019 is taken. The comparison between Beldam 2010 (REF) graphs and Mobel80 graphs (REF) indeed show no significant change (except the morning pic happening slightly later in 2011 than in 1999) in the temporality of the trips between 1999 and 2010 which let think that it still has not changed. The probability distribution for the trips to a leisure place is the result of the weighted sum of all possible leisure presented in Beldam 2010 (REF XXX shopping, service, repas, famille, promenade et loisir TO ADAPT). Concerning the trips to the workplace, a difference is made between a trip to an actual work and trips to a school (including nursery, kindergarten, primary school, secondary and higher education). The probability distributions can be found in the appendix XXX.

When a trip involves the home place or the workplace, its geographic location is already determined. Nevertheless, it is not the case for the leisure places. The methodology applied to determine the leisure place is different from Pr. Kornhauser (REFs) because those data were not available for Brussels. He indeed used the list of leisure place and defined patrons for the ratio of customers per employee per NACEBEL code. The process applied in this thesis is more deductive. To determine the sector of the leisure, the probability distribution of the length trips (Beldam 2010) is used. Knowing the sector of the origin of the trip and a length randomly pick according to the probability distribution, a list of possible sectors is easily determined. The exact sector of the leisure destination is then randomly picked from this list. Once again, the probability distribution used here corresponds to 2010 trips. However, between 1999 and 2010, the average trip length as changed from 12 km to 12,3 km which is not a big change (REF Beldam). Such as in 5’s and 10’s (REF) simulations, all distances are computed as the crow flies from the centroid of the sector of the origin to the sector of the destination according to formula XXX (REF <http://villemin.gerard.free.fr/aGeograp/Distance.htm#bilan>). While the duration of the trip results in the division of this distance by the average car speed in Brussels: 23.7 km/h (REF mobilite mobiliteit cahiier 2).

Equations 1-3 Haversine's formula for the computation of the distance (d) between two points on earth of latitude and longitude respectively and where is the Earth’s radius (XXX km).

Thanks to this simulation, the Trips File is now ready. However, not all of those trips have to be considered for the aTaxis’ fleet simulation. First, the trips with the same sector as origin and destination were removed. Then, according to Monitor 2019 (REF), some of the remaining trips were done by walk or by bike. As depicted on the Figure XXX in Appendix XXX (Graphe from Monitor 2019 REF), depending on the length of the trip a certain part is indeed done by walk or bike. Those trips have thus been removed has well prioritizing the shortest trips in the concerned length category to be assigned to walk or bike.

### aTaxis’ fleet simulation

The aTaxis’ fleet simulation follows Chen’s methodology (Chen 2016) and uses the same logic for the cleaning stations creation. The cleaning stations are indeed added compared to Chen’s work (Chen 2016) as well as the pickup and drop off time.

As explained earlier, the territory of Brussels is divided in sectors. Each sector corresponds to an aTaxis’ station. This means that a user could maximum have to walk XXX m in order to reach the station which is totally feasible and realistic. Charging and cleaning stations are also located at some of those aTaxis’ stations.

In this simulation, there are four different entities: the aTaxis, the charging stations, the cleaning stations and the requests. Each of them can have different status as shown on Figure XXX. A request simply moves from unsatisfied to satisfied once its starting time arrives. On the one hand, charging and cleaning stations can either be busy – when an aTaxis is being charged or cleaned at this station - or free when there is no car at this charging or cleaning station. On the other hand, a taxi can have five different statuses:

* free: when empty at a station ;
* waiting: when at least one passenger is onboard and waits for others to join ;
* working: when travelling with its passengers to their destination ;
* charging or ;
* cleaning.

Figure XXX also depicts the possible transitions between those statuses. A free aTaxi can become waiting if he has accepted a request but it also can become charging if its battery is too low or cleaning if he already has realized forty trips since its last cleaning. While waiting, the aTaxi waits at least one minute corresponding to the pickup time and maximum five minutes and then becomes working. The pickup time allows the passenger to get into the car. Five minutes has been defined as the maximum acceptable waiting time for customers (REF). A working aTaxi only becomes free again once it reaches its destination and has allowed one minute as drop off time to its passengers. Similarly, to the pickup time, the drop off time allow the passenger to get out of the car. A charging vehicle can stop its charge in order to fulfill a request. While a cleaning car can not because the aTaxi has to wait for the fifteen minutes of cleaning to be done. Of course, if a charging aTaxi is fully charged, it becomes free again and releases the station.

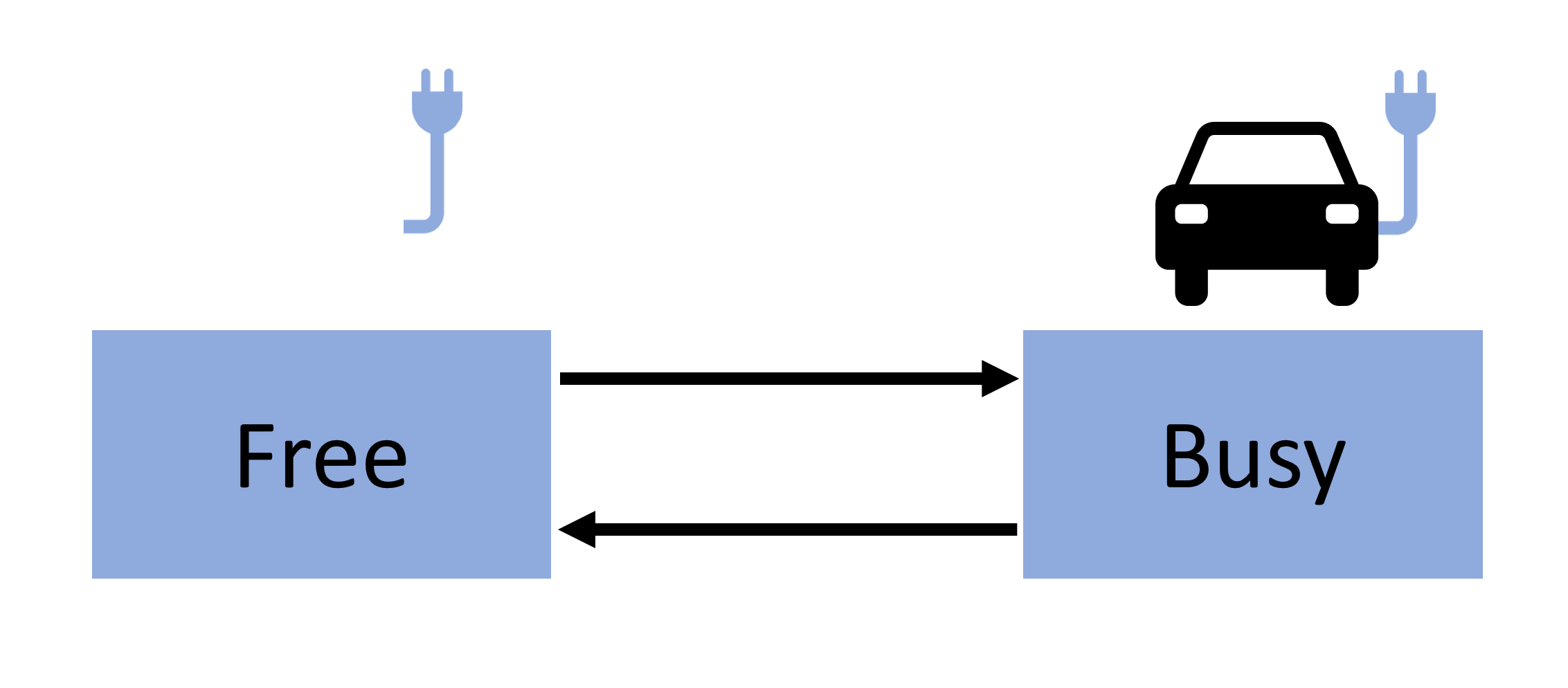


Figure 8 Possible charging stations' statuses and transitions. The arrows depict the possible transitions from one status to another one.

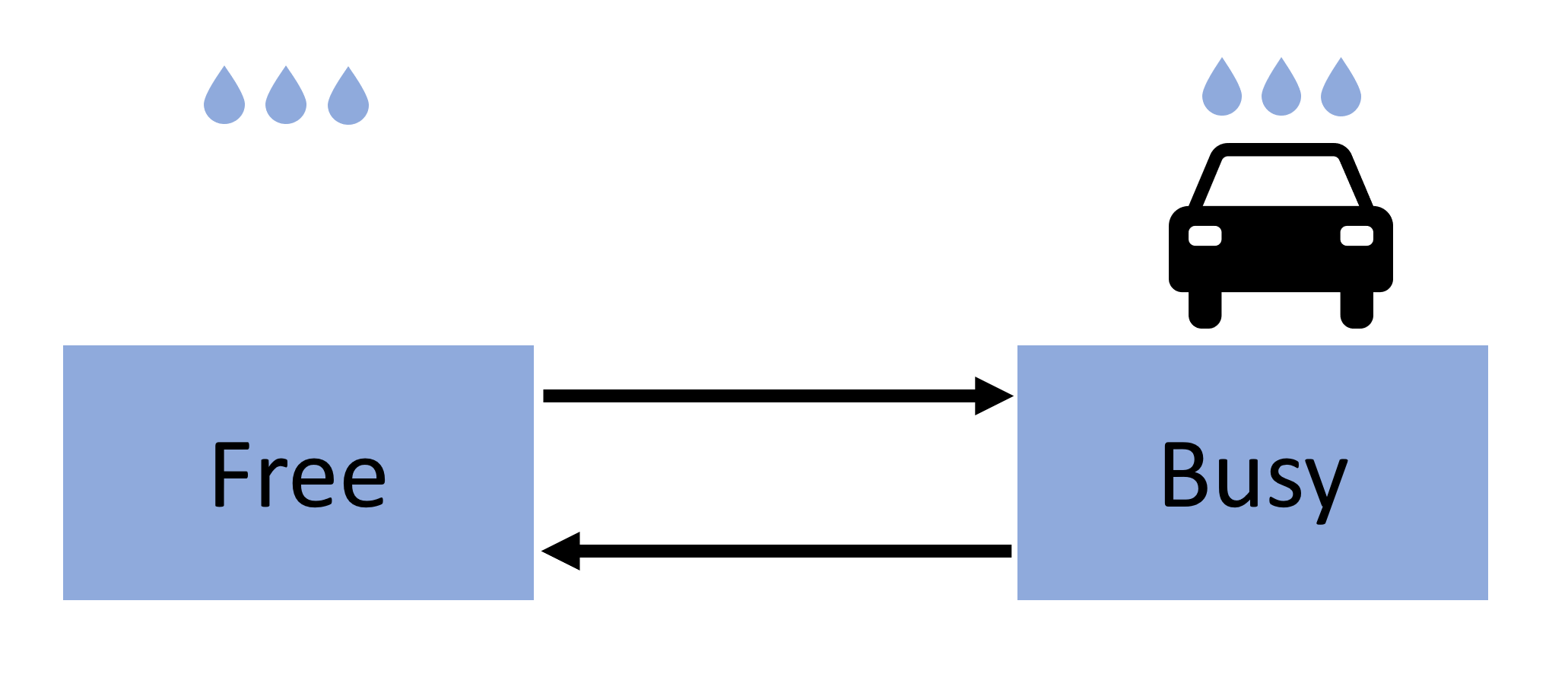


Figure 9 Possible cleaning stations' statuses and transitions. The arrows depict the possible transitions from one status to another one.

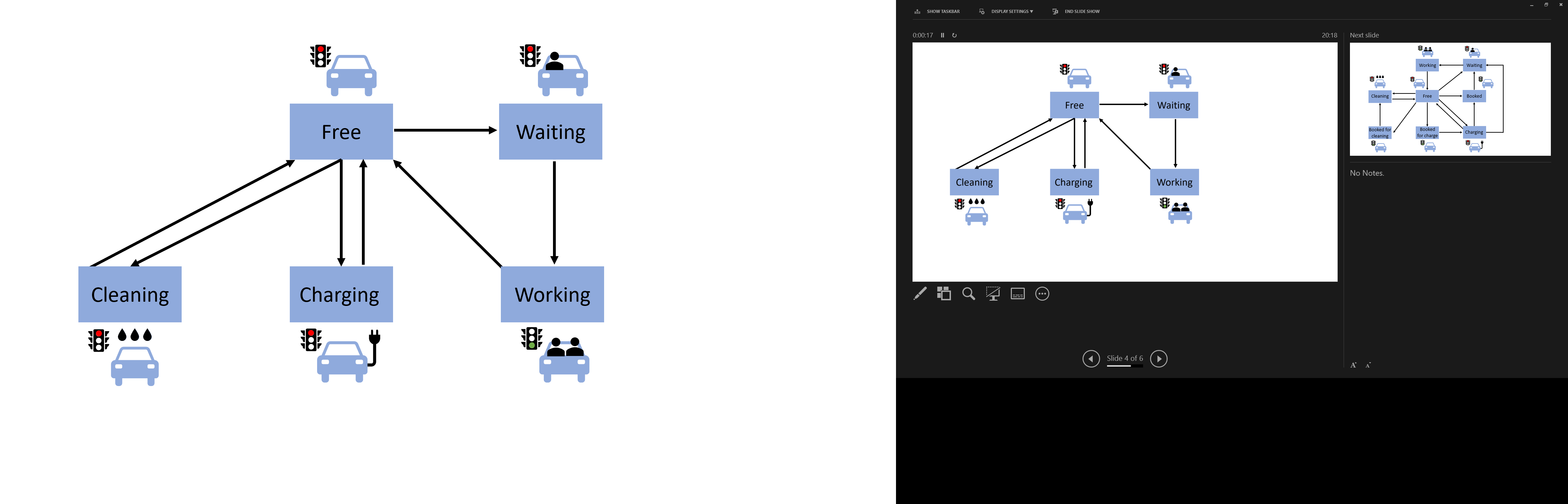


Figure 10 aTaxis' possible statuses and transitions in the scenario whitout empty ride. A red traffic light means that the aTaxi is not moving and staying at the station when in that status. While a green traffic light means the aTaxi is moving from one station to another one when in this status. The arrows depict the possible transitions from one status to another one.

Passengers can share ride with other users having the exact same station of origin, the exact same station of destination and a starting time difference inferior to the maximum waiting time. Those are strict rules forbidding any detour. They have been chosen for sake of simplicity and running time. Up to five passengers can share a ride since the aTaxis are sedans cars such as many other studies (REF).

If no aTaxi can fulfill a request in time, a new aTaxi is created fully charged at the origin of the concerned trip. Identically, if a SAEV can not reach a charging or cleaning station among those free, a new station is created at the position of the SAEV. That is how the fleet is constituted and the stations created.

The simulation is run during the equivalent of one day (1441 minutes).

Some parameters are important in the simulation. The number of seats (5), the maximum waiting time (5 minutes) and the cleaning time (15 minutes) have already been aborded.

A five-seats car corresponds to a sedan similar to the vehicles simulated in similar studies (1, 2, 4, 5, 9, 10, 15, 21, 38 REFs). While some searchers have opted for the rejection of requests once the waiting time is above 10 minutes (36, 35, 4 REFs), this thesis always fulfill a request such as 24 (Ref) within a maximum waiting time of 5 minutes. This corresponds to one of the scenarios of 18 (REF).

However, parameters about the electric characteristics of the car are also important. The battery range in this simulation is 130 km and it takes four hours to fully charge the battery at a Level II charging station. Those hypotheses have been chosen because they allowed the achievement of the lowest costs despite increasing the total fleet and the number of charging stations required in the study of Chen (2016). Chen (2016) indeed has compared different scenarios with different battery range and charging stations’ power.

As explained in section XXX, there is no relocation of the aTaxis because empty rides are forbidden in the studied scenario. However, a smaller simulation has been conducted on the limited territory of XXX in order to compare the impact on empty rides. In this simulation, relocation was realized thanks to trips anticipation similarly to other researches (35, 32 REFs). It is realistic to imagine that the aTaxis’ company would be able to perform some machine learning with the daily trips data in order to predict and anticipate the coming trips. Furthermore, the users should be able to book an aTaxi in advance, helping the dispatcher in this way. Each free or charging aTaxi checks whether there will be a request in the next forty minutes with sector of origin closed enough for the aTaxi to be there before the starting time plus the maximum waiting time. Forty minutes indeed represent longest possible trip duration in Brussels. If the SAEV can reach the origin station in time and has enough battery both in order to , it received a sixth status: “booked” and rides to the concerned station. Once at the station, it becomes waiting as in the simulation without empty rides. In this simulation, aTaxis can also realize empty trips in order to reach a charging or cleaning station. It then has respectively the status “booked to charging station” and “booked to cleaning station”. When a SAEV is booked – wherever he is going to – it can not abandon its original destination for another one. Figure XXX presents the resulting status and possible transitions for this simulation. When riding empty, the aTaxi also reaches the speed of 23.7 km / h.

TODO closest when empty travel

Anticipation = meme hyp que burghout 2015

Même ori and desti ride sharing scheme 1 de burghout 2015 and 15 poulhes

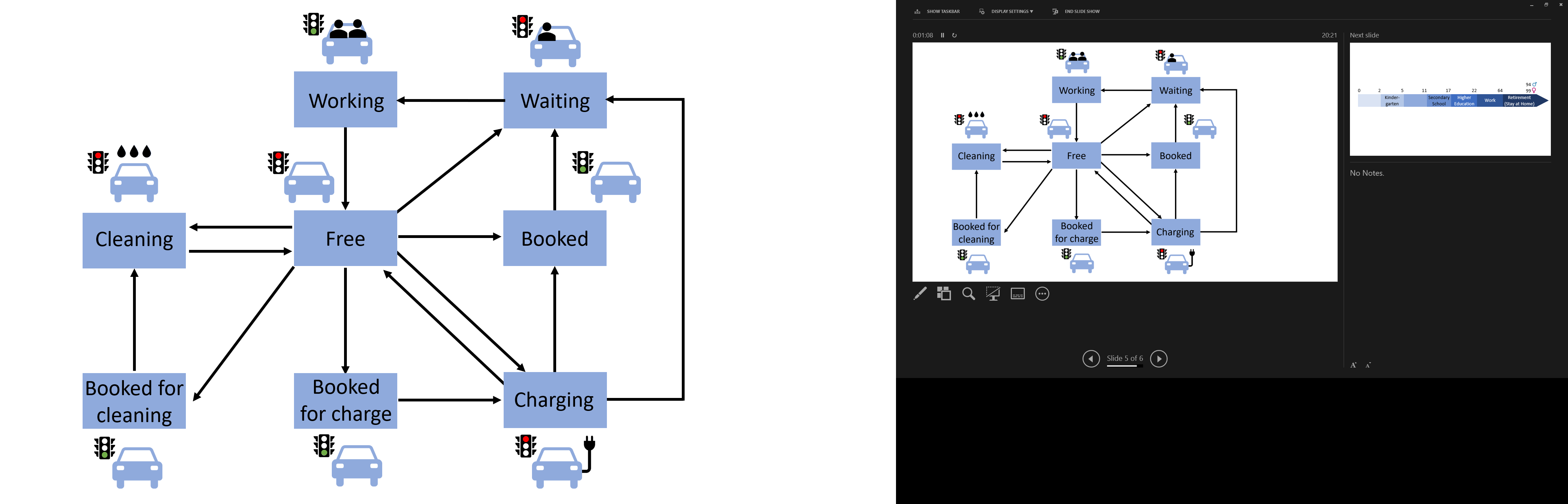


Figure 11 aTaxis' possible statuses and transitions in the scenario with empty rides. A red traffic light means that the aTaxi is not moving and staying at the station when in that status. While a green traffic light means the aTaxi is moving from one station to another one when in this status. The arrows depict the possible transitions from one status to another one.

## Results

### Population simulated

The results obtained show too many (32,216) children with “collective” as household type. A child can not indeed be in prison or in nursing home. For children, a household type being collective thus means that he is at the hospital. However, only 510 beds (IBSA 4213 REF) in total are available for children in the hospitals of Brussels. Therefore, the “too many” “collective” children have been reassigned to households with some children.

Furthermore, the whole population contains XXX people while in reality there should be only XXX. The difference comes mainly from the number of youngers aged between 16 and 19 years living in couple without children. Because of the lack of specific data, the methodology resulted in a number of youngers aged between 16 and 19 years living in couple without children ten times higher than youngers aged of 20 years. Ninety percent of the youngers aged between 16 and 19 years living in couple have been removed.

### Trips simulated

### aTaxis’ fleet simulation

# Costs analysis

The costs analysis follows the methodology of Chen (Chen 2016) while adding the cleaning costs and all “administrative” costs linked to the company management. Chen indeed describes vehicles’ costs and then fixed and variable costs due to the charger. All costs per km are summarized in table XXX. The convention in the field is to present cost per km to facilitate comparison between studies. However, yearly costs are used for the profitability analysis in section XXX. The shift from per kilometer values to per year values is easily achieved by a simple multiplication by the total number of kilometers traveled per year (XXX km).

|  |  |
| --- | --- |
|  | Cost (€ / km) |
| Vehicle Capital (Total) | XX |
| Non-autonomous electric vehicle | XX |
| Autonomous premium | XX |
| Battery replacement | XX |
|  |  |
| Vehicle operations (Total) | XX |
| Maintenance | XX |
| Insurance | XX |
|  |  |
| Electricity (Total) | XX |
|  |  |
| Charging infrastructure (Total) | XX |
| Level II charger | XX |
| Maintenance | XX |
|  |  |
| Cleaning Costs (Total) | XX |
| Outside cleaning material | XX |
| Outside cleaning workforce | XX |
| Inside cleaning material | XX |
| Inside cleaning workforce | XX |
|  |  |
| Administrative Costs (Total) | XX |
| Workforce | XX |
| Office | XX |
| Office material | XX |
| Abonnements | XX |
|  |  |
| Total | XX |

Table 1 aTaxis Company Costs per kilometer

The vehicle capital costs are computed based on an electric non-autonomous vehicle with five seats price on top of which an autonomous premium is added (Chen 2016). The reference car is comparable to a Nissan LEAF or a Ford Focus Electric BEV (Chen 2016) which price is about 40,000 € (REFs of voitures). As stated by Schultz (REF 2014), the autonomous premium is 10,000 $ which corresponds to 8,500 € (with the change rate on the XXX date (REF)). The aTaxi’s lifespan is approximated to 372,000 km (REF Chen) which represents XXX years in our simulation. The Belgian law forbid taxi to ride more than 7 years (REF). In this case, the lifespan is inferior to seven, thus it does not matter. According to Chen’s assumptions (REF chen 2016), the battery must be replaced once in the car’s life. This replacement costs amount to 8,160 € per vehicle. In a nutshell, capital vehicle’s cost reach 0.152 € / km.

The vehicle operations’ costs gather maintenance and insurance costs. Chen (REF 2016) affirms that maintenance costs are 0.055 $ / miles which is worth 0.028 € / km. Following Chen (REF 2016) and Burns et al. (REF 2013 from chen 2016)’s hypotheses, the insurance cost of an aTaxi is 2.5 (TOCHECK) times the normal insurance cost for a non-autonomous car travelling XXX km per year (XXX € (REF)). Brought back to a per kilometer basis, the insurance costs represent XXX € / km.

The aTaxis considered in this simulation consume 0.1 kWh / km (REF kelwatt) and the electricity price is 0.25 € / kWh (REF kelwatt). This means that the vehicle’s fuel costs 0.025 € / km.

Concerning the charging infrastructures, one Level II charger costs 10,000 € (REF Chang et al., 2012; USDOE, 2012 through chen 2016) and has a lifespan of 10 years (REF Chang et al., 2012 throught Chen 2016). It also requires maintenance costs of 32 € / year (USDOE, 2012 through chen 2016). Given that XXX chargers are required in Brussels, the total costs due to the charging infrastructures amount to XXX € / km.

Furthermore, the cleaning costs are considered in two different ways: the seldom outside cleaning and the recurrent inside cleaning. On the one hand, the outside cleaning only happens six time a year (REF) and lasts 1 hours per car. The costs associated to it are the water and products needed (6.3 € per cleaning in average (REF)) and the workforce. The workforce corresponds to the average gross wage in Brussels, 4,156 € / month (REF) broken down to an hourly wage. On the other hand, the inside cleaning is done every forty trips (REF) and lasts fifteen minutes. It requires less materials than the outside cleaning explaining that the average cost per cleaning is only 2 €. TODO wage (per hour or per station ?)

Finally, the administrative costs linked to the company in itself are tackled. In order to determine the number of employees needed, the ratio of employees per car in the fleet of the car sharing company Cambio in Brussels has been used (0.09 employees per car) (REF). Keeping the same gross average wage in Brussels, adding laptop, phone (with lifespan of 3 years) and abonnement costs, this represents XXX per year employee. Even if there is more and more homeworking, an office is needed and costs XXX € / month. The total administrative costs thus reach XXX € / km.

In summary, all costs considered, an aTaxi in Brussels costs in average XXX € / km meaning XXX € / year.

TODO justify personne aux bornes de chargmeent, add loeb and kockelman 2018 as a ref

# Pricing analysis

# Profitability analysis

## Results

## Sensibility analysis

# Discussion and limitations

## Possible improvements

The quality of this work relies mainly on the data used. The more specific are the data the more accurate is the simulation. If sometimes the data available are really specific such has the flow of workers (REF), some parts of the simulation (notably data on students in the Dutch higher education) have required many hypotheses because of the lack of data. Also, all data were not available at a statistics sector level and had to be broken down using the population ratio losing some accuracy. This population ratio could be more specific, adapted to the age category for example. Furthermore, the random assignment reducing the accuracy was used a lot because of this lack of data.

While determining the number of single fathers, the age has been assigned randomly. It could have been more accurate if the real probability distribution was accessible. A distribution could also have been created based on the known average age difference between a father and his child (36 years (REF)). On the other hand, when a child was assigned to a mother, the probability distribution of the age difference was available. However, only the distribution of 2019 has been used while the distribution used should have been dependent on the child’s birth year. Furthermore, the assignment of the gender to a child follows a simple random rule while it could have been based on the gender ratio in the concerned sector or at least in the whole territory of Brussels.

In other to establish the number of students with some delay on their study path, the total number of children with delay in primary (resp. secondary) school has been divided by the six years of this part of the path. Nevertheless, it means that all people repeating a year, repeats the first year of the part in question and keep their delay for the rest of the section. In reality, there is kind of an accumulation with less students with delay in the beginning of the section and with some different children repeating each year. Moreover, once in first year of secondary school, the number of children already having redoubled in primary school should be taken into account.

For the sake of simplicity, all simulated couples are hetero couples. This does not have any impact on the fleet sizing since every household is created at a sector level and not at a real address level. It is thus aggregated. However, it could be improved for readers interested in the household simulation. One could simply invert two household ids in order to create homo couples.

For the workplace assignment of people living in Brussels but studying or working outside Brussels, the closest sector being on the periphery of Brussels to their sector of residence was selected. The opposite was done for commuters living outside Brussels but studying or working in Brussels. However, the real direction to the final destination could have been used for more accurate itineraries.

For the creation of commuters living outside Brussels but studying or working in Brussels, many personal attributes have been ignored because they had no impact on the rest of the simulation in order to generate the trips file. Nevertheless, it could have been useful for readers interested in the resulting simulated population.

Concerning the tourists, this was understood at a broad level gathering business trips and holiday together. However, it seems obvious that the daily trip of a holidaymaker and a businessman are not the same. A difference could thus have been done if the trip chain type allocation depended on the work id like in Pr. Kornhauser work (REF). Nevertheless, this broken-down data was not available in Belgium. It would for sure improve the simulation’s quality for every person simulated. It is indeed logical to think that a baby or a young child does fewer daily trips than a higher education student.

The tourists’ trips from and to a train station or an airport at the beginning and the end of their trip could also have been considered in itself.

During the trips simulation, the temporality is just considered for the trips to be in the right order according to the trip chain. However, it can result in some very short activities because two following trips are close. It could have been improved by incorporating information on the activities’ length per type of activity.

Moreover, the leisures’ destinations are determined based on the travels’ length probability distribution. Nevertheless, this distribution concerns all types of trips not only the ones to a leisure place. In the absence of an own probability distribution for leisures’ trips only, a probability distribution of the simulated trips to home and work should have been deduced from this probability for more accurate results.

The leisures destinations could have been better defined if the same data as those used by Pr. Kornhauser were available. He indeed used the list of leisure places and defined patrons for the ratio of customers per employee per NACEBEL code. The exact position of the leisure places could have been determined with Open Street Map (REF) for example. However, being an open source and maintained by a community database, Open Street Map data for Brussels were not complete and cleaned enough. On another note, data on the number of clients per leisure place could have been determined based on the average daily revenue of the place. Unfortunately, this data was not accessible either.

Trips’ distance is computed such as the crow flies. Using the actual roads with Google Maps (REF) data for example would be more accurate. Same for the speed, only an average speed is used while, in reality, it varies from road to road. The reduction of the number of cars on the road and the fact that all of them are autonomous will probably also impact the average speed.

For the aTaxis fleet simulation to be more accurate, the drop off time could be proportional to the number of passengers who were onboard. It indeed takes more time for four users to get out of the car than it takes to only one.

The relocation method in the simulation is based on the anticipation with a time window of forty minutes. The results could maybe be improved if this time window was expanded. Other relocation strategies could also be tried and compared with this one.

The results here probably overestimate the real number of aTaxis needed because all charging stations, cleaning stations and aTaxis have been created in one simulation of one day. To be more accurate stations should have been created thanks to a first simulation. Then aTaxis should have been generated. Finally, the simulation should run during the equivalent of several days in order to get the characteristic numbers (mainly for the simulation with relocation).

The whole process of simulation should have been repeated several times in order the aggregate the results and assess their stability. There are indeed many random allocations which should be demonstrated as stable.

Another important improvement is to make the code run faster. The whole simulation from the population creation to the fleet sizing indeed takes XXX days to run and many limitations of the fleet simulation are due to this high computation time. On one hand, improvements in the Python code are possible. On the other hand, Python is easy to use but maybe not the best programing language for simulations with so big databases. Translate the code to C++ or Java would probably make it more efficient.

TOCOMPLETE

Trips files to allocate to multi modal

Cleeaning la nuit, enfants seuls, position polus détaillée pas de walk to the station

Compared to musti

Reallocation des enfant collectifs age parent

Charge plus vite au debut

## Futures researches

The autonomous vehicles are seen by many as the future and this paper is a first look on its implementation in Brussels. However, AVs impact many sectors and raise many questions. It can be attacked from so many angles, justifying was this section of further possible researches is so long.

Now that the population simulation, the trips file and a first simulation of the behavior of an aTaxis fleet have been done, those can be used for further studies. On the one hand, other analysis can be done on the simulated population. On the other hand, other simulation projects can use the trips file.

One could also work on the prediction of the population in 2030 and run the aTaxis simulation with those new data in order to compare the results obtained with those presented in this thesis.

Furthermore, one could want to visualize all trips from the trips File. Depending on the time, a dynamic visualization of the trips on a real map of Brussels would be useful. This thesis affirms that the total number of vehicles needed in order to satisfy all trips in Brussels is inferior to the current total number of cars riding and that it will thus result in less congestion. However, this dynamic visualization could shed light on some roads congested during peak hours. It could thus lead to other improvements of the simulation.

One could analyze the impact of allowing empty travels with different price penalties. Different parking scenarios could also be study. The inspection of a scenario where all charging and cleaning stations are outside the city could provide valuable conclusions.

Even if charging and cleaning stations are inside the city, far fewer parking spaces will be required since an autonomous taxi can simply drop off a passenger and leave with another one or to another one (if empty trips are allowed). There will also be less vehicles on the roads. Thus, the public space assigned to vehicle could be reduced and reallocated to other use. Our complete environment could be changed. The question arising is how this new environment would be. That could be the topic of another study.

In this thesis, the cleaning is done by humans because automatic carwash would be far too expensive. However, these different hypotheses should be studied in a scenario where empty trips are allowed. Moreover, studies could be conducted in order to develop self-cleaning cars or cheaper autonomous cleaning stations.

The aTaxis simulation allows now to try more exotic scenarios. One could try different pricing plan such as abonnements, a fix price per trip plus a variable part depending on the number of kilometers traveled, a regressive price depending on the number of people sharing the aTaxi, a pricing system where the passenger can pay more in order to have priority on the road and reach quicker his destinations, or as proposed by Pr. Chen (REF 2016 electric), a dynamic pricing penalizing trips resulting in longer relocation miles, … The scenarios are limitless. Nevertheless, it would be interesting to add a demand sensibility analysis dimension to those studies. It is not indeed because one can imagine an exotic scenario that customers will adopt it. A pricing elasticity analysis could be conducted in this purpose.

The pricing plan is one of the economic aspects of the study which can be further developed. However, it is not the only one. The market type can also be simulated differently. Here only a monopoly has been considered. It would be interesting to study the impact of have more than one aTaxis provider in Brussels.

One could inspect the impact of the introduction of autonomous vehicles on the overall welfare of all stakeholders including users and the company but also citizens and the government such as Berrada has done in his doctoral thesis on autonomous cars in Paris (REF).

The insurance industry will be disrupted by the introduction of autonomous vehicles. A specific analysis on the impacts and possible adaptations of this sector to this disruption could be led. Moreover, the well-known question of responsibility in case of accident can also be undertaken.

As seen in this thesis, (???) the charge of SAEVs led to overload on the power grid. This is a problem which needs to be tackle and is worth more analyses.

Another aspect which is not studied in this paper, is the opportunities of vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication. In the exotic scenario proposed above where the price depends on the speed of the aTaxi, or simply for emergency vehicles, it could be imagined that vehicles communicate and adapt their itinerary in order to let the priority to such vehicles. On their side, infrastructures warned by the vehicles would make sure that all traffic lights are green when those vehicles arrive near them.

Another simplifying assumption applied in this thesis is the unique aTaxis size (XXX seats). The study of the impact of having different sizes of vehicles in the fleet would certainly result in a better profitability. Other parameters impact could be examined like the vehicles’ battery range and the charge speed.

To be even more futurist, one could reproduce the study with charging road such as those currently developed by XXX (REF papa ?). This would probably reduce the costs and improve the profitability of aTaxis in Brussels.

This thesis focuses on trips inside Brussels. Nevertheless, it could be interesting to extend the analysis to all trips happening in Belgium. Such a study will probably highlight the differences between urban and rural areas.

Moreover, this thesis jumps ten years ahead once the new environment is set up. However, the transition phase could be studied. Autonomous cars and non-autonomous cars cohabitation is an interesting environment with different impacts on the traffic, the safety and the pollution than an environment where only autonomous vehicles ride (REF ?). Also, the last years have seen ZipCar, DriveNow and other carsharing companies leaving Brussels because the Belgian were not ready to jump for the change from owning to sharing (REF). One could look deeper in this topic and analyse why and the solution to this obstacle to aTaxis.

Furthermore, this thesis only takes people transport into consideration. Another study could focus on the freight transport by autonomous trucks. Then, both studies could be gathered. More specific analyses on the congestion and pollution resulting from those autonomous vehicles in Brussels could then be conducted.

Finally, after all those studies, one could want to launch a company to manage this whole new transport system. Then new questions arise. One could focus on how to set up this environment, studying if a new player can start this project or whether existing players in the vehicle industry are better placed. A comparison between a public company and a private company can be conducted including the investigation of possible subsidies.

TODO probleme des siege auto et item dans la voiture a manage ?

# Conclusion

# Bibliography

Leclipteur, J. (2021). *Autonomous cars brussels.* SBSM. Brussels: ULB.

# Appendix

## Figures

* Figure des 4 distributions trajet par temps

## Tables

### Descriptive statistiques statistics sectors (REF)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Code | Territoire | Densité de population (hab/km²) | Nombre de femmes | Nombre d'hommes () | Surface du quartier (km²) |
| 21001A00- | RESISTANCE | 22,342.22 | 1,348 | 1,494 | 0.12514 |
| 21001A011 | KLEINMOLEN | 17,798.00 | 1,514 | 1,716 | 0.17884 |
| 21001A02- | WAYEZ | 26,629.75 | 460 | 555 | 0.03875 |
| 21001A031 | RAUTER-SUD | 17,937.16 | 941 | 1,008 | 0.10894 |
| 21001A041 | VEEWEYDE-SUD | 17,140.66 | 1,346 | 1,328 | 0.15746 |
| 21001A051 | LINDE-EST | 14,616.48 | 752 | 779 | 0.10420 |
| 21001A07- | BIRMINGHAM | 1,289.32 | 159 | 182 | 0.25362 |
| 21001A08- | ASTRID (PARC) | VS | 1 | 1 | 0.16494 |
| 21001A10- | PORSELEIN | 13,629.10 | 532 | 551 | 0.08005 |
| 21001A112 | BIESTEBROEK | 17,621.10 | 1,388 | 1,419 | 0.15561 |
| 21001A120 | MINIMES | 26,423.81 | 1,704 | 1,705 | 0.12780 |
| 21001A132 | RAUTER-NORD | 14,208.12 | 499 | 572 | 0.07615 |
| 21001A142 | VEEWEYDE-NORD | 13,356.27 | 603 | 581 | 0.08827 |
| 21001A152 | LINDE-OUEST | 18,903.42 | 683 | 694 | 0.07549 |
| 21001A30- | BIZET | 14,531.38 | 1,406 | 1,418 | 0.19448 |
| 21001A31- | CHAUSSEE DE MONS - SAINT-LUC | 8,218.17 | 420 | 404 | 0.09467 |
| 21001A32- | AURORE | 25,968.79 | 2,212 | 1,929 | 0.16058 |
| 21001A331 | WALCOURT | 2,524.68 | 77 | 96 | 0.07169 |
| 21001A332 | ROUE | 16,158.99 | 590 | 633 | 0.07748 |
| 21001A34- | ROUE - CITE JARDIN | 10,895.25 | 1,152 | 1,067 | 0.20229 |
| 21001A350 | CERIA - ZONE D'HABITAT | 6,840.66 | 633 | 680 | 0.18902 |
| 21001A37- | ZUEN - INDUSTRIE | VS | 9 | 6 | 0.23869 |
| 21001A3MJ | CERIA I | VS | 5 | 6 | 0.25102 |
| 21001A401 | ARBORETUM | 13,145.96 | 422 | 329 | 0.06047 |
| 21001A41- | ROMAIN ROLLAND | 12,384.57 | 1,304 | 1,081 | 0.19839 |
| 21001A42- | KAT | 8,592.65 | 283 | 265 | 0.06366 |
| 21001A43- | VAN BEETHOVEN | 18,757.18 | 703 | 653 | 0.07357 |
| 21001A441 | DOCTEUR ROUX | 18,090.38 | 1,132 | 1,166 | 0.12758 |
| 21001A451 | VENIZELOS | 14,274.06 | 849 | 799 | 0.11868 |
| 21001A472 | STADE COMMUNAL - INDUSTRIE | 10,245.28 | 433 | 426 | 0.08541 |
| 21001A492 | ETANGS - PARC | VS | 0 | 0 | 0.07544 |
| 21001A503 | VIVES | 27,921.72 | 924 | 720 | 0.05791 |
| 21001A51- | SCHERDEMAEL | 8,184.61 | 820 | 707 | 0.18852 |
| 21001A52- | SCHERDEMAEL-NORD | 3,054.64 | 270 | 247 | 0.17220 |
| 21001A53- | NELLIE MELBA | 4,649.39 | 213 | 204 | 0.08969 |
| 21001A552 | TREFLE | 5,708.56 | 1,312 | 1,267 | 0.46947 |
| 21001A712 | SCHEUT - DE SMET | 11,023.75 | 475 | 485 | 0.08418 |
| 21001A72- | OSSEGEM | 16,765.11 | 1,668 | 1,641 | 0.19547 |
| 21001A732 | SCHEUTVELD | 2,694.35 | 169 | 143 | 0.12322 |
| 21001A74- | SCHEUT-OUEST | 17,675.60 | 1,334 | 1,338 | 0.15190 |
| 21001A783 | SCHEUT-INTERNAT | VS | 0 | 1 | 0.04418 |
| 21001A80- | SILLON | 12,682.34 | 1,610 | 1,315 | 0.23276 |
| 21001A81- | BROECK | 8,619.87 | 1,006 | 885 | 0.23399 |
| 21001A82- | MOORTEBEEK | 5,679.71 | 951 | 869 | 0.32660 |
| 21001A83- | PETERBOS | 17,089.28 | 1,692 | 1,337 | 0.17297 |
| 21001A84- | POESIE | 10,548.16 | 633 | 544 | 0.11765 |
| 21001A85- | AUBADE | 8,499.04 | 334 | 353 | 0.08354 |
| 21001A90- | SCHEUTKAPEL | 13,199.55 | 1,127 | 987 | 0.16311 |
| 21001A911 | SCHEUT-EST | 16,594.30 | 1,096 | 1,112 | 0.13878 |
| 21001A92- | JAKOB SMITS | 17,183.76 | 1,823 | 1,778 | 0.21014 |
| 21001A931 | AGRAFE-NORBERT GILLE | 13,105.41 | 982 | 976 | 0.15085 |
| 21001A941 | CROCUS | 17,316.27 | 1,208 | 1,079 | 0.13282 |
| 21001A95- | BUFFON | 16,114.40 | 1,615 | 1,601 | 0.20044 |
| 21001A982 | PARC FORESTIER | VS | 0 | 0 | 0.04665 |
| 21001B10- | ROSEE-EST | 18,095.32 | 1,243 | 1,394 | 0.14214 |
| 21001B11- | ROSEE-OUEST | 9,855.07 | 368 | 489 | 0.09011 |
| 21001B17- | ABATTOIR | 4,026.93 | 498 | 535 | 0.26546 |
| 21001B20- | CONSEIL-NORD | 27,126.12 | 2,575 | 2,894 | 0.19645 |
| 21001B21- | BROGNIEZ-NORD | 25,692.75 | 1,589 | 1,926 | 0.14160 |
| 21001B22- | BROGNIEZ-SUD | 16,838.93 | 637 | 625 | 0.07465 |
| 21001B23- | CONSEIL-SUD | 16,407.13 | 678 | 825 | 0.09088 |
| 21001B241 | REVISION-SUD | 13,782.61 | 947 | 1,049 | 0.14656 |
| 21001B25- | REVISION-NORD | 21,517.32 | 1,814 | 2,035 | 0.17753 |
| 21001B31- | ALBERT I- IMMEUBLES | 23,430.61 | 469 | 392 | 0.03662 |
| 21001B321 | ALBERT I- QUARTIER | 12,687.80 | 921 | 1,029 | 0.14636 |
| 21001B332 | GOUJONS | 19,051.84 | 562 | 514 | 0.05648 |
| 21001B372 | DEUX GARES | 563.41 | 30 | 33 | 0.10827 |
| 21001B3MJ | PETITE ILE - RIVE DROITE | 235.48 | 68 | 65 | 1.97042 |
| 21001C512 | CHANTS D'OISEAUX | 5,749.38 | 878 | 637 | 0.26559 |
| 21001C522 | HOPITAL U.L.B. | 404.39 | 116 | 97 | 0.53166 |
| 21001C581 | CIMETIERE | 69.36 | 27 | 25 | 0.69207 |
| 21001C5MA | MEYLEMEERSCH | VS | 36 | 44 | 0.38020 |
| 21001C5PA | MEERVELD | 1,275.98 | 95 | 101 | 0.56662 |
| 21001C611 | SOETKIN | 1,225.51 | 278 | 268 | 0.45042 |
| 21001C6MB | MEYLEMEERSCH-EST | VS | 0 | 0 | 0.34073 |
| 21001C6PB | ZONE RURALE | 163.15 | 230 | 219 | 2.73365 |
| 21001C70- | BON AIR - CENTRE | 5,602.40 | 152 | 127 | 0.06943 |
| 21001C71- | BON AIR - CITE JARDIN | 6,308.44 | 749 | 694 | 0.23128 |
| 21001C79- | BON AIR - HABITATIONS DISP. | 635.22 | 81 | 52 | 0.20150 |
| 21002A00- | CENTRE - NORD | 9,267.47 | 581 | 520 | 0.13477 |
| 21002A01- | SAINTE-ANNE | 5,635.10 | 356 | 335 | 0.12529 |
| 21002A02- | CENTRE-SUD | 6,222.07 | 585 | 496 | 0.17840 |
| 21002A030 | LAMMERENDRIES | 10,218.88 | 1,048 | 939 | 0.19855 |
| 21002A041 | VIGNETTE | 7,221.51 | 286 | 274 | 0.07865 |
| 21002A072 | CENTRE COMMERCIAL | 922.85 | 49 | 54 | 0.10186 |
| 21002A091 | TROIS COULEURS | VS | 0 | 0 | 0.29383 |
| 21002A10- | TRANSVAAL | 8,705.01 | 1,394 | 1,191 | 0.29167 |
| 21002A11- | SACRE-COEUR | 8,436.49 | 545 | 464 | 0.12197 |
| 21002A12- | AVENUE SCHALLER | 4,043.39 | 794 | 722 | 0.36974 |
| 21002A130 | PARC DES PRINCES | 4,388.25 | 670 | 636 | 0.29761 |
| 21002A14- | TEN REUKEN | 3,187.69 | 200 | 203 | 0.12831 |
| 21002A15- | SOUVERAIN (BLV DU)- BUILDINGS | 7,694.09 | 83 | 64 | 0.01937 |
| 21002A18- | ROUGE CLOITRE | VS | 2 | 5 | 0.90702 |
| 21002A190 | FORET DE SOIGNES | 13.96 | 19 | 25 | 2.79381 |
| 21002A20- | SAINT-JULIEN | 11,243.03 | 600 | 583 | 0.10522 |
| 21002A21- | LEBON | 18,547.22 | 1,767 | 1,407 | 0.17614 |
| 21002A22- | CANARIS (AVENUE DES) | 9,174.18 | 450 | 428 | 0.09734 |
| 21002A23- | TH. BALIS (PLACE) | 13,928.61 | 718 | 680 | 0.10360 |
| 21002A24- | AVENUE DE BROUCKERE | 15,527.17 | 727 | 629 | 0.08688 |
| 21002A25- | WATERMAEL (CHAUSSEE DE) | 9,764.07 | 743 | 683 | 0.14635 |
| 21002A30- | TRIOMPHE (BOULEVARD DU) | 9,733.10 | 625 | 631 | 0.12997 |
| 21002A311 | AMITIE (PLACE DE L') | 13,859.63 | 537 | 486 | 0.07475 |
| 21002A372 | QUARTIER INDUSTRIE | 9,588.56 | 321 | 306 | 0.06476 |
| 21002A39- | CHEMIN DE FER | VS | 0 | 0 | 0.16174 |
| 21002A411 | PUTDAAL | 2,578.16 | 339 | 300 | 0.25406 |
| 21002A422 | AVENUE IS.GERARD | 1,988.66 | 70 | 75 | 0.07191 |
| 21002A43- | SOUVERAIN (BOULEVARD DU) NORD | 8,902.36 | 794 | 864 | 0.18501 |
| 21002A441 | CHANT D'OISEAUX | 5,163.38 | 618 | 606 | 0.23880 |
| 21002A45- | VAL DUC | 6,870.15 | 409 | 389 | 0.11688 |
| 21002A482 | VAL DUCHESSE | VS | 2 | 4 | 0.28024 |
| 21002A492 | WOLUWE PARC | VS | 5 | 3 | 0.12317 |
| 21002A511 | INVALIDES (BOULEVARD DES) | 12,691.96 | 1,368 | 1,262 | 0.20777 |
| 21002A52- | BEAULIEU | 4,416.77 | 356 | 309 | 0.15079 |
| 21002A53- | PECHERIES | 22,168.25 | 732 | 618 | 0.06216 |
| 21002A572 | DEPOT METRO | VS | 0 | 0 | 0.09362 |
| 21003A00- | CENTRE | 11,915.83 | 1,558 | 1,458 | 0.25495 |
| 21003A011 | MOLENBERG | 12,140.59 | 850 | 773 | 0.13146 |
| 21003A02- | LAURE - BASILIQUE | 10,903.62 | 1,627 | 1,549 | 0.29816 |
| 21003A03- | HAUT-CHAMP | 12,056.11 | 961 | 968 | 0.16498 |
| 21003A04- | L. DE SMET | 17,980.87 | 568 | 558 | 0.06234 |
| 21003A05- | DE SELLIERS DE MORANVILLE | 8,749.25 | 988 | 979 | 0.22779 |
| 21003A0AJ | HUNDERENVELD | 7,042.28 | 562 | 478 | 0.14669 |
| 21003A10- | HOPITAL FRANCAIS | 20,069.78 | 1,731 | 1,559 | 0.16617 |
| 21003A11- | CITE MODERNE | 11,827.50 | 466 | 403 | 0.06941 |
| 21003A212 | CLOS DU ZAVELENBERG | 15,102.13 | 341 | 318 | 0.04377 |
| 21003A283 | ZAVELENBERG | 1,321.34 | 133 | 100 | 0.18617 |
| 21003A2MJ | GARE | 2,075.52 | 237 | 234 | 0.23994 |
| 21003A312 | POTAARDE VLAK | 5,269.22 | 1,115 | 1,071 | 0.41239 |
| 21003A323 | SEPT ETOILES | 9,954.41 | 499 | 455 | 0.09724 |
| 21003A331 | ALLEE VERTE | 11,315.13 | 378 | 380 | 0.06779 |
| 21003A342 | HOGENBOS | 5,956.69 | 462 | 466 | 0.17711 |
| 21003A38- | KONINCKXBOS | 1,072.88 | 92 | 98 | 0.17803 |
| 21003A41- | MONNET | 31,971.92 | 412 | 335 | 0.02336 |
| 21004A001 | GRAND-PLACE | 7,888.63 | 324 | 525 | 0.10775 |
| 21004A002 | BOURSE | 15,107.72 | 233 | 331 | 0.03952 |
| 21004A01- | VIEILLE HALLE AUX BLES | 10,463.84 | 406 | 541 | 0.09002 |
| 21004A02- | SAINT-FRANCOIS XAVIER | 13,545.64 | 782 | 858 | 0.13650 |
| 21004A03- | BON SECOURS - PALAIS DU MIDI | 20,317.02 | 899 | 1,169 | 0.10523 |
| 21004A04- | NOTRE-DAME DE LA CHAPELLE | 14,606.34 | 567 | 605 | 0.07695 |
| 21004A10- | GARE CENTRALE | 412.99 | 34 | 46 | 0.19371 |
| 21004A12- | REGENT (BOULEVARD DU) | 1,819.38 | 65 | 89 | 0.08190 |
| 21004A13- | PETIT SABLON | 3,348.09 | 450 | 469 | 0.27478 |
| 21004A14- | GRAND SABLON | 9,872.47 | 854 | 959 | 0.18871 |
| 21004A15- | JACOBS (PLACE) | 8,192.63 | 278 | 296 | 0.07482 |
| 21004A16- | PALAIS JUSTICE-HOP. ST.-PIERRE | 16,608.62 | 1,097 | 1,619 | 0.15895 |
| 21004A19- | PALAIS ROYAL | 117.81 | 21 | 14 | 0.29709 |
| 21004A1MJ | COLONIES (RUE DES) | 538.95 | 18 | 23 | 0.06865 |
| 21004A20- | BOURSE-NORD-OUEST | 17,791.31 | 1,133 | 1,344 | 0.13849 |
| 21004A21- | ANNEESSENS (PLACE) | 26,723.39 | 2,950 | 3,572 | 0.24293 |
| 21004A22- | SENNE (RUE DE LA) | 17,865.01 | 1,689 | 1,832 | 0.20056 |
| 21004A23- | NOUVEAU MARCHE AU GRAIN | 15,597.91 | 1,538 | 1,744 | 0.20516 |
| 21004A24- | MARCHE AU PORCS | 18,237.62 | 1,576 | 1,882 | 0.18922 |
| 21004A25- | BEGUINAGE (PLACE DU) | 13,229.40 | 819 | 969 | 0.14891 |
| 21004A30- | SAINT-MICHEL ET GUDULE | 337.55 | 6 | 14 | 0.05925 |
| 21004A32- | CONGRES - GARE | 6,437.95 | 592 | 681 | 0.20736 |
| 21004A33- | LIBERTE (PLACE DE LA) | 13,039.77 | 1,106 | 1,227 | 0.18750 |
| 21004A34- | MONNAIE | 7,010.48 | 406 | 618 | 0.14935 |
| 21004A35- | AD. MAX (BOULEVARD) | 7,861.15 | 545 | 745 | 0.16804 |
| 21004A3MJ | CITE ADMINISTRATIVE ET CONGRES | 1,365.20 | 53 | 82 | 0.10475 |
| 21004A70- | BLAES (RUE)-SUD | 27,764.10 | 2,320 | 2,455 | 0.16835 |
| 21004A71- | BLAES (RUE)-CENTRE | 20,955.12 | 770 | 928 | 0.07879 |
| 21004A72- | SAINT-THOMAS (INSTITUT) | 19,462.73 | 741 | 890 | 0.08591 |
| 21004A811 | QUAI DU COMMERCE | 22,318.67 | 1,234 | 1,395 | 0.12084 |
| 21004A822 | RUE DES COMMERCANTS | 20,022.70 | 262 | 428 | 0.03491 |
| 21004A83- | E. JACQMAIN (BOULEVARD)-OUEST | 19,345.17 | 664 | 851 | 0.08002 |
| 21004B10- | ORBAN (SQUARE) | 1,433.79 | 200 | 219 | 0.32711 |
| 21004B112 | RUE DU COMMERCE | 979.84 | 19 | 22 | 0.03878 |
| 21004B13- | TREVES (RUE DE) | 4,880.68 | 197 | 215 | 0.09896 |
| 21004B1MJ | RUE JOSEPH II | VS | 0 | 0 | 0.05199 |
| 21004B293 | LEOPOLD (PARC) | 1,286.17 | 78 | 64 | 0.11196 |
| 21004B2MJ | SCHUMAN (ROND-POINT) | 4,033.40 | 294 | 312 | 0.15967 |
| 21004B2NJ | CITE DE LA CHAUSSEE | 4,856.05 | 169 | 213 | 0.07784 |
| 21004B2WJ | RUE DE PASCAL - ST.-SACREMENT | 5,146.61 | 175 | 180 | 0.07131 |
| 21004B411 | DEUX EGLISES (RUE DES) | 13,756.17 | 747 | 804 | 0.11173 |
| 21004B421 | MARIE-LOUISE (SQUARE) | 16,448.46 | 1,774 | 1,935 | 0.22513 |
| 21004B43- | AMBIORIX-NORD (SQUARE) | 22,480.37 | 2,829 | 2,709 | 0.25413 |
| 21004B44- | AMBIORIX-SUD (SQUARE) | 13,854.21 | 1,455 | 1,389 | 0.21401 |
| 21004B45- | ECOLE MILITAIRE | 11,042.70 | 759 | 780 | 0.13964 |
| 21004B49- | CINQUANTENAIRE (PARC DU) | VS | 8 | 11 | 0.32650 |
| 21004C501 | LOUISE (AVENUE)-NORD | 7,021.79 | 302 | 257 | 0.08545 |
| 21004C51- | LOUISE (AVENUE)-NORD-EST | 12,084.27 | 524 | 505 | 0.08830 |
| 21004C52- | LOUISE (AVENUE)-NORD-OUEST | 14,301.65 | 603 | 531 | 0.08300 |
| 21004C53- | LOUISE (AVENUE)-SUD-OUEST | 9,412.27 | 398 | 397 | 0.08521 |
| 21004C54- | LOUISE (AVENUE)-SUD-EST | 8,244.90 | 904 | 828 | 0.21625 |
| 21004C552 | LOUISE (AVENUE)-SUD | 10,258.30 | 857 | 840 | 0.16903 |
| 21004C591 | CAMBRE (BOIS DE LA) | VS | 0 | 1 | 1.25297 |
| 21004C61- | U.L.B. | 3,961.24 | 472 | 405 | 0.24386 |
| 21004C62- | BOENDAAL-OUEST | 7,458.22 | 350 | 304 | 0.09453 |
| 21004C63- | NATIONS (SQUARE DES) | 5,274.07 | 700 | 634 | 0.26962 |
| 21004C642 | AVENUE FRANKLIN ROOSEVELT | 1,652.26 | 201 | 171 | 0.21667 |
| 21004C65- | VIVIER D'OIE | 2,315.70 | 188 | 178 | 0.15589 |
| 21004D600 | PARVIS SAINT-ROCH | 21,901.59 | 642 | 606 | 0.05328 |
| 21004D610 | ANVERS (CHAUSSEE D')-SUD | 11,585.56 | 1,422 | 1,431 | 0.24824 |
| 21004D62- | ANVERS (CHAUSSEE D')-NORD | 20,807.58 | 1,685 | 1,902 | 0.17321 |
| 21004D631 | ALLEE VERTE - BASSIN VERGOTE | 1,372.73 | 244 | 331 | 0.47861 |
| 21004D64- | MASUI (PLACE)-NORD | 4,365.37 | 505 | 519 | 0.23526 |
| 21004D672 | QUAI DE WILLEBROECK | 14,033.96 | 551 | 614 | 0.08800 |
| 21004D6MJ | QUAI DES USINES - MONNOYER | VS | 5 | 3 | 1.64215 |
| 21004D6NJ | TOUR ET TAXIS | 610.04 | 150 | 164 | 0.51636 |
| 21004E101 | PARVIS NOTRE DAME | 15,750.77 | 1,066 | 1,091 | 0.13745 |
| 21004E112 | RUE DES CHRYSANTHEMES | 24,625.42 | 266 | 269 | 0.02104 |
| 21004E12- | PRINCE LEOPOLD (SQUARE) | 22,093.52 | 2,765 | 2,740 | 0.24623 |
| 21004E130 | SACRE-COEUR | 16,532.36 | 2,611 | 2,789 | 0.33226 |
| 21004E14- | ECOLE DES CADETS | 7,243.25 | 1,455 | 1,483 | 0.40231 |
| 21004E180 | DOMAINE ROYALE | 10.44 | 14 | 10 | 2.58709 |
| 21004E193 | N.D. DE LAEKEN | VS | 0 | 0 | 0.07140 |
| 21004E201 | AVENUE JEAN DE BOLOGNE | 13,821.32 | 2,861 | 2,609 | 0.40003 |
| 21004E211 | RUE DE WAND | 11,513.25 | 486 | 457 | 0.08182 |
| 21004E222 | MUTSAARD (AVENUE) | 24,942.57 | 1,413 | 1,164 | 0.10652 |
| 21004E233 | DE MEYSSE (AVENUE) | 2,155.09 | 365 | 310 | 0.30440 |
| 21004E292 | AVENUE DES CROIX DU FEU | VS | 3 | 3 | 0.20313 |
| 21004E70- | MARIE-CHRISTINE (RUE) | 17,984.16 | 2,704 | 2,985 | 0.31439 |
| 21004E72- | MAISON ROUGE (PLACE)-SUD | 20,375.92 | 2,943 | 3,188 | 0.33859 |
| 21004E73- | EM. BOCKSTAEL (BOULEVARD)-SUD | 23,656.14 | 1,869 | 2,069 | 0.16647 |
| 21004E74- | EM. DELVA (RUE) | 16,781.39 | 4,053 | 4,291 | 0.49752 |
| 21004E800 | DIVIN JESUS | 8,987.91 | 654 | 580 | 0.14097 |
| 21004E81- | DISQUE (RUE DU) | 13,215.17 | 769 | 625 | 0.10798 |
| 21004E82- | CITE MODELE | 13,963.90 | 1,934 | 1,669 | 0.25301 |
| 21004E83- | STIENON (AVENUE) | 19,035.31 | 2,295 | 2,129 | 0.23682 |
| 21004E8MJ | HEYSEL | 123.66 | 122 | 61 | 1.57689 |
| 21004E8NJ | HOPITAL BRUGMANN | VS | 17 | 2 | 0.20501 |
| 21004F511 | AVENUE DES PAGODES | 10,103.98 | 955 | 877 | 0.18300 |
| 21004F522 | AVENUE DE VERSAILLES | 7,603.40 | 1,299 | 1,134 | 0.31183 |
| 21004F531 | RUE DES FAINES | 15,205.17 | 1,473 | 1,416 | 0.19868 |
| 21004F572 | MARLY-SUD | 82.45 | 23 | 28 | 0.66706 |
| 21004F901 | PLACE PETER BENOIT | 8,351.31 | 1,052 | 937 | 0.23182 |
| 21004F91- | CROIX DE GUERRE (AVENUE DES) | 10,162.32 | 1,436 | 1,315 | 0.27366 |
| 21004F922 | RUE CHATEAU BEYAERD | 9,473.66 | 1,519 | 1,531 | 0.32754 |
| 21004F930 | COIN DES CERISES | 21,395.56 | 1,090 | 899 | 0.09320 |
| 21004F94- | VAL MARIA | 3,985.72 | 474 | 392 | 0.19444 |
| 21004F953 | RUE DU WIMPELBERG | 5,360.33 | 756 | 641 | 0.29942 |
| 21004F970 | MARLY-NORD | 207.20 | 85 | 95 | 0.91218 |
| 21004F994 | TRASSERSWEG - NEDER-HEEMBEEK | 277.80 | 48 | 40 | 0.31678 |
| 21004F9MJ | NEDER-HEEMBEEK-NORD | 1,299.31 | 734 | 712 | 1.14291 |
| 21004G30- | SAINTE-ELISABETH | 5,110.53 | 1,687 | 1,683 | 0.67547 |
| 21004G310 | HAREN-SUD-OUEST | 3,743.52 | 550 | 546 | 0.30773 |
| 21004G321 | HAREN-EST | 3,730.45 | 532 | 550 | 0.29514 |
| 21004G371 | GARE DE FORMATION | VS | 3 | 3 | 2.07856 |
| 21004G3MJ | DOBBELENBERG (RUE DE) | 747.88 | 249 | 222 | 0.65920 |
| 21004G3NJ | HAREN-SUD | 221.26 | 194 | 191 | 2.10608 |
| 21005A00- | HOTEL COMMUNAL | 14,415.75 | 1,966 | 1,856 | 0.26853 |
| 21005A01- | SAINTE-GERTRUDE | 17,906.07 | 1,810 | 1,719 | 0.19692 |
| 21005A02- | CHAMP DU ROI (RUE) | 22,641.24 | 1,495 | 1,446 | 0.13029 |
| 21005A031 | MAELBEEK | 17,883.60 | 876 | 773 | 0.09182 |
| 21005A042 | PH. BAUCQ (RUE) | 26,557.58 | 2,196 | 2,165 | 0.16131 |
| 21005A051 | RINSDELLE | 20,233.76 | 2,308 | 1,988 | 0.22102 |
| 21005A082 | COURS ST-MICHEL | 3,667.63 | 150 | 125 | 0.07607 |
| 21005A10- | GENERAL HENRI (RUE) | 17,297.45 | 1,841 | 1,681 | 0.20171 |
| 21005A11- | NOTRE-DAME DU SACRE-COEUR | 17,369.38 | 1,755 | 1,478 | 0.18665 |
| 21005A12- | SAINT-ANTOINE | 19,670.23 | 3,338 | 3,384 | 0.34158 |
| 21005A13- | LA CHASSE | 21,418.71 | 745 | 709 | 0.06835 |
| 21005A14- | ARMEE (AVENUE DE L') | 13,647.96 | 1,712 | 1,553 | 0.23637 |
| 21005A15- | SAINT-MICHEL COLLEGE | 6,649.96 | 1,053 | 951 | 0.29684 |
| 21005A20- | PORTE DE TERVUEREN - TONGRES | 13,878.80 | 968 | 854 | 0.13596 |
| 21005A21- | PORTE DE TERVUEREN - BRAFFORT | 13,124.65 | 405 | 345 | 0.05646 |
| 21005A22- | PORTE DE TERVUEREN - L. DE LAN | 12,559.71 | 558 | 539 | 0.08710 |
| 21005A29- | CINQUANTENAIRE (PARC) | VS | 0 | 0 | 0.05753 |
| 21005A311 | CASERNE (Etterbeek) | 6,269.28 | 912 | 821 | 0.27627 |
| 21005A322 | NOUVELLE AVENUE-SUD | 27,733.68 | 206 | 144 | 0.01204 |
| 21005A33- | CARDINAL LAVIGERIE (RUE) | 20,484.04 | 797 | 722 | 0.07254 |
| 21006A001 | VIEIL EVERE | 15,862.74 | 1,554 | 1,504 | 0.19536 |
| 21006A011 | CENTRE | 15,577.90 | 1,441 | 1,373 | 0.18526 |
| 21006A02- | IEDER ZIJN HUIS - STROOBANTS | 18,006.53 | 373 | 265 | 0.03465 |
| 21006A03- | BLOCS SAINT-VINCENT | 44,701.34 | 438 | 351 | 0.01839 |
| 21006A042 | KERKHOEK | 8,367.13 | 648 | 597 | 0.15214 |
| 21006A052 | CHAMP DE REPOS | 14,510.53 | 1,249 | 1,256 | 0.17801 |
| 21006A073 | GARE DE FORMATION | VS | 0 | 0 | 0.21776 |
| 21006A094 | BON PASTEUR | 1,491.69 | 248 | 193 | 0.30971 |
| 21006A101 | CONSCIENCE | 18,607.60 | 2,352 | 2,141 | 0.24039 |
| 21006A11- | OASIS - PROVENCE - LANGUEDOC | 4,604.48 | 453 | 427 | 0.19047 |
| 21006A12- | GERMINAL I | 14,827.78 | 439 | 338 | 0.05611 |
| 21006A13- | MAISON COMMUNALE | 15,752.50 | 772 | 694 | 0.09687 |
| 21006A142 | ED. DEKNOOP (RUE) | 22,262.42 | 657 | 617 | 0.05871 |
| 21006A153 | KEET | 13,668.17 | 671 | 587 | 0.09584 |
| 21006A171 | ANCIEN COMBATTANTS (AVENUE) | 1,903.22 | 299 | 319 | 0.45502 |
| 21006A201 | HAUT-EVERE | 12,557.70 | 1,361 | 1,229 | 0.20832 |
| 21006A21- | HOME FAMILIAL BRABANT | 9,298.49 | 620 | 531 | 0.12303 |
| 21006A22- | SAINT-EXUPERY | 22,128.43 | 1,127 | 979 | 0.09644 |
| 21006A23- | DU BONHEUR | 15,612.90 | 1,575 | 1,384 | 0.19657 |
| 21006A24- | IEDER ZIJN HUIS - ZAVENTEM | 9,608.12 | 287 | 257 | 0.06213 |
| 21006A25- | GIBET | 8,166.76 | 622 | 453 | 0.13175 |
| 21006A272 | QUARTIER GROSJEAN | 608.28 | 77 | 27 | 0.17591 |
| 21006A312 | J. BORDET (AVENUE DE) | 5,005.31 | 235 | 266 | 0.10249 |
| 21006A323 | GERMINAL II | 10,580.66 | 521 | 364 | 0.08648 |
| 21006A37- | ZONE INDUSTRIELLE | 485.68 | 70 | 84 | 0.33561 |
| 21006A403 | QUARTIER CICERO | 18,425.75 | 1,002 | 951 | 0.09427 |
| 21006A414 | P. DUPONT (RUE) | 13,041.74 | 1,675 | 1,526 | 0.24636 |
| 21006A474 | COMMUNAUTES | 7,485.48 | 530 | 555 | 0.16365 |
| 21006A48- | CIMETIERE BRUXELLES | 44.84 | 13 | 13 | 0.49063 |
| 21006A515 | CARLI | 8,286.59 | 536 | 541 | 0.13021 |
| 21007A00- | CENTRE SAINT-DENIS | 11,447.88 | 1,596 | 1,740 | 0.29429 |
| 21007A01- | CURE D'ARS | 8,996.85 | 631 | 631 | 0.14394 |
| 21007A02- | STUART MERRIL | 5,572.18 | 300 | 298 | 0.10678 |
| 21007A03- | FOYER FORESTOIS - FAMILLE | 16,448.71 | 612 | 510 | 0.06700 |
| 21007A04- | FOYER FORESTOIS - MADELON | 7,125.51 | 237 | 182 | 0.03663 |
| 21007A05- | NEERSTALLE | 7,830.29 | 472 | 507 | 0.13205 |
| 21007A06- | KATANGA | 25,174.15 | 353 | 358 | 0.02832 |
| 21007A071 | BOLLINCKX | 1,046.89 | 554 | 618 | 1.25228 |
| 21007A082 | BEMPT | 80.82 | 34 | 21 | 0.66815 |
| 21007A101 | BOURGOGNE | 17,333.61 | 1,448 | 1,375 | 0.16534 |
| 21007A111 | MESSIDOR I | 6,275.63 | 318 | 271 | 0.09688 |
| 21007A12- | HAVESKERCKE | 4,962.29 | 129 | 124 | 0.05441 |
| 21007A132 | DENAYER (RUE) | 7,759.93 | 77 | 86 | 0.02049 |
| 21007A142 | MONTE CARLO | 14,300.08 | 761 | 700 | 0.10538 |
| 21007A201 | ROOSENDAEL (RUE) | 11,885.70 | 1,477 | 1,144 | 0.21682 |
| 21007A21- | MAGNANERIE | 23,572.98 | 308 | 219 | 0.02295 |
| 21007A239 | NEPTUNE (AVENUE) I | 22,544.41 | 1,743 | 1,348 | 0.13862 |
| 21007A242 | GLOBE | 22,629.11 | 347 | 269 | 0.02735 |
| 21007A252 | MESSIDOR II | 18,438.94 | 156 | 105 | 0.01388 |
| 21007A291 | FOREST NATIONAL - STADE | VS | 3 | 4 | 0.10381 |
| 21007A373 | CHARROI (RUE DE) | VS | 11 | 7 | 0.25237 |
| 21007A40- | PONT DE LUTTRE | 22,320.68 | 971 | 1,060 | 0.09417 |
| 21007A41- | PONT DE LUTTRE-OUEST | 10,346.89 | 255 | 257 | 0.05055 |
| 21007A50- | BERANGER | 21,146.61 | 1,540 | 1,575 | 0.14494 |
| 21007A51- | CHATAIGNE | 13,548.84 | 480 | 486 | 0.07366 |
| 21007A52- | VAN VOLXEM - PETITE INDUSTRIE | 11,544.02 | 587 | 515 | 0.09659 |
| 21007A53- | WIELEMANS CEUPPENS | 18,231.82 | 1,392 | 1,373 | 0.15073 |
| 21007A541 | LYCEE | 14,349.08 | 310 | 313 | 0.04293 |
| 21007A552 | REINE MARIE-HENRIETTE | 4,325.91 | 127 | 140 | 0.06218 |
| 21007A60- | SAINT-ANTOINE | 30,691.33 | 2,184 | 2,297 | 0.14450 |
| 21007A61- | MONTENEGRO (RUE) | 30,170.58 | 2,678 | 2,575 | 0.17225 |
| 21007A70- | ALTITUDE CENT | 15,574.79 | 1,784 | 1,454 | 0.21098 |
| 21007A71- | CHAUSSEE D'ALSEMBERG | 24,493.96 | 716 | 647 | 0.05683 |
| 21007A72- | MOLIERE | 17,860.91 | 2,365 | 2,180 | 0.25318 |
| 21007A73- | BERCKENDAEL (RUE) | 8,713.31 | 1,150 | 1,064 | 0.25157 |
| 21007A75- | TOURNOI (RUE DU) | 19,307.68 | 542 | 472 | 0.05345 |
| 21007A783 | PARC DE FOREST | 2,820.17 | 246 | 248 | 0.18084 |
| 21007A79- | PARC DUDEN | VS | 5 | 4 | 0.30569 |
| 21007A814 | VILLAS - MONT KEMMEL | 14,949.21 | 87 | 91 | 0.01124 |
| 21008A00- | CENTRE | 11,539.01 | 566 | 546 | 0.09455 |
| 21008A01- | VAN PAGE-SUD | 12,600.26 | 320 | 310 | 0.04841 |
| 21008A02- | SIPPELBERG | 16,991.58 | 1,483 | 1,524 | 0.17956 |
| 21008A10- | PLATEAU | 15,473.59 | 1,619 | 1,616 | 0.21268 |
| 21008A19- | BASILIQUE | VS | 2 | 0 | 0.04428 |
| 21008A20- | CHARLES-QUINT | 23,480.59 | 2,135 | 2,034 | 0.18002 |
| 21008A21- | MAIL | 16,647.05 | 1,294 | 1,165 | 0.15180 |
| 21008A220 | VILLAS DE GANSHOREN (OUEST) | 15,570.75 | 1,686 | 1,330 | 0.19704 |
| 21008A23- | DE MESMAEKER | 1,975.35 | 182 | 132 | 0.15997 |
| 21008A240 | REFORME | 13,858.52 | 850 | 622 | 0.10824 |
| 21008A27- | NESTOR MARTIN | VS | 0 | 0 | 0.09325 |
| 21008A29- | RIVIERE MOLENBEEK | VS | 0 | 0 | 0.39033 |
| 21008A30- | LE HOME | 10,891.52 | 664 | 616 | 0.11982 |
| 21008A31- | TOUSSAINT | 15,290.12 | 244 | 219 | 0.03244 |
| 21008A32- | HEIDEKEN | 19,258.67 | 862 | 734 | 0.08349 |
| 21008A33- | VAN PAGE-NORD | 12,024.60 | 609 | 565 | 0.09788 |
| 21008A34- | PARC ALBERT | 4,452.60 | 285 | 300 | 0.13251 |
| 21008A35- | CHARTE | 8,087.77 | 175 | 169 | 0.04204 |
| 21008A38- | PARC DE RIVIEREN | VS | 0 | 1 | 0.06540 |
| 21009A00- | CENTRE | 19,423.34 | 1,298 | 1,314 | 0.13283 |
| 21009A01- | BLYCKAERTS | 16,930.65 | 1,074 | 1,088 | 0.13077 |
| 21009A02- | MUSEE | 26,780.65 | 1,560 | 1,704 | 0.12195 |
| 21009A03- | ERMITAGE | 14,643.12 | 1,052 | 932 | 0.14355 |
| 21009A041 | ARBRE BENIT | 16,964.63 | 1,222 | 1,156 | 0.14153 |
| 21009A051 | SAINT-BONIFACE | 19,819.43 | 653 | 684 | 0.06877 |
| 21009A101 | FLAGEY (PLACE) | 24,827.75 | 943 | 852 | 0.07302 |
| 21009A111 | WERY (RUE) | 21,153.88 | 1,629 | 1,613 | 0.15037 |
| 21009A121 | GENERAL DE GAULLE | 13,316.92 | 647 | 589 | 0.09199 |
| 21009A13- | GACHARD | 17,758.61 | 744 | 705 | 0.08069 |
| 21009A151 | A. DELPORTE-NORD | 11,872.76 | 473 | 499 | 0.08136 |
| 21009A192 | ETANGS | VS | 0 | 1 | 0.10022 |
| 21009A20- | PETITE SUISSE (PLACE DE LA) | 15,839.36 | 1,555 | 1,617 | 0.19691 |
| 21009A21- | ETE | 16,175.75 | 1,734 | 1,918 | 0.22991 |
| 21009A22- | UNIVERSITE | 17,434.63 | 2,093 | 1,842 | 0.23172 |
| 21009A23- | ETOILE (ROND POINT DE L') | 15,468.04 | 1,196 | 1,070 | 0.14734 |
| 21009A29- | CIMETIERE | VS | 0 | 1 | 0.11472 |
| 21009A2MJ | CAMPUS UNIVERSITAIRE | 1,885.60 | 461 | 426 | 0.58761 |
| 21009A301 | BOONDAEL-NORD | 12,570.23 | 535 | 454 | 0.07804 |
| 21009A311 | TREILLE (RUE DE LA) | 14,413.43 | 173 | 157 | 0.02387 |
| 21009A33- | SAINT-ADRIEN | 16,569.20 | 2,167 | 1,793 | 0.24002 |
| 21009A34- | STADE COMMUNAL | 5,553.84 | 238 | 235 | 0.08769 |
| 21009A40- | MELEZES | 13,852.24 | 983 | 892 | 0.14019 |
| 21009A41- | SAINT-GEORGES | 17,842.31 | 1,178 | 1,101 | 0.12986 |
| 21009A42- | RENIER CHALON | 14,522.92 | 1,455 | 1,286 | 0.19108 |
| 21009A43- | FERNAND NEURAY | 14,997.75 | 990 | 878 | 0.12529 |
| 21009A44- | PREVOT | 15,261.24 | 968 | 1,039 | 0.13151 |
| 21009A451 | CHATELAIN (PLACE DU)-EST | 15,532.86 | 1,294 | 1,154 | 0.15767 |
| 21009A501 | LUXEMBOURG (PLACE DE) | 7,140.81 | 214 | 188 | 0.05924 |
| 21009A512 | WIERTZ | 10,417.37 | 122 | 127 | 0.02697 |
| 21009A52- | GRAY (RUE) | 19,611.47 | 1,825 | 1,831 | 0.18423 |
| 21009A53- | LONDRES (PLACE DE) | 19,553.35 | 1,749 | 1,849 | 0.18585 |
| 21009A542 | EGLISE ANGLICANE | 11,972.40 | 338 | 325 | 0.05805 |
| 21009A552 | PORTE DE NAMUR | 15,380.10 | 690 | 796 | 0.09896 |
| 21009A593 | QUARTIER LEOPOLD | VS | 0 | 0 | 0.05721 |
| 21009A602 | BELVEDERE | 8,549.20 | 174 | 198 | 0.04199 |
| 21009A612 | LIEGEOIS (RUE) | 22,148.03 | 1,579 | 1,460 | 0.13464 |
| 21009A623 | KLAUWAERTS | 12,951.91 | 160 | 163 | 0.02563 |
| 21009A63- | MACAU | 17,549.61 | 1,486 | 1,298 | 0.15681 |
| 21009A652 | HOPITAUX | 22,340.07 | 1,461 | 1,450 | 0.13460 |
| 21009A712 | CHATELAIN (PLACE DU)-OUEST | 16,411.12 | 441 | 432 | 0.05368 |
| 21009A72- | DEFACQZ | 17,824.96 | 929 | 866 | 0.10048 |
| 21009A73- | BERCKENDAEL | 11,286.26 | 1,391 | 1,262 | 0.23303 |
| 21009A802 | BOONDAEL-SUD | 3,625.51 | 150 | 140 | 0.07751 |
| 21009A812 | SCHOOLGAT | 4,369.53 | 227 | 227 | 0.10321 |
| 21009A82- | FORET | 8,920.48 | 690 | 516 | 0.14271 |
| 21009A83- | L. ERNOTTE (RUE) | 10,382.02 | 539 | 512 | 0.09863 |
| 21009A90- | SAINT-PHILIPPE DE NERI | 11,242.05 | 767 | 778 | 0.13788 |
| 21009A911 | A. DELPORTE-SUD | 21,248.74 | 856 | 812 | 0.07888 |
| 21009A922 | CASERNE (Ixelles) | 3,818.07 | 172 | 166 | 0.08591 |
| 21010A00- | CENTRE | 15,226.81 | 3,264 | 2,960 | 0.41210 |
| 21010A01- | ESSEGHEM | 19,943.55 | 2,686 | 2,295 | 0.25321 |
| 21010A02- | LEOPOLD I | 18,785.28 | 2,276 | 2,139 | 0.23284 |
| 21010A03- | MIROIR | 15,043.66 | 1,702 | 1,683 | 0.22275 |
| 21010A04- | NOTRE-DAME DE LOURDES | 16,229.72 | 2,344 | 2,190 | 0.28429 |
| 21010A05- | ALBERT (QUARTIER) | 20,008.79 | 2,885 | 2,873 | 0.29067 |
| 21010A092 | PARC DE LA JEUNESSE | VS | 0 | 0 | 0.10867 |
| 21010A10- | ANCIENNE BARRIERE | 10,765.56 | 1,106 | 1,060 | 0.20148 |
| 21010A111 | HEYMBOSCH | 13,084.44 | 1,640 | 1,360 | 0.23203 |
| 21010A121 | F. MOHRFELD (RUE DE) | 15,146.90 | 688 | 617 | 0.08688 |
| 21010A13- | CITE-JARDIN | 16,324.54 | 2,354 | 2,116 | 0.27333 |
| 21010A141 | BRUGMANN | 18,969.91 | 2,331 | 1,961 | 0.22378 |
| 21010A182 | DIELEGEM (BOIS DE) | VS | 1 | 1 | 0.20112 |
| 21010A1AJ | ARBRE BALLON | 6,263.91 | 1,550 | 1,468 | 0.47989 |
| 21010A21- | MADELEINE | 17,990.85 | 1,926 | 1,888 | 0.21244 |
| 21010A312 | BAECK DUPRE | 5,639.56 | 483 | 481 | 0.17324 |
| 21010A393 | SACRE-COEUR | 523.05 | 43 | 47 | 0.16442 |
| 21010A493 | LAERBEEK (BOIS DE) | 31.48 | 11 | 9 | 0.76243 |
| 21010A4MJ | VUB | 112.47 | 22 | 30 | 0.37344 |
| 21011A00- | VANHUFFEL | 18,715.82 | 1,083 | 1,199 | 0.11910 |
| 21011A01- | SAINTE-ANNE | 30,213.41 | 2,242 | 2,143 | 0.14434 |
| 21011A02- | JACQUET (RUE DE) | 24,419.98 | 1,033 | 1,094 | 0.08673 |
| 21011A10- | PAIX (AVENUE DE LA) | 25,751.60 | 1,356 | 1,244 | 0.10205 |
| 21011A11- | LEPREUX | 31,050.38 | 1,163 | 1,026 | 0.07088 |
| 21011A12- | BASILIQUE | 21,399.61 | 1,075 | 970 | 0.09832 |
| 21011A20- | PLATEAU | 16,154.49 | 1,876 | 1,842 | 0.22966 |
| 21011A29- | PARC ELISABETH | VS | 0 | 0 | 0.18856 |
| 21011A30- | ARCHERS - FOUREZ | 17,553.34 | 1,221 | 1,417 | 0.14806 |
| 21012A00- | CENTRE | 26,369.36 | 1,197 | 1,293 | 0.09587 |
| 21012A011 | CANAL-SUD | 23,032.57 | 589 | 688 | 0.05557 |
| 21012A02- | BRUNFAUT (QUARTIER) | 15,841.84 | 476 | 422 | 0.05523 |
| 21012A03- | RANSFORT | 24,705.38 | 973 | 967 | 0.07885 |
| 21012A041 | QUATRE VENTS | 28,502.32 | 1,001 | 1,090 | 0.07220 |
| 21012A05- | SAINT-JOSEPH | 31,286.63 | 536 | 581 | 0.03612 |
| 21012A10- | DUCHESSE DE BRABANT | 20,234.19 | 1,183 | 1,334 | 0.12311 |
| 21012A11- | INDUSTRIE | 7,993.46 | 649 | 780 | 0.18390 |
| 21012A12- | BIRMINGHAM-SUD | 11,189.01 | 674 | 732 | 0.12459 |
| 21012A13- | BIRMINGHAM-NORD | 11,968.95 | 715 | 820 | 0.12399 |
| 21012A141 | INDEPENDANCE | 27,873.21 | 1,314 | 1,377 | 0.09845 |
| 21012A152 | ETANGS NOIRS | 31,031.01 | 2,793 | 3,062 | 0.18591 |
| 21012A172 | GARE OUEST | 13,060.76 | 574 | 569 | 0.11401 |
| 21012A20- | BAECK | 17,434.93 | 1,080 | 957 | 0.11724 |
| 21012A21- | MARIE-JOSE BLOCS | 41,940.51 | 1,024 | 813 | 0.04394 |
| 21012A22- | BRASILIA | 6,360.23 | 143 | 125 | 0.04135 |
| 21012A23- | MACHTENS-SUD | 21,163.23 | 1,916 | 1,667 | 0.17171 |
| 21012A24- | OSSEGHEM | 26,723.24 | 1,904 | 1,743 | 0.13902 |
| 21012A25- | BEEKKANT | 26,523.08 | 436 | 412 | 0.03186 |
| 21012A26- | MACHTENS-NORD | 25,455.02 | 2,067 | 1,778 | 0.15192 |
| 21012A29- | MARIE-JOSE (PARC) | VS | 0 | 0 | 0.07855 |
| 21012A2MJ | CHEMIN DE FER | 530.92 | 31 | 33 | 0.11866 |
| 21012A30- | METTEWIE - IDYLLE | 10,158.45 | 1,187 | 1,038 | 0.21499 |
| 21012A39- | DE RAEDT | 199.34 | 58 | 31 | 0.45652 |
| 21012A41- | MOORTEBEEK | 6,603.02 | 833 | 780 | 0.24337 |
| 21012A50- | BENES | 18,834.75 | 1,777 | 1,578 | 0.17861 |
| 21012A511 | STEYNS | 19,625.33 | 1,515 | 1,489 | 0.15770 |
| 21012A52- | NEEP (QUARTIER DU) | 18,506.75 | 2,018 | 1,854 | 0.21311 |
| 21012A53- | SIPPELBERG | 9,503.36 | 175 | 176 | 0.03851 |
| 21012A54- | DELHAIZE | 12,677.14 | 1,649 | 1,640 | 0.26071 |
| 21012A552 | PFEIFFER | 32,648.18 | 718 | 652 | 0.04239 |
| 21012A59- | KARREVELD | VS | 8 | 11 | 0.18596 |
| 21012A60- | LAEKENVELD | 26,657.46 | 2,447 | 2,521 | 0.18798 |
| 21012A611 | MEXICO | 25,205.79 | 818 | 910 | 0.06915 |
| 21012A62- | LIBERATEURS | 28,919.53 | 2,661 | 2,814 | 0.18877 |
| 21012A63- | DUBRUCQ-NORD | 16,114.89 | 1,124 | 1,168 | 0.13764 |
| 21012A672 | ULENS | 16,306.79 | 1,230 | 1,375 | 0.15926 |
| 21012A71- | PIERS | 27,659.43 | 1,835 | 2,133 | 0.14237 |
| 21012A72- | LAVALLEE | 26,012.68 | 1,339 | 1,420 | 0.10710 |
| 21012A732 | CANAL-NORD | 18,073.94 | 636 | 731 | 0.07591 |
| 21012A811 | MYRTES-NORD | 15,671.44 | 425 | 477 | 0.05788 |
| 21012A822 | KORENBEEK | 19,894.25 | 2,471 | 2,322 | 0.24464 |
| 21012A833 | ELBERS | 4,072.91 | 260 | 171 | 0.11220 |
| 21012A84- | METTEWIE-BUILDINGS | 29,603.42 | 1,138 | 987 | 0.07090 |
| 21012A851 | CONDOR | 11,944.27 | 747 | 638 | 0.12391 |
| 21012A882 | DARING | 5,435.67 | 260 | 274 | 0.09401 |
| 21013A00- | HOTEL DE VILLE | 22,404.43 | 1,827 | 1,713 | 0.15341 |
| 21013A01- | ESPAGNE (RUE D') | 21,436.46 | 1,725 | 1,596 | 0.15469 |
| 21013A02- | CAPOUILLET (RUE) | 17,654.28 | 1,659 | 1,513 | 0.18120 |
| 21013A031 | AMAZONE (RUE DE) | 17,789.63 | 749 | 651 | 0.08055 |
| 21013A04- | PRISON | 11,522.93 | 887 | 833 | 0.15109 |
| 21013A052 | FAIDER (RUE) | 13,784.51 | 691 | 668 | 0.09881 |
| 21013A101 | PARVIS | 26,947.91 | 1,284 | 1,271 | 0.09463 |
| 21013A102 | PARVIS | 35,248.17 | 203 | 228 | 0.01172 |
| 21013A11- | PARME (RUE DE) | 12,730.47 | 837 | 828 | 0.12930 |
| 21013A121 | GUILLAUME TELL-SUD | 34,608.55 | 416 | 456 | 0.02465 |
| 21013A13- | DETHY (RUE) | 31,662.51 | 1,130 | 1,170 | 0.06989 |
| 21013A151 | METAL (RUE DU) | 25,409.14 | 975 | 975 | 0.07572 |
| 21013A201 | ANGLETERRE (RUE D') | 17,399.32 | 1,091 | 1,271 | 0.13615 |
| 21013A211 | FONTAINAS | 28,196.47 | 1,181 | 1,133 | 0.08097 |
| 21013A22- | REGIES | 33,546.36 | 1,828 | 1,988 | 0.11363 |
| 21013A23- | ROI (AVENUE DU) | 16,687.17 | 765 | 756 | 0.08677 |
| 21013A242 | BETHLEEM (PLACE DE) | 24,420.24 | 876 | 981 | 0.07445 |
| 21013A252 | DANEMARK (RUE DE) | 30,632.17 | 1,021 | 1,079 | 0.06513 |
| 21013A2MJ | GARE DU MIDI | 115.59 | 15 | 16 | 0.24223 |
| 21013A40- | BARRIERE | 26,341.17 | 1,031 | 1,086 | 0.07855 |
| 21013A41- | VILLAS (AVENUE DES) | 30,517.81 | 1,373 | 1,315 | 0.08552 |
| 21013A422 | CRICKX (RUE) | 45,813.77 | 1,438 | 1,501 | 0.06337 |
| 21013A51- | TOISON D'OR (AVENUE) | 16,487.78 | 899 | 891 | 0.10838 |
| 21013A522 | RUE D'ECOSSE | 23,999.88 | 954 | 961 | 0.07833 |
| 21013A612 | JAMAR | 13,504.71 | 144 | 281 | 0.03340 |
| 21013A623 | FRANCE (RUE DE) | 1,175.41 | 27 | 34 | 0.05445 |
| 21014A00- | PLACE SAINT-JOSSE | 35,430.70 | 1,619 | 1,736 | 0.09941 |
| 21014A01- | STEURS | 30,255.18 | 573 | 577 | 0.03761 |
| 21014A02- | CHARITE | 28,704.16 | 878 | 930 | 0.06341 |
| 21014A03- | MADOU | 13,431.85 | 580 | 603 | 0.08807 |
| 21014A04- | HAECHT (CHAUSSEE DE) | 20,663.67 | 1,547 | 1,705 | 0.15176 |
| 21014A05- | HOUWAERT | 35,738.54 | 3,728 | 3,976 | 0.21526 |
| 21014A10- | SAINT-FRANCOIS | 29,009.97 | 1,295 | 1,346 | 0.08821 |
| 21014A12- | SAINT-LAZARE | 8,215.13 | 136 | 212 | 0.03920 |
| 21014A13- | ROGIER | VS | 0 | 0 | 0.03453 |
| 21014A14- | PRAIRIE | 33,868.85 | 611 | 724 | 0.04086 |
| 21014A18- | JARDIN BOTANIQUE | VS | 0 | 0 | 0.07049 |
| 21014A2MJ | NORD | VS | 3 | 2 | 0.03006 |
| 21014A3MJ | MANHATTAN | 5,256.26 | 255 | 292 | 0.10235 |
| 21014A41- | BOSSUET | 34,822.73 | 1,934 | 2,104 | 0.11596 |
| 21015A00- | COLIGNON (PLACE) | 27,754.25 | 3,686 | 3,859 | 0.26461 |
| 21015A01- | VAN YSENDYCK (RUE) | 12,836.18 | 512 | 515 | 0.08772 |
| 21015A021 | HOUFFALIZE (PLACE) | 38,239.18 | 1,741 | 1,813 | 0.09218 |
| 21015A03- | JOSAPHAT (RUE) | 27,970.23 | 2,749 | 2,692 | 0.19485 |
| 21015A04- | L'OLIVIER (RUE) | 28,449.53 | 2,422 | 2,524 | 0.17301 |
| 21015A05- | ROYALE SAINTE-MARIE (RUE) | 23,836.88 | 2,204 | 2,363 | 0.19306 |
| 21015A101 | GARE | 18,093.28 | 932 | 958 | 0.09937 |
| 21015A111 | MAETERLINCK | 21,203.69 | 1,381 | 1,426 | 0.13205 |
| 21015A12- | HUART HAMOIR (AVENUE) | 14,797.88 | 1,282 | 1,186 | 0.16746 |
| 21015A13- | PORTAELS (RUE) | 17,442.44 | 1,120 | 1,134 | 0.12945 |
| 21015A142 | SAINTE-FAMILLE | 2,680.94 | 129 | 104 | 0.08915 |
| 21015A152 | PR. ELISABETH-NORD | 33,634.21 | 1,798 | 1,813 | 0.10739 |
| 21015A20- | HELMET | 22,008.64 | 2,802 | 2,876 | 0.25663 |
| 21015A21- | GUIDO GEZELLE (RUE) | 23,062.97 | 1,079 | 1,062 | 0.08468 |
| 21015A22- | MARBOTIN A. (RUE) | 24,736.00 | 1,880 | 1,731 | 0.14497 |
| 21015A231 | J. BLOCKX (RUE) | 22,297.52 | 821 | 820 | 0.07162 |
| 21015A24- | WAELHEM (RUE) | 20,350.85 | 1,424 | 1,393 | 0.13601 |
| 21015A272 | HOPITAL P. BRIEN | 4,693.23 | 165 | 135 | 0.07692 |
| 21015A30- | GRANDE RUE AU BOIS | 21,277.40 | 1,844 | 1,810 | 0.17154 |
| 21015A31- | PATRIE | 17,526.16 | 1,286 | 1,269 | 0.14247 |
| 21015A32- | CONSOLATION (RUE DE LA) | 17,748.76 | 1,513 | 1,454 | 0.16497 |
| 21015A33- | BIENFAITEURS (PLACE DE) | 22,781.44 | 1,215 | 1,226 | 0.10416 |
| 21015A34- | PAQUERETTES (RUE) | 19,461.66 | 827 | 802 | 0.08268 |
| 21015A35- | JEAN STOBBAERTS (AVENUE) | 19,269.56 | 1,152 | 1,057 | 0.11163 |
| 21015A36- | CAMBIER (AVENUE E.) | 12,102.75 | 985 | 945 | 0.16261 |
| 21015A39- | JOSAPHAT (PARC) | VS | 6 | 5 | 0.38225 |
| 21015A40- | BRABANT (RUE DE) | 21,314.89 | 1,791 | 1,966 | 0.17288 |
| 21015A41- | VANDERLINDEN (RUE) | 20,049.31 | 1,607 | 1,767 | 0.16774 |
| 21015A421 | PALAIS (RUE DE) | 21,820.36 | 939 | 1,010 | 0.08891 |
| 21015A43- | GARE DU NORD | 9,074.52 | 827 | 973 | 0.19803 |
| 21015A44- | REINE (AVENUE) | 23,689.01 | 1,790 | 1,762 | 0.15488 |
| 21015A45- | STEPHENSON (PLACE) | 33,574.42 | 832 | 833 | 0.04807 |
| 21015A50- | OPALE | 19,790.42 | 2,675 | 2,451 | 0.26164 |
| 21015A51- | CERISIERS (AVENUE DES) | 11,231.83 | 906 | 804 | 0.15447 |
| 21015A52- | LINTHOUT (RUE) | 10,623.11 | 1,464 | 1,343 | 0.26904 |
| 21015A53- | DAILLY (PLACE) | 19,359.81 | 1,732 | 1,715 | 0.17624 |
| 21015A54- | EMERAUDE (AVENUE) | 21,158.60 | 2,647 | 2,452 | 0.24151 |
| 21015A612 | BRICHAUT (RUE DE) | 31,684.60 | 2,132 | 2,189 | 0.13666 |
| 21015A622 | BRUSILIA | 14,664.24 | 514 | 459 | 0.06710 |
| 21015A63- | DESCHANEL P. (AVENUE) | 18,556.94 | 816 | 784 | 0.08584 |
| 21015A64- | DUPLOYE SQUARE | 24,832.63 | 1,531 | 1,530 | 0.12262 |
| 21015A70- | P. HYMANS (RUE) | 22,748.17 | 997 | 934 | 0.08533 |
| 21015A71- | JARDINS | 12,927.74 | 859 | 740 | 0.12438 |
| 21015A721 | F. COURTENS (AVENUE) | 11,386.10 | 532 | 451 | 0.09072 |
| 21015A73- | H. EVENEPOEL (RUE) | 12,506.80 | 708 | 679 | 0.11050 |
| 21015A77- | R.T.B. | 4,860.07 | 1,068 | 1,256 | 0.48703 |
| 21015A782 | CIMETIERE DE SAINT-JOSSE | 4,016.10 | 143 | 143 | 0.07345 |
| 21015A7MJ | JOSAPHAT GARE | VS | 2 | 3 | 0.23156 |
| 21015A811 | TERDELT | 12,102.72 | 703 | 645 | 0.11039 |
| 21015A822 | CH. GILISQUET - SUD (AVENUE) | 15,246.96 | 215 | 216 | 0.02781 |
| 21015A831 | LATINIS (AVENUE G.) | 11,696.69 | 1,948 | 1,783 | 0.32026 |
| 21015A883 | THEUNIS PIERRE (RUE) | 8,403.29 | 321 | 247 | 0.06747 |
| 21016A00- | GLOBE-EST | 11,259.44 | 2,358 | 2,082 | 0.39496 |
| 21016A01- | DIEWEG | 5,107.24 | 2,187 | 1,895 | 0.80494 |
| 21016A02- | ALSEMBERG-NORD | 18,173.05 | 1,773 | 1,846 | 0.19199 |
| 21016A03- | COGHEN | 9,151.59 | 1,633 | 1,350 | 0.32672 |
| 21016A042 | ECHEVINAGE | 6,722.36 | 296 | 224 | 0.07795 |
| 21016A05- | LE CHAT | 17,850.10 | 2,177 | 1,946 | 0.23428 |
| 21016A102 | GROESELENBERG | 3,112.63 | 1124 | 959 | 0.68624 |
| 21016A111 | VERT CHASSEUR | 2,762.53 | 487 | 467 | 0.34208 |
| 21016A12- | HAMOIR | 3,449.02 | 1,317 | 1,057 | 0.69527 |
| 21016A13- | OBSERVATOIRE | VS | 0 | 3 | 0.12769 |
| 21016A193 | WOLVENDAEL | VS | 0 | 0 | 0.15618 |
| 21016A214 | ASTRONOMES | 10,365.75 | 270 | 228 | 0.04534 |
| 21016A225 | PTOLEMEE | 5,981.47 | 281 | 230 | 0.09061 |
| 21016A232 | BEAU SEJOUR | 8,826.32 | 759 | 721 | 0.17199 |
| 21016A311 | FORT JACO | 1,784.40 | 826 | 745 | 0.89498 |
| 21016A322 | CHAUSSEE DE WATERLOO-EST | 4,835.15 | 449 | 404 | 0.17807 |
| 21016A331 | CHAUSSEE DE WATERLOO-OUEST | 5,753.04 | 201 | 145 | 0.05753 |
| 21016A342 | FOND | 1,267.22 | 1,657 | 1,543 | 2.50548 |
| 21016A383 | FORET DE SOIGNES LORRAINE-W. | VS | 0 | 0 | 0.24905 |
| 21016A39- | FORET DE SOIGNES LORRAINE-EST | VS | 2 | 6 | 4.81414 |
| 21016A400 | SAINT-JOB | 5,855.76 | 1,426 | 1,289 | 0.46535 |
| 21016A410 | ALPHONSE XIII | 4,852.91 | 473 | 426 | 0.18401 |
| 21016A429 | CARLOO | 4,117.79 | 888 | 833 | 0.43154 |
| 21016A44- | PECHERIE | 6,507.95 | 1,393 | 1,177 | 0.39029 |
| 21016A490 | KAUWBERG | 452.19 | 212 | 185 | 1.09467 |
| 21016A521 | VERREWINKEL | 1,024.05 | 234 | 225 | 0.45896 |
| 21016A533 | MOENSBERG | 3,182.25 | 357 | 295 | 0.20709 |
| 21016A601 | BOURDON | 5,381.74 | 600 | 537 | 0.21870 |
| 21016A610 | ENGELAND | 3,050.81 | 262 | 236 | 0.17897 |
| 21016A620 | KRIEKENPUT | 2,001.33 | 568 | 514 | 0.53364 |
| 21016A639 | HOMBORCH | 3,580.63 | 1,389 | 1,113 | 0.73088 |
| 21016A64- | MOLENSTEEN | 5,746.89 | 1,136 | 996 | 0.36907 |
| 21016A65- | ALSEMBERG-SUD | 12,502.35 | 531 | 519 | 0.08358 |
| 21016A692 | CIMETIERE - ST.-GILLES | VS | 0 | 1 | 0.23825 |
| 21016A701 | MERLO | 9,541.21 | 1,388 | 1,232 | 0.27586 |
| 21016A71- | KEIENBEMPT | 4,604.00 | 1,073 | 808 | 0.44722 |
| 21016A72- | MELKRIEK | 6,094.43 | 456 | 362 | 0.13849 |
| 21016A731 | ROETAERT | 6,376.92 | 292 | 246 | 0.07966 |
| 21016A772 | ZWARTEBEEK | 2,635.82 | 365 | 320 | 0.26937 |
| 21016A80- | VANDERKINDERE | 15,335.46 | 1,524 | 1,245 | 0.18076 |
| 21016A81- | BASCULE | 14,112.63 | 1,724 | 1,507 | 0.23079 |
| 21016A82- | CHURCHILL | 12,046.92 | 2,725 | 2,292 | 0.42758 |
| 21016A831 | LONGCHAMP | 4,973.22 | 1,670 | 1,350 | 0.61148 |
| 21016A841 | ZEECRABBE | 1,645.73 | 212 | 201 | 0.25764 |
| 21016A85- | BRUGMANN | 7,314.70 | 1,070 | 809 | 0.26331 |
| 21016A901 | CENTRE-OUEST | 8,873.31 | 1,154 | 940 | 0.23745 |
| 21016A912 | GLOBE-OUEST | 7,090.00 | 589 | 506 | 0.15656 |
| 21016A922 | WOLVENBERG | 9,043.19 | 628 | 540 | 0.13203 |
| 21016A933 | VOSSEGAT-OUEST | 6,568.52 | 1,603 | 1,321 | 0.45444 |
| 21016A943 | SEPT-BONNIERS | 17,394.57 | 525 | 455 | 0.05467 |
| 21016A954 | VOSSEGAT-EST | 19,380.13 | 184 | 150 | 0.01739 |
| 21017A000 | CENTRE DE BOITSFORT | 7,409.10 | 604 | 511 | 0.14388 |
| 21017A01- | COIN DU BALAI | 7,628.24 | 682 | 588 | 0.16950 |
| 21017A021 | DREVE DES EQUIPAGES | 5,725.35 | 194 | 169 | 0.06323 |
| 21017A031 | AVENUE DELLEUR | 911.76 | 72 | 65 | 0.14916 |
| 21017A041 | DREVE DU DUC | 6,818.13 | 450 | 417 | 0.13009 |
| 21017A08- | SOUVERAIN-EST | 291.39 | 99 | 86 | 0.60744 |
| 21017A09- | FORET DE SOIGNES | VS | 4 | 5 | 7.53441 |
| 21017A11- | FLOREAL | 6,120.85 | 869 | 634 | 0.25699 |
| 21017A12- | LE LOGIS-NORD | 6,196.82 | 1,242 | 988 | 0.36470 |
| 21017A13- | BOULEAUX | 5,591.76 | 588 | 586 | 0.21156 |
| 21017A192 | STADE DES TROIS TILLEULS | VS | 6 | 8 | 0.13159 |
| 21017A212 | AVENUE DE LA TENDERIE | 4,277.17 | 932 | 826 | 0.41125 |
| 21017A220 | LE LOGIS-SUD | 5,862.62 | 369 | 298 | 0.11002 |
| 21017A230 | BEGUINETTES | 8,079.09 | 672 | 633 | 0.16710 |
| 21017A240 | SOUVERAIN-OUEST | 4,268.12 | 434 | 392 | 0.20384 |
| 21017A312 | CLOS DES CHENES | 5,291.42 | 99 | 77 | 0.03156 |
| 21017A323 | DREVE DES TUMULI | 1,273.29 | 67 | 47 | 0.09110 |
| 21017A374 | ZONING DE BUREAUX-SUD | 4,192.28 | 133 | 135 | 0.06440 |
| 21017A382 | FORESTERIE | VS | 0 | 0 | 0.30486 |
| 21017A393 | ETANGS DE BOITSFORT | 91.53 | 11 | 18 | 0.36052 |
| 21017A41- | AVENUE DE VISE | 10,618.38 | 855 | 750 | 0.14927 |
| 21017A421 | WATERMAEL - STATION | 2,664.55 | 80 | 67 | 0.05705 |
| 21017A432 | DRIES | 6,305.71 | 561 | 527 | 0.17191 |
| 21017A443 | VILLE-ET-FORET - ELAN | 20,176.85 | 461 | 333 | 0.03658 |
| 21017A451 | FUTAIE | 9,147.27 | 726 | 614 | 0.14944 |
| 21017A472 | ZONING DE BUREAUX-NORD | VS | 10 | 9 | 0.06459 |
| 21017A501 | CENTRE DE WATERMAEL | 11,166.27 | 198 | 193 | 0.03645 |
| 21017A512 | VANDER ELST - BIEN FAIRE | 9,164.31 | 573 | 534 | 0.12385 |
| 21017A523 | MARTIN-PECHEUR | 8,258.61 | 901 | 690 | 0.18744 |
| 21017A534 | RUE DES BEGONIAS | 11,188.38 | 188 | 158 | 0.02878 |
| 21017A541 | LOUTRIER - WIENER | 6,471.81 | 519 | 407 | 0.15112 |
| 21017A613 | AVENUE DE TERCOIGNE | 2,659.81 | 64 | 61 | 0.04399 |
| 21017A624 | PECHERIES | 10,937.98 | 576 | 546 | 0.10121 |
| 21017A635 | PRINCES BRABANCONS | 5,793.64 | 245 | 213 | 0.07992 |
| 21017A696 | HERONNIERE | 1,362.74 | 45 | 43 | 0.08806 |
| 21018A00- | TOMBERG | 10,294.27 | 888 | 719 | 0.15863 |
| 21018A01- | SAINT-LAMBERT | 4,048.64 | 522 | 467 | 0.23983 |
| 21018A02- | SLEGERS (AVENUE) | 11,763.93 | 698 | 624 | 0.11272 |
| 21018A031 | ABELOOS | 19,330.46 | 858 | 692 | 0.08551 |
| 21018A04- | BEETEPUT | 18,851.07 | 1,001 | 893 | 0.10243 |
| 21018A05- | DRIES | 7,493.33 | 623 | 578 | 0.15961 |
| 21018A09- | RASANTE | 4,923.50 | 155 | 131 | 0.05768 |
| 21018A12- | STOCKEL (CHAUSSEE DE) | 8,379.51 | 729 | 632 | 0.16922 |
| 21018A13- | GROOTVELD | 7,963.91 | 297 | 258 | 0.06894 |
| 21018A14- | CHANCELLERIE | 7,294.30 | 643 | 563 | 0.16725 |
| 21018A15- | LES SOURCES | 2,293.69 | 126 | 110 | 0.09897 |
| 21018A19- | STRUYCKBEKEN | 87.42 | 11 | 8 | 0.29742 |
| 21018A20- | GEORGES HENRI (AVENUE) | 11,794.50 | 1,701 | 1,571 | 0.27428 |
| 21018A21- | DE BROQUEVILLE (AVENUE)-NORD | 15,014.16 | 1,731 | 1,347 | 0.20487 |
| 21018A22- | DE BROQUEVILLE (AVENUE)-SUD | 14,912.62 | 953 | 806 | 0.11976 |
| 21018A24- | LAMBEAU (AVENUE) | 13,870.96 | 1,149 | 1,016 | 0.16012 |
| 21018A30- | SAINTE-FAMILLE | 11,976.39 | 683 | 609 | 0.10938 |
| 21018A311 | PARC SCHUMAN | 20,743.40 | 1,285 | 1,030 | 0.11319 |
| 21018A32- | CLOS DES PEUPLIERS | 6,583.62 | 230 | 226 | 0.06774 |
| 21018A33- | NEERVELD | 5,654.35 | 1,197 | 1,002 | 0.39456 |
| 21018A34- | HOF TEN BERG-SUD | 7,568.13 | 577 | 536 | 0.14627 |
| 21018A35- | HOF TEN BERG-NORD | 9,496.35 | 579 | 470 | 0.11404 |
| 21018A37- | COMMUNAUTES | 825.30 | 188 | 148 | 0.43257 |
| 21018A3MJ | GULLEDELLE | 10,066.16 | 1,828 | 1,736 | 0.37542 |
| 21018A41- | EUROPE | 21,418.34 | 836 | 652 | 0.06989 |
| 21018A42- | VERVLOESEM | 6,980.15 | 727 | 561 | 0.18323 |
| 21018A43- | ROODEBEEK | 7,584.75 | 594 | 537 | 0.14885 |
| 21018A512 | QUARTIER DES PEINTRES | 14,478.69 | 906 | 769 | 0.11513 |
| 21018A60- | ROODEBEEK PARC | 4,417.38 | 300 | 319 | 0.13922 |
| 21018A61- | HEYDENBERG-EST | 14,168.71 | 1,064 | 911 | 0.14003 |
| 21018A62- | HEYDENBERG-OUEST | 15,511.56 | 1,848 | 1,566 | 0.22171 |
| 21018A63- | CONSTELLATIONS | 5,749.81 | 974 | 789 | 0.35410 |
| 21018A643 | DEUX MAISONS | 15,460.79 | 1,109 | 839 | 0.12399 |
| 21018A72- | ROGATIONS | 11,102.39 | 1,250 | 1,174 | 0.22220 |
| 21018A81- | KAPELLEVELD-SUD | 4,251.46 | 355 | 300 | 0.15900 |
| 21018A82- | MARIE LA MISERABLE | 2,855.68 | 282 | 289 | 0.19855 |
| 21018A83- | KLAKKEDELLE | 4,991.34 | 494 | 453 | 0.19674 |
| 21018A84- | KAPELLEVELD-NORD-EST | 4,605.03 | 481 | 389 | 0.19327 |
| 21018A87- | SAINT-LUC | 1,758.21 | 488 | 504 | 0.60061 |
| 21019A001 | CENTRE | 11,208.09 | 892 | 752 | 0.15391 |
| 21019A01- | BOULEVARD DE LA WOLUWE | 3,031.75 | 367 | 345 | 0.23551 |
| 21019A02- | CLOS DU SOLEIL | 2,696.70 | 162 | 152 | 0.11644 |
| 21019A03- | CAPITAINE PIRET (AVENUE) | 13,969.98 | 593 | 559 | 0.08561 |
| 21019A04- | EGGERICX (RUE) | 12,393.95 | 572 | 495 | 0.08577 |
| 21019A052 | DON BOSCO | 8,464.34 | 490 | 475 | 0.11862 |
| 21019A09- | WOLUWE (PARC DE) | VS | 0 | 1 | 0.60697 |
| 21019A10- | STOCKEL | 9,366.57 | 1,408 | 1,100 | 0.26392 |
| 21019A11- | MILLE METRES (AVENUE) | 3,422.23 | 590 | 498 | 0.32230 |
| 21019A12- | ESCRIME (AVENUE DE L') | 2,810.25 | 301 | 295 | 0.21386 |
| 21019A131 | KONKEL | 6,446.67 | 935 | 827 | 0.27534 |
| 21019A14- | VAL DE SEIGNEURS | 6,246.67 | 906 | 800 | 0.26990 |
| 21019A15- | KAPELLEVELD | 6,552.43 | 927 | 725 | 0.25655 |
| 21019A20- | SAINT-PAUL | 4,283.03 | 676 | 611 | 0.29979 |
| 21019A21- | MANOIR | 3,215.59 | 886 | 717 | 0.49416 |
| 21019A22- | PUTDAAL | 1,388.91 | 311 | 312 | 0.45359 |
| 21019A231 | KELLE | 10,619.75 | 547 | 480 | 0.09737 |
| 21019A242 | VENELLES | 8,409.03 | 608 | 489 | 0.13236 |
| 21019A252 | MONTGOLFIER | 6,030.01 | 651 | 596 | 0.20116 |
| 21019A28- | ETANGS MELLAERTS | 306.92 | 63 | 48 | 0.34536 |
| 21019A30- | EGLANTINES (AVENUE) | 6,035.14 | 498 | 464 | 0.16205 |
| 21019A31- | BEMEL | 5,378.25 | 711 | 604 | 0.24023 |
| 21019A32- | CHANT D'OISEAU | 7,033.72 | 1,455 | 1,223 | 0.38045 |
| 21019A33- | MIMOSAS (AVENUE) | 12,473.51 | 973 | 839 | 0.14767 |
| 21019A34- | EUROPE (QUARTIER DE L') | 8,475.73 | 622 | 533 | 0.13521 |
| 21019A35- | HORIZON (AVENUE) | 5,598.24 | 793 | 708 | 0.26490 |
| 21019A40- | SAINTE-ALIX | 9,546.02 | 1,526 | 1,366 | 0.30714 |
| 21019A41- | CITE JOLI-BOIS | 3,533.65 | 572 | 468 | 0.29205 |
| 21019A42- | SALOME AVENUE | 4,608.22 | 698 | 564 | 0.28232 |
| 21019A43- | CORNICHE VERTE | 1,423.20 | 283 | 244 | 0.39067 |
| 21019A441 | FAISANDERIE | 2,327.90 | 200 | 203 | 0.16281 |
| 21019A45- | HELICE (AVENUE DE L') | 4,524.51 | 505 | 462 | 0.21240 |
| 21019A492 | BOIS | VS | 1 | 1 | 0.61751 |
| 21019A51- | COLLEGE SAINT-MICHEL | 9,396.78 | 878 | 872 | 0.18975 |
| 21019A52- | DUC (RUE) | 11,252.09 | 708 | 651 | 0.12673 |

### Descriptive statitistics on Brussels neighborhoods (REF)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Code | Territoire | Densité de population (hab/km²) | Nombre de femmes () | Nombre d'hommes () | Surface du quartier (km²) |
| 1 | Grand Place | 8,886.86 | 1,369 | 2,015 | 0.38664 |
| 2 | Dansaert | 17,105.34 | 4,247 | 4,970 | 0.53287 |
| 3 | Béguinage - Dixmude | 17,973.30 | 2,979 | 3,643 | 0.38468 |
| 4 | Martyrs | 7,075.01 | 1,137 | 1,426 | 0.37541 |
| 5 | Notre-Dame-aux-Neiges | 8,855.44 | 1,159 | 1,309 | 0.29225 |
| 6 | Quartier Royal | 458.18 | 144 | 186 | 0.70059 |
| 7 | Sablon | 6,004.45 | 1,304 | 1,428 | 0.46349 |
| 8 | Marolles | 19,221.09 | 5,773 | 6,793 | 0.64377 |
| 9 | Stalingrad | 16,493.37 | 1,681 | 2,027 | 0.24173 |
| 10 | Anneessens | 22,717.38 | 4,639 | 5,404 | 0.44349 |
| 11 | Cureghem Bara | 20,679.12 | 5,650 | 6,585 | 0.59142 |
| 12 | Cureghem Vétérinaire | 14,426.51 | 4,743 | 5,052 | 0.67182 |
| 13 | Cureghem Rosée | 8,801.28 | 2,758 | 3,198 | 0.68161 |
| 14 | Duchesse | 14,445.13 | 2,572 | 2,886 | 0.37168 |
| 15 | Gare de l'ouest | 19,467.17 | 4,712 | 5,041 | 0.51702 |
| 16 | Molenbeek Historique | 24,908.45 | 8,582 | 9,325 | 0.71923 |
| 17 | Koekelberg | 24,867.97 | 4,358 | 4,436 | 0.35017 |
| 18 | Quartier Maritime | 10,358.17 | 8,674 | 9,283 | 1.73776 |
| 19 | Vieux Laeken Ouest | 16,781.39 | 4,053 | 4,291 | 0.49752 |
| 20 | Vieux Laeken Est | 18,272.53 | 8,848 | 9,602 | 1.04933 |
| 21 | Quartier Nord | 12,078.81 | 7,680 | 8,101 | 1.31784 |
| 22 | Quartier Brabant | 24,531.96 | 9,343 | 10,047 | 0.78253 |
| 23 | Colignon | 23,170.01 | 8,997 | 9,173 | 0.77708 |
| 24 | Chaussée de Haecht | 25,410.97 | 8,922 | 9,284 | 0.71268 |
| 25 | Saint-Josse Centre | 31,295.03 | 9,312 | 9,926 | 0.61971 |
| 26 | Dailly | 20,300.19 | 9,121 | 9,004 | 0.88201 |
| 27 | Josaphat | 16,535.15 | 3,780 | 3,588 | 0.44275 |
| 28 | Plasky | 20,447.14 | 5,322 | 4,903 | 0.50315 |
| 29 | Squares | 17,289.31 | 6,805 | 6,837 | 0.80501 |
| 30 | Porte Tervueren | 11,631.08 | 5,404 | 5,035 | 0.91041 |
| 31 | Saint-Michel | 9,658.88 | 3,643 | 3,376 | 0.72296 |
| 32 | Saint-Pierre | 17,842.09 | 7,518 | 6,756 | 0.81095 |
| 33 | Chasse | 16,981.70 | 9,238 | 8,904 | 1.06126 |
| 34 | Jourdan | 16,758.16 | 4,667 | 4,460 | 0.54457 |
| 35 | Quartier Européen | 3,181.37 | 1,390 | 1,476 | 0.96908 |
| 36 | Matonge | 18,706.43 | 4,390 | 4,643 | 0.48641 |
| 37 | Flagey - Malibran | 21,164.25 | 6,959 | 6,915 | 0.65275 |
| 38 | Hôpital Etterbeek-Ixelles | 15,218.35 | 5,215 | 5,003 | 0.67543 |
| 39 | Etangs d'Ixelles | 10,571.96 | 4,508 | 4,196 | 0.83116 |
| 40 | Louise - Longue Haie | 14,521.64 | 3,136 | 2,918 | 0.43143 |
| 41 | Berckmans - Hôtel des Monnaies | 19,813.35 | 4,487 | 4,340 | 0.44364 |
| 42 | Châtelain | 14,709.75 | 5,009 | 4,559 | 0.65963 |
| 43 | Brugmann - Lepoutre | 12,847.42 | 8,513 | 7,919 | 1.28773 |
| 44 | Churchill | 11,888.31 | 7,043 | 5,853 | 1.10243 |
| 45 | Molière - Longchamp | 18,548.82 | 5,258 | 4,773 | 0.54429 |
| 46 | Altitude 100 | 18,338.73 | 4,594 | 3,729 | 0.45772 |
| 47 | Haut Saint-Gilles | 19,621.86 | 7,767 | 7,462 | 0.76379 |
| 48 | Porte de Hal | 25,596.05 | 6,786 | 7,133 | 0.53293 |
| 49 | Bosnie | 37,531.10 | 3,682 | 3,945 | 0.20165 |
| 50 | Bas Forest | 17,141.77 | 6,864 | 6,952 | 0.80062 |
| 51 | Van Volxem - Van Haelen | 15,662.55 | 6,645 | 6,477 | 0.84175 |
| 52 | Veeweyde - Aurore | 17,464.06 | 8,112 | 7,894 | 0.91525 |
| 53 | Bizet - Roue- Ceria | 8,576.96 | 7,589 | 7,558 | 1.78711 |
| 54 | Vogelenzang - Erasme | 743.58 | 1,066 | 809 | 2.44895 |
| 55 | Neerpede | 467.84 | 684 | 640 | 3.95221 |
| 56 | Bon Air | 6,145.41 | 901 | 821 | 0.30071 |
| 57 | Scherdemael | 10,204.84 | 5,846 | 4,868 | 1.06361 |
| 58 | Anderlecht - Centre - Wayez | 19,758.30 | 6,993 | 7,494 | 0.73028 |
| 59 | Scheut | 14,481.18 | 6,837 | 6,677 | 0.94316 |
| 60 | Buffon | 12,841.58 | 2,992 | 2,823 | 0.45649 |
| 61 | Moortebeek - Peterbos | 8,839.81 | 5,115 | 4,415 | 1.09459 |
| 62 | Machtens | 16,939.55 | 12,444 | 11,201 | 1.40405 |
| 63 | Karreveld | 18,753.47 | 7,535 | 7,036 | 0.78823 |
| 64 | Hôpital Français | 17,021.30 | 7,110 | 6,388 | 0.80199 |
| 65 | Korenbeek | 12,255.31 | 4,579 | 4,404 | 0.75681 |
| 66 | Potaarde | 5,338.83 | 1,775 | 1,727 | 0.65276 |
| 67 | Berchem Sainte-Agathe Centre | 8,741.62 | 8,051 | 7,462 | 1.78674 |
| 68 | Villas de Ganshoren | 9,555.37 | 4,012 | 3,250 | 0.77569 |
| 69 | Ganshoren Centre | 14,131.95 | 6,062 | 5,895 | 0.85275 |
| 70 | Basilique | 16,718.01 | 6,642 | 6,763 | 0.80285 |
| 71 | Woeste | 18,712.14 | 10,191 | 9,497 | 1.06102 |
| 72 | Jette Centre | 13,505.27 | 6,730 | 6,246 | 0.96607 |
| 73 | Heymbosch - AZ-Jette | 6,965.75 | 5,006 | 4,535 | 1.37372 |
| 74 | Heysel | 5,514.64 | 8,145 | 7,182 | 2.79402 |
| 75 | Houba | 15,019.53 | 9,162 | 8,973 | 1.20456 |
| 76 | Mutsaard | 10,092.21 | 7,379 | 6,551 | 1.38761 |
| 77 | Heembeek | 7,906.32 | 7,848 | 7,171 | 1.93554 |
| 78 | Haren | 3,198.91 | 3,018 | 3,001 | 1.93754 |
| 79 | Paix | 10,656.74 | 6,487 | 6,080 | 1.20375 |
| 80 | Helmet | 17,717.47 | 6,377 | 6,423 | 0.71105 |
| 81 | Gare de Schaerbeek | 21,078.46 | 4,012 | 3,957 | 0.37422 |
| 82 | Terdelt | 14,397.01 | 5,067 | 4,622 | 0.67090 |
| 83 | Conscience | 17,518.92 | 4,452 | 4,039 | 0.49181 |
| 84 | Avenue Léopold III | 7,580.88 | 4,749 | 4,219 | 1.23337 |
| 85 | Gare Josaphat | 8,063.46 | 2,533 | 2,271 | 0.60545 |
| 86 | Paduwa | 10,012.70 | 6,074 | 5,387 | 1.15563 |
| 87 | Reyers | 6,274.16 | 1,776 | 1,935 | 0.59753 |
| 88 | Georges Henri | 13,578.81 | 8,399 | 7,215 | 1.15548 |
| 89 | Gribaumont | 11,444.59 | 6,095 | 5,354 | 1.02398 |
| 90 | Roodebeek - Constellations | 9,386.53 | 7,735 | 6,496 | 1.54935 |
| 91 | Val d'Or | 6,905.33 | 5,884 | 5,148 | 1.64380 |
| 92 | Kapelleveld | 3,090.20 | 3,038 | 2,668 | 1.90214 |
| 93 | Boulevard de la Woluwe | 6,065.34 | 3,394 | 2,975 | 1.06177 |
| 94 | Stockel | 5,978.70 | 4,869 | 4,152 | 1.51454 |
| 95 | Sainte-Alix - Joli Bois | 4,566.30 | 2,381 | 2,078 | 0.98986 |
| 96 | Saint-Paul | 4,392.18 | 4,224 | 3,642 | 1.78499 |
| 97 | Putdael | 1,831.80 | 720 | 687 | 0.77956 |
| 98 | Auderghem centre | 6,684.28 | 2,651 | 2,543 | 0.80398 |
| 99 | Chant d'Oiseau | 6,786.40 | 5,670 | 4,977 | 1.56932 |
| 100 | Chaussée de Wavre - Saint-Julien | 12,597.17 | 9,062 | 8,206 | 1.38222 |
| 101 | Trois Tilleuls | 6,899.75 | 3,773 | 3,072 | 1.01018 |
| 102 | Transvaal | 5,637.83 | 3,686 | 3,280 | 1.22867 |
| 103 | Boitsfort Centre | 3,757.72 | 3,207 | 2,861 | 1.63424 |
| 104 | Watermael Centre | 6,211.52 | 5,678 | 4,979 | 1.72824 |
| 105 | Dries | 6,143.71 | 3,376 | 2,955 | 1.03488 |
| 106 | Boondael | 7,827.76 | 6,058 | 5,152 | 1.45738 |
| 107 | Université | 9,618.35 | 5,843 | 5,803 | 1.24616 |
| 108 | Montjoie - Langeveld | 4,921.15 | 2,937 | 2,496 | 1.11905 |
| 109 | Observatoire | 3,267.36 | 3,479 | 2,944 | 1.98723 |
| 110 | Fort Jaco | 2,448.54 | 1,664 | 1,472 | 1.28648 |
| 111 | Vivier d'Oie | 1,267.22 | 1,657 | 1,543 | 2.50548 |
| 112 | Kriekenput - Homborch - Verrewinkel | 2,471.02 | 2,453 | 2,088 | 1.90245 |
| 113 | Saint-Job Kauwberg | 2,707.32 | 2,999 | 2,733 | 2.17558 |
| 114 | Dieweg | 5,564.63 | 3,580 | 3,072 | 1.19523 |
| 115 | Kalevoet - Moensberg | 5,627.01 | 6,198 | 5,315 | 2.08903 |
| 116 | Globe | 10,756.99 | 8,319 | 7,414 | 1.45710 |
| 117 | Vossegat - Roosendaal | 7,936.45 | 4,418 | 3,543 | 1.01103 |
| 118 | Saint-Denis - Neerstalle | 10,344.75 | 4,201 | 4,226 | 0.80901 |
| 700 | Cimetière de Bruxelles | 44.84 | 13 | 13 | 0.49063 |
| 701 | Cimetière d'Ixelles | VS | 0 | 1 | 0.11472 |
| 702 | Cimetière de Saint-Gilles | VS | 0 | 1 | 0.23825 |
| 800 | Industrie Nord | 261.99 | 850 | 841 | 6.66062 |
| 801 | Industrie OTAN | 257.61 | 264 | 275 | 2.44169 |
| 802 | Delta | VS | 0 | 0 | 0.25536 |
| 803 | Industrie Sud | 470.08 | 656 | 704 | 3.89084 |
| 804 | Gare du Midi | 115.59 | 15 | 16 | 0.24223 |
| 805 | Industrie Birmingham | 1,289.32 | 159 | 182 | 0.25362 |
| 900 | Domaine Royal Laeken | 10.75 | 17 | 13 | 2.79021 |
| 901 | Parc Josaphat | VS | 6 | 5 | 0.38225 |
| 902 | Botanique | VS | 0 | 0 | 0.07049 |
| 903 | Cinquantenaire | VS | 8 | 11 | 0.38403 |
| 904 | Parc Léopold | 1,286.17 | 78 | 64 | 0.11196 |
| 905 | Parc de la Woluwe | 89.25 | 70 | 56 | 1.35575 |
| 906 | Forêt de Soignes | 5.59 | 39 | 60 | 17.87515 |
| 907 | Bois de la Cambre | VS | 0 | 1 | 1.25297 |
| 908 | Parc Wolvendael | VS | 0 | 0 | 0.15618 |
| 909 | Parc Duden - Parc de Forest | 1,066.74 | 251 | 252 | 0.48653 |
| 910 | Parc des Etangs | VS | 0 | 0 | 0.07544 |
| 911 | Parc Astrid | VS | 1 | 1 | 0.16494 |
| 912 | Parc Forestier | VS | 0 | 0 | 0.04665 |
| 913 | Parc Marie-José | VS | 0 | 0 | 0.07855 |
| 914 | Scheutbos | 199.34 | 58 | 31 | 0.45652 |
| 915 | Parc Elisabeth | VS | 2 | 0 | 0.23283 |
| 916 | Bois du Laarbeek - Poelbos | 20.82 | 11 | 9 | 1.15276 |
| 917 | Parc Baudouin - Dielegembos | 187.68 | 44 | 48 | 0.47421 |

### Descriptive statistics on the municipalities of Brussels

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Code | Territoire | Densité de population (hab/km²) | Nombre de femmes () | Nombre d'hommes () | Surface du quartier (km²) |
| 21001 | Anderlecht | 6,748.92 | 60,081 | 59,633 | 17.91204 |
| 21002 | Auderghem | 3,834.58 | 17,807 | 16,206 | 8.97203 |
| 21003 | Berchem-Sainte-Agathe | 8,651.31 | 12,989 | 12,190 | 2.94776 |
| 21004 | Bruxelles | 5,596.34 | 88,958 | 92,768 | 33.07572 |
| 21005 | Etterbeek | 15,265.42 | 25,105 | 23,262 | 3.17535 |
| 21006 | Evere | 8,317.28 | 21,882 | 19,881 | 5.12860 |
| 21007 | Forest | 8,975.40 | 29,001 | 27,288 | 6.30401 |
| 21008 | Ganshoren | 10,368.54 | 12,995 | 11,907 | 2.43371 |
| 21009 | Ixelles | 13,678.52 | 44,366 | 42,510 | 6.40654 |
| 21010 | Jette | 10,161.43 | 27,324 | 25,212 | 5.18903 |
| 21011 | Koekelberg | 18,488.69 | 11,051 | 10,939 | 1.18770 |
| 21012 | Molenbeek-Saint-Jean | 16,314.57 | 48,744 | 48,718 | 6.00561 |
| 21013 | Saint-Gilles | 19,659.14 | 25,046 | 25,221 | 2.52697 |
| 21014 | Saint-Josse-ten-Noode | 23,358.25 | 13,178 | 14,279 | 1.17719 |
| 21015 | Schaerbeek | 16,814.23 | 66,842 | 66,467 | 7.89801 |
| 21016 | Uccle | 3,672.82 | 44,493 | 38,531 | 22.86526 |
| 21017 | Watermael-Boitsfort | 1,952.08 | 13,540 | 11,644 | 12.97693 |
| 21018 | Woluwe-Saint-Lambert | 7,909.01 | 30,388 | 26,272 | 7.29700 |
| 21019 | Woluwe-Saint-Pierre | 4,711.10 | 22,323 | 19,501 | 8.94038 |

### Appendix 1: Possible combinations of age category, status in the household, household type and work id

|  |  |  |  |
| --- | --- | --- | --- |
| **Age Category (years old)** | **Status in the household** | **Household Type** | **Work ID** |
| 0 – 2 | Child | Couple with child | Nursery |
| Stay at home |
| Single with child | Nursery |
| Stay at home |
| Collective | Hospital |
| 3 – 5 | Child | Couple with child | Kindergarten |
| Primary school |
| Stay at home |
| Single with child | Kindergarten |
| Primary school |
| Stay at home |
| Collective | Hospital |
| 6 – 11 | Child | Couple with child | Primary school |
| Secondary school |
| Single with child | Primary school |
| Secondary school |
| Collective | Hospital |
| 12 – 15 | Child | Couple with child | Primary school |
| Secondary school |
| Single with child | Primary school |
| Secondary school |
| Collective | Hospital |
| 16 – 17 | Child | Couple with child | Secondary school |
| Single with child | Secondary school |
| Parent | Couple with child | Worker |
| Couple without child | Worker |
| Single | Worker |
| Single with child | Worker |
| In flatsharing | Higher education on campus |
| Worker |
| Child or Parent | Collective | Prison |
| Hospital |
| 18 – 20 | Child | Couple with child | Secondary school |
| Higher education off campus |
| Single with child | Secondary school |
| Higher education off campus |
| Parent | Single with child | Worker |
| Couple with child | Higher education on campus |
| Higher education off campus |
| Worker |
| Stay at home |
| Couple without child | Higher education on campus |
| Higher education off campus |
| Worker |
| Stay at home |
| Single | Higher education on campus |
| Higher education off campus |
| Worker |
| Stay at home |
| Child or Parent | Collective | Prison |
| Hospital |
| 21 – 64 | Child | Couple with child | Higher education off campus |
| Worker |
| Stay at home |
| Single with child | Higher education off campus |
| Worker |
| Stay at home |
| Parent | Couple with child | Higher education off campus |
| Worker |
| Stay at home |
| Couple without child | Higher education on campus |
| Higher education off campus |
| Worker |
| Stay at home |
| Single | Higher education on campus |
| Higher education off campus |
| Worker |
| Stay at home |
| In flatsharing | Higher education on campus |
| Higher education off campus |
| Worker |
| Stay at home |
| Child or Parent | Collective | Prison |
| Hospital |
| 65 – 99 | Parent | Couple with child | Worker |
| Stay at home |
| Couple without child | Worker |
| Stay at home |
| Single | Worker |
| Stay at home |
| Single with child | Worker |
| Stay at home |
| In flatsharing | Worker |
| Stay at home |
| Collective | Prison |
| Hospital |
| Nursing home |

Table 2 Possible combinations of age category, status in the household, household type and work id

## Code