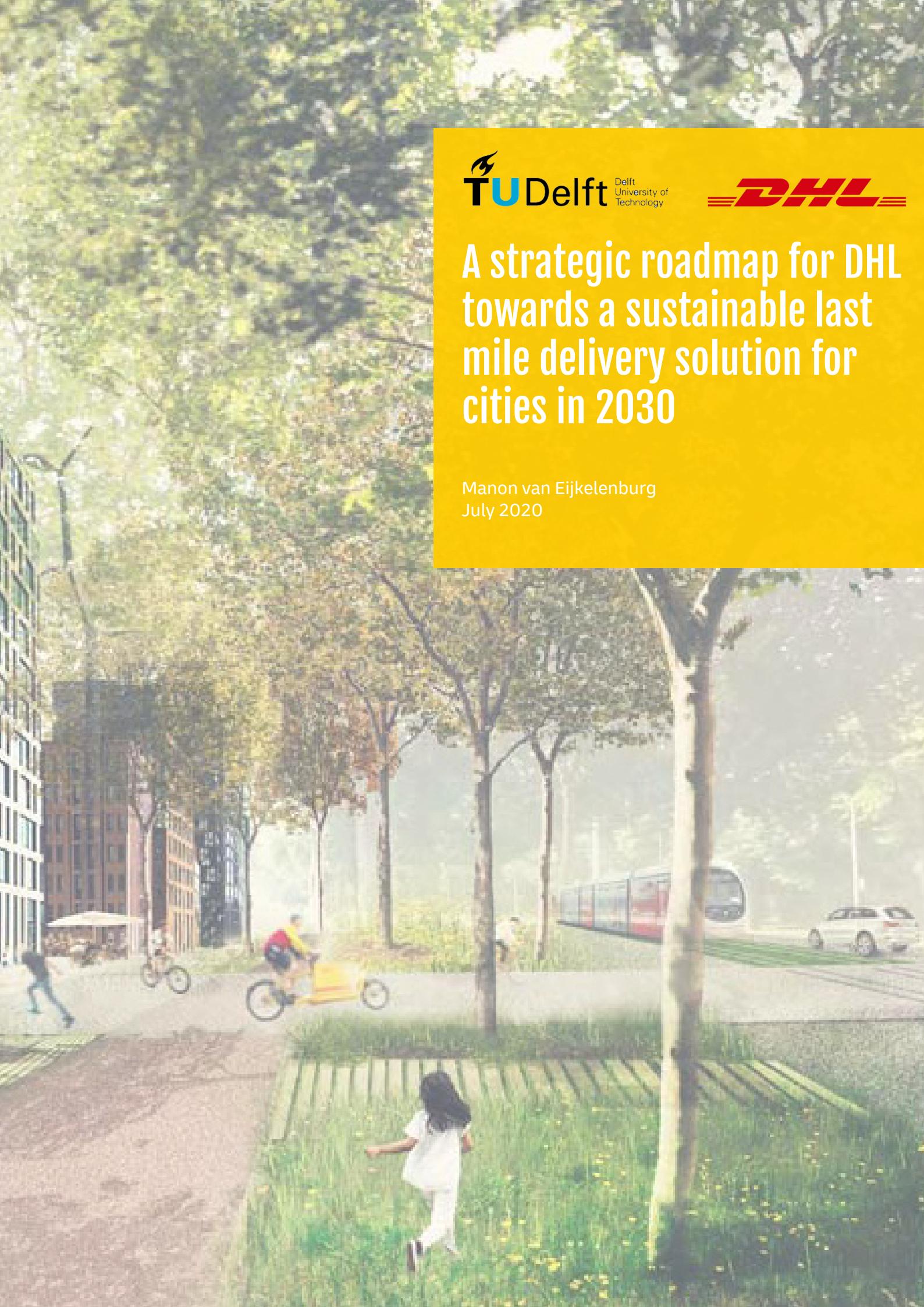




A strategic roadmap for DHL towards a sustainable last mile delivery solution for cities in 2030

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July 2020



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Preface

This thesis is the final piece of my 5 year education at the Faculty of Industrial Design Engineering at the Delft University of Technology. Apart from succeeding this final project, my goal was to inspire DHL with their opportunities to contribute to establishing a safer, cleaner and more livable urban context.

First of all, I would like to thank Dajo Fernandes for giving me the opportunity to do this project for DHL and for supporting me with his critical and motivational attitude. Your involvement throughout the project is very much appreciated and admirable. You helped to evaluate my ideas on the business of the company and provided me with the resources to successfully finish this project.

Besides Dajo, I would like to thank our colleagues at DHL Parcel. Although the time we spent together at the Parcel House was less than I hoped, I enjoyed working with you on the fifth floor. Thank you for your help and your open attitude towards my project.

I would like to acknowledge my chair, Prof. dr. ir. Mugge, for her support during my graduation. Thank you for being there when I needed a motivational phone call. Also, your criticism on my work showed me new perspectives and made me reflect on my work which led to new outcomes.

I would like to thank my mentor Rebecca Price, for being a true inspiration for me and helping me when I needed new perspectives on the

Executive summary

subject. I could not have wished for a better mentor during this project. You helped me with your theoretical background and gave me the support I needed at the right moments.

Last, I would like to thank my family for supporting me throughout the project. Thank you Karin, for your help and your time for discussions. Thank you Edda, Rosan and Gerianne for brainstorming with me. And lastly, thank you Oosteinde 140 for your company during the COVID 19 quarantine.

The e-commerce market is growing rapidly in the last decade and is expected to keep on growing. The growth of this industry is causing several private and societal challenges. Private challenges include a larger number of parcels delivered at service points, which especially during peak periods causes problems at the service points. A serious societal problem is the CO₂ emitted in the parcel delivery. Especially the last mile delivery is a CO₂ intensive process. The sector is innovating to reduce their emissions, but the choices made by the consumers also have an influence on the total emitted CO₂ per parcel.

DHL, a domestic and international shipper, decided to take their responsibility by lowering the CO₂ emitted in the transportation. They defined Zero Emission goals for 2050, which stated that all transport related emissions need to be brought to zero by 2050. DHL is already taking steps towards this goal by replacing fossil fuel delivery vans for electric delivery vans. In order to create a delivery system which is safe, free of emissions and resistant to future developments in a city the current last mile delivery system needs a critical look. A sustainable last mile delivery system that fits customer needs will be designed for 2030 to inspire DHL with a strategy for reducing their CO₂ emissions in the last mile.

This thesis aims to create an overview of the context DHL is operating in. In the problem analysis, this context is researched and defined. A CO₂ analysis showed that delivery to a pick

up point is the most environmentally friendly delivery option and besides renewing the old fleet for electric vehicles, efficiency gain can play a part in reducing CO₂ emissions. In the user analysis, consumers are investigated and a customer journey is created. A target group is chosen to focus the solution on and accordingly the design statement for this project is defined: Design a parcel collecting point for high rise apartment buildings in the city centre which meets customer needs.

With a traditional design approach, this design statement was solved and 4 concepts are presented. However, the presented concepts are not bold enough for the context of 2030. Another iteration in this design process is done and a different design approach showed how more value can be created for cities and citizens through the design of a new parcel locker station. This locker station is fitting customer needs, and convinces important stakeholders.

A plan for implementation is worked out in a roadmap, which gives a step by step approach for DHL on how the concept can be realized. The design of this Powerhouse is validated through co-creation sessions with residents, which resulted in a modular design of the Powerhouse that fits a variety of urban locations in the context of 2030.

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It takes some time to read the full report. To help the reader, this reading guide is added.

Interim conclusions are written in the yellow boxes at the right side of the pages.

The Appendices are linked with the right page. With an interactive PDF, you are able to jump back and forth to the right pages in the Appendix.

By reading the following pieces you are able to quickly understand this graduation project:

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1 Intro- duction

This chapter gives an introduction to the problem that is investigated. The context to the assignment is explained and the assignment is presented. In the second part of this chapter, the design approach for the project is explained.

1.1 THE ASSIGNMENT

This research project about a sustainable last mile delivery system fitting customer needs is a result of the growing e-commerce market and the growing demand for green delivery solutions. This chapter gives background information about the origin of this assignment.

Context

The worldwide parcel industry is growing rapidly. Research shows that the amount of domestic parcels grew from 295 million in 2017 to 351 million parcels in 2018 in The Netherlands (ACM, 2019) and the amount of parcels delivered per capita grew from 10.7 in 2014 to 20.4 in 2018. This growth is mainly caused by the increased numbers of goods and services bought on the internet that need to be delivered to the end consumer. This way of online retailing is called e-commerce. The e-commerce market in The Netherlands grew in 2018 with 10% compared with 2017 and is expected to continue growing (Thuiswinkel.org, 2019).

The growing amount of parcels that need to be delivered every day is putting pressure on the delivery companies. Several problems occur due to this growth.

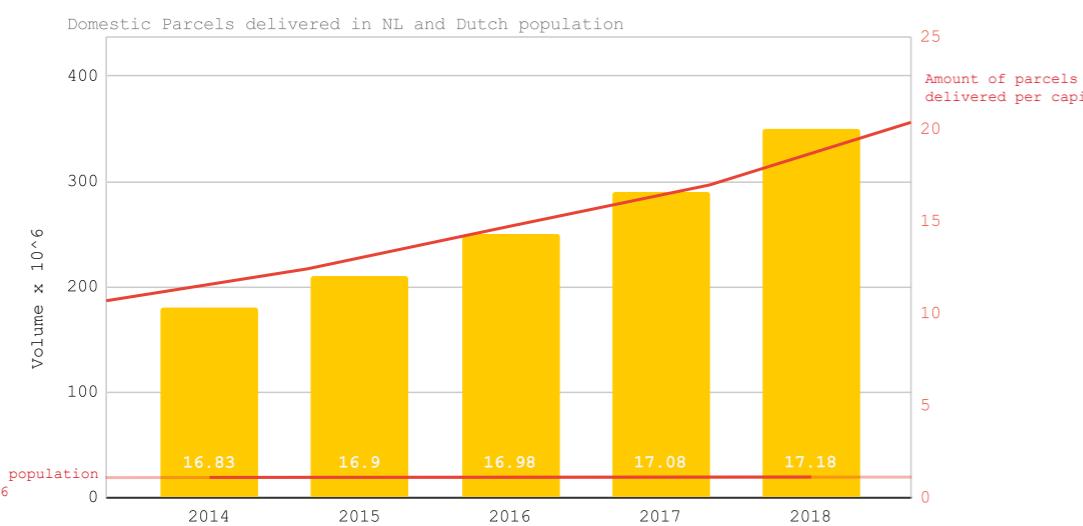


Figure 1.1: Yearly volume of delivered parcels in The Netherlands (ACM, 2019)

Private challenges due to growth

The first is that an increased number of delivery vans is operating in order to deliver all the parcels at the right time on the right spot. The VNN, a social organisation for safe traffic in The Netherlands is worried that this causes nuisance in neighborhoods and can result in unsafe traffic situations (Fygi , 2019).

The second is that service points are dealing with more parcels a day. Besides the growth of the amount of domestic parcels two other factors are causing this. First, PostNL and DHL moved from 3 or 4 delivery attempts to the home address to only 1. After this attempt, the parcel is brought to a service point. Second is that more people choose to let their parcel be delivered directly to a service point (ACM, 2019). Around 10% of the delivered parcels end up at service point.

Especially in the peak periods, this is causing problems at the service points. The small stores are getting overfilled with parcels, the waiting lines become very long and the store managers are busy with the parcels instead of running their store (VGPNL, 2019).

Next to that, consumers and shippers are demanding more service from the delivery companies. Same day delivery is one example of this. Research showed that 61% of the consumers are willing to pay extra for the convenience of same day delivery (Hartman, 2018).

Another example is that customers expect transparency and wish to be in control (Kuunders, 2019) .

Track and trace codes and smaller time frames of delivery are two developments that result from these trends.

Societal challenges due to growth

Urban logistics are one of the challenges of the 21st century. Freight traffic and delivery vans in the city are causing congestion, affecting air quality, cause unsafe situations and are noisy.

In Europe, city logistics are responsible for 25% of transport related CO2 emissions and up to 50% to other transport related air pollution. Apart from that, despite the fact that the amount of vehicles is limited, these vehicles are relatively more often involved in accidents with cyclists and pedestrians. (OECD, 2015)

The amount of delivery vans in urban contexts is growing. Currently, more than 80% of the freight traffic in Dutch cities is a delivery van. These logistic movements are simply necessary to facilitate life in the city. But not everyone is happy with all the delivery vans. The negative consequences of city logistics directly affect the attractiveness and quality of life of the city.

Considering that the number of vans is only expected to grow, the urge to tackle the problems with city logistics is increasing. Post and parcel delivery in an urban context are in 2016 calculated by CEDelft on a total share of 3% of the CO2 emitted in the urban context. This seems not much, but the volume in e-commerce is growing each year with a rough 10 percent. This makes the post and parcel sector a serious contributor to the CO2 emitted in urban areas.

The e-commerce sector decided on taking its responsibilities by working together on an initiative with the goal to reduce the CO2

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emissions. The sector is aiming for a CO2 reduction of 50% in 2025 compared with 2018. (Thuiswinkel.org, 2018)

DHL Parcel, hereafter referred to as DHL, is the second largest player in e-commerce delivery in The Netherlands. It has a wide logistic network of sorting centres, delivery vans, service points and DHL locker walls. This network allows them to work with massive volumes. Daily, over 800.000 parcels are delivered to companies and consumers, fluctuating depending on the time of the year (DHLParcel, 2020) . The increased volumes and CO2 reduction targets are putting pressure on the current network of DHL which challenges them to innovate.

To contribute positively to the goal of limiting global warming to well below two degrees Celcius, established at the Paris climate conference in 2015, DHL has a responsibility of lowering its CO2 emissions throughout the whole supply chain. Therefore, DHL implemented the Green Goals in their strategic plan and stated that they want to be a market leader in green logistics to help their customers to minimize their CO2 emissions. Their mission is that all logistic-related emissions are brought to zero in the year of 2050 (DPDHL, 2020).

Studies show that the last-mile delivery, which is the part when the parcel is brought from the local distribution centre of the city to the consumer's house, is the most CO2 intensive process (Nabot et al., 2016). This is due to the smaller volumes that can be transported per ride, and many stops needed on a relatively small distance.

' DHL wants to be a market leader in green logistics to help their customers to minimize their CO2 emissions.'

Not only webshops and delivery services have a responsibility to lower their CO2 emissions. Consumers have a responsibility of minimizing the CO2 reductions too. The growth of e-commerce is the reason why more delivery is needed and the increasing wishes of the shippers and consumers are causing a shift in transport movements.

A tool is developed by thuiswinkel.org (a Dutch advocacy group for the e-commerce market) to give the consumer insights into the effect of their (online) shopping behaviour. The involved parties hope that these insights will influence the shopping behaviour of the consumer (De Weerd, 2018).

A study from 2014 conducted by BearingPoint showed that 60% of the European respondents are willing to pay extra for sustainable delivery. And 76% of them were willing to wait up to 3 days longer for sustainable delivery. Sustainable delivery is here defined as climate friendly transport alternatives/options like alternative delivery windows and transportation modes. An

' Both consumers, shippers and logistic partners have a responsibility in lowering their CO2.'

interesting mention is that 82% of respondents aged 18-25 would be willing to accept some delay. This was much higher than all other age groups (West Monroe Partners, 2014). This high percentage can be explained by the fact that this group, called the millennials and generation Z, is on average the most concerned about the environment from all generations. Millennials are socially conscious consumers who grew up with technology. They are willing to hand in some of their own comfort for eco-friendly delivery (Price, 2018).

Concluding, there is a pressure on the sustainability of delivery options, especially for the last mile. Now, the sector wants to operate more sustainably by minimizing the CO2 emissions and consumers are more willing to contribute to sustainability, it is time to look for a change in the last mile delivery system.

The assignment

As discussed in 1.1, there is a need for a redesign of the last mile delivery system. This system should both solve the problems that occur due to the growth of e-commerce as answer the increased demand for sustainable delivery options.

For this research, the following definitions are stated:

Sustainable delivery refers to the transportation process of bringing a parcel from the vendor to the end customers with the lowest possible impact on the ecological and social environment.

The last mile of parcel delivery is the logistic process from the distribution centre of the delivery company until the delivery of the parcel to the end consumer.

A parcel is defined as an object or collection of objects wrapped in paper in order to be carried or sent by post.

The solution should lower the CO₂ emissions compared to the current situation of the last mile delivery and can be adapted to the dynamic network of DHL.

The assignment is to design a solution within a sustainable last mile delivery system that fits the customer needs. There is chosen to design the concept for the year of 2030. This has three reasons. The first reason is that the system will be a vision for the company to work towards. The second reason is that global trends are often based on 2030. The third reason is that this gives the company time to change the current operation. To show the company how the concept can be implemented, 3 horizons will be created. The first horizon will show what innovations are needed to implement in the first 3 years. The second horizon shows the implementations for 2025 and the last will show the implementations for 2028.

The following questions will be answered before designing the solution.

- What does the sustainable delivery scenario for 2030 look like?
- Which consumer is living in an area where sustainable delivery is a challenge?
- What are the consumer needs of the chosen target group?

Answers to these questions are given in phase 1 and phase 2 of the project, described in chapter 2 and 3. The solution is found in phase 3 and 4 of the project, described in chapter 4, 5, and 6.

The assignment

Design a last-mile delivery solution that fits customer needs in a sustainable delivery scenario in 2030 and can be adapted to the changing future network of DHL in 2030.

1.2 The project approach

The project approach and methodology are explained in this part.

The Double Diamond

The design process used for this project is the Double Diamond from the UK Design Council (2019). This process defines four main project stages: Discover, Define, Develop and Deliver. The Double Diamond is an iterative process in which you can move back and forth through the diamonds. The UK Design Council listed 4 design principles which are key when using this design process:

- Put people first. Start with an understanding of the people using a service, their needs, strengths and aspirations.
- Communicate visually and inclusively. Help people gain a shared understanding of the problem and ideas.
- Collaborate and co-create. Work together and get inspired by what others are doing.
- Iterate, iterate, iterate. Do this to spot errors early, avoid risk and build confidence in your ideas.

The methodology of the double diamond is further explained in [Appendix A1](#).

The first two phases of the double diamond, discover and define, are described in chapter 2 and chapter 3. In chapter 3.2, the specific design challenge for the solution is stated. In chapter 4, the development phase is explained. Chapter 5 explains how I came to the final design through an extra iteration with the Speculative Critical design approach. Chapter 6 is the delivery phase, where the final design is discussed.

Discover

In the phase of discovery, a problem analysis is used as a starting point. According to the findings in chapter 1.1, the following three aspects are researched in the first phase of the process:

1. DHL Parcel, and what are opportunities and risks around last mile delivery?
2. Sustainability, how to decrease the environmental impact of the last mile delivery?
3. The consumer needs, who are the consumers and what is important to them for delivery?

In order to investigate the first two aspects, 5 analyses are conducted. These are discussed in chapter 2.

First, the company DHL is investigated to see what last mile delivery means to them and which solutions they already work on.

Thereafter, the CO₂ impact of different last mile delivery solutions is calculated and compared. The goal of this is to find out which delivery scenario has the least CO₂ emissions per parcel. Third, the market is investigated in order to see trends in the last mile delivery and predict what last mile delivery will look like in 2030. The fourth step is analyzing future trends with the DEPEST method. These results will also be used to define the context of the future last mile delivery system in 2030.

The fifth analysis is done to gain a better understanding of the operations done in the last mile delivery. Therefore, field research is conducted.

The sixth and last analysis is aimed at an

important player in the last mile delivery: the end consumer. I conduct research of the consumer needs through interviews. The goal is to find out what the important aspects of delivery are for the end consumer. This last analysis is discussed in chapter 2.2.

Define

The conclusions from chapter 2 are used to envision the context and the target group for a delivery scenario in 2030. An analysis of the target group is done through surveys, to find out what the needs are of the chosen target group. A survey is done, since this is a good way to approach a large number of people and the data can be quantified.

The outcomes of this first part are used to define the specific design challenge for this project, and requirements for the solution. This can be found in chapter 3.2.

Develop and deliver

In creative sessions, participants are involved in the process in order to come up with a variety of ideas. These ideas are explored and worked out into concepts. After going through the traditional design process, I used another design method to come up with more radical ideas: Speculative Critical design. This approach led to three concepts for a future delivery solution for 2030. After discussing the concepts with the stakeholders and speculating on different options, a choice is made to work out one of the concepts. In the last phase, the final design is explained and visualised in a roadmap. This roadmap is evaluated with stakeholders, which resulted in changes in the design of the solution. This can be read in chapter 6.3. Chapter 7 gives the conclusion and recommendations for implementation.

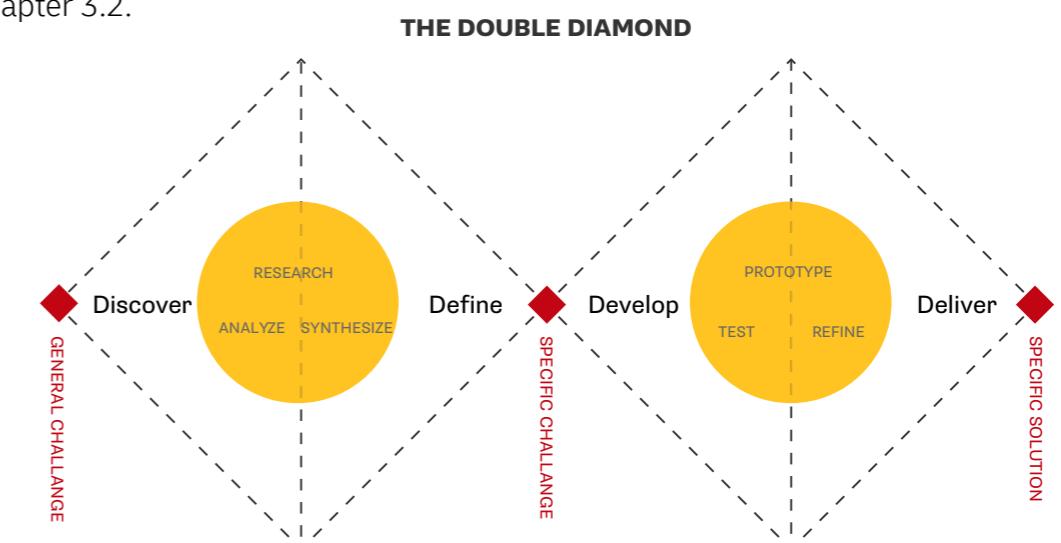


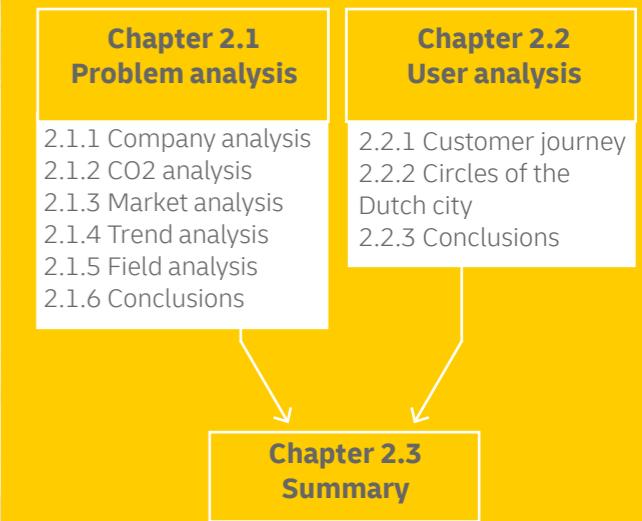
Figure 1.2: A visualisation of the double diamond process.

2 Discover



This chapter is split into two parts: The problem analysis and the user analysis. The first part is to learn about the context of this project by doing 5 analyses. The second part explains the user analysis, where a customer journey is made and differences between parts in the city are explained.

The outcomes of this research define the context and the target group and are used in the next phase (Chapter 3) to define the design challenge.



2.1

Problem analysis

2.1.1 Company Analysis

The problem analysis starts with an analysis about DHL. The goal of this part is get to know the company and the context they operate in. What is the company's history, what does last mile delivery mean to them and which innovations are they already working on considering sustainable last mile delivery? Also, we looked at which opportunities and risks have an influence on the development of the company and how the company can react to these.

History of DHL

In 1969, the first logistics company in the world was born with the vision to deliver on the moon. Adrian Dalsey, Larry Hillblom and Robert Lynn in San Francisco founded the company DHL. It started with personally transporting cargo documents from San Francisco to Honolulu by aeroplane. Now, 50 years later, DHL which has become a subsidiary of Deutsche Post, is the world's largest logistic company. Deutsche Post DHL Group employs approximately 550,000 people in over 220 countries and territories worldwide (DPDHL,2020).

The timeline in figure 2.1 shows the development of the company between the starting date and 2019.

In 2003, the company Van Gend & Loos Euro Express, DHL and Danzas in the Benelux continued to operate under the name DHL

Benelux. Nowadays, the influences of these companies are still present in the daily operation. In 2017, the group announced that they will reduce all logistic-related emissions to zero by the year 2050. This ambitious target is set to contribute positively to the goal of limiting global warming to well below two degrees Celcius, established at the Paris climate conference in 2015.

The latest large event is the launch of the strategy 2025. This "Strategy 2025 - Delivering excellence in a digital world" is the company's answer to 4 key trends of the next decade: Globalisation, Digitalisation, Sustainability and E-commerce.

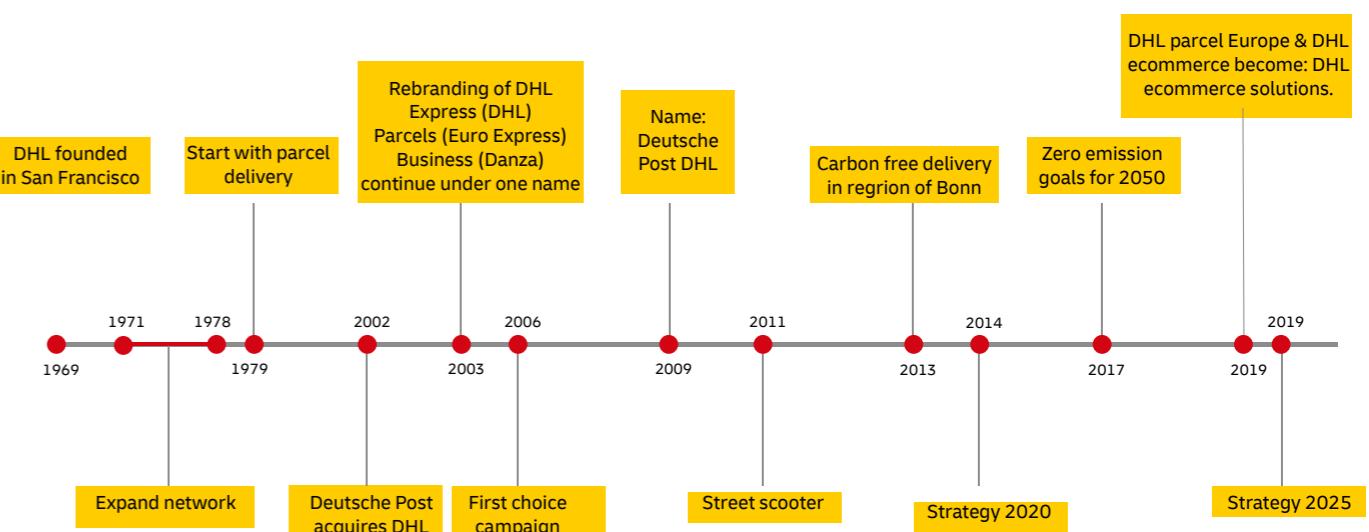


Figure 2.1: Timeline with events of DHL

The core activity of DHL is enabling logistic flows throughout the country. Until 2017, there was no official stated ambition to do this in a CO₂ neutral way. Transportation is their business, so the challenge lies in how to reduce CO₂ emissions while keeping the business running. What is remarkable is that Deutsche Post DHL group started producing their own electric vehicles. This shows that they take their sustainability goals seriously and they are working on their road to accomplish this.



Figure 2.2: Divisions of Deutsche Post DHL Group

The Company structure

Deutsche Post DHL Group is split up in 5 divisions (DHL divisions, 2020):

- DHL Express
- DHL E-commerce solutions.
- DHL Supply chain
- DHL Global forwarding
- The Post & Parcel Germany

Where DHL Express only delivers international services, DHL e-commerce solutions is for domestic and international services. This project is done for the DHL e-commerce division of the Benelux (DHL parcel & e-commerce, 2020).

Figure 2.2 shows the divisions of the company.

Vision and mission

DHL's vision is to become the logistics company of the world. Their core business is to deliver excellent service to their customers- for any product, at any time at any place. DHL aims on improving its core business by achieving greater efficiencies in the delivery process. Strategy 2025 'Delivering excellence in a digital world' shows that the company uses innovations to strengthen their core business. DHL has set itself the target of reducing its transport related CO₂ emissions by 50 percent in 2025 and even operating completely emission-free in 2050. This means that they will become the greenest delivery company in The Netherlands, showing the sector that they take their corporate responsibility. These goals seem ambitious, but with the increasing available technology and changing mindset of customers this should be feasible.

Product portfolio

The [Appendix A2](#) shows the product portfolio of DHL. The last couple of years they responded to the market by adding new products to their portfolio as for example evening delivery and same day delivery. The whitepaper from kieskeurig.nl showed that 54% of the respondents are interested in same day delivery, but only 15% percent is also willing to pay extra for this option (kieskeurig, 2019). Same day delivery creates many challenges in the proces, with inefficient delivery movements as result. Now DHL wants to put sustainability higher on their agenda, they should also translate this in their product portfolio. What such a sustainable product should look like is not defined yet, but a recommendation will be done in this report.

The network of DHL Parcel

DHL Parcel has a large domestic network which enables them to deliver roughly 130 million parcels on a yearly basis. This network consists of 16 sorting centres (with 3 of them having ecom sorting capabilites) , 3.000 vans, 140 CityHubs and 3.000 service points. Consult [Appendix A3](#) for further details on the network and its operations. The most relevant information to understand the context of the e-commerce network is that parcels are delivered to the end consumer from 140 CityHubs throughout the country. These CityHubs are independent entrepreneurs who run the business. DHL parcel has directives and key performance indicators to give direction to how they should operate.

In the following part, the service point network is discussed in more detail, since this is a touchpoint for the end consumer and one of the challenges DHL is currently dealing with.

Service point network

The service point network of DHL consists of 2500 service points that come in three different shapes:

- Shops
- Private partners in a neighborhood
- Locker walls

In the current servicepoint network of DHL, 78% of the consumers has a service point within 1 km of their home address (DHL, 2020). Figure 2.3 shows the partners of service points.

The lockers are owned by Bij de Buren, a startup that focuses on last-mile delivery solutions. DHL is paying Bij de Buren per parcel that is delivered or returned via the locker.

Next to Bij de Buren, DHL Parcel has other partners in order to enlarge their service point network. This helps DHL to keep the focus on their core business, which is the transport of parcels in an efficient way, instead of spending much time on policy for the placement of locker walls.

A problem occurring nowadays is that current service points of several delivery companies are under pressure with the large volumes they need to store in their shops and the number of consumers that are visiting their shop for picking up the parcels. (logistiekprofs, 2020) These customers overshadow the business of the shop and their loyal shop customers become dissatisfied. This is for service points a reason to quit.

Another reason is that the financial reward per parcel is too low if you look at the space and time this service consumes. This problem became a national discussion in February 2020 (Radar, 2020).

If we assume that the e-commerce continues to grow with the same numbers until 2025, taking into account the characteristics of service points now, the expected number of service points needed in that year would be approximately 8,500 points for only DHL. I argue that this number is practically too high, taking into account that criticism has arisen from the service points and therefore resource scarcity is created. Drawing on this line of thinking, DHL would benefit from expanding their last mile delivery solution portfolio with novel drop-off solutions.

'The number of servicepoints needed in 2025 is practically too high. DHL could benefit from expanding their portfolio with novel drop-off solutions.'

Partners in the service point network



Figure 2.3: Service point partners of DHL Parcel Benelux

SWOT Analysis

The swot analysis is a framework used to analyze strengths, weaknesses, opportunities and threats for DHL Parcel. Figure 2.4 shows the SWOT analysis matrix. The SWOT analysis gives insights into what DHL Parcel is doing well, what to continue to build on and what are threats to keep an eye on and respond to.

DHL is operating in a worldwide network with a range of 220 countries and territories which shows that they have a well-established core logistic business (DHL, 2020). The results of Q3 2019 show that the whole DPDHL group is doing well in case of revenue and earnings. The e-commerce solutions played its part in this growth: the division increased its revenue by 5.4% to 964 million euros compared with the prior-year where particularly the countries the United States, The Netherlands and Poland have shown a good performance(DPDHL, 2019).

The fast growing business DHL is operating in is pushing them to keep innovating. To keep up with the pace of the industry, DHL invested in technical solutions and new sorting centres. DHL opened an innovation centre in Bonn, which is unique in the logistic sector. The new built sorting centre in Zaltbommel also shows that DHL is working on innovations to keep up with the growing numbers in e-commerce. Next to that, large investments are planned by DPDHL for innovation such as 2 billion euros for digitalisation (Neuffer, 2019) .

Another large investment are the electric

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delivery vehicles developed in cooperation with other parties. This is an important step towards their green goals shows that DHL is a forerunner in green delivery (DPDHL, 2020) .

When looking at the last mile delivery, 40-45% of the deliverers are subcontractors (DHL, 2020). This brings two difficulties: 1) It is hard to manage for DHL: The subcontractors are the face of the delivery company while they are not working for DHL. 2) When changes are made in the process it is complicated to inform everyone with the new standards. It is the challenge to find and optimum in strict regulations and letting the subcontractors free to a certain extent. When a certain regulation is necessary for their brand image, this should be regulated. For example, the implementation of compulsory DHL working clothes or obliging CityHubs to use green energy for their operations. DHL should facilitate these changes in order to generalize the brand image.

Threats for DHL are listed on the bottom right of figure 2.4. Large e-commerce players as for example Amazon and Bol.com want to control the last mile themselves. Small webshops use these platforms to put their products on the market. And since they offer both marketing and shipping, these large platforms are a direct threat for DHL. Another threat is the limited amount of resources for service points. Not only DHL, but also competitors are expanding their service point network which makes it harder to find new partners.

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"> Worldwide network Market leader in business to business Well established brand name Reliable service Inhouse developed electric vehicles Large investments for innovation Market share leader worldwide. Focus on customer loyalty Recognizable brand image Large customers in The Netherlands Operating in different logistic solutions 	<ul style="list-style-type: none"> No phone application available Not much communicating on social media platforms Working with many subcontractors Subcontractors are the face of the company In The Netherlands more known as international carier.
OPPORTUNITIES	THREATS
<ul style="list-style-type: none"> Ecommerce market is growing (ACM, 2019) Increasing awareness for the environment Product and service expansion Digitisation and automation of processes Give a visible meaning to the brand values of the company which are: easy, personal and trustworthy. Growing installation of electric LDV chargers Rapidly growing electric vehicle market. Market leader in ecommerce solutions in Germany 	<ul style="list-style-type: none"> Strong competition of PostNL Policies on urban traffic Land is getting more expensive in urban areas Fast growing ecommerce industry Limited amount of service points New competitors entering the market Large players like Amazon are trying to dominate the e-commerce market Amazon is starting in The Netherlands in Q1 2020 (Craske, 2019)

Figure 2.4: SWOT matrix of DHL Parcel

Interim conclusion

From Company analysis

The questions that are answered in this part are: What is the company's history, what does last mile delivery mean to them and which innovations are they already working on considering sustainable last mile delivery?

DHL has a large network which enables it to transfer every parcel from the shipper to the end consumer. When talking about the last mile, their network consists of service points and delivery vans. Solutions they work on considering sustainability are replacing the current fleet for electric vans and expanding their service point network.



Some of the strengths can be linked to the opportunities and threats, which results in a strategy to make the strengths even stronger. This can also be done for the weaknesses, to make them less weak. This is shown in figure 2.5.

The fact that people and businesses have an increased awareness of the environment can be used by DHL to strengthen their relationship with the customer when DHL is choosing to add

environmental friendly delivery options to their product portfolio. This can be done in collaboration with large webshops. The fact that DHL already has large customers in The Netherlands brings them in the position to test certain solutions on a large group of customers.

	Opportunities	Threats
Strengths	<p>Strength - Opportunity strategies</p> <p>The increased awareness of the environment for customers and business can be a new focus to further increase customer loyalty.</p>	<p>Strength - Threat strategies</p> <p>DHL should use the partnership with their large customers in The Netherlands, keep them satisfied and strengthen in this way their position against Amazon.</p>
Weaknesses	<p>Weakness - opportunity strategies</p> <p>Since DHL is market leader in Germany, this can be used as playing field to test new products and services, as for example a phone application.</p>	<p>Weakness - Threat strategies</p> <p>DHL can look at what PostNL is doing with the implementation of new products and services and learn from their experiences.</p>

Opportunities for DHL concerning sustainable last mile delivery are the digitisation and automation of processes which could make the process more efficient. Next to that, the increased environmental awareness could create possibilities for them too.

Threats are the new competitions that are entering the market, which could be an opportunity to collaborate with at the same time. Another threat are the players like bol.com and Amazon. Since they cover their own deliveries, the chance that DHL's share will drop is present.

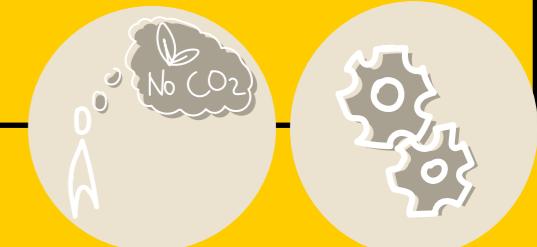


Figure 2.5: SWOT strategy matrix

2.1.2 CO2 analysis

As described in the introduction, sustainable delivery refers to the transportation process of bringing a parcel from the vendor to the end customers with the lowest possible impact on the ecological and social environment. This chapter addresses what is discussed in literature about sustainable last mile delivery and is followed by a CO2 analysis of the current delivery system with a Life Cycle Assessment.

Literature

Some 25-30% of world's energy consumption is related to transport and its share in total energy use is expected to increase, making it a large contributor in the global problems of energy scarcity and greenhouse gas emissions. Although last mile delivery is just a part of this percentage, last mile deliveries in urban areas put serious pressures on environmental, social and economic well-being within a city.

The challenge for the logistic sector to decrease their CO2 emissions is known since a couple of decades and therefore solutions for the last mile delivery problem are already discussed in literature.

Schöder, Ding, & Campos (2016) looked into the impact of the growing e-commerce industry on urban logistics and concluded that there are two powerful levers to face the challenges of e-commerce in urban areas. The first is the utilization of new power train technologies which will need high investments but could result in a zero emission distribution in urban areas hence meets the demand of the customers for faster and more sustainable transport.

The second is integration of all supply chain participants by collaborative initiatives in order to achieve a more efficient logistic process. This asks for a keen interlink between all participants of a supply chain as well as an integrated approach in fleet management and vehicle routing.

Awwad ,Shekhar and Iyer (2018) became even more specific about this topic with steps

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needed to be taken to reduce greenhouse gas (GHG) emissions in the logistic sector. They presented 9 solutions that can be integrated in order to reduce the GHG emissions in the last mile delivery. Two examples of these are the use of electric vehicles for delivery and the use of urban consolidation centres. Both are already a focus of DHL.

Next to that, a crowd-tasking model for parcel lockers is designed by Wang et al. (2016) in order to redesign the current system into a crowd sourcing delivery model which is eco-friendly and social.

What literature is not addressing, is what the responsibility of consumers is in order to reduce the CO2 emissions of the logistic sector. According to Vakulenko et al. (2019), the last mile shopping experience has a significant effect on the online shopping experience and thus on the total customer satisfaction. This is relevant because this could be a driver for webshops to choose one or the other delivery service.

In the end, consuming less is the most eco friendly. The choices made at the check-out of an online order are defining what is ordered and how it is transported to the end consumer. What are the drivers for making this choice? What would be the most sustainable option and how can the consumer be motivated to make that choice? This research is addressing these questions.

First, calculations are done in order to find out what the most eco friendly choice for delivery is.

This is followed by market research and a trend analysis in order to estimate what the context of delivery will be in the future.

Life cycle assessment

In order to calculate the environmental impact of a product, a Life Cycle Assessment (LCA) can be done. By performing a LCA a factual analysis is done of a product's entire life cycle in terms of sustainability. With LCA, the environmental impacts of your product or service from cradle to grave can be evaluated.

The process of delivery can also be analyzed by a LCA. The results will show the environmental impact from every aspect of the process. By doing this, different scenarios can be compared in order to see which scenario has the least environmental impact.

For last mile delivery, these calculations are already done in older research. In the next part, the outcome of these calculations are compared and criticized followed by a calculation done with the numbers of DHL, for 4 relevant delivery scenarios. The conclusion shows which scenario has the least environmental impact.

In 2015, Ernst & Young Consultancy, published a paper which showed that the chosen scenario of shopping has a significant impact on the footprint per purchase. In this paper, the footprint of 4 scenarios is compared. The results are shown in figure 2.6. In this case, the drop-off point delivery has the smallest footprint, under the condition that the parcel is picked up from

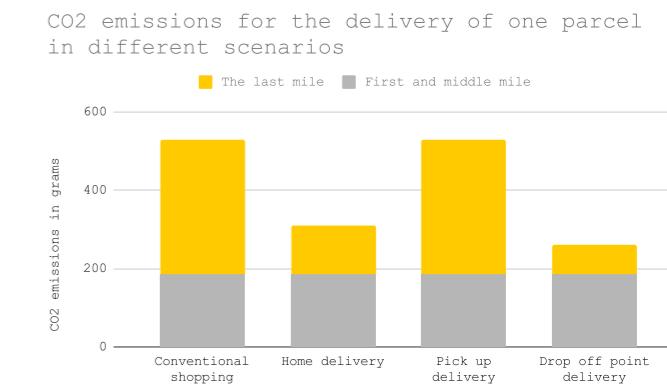


Figure 2.6: Results CO2 emission calculation EY research
the drop-off point on a CO2 neutral way (by bike or by foot).

'Delivery to a drop-off point has the least environmental impact (EY ,2016). '

Where the study of EY showed the differences in environmental impact of shopping online and offline, the following analysis dives deeper into the last mile activities of online shopping. The reason for analysing this is to answer the question: What is the last mile delivery scenario with the least environmental impact. And: which scenario has the highest impact, and thus needs to be avoided?

For the last mile delivery four scenarios are compared:

1. Delivery directly to consumers house
2. Delivery to a pick up point and picked up by a car on the way. This is an extra stop on a ride that the consumer would already do, as for example a ride from work to home.
3. Delivery to a pick up point and picked up as a separate ride by car.
4. Delivery to a pick up point and picked up on a CO2 neutral way, by foot or by bike.

Literature showed that the drop off delivery has the lowest footprint compared with conventional shopping and delivery to house. Therefore, different ways of pick up by the consumer are compared. A survey from DHL showed that 29% of the consumers are doing the pick up by car. From this percentage, 9% is doing this as a separate ride and 20% is doing this on the way.

The hypothesis for the calculation of the scenarios is that the delivery to a pick up point is the most ecofriendly, if pick up is done on a

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CO2 neutral way. In both scenarios, 2 and 3, it is expected that the footprint will be higher than in scenario 1, delivery directly to house.

Some assumptions are made with doing the LCA. See Table 1 for the used numbers.

The numbers used for the emission factors are from the list of emission factors made by the government and they are representing the well-to-wheel CO2 impact of a vehicle (CO2emissiefactoren, 2020). Since the source

	Emission factor	Source
Electricity WtW	0.475 kgCO2/kwh	CO2emissiefactoren, Rijkswaterstaat
Diesel WtW	3.23 kgCO2/l	CO2emissiefactoren, Rijkswaterstaat
Renault traffic WtW	0.274 KG CO2/KM	ANWB
Kangoo/Citan WtW	0.226 KG CO2/KM	ANWB
Private car WtW	0.258 KG CO2/KM	ANWB
Ecom mix WtW	0.248 KG CO2/KM	DHL
Streetscooter WtW	0.119 KG CO2/KM	DHL

Table 1: Numbers used for calculation

of electricity at the CityHubs of DHL Parcel is unknown, the number for the unknown energy mix is taken.

The term well-to-wheel refers to the entire process of energy flow, from the mining of the energy source to a vehicle being driven (Woo, 2017).

The numbers of DHL Parcel are used in order to come to the most realistic outcomes as possible. For the distance from a household to a service point 2.5km is used because 94 percent of the households has a service point on a distance within 2.5km from its home address (DHL, 2020). This means a retour is 5km.

		Number	Source
Distance [KM]	From house to service point	5	DHL Parcel
	For pick up on the way	2.5	
	One delivery home round	80	
	One servicepoint delivery round	26	
Fill [Pieces]	E-commerce mix	134	DHL Parcel
	Streetscooter	134	DHL Parcel

'When the number of parcels delivered to a service point is higer, the CityHub chooses to make a seperate ride for these.'

For scenario 2 is assumed that a 'pick up on the way' is never completely on the way. Therefore, half of the distance for a separate pick up is taken. A retour is 2.5km.

An e-commerce vehicle mix is taken for the WTW KG CO2/KM. This e-commerce vehicle number is based on the real mix of DHL Parcel. Private cars are included in this mix since subcontractors are sometimes driving with their own car.

The electric car does not have a CO2 impact of zero. The emission factor for electricity is calculated for the Streetscooters and taken into account for the e-commerce vehicle mix. The average number of parcels delivered in the e-commerce vehicles is calculated and set on 134 pieces.

The average distance driven for a servicepoint round is assumed to be less than the distance driven in a regular delivery round. This number is based on a real ride and is set on 26 km. For a regular delivery round this is 80 km's. There must be noted that this number is essential for the result, while it differs per CityHub how they organize this. From a sample can be learned that Cityhubs in the larger cities of The Netherland more often plan an seperate ride for the servicepoints. It occurs more often that the service point delivery is combined with a regular delivery round. Generally, with a higher number of parcels for service points, seperate rides are

Interim conclusion

From CO2 Analysis

From literature we can learn that different parties already investigated solutions for sustainable last mile delivery. Electrifying the delivery vehicles and using consolidation centres to decrease the amount of unnecessary traffic movements are two named solutions. But on the customer side also lies a responsibility for lowering the overall footprint. For this project, this means that the solution should make the customer aware of the CO2 footprint of the delivery movements and motivate them to act right.

planned by the CityHub.

The results of these calculations are shown in figure 2.7.

As expected, the pick up by car has a significant impact on the total footprint of a parcel delivery. Pick up on a CO2 neutral way has the smallest impact, followed by scenario 1: Delivery to home address.

With a higher delivery density for home delivery, these two scenarios could be comparable.

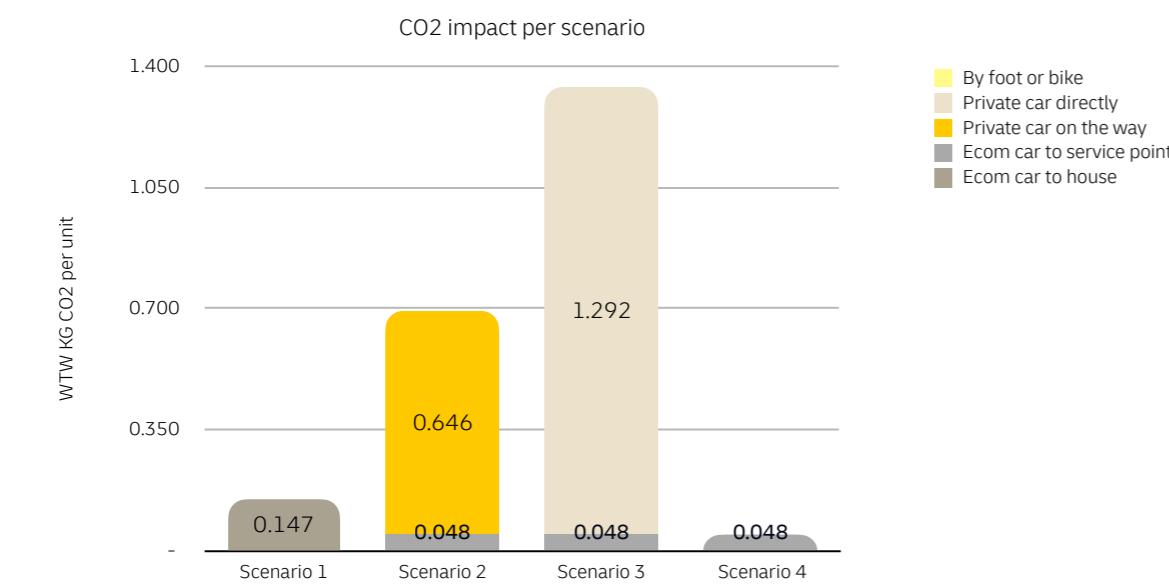
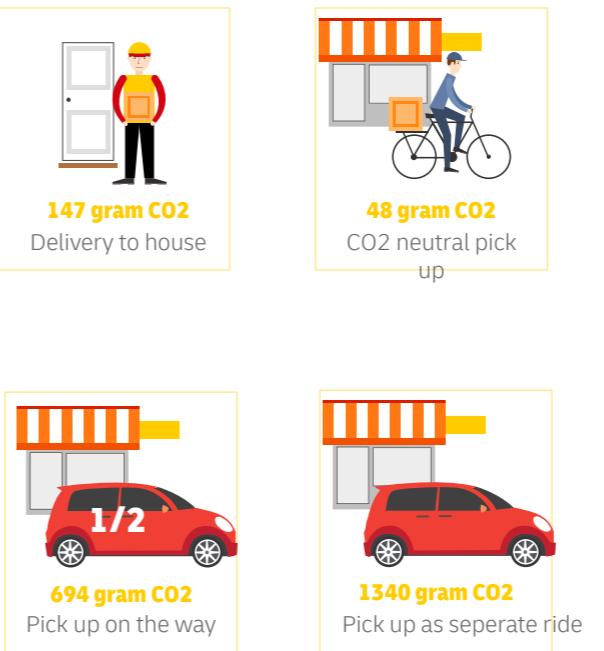


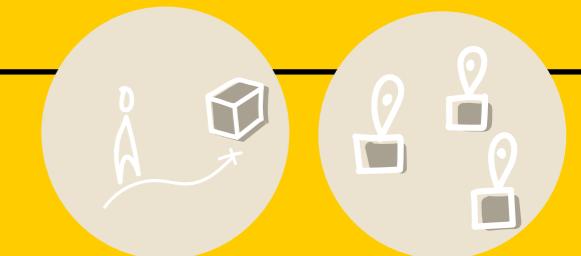
Figure 2.7: Results of CO2 emission calculation

What could be concluded is that the service point delivery is the most ecofriendly option, when picking up on a CO2 neutral way. From the research of DHL can be concluded that 29 percent of the almost 5000 respondents is picking the parcel up by car. This significantly increases their CO2 impact off an online order compared with a CO2 neutral pick up. Therefore, pick up by car should be avoided.



'Delivery to a service point and pick up on CO2 neutral way is the most environmental friendly option. Pick up by car should be avoided.'

From the results of the LCA can be concluded that the delivery to a pick up point is the most sustainable option if the pick up is done in a CO2 neutral way. This number can even be lower if all delivery vehicles are driving electric. From this analysis we learned that the solutions should be in the context of delivering to a pick up point in such a way that the customer is motivated to do the pick up by foot or by bike. This means that there should always be an option for the customer to deliver directly to a service point. Also, the servicepoint network should be more extensive in order to always have a service point on walking or biking distance from the customers address.



2.1.3 MARKET ANALYSIS

In this chapter is described what developments are going on in the last mile delivery, and what this will mean for DHL.

Main competitors

Table 2 shows the main competitors of DHL. Further details about the competitors can be found in the [Appendix A4](#).

When looking at eco friendly delivery options, all competitors are working on implementation of eco-friendly vehicles. Electric vehicles are popular among the delivery companies. Other options are also tried, as for example biofuels. An advantage of biofuels over electric vehicles is that most existing vehicles are

compatible with biofuels. They could function as an alternative for fossil fuels in a transition period. However, it is questioned if the net impact of growing biofuels crops on the earth's soils and ecosystems is not too large (Fulton, 2005).

The competitor research learned that all the delivery companies are investing in electric vehicles. This probably has to do with the growing popularity of electric vehicles (Global EV Outlook 2019). Both PostNL as DPD are also

experimenting with smaller vehicles like electric cargo vehicles.

Except for choosing to deliver with electric vehicles, delivery companies are also looking into other alternatives such as urban delivery by bike. DPD and DHL both started a collaboration with fietskoerier.nl, for delivering parcels by bike. This is how it works: A webshop can choose for delivery with fietskoeriers.nl. The order is picked up and delivered in an eco-friendly way: by bike. When webshops are partners of DPD or DHL, they can also choose to let the parcel be delivered by bike, the order will then be shared with fietskoerier.nl to let them do the delivery. Although these solutions are a good alternative for diesel vehicles in the city, it is currently not possible to deliver a large amount of parcels with these bikes. The bikes are limited in the volume and amount of parcels they can carry and therefore need to bike back and forth. This is time consuming and thus a more costly operation compared to delivery with a van.

Market share domestic B2C	25-30%	65-70%	0-5%	0-5%	0-5%
Price for home delivery	5,75	6,75	4,88	6,25	8,68
Discount for delivery at service point	1,25 euro	0,50 euro	0,38 euro	No data	1,50 euro
Max dimensions	80 x 50 x 35 cm	100 x 50 x 50 cm	100 x 50 x 50 cm	Z + X is max 50 cm	No Data
Home/ Service point/locker options	Home Locker Service points	Home Locker Service points	Home Locker Service points	Home Service points	Home Locker Service points
Same day delivery	Yes	Yes	No	No	No
Investments in alternative fuels for delivery vehicles					

Table 2 The largest e-commerce delivery companies in The Netherlands



Image 2.1: Impression of Fietskoeriers

' Both DHL as their competitors are investing actively in electric vehicles.'

Company name	Business	Large delivery partner	Still operating
Parcls.com	Consolidate all the parcels at one city hub for pick up	Yes	Yes
Pick this up	Connecting rides with people	No	Yes
Smart mile	Locker stations	No	Yes
De Buren	Locker stations and neighbourhoodpoints	Yes	Yes
Red je pakketje	Last mile delivery	Yes	Yes
Delvry	Delivery in 1,5 hours	No	No
Saddl	Delivery in a couple of hours	No	No
Pluplus	Delivery in two hours	No	No
De versnelling	Delivery with a bike	No	Yes
Trunkrs	Same day delivery	No	Yes
MyPup	Locker stations	Yes	Yes
Fietskoeriers.nl	Delivering the last mile with bikes	Yes	Yes
Fadello	Same day delivery	No	No
Emily Company Suit Up Courier	Personlized delivery	No	Yes
Dynalogic	Personlized delivery	Yes	Yes
Bubble Post	Eco friendly delivery	Yes	Yes, as a part of Bpost
Budbee	Personal delivery	No	Yes

Table 3: Last mile delivery start up companies, yellow is interesting to collaborate with, red is marking which companies are not operating anymore at the moment.

Startups

As said earlier, both large companies as startups are working on innovative solutions to improve the last mile of parcel delivery. This part analyzes the start ups in the field of parcel delivery. Looking at the startups taught us that starting businesses have a greater focus on the desires of the end consumers. Think of same-day delivery, evening delivery and smart communication via applications.

Table 3 shows the different startups in the last mile delivery. [Appendix A5](#) shows the full description of every company. The yellow marked companies are interesting to collaborate with since they could either help DHL to enlarge their service point network, or provide the service of eco-friendly delivery in urban areas. With some of them, DHL is already collaborating. The collaboration of DHL and DPD with Fietskoerier.nl, for example, helps to guarantee eco-friendly delivery for all delivery timeframes. The red marked companies did not survive. We do see this often happening in the last mile delivery business, since starting a business does not require high investments, but high volumes are needed to survive. Partnering with large carriers is the solution for the startups.

Consolidated city hubs are, next to eco friendly vehicles, also an interesting innovation to look at. Startups working on this are Parcls, Bij de Buren and Smart mile. These three companies' business is about creating a network where parcels from every carrier can be delivered and returned. Parcls is the youngest company of these three. And this is definitely one that

is relevant to look at when talking about sustainable last mile delivery. Parcls has several locations in Amsterdam where they function as the local parcel store for every carrier to drop off and pick up parcels.

Next to the companies that are interesting to collaborate with, there are some companies that could inspire in case of user centric delivery. Budbee is an example of such a company that puts customer satisfaction high on the agenda. They do this by aiming for fast delivery, clear communications with the customer to ensure that the customer is home when delivering. Another logistic company that could inspire by the way the work is Picnic, which is already a

partner of DHL. They use location tracking to show the customer when they arrive at their house.

For services that offer delivery within 2 hours, it is hard to survive. This probably has to do with the demand and the price people are willing to pay for this service. It is a niche market they are operating in.

The matrix below shows the companies with on the x-axis how eco-friendly the delivery is, and on the y-axis how user-centric their solution is. What we see here, is that there are no companies yet that are operating fully eco friendly and with a user centric solution. This could be an interesting direction for DHL Parcel to move to.

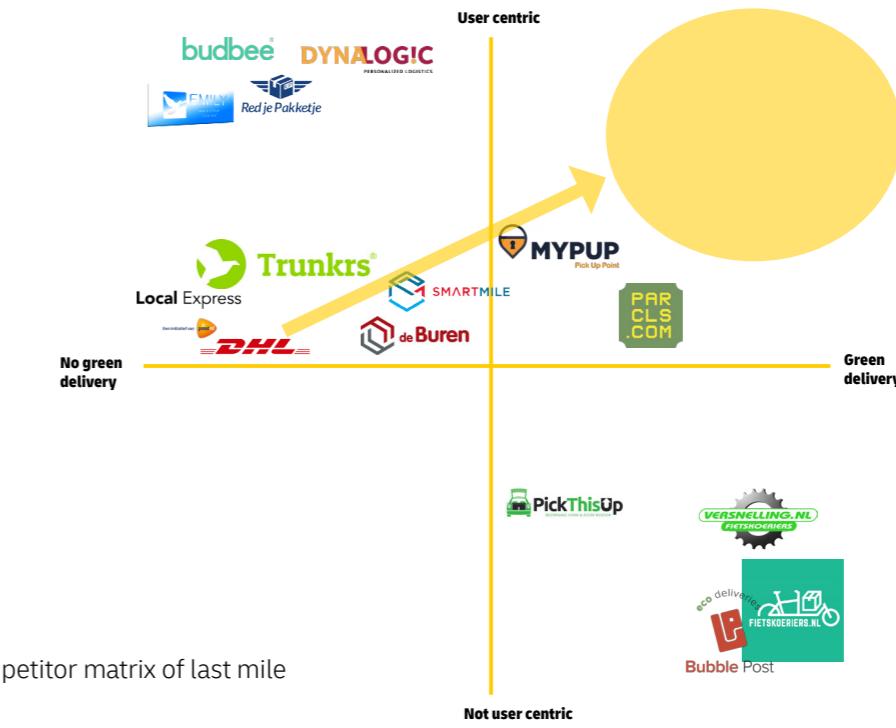


Figure 2.8: Competitor matrix of last mile delivery players

Trends in delivery

In this part, the trends within the last mile delivery are listed and described.

White label hubs

The larger delivery companies like DHL and PostNL are dealing with an increased number of parcels ending up at the service points. This causes problems for the retailers that run a service point. So called ‘white label hubs’ start popping up in large cities. These hubs collect parcels from different delivery companies and serve as a pick up point for the neighbourhood. If the customer wishes to have it delivered at home, they deliver the last mile with eco-friendly vehicles on a moment that suits the customer. Examples of startups in this business are Parcls and Smart Mile. See image 2.2 for a Parcls point in Amsterdam.



Image 2.2: Parcls in Amsterdam

Parcel lockers

Another option for delivering the parcel to the end consumer are unattended delivery solutions. Locker stations are an example of an unattended delivery solution. The lockers are basically a wall filled with closed boxes where parcels can be placed. The consumer receives a code to open the locker and they can get access to their parcel 24 hours a day. In Germany, DHL is investing a lot in these lockers, but in The Netherlands, the pilots were yet not successful. The explanation for this is that in The Netherlands, it proved to be a long and complicated way to arrange areas to place to lockers. Strict local policies were standing in the way of success.

For this reason DHL sold the lockers to a third party, whose main business is focussed on the parcel lockers: De Buren. Mypup is another party working on the parcel lockers. They are focussed on placing the parcel lockers at offices and apartment buildings (Mypup, 2020).



Image 2.3: A locker station from DeBuren

Neighborhood hubs

Several initiatives are popping up trying to improve the efficiency of parcel delivery. Since customers are often not home and many extra km's are driven because of the delivery man missing the customer, the idea developed of making money for receiving parcels for your neighbourhood.

ViaTim is one of the startups that based its company on this principle. If you are home during the day, you can subscribe yourself to become a parcel hub for your neighbourhood. By doing this ViaTim wants to improve the neighbourhoods community feeling. DHL is already a partner of VIATIM.



Image 2.4: Advertisement of VIATIM

Eco-friendly vehicles

Light electric freight vehicles are an example of bicycle solutions for freight transport. A company who is working on upscaling these solutions is Cyclespark. They develop cargo bikes as a transport solution, see figure 2.9 (Cyclespark, 2020).

An application of these bikes can be seen by DHL. They launched a City Hub concept in 2017, where parcels in containers are brought to a city hub and transferred to a Cubicycle-cargo bike to deliver in the city (Greenfleet, 2017).



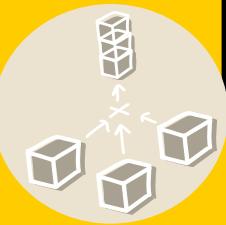
Figure 2.9: Cargo bike design from CycleSpark

Interim conclusion

From market analysis

In the market, I consider four aspects to be relevant for the next phase of the project.

The first is the increased number of white label hubs, parcel lockers and neighbourhood hubs. These are all innovative solutions for expanding the service point network of DHL.



Subscription based models in e-commerce

Amazon Day is an example of a subscription based model that offers advantages for the Prime members. With Amazon Day, the customer can choose to have all your ordered packages delivered on the same day. This is an additional service of Amazon and thus not replacing other services, like same day delivery and evening delivery.

These so called delivery subscription models became a trend in 2018.

With the growing e-commerce, it becomes more and more attractive to have a subscription on premium delivery methods such as next day delivery. From research it is learned that at £9.99 a year 34% of consumers say they would be very likely to subscribe to a free next day delivery service (Paazl, 2017). The Dutch market leader bol.com followed this example of Amazon and offers now Bol.com Select. For 9.99 euros per year, the customer can enjoy many advantages (Bol.com, 2020).

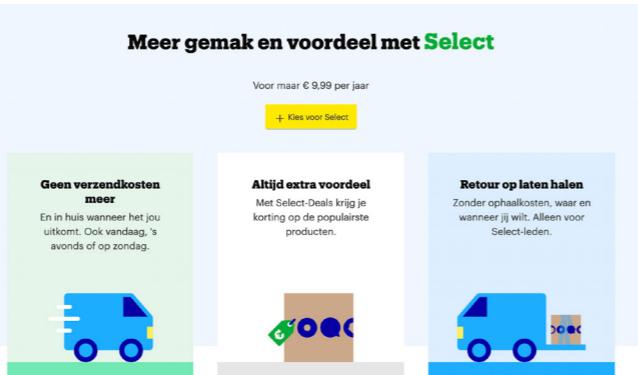
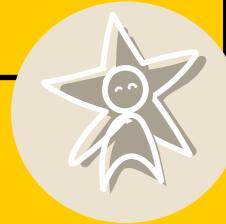


Figure 2.10: Advertisement of Bol.com Select

'Startups need volume to survive, and DHL needs startups to outsource the last mile and focus on efficiency of the so called middle mile.'

The second is that start-ups focus their business on the consumer. A good customer service, clear, personal communication and options to change the delivery via an app and fast delivery are ways to achieve this.



The third is the increase of eco-friendly vehicles (SEV'S) used for last mile delivery in combination with city hubs. Both delivery companies as start ups are working on solutions with the goal to exclude fossil fuel vehicles from the system.



And fourth, there is a trend to collaborate with companies such as for example Fietskoeriers.nl and De versnelling in order to ensure eco-friendly delivery.



2.1.4 TREND ANALYSIS

A trend analysis is done in order to predict the future context where last mile delivery will operate in. The method used for the trend analysis is DEPEST. This method assesses the macro-environmental factors that influence the business DHL Parcel is operating in. The full trend analysis is shown in [Appendix A6](#). The most relevant trends which are used to predict the future environment in which DHL will operate are discussed below.

Growing EV market

The sales of electric vehicles are growing each year. For 2040 it is expected that 56% of light commercial vehicle sales and 31% of medium commercial vehicles in China, The US and Europe will be electric (Electric Vehicle Outlook 2019, Bloomberg NEF). Delivery vans are light commercial and medium commercial vehicles, and as shown in figure 2.11, these segments will grow in the next 20 years.

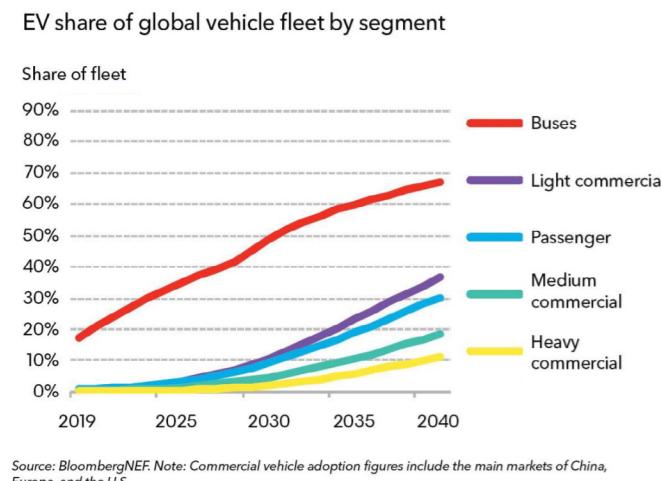


Figure 2.11: EV share of global vehicle fleet by segment. Source: Electric vehicle outlook 2019, Bloomberg NEF

Urbanisation

Randstad is growing. Half of the dutch population lives in Noord-Holland, Zuid-Holland, Utrecht en Flevoland (PBL, 2019). Figure 2.12 shows the prognosis for the population distribution in The Netherlands for 2018-2035. This map shows that most orange areas are located in the randstad, and most purple areas are rural areas of The Netherlands. It shows that people are moving out of the small villages and moving to the larger urban areas. This means for the e-commerce sector that people are more concentrated living in the cities and more separated in the rural areas. High volumes with a high concentration are expected in the urban areas while smaller volumes with more distance between one and another delivery are more likely in the rural areas.

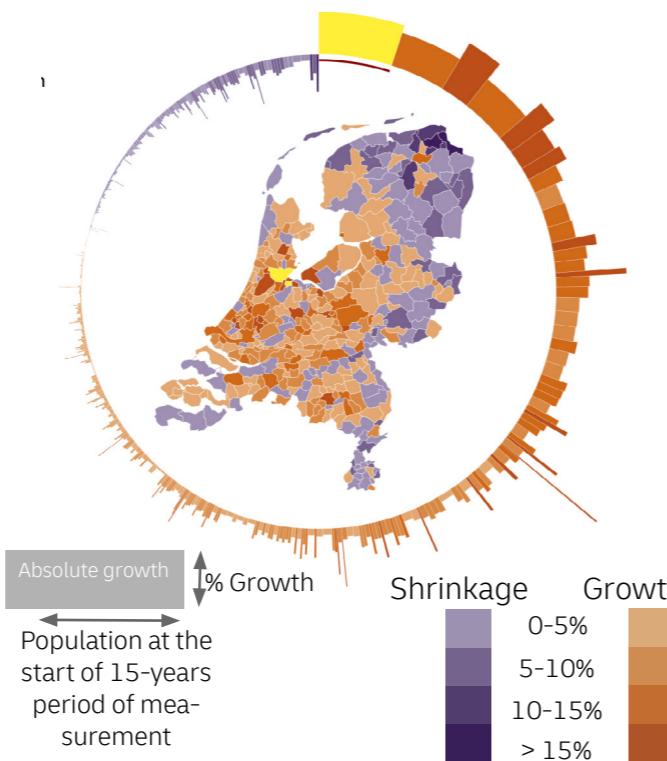


Figure 2.12: The decrease or increase of population per area in The Netherlands.

More single person households

The amount of single-user households is increasing. This will be 31% of the households in 2030 (CBS, 2018). The prognosis is shown in figure 2.13. This means for delivery that it becomes even more important to agree on a delivery time frame and place in order to increase the number of first time attempt deliveries.

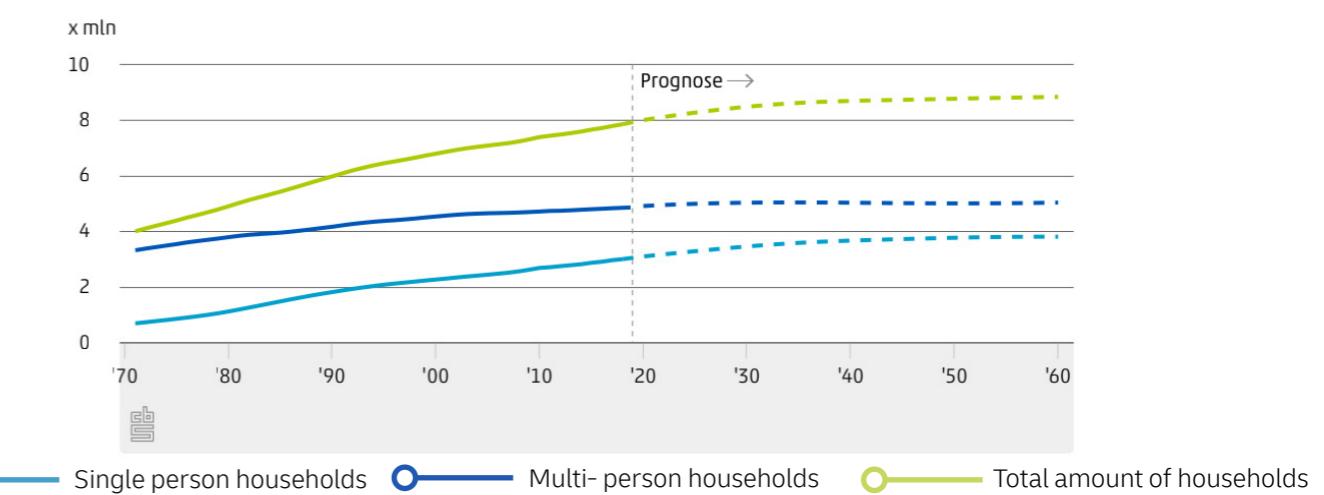


Figure 2.13: Prognosis of amount of single person households.

'The population in De Randstad will grow while the population in rural areas shrinks. Delivery to the randstad will be more dense while delivery to the rural areas is spread over larger distances.'

Interim conclusion

From Trend analysis

What can be concluded from the DEPEST trend analysis is that the following trends will influence the delivery of parcels:

Industry 4.0

Industry 4.0 refers to the current transformation we are going through in the way we produce things thanks to digitization in manufacturing. The industry is working with Cyber-physical systems: connecting real objects with data processors / virtual objects and processes through information networks (eg. Internet). Industry 4.0 has an influence on how the delivery system of the future will look like. Machines, sensors, devices and people will be able to communicate with each other via the internet. The interconnection of these systems is expected to increase optimization throughout the whole supply chain (Odanis, 2019).

Due to these developments in interconnectivity people will get more used to the fact that their products and services are connected. This means that in a couple of years, they will expect from a service that they have full transparency in what is happening when. For delivery this could mean that the tracking data of a parcel can be used to communicate directly to the end customer. This is already happening with the track and trace codes but could be done more by showing the delivery route of the van and more precise timeframes. This will increase transparency to the customer and is expected to result in higher customer satisfaction.

Ban of diesel vehicles in cities

Cities are taking action on reducing the pollution caused by traffic within cities. Several examples of large cities that start with banning fossil fuel vehicles from the city centre (Bendix, 2019). Amsterdam also presented plans to be fully free of emissions in the city in 2030. It is expected that in the near future, more cities will follow these examples (Actieplan schone lucht Amsterdam, 2019).

These developments have a large impact on the urban traffic and the electric vehicle market. For residents of these cities these regulations push them to buy more environmentally friendly cars such as hybrid or electric vehicles or choose for shared car services. It will result in more quiet traffic within a city and increases city liveability. Next to that, delivery companies are pushed to innovate their fleet in order to deliver to these regulated areas. DHL is well prepared for these changes by already replacing old vehicles for electric vehicles.

'The ban of fossil fuel vehicles will both push consumers and delivery companies to choose different transport modes.'

A large growth in the electric vehicle market is recognized and this will be part of the solution for the future delivery system. The share of renewable energies is also growing each year, and large energy companies are investing in green energy. This means that it is possible to use only green energy as energy supply for the vehicles. Regulation on traffic within cities is banning diesel vehicles from the city centres. Which pushes the innovation of alternative vehicles in the city centre.



When the number of single person households is growing, the agreed timeframe and place becomes even more important in order to achieve a first attempt delivery.



Industry 4.0 has an influence on how the delivery system of the future will look like. The fact that systems and products will be more interlinked will mean that consumers can inform the system when they want to receive their parcel and where. When combining their demands with their neighbours demands, orders can be consolidated and combined. Industry 4.0 allows the system to recognize orders, combine them and communicate this to the necessary devices and people.



2.1.5 FIELD ANALYSIS

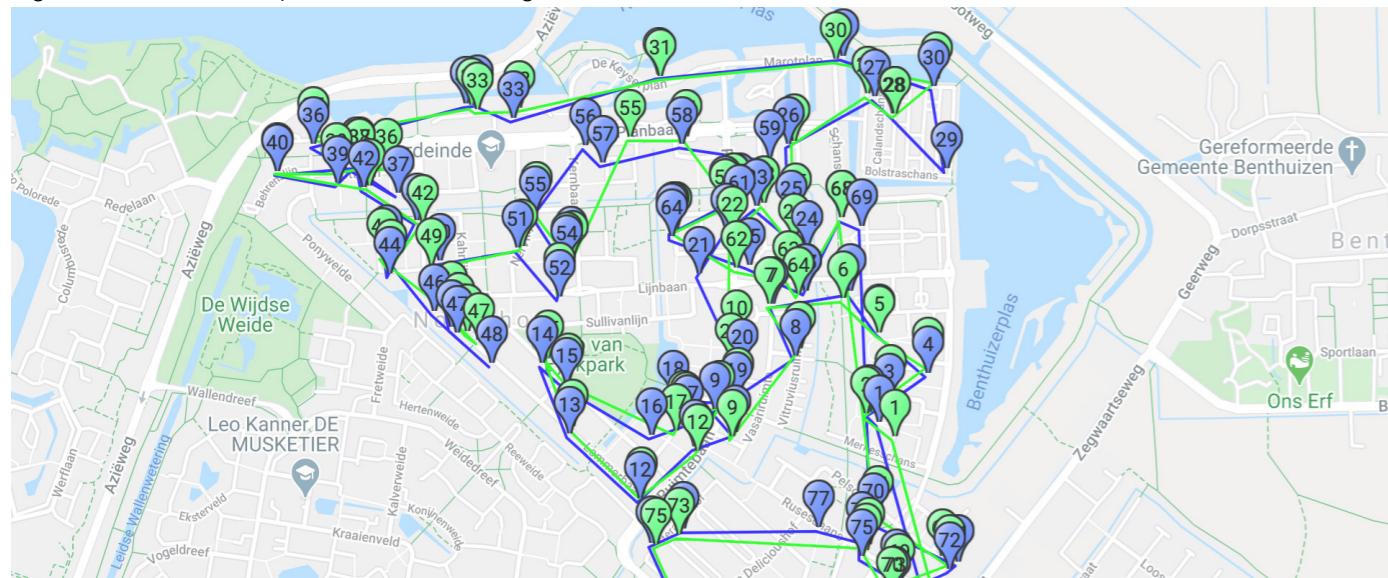
In this part, the following question is answered: What are pain points in the current last mile delivery process. In order to find the answer on this question, field research was conducted where I joined an e-commerce delivery van, and visited several service points.

E-commerce Delivery

In order to get a feeling for the operation, I joined an e-commerce delivery round. The whole report of this day can be found in [Appendix A7](#). Figure 2.14 shows the delivery route driven on one morning. The blue color shows the planned route, and the green shows the actual location of the successfully delivered parcel. This is communicated through the handheld device of the driver.

The first insight is that the operation of delivery could be more efficient when drivers know the neighbourhood they are driving in. Every CityHub is free to plan this how they want, but it would make the operation more efficient if deliverers are planned on the same areas. The delivery woman I joined agreed on this and said that driving the same route for a month would be no problem.

Figure 2.14: Full delivery route of one morning



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We were parking many times on the middle of the street, which could cause dangerous situations. The pressure to deliver the parcels as quickly as possible results in us running from one house to another, parking the car on random spots and turning the car multiple times.

Some locations were hard to reach by car and it took more time to deliver the parcel at the correct house. Especially houses in pedestrian areas and apartment buildings are hard to deliver quickly. See image 2.5 for an example of such an area.

The last insight is that we were driving through the same streets multiple times a day. The reason for this is that the route planner is planning the route first via one side of the street, and on the way back navigating to the other side of the street. Again, here it could help if the deliverer is more known in this area. See figure 2.15 for an example of this inefficient routing.



Image 2.5: Pedestrian location in Zoetermeer

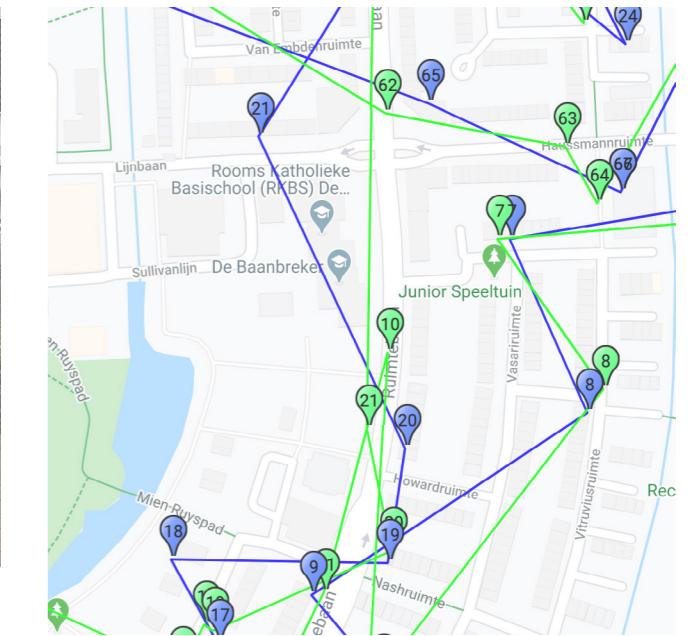


Figure 2.15: Number 10, 21 and 62 are in the same street, but all delivered at another moment.

'Inefficient routing results in extra kilometers. Planning drivers for multiple rides on the same area could make the process more efficient.'

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Interim conclusion

From Field analysis

The goal of this part was to find out what the pain points are in the current delivery process. Two main things are found, the first is concerning efficiency the second is concerning consumer satisfaction.

The first is that different parts in the process of last mile delivery are considered as inefficient. If these aspects are done on a more efficient way, there could be a significant decrease in emissions:

- A. The route driven by the driver;
- B. The amount of attempts before delivering to a service point;
- C. The amount of different companies delivering in the same street on one day.



Image 2.6: Two delivery vehicles placed in a small street

Another insight is that the service points are dealing with large parcels. A service point owner noted that more than half of the people unwrap the parcel in the store and only take the smaller box with them. See image 2.7 of an example for a parcel that is double wrapped in a larger box.

That webshop are wrapping their products in an extra box which is often larger than the product itself results in the fact that delivery companies are transporting air. This takes up more space in the delivery vans than necessary which lowers efficiency. It would be more sustainable if the parcels are not wrapped in larger boxes, to prevent transporting air.

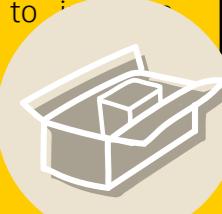


Image 2.7: The packaging of Adidas shoes is transporting air.

The second is that service points often get complaints about the note they find which says they were not home while they were home, waiting for the parcel. The delivery man is expected to deliver a certain amount of parcels a day so is rushed. This is at the expense of customer satisfaction.



The last remark in this chapter is that service points are complaining about the size of the parcels. Further research showed that this size is often larger than necessary. Webshops have the responsibility to limit the volume of the parcels to increase delivery efficiency.



Service points Delft

To get insights into the problems occurring at the service points, I joined a service point manager in Delft. The visit included five locations, both small shops as large supermarkets.

BCC and the Manfield are partners of DHL Parcel which means that they can enjoy extra advantages as for example being only a drop off point and no return point. This is the case for BCC. Since Nobel shoe store is the closest DHL service point to BCC, they are receiving many people for the retour of their parcel. Nobel is already a servicepoint for 10 years, and the owner says she became less satisfied with the developments in the last couple of years.

As shown in image 2.6, several delivery guys are blocking the pedestrian area which causes unsafe situations with bicycles and pedestrians.

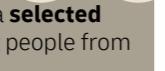
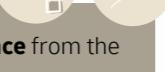
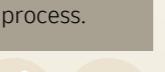
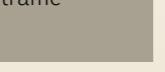
The owner of Nobel shoes told us that customers often complain that they received a note in the mailbox while they were home. The dissatisfaction of these DHL customers is affecting the customer relationship with the retail location.

For the consumer it is confusing that there is a difference in the service provided per service point and that their contact face at the service point is not responsible for the operations of DHL. Therefore, they often are advised to call the service desk of DHL. Customers become confused, annoyed and impatient in these kinds of situations.

'Bad delivery service dissatisfies customers and worsens the relationship between retail location and customer'

2.6 CONCLUSION PROBLEM ANALYSIS

This part is concluding the problem analysis and describes the most important factors that define the future context of a sustainable last mile delivery system in 2030. A visualisation is created based on the conclusions from the problem analysis. This visualization is created to give an impression of the context of delivery in 2030.

- Discount for servicepoint delivery 
- 1** Service point delivery in combination with a **selected home delivery** for larger orders to prevent people from picking up their parcels by car. 
- Expand service point network 
- 2** Service points on **walking or biking distance** from the customers house. 
- Track and trace code 
- 3** Industry 4.0 allows the system to **recognize** orders, **combine** them and **communicate** this to the necessary devices and people; 
- Collaboration Parcls, Mypup & DeBuren 
- 4** **White label** service points which are all providing the same service. 
- The Streetscooter 
- 5** **Electric vehicles** are used for the delivery from a CityHub into the city 
- Parcls, Mypup, DeBuren, Fietskoeriers 
- 6** **Collaboration** between large delivery companies and startups to outsource the last mile delivery process. 
- Consolidate 
- 7** **Consolidate** parcels in order to reduce the traffic movements in a street; 
- Development of phone app 
- 8** **Clear information** about delivery impact and timeframe of the order to the end consumer; 

The yellow bars on the left show how much DHL is currently focussing on this aspect. Examples of what they currently do to achieve this are written in the yellow bars.

More focus is needed on the selected home delivery, combine and cummunicating orders, development of white label hubs and consolidation of parcels.

The answer on the question: how to decrease the environmental impact of the last mile delivery? is answered in two statements:

1. Servicepoint delivery is the least polluting option for last mile delivery if the parcel is picked up on a CO2 neutral way.
2. Consolidate parcels with the goal to decrease the amount of traffic movements

In the following chapter, I will find out what the customer needs are in last mile delivering. The conclusions of this problem analysis and the user analysis of the next chapter form the base of the design challenge stated in chapter 3.2.



2.2

User analysis

Part 2.1 focussed on the operation and the developments concerning last mile delivery. The following part will zoom in on an important stakeholder in the last mile delivery process: the end consumer. The needs of the end consumer will first be investigated before stating the design challenge for this project in chapter 3.2.

Questions that need to be answered in this chapter are: What delivery aspects are important to end consumers? And in which urban area is much to win, when talking about sustainable delivery?

2.2.1 The customer journey

In this part, the consumer journey shows us on which part of the delivery process DHL has more or less influence on customer satisfaction. To let a sustainable solution work out well, DHL should not only develop a solution but also stimulate the users to act sustainable. This is why I want to know more about the drivers for consumers to choose one or another delivery option.

Research set up

In order to design the customer journey, I decided to undertake several interviews with a mixed group of customers. The scope of these interviews was to understand more of the consumers' behaviour in the delivery process. The results of these interviews give insight in the drivers for people to choose a certain delivery option. Also, the results are telling if and when people think of sustainability when ordering online, and how this can be changed.

19 individual interviews are held through telephone. Several questions were asked and it happened to be an interactive conversation. Interviewees were aged between 17 and 68 years old.

Findings

When thinking about the impact of an online purchase, people were not thinking about reducing their environmental impact by choosing a different delivery option. The interviewees that mentioned the environmental impact said they try to reduce it by minimizing their online orders.

There is a difference in preferred solutions per living structure and age group. People between 20 and 30 that live in an apartment building say they prefer a servicepoint delivery because they are often missing the delivery man when it is delivered to home.

People living in family houses answered the same question that they prefer home delivery because when they miss it, there will always be a neighbour opening the door for their parcel.

People select the servicepoint based on the size of the parcel. When this is large, they prefer to pick it up by car and choose a pick up point that facilitates pick up by car with parking lots.

Customer journey

The journey is split up in 9 steps. Starting with the decision to buy online or offline and ending with returning the parcel to the webshop, as shown in figure 2.16 (See next page) . The [Appendix A8](#) shows a larger visualisation of the customer journey.

This decision of purchasing something online instead of offline is based on the factors time, availability and convenience. The delivery company has no influence on this decision.

Consumers compare webshops based on price of product, price of delivery, delivery timeframe and reviews of the webshop. Who is shipping the parcel often does not matter to the customer. But people overall like it when they can choose several options for delivery. People say they base the choice of location for the delivery on the size of the parcel.

If they have to pay an extra price for a certain delivery option, they do not choose this one, except for the cases where they desire a fast delivery, for example with a gift for a birthday.

When the delivery method is selected, the actual paying process is not interesting for the delivery company. But after the paying process, a confirmation is sent to update the customer about the delivery status with a track and trace code.

Interim conclusion

From Customer journey

The questions that needed to be answered in this part are:
What delivery aspects are important to end consumers? And in which urban area is much to win regarding sustainable last mile delivery?

From the customer journey can be concluded that 4 aspects are important to them for the last mile delivery:

- Providing correct and timely information about the delivery;
- Being in control of when to receive the parcel;
- Efficient delivery, no unnecessary movements to and from my house;
- Knowing what to expect;

Overall, users are not aware of their environmental impact considering delivery of parcels. Some consumers try to limit the impact by shopping offline and only shop online when necessary.

Delivery companies have a large influence in this phase, they should communicate clearly. Customers like it to check the current state of delivery with the track and trace or even adjust their week schedule to the delivery. For this reason, a small delivery window is desired. If it is possible, people change the time and place for the delivery on the day itself. Missing the delivery often happens. For most interviewees the amount of missed deliveries is 3 out of 5. This is very frustrating, especially when they were waiting for the parcel at home. Also, one aspect they dislike is that the parcel is brought

to the service point on the next day which means pick up is possible on the next day after 3 pm, why not on the same day?

It is fine if the parcel is delivered to the neighbours, because they do this for each other. In some buildings this is not possible and the parcel is brought to the service point. Consumers do not see a point in trying it again, because they are afraid of missing it again. People prefer to pick it up directly. When getting the parcel from a service point, sometimes users unwrap it on the spot, in order

to bring it home by bike. For the return of the parcel, people use the original package and bring it to the service point of the company who was responsible for the delivery. Sometimes they use the pick up option, but then this feels very inefficient because parcels are dropped off at another moment on the same day.

Figure 2.17 shows where DHL has an influence on the satisfaction of the delivery of the end consumer. This is used later in the process to see where in the process DHL can improve to increase the customer satisfaction of the end consumer.



Figure 2.16: Customer journey with comments from interviewees

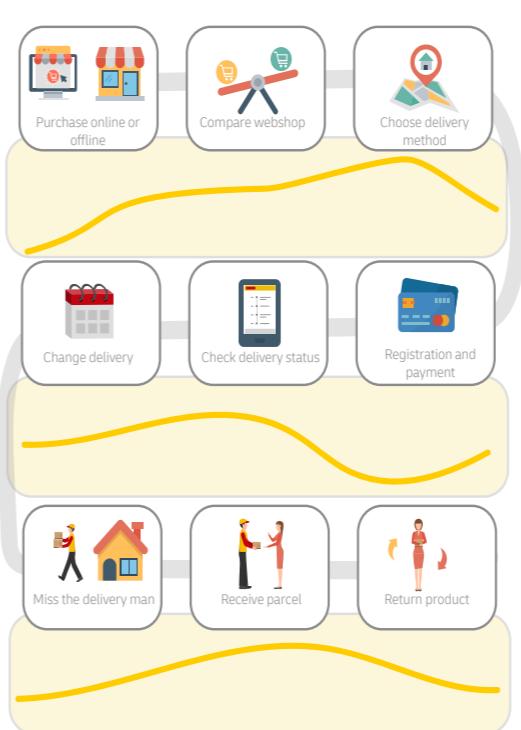
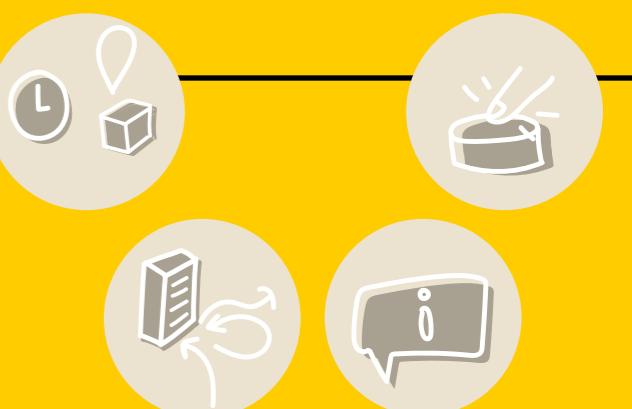


Figure 2.17: Every part of the delivery process with the influence DHL has on the customer satisfaction.



2.2.2 The circles of a Dutch city

The interviews showed that there is no one size fits all solution for the last mile delivery.

Therefore, research is done in the different living structures of The Netherlands in order to find the target group for this project. The target group will be the people living in an area where the most gains can be made regarding sustainable last mile delivery and where it is urgent to have a solution.

Dutch city structure

Dutch cities mostly have a fixed pattern because of the historical development of the city. The city is built up in cirkels which each have their own characteristics: the living structure, the amount of space, the kinds of shop facilities and the people who live in this area. Also, they all have their own challenges for delivery. The characteristics of the city circels are described in the analysis that can be read in [Appendix A9](#).





Based on the analysis done to understand the different living structures of The Netherlands, and based on my interview with the delivery woman from DHL, I listed pain points of delivery per living structure. In figure 2.18 is summarized which challenges every living structure of a current city experiences, based on my research. The full analysis per living structure can be found in [Appendix A9](#).

To analyze the demographics per area, three cities are taken as examples: Rotterdam, The Hague and Utrecht (CBS, 2020). Some demographic facts based on these cities are added in figure 2.18 to give an idea of density of this area and characteristics of households.

Figure 2.18: Different living structures with their demographics and delivery challenges.

Interim conclusion

From Circles of the city

To answer the question in which area there is much to gain regarding sustainability, in order to focus the solution on a target group, we looked at the different living structures within a city. Despite the fact that every living structure has its own challenges, the second circle ‘mixed high rise apartments buildings and offices’ has the most potential. This is due to two aspects:

First, the high rise buildings and apartments are nowadays a challenging structure to deliver at, due to the time consuming job and failed deliveries. And second, in the near future, cities are building more and more of these buildings to meet the demand for housing in the city.

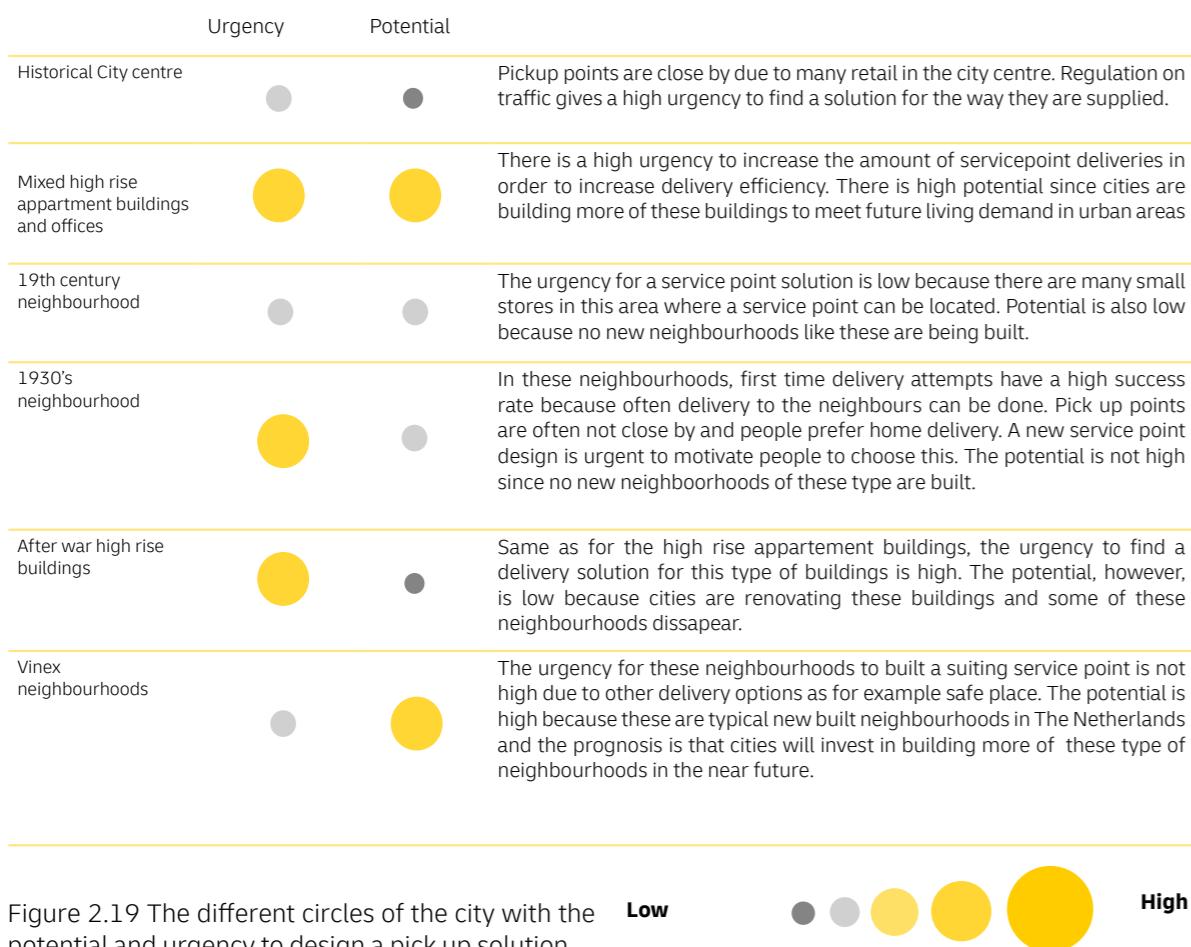
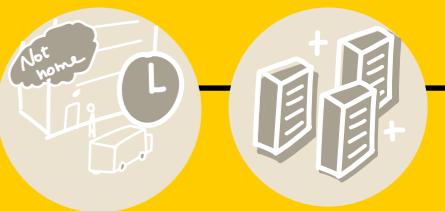


Figure 2.19 The different circles of the city with the potential and urgency to design a pick up solution

Figure 2.19 shows the urgency and potential for designing a sustainable last mile delivery solution that improves the first hit rate. For apartment buildings, it is hard to achieve a high first hit rate. People are often not home and the delivery guys/girls do not try neighbours. This causes many unnecessary traffic movements from and to the apartment building and parcels ending up somewhere in the apartment with dissatisfaction at the customer as a result. Having more parcels delivered directly to service points would positively affect the delivery efficiency.

Cities see apartment buildings as a part in the solution for the shortage of housing in urban areas (NOS, 2018). Since more and more apartment buildings are planning to be built, the potential for a delivery solution for this segment is high.

2.2.3 CONCLUSION

User analysis

Chapter 2.2.1 and 2.2.2 discussed consumer related challenges with parcel delivery.

This chapter draws an overall conclusion from the user research in order to answer the question stated in chapter 1.1: Which consumer is living in an area where sustainable delivery is a challenge?

A customer journey is made to present the insights gained during interviews with customers. 4 aspects are considered to be the most important in the delivery of their parcel:

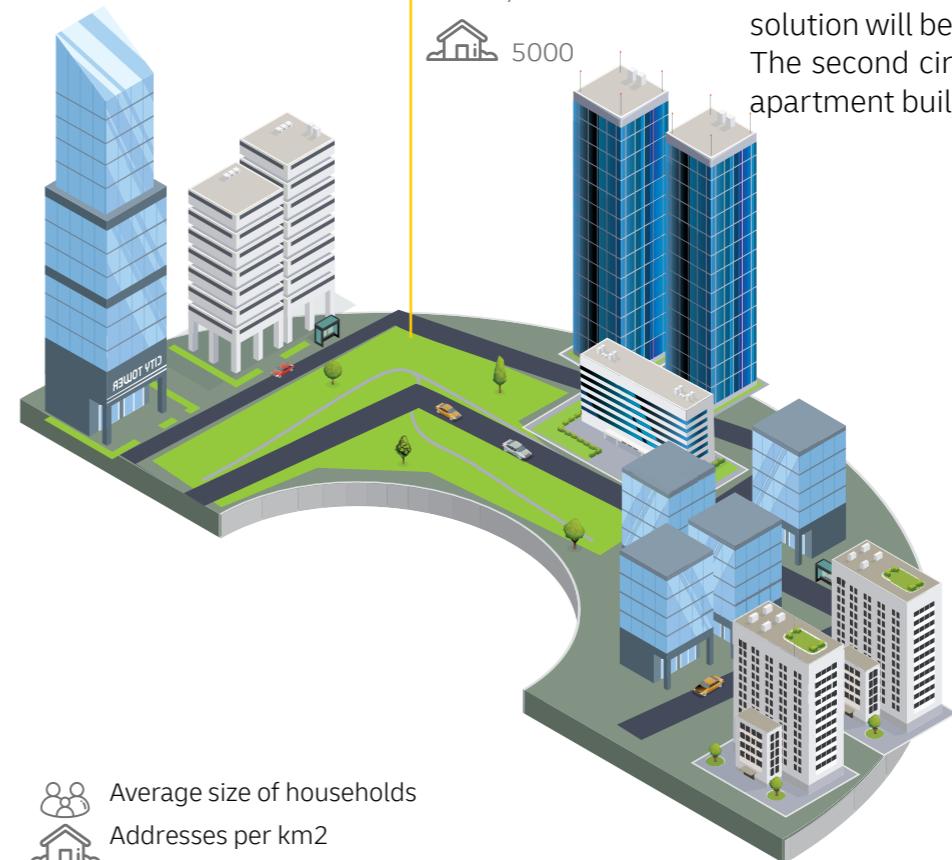
- Correct and timely information about the delivery;
- Being in control of when to receive a parcel;
- No unnecessary movement to and from the house;
- Know what to expect.

The customer journey also shows where in the delivery process the touchpoints with the customer are for DHL. At these touchpoints, DHL has an influence on the customer experience of the overall delivery process. If DHL aims to improve the customer experience for the receiver of a parcel, the 4 named points are aspects to focus on.



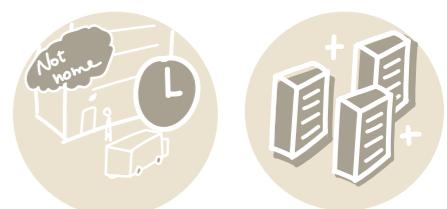
MIXED APARTMENTS AND OFFICES

People not home during day
No delivery to neighbours
Order much online
Time consuming delivery
Many new buildings
Hard to find parking spot



Since there is no one size fits all solution for different living structures in urban areas of The Netherlands, I chose to scope this project on a certain target group.

After analyzing the different living structures in urban areas of The Netherlands, I looked for the living structure with the highest urgency and most potential to design a solution for. Due to the challenging circumstances for apartment building delivery, current problems occurring with delivery to these buildings and the focus of cities for building more of these buildings. The solution will be focussed on this living structure: The second circle of the city 'Mixed offices and apartment buildings'.



2.3 Summary

Problem and user analysis

At the moment you arrived here, you got an impression of the problem we are trying to solve. As stated in chapter 1.1, there are 3 questions that needed to be answered before stating the specific design challenge for this project:

- *What does the sustainable delivery scenario or 2030 look like?*
- *Which consumer is living in an area where sustainable delivery is a challenge?*
- *What are the consumer needs of the chosen target group?*

In this first phase of the design process, we answered the first two questions. The third question is going to be answered in chapter 3.1 since further research was desired for the specific target group when defining the specific design challenge.

The problem analysis answered the question: what does the sustainable delivery scenario for 2030 look like. The answer is that I consider two things most important things for lowering the environmental impact of last mile delivery:

1. The parcel should be delivered to a pick up point/service point and picked up on a CO₂ neutral way
2. The parcels should be consolidated in order to decrease the total amount of traffic movements. The context I envision for sustainable delivery in 2030 is drawn in the visual shown in chapter 2.6.

The user analysis is done to answer the question: Which consumer is living in an area where sustainable delivery is a challenge? A customer journey was created to show pain points for the customer in the delivery process, how to improve these and to see where DHL has touchpoints with the end consumer.

4 aspects are considered to the customer as most important in the delivery of their parcel:

- Correct and timely information about the delivery;
- Being in control of when to receive a parcel;
- No unnecessary movement to and from the house;
- Know what to expect.

There is no one size fits all solution for last mile delivery. To find a target group for this project, I analyzed the different living structures of the Dutch cities. From this it is concluded that the mixed offices and apartments have the most potential and the highest urgency to focus the designed last mile delivery solution on.

3 Define

This part continues on the conclusions from chapter 2. Both the conclusions for the problem analysis as the user analysis are used to create a design challenge in chapter 3.2. But first, more information about the apartment buildings and their residents is needed to set requirements for the design of the solution. In chapter 3.1, you can read the analysis of this group and in chapter 3.2, the insights are used to create the specific design challenge and requirements for the solution.



3.1 Analysis Target group

One question named in chapter 1.1 remains unanswered: What are the consumer needs of the chosen target group? This is partly answered in chapter 2.2.1, since the customer journey already taught us four important aspects to satisfy the end receiver with their delivery. Two surveys are spread along apartment buildings in the city centre to gain a deeper understanding of the group we are designing for. This research is discussed in the following part.

Target group survey

The solution will be designed for people living in high rise buildings and apartments.

A survey is conducted along people living in selected high rise city buildings in Rotterdam, Delft and Utrecht.

The buildings were selected on location and characteristics (minimum amount of floors, large main hall, built after 2010)

The total amount of spread surveys is 1200 pieces. The response is 94.

The questions of the survey can be read in the [Appendix B1](#). To summarize the results of this research, an infographic is created, see figure 3.1-3.3.

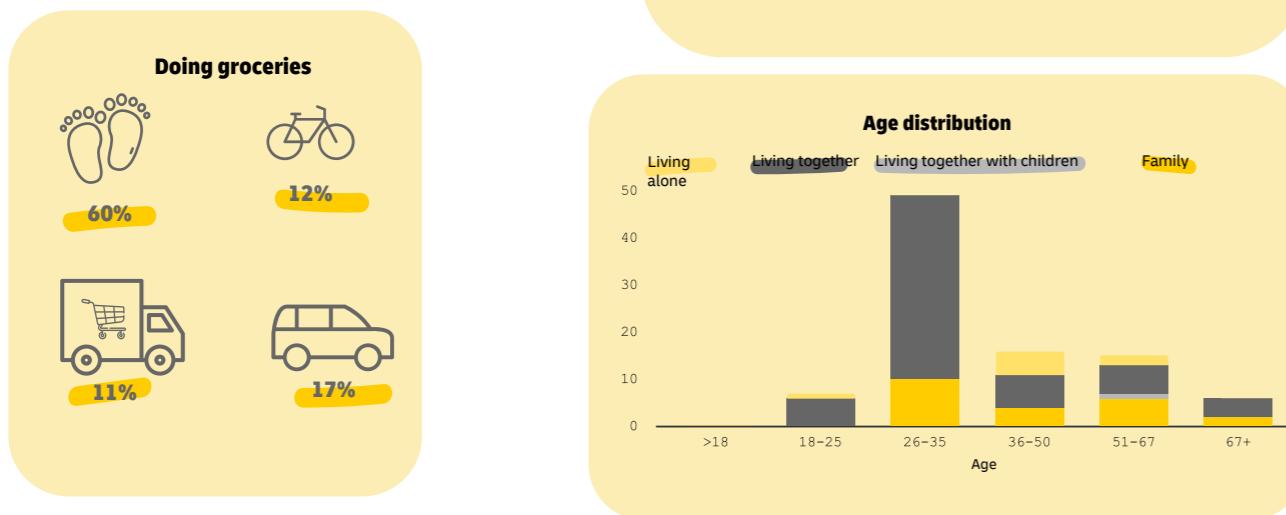


Figure 3.1: Infographic of survey results.

Results from the survey show that the customer feels more delighted, and less irritated when the parcel is delivered to their home address. When the goal is to motivate people to choose parcel pick up point delivery at the check out of their order, they should have a more positive experience with this delivery option.

This can either be done by making the home delivery less attractive through punishments, or making the service point delivery more attractive by fitting to the customers needs (e.g. opening times and location).

How does the customer feel?

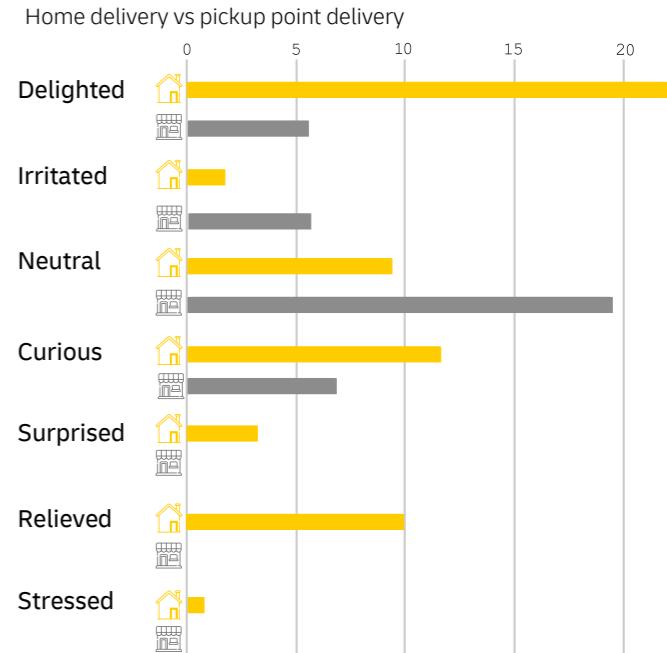


Figure 3.2: Results of customers' feeling comparing service point pick up with home delivery.

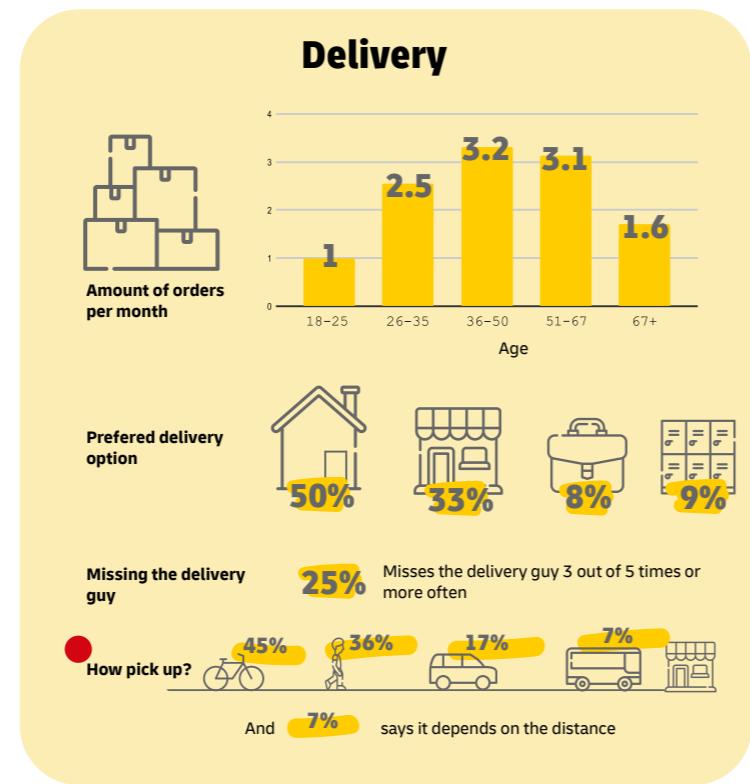
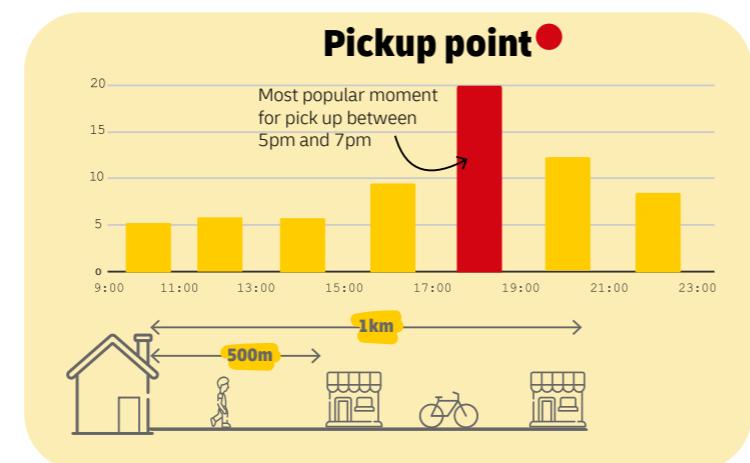
For the targeted group, half of them prefers home delivery. However, when delivering to a pick up point turns out to be the most sustainable option, some people change their opinion and 61% is okay with always delivering to a pick up point.

When delivering to pick up point, the most popular time for pick up is between 5pm and 7pm, a moment that most retail shops are closing their doors, apart from supermarkets.

Pick up in the evening is also more popular than during the day, so if you take a critical look at the current service point network, many of the service points are not matching the desires of customers.

The walking distance between their house and the pick up point should be maximum 500 meters, and when biking, this distance can be 1000 meters. Currently, 81% says they do the pick up by foot or by bike.

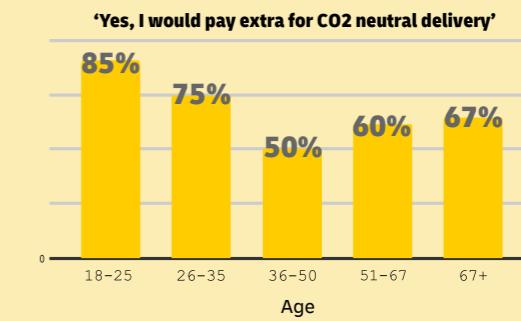
From this target group analysis we can conclude that people are willing to let their parcel be delivered to a parcel pick up point if this turns out to be the more environmental friendly option. However, current service points are often not matching their needs and therefore people have a more positive experience with home delivery than with service point delivery.



Some facts considering sustainability

What is the customers view on this?

68% Is willing to pay extra for CO2 neutral delivery of their order.



54% Is okay with delivering always to a pick up point.

If this is proved to be the most sustainable delivery option this percentage is **61%**

75% Is okay with waiting a couple days longer for their order if this minimizes the CO2 impact of the delivery.

72% Is interested in receiving information about the CO2 impact of the delivery of their order.

68% Says they are currently not informed about the CO2 impact of the delivery of their order.

Figure 3.3: Infographic of survey results.

Generation Y vs Generation Z

The largest age group living in the apartment buildings nowadays is between 26 and 35 years old. This is also called generation Y or Millennials. When designing for 2030, there will be a shift in generation, and people who are in 2020 between 8 and 23 years old will be the target group for apartment buildings in 2030. (Dimock 2019)

There are 3 main differences shown in table 4. (McKinsey&Company, 2018) (Premack, 2018) For a collecting and pick up service this means that the design for 2030 can be more focussed on communities and sharing, instead of being it an individualistic solution which is anonymous. But for the first steps, it is still focussed on generation Y. The community and sharing values can be added in the later horizons of the design.

Generation Y	Generation Z
Self oriented	Focus on the bigger picture
Anonymous	Community focussed
Driving force behind sharing economy	Grew up with sharing economy

Table 4: Comparison generation Y to Generation Z.

Characteristics of apartment buildings

In order to design a last mile delivery solution for high rise apartment buildings characteristics of these buildings are investigated through field research. The results of this analysis are visualized in the [Appendix B2](#). The most important takeaways from this analysis are that the apartment buildings have matching characteristics where the design can be focussed on. A shared main entrance is one of them, but also the shared green facilities in or around the building are an opportunity.

Current solutions and their problems

I analyzed current solutions for apartment building delivery to gain a deeper understanding of what is already out there. The solutions focus on three main aspects: Parcel locker solutions, an additional concierge service for apartment buildings and technology added to the buildings, as for example smart doorbells. See figure 3.4 for the problems, solutions and their limitations.

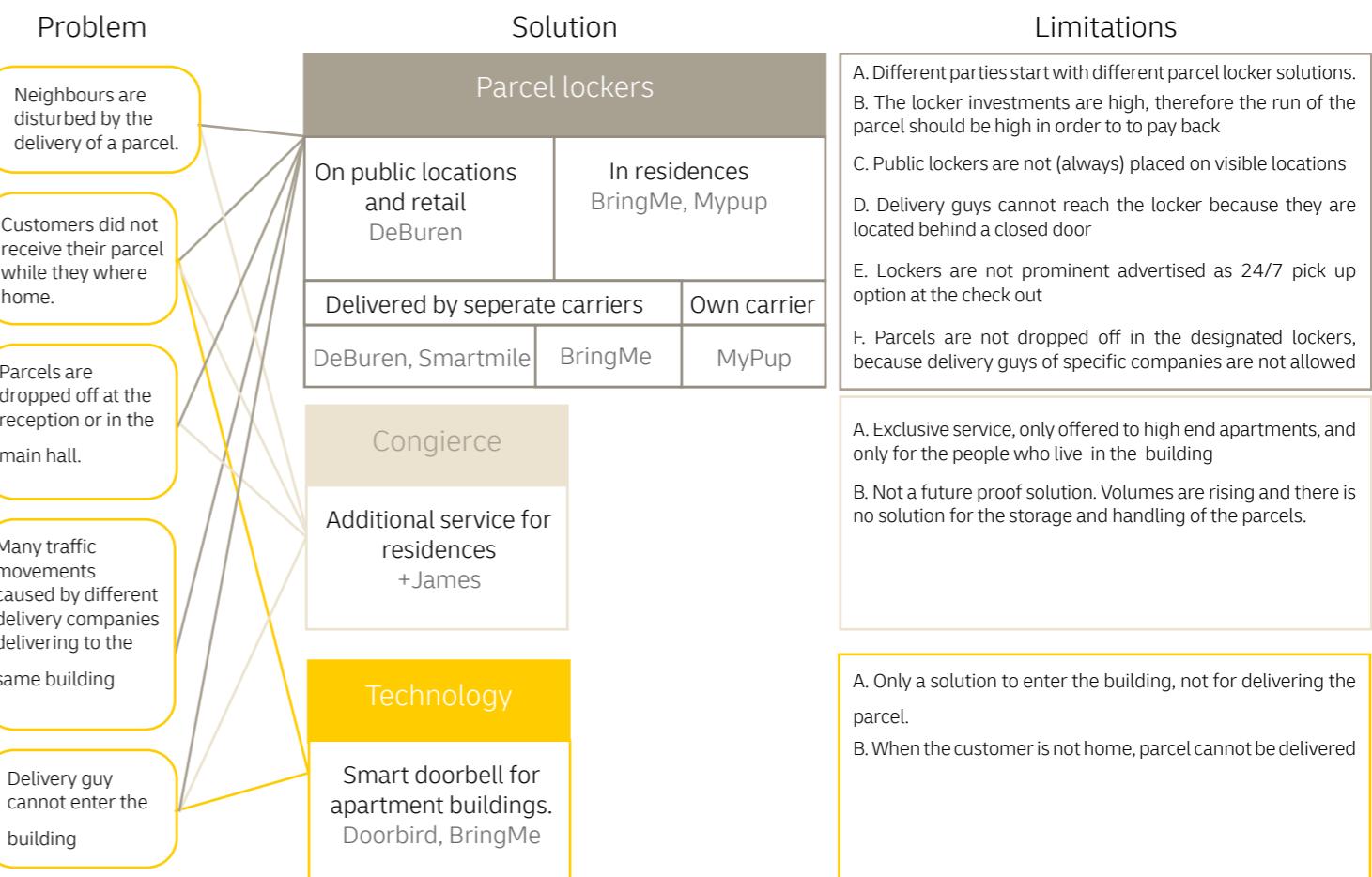


Figure 3.4: Problems, current solutions for apartment building delivery and their limitations .

The communication to the consumer about the parcel lockers for public locations could be more clear. Figure 3.5 shows a handwritten note to customers looking for a parcel station which is placed on the first floor of this residential area. There is no advertisement or sign that the parcel locker is placed there, and therefore it is hard to find for someone that wants to pick up. Next to that, in the check out of the webshop the closest servicepoint is shown on top. Which implicates that this is the 'best' option for pick up. But often, this is a retailer with limited opening times.

Some delivery companies do not allow their deliverers to drop off at a parcel station. In case of lowering CO₂ emissions by reducing the transport movements, it would be beneficial to have an open network of parcel lockers. Which means that every delivery company can deliver to the locker.

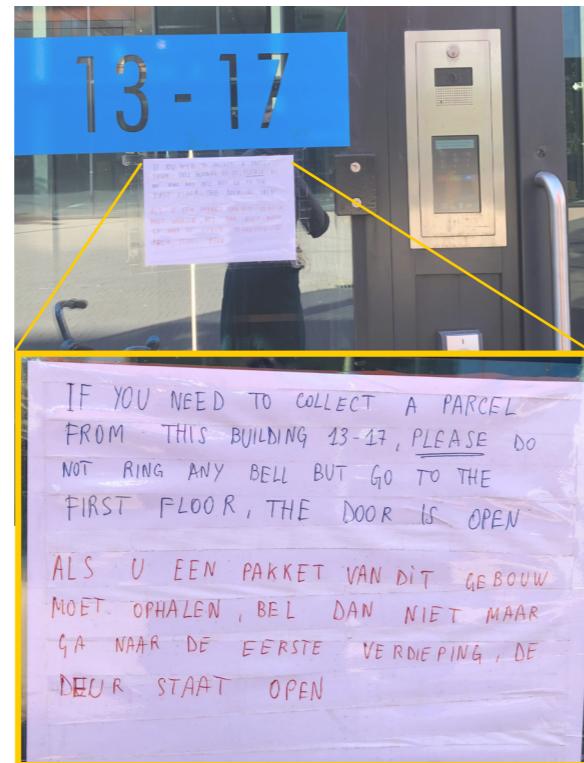


Figure 3.5: Handwritten note at entrance door to parcel lockers giving instructions to not ring any doorbell.

The take aways from this chapter are that pick up points should be more fitting to the customer needs. These needs can be defined as follows:

- Correct and timely information about the delivery;
- Being in control of when to receive a parcel;
- No unnecessary movement to and from the house;
- Know what to expect.

In the next part, the design challenge is stated, based on the research findings.

3.2 Specific design challenge

As explained in chapter 1.2, after the discovery phase, a specific design challenge is defined to design the solution for. In this part, this design challenge is stated followed by the design criteria for the solution. These criteria will be the start of the next phase: 'develop'.

From the problem analysis is concluded that delivery to service point is the most sustainable delivery option, and parcels should be consolidated in order to reduce traffic movements. From the user analysis we learned that delivery to apartment buildings in the city centre can be improved and there is much potential since this group is expected to grow. Next, from the analysis of the target group can be concluded that current service points and parcel pick up points do not (always) meet the customer needs:

- Correct and timely information about the delivery;
- Being in control of when to receive a parcel;
- No unnecessary movement to and from the house;
- Know what to expect.

This made me scope my project to the following design statement:

Design a parcel collecting point for high rise apartments buildings in the city centre which meets customer needs.

A list of design criteria is set up and listed on the next page. The design should meet these criteria in order to solve the design challenge of this project.

Design criteria

Feasibility

- A** The solution contributes to achieving the zero emission goals of DHL for 2030
- B** The solution strengthens the core business of DHL by making the delivery more efficient
- C** The solution is innovative and bold
- D** The solution is realistic to achieve by 2030

How

- E** The solution should encourage the customer to do the pick up by foot or by bike
- F** The solution should minimize the amount of unnecessary traffic movements from and to the apartment buildings
- G** Parcels from every delivery company are delivered here
- H** The solution is for both receiving and returning parcels

When

- I** Enable the customer to pick up at preferred times
- J** The solution should include communication with the end consumer about the delivery of the parcel.

Where

- K** The solution should be feasible to integrate in green zones of the city
- L** The solution can be placed in the second circle of the city: apartments and office

4 Develop

This part shows the creative process of designing solutions for the stated design challenge. First, the creative process is explained in chapter 4.1. Next, resulting from the creative process, 4 possible solutions are presented.



4.1 The creative process

The design statement named in chapter 3.2 is the starting point for the next phase: Develop. In this phase, a solution is designed through individual brainstorm sessions and collaborative creative sessions.

Brainstorm session

In an individual brainstorm, I listed ‘how to’ questions based on the outcomes of the research. For example: ‘How to minimize car movements?’, ‘How to encourage the user to pick up?’ and ‘How to add an experience to the pick up process?’. Different interesting ideas came by, one more realistic than the other: using trailers full of parcels to deliver many parcels at once, hanging parcels on the ceiling in the main hall of apartment buildings, and using convey belts to get parcels to the right floor of the building. In the [Appendix C1](#), the framework with ‘How-To questions’ and ideas is shown.

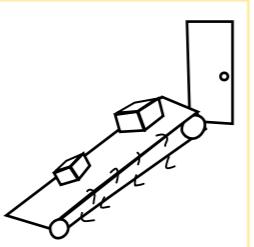
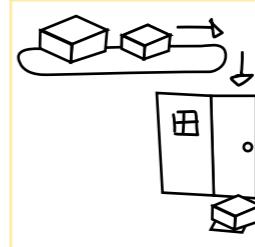
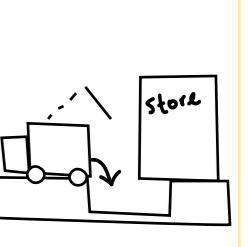
The next step was to link different ideas with each other to create an idea for the total solution. One idea that came from this session is a green point where can people not only receive their parcel, but also drink a coffee and meet their neighbours, like a community house.

In this phase I found out that I needed more input from the customer, ‘what would they like to see as a solution?’ was the question I asked myself. To answer this question, I organized two creative sessions with different groups of people who order online regularly.

Creative sessions

To find multiple solutions for the design statement, creative sessions are set up. Both sessions started with an introduction to the topic and an explanation of the procedure.

The first creative session was held online due to the measures against the COVID19 virus. For this session, an online whiteboard is used to exchange the thoughts of five participants. Seven ‘How to’ questions were prepared and everyone had 3 minutes to answer the how to questions with their thoughts. The results of this session are shown in [Appendix C2](#).

Only deliver when the van is full	Collaboration between delivery companies								
Consolidate parcels of different webshops	Many ideas were about consolidation of parcels through collaboration	Make fast delivery more expensive	One large container for every street or neighbourhood as collection point	Use empty stores as parcel pick up point	Deliver on specific day of the week	Autonomous vehicles driving the same route each day	Design flatter parcel boxes	Automatic scan integrated in the van	A local delivery person for a neighbourhood was named in different forms
Make the most popular delivery timeslot cheaper and let the customer choose	Discount on order if the neighbourhood also ordered at this webshop		Vacuum packaging	Packaging redesign as idea to minimize the amount of space needed and increase efficiency	Volunteers in the neighbourhood that want to be the parcel pick up point	Let people on scootmobiles deliver the parcels	Make service point delivery faster and cheaper	Commercials for webshops at the pick up point	Rewards for choosing the pick up option
Make pick up of parcels more personal	Competition element for parcel pick up	Combine parcel delivery with grocery delivery	Multiple counters to make it quick		Deliver where you are, with tracking your location	Lockers with access via a card or a code		Green marketing for pick up points	Scan many parcels automatically when in a box (Decathlon paying system)
					Only open on peak hours	Many ideas included locker systems and different systems for opening and scanning	Deliver to community house		Introduce a delivery dog
					Community app: pick up parcels for each other	Ideas about communities doing the pick up for each other were named	Anonymous lockers. Delivery man only puts the parcel in and the locker scans automatically	User account with which you earn points for quick pick up	Follow the delivery van with live tracking
					Modular trollies to quickly drop many parcels at once	Activate a stand-by van when you are ready for delivery	Anyone can pick up your parcel	Combine with coffee corner	

The offline session was held with 4 participants. The procedure for this session is described in [Appendix C3](#). A provocative question was asked to warm up the creative thoughts of the participants. From this question, How To questions were created from problems that were named as answers to the first question. With these how-to questions, many ideas were generated. These are mixed with ideas from the other creative session shown in figure 4.1. The most interesting ideas are highlighted with an explanation.

Figure 4.1: Interesting ideas named in the creative sessions.

Clusters

The creative sessions led to a large variety of solutions for different parts of the design statement. To clearly act as a starting point for the concepts, these ideas were clustered into topics. The clusters are based on several similar ideas from the creative sessions. Following, the clusters are bundled and an overall title is given. The clusters and their overall title are discussed in this part.

Make delivery more efficient by consolidation

An often named topic was how to create a system where parcels are not all delivered on separate days, but more combined and delivered to a certain address together. Collaboration was an essential word in this discussion, both for delivery companies as for webshops and consumers. DHL is currently already opening their servicepoints for other carriers to deliver to. In the research phase we learned that PostNL, the market leader, values exclusivity of their brand. This means that they are currently not opening their servicepoints for other delivery companies yet. This could change in the near future when the pressure on their network increases.

Merge orders from different webshops

Combine orders of the neighbourhood

Combine grocery delivery with parcels

Change the parcel packaging to increase efficiency and be user friendly

Several ideas were about the packaging of parcels. They are not easy to carry, often way to big for the parcel inside and often unnecessary. Reducing the size of parcels will increase the amount of parcels delivered per delivery van and thus increase efficiency. DHL is not responsible for the way products are packed, but they can motivate webshops to decrease the package sizes with price incentives. It will be in DHL's advantage if parcel sizes are reduced, therefore they should inform their customers (webshops) in conversations too and motivate them with price incentives.

Vacuum packaging

Redesign for easy carrying

Make delivery to a parcel point more attractive

Ideas were discussed about how to make the pick up point delivery more attractive. Ideas about green promotion were named to make the customer feel good. But also price incentives and making it the fastest delivery option were discussed. Another cluster was to combine the pick up with other activities in the customers daily life as for example going to the gym.

What was also named and is linked with the clear communication cluster, is that the pick up option could be a more prominent option on the website of the webshop. Currently, the option of service point delivery is not always shown on the website. This is frustrating if the consumer already knows he/she will not be home. DHL is working on this with interventions, which allow the consumers to change the delivery time and place. But this system can even be more elaborate, with for example an agreement for a moment of delivery, right after the order is placed.

DHL is careful with promoting the service points as a green point. In my opinion, there is no need for being careful, and green promotion for service points has two large advantages: It can strengthen their green brand image and people are motivated to choose pick up at a service point.

Green promotion

Combine the pick up with something else

Price and time incentives

Make prominent option on website

Access on a suited moment

Parcel lockers are an example of a pick up place that is accessible whenever you want. Many retailers have limited opening hours, which is a reason for consumers to choose for home delivery. Ideas were about where to place the lockers and how to interact with them. The parcel vending was named as an idea. Ideas were also about how to make it easy for the delivery guy to place the parcels in the lockers. An example of this is an automatic scan when the parcel is placed in the locker.

DHL worked on parcel lockers in The Netherlands, but now sold the lockers to another party. The lockers should be advertised more in order to make this option more popular and create a profitable business model. Also, it takes time for users to get used to a new system. This could be the reason why the lockers are currently not a popular option yet.

24/7 lockers

Delivery volunteer for neighbourhood

Personal collection point for the neighbourhood

Agree on a moment for delivery

Clear communication towards the consumer

A discussed issue during the session was the communication towards the end consumer. Many ideas were about real life tracking and informing the customer beforehand on which day the delivery would come. Examples such as Hellofresh and Picnic were discussed. These companies found interesting solutions to inform the customer about the delivery. Hellofresh delivers always on the same day and Picnic shares real time tracking data with their customers. These are both interesting ideas for DHL to look into. However, these ideas are more focussed on increasing the success rate for home delivery instead of focussing pick up point delivery.

Real life tracking data

Transparency

Clear which service is provided at which point

Modular container solutions

How to achieve a sustainable logistic solution for the transportation of parcels also was a point of attention during the session. This in combination with large volumes for the same place, and quick drop off for the delivery man resulted in modular locker ideas for parcel collection points. Although these ideas are further from the current reality because a redesign for the logistic system is needed, these ideas are promising and can function as inspiration for the long term.

Modular locker system

Cityhubs

From ideas to concepts

The clusters are combined and worked out into concepts. The process of this step is described in [Appendix C4](#). On the next page, four concepts are presented as possible solutions for the design challenge.

4.2 The concepts

Different ideas from the individual brainstorm and the creative sessions were combined and worked out into concepts. In [Appendix C4](#) is shown how the clusters are worked out into concepts. In the following part, 4 concepts are briefly explained. The full description of each concept can be found in the [Appendix C5](#).

Concept 1: The Green point

The Green Point is a white label parcel shop for receiving and sending parcels close to apartment buildings, open for every consumer in the neighbourhood. The solution is based on the insight that people want to be in control of their pick up. The green point is open during the evenings, to give consumers the possibility to pick up their parcels after working hours. An extra service is added to this service point: parcels are delivered by bike from the Green Point to the customers home, if the customers prefers home delivery instead of doing the pick up by themself.



Figure 4.2: DHL Green Point.

Concept 2: Mobile locker station

The second solution is based on reducing the traffic movements within the city. The solution is a mobile, unmanned locker station that can be placed on a certain location for the whole day. The lockers for a group of apartment buildings are filled outside the city in a CityHub and brought into the city with one vehicle. The advantage of this solution is that the vehicles can drive to the apartments during off peak moments. In this way, city residents will experience less nuisance of the delivery vans.



Figure 4.3: Mobile locker station

Concept 3: Platform for parcel lockers

This solution is based on current locker solutions implemented in or around apartment buildings. The solution is a locker system platform that connects deliveries to addresses with a locker system and only allows locker delivery for these locations. The potential for these solutions is high, but at the moment, the implementation of these lockers is not ideal yet. Current problems are on both the consumer side as the delivery side.

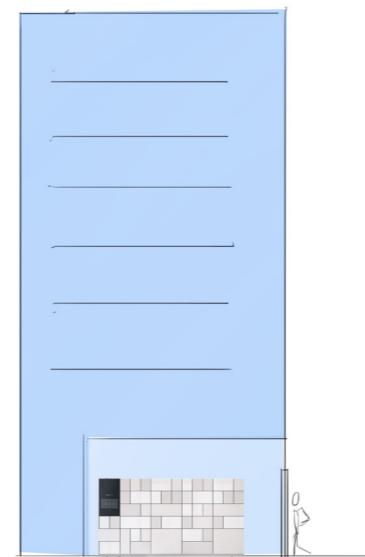


Figure 4.4: Locker in the apartment building

Concept 4: Mobile pick up station

This solution is based on the fact that people like to know what they can expect and want transparency in the delivery process. The solution is a driving pick up location that visits different neighbourhoods on a specific moment. Instead of receiving the parcel in a certain timeframe, the pick up location is parked in the neighbourhood for a specific time and people can pick up the parcel in this timeframe.



Figure 4.5: A mobile pick up station for parcels.

Evaluation on concepts

When critically reflecting on the presented solutions, one could argue that these are not far away from the current way of operating. One of the design criteria states that the solution should be bold and innovative. Another criteria is states that the design should be feasible for 2030. The presented concept are probably already feasible in 2022, and therefore considered as too safe. In order to inspire DHL, the solution should be more out of the box. Another iteration is needed to come up with concepts that are more futuristic and not only solve the delivery problem, but also add more value to the future city.

In the next chapter I introduce a new design approach which brought me to new concepts.

5 Speculative Critical Design

After going through the developing phase of the double diamond design method, I was not satisfied with the level of creativity of the presented concepts. Until here, it was all quite rational and functional. In order to come up with more radical concepts, I decided to add a new cycle in the process where I use the Speculative Critical Design (SCD) approach to come up with new concepts. In the next part, I would like to introduce you to this design method and explain the concepts I came up with.



5.1 Literature

In this part, the literature about Speculative and Critical design is discussed. These design approaches are first explained separate, and lastly a paper from Johannessen is discussed who developed an umbrella term: Speculative Critical design. In this part it will become clear to you what the differences are in the traditional design approach, executed in chapter 4, and the Speculative Critical design approach used in the following chapter.

Speculative and Critical Design (SCD) confronts traditional design practice. Where traditional design is solving problems with the goal to satisfy users, Speculative and Critical Design seeks to challenge the stakeholders and spur debate on what is preferable societal development. A critical designer dares to dream, and uses these conceptual designs to provoke their audience (Johannessen, 2019).

In the following part the terms Critical Design and Speculative design are explained, followed by the explanation of the umbrella term Speculative and Critical design.

Critical Design

The term critical design was first named by Anthony Dunne and Fiona Raby at the London Royal College of Art. Later, the term was elaborated by Dunne & Raby in their 2001 book: "Design Noir: The Secret Life of Electronic Objects". In this book they write: "Instead of thinking about appearance, user-friendliness or corporate identity, industrial designers could develop design proposals that challenge conventional values."

When practicing critical design, the goal is to challenge what is given by society, and thus affect how the world develops: by provoking the audience to think critically about their norms and values, CD practice strives to encourage public debate.

Speculative Design

In their book, Speculative everything, Dunne & Raby present the A/B manifesto. The manifesto comprises two connected categories, where each element has a direct counterpart in the other. A shows what speculative design is not where B represents what it is. Speculative Design complements traditional design. See table 5.

A	B
Affirmative	Critical
Problem solving	Problem finding
Provides answers	Asks questions
For how the world is	For how the world could be
Makes us buy	Makes us think

Table 5: Excerpt from A/B manifesto (Dunne & Raby, 2001)

Speculative and critical design

In his paper 'Speculative and Critical Design — Features, Methods, and Practices' Leon Karlsen Johannessen developed the umbrella term Speculative and Critical Design. He analyzes critical design, speculative design and traditional design and compares SCD to traditional design. His conclusion on the comparison is that Speculative and Critical Design is a complement to traditional design. Figure 5.1 shows Johannessen's extension of the A/B manifesto.

	Traditional design	SCD
Attitude	Normative	Critical
Foundation	Information	Speculation
Mindset	Pragmatic Productive	Idealistic Dreaming
Purpose	Commercial Satisfy industry's need to make money	Discursive Spur debate on the development of society
Goal	Develop solutions Provide answers by solving problems	Explore ideas Find problems by asking questions
Intent	Serve a user In seriousness provide clarity	Provolve an audience Use ambiguity to make satire

Figure 5.1: Johannessen's extension of the A/B manifesto.

5.2 SCD applied to design challenge

Now it is clear to you what SCD is, this part will explain to you how I used it in my design process. A visual is created to show which steps I took and how I changed my mindset in this design.

The scope for the stated design challenge is set in 2030. The current design process was too much focussed on solving the problems in the present. In this part is explained how the SCD mindset helped me with getting to more radical concepts. Although Dunne & Raby suggest no methodology to use for conducting SCD, Johannessen attempts to codify SCD in his paper and presents 3 steps for SCD practice: A) Define a context for debate, B) Ideate and find problems, and define a scenario, C) Materialize the scenario to provoke the audience. I conducted SCD by creating scenarios from trends that are likely to happen in the Dutch cities by 2030. Speculating with asking 'What if'- questions brought me to new challenges to solve. The whole process is visualized in figure 5.2.

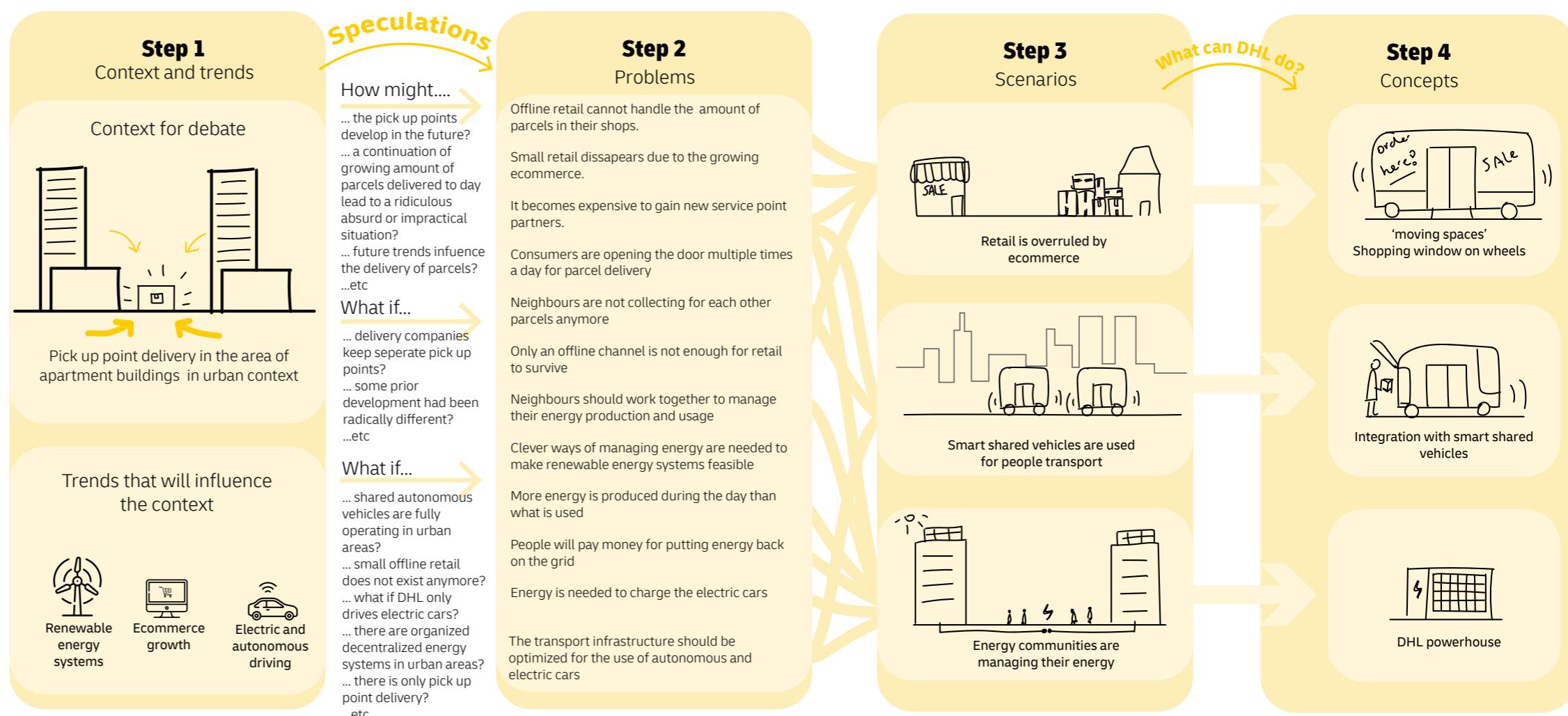
There is no handbook for practicing SCD, as long as the designer has a critical attitude towards, commercial industry, technology and norms given by society. The designer should question everything. What worked for me was speculating on the future by working with 'What if- and How might-questions' based on current trends and the chosen context for debate. Some examples are: 'How might this topic develop in the future', or 'what would be the issue look like today, if some prior developments had been radically different' ? (Johannessen, 2019)

Figure 5.2: My SCD process

This speculation led to problems, which were used to set up scenarios. In the visualisation, examples of problems are named to give an idea of the process. Many more problems followed from the ideation.

The scenarios can either be Alternative Presents or Possible futures. In this case, the chosen scenarios to work with are all possible futures. The concepts are designed based on these scenarios. The concepts are not presented

as solutions that fit the users needs. They are designed to provoke the audience, and create debate on the topic of how the world should look like. The concepts are shown and explained on the next pages.



5.3 Concepts 2.0

In the following part, the three concepts that followed from the Speculative Critical Design approach are presented. The concepts are designed for the context of an urban area in 2030. Three trends were on the base of these concepts: 1) Renewable energy systems in urban areas, 2) Retail looking for new channels for sales and 3) Shared autonomous vehicles. The concepts are all designed around the mission statement: Connecting people, improving lives. With the goal to let DHL be the facilitator of increased connectivity in urban areas.

DHL integration with smart shared vehicles

The top 11 automotive companies all shared their vision about the expectations of autonomous driving. 5 levels of autonomous driving are defined. Where level 1 is driver assistance and level 5 is full automation in all conditions. In 2015 many of these companies spoke about fully autonomous driving in 2020 and are now careful in their predictions for the future. Hyundai expects urban driving to be

reality in 2030, while autonomous driving can already be achieved in 2020. Why urban driving takes another 10 years of development, has not only to do with strict safety regulations and a long testing time. It is also due to the fact that there are many complex situations in an urban environment.

In this concept, DHL plays into the trend of using smart shared vehicles for people's transport.

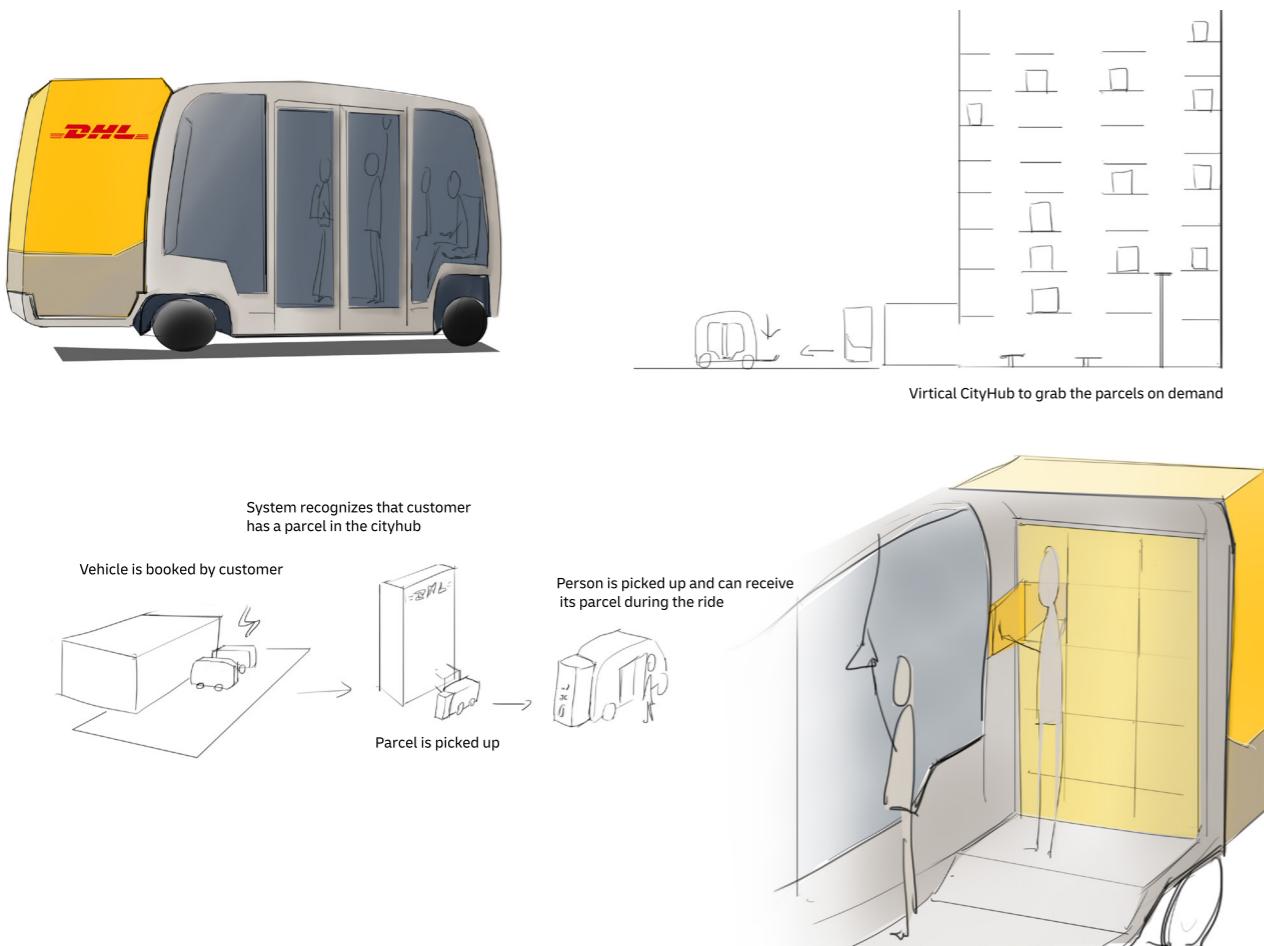


Figure 5.3: Concept drawing of how parcel lockers can be attached to autonomous vehicles

When a vehicle is booked by a consumer, the vehicle first drives past the CityHub of DHL at the edge of the city. The parcel will be loaded on the vehicle on demand. To make this possible, there should be a vertical distribution centre that allows DHL to grab parcels on demand. The vertical distribution centre, as shown in figure 5.3 on the top right can help DHL in consolidating parcels and saving money on ground space since it is built vertically.



Figure 5.4: Value map of stakeholders

Figure 5.4 shows each stakeholder and the advantages for them in this concept. There are many advantages for the consumer. The parcels are delivered on the way, which does not ask for extra effort from the consumers to pick up their parcel.

Figure 5.5 explains the business model. This shows that the first steps needed to be taken are done by manufacturing companies and vehicle sharing platforms. At the moment this is realized, DHL could hop on. For this concept, the market should move first and DHL will follow. DHL could strengthen its position by already developing the vertical distribution centres and look for partners to facilitate the shared autonomous vehicles. By doing this, they can easily hop on when the technology and regulations are ready.

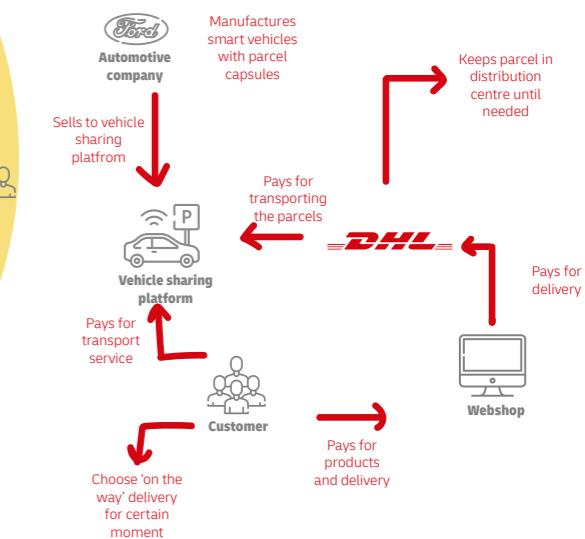


Figure 5.5: Potential business model

DHL POWERHOUSE: A pick up and pop up station
The graph in figure 5.6 shows the energy load profile for residential buildings published in a report of Enexis Group. This report showed the results of their pilot with a Smart Storage Unit (SSU) to store energy in a neighbourhood (Enexis, 2016). What you can see in the figure is that the use of SSU can flatten the peaks of load on the energy grid. Expected is, that with

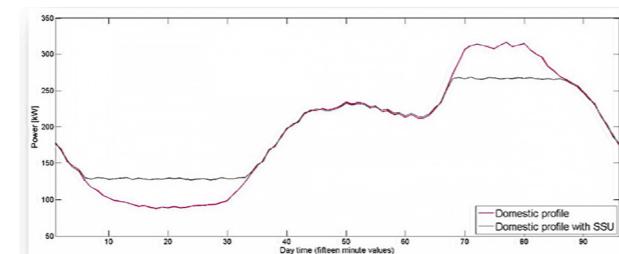
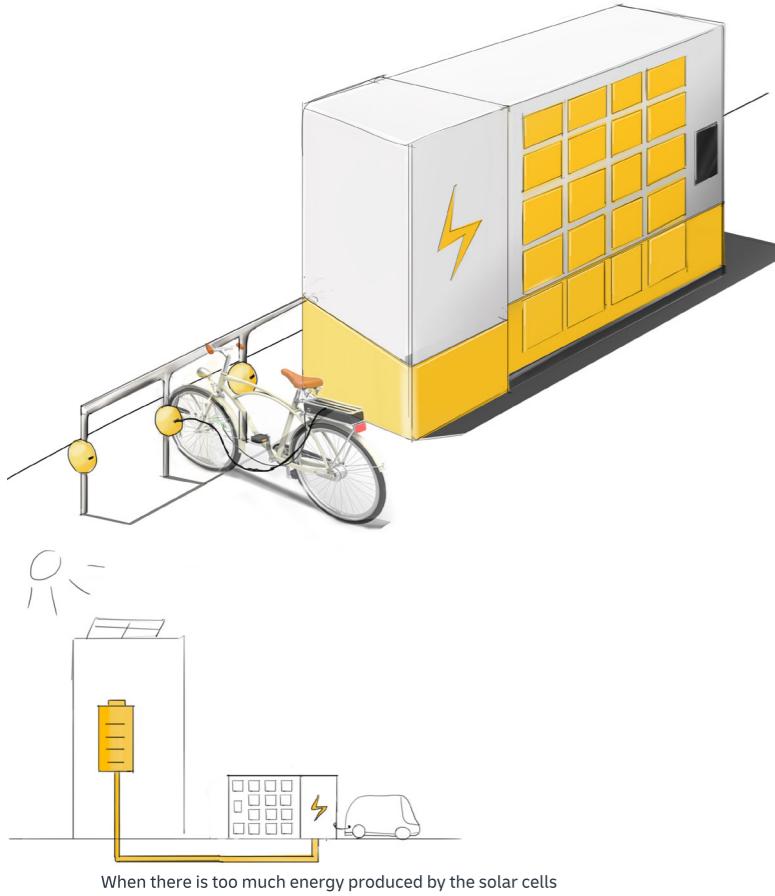


Figure 5.6: Energy load profile during the day.
(Enexis, 2016)

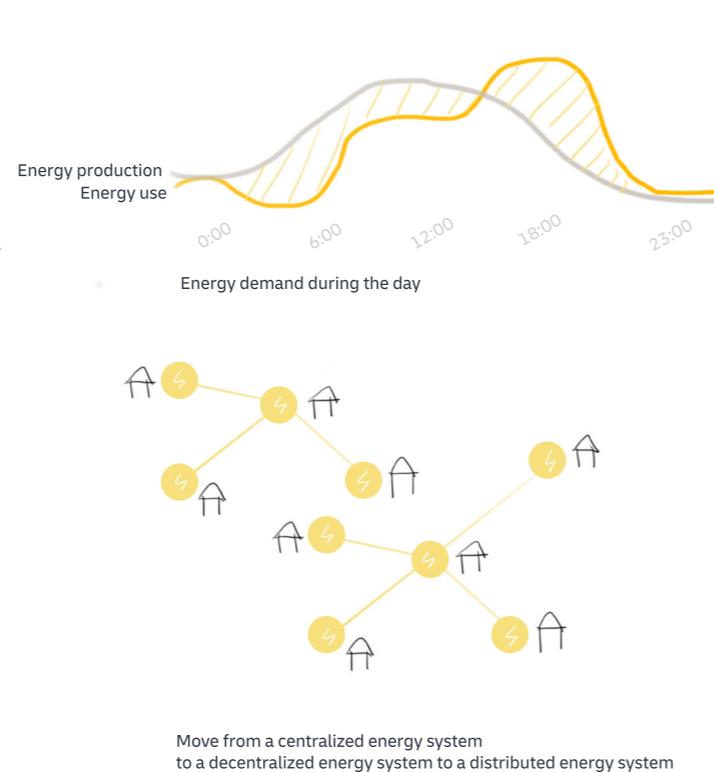


Figure 5.7: Visualisation of DHL Powerhouse concept

the increased use of renewable energy sources, the differences between energy production and energy use are serious and therefore storage is needed.

Okay, but what does this have to do with DHL? From user research we learned that parcel lockers are a practical solution that fits customers' needs for parcel pick up: it can be close to home, at any moment you want and the parcel is safe until pick up. Also, for DHL it has advantages in case of increased delivery efficiency and success rate of first attempt delivery.

At the moment, municipalities are one of the two main reasons why parcel lockers are not a success in The Netherlands yet. Policies around placement of parcel lockers differ per city, but in general the municipalities do not want parcel lockers to disrupt public spaces. They say that such parcel lockers should have an added value to the public spaces and thus to the city. Also, different companies place different lockers. An universal solution could solve this problem, but collaboration is needed to achieve this.

The concept of an electricity hub is solving different urban problems at once and enlarges the role of DHL in the city.

The idea is that DHL places lockers with energy storage units. These lockers can then be used as pick up and pop up stations. The DHL Powerhouse could both charge small urban vehicles like electric bikes, as larger vehicles like the delivery van. All with renewable energy sources. The energy that is overproduced during

the day can be stored in the Powerhouse and can be used during the day, or during the evening when families come home and energy load on the grid is high.

The Powerhouse is a way for DHL to promote electric driving and to help their customers to act more sustainable.

The stakeholder value analysis in figure 5.8 shows the added value for every stakeholder. What is interesting to highlight is that this concept adds a new value for customers: the storage of energy. This concept is therefore not only sustainable because less unnecessary movements are done, it also increases the feasibility of renewable energy systems in urban areas and promotes electric driving.

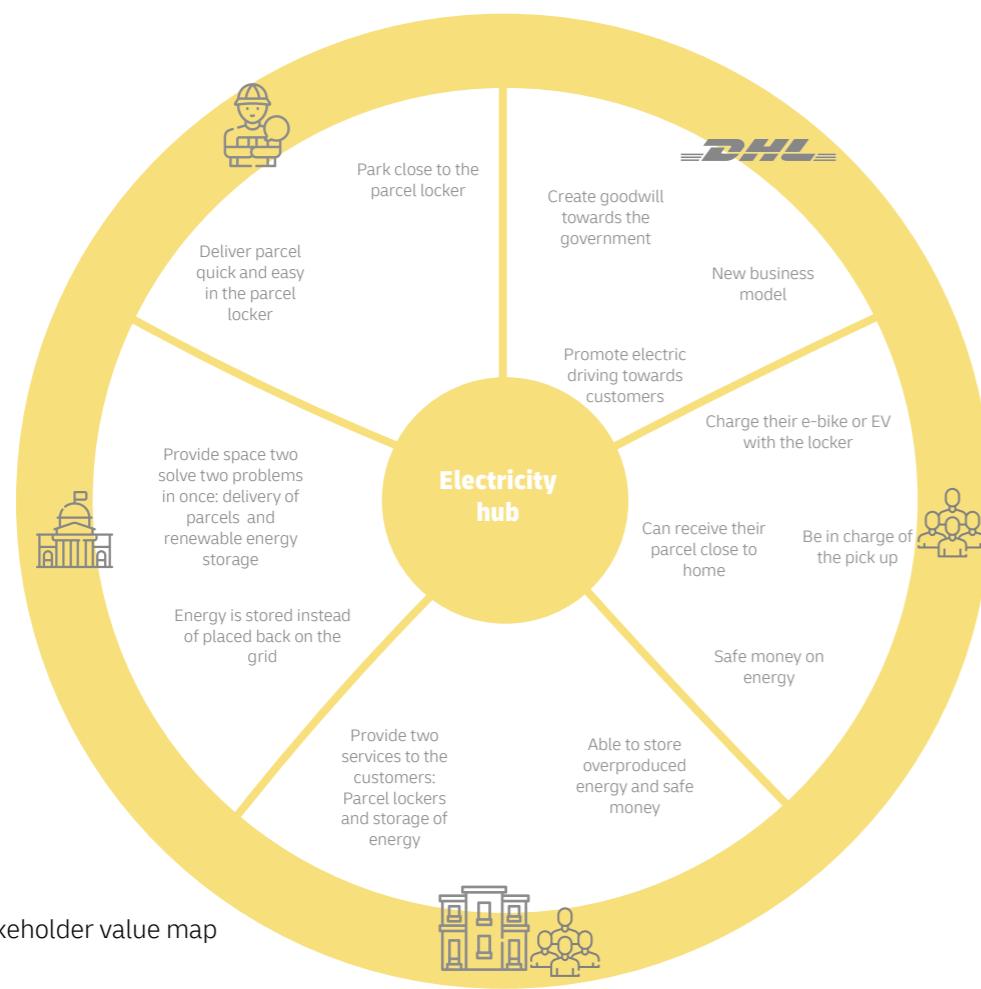


Figure 5.8: Stakeholder value map

Figure 5.9 shows the potential business model. When connecting the lockers to the solar panels of apartment buildings, partnerships with energy companies are needed. This concept is both strengthening the core business of DHL by increasing efficiency of parcel delivery through the locker, as creating new opportunities for business on the long run.

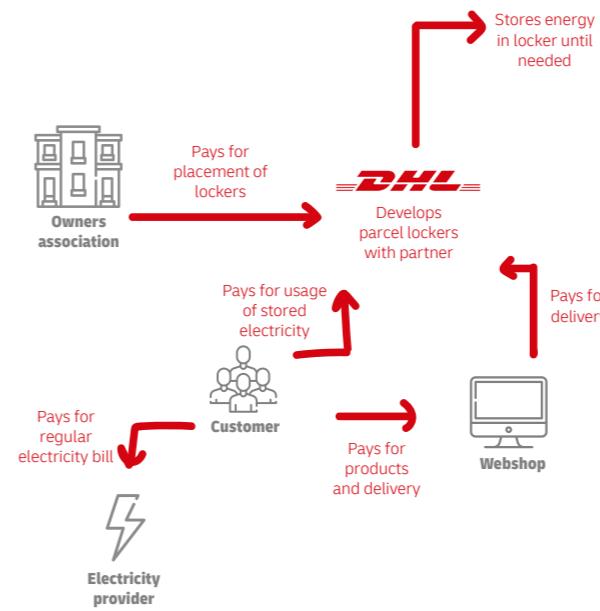


Figure 5.9: Potential business model Powerhouse

DHL MOVING SPACES

When looking into the trend of rising e-commerce I discovered that the growing e-commerce puts pressure on physical retail and forces them to use a multichannel approach. This means that a physical store will create multiple touchpoints with their customer. Next to a physical store, a webshop will help them to reach their customers and keep up sales. An example of this are stores like Hema and Douglas that started an online

channel next to their physical stores. This works also the other way around. E-commerce shops are exploring opportunities in opening physical (pop up) stores to let the customer experience their products. An example of this are the Coolblue pop up stores.

DHL is the connection between the (web) shop and the customer by transporting the products to the end receiver. This third concept is inspired by the multichannel approach trend and experience trend in retail. Through pop up stores, DHL is able to facilitate an extra channel for the (web)shops. This works both for physical shops as for webshops: Physical shops can rent the pop up stores, called 'Moving spaces', from DHL to display their products without renting locations in buildings. It is a more flexible way of selling products to their customers.

Webshops can rent the Moving spaces to showcase their products to the customers and give them an extra experience before buying. This also plays into the trend of community building for a brand. Showcasing the products in a certain environment gives a feeling to the buyer and could increase customer loyalty with a brand.

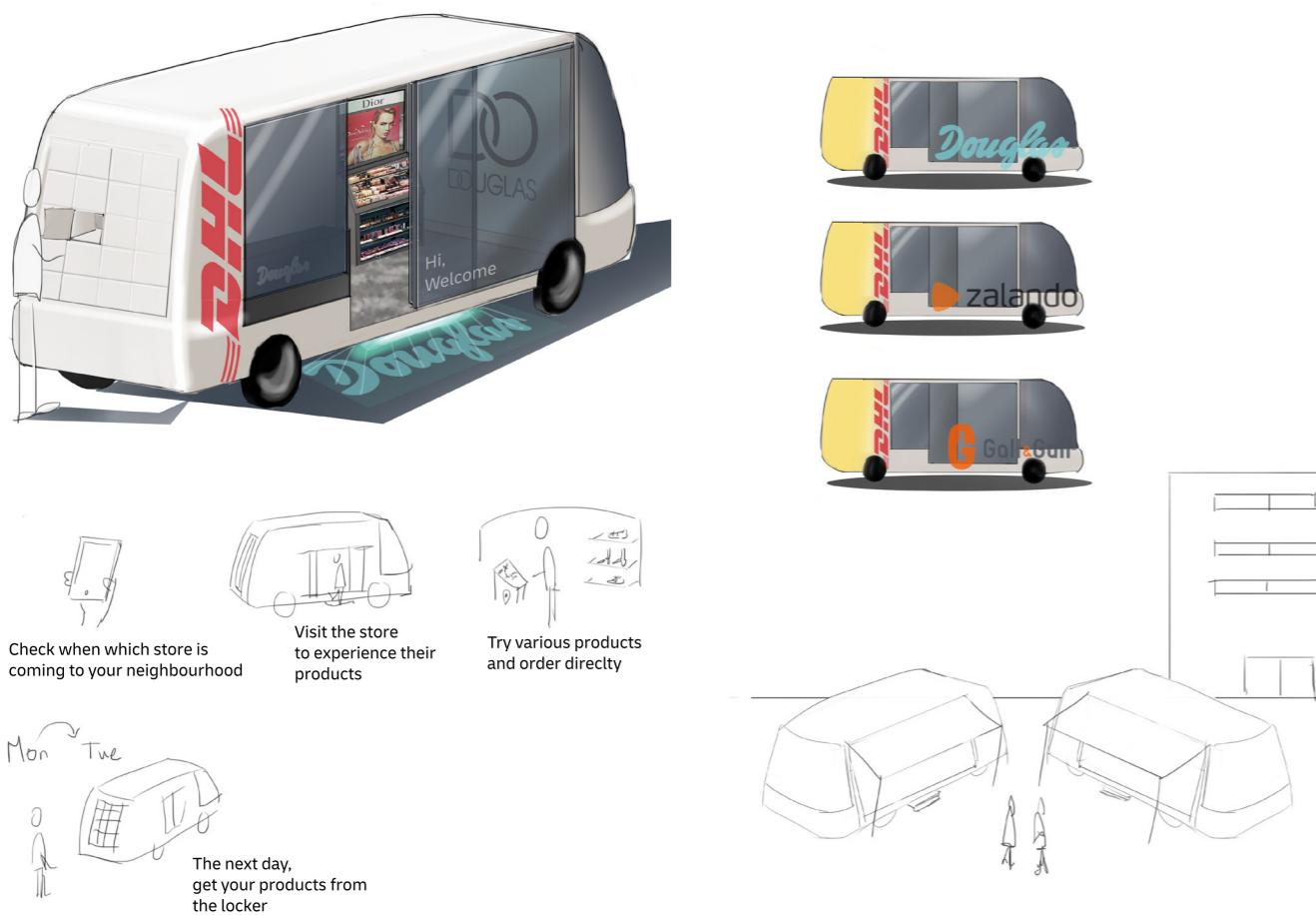


Figure 5.10: Visualisation of Moving Spaces concept

How it works? Webshops or physical stores can rent a Moving space from DHL and design the interior to their wishes. The Moving Spaces are placed on a desired spot to reach the brands' customers. This concept does not limit the brand to urban areas, it could also be used to reach people living in rural areas. Customers can experience products in the Moving Space, and directly order products they like. The products are delivered in the lockers of the Moving Space, and can be picked up by the consumer.



Figure 5.11: Stakeholder value map

The stakeholder value map in figure 5.11 shows many advantages for the consumers, but it should be mentioned that the customer is obligated to come to a certain spot for the pick up of their parcel on a certain day. This asks more from the customer than with the other concepts. The business model shows that the Moving Spaces itself are produced by another party and high investments are needed to make this happen. A first step for realization could be to start a DHL pop up point in city centres where parcels can be brought and picked up and different (web) shops can hire spaces in this shop to showcase their products.

This concept gives DHL the opportunity to increase customer loyalty with their own customers. Next to that, small webshops that cannot afford stores in the city centre can become new customers of DHL by renting a Moving Space. When looking at strengthening their core business, this concept is not the most promising. Parcels are delivered in the moving spaces, before they drive to certain spots. This asks for operational changes and is also probably not enough to cover the full volume of delivery per day.

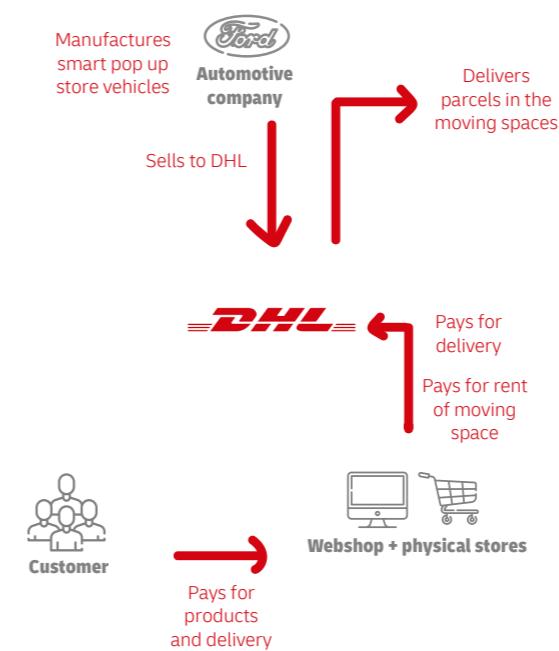


Figure 5.12: Potential business model of Moving Spaces

5.4 Choice of concept

Usually, what we as designers do to make a choice in concept is ranking the concepts on the requirements with for example the Harris Profile method. After doing a ranking on already set requirements and new requirements, I decided to make a choice by arguing which concept is most promising for DHL to continue with. When interested in the ranking, see [Appendix D1](#) for the list. I will argue based on feasibility, desirability and viability of the concepts to make a choice.

Feasibility

When discussing feasibility, we not only think about technical development needed to realize the concept, but also economical, political and social factors.

As discussed before, the concept of moving spaces asks for high investments. The electricity hub also asks for investments which could be quite high, but expectations for the near future are that battery technology increases fast and will become cheaper in 5-10 years.

The concept of integrating parcel delivery with smart shared vehicles is not feasible for DHL to develop by themselves. As mentioned before, the market should move first for DHL to hop on at a certain moment. But they can be prepared by already developing ways to consolidate parcels on locations outside the city and deliver on demand.

Desirability

Change in regulation on energy systems will increase the demand for home storage. It is expected to become less advantageous to put energy back on the grid during the day and flexible energy prices will motivate consumers to become aware of when to use energy from the grid. (Technische Unie, 2019) The relevance of this topic advocates for choosing the Powerhouse concept to continue with. Next to that, the increased electrification of vehicles in urban areas asks for another infrastructure with more charging points for vehicles.

The different concepts all address a different stakeholder to be desirable for. The Powerhouse is both for DHL, to increase efficiency of delivery,

as for municipalities to create a solution for more problems at once. But also energy companies have a large share in this since they cope with high fluctuations on the grid and this concept can solve this.

The Moving Spaces is mostly desirable for (web) shops, since they are in need for a multiple channel approach. You could argue that it is therefore also desirable for DHL, however the efficiency of delivery is not increased and the future perspective of this concept is not clear (yet).

The desirability for the integration with smart shared vehicles mostly lies with the customers and DHL. For the customers since it is optimally integrated in their journey and no extra effort is needed. For DHL because it is making their core business more efficient.

Viability

In case of viability, I think that the Powerhouse has the most potential. It can start as a locker with integrated accu for charging small electric vehicles to create a new brand image connected to energy facilitation. At a later stage, a community can be created with residents connected to the Powerhouse and advantages for users that are connected to the Powerhouse. In the long run, the Powerhouse can play a larger role in the city by serving a public service through facilitating the infrastructure for electric driving. This concept is relevant to the changing needs of urban areas and creates added value for the neighbourhood. Moreover, the Powerhouse helps DHL in their energy transition by providing charging points with green energy and shows the customers that they advocate for electric

driving and using green energy. This is a good promotion for the brand.

Conclusion

The DHL Powerhouse concept is an interesting direction to work out for this project. This concept plays into the social-cultural role DHL has in cities. A dense network of these Powerhouses will increase the delivery efficiency of delivering in urban areas and therefore strengthens the core business of DHL. Next to that, it explores a new field of practice: facilitating energy. This will enlarge the role DHL plays in the city. This concept is not just a product. When successfully implemented, this concept can be the start of new strategy: becoming a public service provider through parcel pick up stations.

The topics that need to be explored further to determine if this concept could be realized in 10 years are: the development of batteries, the developments in renewable energy systems of urban areas, the requirements for cities and how to create value in the city through these Powerhouses. Also, the business economic perspective should be investigated more to validate the concept. After explaining the solution and showing the roadmap, the validation is done in chapter 6.3.

6 Deliver Final design and valuation

This phase demonstrates the outcomes of this thesis. The chosen concept to continue with is the DHL Powerhouse, a locker with accu that will serve as energy facilitator in future urban areas. In this chapter, a roadmap is presented that shows the different innovations necessary to work towards the vision of the Powerhouse concept.

In this phase, the horizons are elaborately discussed. Then, the roadmap is evaluated based on previous research.



6.1 The final design

A visualisation and scenario of the concept are created to communicate the concept to the stakeholders of this project. As explained in the literature of Speculative Critical design, the concept is materialized with the goal to provoke its intended audience (Auger, 2013). In this part, different functionalities are explained and the relevance is argued. I decided to materialize the concept until a certain level of detail, just enough to be provoking.

How it works

When placing an order, the user chooses to deliver to the Powerhouse close to the apartment. No extra costs are asked for delivery to this locker. After placing the order, the customer is informed about the delivery day and time. On the morning of delivery, the customer receives a notification that DHL is on its way to the Powerhouse.

At the moment the parcel is placed in the locker, the customer receives a notification that the parcel is delivered. The notification comes with a code to open the assigned locker in the Powerhouse.

When the customer arrives home from a day at work he comes past the Powerhouse which is located next to the apartment building. For the pick up of the parcel, the customer opens the

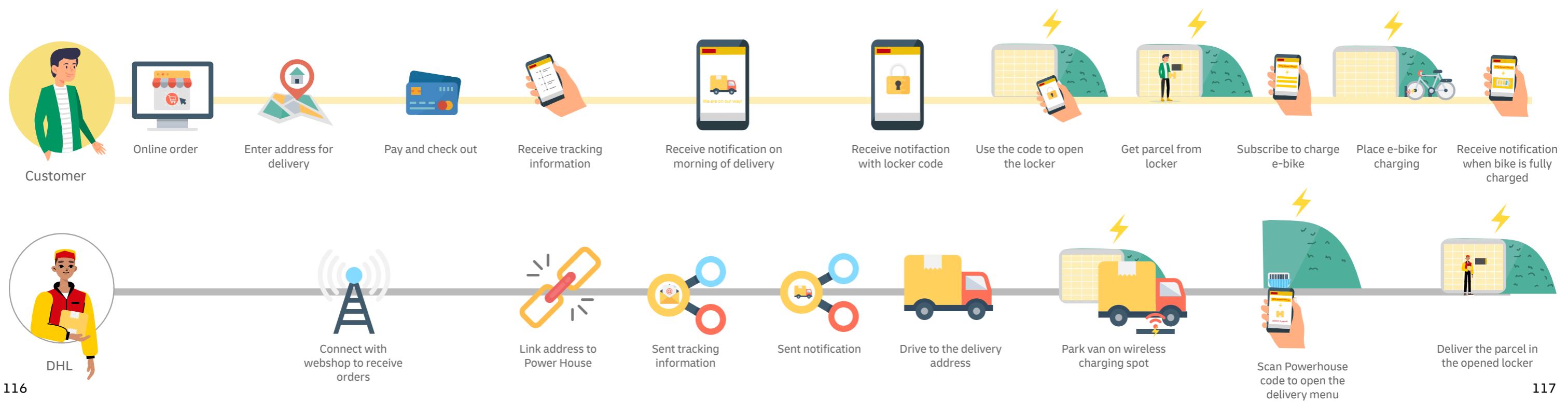
DHL application. From the menu, he/she can choose for opening the locker. After scanning the label on the locker, the customer is asked which locker to open and types in the code to open. A click sound lets the customer know that the locker is open and the customer grabs its parcel. Also, the customer notices that the Powerhouse is fully charged during the day and can now charge its e-bike with the renewable energy that is collected. A subscription to the DHL Powerhouse is needed to use this free service. When opening the DHL phone application, the Powerhouse is shown on the dashboard. The service asks to fill in personal information as name and address. The system now couples orders for the customers address to the nearest

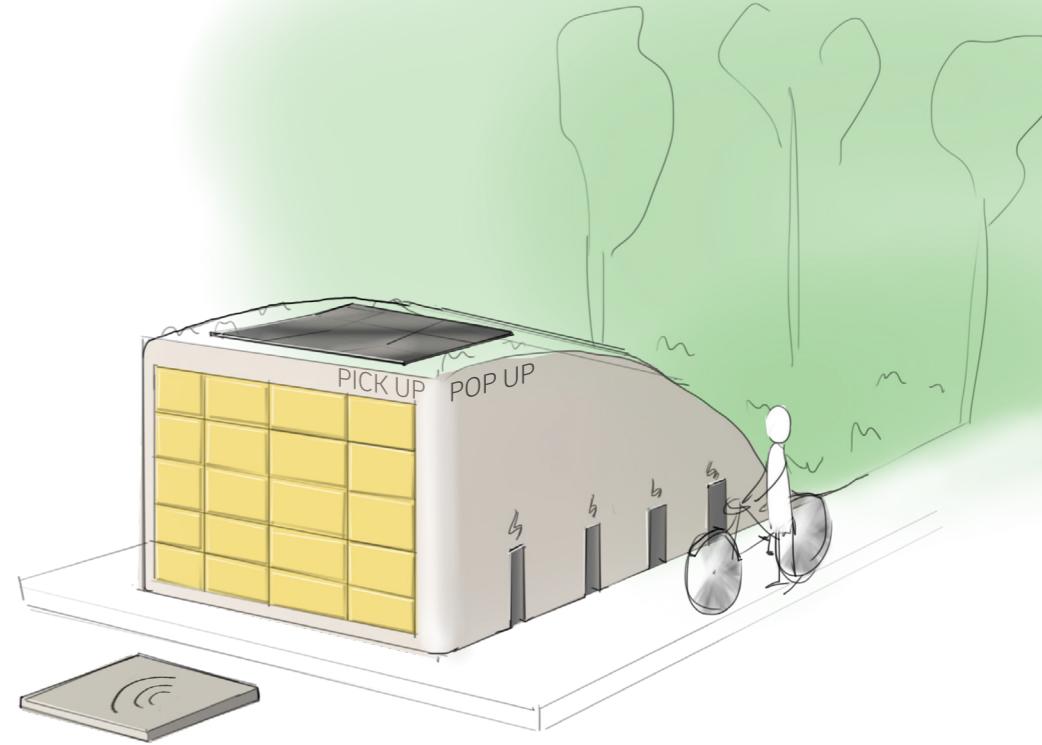
Powerhouse and asks if it is okay to set delivery to this location as default. When agreeing with the terms and conditions, the customer is allowed to park its e-bike and unlock the charging function with its phone. When the bike is fully charged, the customer receives a notification on its phone.

From DHL's perspective:

After collecting all the parcels for its delivery round the driver departs from the CityHub. The parcels with the Powerhouse as end destination have another letter on the label. The address of the customer is shown on both the handheld of driver as on the label, but they also both show the Power House letter. When arriving at the right address, the driver looks for the Powerhouse

to deliver to. He/she can park its car in front of the locker, at the designated drop off spot. The Powerhouses are equipped with a code that can be scanned or typed into the device of the driver. After scanning this code, a Powerhouse environment opens on its device. The driver can choose which compartment to open to place the parcel in. The driver scans the parcel and places the parcel in the locker. When closing the locker, the customer receives the notification of delivery. When the locker is full, the system is able to recognize this and sends a reminder to the customers to pick up their parcels.



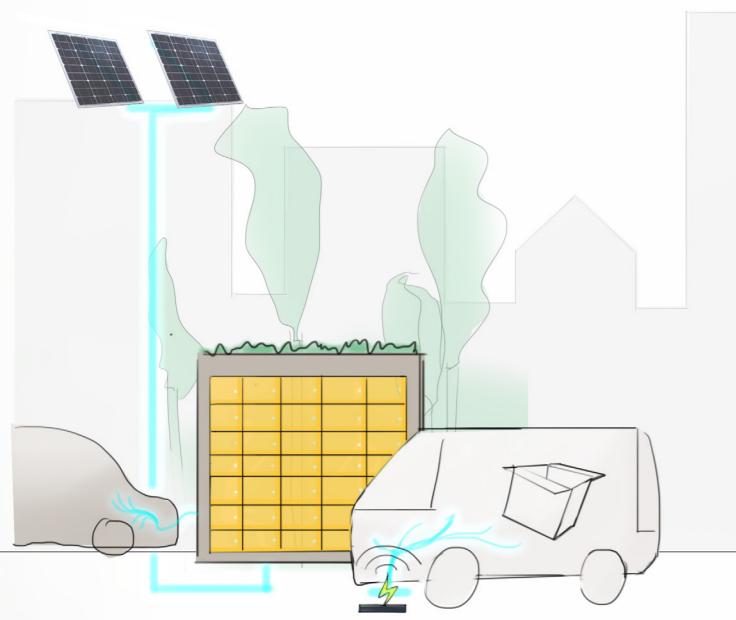


The technology

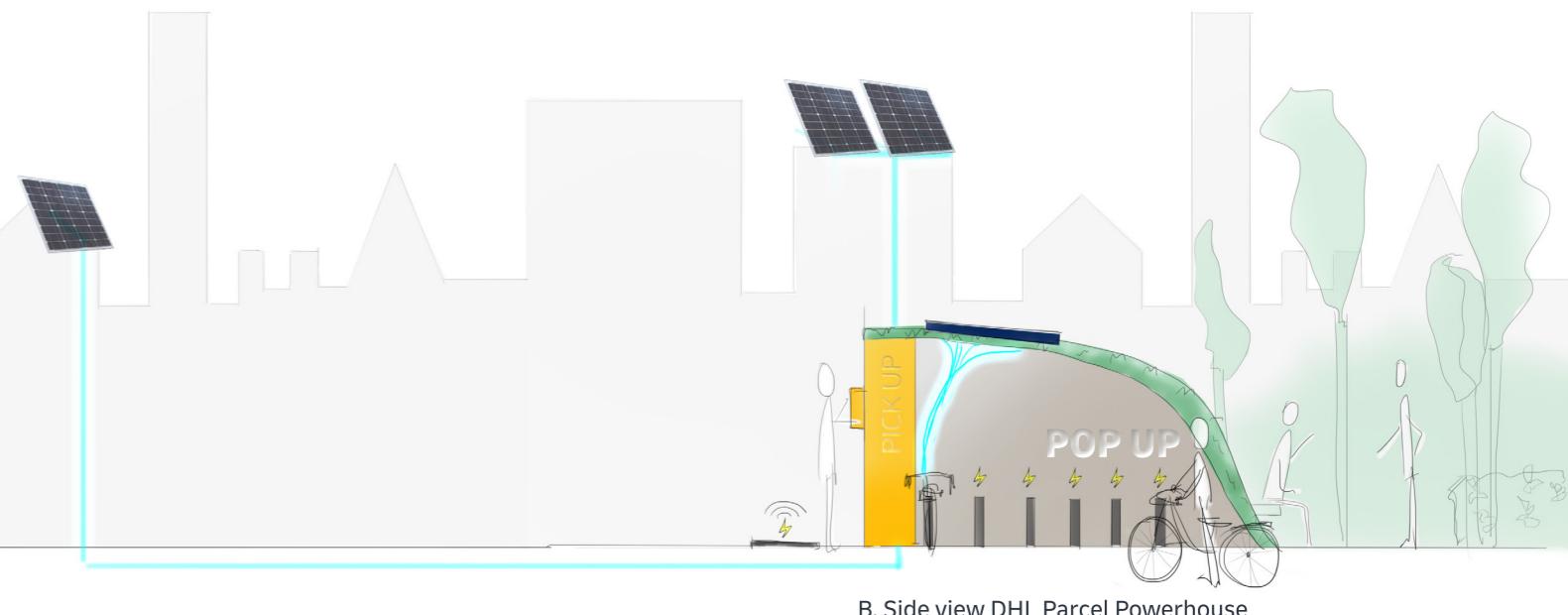
The Powerhouse is equipped with more technology than the lockers that are currently developed by DHL. This is with the goal to improve the user experience of both the receiver as the driver. Three products in this concept are interlinked and should be able to communicate with each other: The Powerhouse (hardware and software), the user application (software) and the device of the driver (software). As named in the research phase, IoT is expected to play a larger role in logistics. In the current system, all parcels have an unique code that is used for scanning at each phase of the logistic process. The same code can be used for the Powerhouse concept. The only addition is the Powerhouse identification in the code, so the driver knows that the parcel should be delivered to a locker at the Powerhouse.

The charging technology is wireless charging.

This is for two reasons: 1)Vulnerability of plugs and cables and 2)User friendliness. Wireless charging of both the ebikes as the delivery van while dropping off the parcels allows them to start charging without plugging in. For the driver this has the advantage that this saves time. For the customer this means that there is no specific charging cable or plug desired for charging. Wireless charging of both the ebikes as the delivery van while dropping off the parcels allows them to start charging without plugging in. For the driver this has the advantage that this saves time. For the customer this means that there is no specific charging cable or plug desired for charging. Wireless charging technologies are currently in development and have a too low efficiency for the delivery van use case. (Shubhangi DashKajal et al., 2018) But many research is currently done in this field, and therefore I advise to keep an eye on these innovations since it could be interesting to implement in a later stage. (Riekerk, 2020)



A. Front view DHL Parcel Powerhouse



B. Side view DHL Parcel Powerhouse

Criteria	How is it achieved by the design?
From problem analysis	
Service point delivery in combination with a selected home delivery for larger orders to prevent people from picking up their parcels by car.	All the parcels that fit into the locker system are delivered to the lockers. This constraint must be shown on the webshop.
Service points on walking or biking distance from the customers house.	The Powerhouse is located close to apartment buildings, so is always on a walking distance.
Industry 4.0 allows the system to recognize orders, combine them and communicate this to the necessary devices and people;	The three connected elements in this concept make sure that the consumer is always informed about the delivery of their parcel.
White label service points which are all providing the same service.	The Powerhouse will be white label: all delivery companies are allowed to deliver to this location. However, this will bring challenges of integrating different systems into one product. And one should think about how to encourage the competitors to deliver in these lockers too.
Electric vehicles are used for the delivery from a CityHub into the city	Driving electric is encouraged through this concept. The Powerhouse can also be used as a charging location for subcontractors. This will enable them to drive electric too.
Collaboration between large delivery companies and startups to outsource the last mile delivery process	In this concept, there is no collaboration with startups. But DHL could look into opportunities to expand the collaboration with locker companies.
Consolidate parcels in order to reduce the traffic movements in a street;	Parcels are not delivered to the apartment buildings but are consolidated in the lockers. More consolidation can be done by only delivering on specific days in one area.
Clear information about delivery impact and timeframe of the order to the end consumer;	This concept includes clear information about the delivery timeframe and place. But there will be no explicit information about the impact of delivery. This is what the webshop should do as an advertisement on the website. DHL could communicate with their customers what the most sustainable delivery option is and motivate them with price incentives. (they already do this with the discount on service point delivery)

Reflection on design criteria

From the problem analysis, 8 aspects are named to achieve a more sustainably last mile delivery in the urban context. In the following paragraph is discussed if these aspects are fulfilled in the design of the Powerhouse, shown in table 6. From the user analysis, 4 aspects are named as being crucial for a delivery design of last mile delivery to satisfy the consumer. If this is achieved through the design, is also shown in the table.

Criteria	How is it achieved by the design?
From user analysis	
Correct and timely information about the delivery	This will automatically be done when scanning the parcel and placing it in the locker.
Being in control of when to receive a parcel	The customer can do the pick up whenever they want. But it is important that it is done as quickly after delivery as possible, to create space in the locker.
No unnecessary movement to and from the house	Only traffic movements to the parcel lockers. This has 100% delivery success. So there are no unnecessary traffic movements.
Know what to expect	Location is known to the user. The user will know that the parcel will always be delivered to that location.

6.2 The roadmap

Simone (2017) defined in her book a roadmap as a visual portrait of design innovation elements plotted on a timeline. For this project, the roadmap is used to visualise which innovations from DHL are needed to work towards the concept I designed with the vision:

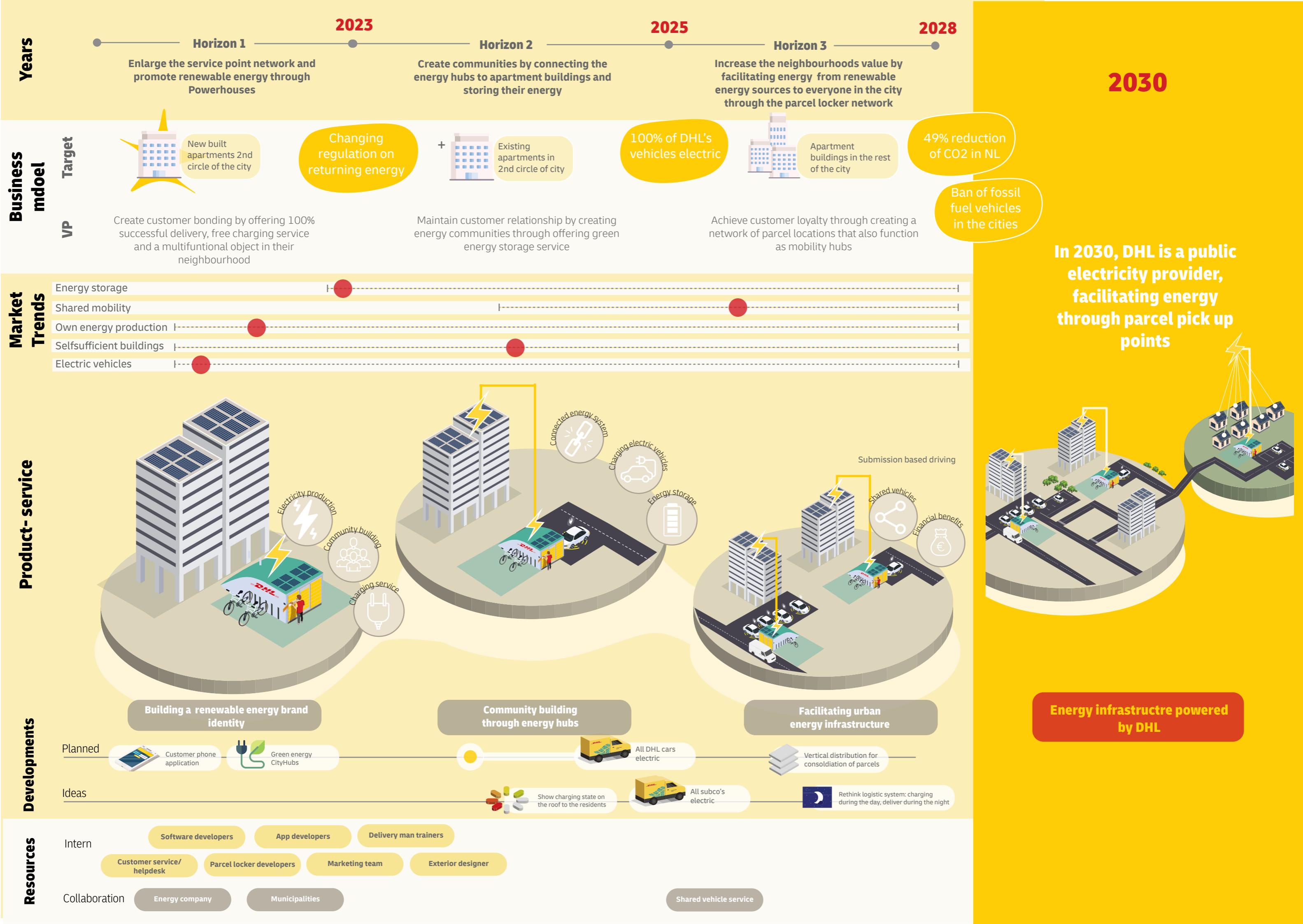
A future where DHL is a public energy provider, facilitating energy through parcel pick up points.

The roadmap consists of 3 consecutive horizons. In each horizon, steps are taken into the direction of the final envisioned sustainable delivery solution for DHL in 2030, a product service combination that serves a public energy service. These steps are on partnerships, technical development and target group.

Time pacing for horizons

When deciding on the length of the horizons in years, I looked at planned events in the future that will influence the context DHL will operate in. For the first horizon, the chosen time pace is 3 years because in 2023, regulations on putting energy back on the grid will change. Currently, people receive a payback for putting energy on the grid. From 2023 this law changes into another paying system, which is less beneficial for the owner of the solar panels.

The second horizon is set 2 years from then. DHL set its goal for 2025 to drive 100% electric with their own vehicles. This asks for a different infrastructure where the lockers can play a part in. The next horizon is again 3 years, until 2028. Due to the ban of diesel cars in the city centres of large cities, it is expected that subscription based driving will experience a growth somewhere around this time. The community feeling that comes along with this and the needed charging/resting spots are again an interesting opportunity for DHL's Powerhouses.



HORIZON 1

Enlarge the service point network with Powerhouses

The objective of the first horizon is to make people familiar with the fact that DHL is going to provide multiple functions through their parcel stations. The brand identity should be more focussed on electrification of the urban transport and facilitating the infrastructure for this. In the first horizon, DHL starts with building a community of people that subscribe to their energy platform and make use of the free charging functionalities. DHL is currently already working on the developments of a phone application. This application can be further expanded to an application that also shows



Figure 6.1: Visualisation first horizon

where a Powerhouse is located for charging their e-bike.

In the first horizon, the target for placing the lockers will only be new built apartment buildings in the second circle of the city. By integrating the Powerhouse in the building plans of the new neighbourhood, the Powerhouse becomes part of it and raise the value of the neighbourhood by fulfilling different functions.

Collaboration

The DHL Parcel Powerhouses are aimed to be white label, which means that every delivery company can deliver here, and every parcel can be returned via these locations. This asks for changes in the current delivery model in The Netherlands. The software of every delivery company should be compatible with delivering to the lockers. This asks for cooperation from the other delivery companies which might be a challenge since every companies values their exclusivity. This means for DHL that they must show an open attitude to facilitate this process.

The hardware

In the first horizon, the needed hardware are the physical Powerhouses consisting of two parts. One part are the lockers to place the parcels in. The lockers do not have a display since this will make them more vulnerable and this is undesirable for lockers in public areas.

The other part is the storage of produced energy. The hardware needed for this are a lithium-ion battery and a transmitter. Today, fast charging an ebike with a current of 10 ampere, still takes

up approximately 1 hour to charge from 0%-50% and 1.5 hours to charge from 0-100%. However, due to the rising popularity of electric vehicles, developments in technologies as fast charging and wireless charging are expected to become faster and cheaper.

The Powerhouses are placed in the public area, and therefore they should add value to the environment in order to be approved by the municipalities. For the design this means that they should fit in with the surrounding apartment buildings and create added value through new functions for the neighbourhood. In chapter 6.3, it will be discussed how this can be achieved taking into account the vision of different stakeholders.

Software

The phone application DHL is already working on should be expanded with the option to subscribe to the charging possibilities. Software is needed that connects the locker with the receiver, in order to show when a parcel is delivered. The

existing lockers of DHL are already doing this, but it will be a new development to integrate their system with the systems of other delivery companies to make these lockers white label.

The business model

DHL is able to get a financial gain in this situation from the streams displayed in figure 6.2. The locker will guarantee a 100% hit rate which will save DHL on transport movements. However, the savings on these delivery costs will probably not be enough to cover the investment costs. In order to make this concept financially more attractive, customers will pay a monthly fee in the service costs of their building. The investments for the lockers need to be done by DHL, which is challenging and risky. In chapter 6.3, the business model is calculated to check the financial feasibility. Here it is assumed that the investments will be partly shared by a third party who has an interest in making the energy grid more stable, this could for example be one of the Distribution system operators (DSO) in The Netherlands.

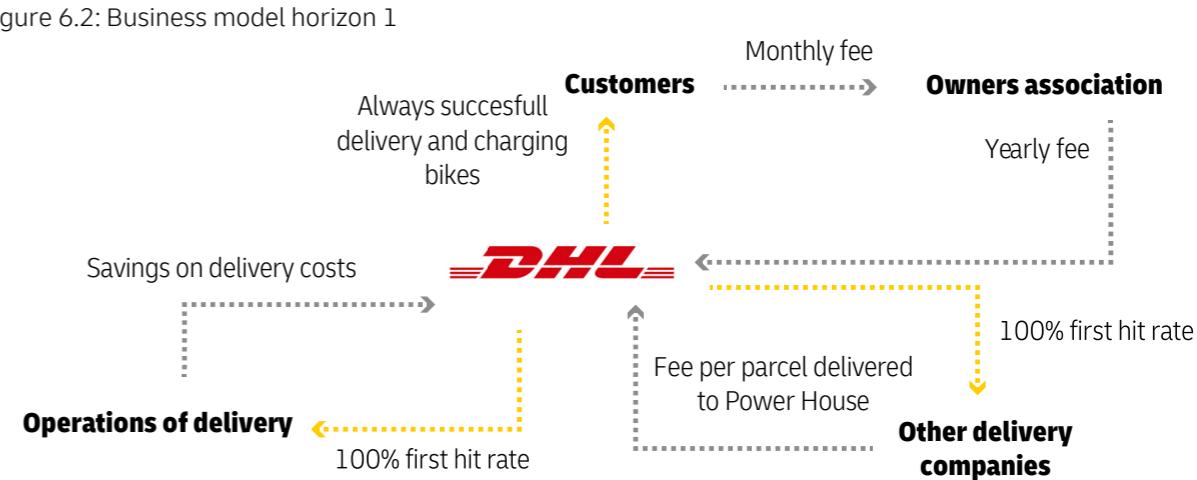


Figure 6.2: Business model horizon 1

HORIZON 2

Create communities by connecting the energy hubs to apartment buildings and storing their energy

In the second horizon, the Powerhouse becomes more extensive by linking the lockers to the apartment buildings. The goal of this horizon is to create a community feeling by storing the green energy produced at the apartment buildings in the Powerhouse. During the day, the Powerhouse collects energy from the solar panels of the apartment buildings. This energy can directly be used to charge electric bikes and pop up delivery vans. If not all the energy during the day is used, the energy is sold back to the households of the apartment buildings in the evening.

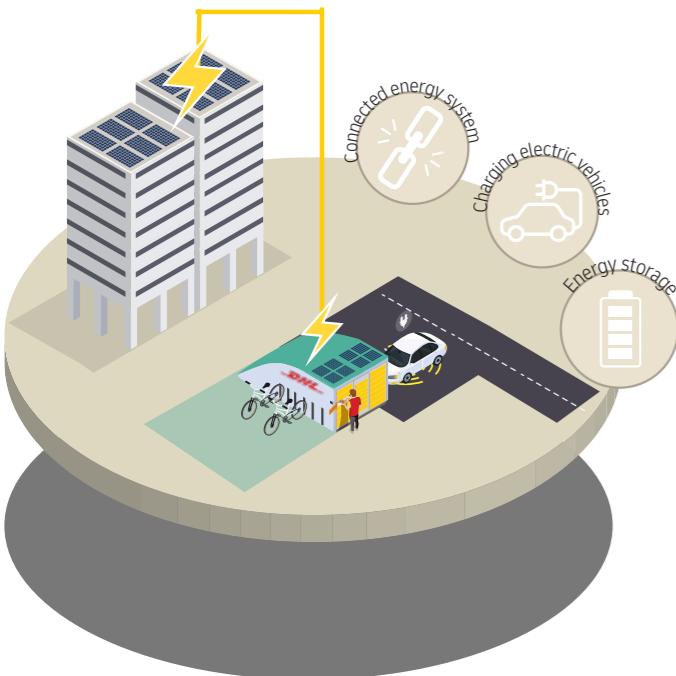


Figure 6.3: Visualisation second horizon

Partnerships

Partnerships are needed to be able to connect the Powerhouse to the energy grid of the apartment buildings. The connections with the DSO, started in horizon 1, can be extended to a connected network of Powerhouses and grid energy. DSO's differ per region in The Netherlands, and therefore it is advised to look for the region where the Powerhouse can have the most value to start with. These are locations where there is a large number of (newly built) apartment buildings and not much demand during the day, locally.

Next to the location, it is also an option to approach companies that are already developing similar solutions. DSO's working on the realization of renewable energy systems or energy storage are interesting to look at. Enexis Group, for example, already executed a pilot with a neighbourhood battery. The results of this pilot showed that at that moment, in 2016, it was from a financial perspective more interesting to expand the grid capacity with for example larger cables. It would be beneficial for these DSO's to collaborate on such a project as the Powerhouse since it is reducing the load on the energy grid.

For the DSO, this will mean that there are less investments needed for upgrading the grid. For DHL it will mean they can share the investments and win goodwill at the municipalities by creating multi purpose energy hubs in the city, in order to facilitate an energy infrastructure. What is needed is that they allow DHL to connect with their network and find appropriate locations together.

Hardware

Larger batteries are needed for the Powerhouse. In horizon 1, only a capacity of around 50kwh is needed to store energy produced by the solar panels and in order to charge ebikes. In this second horizon, the battery should have a capacity of 150 kwh, which allows the Powerhouse to pop up multiple cars per day, when fully charged. More of this is explained in chapter 6.3, where the technological feasibility is discussed.

On the roof of the Powerhouse, the amount of energy stored is visually communicated to the users. The objective of this is to inform the residents of the available power and make them aware of their energy usage.

Software

When Powerhouses are connected to the energy production of apartment buildings, the software of both parties should be connected in order

to communicate information about energy to the users. The Powerhouse function in the DHL phone application is extended with a function that shows the available energy in the battery. Business model

The streams of revenue are visualised in figure 6.4. An extra stream is added compared with the first horizon: DHL will receive a fee per kwh of energy used during the evening. In the first horizon, the storage of energy was mostly for branding reasons and community building. In this horizon, a revenue stream is added for storing energy and selling it during the evening. This rate depends on the fluctuating energy prices from the grid. This will make the concept rather complex. Hence, the partnerships with energy companies are a necessity. Just like in horizon 1, charging your ebike at the Powerhouse during the day will be free of charge, provided as a service from DHL used as promotion.

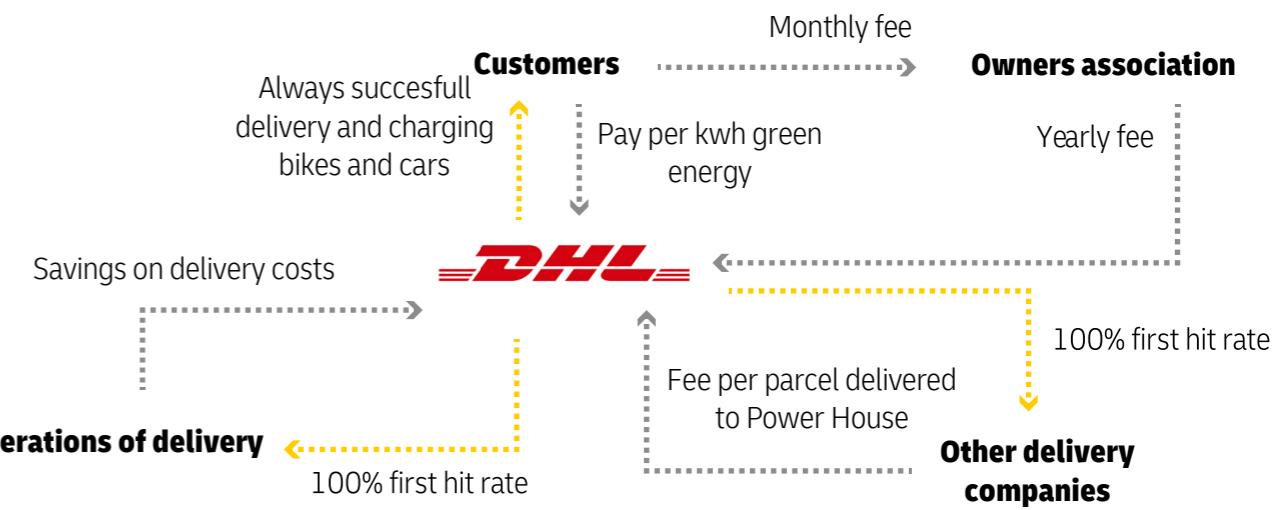


Figure 6.4: Business model horizon 12

HORIZON 3

Increase the neighbourhood's value by facilitating energy from renewable energy sources to everyone in the city through the parcel locker network.

The third horizon's objective is to create a dense network of Parcel Powerhouses in the city to facilitate the infrastructure needed for electric vehicles. Cities are planning on banning all non electric private vehicles from the city centre, which compels residents to drive electric. But the infrastructure for this is in many cities not ready yet. The third horizon reacts on the trend

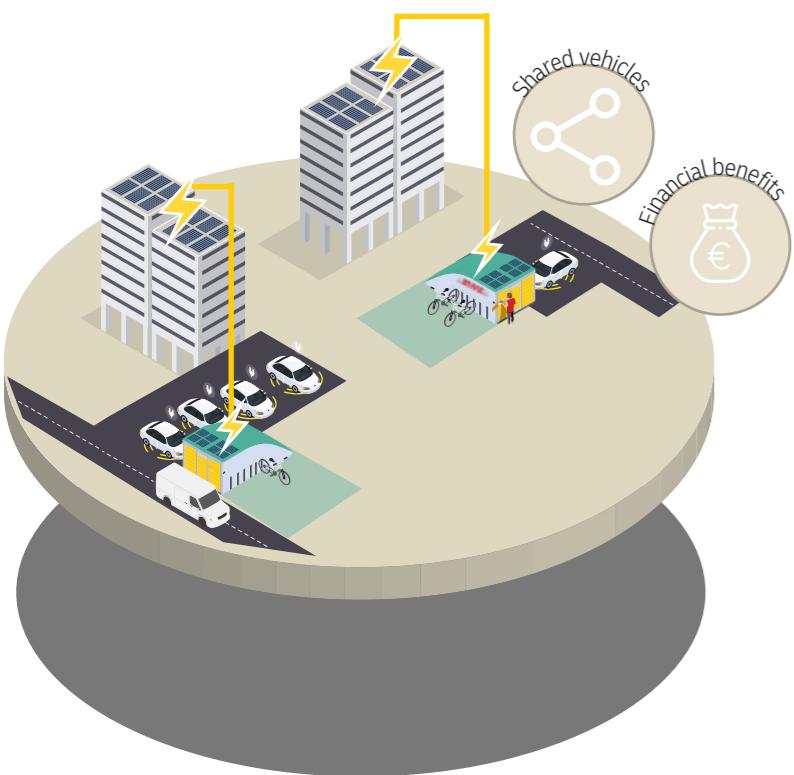


Figure 6.5: Visualisation third horizon

of shared driving, by accommodating spaces for parking and charging shared electric vehicles. These e-hubs become a spot where people can park their shared car, pick up their parcel and charge their e-bike. At the edge of the city, these hubs could also function as transfer places for replacing one form of transport for the other. Therefore, the Powerhouses will not only be focussed on the apartment buildings in the city centre, but also in other parts of the city.

Partnerships

When expanding the service to shared vehicle hubs, collaboration is needed with companies that offer shared vehicle services. Together, they can explore ideal locations for placing the Powerhouses.

Hardware

More Powerhouses are needed to expand the network. In line of expectation lies that the battery rates in 2028 will be almost half of the price we pay nowadays. Larger energy hubs can be built which enable them to charge more vehicles a day. This will probably go in collaboration with the municipalities and partners in shared vehicle services. In order to respond to the growing e-commerce market, more locker compartments are placed per Powerhouse.

Business model

The Powerhouses will function as an e-hub for parking and charging electric vehicles which are used in the urban areas. The business model of horizon 2 is expanded and includes payment

from shared vehicle services for parking and charging their vehicles.

Residents of apartments are together owning the Powerhouse of their neighbourhood. The business model will slightly change, and will give visitors the opportunity to charge their vehicles too. Visitors have to pay for this service and the income will go to the residents of the apartment building, who are partly owning the Powerhouse.

What is mentioned before are the consolidation centres of DHL at the edge of the city. These

consolidation centres create new opportunities for rethinking the delivery system. Parcels can be delivered to the Powerhouses during the night, while the electric vehicles of DHL are charged during the day. Delivering more during the night is an opportunity to decrease congestion in cities during daytime, but this will mean that major changes are needed in the current way of operating. For such a transition, time and money need to be invested to come to a success.

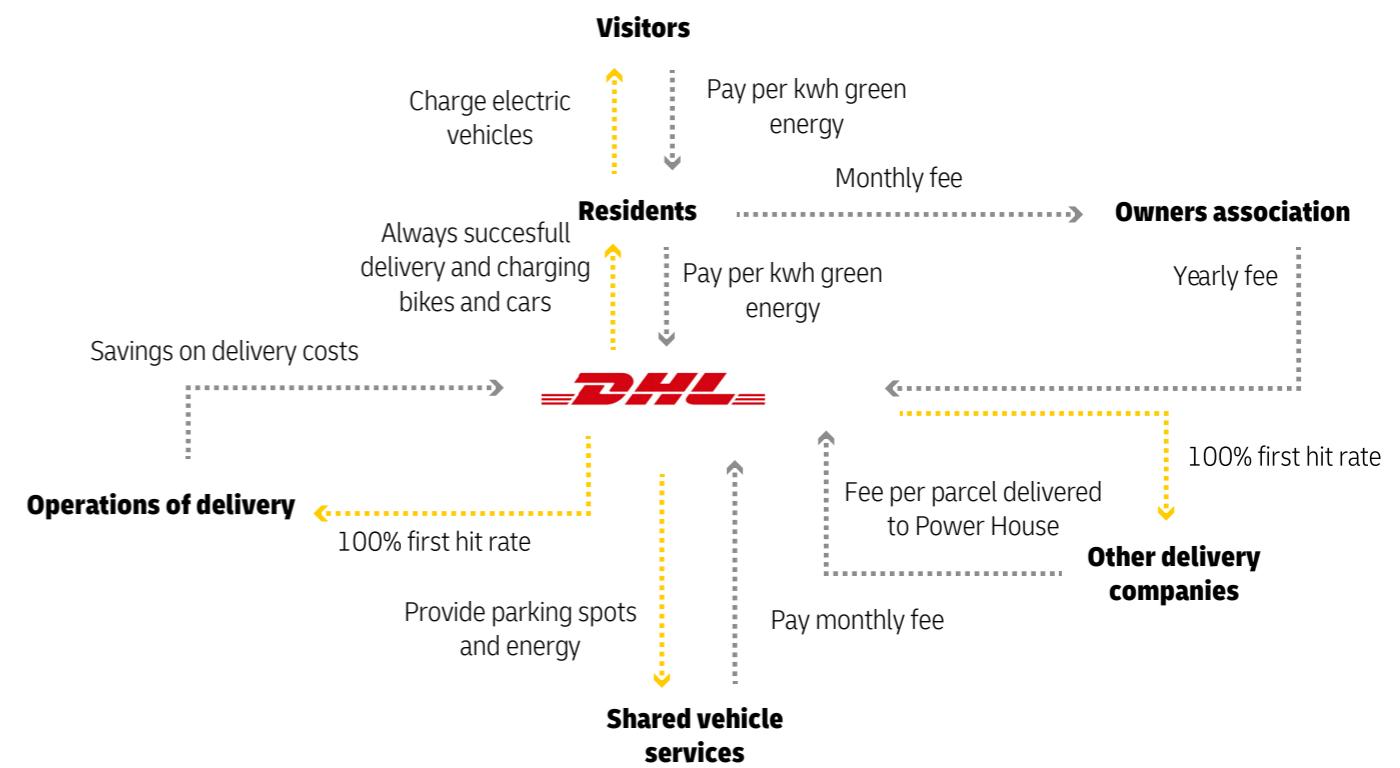


Figure 6.6: Business model horizon 3

6.3 Validation of Roadmap

Validation of a concept is done to check if the concept fulfils a specific set of design specifications. This is done on three different aspects: social acceptance, technology and financial. The insights are used for the recommendations and conditions for successful implementation. A list with constraints for the context of the Powerhouse is set up which concludes the insights.

Social acceptance and desirability

In this part, the concept is evaluated with future users (residents of apartment buildings). Besides that, I evaluated the design with another important stakeholder: municipalities. According to research of ACM (2019) municipalities have a crucial role in the realization of the parcel lockers and are currently not in favor of these developments. Their opinion is checked through two interviews in order to find out what is necessary for realization of the Powerhouses.

The users are involved in the design process of the Powerhouse through co-creation sessions. These sessions are held to find out what the Powerhouse should look like, how it will fit in their neighbourhood and which functionalities it must have to create added value in their living area.

Co-creation sessions with residents

For the co-creation sessions an abstract scale model was used. After building their neighbourhood, the participants are asked to place the Powerhouse in the context, and add functionalities to it (the small building blocks with icons). Then, they were asked to create a shape for their Powerhouse with clay. This scale model and the context are used as starting points for discussion. The discussions are used to gain insights in what is important for them if the Powerhouse is placed in their neighbourhood.

First, a pilot with a student living in a student apartment building is done. This session was followed by three individual sessions with

residents in apartment buildings in Delft and Rotterdam. The fifth session was held with a small group of two people both living in De Groene Haven, a newly built building in the train station area of Delft. This session was done with a small group, in order to find out if they have a shared opinion about the role of the Powerhouse in their neighbourhood. The approach for the co-creative sessions, and the outcomes are fully presented in [Appendix E1](#).



Image 6.1: Functionalities of Powerhouse as blocks with icons



Image 6.2 : Scale model for Co-creative sessions

Results

The first participant, living in a high apartment building in Rotterdam mostly values the charging possibilities and the centred spot for pick up of parcels for the surrounded buildings. The by him chosen location is easy accessible by delivery vans and is already on a spot where a resting place is located including facilities like a toilet and fresh water.

The participants 2 and 3, both living in a neighbourhood with many children prefer the Powerhouse to be a multifunctional part of the neighbourhood that brings people together and is a place to rest and play. Also, they already have shared electric vehicles in the neighbourhood so it would be ideal if these vehicles can be charged by the Powerhouse. For one of these two participants, the chosen shape was a locker wall, in the same shape as current locker walls. For the other participant it was more a playing object for children.

The fourth and fifth participants live in an apartment building that is only 3 months old. This building is marketed as green apartment buildings and is built in such a shape that it creates a community with the 130 apartments in these buildings. This apartment building is close to the city centre, and is so designed that shops and cafes can be established on the ground floor. When this is realized, the Powerhouse could function as a spot where people can sit and drink their coffee. But also for children to play (even with their digital toys). The Powerhouse should blend in the park that

is going to be developed next to their building. Since there is planned to be a mobility hub close to their building, they do not think that charging your car at this hub is necessary. It could be interesting to look at combining the mobility hub with the Powerhouse.

Figure 6.7 shows the results of the co-creative sessions. Per participant is shown which functionalities are important to them.



Figure 6.7: Preference of the participants for the Powerhouse

Conclusion

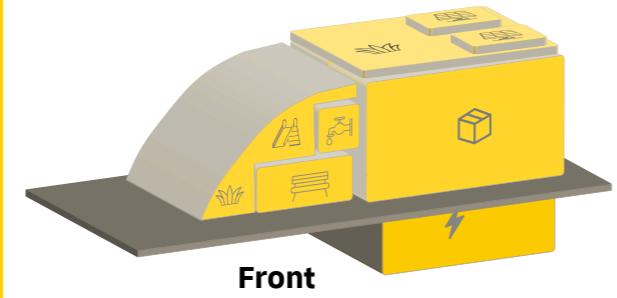
From the sessions can be concluded that in general they all like the idea of having a parcel drop off point in their neighbourhood. As long as the Powerhouse has an added value to the neighbourhood, they are okay with having it placed close to their building. The added value is created by adding different functions that will increase liveability in the area.

But logically, these functions differ per area. The co-creation sessions gave me a feeling of how the functionalities differ per area. And through this, I came up with a modular design for the Powerhouse, which enables every different area to design their own Powerhouse, fitting to their needs. Different typologies are created for the Powerhouse, which means that every context will have different modules. Three examples of areas and a fitting Powerhouse for the context are presented on the next page. Figure 6.8 shows these examples for the Powerhouse.

Case 1

Child friendly neighbourhood

For this context, the focus will be on creating a location where children play and parents can sit and relax. A water facility module is added and neighbours can together maintain the small community garden with herbs. This is intended to be something the neighbourhood can be proud off. Residents living in apartment buildings have a top view on the Powerhouse. To make sure this does not disrupt their vision, a part of the roof is a hill shape, covered with extensive green roof.



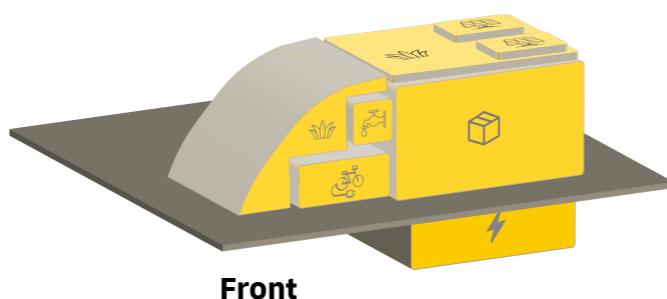
Front

Back

Case 2

Crowded area, in the city centre

In this case, the Powerhouse will be located in a crowded area preferably close to public transport. Here, the Powerhouse can be used as a transfer point for public transport, where people can grab a bike or wait for their transport to arrive. For a context like this, the Powerhouse should have different charging points for different kinds of transport and enough places to sit and rest.



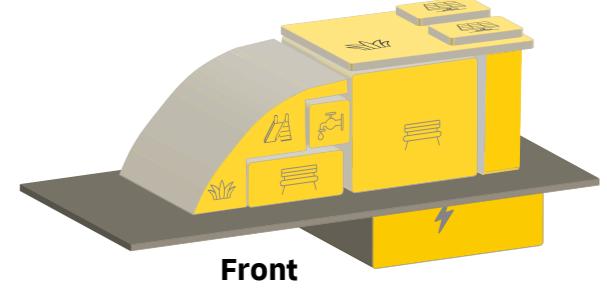
Front

Back

Case 3

Close to shops, cafes and a green strip

For a location in the city centre or at the edge of city centre, where commercial facilities are alternated with green areas, the Powerhouse functions as place to rest and sit, and for children to play. The hill shaped roof can function as a place for a slide too, and people can sit on the benches. Visitors can park their e-bikes at the charging spots and refill their water bottles at the tap.



Front

Back

Figure 6.8: How the Powerhouse is build up from different modules, fitting in a different context

Interviews with municipality

Two urban planning experts from the municipality of Delft are interviewed in order to find out what requirements are for the placement of such innovations. These interviews are shown in [Appendix E2](#).

The experts both compared the Powerhouse to transforming buildings from the electricity grid. These buildings are placed above the ground and come in different sizes. These houses should be connected to the grid, and located close to buildings. Expert 1 notes that they prefer the transformator houses to be included in the design of new neighborhoods. See the example of the Schoemakersplantage in Delft, a new 'green' neighbourhood in Delft (2016) on image 6.3 and 6.4.

After these interviews, I looked for transformator houses in the city of Delft. This gave me the insight that the locations of the current transformator houses have similarities with the locations which are ideal for the Powerhouse. The transformator houses are connected to the grid, close to buildings and close to the road. Expert 2 said it would be ideal if the designs for different services are combined in the



Image 6.3: Example of transformator house in the same design as the surrounded houses



Image 6.4: Example of transformator house in the same design as the surrounded houses

same buildings. What currently happens is that different houses are placed next to each other, this looks messy in the cities. Images 6.5 shows an example. Currently, telecommunication providers want to place houses for optical fiber. This is another additional building that needs 10-15 locations in the city of Delft. For the future, it is necessary to look into how all these buildings can be combined.

From these interviews can be concluded that for a future scenario, it would be ideal if multiple houses could be integrated into one. For the Powerhouse this is important information, since this is another building added to public space. As long as the Powerhouse is not disturbing the environment, and it is an addition to public space or increases quality of life, municipalities are okay with placing them.



Image 6.5: Different transformator houses close to each other.

Technology

In order to check the technological feasibility of storing the energy and using it for charging, interviews are held with three experts. These interviews are written in [Appendix E2](#). Expert 1, currently working at Enexis Group, sees opportunities in sharing one battery with a group of households. The investments for a battery system are high, but in this way it can become financially interesting for these households.

Two interviews with PhD candidates at the TU Delft taught me that there is a demand for storage solutions in the power and energy sector. Current researched solutions involve large batteries and dynamic batteries (EV's), but also neighbourhood batteries are part of the renewable energy system solutions. Expert 2 thinks that the parties investing in such batteries are probably not the ones responsible for the

energy grid, but third parties regulating the smart grid and selling this as a service. These parties are called aggregators and they will be responsible for having the right capacity available on the grid at the right moment. In his research, he assumes that these parties will exist in a couple of years.

For the Powerhouse, a calculation is done on how large a battery should be in order to store the surplus of energy from the solar panels. This calculation will give an idea of what the costs will be for such a battery, and for which purposes it can be used.

Two simulations are done with real data from household electricity demand and the electricity production of a PVsystem.

The first simulation is from a scenario on January the first, where there is not a lot of

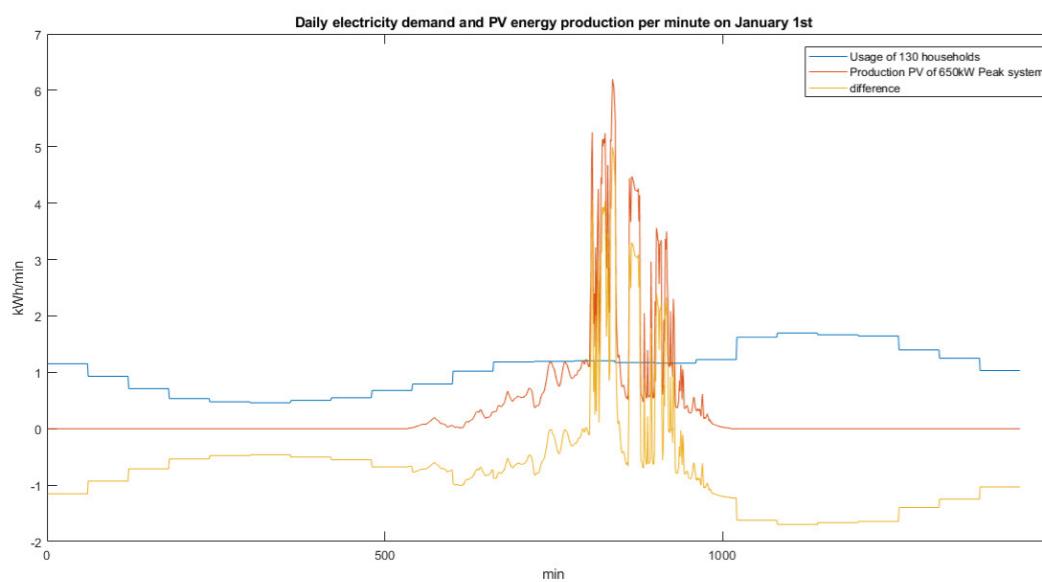
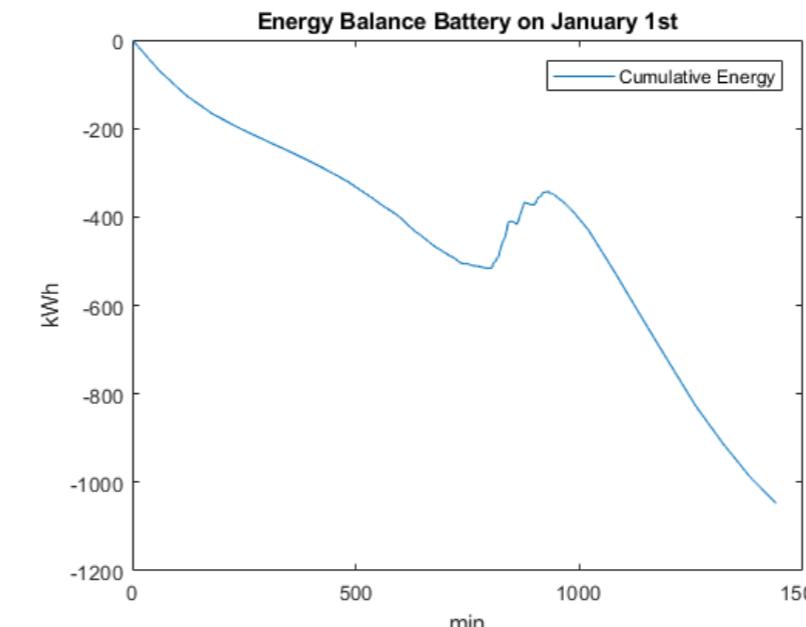


Figure 6.9: Daily electricity demand and energy production of a 650kWp system in January

electricity production during the day. Figure 6.9 shows the daily electricity demand in kWh/min for 130 households (number taken for this case) in blue. In red, the electricity production is plotted, based on a 650 kwpeak system. This is a very large system, but is only used as example to calculate with, so the differences are visible. Figure 6.10 shows the energy balance, which shows how much energy is not used by the households at certain moment during the day,

and thus can be stored. During this day, only at one short moment at the middle of the day, the storage will be used, this is the location in the graph where the line is rising. This means that the storage is not that useful in this case.

Figure 6.10: Energy balance of the system on a day in January



But, if we look at a day in the middle of the summer there is a lot of production during the day. See figure 6.11 for the electricity demand and the energy produced by the PV system. The surplus energy that could be stored on this day is 800kwh. See figure 6.12.

Batteries of 800kwh are not fitting the use case of the Powerhouse. These batteries are too expensive (currently around 160 dollars per kwh) and large.

For the design of the Powerhouse, we find a fitting size that is able to flatten the large peaks on the energy grid and use this energy for charging vehicles, but also is affordable and not too large.

In table 7 is shown that the prices of batteries are dropping. (Goldie-Scot, 2019) This is taken

Capacity	Size (m ²)	Price (euros) in 2020	Price (euros) in 2030	Charging
50	3.5	7000	2500	1 EV fully or 60-120 E-bikes
130	7.8	18000	6600	3 EV's fully
300	15	4100	15000	6 EV's fully or 3 households 1 week of electricity

Table 7: Estimated battery prices per kwh.
(Goldie-Scot, 2019)

into account for the design of the Powerhouse. First, a small battery will be implemented that is able to store the energy from the solar panels on the rooftop of the Powerhouse. This energy can be used for charging electric bikes. Later, in 2023 larger Powerhouses are developed, which allow delivery vehicles and residents to charge their car, next to charging electric bikes. And in the third horizon batteries of around 300 kwh will be placed. These batteries are able to manage large peaks in the energy grid, and this energy can be used for charging multiple cars during the day.

These numbers are used in the next paragraph, where the business economic perspective of the Powerhouse is discussed.

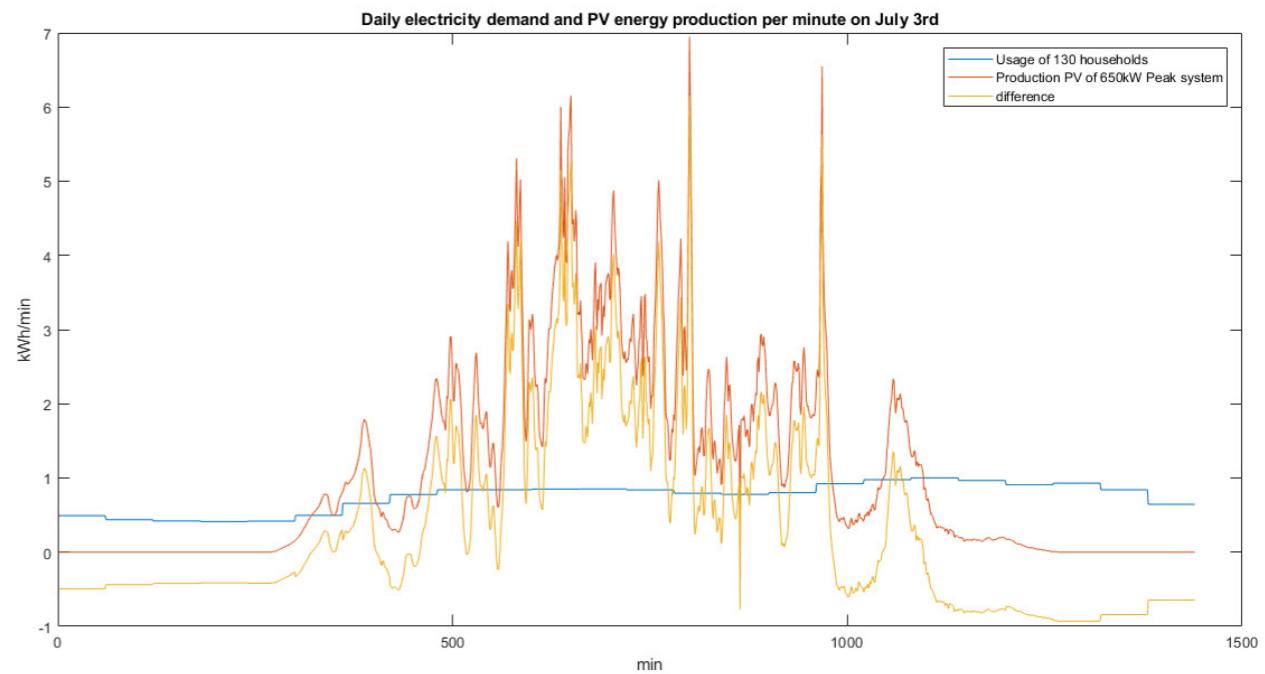


Figure 6.11: Daily electricity demand and energy production of a 650kwP system in June

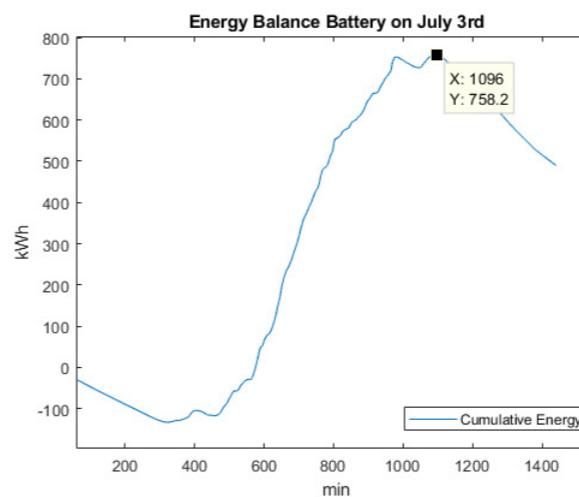


Figure 6.12 Energy balance of the system on a day in June

Business economic perspective

Compared to current locker stations, the Powerhouses require higher investment costs. In this paragraph, the business model of the Powerhouse is discussed throughout the years.

In [Appendix E3](#), the whole cost price estimation of the Powerhouse can be found. This estimation is based on the designs for the different horizons.

Where in horizon 1, the Powerhouse is a self-sufficient system, not connected to the energy grid. In horizon 2, the Powerhouse is connected to the energy grid and has a larger battery in order to store energy produced by the PV system of the apartment buildings and provide energy for cars to charge. In the third horizon the Powerhouse has a larger battery so more cars can charge which makes the Powerhouse a mobility hub in the neighbourhood.

Thanks to the growing EV market, developments in accu technologies are going fast and prices are dropping. Studies of Bloomberg show that the price per kWh for a battery package will reach 100 dollars per kWh in 2023 and even around 60 dollars per kWh in 2030.

The paper by J.H.R. van Duin et al. (2020) compares delivery to home with delivery to a locker on sustainability and economically. My research analysis already showed that delivery to a pick up point, which could be a locker, has a much lower environmentally impact than delivery to a home address. This paper also confirms my assumptions about the economic

perspective of the delivery to a Powerhouse. When delivering to a Powerhouse, which is a parcel locker, less unnecessary traffic movements are done thanks to the 100% hit rate. This safes fuel cost and labour time and thus money.

The cost calculation is based on a lot of assumptions, but it is to give an idea about the investments needed, and revenue streams for the Powerhouse.

One assumption is that the price of batteries is going to drop, as predicted by the experts in this field. We take 7 solar panels for the first horizon of the Powerhouse, this should be enough for providing the locker with electricity, and charge a couple of e-bikes. In horizon 2 and 3, this will stay 7, since energy is added from the apartment buildings.

In this case, we take an apartment building of 130 households. They will have a shared ownership over the Powerhouse, which will cost them 25 euros per year. This price is based on the survey, where people were asked what they are willing to pay for a service like this. These 25 euros per household per year are one of the revenue streams for DHL. Another one, are the savings. DHL will save money on two aspects: the first one is fuel costs, since the electricity will be for free when delivery vans can pop up at the powerhouse. The second one is savings on efficiency. There will be a 100% hit rate to the lockers, and it will cost less time.

Research of Bilik (2014) showed that delivering to parcel lockers enables the driver to do 600

parcels in one day instead of 60. So you win 10% efficiency.

Per horizon, the investment costs are set against the income and the savings. This is done for 1 Powerhouse per 1 apartment building with 130 households.

For horizon 1: There will be a breakeven point after 6 years. This has to do with the fact that this Powerhouse has a small battery, and therefore not many DHL cars are able to pop up at this point. So the fuel savings will be minimal.

For horizon 2: There will be a breakeven point after 2.5 years. More savings on fuell can be done thanks to the Powerhouse. When considering more parcels are delivered to the apartment buildings, also more savings are done on efficiency.

For horizon 3: There will also be a breakeven point after 2.5 years. The investments for this Powerhouse are not much higher due to the dropped battery prices. In this way, the Powerhouses are able to grow along with the dropping prices, which keeps this investment stable.

These scenarios are all based on the fact that there is no third party investing in the Powerhouses. However, it is realistic to assume that a DSO is interested in investing in these batteries since this will help them with ensuring a stable grid. That is why I added an investment of 10.000 euros per Powerhouse. Since the investments for the Enexis pilot were 1.3 million,

an investment of 10.000 euros is a reasonable price for partnership.

For these calculations, the savings on energy bill per household are not taken into account. I also did not take into account what the costs are for the additional functions added to the design since this depends on the context.

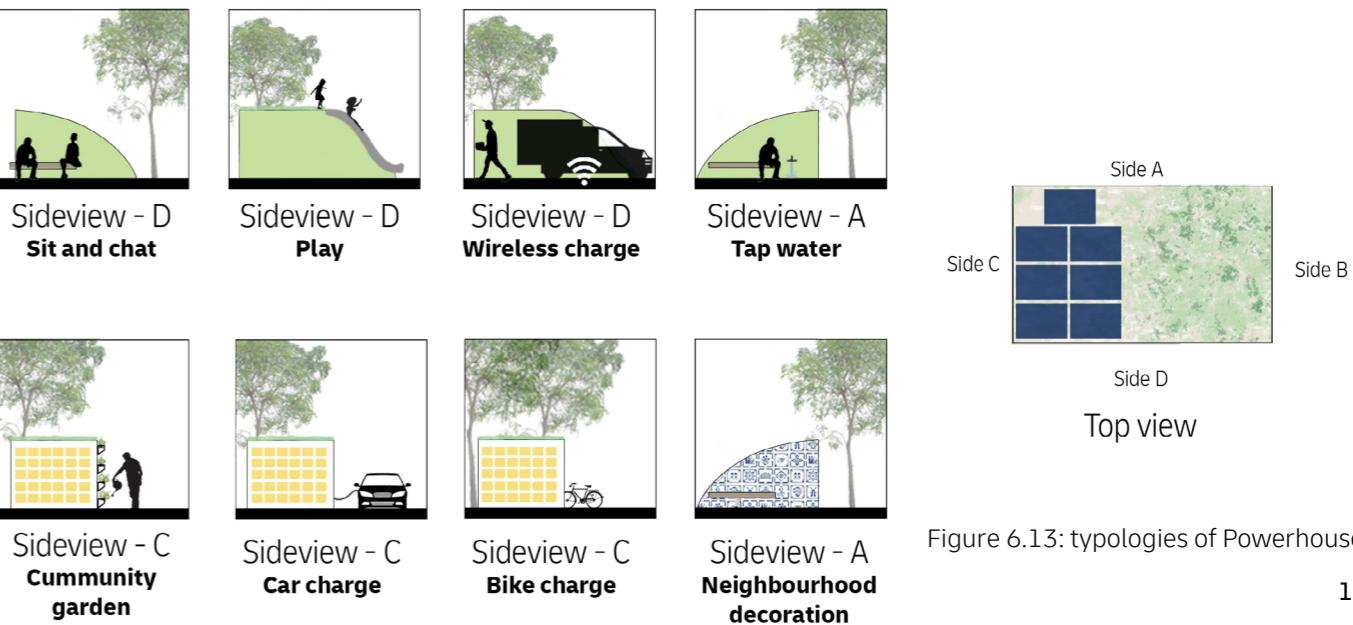




6.4 Summary

The design of the Powerhouse is validated with future users through co-creative sessions. From these sessions can be concluded that the Powerhouse can have an added value to the neighbourhood if the functions are fitting to the specific context. Figure 6.13 shows the different typologies of the Powerhouse. The validation sessions were also used to set up a list of requirements for the location of the Powerhouse:

1. The Powerhouse should be placed close to other public facilities as for example a park.
2. The Powerhouse should be placed next to a road, so it is easy accessible for delivery guys.
3. The Powerhouse creates a natural boundary between a lively area and a resting area.
4. The Powerhouse should be placed next to, or on the sidewalk.
5. With placing the Powerhouse, one should take into account that the PV system of the Powerhouse is most efficient on a sunny



location. The technological feasibility and the business economic perspective are discussed. The Powerhouse asks for high investments and therefore partners are needed to share investment costs. These same partners are needed for the expertise on battery technology. Expanding existing collaborations with Nuon Vattenfall or starting new collaborations with DSO's are possibilities. The earning model on the Powerhouse consists off savings and on yearly contributions from the residents.

To make it financially interesting, the Powerhouse should start with a small battery and once battery prices become lower larger batteries can be implemented in the lockers.

Figure 6.13: typologies of Powerhouse

Discussion

In this chapter the conclusion for the project is given, followed by a discussion including: contribution to practice, recommendations and conditions for successful implementation, limitations on this project and implications for further research and finally: my personal reflection on this project.

7.1 Conclusion

Throughout this project, the initial project brief is solved: "Design a last-mile delivery solution that fits customer needs in a designed sustainable delivery scenario in 2030 and can be adapted to the changing future network of DHL in 2030."

In the problem and user analysis the following research questions are answered:

- What does the sustainable delivery scenario for 2030 look like?
- Which consumer is living in an area where sustainable delivery is a challenge?
- What are the consumer needs of the chosen target group?

Literature showed that solutions to decrease the CO₂ impact of the logistic sector lie in two directions. The first is the utilization of new powertrain technologies as for example electric driving. The second is the integration of all supply chain participants by collaborative initiatives in order to achieve a more efficient logistic process. This does not include the customers behaviour on reducing CO₂ emissions and the impact of their choice for delivery. This is analysed by doing an Life Cycle analysis of different delivery scenarios. This analysis showed that delivery to a pick up point has the lowest environmental impact of the compared scenarios, under the condition that the parcel is picked up on a CO₂ neutral way.

This analysis showed that the choice of delivery and the way the parcel is picked up are two important factors in reducing the impact per parcel.

So, what is the customer's perspective on delivery and how can they be motivated to choose parcel pick up delivery?

From the surveys and interviews it is concluded that people like to be in charge of their parcel pick up, whilst being informed about the delivery

of their parcel. When not delivering to home, they prefer delivery close to home, at a moment they pick.

After the research phase, the following design statement was presented: Design a parcel collecting point for high rise apartment buildings in the city centre which meets customer needs. The customer needs are four aspects concluded from the user analysis: Knowing what to expect, no unnecessary movements to and from the house, being in control of when to receive a parcel and correct and timely information about the delivery.

Besides, some requirements were formulated as essential for the design of a parcel collecting point for high rise buildings in the city centre:

- The solution contributes to achieving the zero emission goals of DHL for 2030
- The solution strengthens the core business of DHL by making the delivery more efficient
- The solution is innovative and bold
- The solution is realistic to achieve by 2030
- The solution should encourage the customer to do the pick up by foot or by bike
- The solution should minimize the amount of unnecessary traffic movements from and to the apartment buildings
- Parcels from every delivery company are delivered here
- The solution is for both receiving and returning parcels
- The solution enables the customer to pick up at preferred times
- The solution should include communication with the end consumer about the delivery of the parcel.
- The solution can be placed in the second circle of the city: apartments and office

Through creative sessions 4 concepts were designed as possible solutions. These solutions include both manned and unmanned pick up point options. But looking critically at these

designs, they do not fit the scope of 2030. The presented solutions are too close to the current situation since these solutions can be implemented by tomorrow. The current design approach does not seem appropriate for solving the design challenge for 2030. Therefore, a second iteration with another design approach is done.

For a second iteration a speculative, critical design approach was chosen in order to come up with a design for 2030. Where traditional design is solving problems with the goal to satisfy users, Speculative and Critical Design seeks to challenge the stakeholders and spur debate on what is preferable societal development. Speculating with asking 'What if'- questions brought new challenges to solve. From these new challenges, three concepts were presented as solutions.

Debate with stakeholders showed that the Electricity hub seemed to be the most promising solution of the three. This solution meets requirements that are important for the customers to motivate them to choose this delivery option. The design allows the customer to pick up at their preferred time, and by foot or by bike since it is located less than 500 meters from their home.

Next to that, the Electricity hub is also serving a public service for residents, which creates added value to the pick up location.

Whilst more and more green and energy neutral buildings are being built, and more people are driving electric, cities are coping with fluctuations on the energy grid. These could make the energy grid unstable. To solve this, companies are already looking into the use of EV batteries as storage, but more solutions are needed in order to make sure we effectively use the renewable energies.

DHL is both in Germany as in The Netherlands coping with municipalities who do not allow them to place lockers in the public space. Only

when the lockers are serving a public service or adding an extra value to the neighbourhood, placing lockers is an option. Another condition is that the locker should be white label in order for the municipalities to agree on the placement.

The opportunity of combining the lockers with neighbourhood batteries is explored.

In this way, lockers will not be just standalone products, but will serve a public function and blend in with the neighbourhood. Also, the investments can be shared by both DHL, households and DSO's. A roadmap is created to conclude the research question: 'Design a last-mile delivery solution that fits customer needs in a designed sustainable delivery scenario in 2030 and can be adapted to the changing future network of DHL in 2030'. The roadmap presents a step by step approach of which innovations are needed to achieve the vision for 2030: A future where DHL is a public energy provider, facilitating energy through parcel pick up points.

To develop an integrated system of Powerhouses that facilitate the energy infrastructure for urban context in 2030, it is recommended that they take a step by- step approach, starting with developing a self-sufficient locker for new built apartment buildings and startinb collaborations. DHL can build a customer base with consumers that use the Powerhouse close to their home for parcel pick up and drop off, charging small electric vehicles and connecting with their neighbours. Next steps include expanding this hub with other functions.

The development of the full service will take 10 years, ending in 2030, where the Powerhouse will function as a mobility hub and parcel pick up and collecting point.

7.2 Contribution to practice

The aim of this master thesis was to contribute to the field of Integrated Product Design, the logistic sector and DHL. During this thesis, a focus has been on answering to the desirability, feasibility and viability of design choices. Overall, this thesis is intended as an inspiration for DHL to show how changing their current way of operation could lead to less environmental impact. With this thesis, new ways to tackle problems have been used that could be applied by DHL in future projects.

Cocreative sessions

At different moments in the design process, cocreative sessions were set up to gain insights from different stakeholders in the project. These sessions help the designer to include the customer in the design of a new product and service in order to come up with a customer centered design. I would advise DHL to also use such sessions for new products or services for their customers.

Speculative critical design

The Speculative critical design approach helped to look with a broader view to the problem. What other things are happening in cities and what could DHL contribute to these developments? By creating problems instead of solving them, one can provoke the audience, which could lead to new ideas. I hope to have inspired DHL by looking at what is ahead, and how their products contribute to the bigger picture in the future city.

Roadmapping

The roadmap is set up to show a more step by step approach to get to the end goal. DHL is already doing this by step by step moving towards their zero emission goals for 2030. But by plotting this over a roadmap, all needed resources are shown and it maps out what should change in the current products and services they are offering.

7.3 Recommendations and conditions for successful implementation

This chapter describes the recommendations for DHL, to help them which steps need to be taken for successful implementation of the Powerhouse.

The proposed concept is designed to inspire them for the direction they could take.

Although this concept seems to be connecting things that are not DHL business, the concept includes aspects that are mentioned throughout the whole project.

An assumption that lies on the base of this concept is that the energy system will change from a static model to more dynamic and that therefore the demand for home storage will rise in the next 5-10 years. This is something that is tested with experts in this field, but only time will tell how this will work out in reality. One thing that is more certain is that more charging facilities will be needed in cities.

Competitors or partners

If DHL decides to play a part in facilitating energy storage in the city, they are exploring a new field of expertise with new competitors. Companies working on neighbourhood batteries are Liander, Enexis and Stedin. DHL should not compete with them but together explore this new usecase for the battery. Alfen is a company that supplies the large batteries, they are competing with Tesla.

Webshops

Participants in the user research often noted that there is not always an option for pick up

point delivery. This is the responsibility of the webshops that this option is shown during the check out of their website. DHL must start a conversation with their customers to make it always possible for the customer to choose to deliver their parcel to the pick up point they prefer.

The bigger picture

Cities are in a transition from fossil fuels to renewable energies, including traffic and buildings. This has direct and indirect effects on the DHL business. The direct influences are attacked with the transition from fossil fuel vehicles to electric.

When looking at the indirect effect, the infrastructure of the cities is changing and people will need different resources to improve the quality of life in the city. Since DHL is in every small street of the city they can contribute to this change in the city, and help people to facilitate their needs. DHL could create a name that is associated with driving electric, and in this way become the green delivery company they envision.

Partnerships

In the proposed design, DHL is including batteries in their locker systems. This is a new field of expertise for them. Therefore, partnerships are needed to share knowledge. This is at the same time a good opportunity to share investments. In further research should become clear if the Powerhouse is interesting for energy companies to work with.

Early in this project, collaboration with smaller delivery companies and startups are named as factor to achieve a sustainable delivery system. In this way, the optimal delivery option can be executed per location and time pace. Also, by collaborating with for example cycling deliveries, DHL can benefit from the CO2 neutral delivery without having to invest time and money in the resources for this last mile delivery.

Batteries, safety and environmental impact

Nowadays, batteries do not have a good reputation. This mostly has to do with fire danger and high environmental impact. Companies that worked on pilots with the neighbourhood storages will probably know the risks. Further research is needed to investigate which requirements the Powerhouse should have in order to be safe.

It is important to consider the production of the battery and its contribution to environmental impacts beyond life-cycle greenhouse gas emissions and urban air pollutant emissions. Mining of the metals in batteries can pollute the soil, water, and air of mining regions and with recovering cobalt and nickel, emissions of sulfur oxides can be high. These impacts can be mitigated through use of different materials in batteries that incur less environmental impacts in the supply chain of batteries.

Further research should look into which batteries are suited for the Powerhouse and how environmental impact can be brought to a minimum.

7.4 Limitations and implications for further research

Limitation of the research

Despite the elaborate research done in this project, several limitations need to be discussed.

In the CO₂ analysis, some assumptions are done in order to calculate the scenarios. These assumptions are based on real rides so it gives a picture of the differences in CO₂ emissions between the different scenarios. However, there is not one number that can be calculated for every parcel. There are many variables defining the environmental impact which differs per parcel.

The customer journey is created from interviews with customers. These interviews are held with a selected group of neighbours that are living in the same area. This is probably not representable for the entire Netherlands.

The research data is interpreted by the researcher. This causes a necessity for subjectivity in some stages of the process. To minimize the subjectivity, the data has been validated with stakeholders in different stages of the project.

Limitations of the design

The Powerhouse is designed in a relatively short time period. Due to the limited amount of time, the embodiment is not fully designed yet. The embodiment and detailed design of the Powerhouse could be done in further research when DHL is interested in exploring this direction.

Based on the LCA done in the research phase, the Powerhouse is designed as more sustainable delivery option. However, when taking the full process of production, transport, use and after life in consideration, outcomes could look different.

7.5 Personal reflection on project

Learning goals

It was one of my learning goals to become more of an expert in sustainability topics. I think working for 6 months helps to learn more about a certain topic. I discovered every sector needs their own approach. And this can differ per field. There is no standard design approach for making a business more sustainable by lowering their CO₂ emissions. Regulations help, because this is what moves companies into the right directions simply because they have no choice. But companies have a business, and the business is determined by the customers preferences. That is why I believe that designing for sustainability starts by designing a sustainable solution fitting to the customer needs. When the sustainable business will become a better choice for the customer than the less sustainable choice, the business can transit to this.

Use the LCA to calculate emissions

In the beginning of the project I calculated the CO₂ emissions in the current delivery model for different scenarios. This was informative and necessary for the project to see where to start with when designing an improvement in case of emissions. For the end of the project, it was not necessary to do an LCA again, since the first LCA already showed that delivery to pick up points is more sustainable. However, we now only looked at the transport movements from the CityHub to someones home. When taking the full process into account of production, transportation, use, and after life, outcomes could look very different. What I learned about the LCA by doing

it in practice for not a product, but a service of bringing parcels, is that it really depends on what you include in your calculations and on what assumptions you take to start with. I would say that the LCA tool is more useful when comparing different products and their whole lifecycle.

Talk to fellow students on a weekly base was also one of my ambitions in order to give myself the opportunity to reflect on my work. Unfortunately, the faculty was closed during 90 percent of my project, and therefore reaching out to fellow students became harder. I did manage to speak to other students once in a while, but not every week. These moments definitely had an effect on my thoughts and my work. I think in every kind of project, it is good to talk to others, who are unknown with the topic, to test your thoughts. Also, for me it helped to talk about my project to make decisions.

Experience at DHL

Due to COVID-19, I worked for only one and a half month at the office of DHL Parcel Benelux instead of 7 months. Of course, it is a large disappointment that I was not able to experience my graduation as how I envisioned. However, I was able to get an impression of the company thanks to my first two months. The company has made a great impression on me. I was positively surprised by their openness and accessibility in my first couple of weeks. This was of major importance for me to reach out to the people I needed during the rest of my project.

Process

When looking back at the project, the process is split up into two parts. The first part is the traditional design approach we brought me to rather safe concepts which had more focus on the usability rather than the values. In the second part, I explored the problem by using the Speculative Critical design approach. Here, I found out that I am flexible in my design approach and I dare to take a new path while I am already halfway in the other process. The critical speculative design approach positively surprised me and I enjoyed working with it. Doing this extra iteration did cost time and also space in my report. The report therefore became bigger than I wanted but in my opinion this space is needed to explain the reader what the process looked like.



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Appendix 9

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Appendix A1: Double diamond process and the used methods

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Discover

This phase is also known as the exploration phase, where the problem is research and analysed. In order to fully understand the problem, rather than simply assume, it includes speaking to and spending time with people who are affected by the issue. For this project, it means that DHL Parcel is investigated thoroughly in order to see how they are responding to the market and what innovations already have been done by the company.

Define

In this phase, all the information which is gathered in the discovery phase is structured. These insights can help to define the challenge in a different way. This is also seen as a diverging project towards a list of requirements or a creative design brief.

Develop

This phase is the start of the second diamond, where different answers can be given to the same clearly defined problem. A strong tool used in the first part of this diamond is brainstorming, in order to get many solutions for the same problem. Co-creation with a range of different people involved in the problem could be used

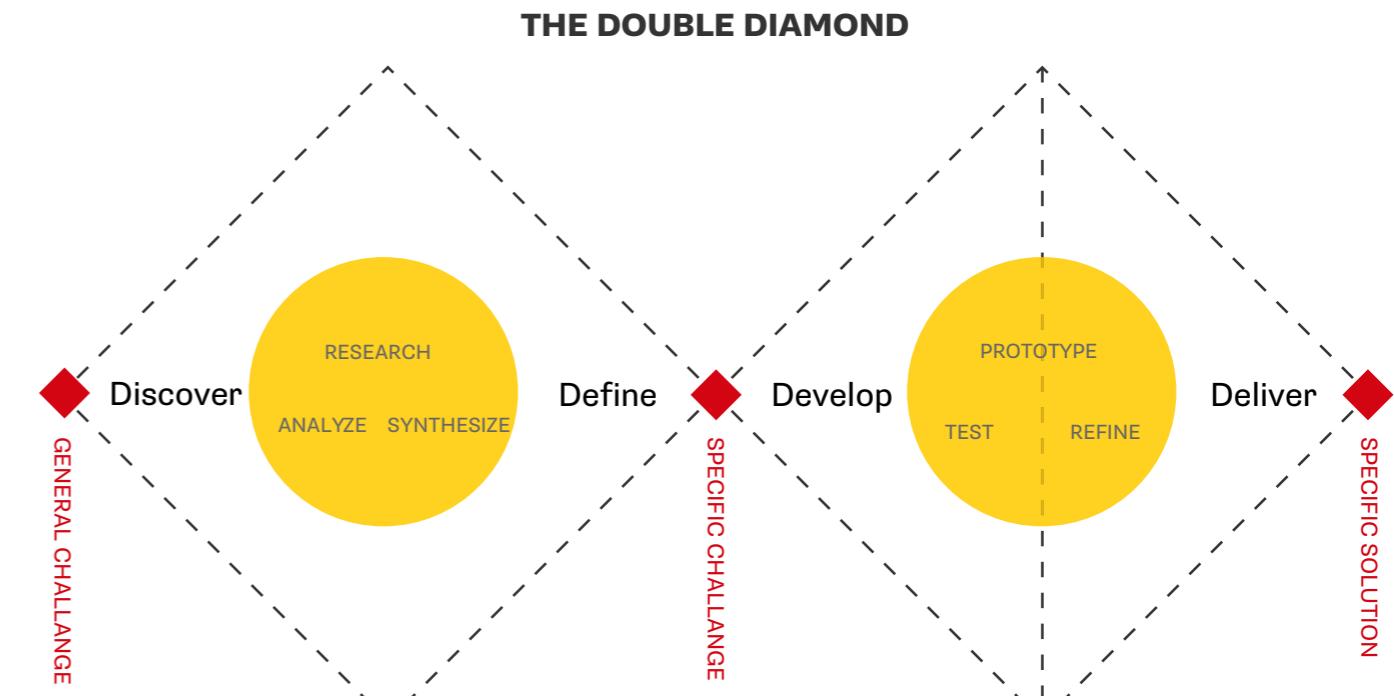


Figure 5: A visualisation of the double diamond process.

to get unexpected outcomes. During this phase, concepts are created and tested and evaluated with the involved stakeholders.

Deliver

In the delivery phase, a concept is chosen and worked out. Different parts of the chosen concept will be tested to validate assumptions and improvement will be made where necessary. This phase also includes communication and visualisation of the chosen concept in order to deliver the concept to the client.

The used methods

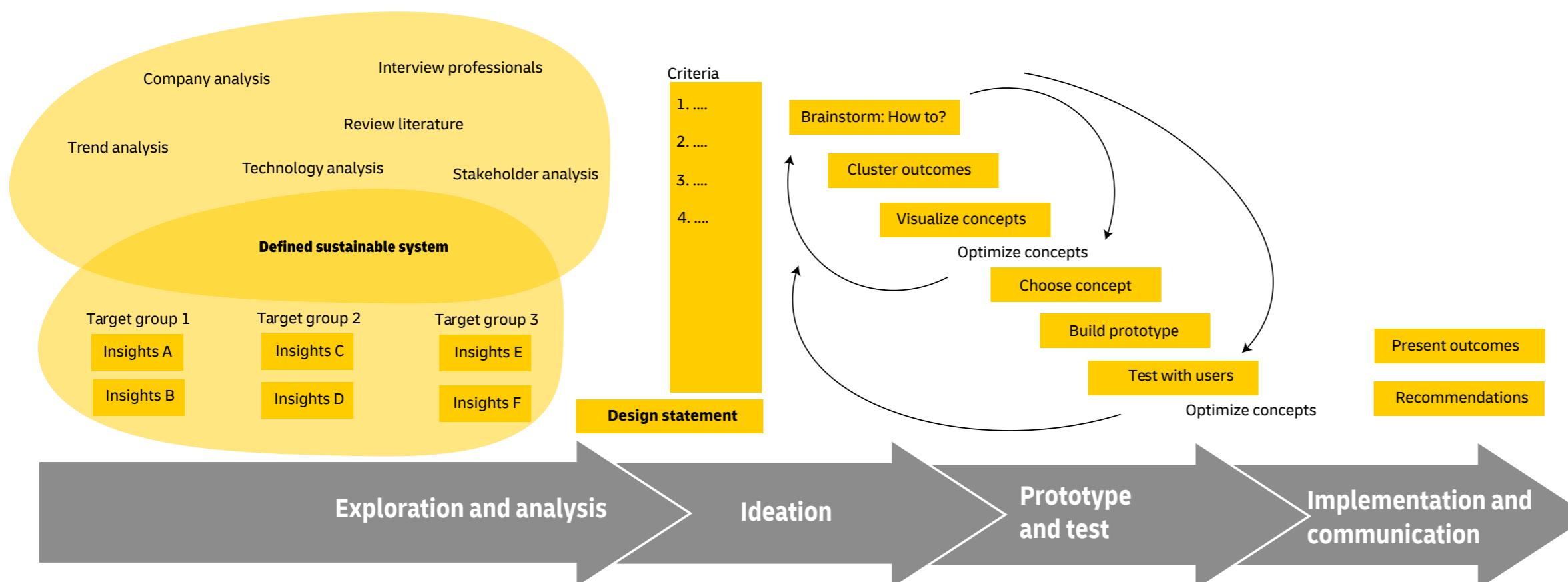
Exploration and analysis

The discovery phase is in this research also called exploration and analysis phase.

The goal of this phase is to gather as much information as possible about the problem and the involved stakeholders and users.

This part is split up in different research areas to investigate and the methods used to gain information are named below:

- Customer journey
- Interviews
- Observation
- Reviews
- Focus groups
- Sustainable logistics
- Interviews
- Desk research
- Industry developments
- Trend research
- SWOT
- Competitor analysis
- Future context
- Technology assessment
- Interviews



and a final concept is chosen after optimization. This choice is done based on feedback from users and stakeholders, the list of requirements and feasibility. A Harris profile could be used to make this decision. (Delft design guide, 2020)

Implementate and communicate

The concept is further worked out during the implementation phase, followed by communicating the concept. Another test is done with the final concept which will give an insight in recommendations. In this last phase, a roadmap is designed to show how the concept can be implemented in the future scenario.

Appendix A2: Product portfolio

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Offered products and delivery options

DHL Parcel is in B2C and C2C solutions focusing more on the customers wishes. New delivery options are added to DHL's portfolio, as for example evening and same day delivery.

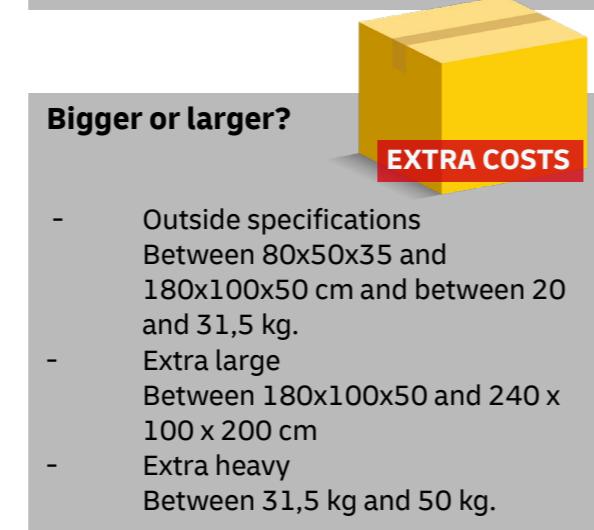
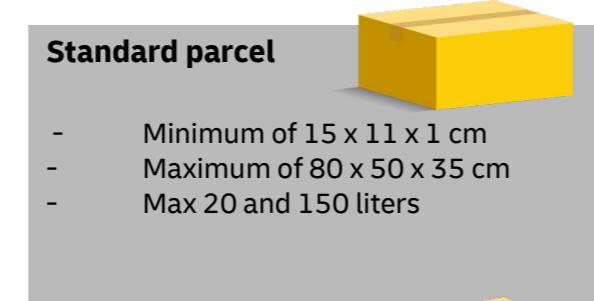
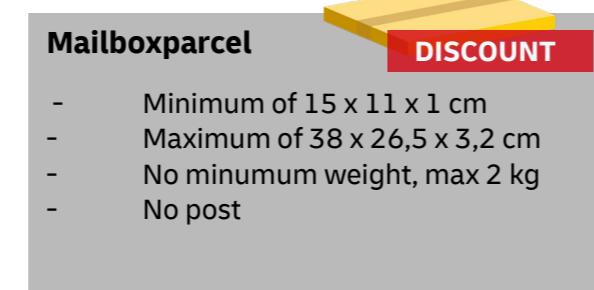
The clients of DHL Parcel can choose from the following delivery options to offer to their customers:

- Location of delivery
- Day and time frame of delivery
- Evening delivery
- Saturday delivery
- Same day delivery
- Track and trace code and change the delivery easily
- Returning options including labels

With these options, DHL parcel is trying to respond to the higher demands of the customers. For the client, there are three different sizes for delivery: The mailbox parcel, the standard parcel and the large parcel.

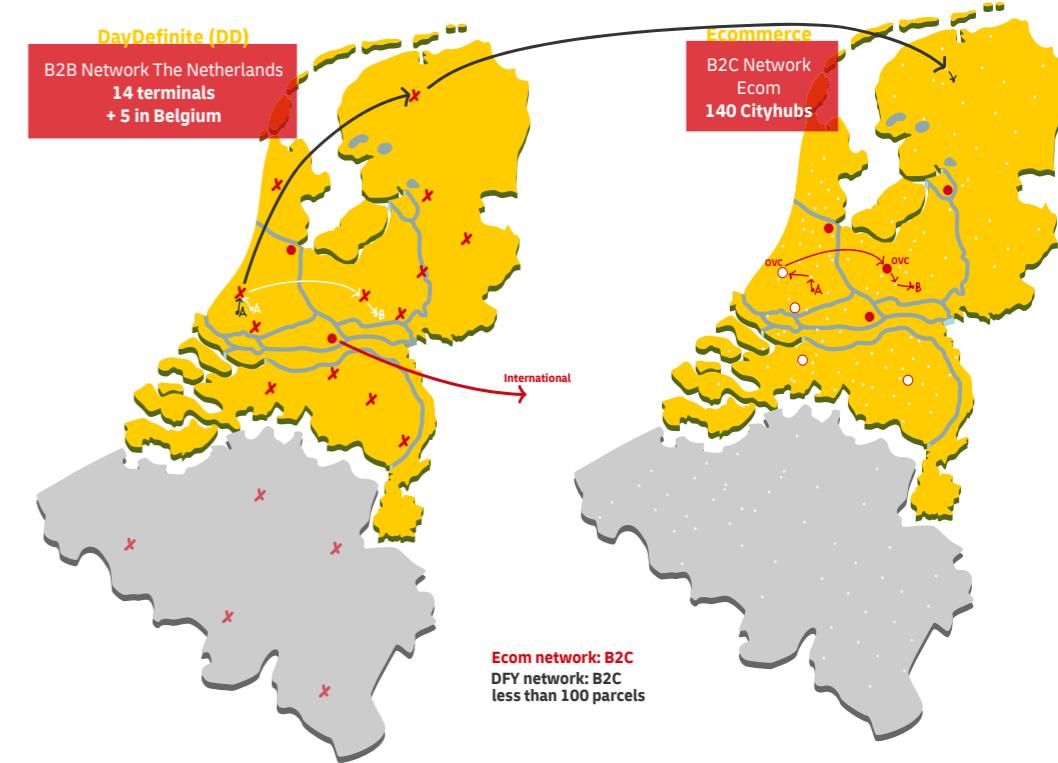
For the large parcel, clients are paying an extra fee. For the mailbox parcel, and for the option to deliver it at a service point, the client will get a discount.

DHL Today is an extra option for clients. This is for the niche market that whishes the parcel to be delivered at the same day, in the evening. This is only an option for the Mailbox parcel and the Standard parcel. (DHLParcel, 2020)



Appendix A3: DHL's domestic network

[GO BACK](#)



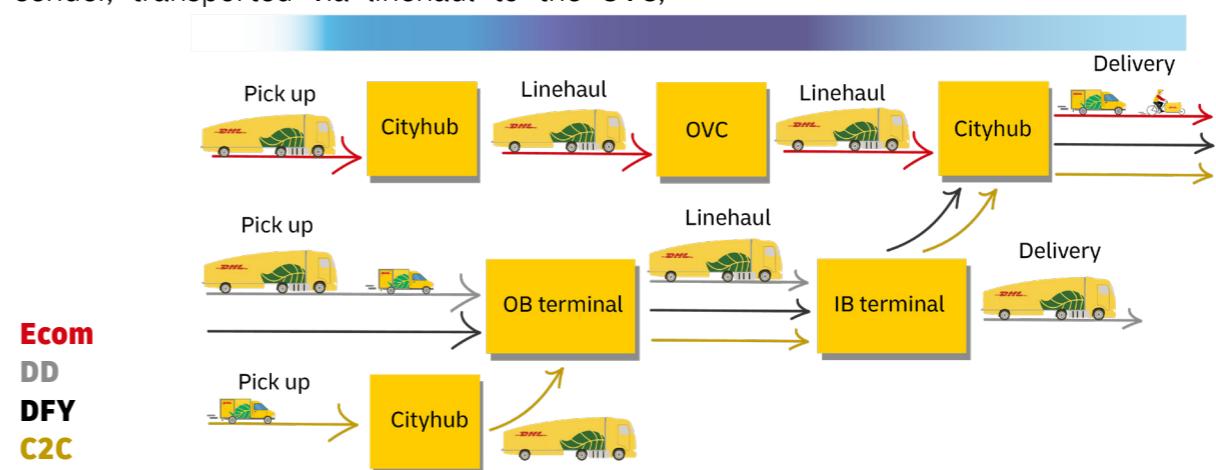
In order to deliver all the right parcels efficiently to the right customers, the network is divided into two large networks: DayDefinite (DD) and E-commerce (Ecom). DayDefinite is the business to business network, which mostly consists of freight transport. The e-commerce network is the business to consumer network, which includes freight transport and smaller vehicles as for example delivery vans. The figure shows via which facilities the parcels are delivered from the client to the end customer. All the parcels in the DD are transported via terminals. The parcels are received in the outbound terminal, and are picked up for delivery at the inbound terminal. For the Ecom, this is different. The Ecom network consists of 140 Cityhubs and sorting centres which are called the 'overslag centrum' (OVC's). Parcels are picked-up at the sender, transported via linehaul to the OVC,

transported via linehaul to the correct Cityhub, and there sorted in the morning, and delivered on the next day.

Next to the DD and Ecom network, two networks are added which are using the two other networks. These are Consumer to Consumer (C2C) and deliveries for senders with less than 100 parcels a day (DFY).

As shown in the figure, these flows make use of the two existing networks.

The C2C clients are marketplaces such as Vinted, Marktplaats and United Wardrobe. These are all platforms that enable consumers to sell their clothes or used products to other consumers. This is a booming market and is expected to continue growing. (Schaap, 2019)



Appendix

A4: Main competitors

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PostNL

Running years: 220 years, started in 1799 in The Netherlands

Size: 40.000 employees in 2018

Revenue 2018 : 2,8 billion euros of which 48% was derived from e-commerce activities. (PostNL Annual report 2018)

Operating countries: Benelux, the UK, Germany and Italy.

Market share in volume The Netherlands (2018): 60-65%

With a market share of 60%, PostNL is the largest deliverer in The Netherlands. For a long time, PostNL was the only letter and parcel deliverer in The Netherlands. (PostNL, 2020) PostNL is working on further implementation of parcel and post machines for pick up and retour sending of parcels and letters. In 2018, PostNL introduced a luggage service in collaboration with Schiphol.

PostNL has a mobile application for consumers which allows them to track their parcels. Their goal is to be the e-commerce front runner in the Benelux and they are working on this goal by innovating on different fields. Their robotised distribution centre in Houten is one example. An example of innovation on the receiver side is the PostNL parcel and letter machine. A second example of this is the smart packaging, which PostNL is developing with the Delft University of Technology and Daklapack. When the receiver is not happy with the product, they can send it back to the webshop in the same package. (PostNL, 2019)

Price for sending a domestic parcel max dimensions 100 x 50 x 50 cm, maximum weight is 10kg. Price is: 6,75 eu.

DPD

Running years: 1976

Size: 41000 employees in 2018.

Revenue 2018 : 7.3 billion

Market share in volume The Netherlands (2018): 0-5%

DPD Group is a german delivery company. They built The HUB in Eindhoven in 2019, the largest sorting centre of Europe. The green sorter, which is the heart of the building, has a capacity of 50.000 parcels a day. This sorting centre will allow parcel service DPD to consolidate its international competitive position. DPD is also working on a climate neutral fleet. The green fleet consists of bicycles (in collaboration with fietskoeriers.nl), electric scooters called TRIPL, and they are testing possibilities with the VW e-crafter. CO2 emissions are measured and everything that cannot be reduced, is compensated in order to ensure carbon neutral delivery. (DPD Group, 2019) For international parcels, DPD is market leader in volume with 25-30% of the market. (ACM, 2018)

GLS

Running years: since 1999

Size: 19.000 employees

Revenue: 2.5 billion in 2018

Market share in volume The Netherlands (2018): 0-5%

GLS stands for General Logistics Systems B.V. , is a Dutch, British-owned logistics company based in Amsterdam. GLS group is together with partners operating in 41 countries of the EU and in the United States. In order to work on its sustainability responsibilities, GLS launched the ThinkGreen initiative to coordinate and promote activities within GLS Group.

The aims of the initiative are: 1) responsible use of resources, 2) reduction of emissions and 3) optimisation of waste disposal. GLS employs an alternative vehicle fleet in several countries. This fleet includes electric vehicles, compressed natural gas as well as liquefied petroleum gas vehicles, bicycles and electric scooters. In The Netherlands, they start this year with delivery with electric vans. (Velthoven, 2020) Furthermore, they try to improve the efficiency and the number of first attempt deliveries (GLS Parcel Service, 2020)

UPS

Running years: founded in 1907

Size: 481.000 employees in 2018 globally (UPS, 2019)

Revenue: 3 billion USD (2018)

For international parcels, UPS is market leader in revenue with a percentage of 30-35%.

UPS, which is at the moment the world's largest package delivery service, started with two entrepreneurs in Seattle. The increase in e-commerce was the reason for UPS to start with UPS My Choice, a platform for consumers to control and manage their parcels. UPS invested more than USD \$1 billion in alternative fuels and vehicles since 2009. They currently have 10.000 of these vehicles in their fleet with different technologies:

Compressed Natural Gas

Liquefied Natural Gas

Hybrid Electric Vehicle

Electric Vehicle

Propane

Ethanol

Biomethane

Hydraulic Hybrid Vehicle

(UPS.com, 2020)

Appendix

A5: full description of companies

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Parcls

They now have 4 pick up locations in Amsterdam. The idea of this startup is that the last mile is the responsibility of Parcls. They are the ultimate example of a white label city hub, where the parcels from different delivery companies are consolidated and either picked up by the consumer or brought to their house by bike. (Parcls.com)

Pick this up

This is an online platform that connects rides of private chauffeurs with the delivery of large and heavy parcels. The company uses the advantage of the fact that people are driving a specific route and by combining this with delivery, they can earn money from it. (Pickthisup, 2020) (Sprout, 2015)

De Buren

One of DHL's partners when it comes to last mile delivery is De Buren. De buren places lockers and allows connected delivery companies to drop the parcel in these lockers. The lockers are accessible 24 hours a day and also give consumers the option to return parcels with these lockers.

Red je pakketje

This is a dutch initiative that is focussed on the fact that people are often not home when their parcel is delivered. They have a drop-off network, which means that parcels are delivered to their facilities and from there the parcels are delivered to the end consumer between 6 pm and 10 pm. The Red Je Pakketje network consists of 50 drop off points across The Netherlands. They are only operating during the week and the price for the webshops per parcel is 7,95 euro. For this price, they offer same day and next day evening delivery. (redjepakketje, 2020)

Smartmile

Just like Parcls, Smartmiles own location for the pick up of every parcel, no matter which delivery company. The only difference is that Smartmile owns locker stations that are placed within cities.

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Pluplus

Pluplus focuses on delivery within cities and aims for a delivery within 2 hours. They have their own network of private deliverers.

De versnelling

'De Versnelling' is a solution for last mile deliveries with a critical time path. They use bicycles for the last mile delivery or motorised deliverers from their partner Kappa Koeriers. In 2014, the company started delivering for large brands in Amsterdam like GStar RAW and FAB.

Trunkrs

Trunkrs is not working with other local delivery partners but aims to work with private partners to deliver the parcels. Amazon is also trying this way of delivery with Amazon flex. Trunkers visions a future where a person will drive past a pick up point to collect all the parcel for its street. Trunks says that in this way, the same day delivery can be offered for the next day delivery prices. Trunks also offers private parcel service points, where people from the neighbourhood can pick up their parcel. This is currently tested in three cities in The Netherlands.

Loopjongens

Loopjongens started as a service for Ikea, before Ikea started with their own webshop. They changed their business into a large network that provides quick delivery option for parcels with a destination The Netherlands. Both private consumers as business consumers can use this option for delivery. Examples of partners are the Amsterdam shoebrand ETQ and the retailplatform Winkelstraat.nl

Local express

Local Express is an initiative of PostNL and is only focussed on same day delivery. This is for the customers that want to add an extra service for their end consumer. PostNL express uses different channels within the PostNL network varying from bicycles to PostNL vans. and Local express started in Amsterdam but is expanding fast to other cities within The Netherlands.

Fietskoeriers.nl

Fietskoeriers started as quick delivery for accounting and lawyer offices in the Dutch big cities. Nowadays, Fietskoeriers.nl provides a quick delivery for different shops and webshops, controlled from one software platform. They promise to deliver the parcel in 1 or 2 hours

Appendix A6: DEPEST trend analysis

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The DEPEST method is used to research the trends for the year of 2030. With this method, the demographical (D), Economical (E), Political (P), Ecological (E), Socia-cultural (S) and Technological (T) trends are listed.

Demographical

- Randstad is growing. Half of the dutch population lives in Noord-Holland, Zuid-Holland, Utrecht en Flevoland. (PBL, 2019)
- Aging society, therefore the 65+ population is increasing (PBL, 2019)
- The population is decreasing in areas like Limburg, Flevoland and Groningen. (CLO, 2020) In 2050, one out of 4 people will be older than 65. (Centraal planbureau, 2015)
- People are moving from small villages to the cities, therefore small villages next to cities are getting more empty. (CLO, 2020)
- The amount of households is going to continue growing until 2035. Therefore, there is a need for an extra 750.000 houses until 2035. (PBL, 2019)

D

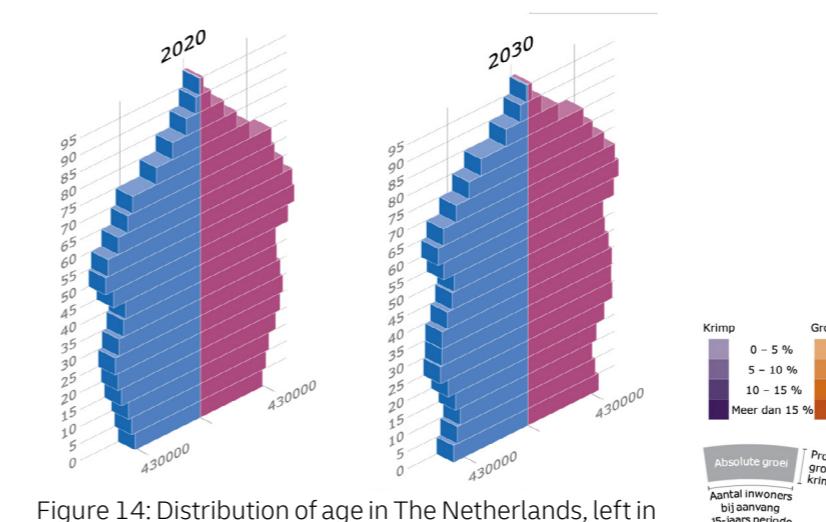
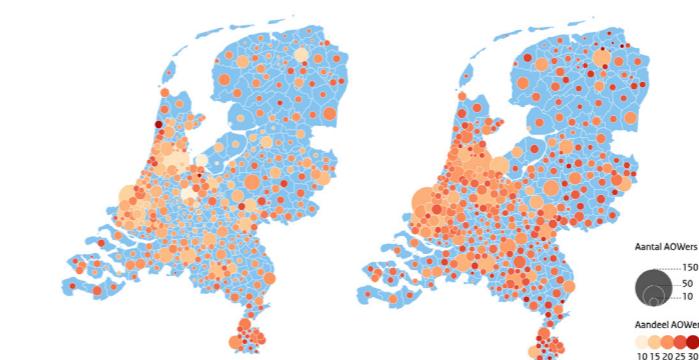
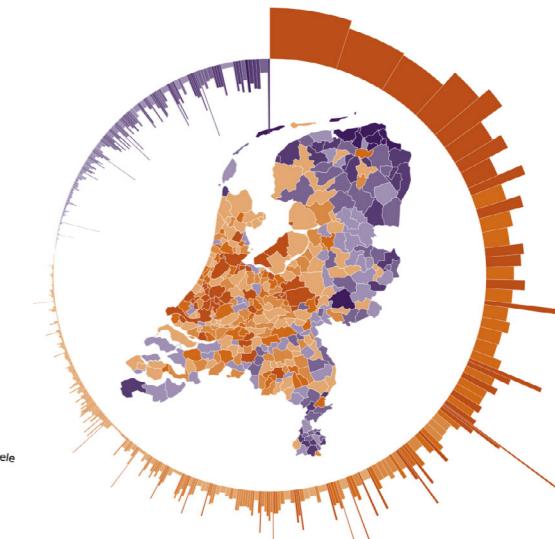


Figure 14: Distribution of age in The Netherlands, left in 2020 and right in 2030.



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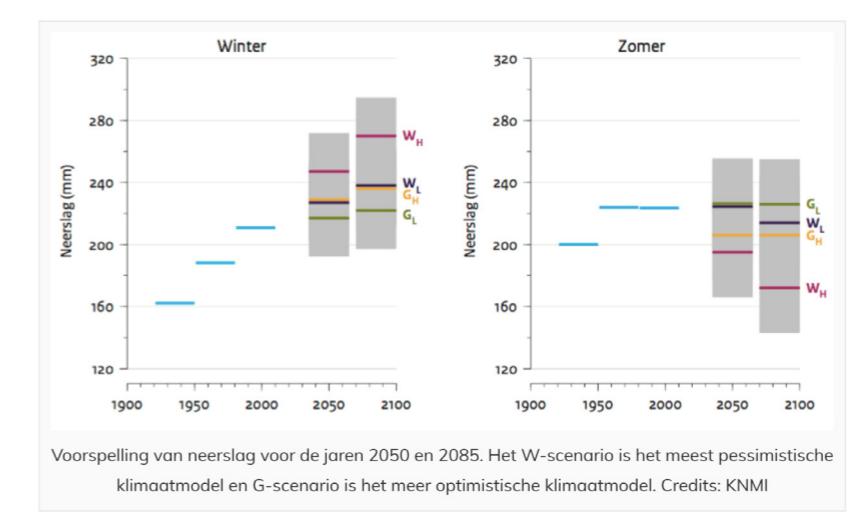
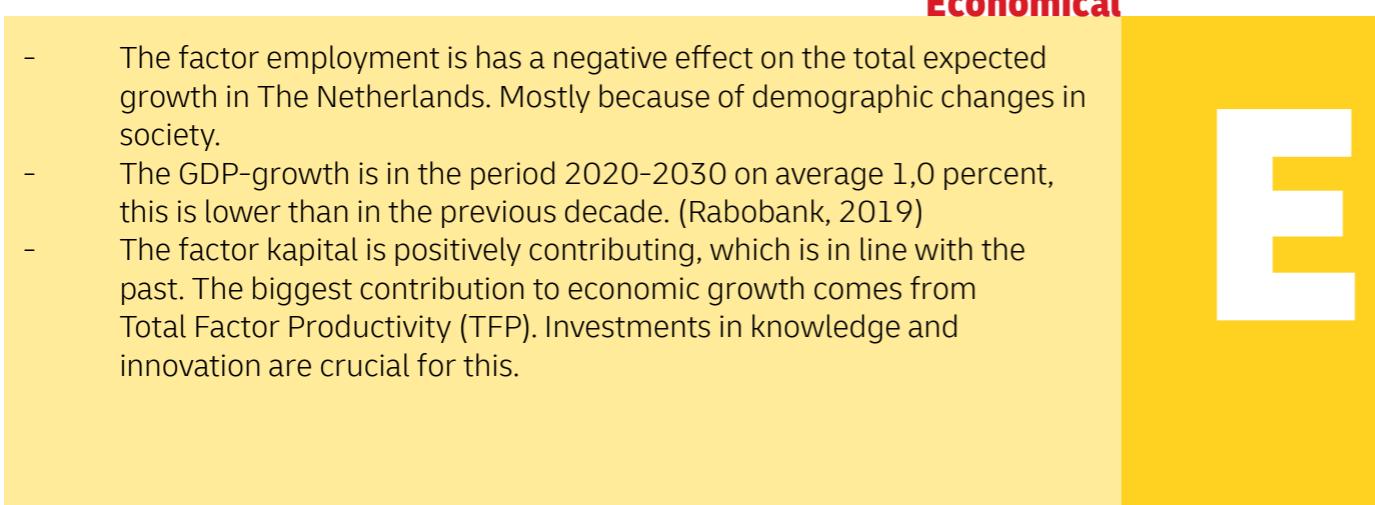


Figure 17: Predictions for the rainfall in the years from 2050 - 2085. (KNMI)

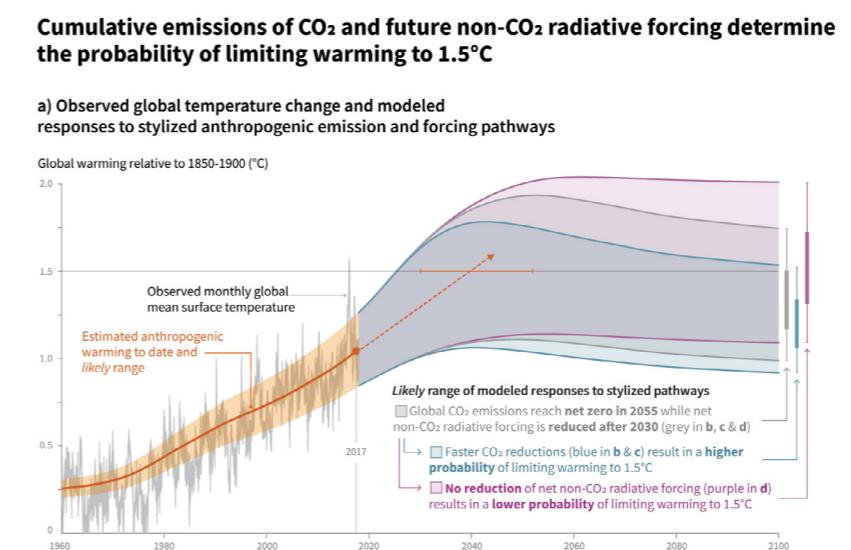
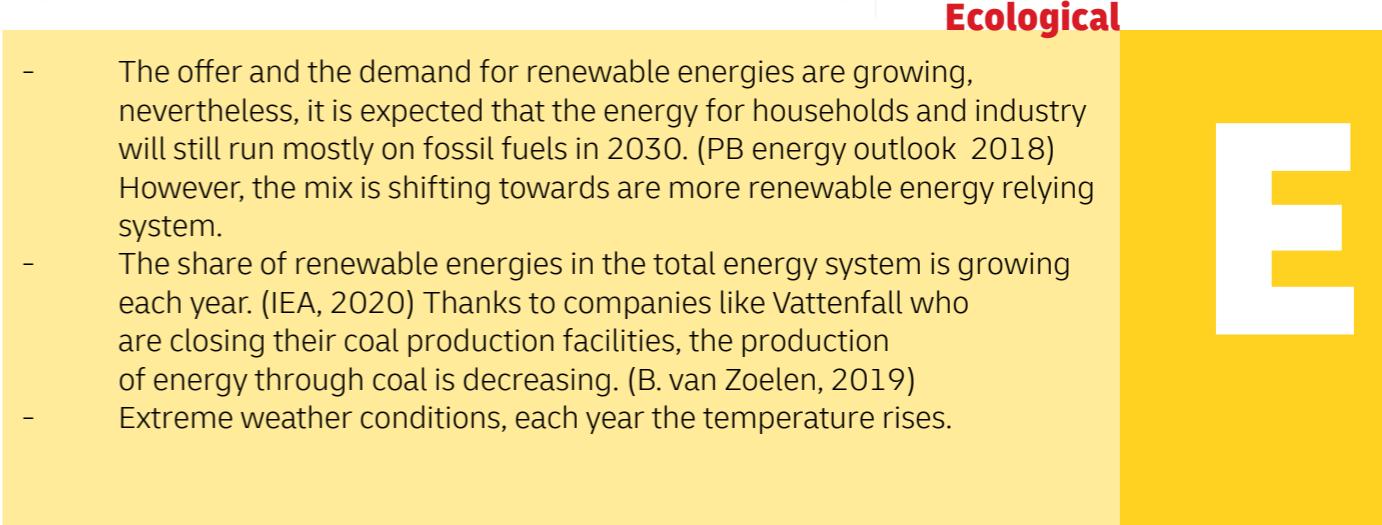
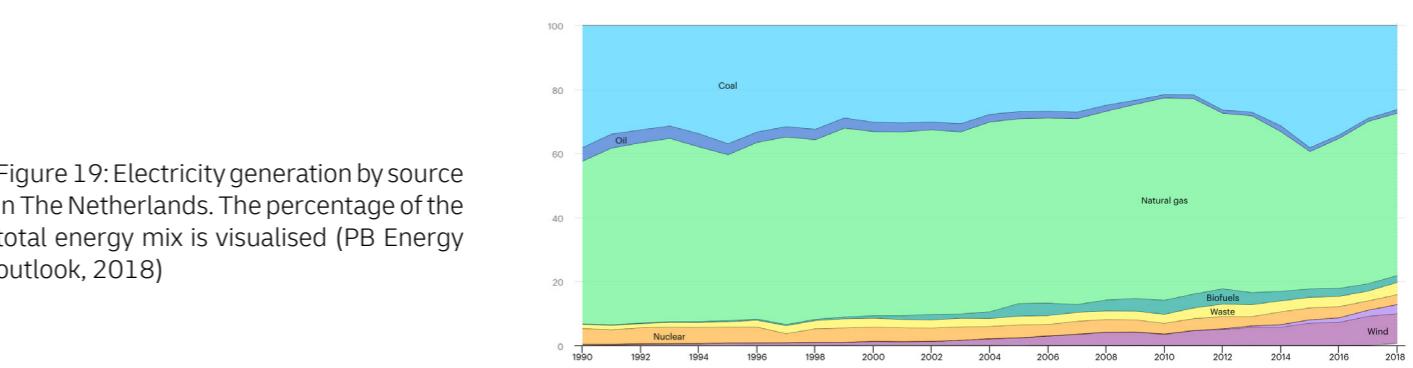


Figure 18: Prognosis for the increasing temperature on earth. Three scenarios are visualized. (IEA, 2020)



Socio-cultural

- An increase in consumers that choose for subscription based models (McKinsey and company, 2018)
- Growing shared economy. Examples like Uber and Airbnb. (Rinne, A. (January 2019))
- The amount of single-user households is increasing. This will be 31% of the households in 2030. (CBS, 2018)
- Increasing connectedness and decrease in privacy (Ipsos, 2019)
- Mix of household is changing, in 2040 this is expected to be like the image below (CBS, 2018)
- Rise of the individual and decline of social cohesion (Ipsos, 2019)
- More obesity (CBS & RIVM, 2017)

S



Figure 20: Development of households (CBS, 2018)

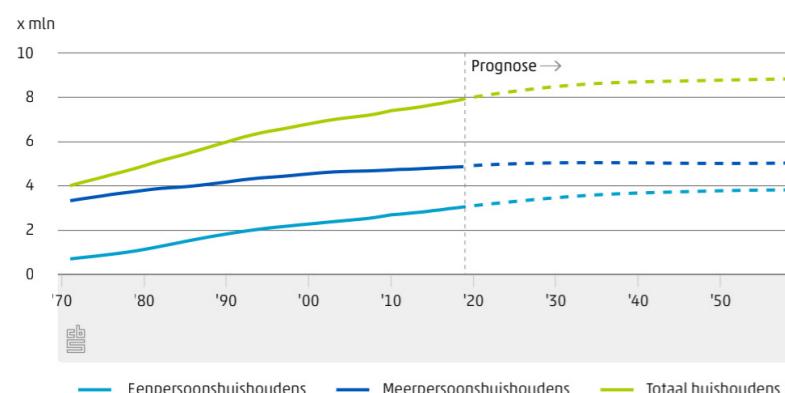


Figure 21: Prediction of development of single-user households in The Netherlands. (CBS, 2018)

Gestandaardiseerde trend volwassenen met overgewicht en obesitas 1990-2017

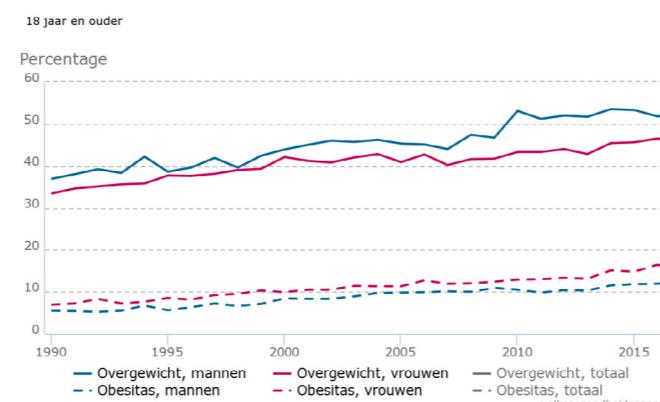


Figure 22: Adults being overweighted and having obisitas.

Technological

- Hydrogen network will increase in Europe which facilitates innovations in hydrogen solutions. (Ad van Wijk, 2020) (fuellcellswork, 2020)
- Energy companies in The Netherlands, but also in Europe are working on a fossil fuel free energy network.
- Three solutions for the mismatch between electricity production and demand:
 - a) Smart grid: adapt the demand to the availability of energy.
 - b) Interconnectivity: connect the grid of different countries with each other
 - c) Storage, in order to save energy for when it is needed. (TU Delft, 2019)
- More and more connected product. Connectivity of products is increasing.
- Rapidly growing electric vehicle market. (Global EV Outlook 2019)
- Increase of installation of electric LDV (Light Duty Vehicles) chargers, worldwide. (Global EV Outlook 2019)
- Nowadays: Industry 4.0. Which means industry is working with Cyber-physical systems: connecting real objects with data processors /virtual objects and processes through information networks (eg. Internet)



Global installation of electric LDV chargers, 2013-2018

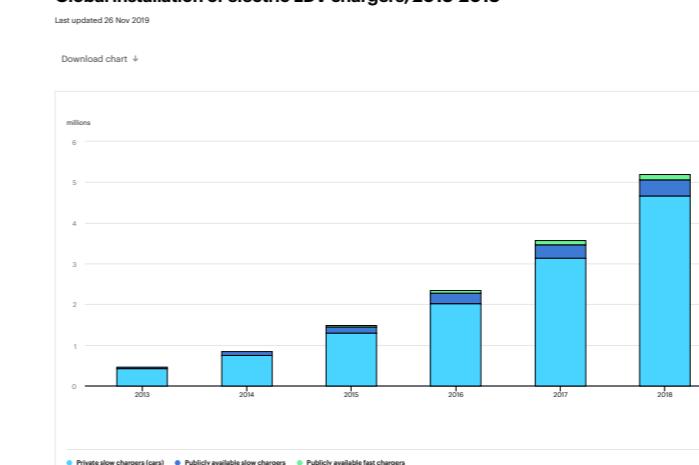


Figure 23: Global installation of Electric LDV chargers over the period of 2013- 2018 (Global EV outlook 2019)

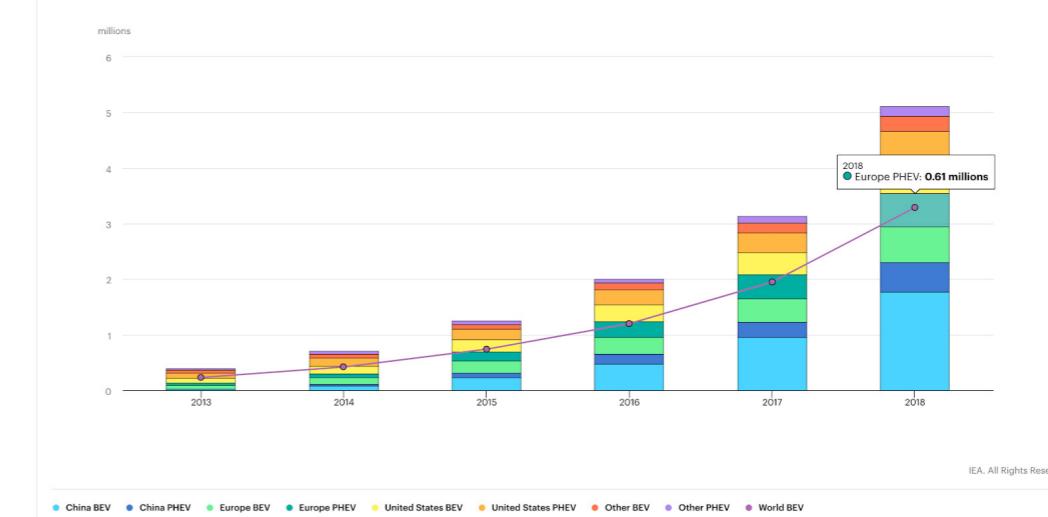


Figure 24: The global electric car development from 2013 - 2018. (Global EV Outlook 2019)

Appendix A7:

GO BACK

Join one day on ecom ride

it is never appreciated if you have the service points on your ride. The parcels that are not able to be delivered, are brought to the service points on the next day.

So, at the sorting station, our rides are sorted and placed on shelves. The shelves are all numbered with magnetic numbers that are all placed on a different shelf every morning before the sorting process starts.

The drivers are responsible for loading their van. It is very busy in the depot between 10 and 11, because all the drivers need a spot inside the depot to load their van. Rene is guiding all the drivers in and out the depot. He is managing the process of guiding drivers to empty spots in the depot. In the depot are around 10 spots for delivery guys and girls to load.

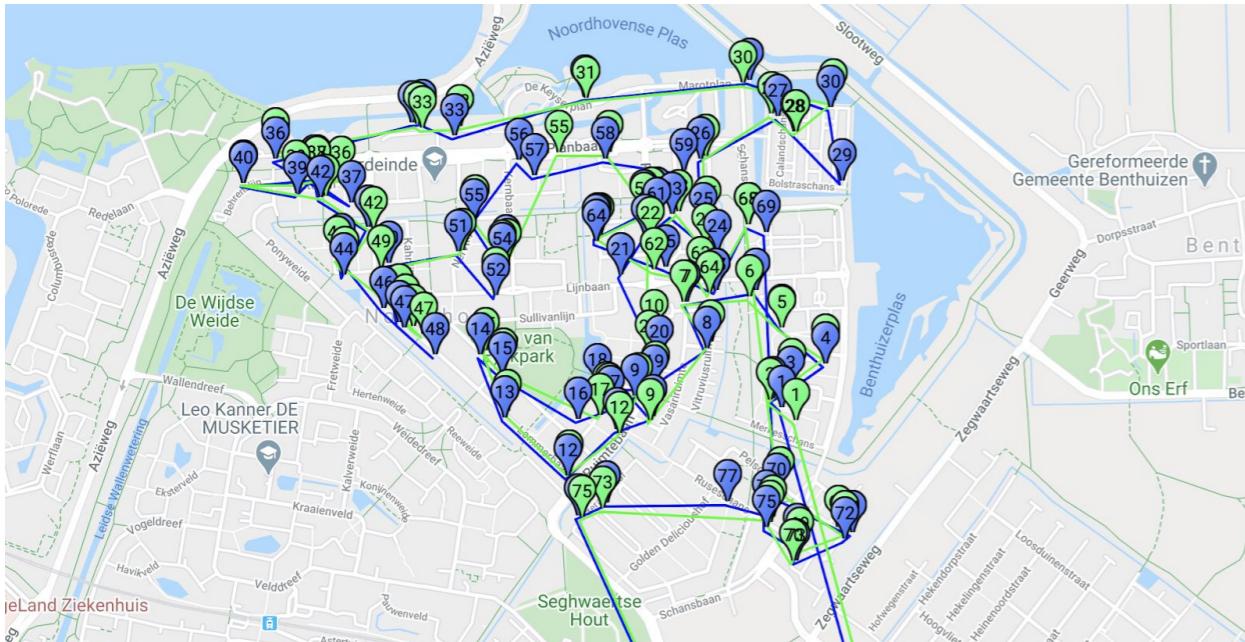
Whilst we are walking from one side of the depot to another, Esther is greeting a lot of colleagues. 'Do you know all your colleagues working here?', am I asking.

Esther: Yes, I know almost everyone! Especially the ones that under contract here at Van Leen. For the part timers it is a bit harder to remember. Also, because the part timers are working mostly during the evenings.

At the check in desk, Esther received a handheld from the ground managers. When logging on on this handheld, Esther sees the rides that we have to fulfill that day. We had ride 26 and 16.

We grabbed a cage to put the parcels in and walked towards our first shelf. There, a little bit more than 80 parcels were waiting for us. We started by putting all the parcels in groups of ten. The first 10 numbers were placed in the cage directly. In the cage, you want the low numbers first. In the van, you want the high numbers first. So by the end you get to the low numbers, your van is full and you can start by grabbing the lowest numbers.

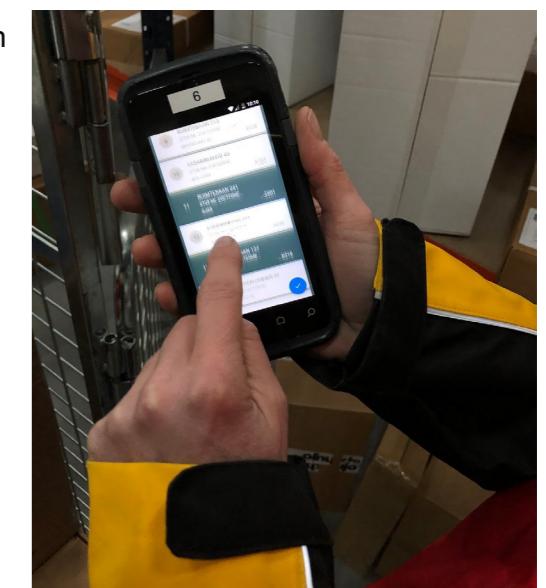
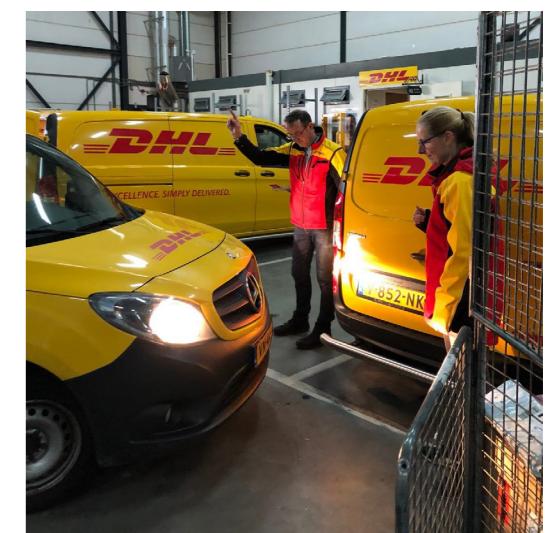
When putting all the parcels in the cage, the drivers should make sure that no parcels are forgotten. The handheld is helping with this because it is showing the numbers that are not scanned yet. This means that you need to scan every



February the 20th I drove along with Esther Heezen van DHL depot Bleiswijk/Zoetermeer. We started at 10 o clock at the depot in Bleiswijk. There, Esther was already checking herself in at the desk.

10:10 Ester received her ride information and showed me where we were going to get our parcels and sort them for in the van.

Our ride information stated that we had to deliver two rides. This means two different areas in the city we were delivering. The first ride had 82 parcels, the second ride had 29 parcels. So in total, we were going to deliver 110 parcels that day. There were no service points in our route. Esther: they are dividing the service points over the employees, therefore you are not always doing servicepoints. The servicepoints are always extra stops at the end of your ride, so



parcel before putting them in the cage. You do not have to do this on chronological order.

When all the parcels are in the cage. We drive the car in the depot to a parking spot. Rene is guiding us. Arrived to our spot, we start loading our van. We start in the back left. The van has a side door and a back door. So you want the highest numbers (the last stops) as far from the door as possible. Small parcels (brievenbuspakketten) are placed in a separate small box which is mostly placed on the passenger seat. Now, I was sitting on the passenger seat, so the box was placed in the back. The packing was done very neat, but this does not matter that much since everything is moving in the back when driving fast when the van is already a bit empty. When it doesn't fit in the van at once, the driver has to come back to the depot to reload. This takes a lot of time.

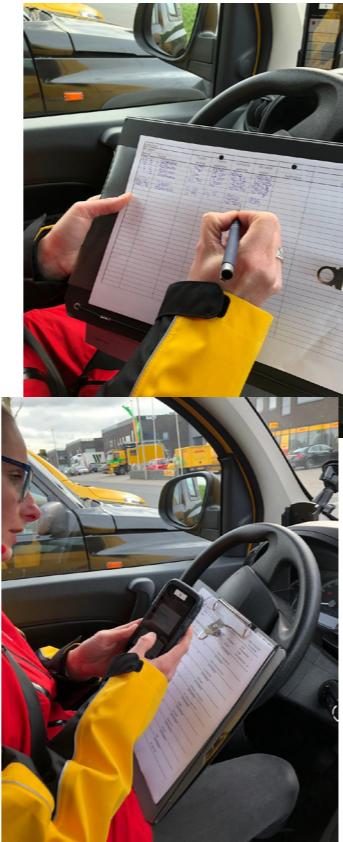


At the same time, other vans were also packing their vans.

When we were finished with loading, a bit before 11 o'clock, Esther parked the car outside. We were not allowed to leave before 11 o'clock. We had a little break before we could start.

At 11, we walked to the van and did the administration that is required before starting. This included writing down the driver's name and the amount of km's on the dashboard.

Then, we started driving. The route is done with navigation (google maps), therefore it is quite important that the driver takes a second battery in case the battery dies. Esther always checks the battery before leaving, and takes a spare battery with her.



We start at number one and parcel for parcel work the whole list. After 2 hours, we delivered 35 parcels. Already quite a lot people did not open the door. I was hoping every time I rang the bell because we wanted to do it as quickly as possible. And the first 89 parcels needed to be delivered between 11 and 15 o'clock. The average delivery time is 20 parcels per hour. We had four hours for 89 parcels, which meant that this was already hard to achieve.

When arriving at an address, we scanned the parcel twice until you hear a happy bleep sound. The handheld asks you to put the delivery state in, the choices are logical: Delivered correctly, delivered to neighbours, no one home thus not delivered, etc.

When no one opened the door, we had to try the neighbours. I would say that 90% of the neighbour tries is successful but sometimes you have to try 3 houses, which takes up a lot of time. Parcels that fit into the mailbox were therefore my favorite.

A lot of acts were required when delivering to the neighbour. This went wrong with me the first time I had to do it: You need to select the right delivery state on the handheld, which is delivered to neighbours. You get a paper card for in the mailbox of the right address. Here, you write that it is delivered to the neighbours and write down which number. You need to scan this paper before putting it into the mailbox (this went wrong with me). Then, you need to say on the handheld on which number you delivered the parcel. And then, as an extra, Esther wrote it down on her administration board in the car. So she knew what she had done with the parcel. It was hard to do all the acts, and took a lot of time. You have a pen, a handheld, the parcel and the paper in your hands. And maybe the car key too. This was a struggle every time.



Largest insight: I felt like we were driving through the same streets a lot of times. This was mostly because the handheld showed us through a street, and on the way back through the same street to deliver the rest of the parcels. See for example number 21, 10 and 62 on figure 1. These are all in the same street, but delivered on a very different moment.

The depot holder says that the system is going to be improved and takes these kind of things into account. Also it will be able to improve itself, so you can give feedback.

Appendix A8:

Customer journey

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Appendix A9: Circles of the City

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Historical city centre

This circle is the inner circle of the city. This part of the city is the oldest, since it was built before the 18th century. Characteristics for this part of the city are small streets, commercial facilities such as shops and restaurants and also we often see the business centre located in the city centre because the rental prices are high. Many historical centres are car-free.

There is not a lot of space in the historical centre of the city. People are living in small and old buildings with often no or a small garden.

There are in the historical centre many opportunities for settling a servicepoint in the retail. However, prices are high to start a business here because the land is expensive.

For people living in the city centre there is always a service point close by. The fact that houses are hard to reach by car due to traffic congestion, one way road and small streets is not an ideal situation for parcel delivery (Bouma, 2019).



Mixed high rise apartments and offices

The apartments built in the city are relatively new or renovated. The large cities in The Netherlands are building more high rise apartment buildings in order to meet the housing demand for the next decade. These buildings are mostly aimed for starters that are couples of individuals. For families it is not attractive to live in a high building, they prefer low rise family houses.

Many municipalities see the high rise mixed apartment and office buildings as a solution for the tight housing market (Steenbeeke, 2018).

The high rise buildings are one of the largest challenges for delivery man. People living in these houses are young double earners that are often not home. When people are not home, the delivery cannot be done to the neighbours. The most fitting solutions for these buildings are the locker systems downstairs or delivery to service points in the neighbourhood. This, however, is challenging because of the volumes.



19th century neighbourhood

The houses built just at the edge of the historical city centre are the so called 'workers houses'. When the industrial revolution came to The Netherlands, many houses were needed to provide housing to the people that worked in the factories of the city. These neighbourhoods now grew out to the multicultural part of the city. In some cities these neighbourhoods are attracting the so-called young urban people (YUPpen) because of the low rental prices and central spot. Examples of these neighbourhoods are Lombok in Utrecht, De Schilderswijk in The Hague and Delfshaven in Rotterdam.

Inhabitants of these neighbourhoods are a mix of young families, students and multicultural families. In these areas, we also see a lot of multicultural small shops. These shops are an opportunity for the service points. There is not a lot of space for safeplace or locker solutions since the housing density is high. But neighbours do know each other and are open for receiving parcels for each other.



1930's houses

These houses are low terraced houses built for families in quiet neighbourhoods just outside the city centre. The houses were built between 1920 and 1940 and are still very popular because of their characteristics.

The houses are built close to each other and therefore parking spots are limited. Since these neighbourhoods are often close to the city centre, the streets deal with a lot of traffic.

Safe place and delivery in the neighbourhoods are both an option in these areas because of the front gardens and the good connection with neighbours. Also, neighbourhood points are an option to collect all the parcels for the neighbours. Another solution for these areas is only delivering on specific days in the week, so people know what to expect.



After war buildings

These neighbourhoods originate from the time after war, when there was a need for a lot of housing for a low price. The houses have a low rental price. Characteristics of these buildings are that they are all mid to high rise buildings with variation from 4 floors to large flats with up to 30 floors. In between, you will find large areas of green. There is a clear division in functions: working, living, commuting and recreation were separate and this results in the fact that these neighbourhoods are not combined with shopping or working areas.

The people living in these areas are the low-middle income families and couples. The percentage of young people is relatively high in these neighbourhoods. Also, elderly are often living in these areas (CBS, 2017). Delivering to the neighbours and 'safe place' are not an option. Also, the houses are not very close to shops and other recreational facilities so delivering to a service point is not desired. The home delivery chance during the day is higher than in other neighbourhoods.



Vinex neighbourhood

The vinex neighbourhoods are mostly constructed after 1990. These neighbourhoods are located far from the city centre. The construction consists of terraced houses with a lot of space around for parking and green areas. In these neighborhoods live mostly families with children.

The people living in these neighborhoods have a middle to high income and work during the day. Therefore, the delivery success rate during the day is not high and people prefer evening or pick up point delivery. Pick up points are mostly located in the local supermarkets or small shopping areas. The social interaction is higher compared to the city centre and high rise buildings.

Safe place delivery, delivery to neighbours and service point delivery are an ideal option for these neighbourhoods.

Appendix B1: Survey questions target group

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05/05/2020

User research parcel delivery

User research parcel delivery

For my graduation at the University of Technology in Delft, I research the wishes of recipients of packages. The group I am researching lives in apartment buildings and residential towers in the center of the major Dutch cities. I would like to ask if you can help me with my research by filling in a short online survey.
The questions are anonymous and are only used for my research. It takes about 5 to 10 minutes to complete the survey!
19 questions are asked about your profile and your delivery preferences. This helps me to design a parcel point which meets your wishes, and hopefully will be realized in the near future!

Thank you in advance for your cooperation and strength in this day and age.

* Required

1. What is your age? *

Mark only one oval.

- Till 18 years old
- 18-25 years old
- 26 till 35 years old
- 36 till 50 years old
- 51 till 67 years old
- Older than 67

2. What is your highest level of education? *

Mark only one oval.

- High school diploma
- Some college
- Associate degree
- Bachelor's degree
- Masters degree or higher

3. What is your current living situation? *

Mark only one oval.

- Living alone
- Live together
- Live alone with a child
- Family
- Other: _____

4. How many hours do you work per week? *

5. How many days do you work from home per week? *

Mark only one oval.

- Zero
- 0.5
- 1
- 2
- 3
- More than 3 days a week

6. How many evenings are you NOT home during the weekdays? *

Excluding weekend.

Mark only one oval.

- Zero, I am always home on evenings during the week
- 1
- 2
- 3
- More than 3
- Other: _____

05/05/2020

User research parcel delivery

7. On which services do you have a subscription? Think of Spotify, Netflix etc. *

8. How do you do your groceries? *

Mark only one oval.

- I order online
- By bike
- By foot
- By car
- Other: _____

Parcel delivery

The following questions are related to delivery of parcels

9. How much online orders are you placing on an average month? *

Delivery of online groceries doesn't count.

Mark only one oval.

- 0
- 1
- 2
- 3
- 4
- 5
- More than 5

10. On which webshops do you often order? *

11. What price would you be willing to pay for a delivery without CO2 emissions? *

12. Would you consider a monthly subscription in order to get free delivery? If the answer is yes, how much would this be per month? *

13. How would you describe your relationship with your neighbours? *

Also think of receiving parcels for each other.

Mark only one oval.

- | | | | | | |
|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
- I never speak to them We are close friends

14. For which delivery option do you choose the most? *

Mark only one oval.

- Delivery at a service point
- Delivery to my home address
- Delivery in a parcel locker
- Delivery to my office

15. How often do you miss the delivery man/woman? *

Mark only one oval.

- Less than 1 out of 5 times
- 1 out of 5 times
- 2 out of 5 times
- 3 out of 5 times
- 4 out of 5 times
- Always, 5 out of 5 times

05/05/2020

User research parcel delivery

16. Do you experience problems with parcel delivery? Yes, tell me why!

17. Do you have a parcel locker system in your apartment building? *

Mark only one oval.

- Yes Skip to question 18
 No

A parcel locker system for apartments

You have indicated that you have a locker system for parcels in your building. Below are briefly a number of questions on this topic.

18. Do you use the parcel locker system for the delivery of your parcels? *

Mark only one oval.

- Yes, always
 No, never
 Sometimes

19. Which problems do you experience with the lockers? *

Mark only one oval.

- They are often full
 Parcels are placed next to the lockers
 There are often technical issues
 I do not understand how they work
 Other: _____

12/06/2020

A future parcel collecting point

A future parcel collecting point

For my graduation at the University of Technology in Delft, I research the wishes of recipients of packages. The group I am researching lives in apartment buildings and residential towers. I would like to ask if you can help me with my research by filling in this short online survey. The questions are anonymous and are only used for my research. It takes about 5 to 10 minutes to complete the survey. Your answers help me to design a parcel point which meets your wishes, and hopefully will be realized in the near future! Thank you in advance for your cooperation and strength in this day and age.

* Required

1. Do you live in an apartment building or city tower? *

Mark only one oval.

- Yes
 No

2. In which city do you live?

Parcel delivery to a parcel pick up point

A parcel pick up point, also named service point, is a parcel locker or a physical store where you can collect or bring your parcels. You can choose to deliver the parcel to a parcel pick up point on the webshop, or your parcel is brought to the parcel pick up point after one or multiple delivery attempts. The following questions are about your preference for parcel pick up points.

3. When your parcel is delivered to a parcel pick up point, how do you pick it up? *

Mark only one oval.

- By foot
 By bike
 By car, as a separate ride
 By car, as a combined ride
 Other: _____

4. It would be fine if my parcel is always delivered to a parcel point *

Mark only one oval.

- 1 2 3 4 5
Fully disagree Fully agree

5. At what time during the day do you prefer to pick up your package? *

Check all that apply.

9:00-11:00 11:00-13:00 13:00-15:00 15:00-17:00 17:00-19:00 19:00-21:00 21:00-23:00

At what time would you like to pick up your parcel?

6. At what maximum distance from your home may the parcel point be if you want to collect the parcel on foot or by bicycle? *

Mark only one oval per row.

- | | | | | |
|-------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| 100 meters | 200 meters | 500 meters | 750 meters | 1 km |
| <input type="radio"/> By foot | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| <input type="radio"/> By bike | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Now, some questions about your feelings

7. How do you feel when the delivery man/woman rings the bell at your front door for your parcel? You can choose multiple answers. *

Check all that apply.

- Delighted
 Irritated
 Neutral
 Curious
 Surprised
 Relieved
Other: _____

12/06/2020

A future parcel collecting point

8. How do you feel when you receive your parcel from a parcel pick up point? You can choose multiple answers.*

Delighted
 Irritated
 Neutral
 Curious
 Surprised
 Relieved
 Other:

CO2 impact of your delivery

The following questions are about the CO2 impact of your delivery. Here, with CO2 impact is meant: the amount of CO2 emitted due to transport movements for the delivery of your parcel.

9. The following questions are about your preferences considering the CO2 impact of your delivery.*

Mark only one oval per row.

Strongly disagree Disagree Neutral Agree Strongly agree

- | | | | | | |
|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| I am okay with waiting a couple days longer for my order if this keeps the CO2 impact of my order to a minimum | <input type="radio"/> |
| I am okay with ALWAYS delivering my parcel to a pick up point, if this is proven to be the delivery option with the lowest CO2 impact | <input type="radio"/> |
| I am interested in the CO2 impact of the delivery of my order | <input type="radio"/> |
| With orders I place, I am informed about the CO2 impact of the delivery option I choose | <input type="radio"/> |

Parcel locker

The following questions are about parcel lockers. Parcel lockers are unmanned lockers for the drop off and returns of parcels. These lockers can be found in apartment buildings, petrol stations, offices, and shopping malls.

10. Did you ever use a parcel locker for the pick up or return of your parcel?*

Mark only one oval.

- Yes Skip to question 11
 No Skip to section 7 (Proposed solutions)
 I do not remember Skip to question 11

The use of a parcel locker

These questions ask you about the experience with the parcel lockers

11. Fill in if you agree or disagree with the statements

Mark only one oval per row.

Strongly disagree Disagree Neutral Agree Strongly agree

- | | | | | | |
|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| It was clear to me where my parcel was brought | <input type="radio"/> |
| Pick up the parcel from the parcel locker was easy | <input type="radio"/> |
| Returning a parcel through the parcel locker was easy | <input type="radio"/> |

Proposed solutions

In deze sectie leg ik u 4 oplossingen voor een pakketpunt van de toekomst voor. Alle oplossingen zijn een vorm van duurzame bezorging. De pakketten moeten op een centraal punt worden opgehaald in plaats van dat ze bij u thuis worden bezorgd. Daarom vraagt dit om een zekere bijdrage van u. We zijn benieuwd naar uw mening over de voorgestelde oplossingen. Er wordt u per oplossing gevraagd deze te scoren op bepaalde factoren.

In this section, 4 possible solutions are presented to you. All of these solutions are a way of sustainable last mile delivery. The parcels need to be collected at a central point, to reduce the CO2 impact of delivery. Therefore, a certain effort is asked from you. We would like to know your opinion about the proposed solutions. You are asked to score the solutions on a variety of factors.

Solution 1:
Trailers with lockers

Concept 1 is a locker trailer which is placed close to your apartment building at the beginning of the day. Your parcel is in this trailer and can be picked up whenever you like, on that same day. At the end of the day, the locker is taken back to the distribution centre of the delivery company. Returning a parcel is also possible with this solution.

12/06/2020

A future parcel collecting point

Concept 1



Delivery van drops off the locker trailers at the beginning of the day



12. Give your opinion about this solution to score on the following factors.*

Mark only one oval per row.

Strongly disagree Disagree Neutral Agree Strongly agree

- | | | | | | |
|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| It feels safe to me if my parcel is delivered to a locker trailer | <input type="radio"/> |
| If this was placed in front of my building, I would rather have my parcel delivered in here than at my home | <input type="radio"/> |
| I would rather have such a solution inside instead of outside | <input type="radio"/> |
| I need to be motivated to pick up my parcel | <input type="radio"/> |
| I like it that it is self service | <input type="radio"/> |

Solution 2:
Mobile pick up point

Concept 2 is a mobile pick up point which moves through a city during the day. Instead of receiving a notification about the delivery frame of your parcel, you receive a notification when the pick up point is parked close to your house. This can be for example between 4pm and 6pm. In this timeframe you can pick up your parcels from the unmanned lockers.

12/06/2020

A future parcel collecting point

Concept 2



Parcel point had different stops per day



13. Give your opinion about this solution to score on the following factors *

Mark only one oval per row.

Strongly disagree Disagree Neutral Agree Fully agree

It feels safe to me if my parcel is delivered to a the mobile locker	<input type="radio"/>				
If this would drive past my apartment building, I would rather have my parcel delivered to this concept than to my home.	<input type="radio"/>				
I need to be motivated to pick up my parcel	<input type="radio"/>				
I would rather have such a solution inside instead of outside	<input type="radio"/>				
I like it that it is self service	<input type="radio"/>				
It seems annoying to me that I can only pick it up at a specific time	<input type="radio"/>				
It seems safer to me if there is personnel guarding my package	<input type="radio"/>				

Solution 3: Parcel pick up point in your neighbourhood

Concept 3 is a physical, statical pick-up point where every delivery company can drop off and pick up parcels. When the parcel is delivered to this point in your neighbourhood, you have the choice to pick up the parcel yourself, or let it be delivered by bike to your home. This location can also function as a community house where you can meet your neighbours and drink a coffee.

12/06/2020

A future parcel collecting point

Concept 3: Green point



14. Give your opinion about this solution to score on the following factors *

Mark only one oval per row.

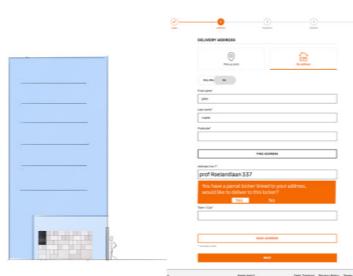
Strongly disagree Disagree Neutral Agree Strongly agree

It feels safe to me if my parcel is delivered to a the Green point	<input type="radio"/>				
If this is near my apartment building, I would rather have my parcel delivered to this concept than to my home.	<input type="radio"/>				
I need to be motivated to pick up my parcel	<input type="radio"/>				
I like it when there are employees to help me	<input type="radio"/>				
It seems annoying to me that I can only pick up during opening hours	<input type="radio"/>				
It motivates me to select delivery to a parcel pick up point if I can collect points with which I can get discounts on products	<input type="radio"/>				
I would use the service to have my package delivered at home by bike	<input type="radio"/>				

Solution 4: Parcel locker
for apartment buildings

This last solution is a parcel locker located in apartment buildings. When your apartment building has a parcel locker, this will pop up in the check out menu of your webshop order. You can click this popup to deliver to this locker instead of to your door. For this solution will be additional costs.

Parcel locker for apartment buildings



15. Give your opinion about this solution to score on the following factors *

Mark only one oval per row.

	Strongly disagree	disagree	Neutral	Agree	Strongly agree
It feels safe to me if my parcel is delivered to a locker in my apartment building	<input type="radio"/>				
If my apartment building has such an option, I would rather have my parcel delivered to this concept than to my home.	<input type="radio"/>				
I need to be motivated to pick up my parcel	<input type="radio"/>				
I like it that it is self service	<input type="radio"/>				
It motivates me to select delivery to a parcel pick up point if I can collect points with which I can get discounts on products	<input type="radio"/>				
It seems safer to me if there is personnel guarding my package	<input type="radio"/>				
It seems annoying to me if delivery guys are walking and in and out of the building for delivery	<input type="radio"/>				

16. The placing and maintenance of this solution do cost money. In return, you will get the service that your parcel can always be delivered and you never miss the delivery man/woman. How much would you be willing to pay on a yearly base? *

Preference for solution

In deze sectieIn this section is asked which solution you prefer.

Concept 1: Mobile lockers (The whole day at one location)



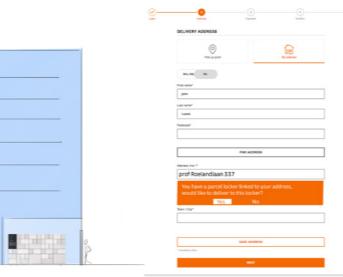
Concept 2: Driving pick up point (moving from 1 location to the next)



- Concept 3: The Green point



Concept 4: Locker in apartment building



17. Which solution is attracting you the most? Why this one? *

18. What do you like about this solution? *

19. What do you dislike about this solution? *

Additional comments

20. Below, you are free to leave any additional thoughts on this subject.

12/06/2020

A future parcel collecting point

21. May I approach you to ask for further explanation of your answers? If so, please leave your email below

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Google Forms

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Appendix B2: Characteristics of apartment buildings



Main hall with elevator and mailboxes

Mailboxes are either located inside or outside. Some buildings have an extra room where the post can be delivered, while the pick up can be done at the other side of a wall. The mailbox goes through this wall or window. At some of the buildings in this category, there is a counter with a receptionist.



Minimal 4 floors high

The buildings are all minimal 4 floors high. This makes the delivery very time consuming. Also, sometimes parcels are ending up at totally different floors.



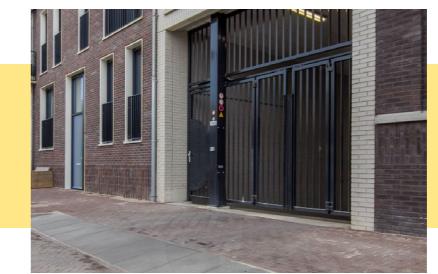
Close to or above shops

Shopping facilities are close to the building or placed below the apartments. Also, other facilities as for example a gym are often placed below or close to the apartment buildings.



Shared (underground) car parking

The parking garage is one of the shared facilities of the residents. They all have access to this with their key. People from outside cannot get in so for delivery it is not interesting to look at.



Shared green facilities

The apartments are connected via shared green facilities that function as collective garden. This area is not always open for people from the outside, but it could be possibility for delivery solution.



More of the same apartments close to each other

The apartments that are newly built often are grouped and shaped as a community. This gives the opportunity to deliver to one spot for all the apartment buildings of a group.

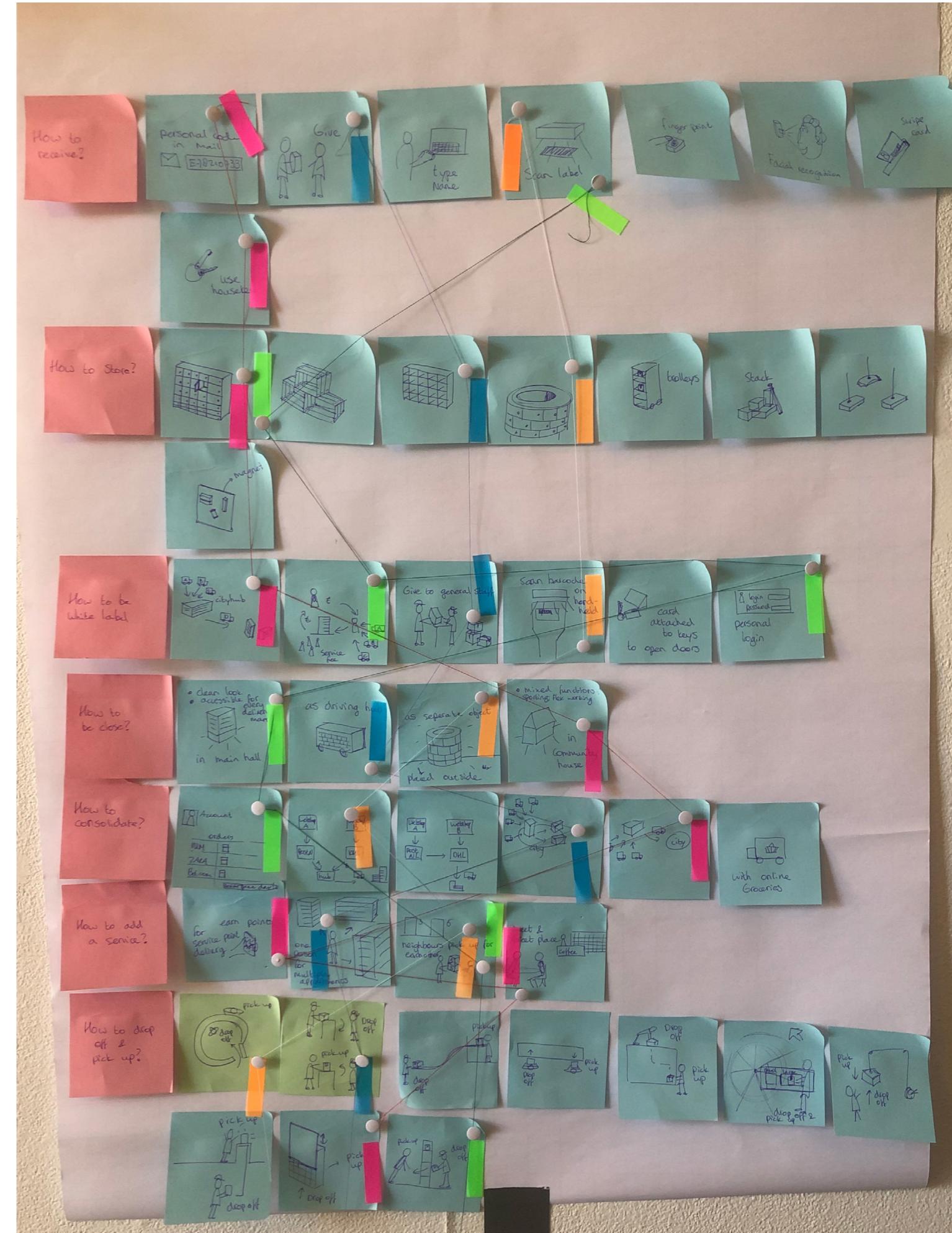
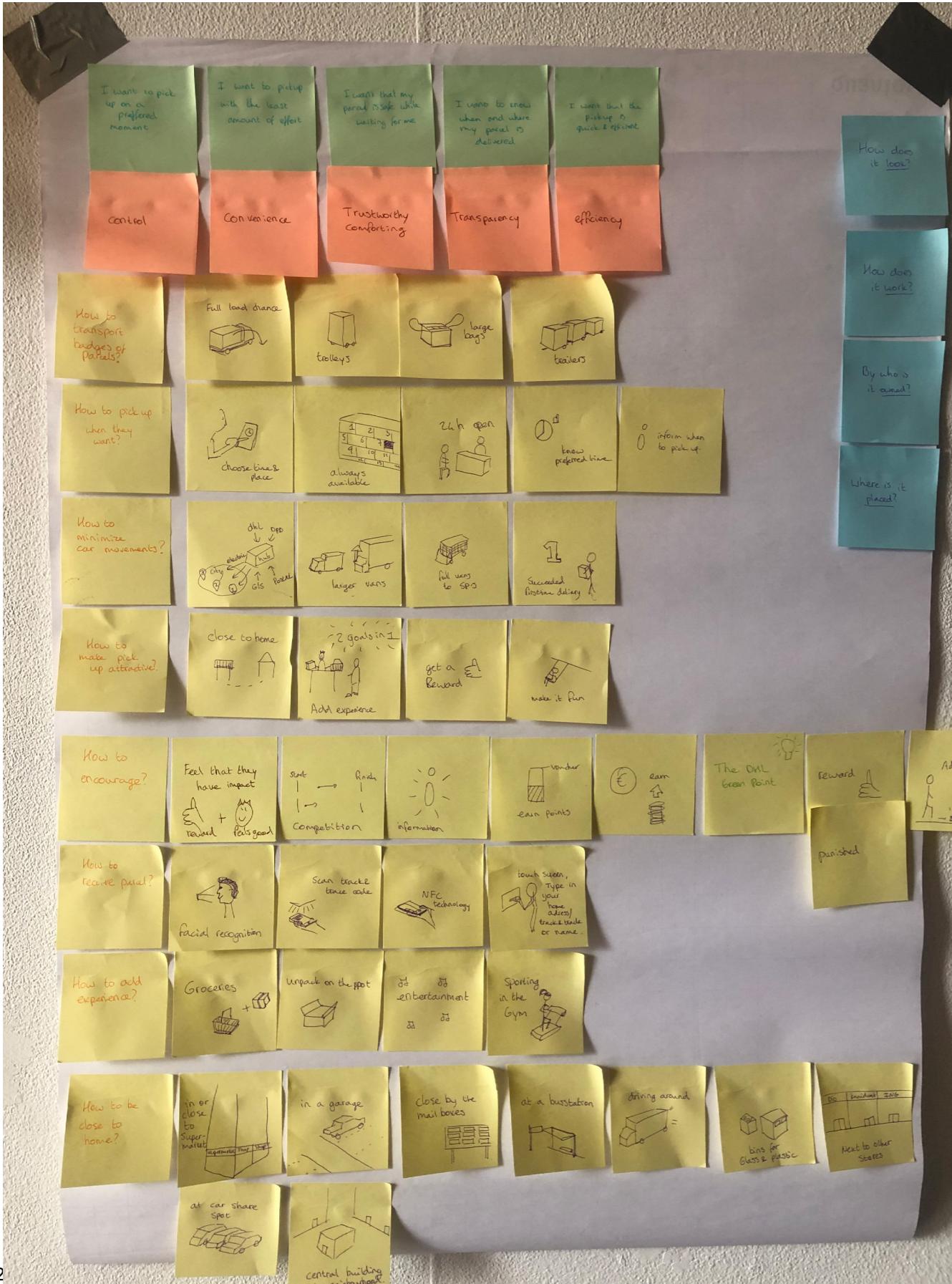


Close to or above offices

The newly built apartments are built with a vision to connect people and introduce a new way of living where life, work and leisure are combined. Therefore, flex working spaces are introduced in the area of the apartments.

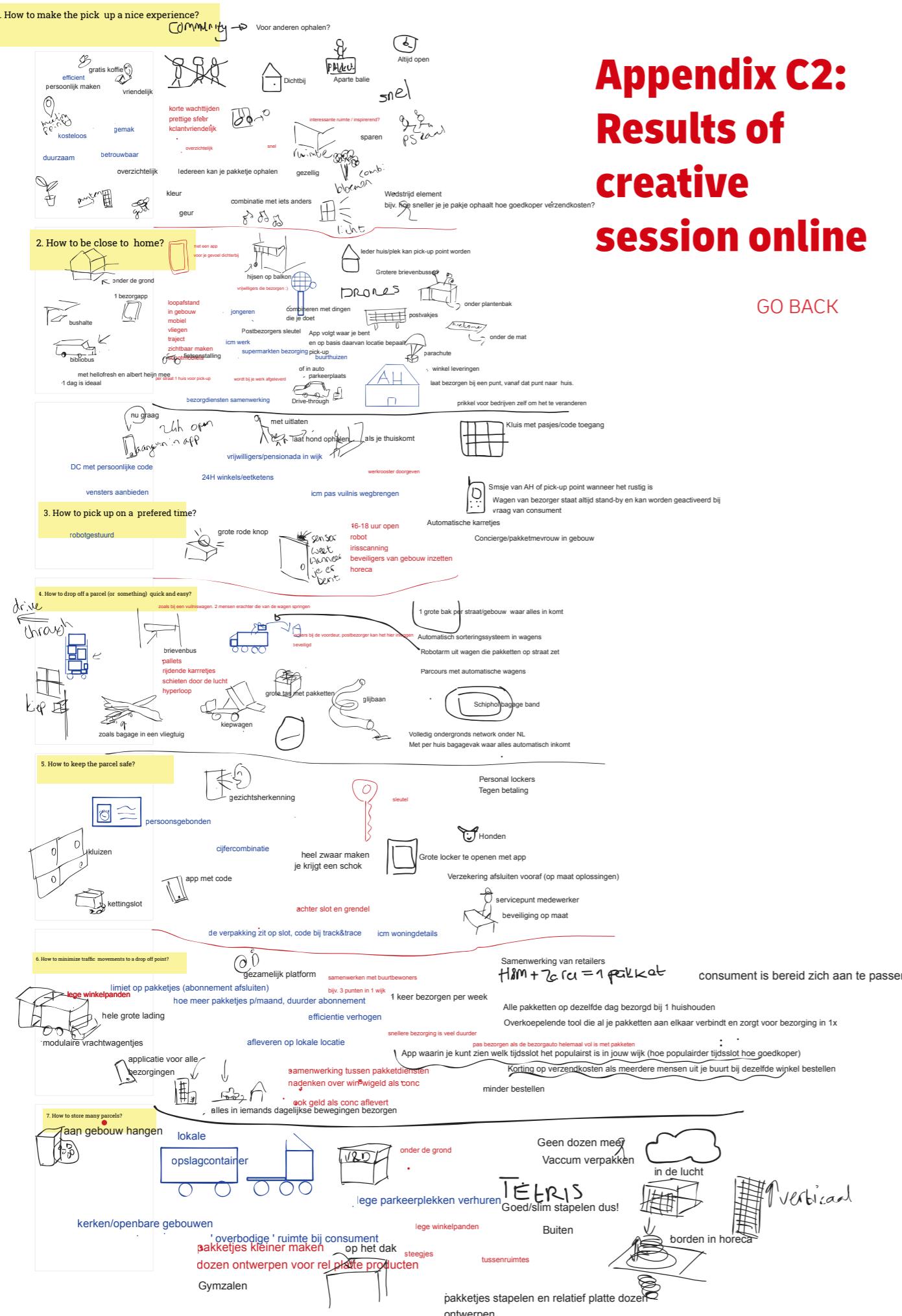


Appendix C1: Framework with How to questions



Appendix C2: Results of creative session online

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Appendix C3: Creative session, offline

GO BACK

Offline brainstorm, Brainwriting and C-box

Hello, when reading this you are participating in the co-creation session of Manon, Welcome! The goal of this session is to generate as many ideas as possible on the stated design statement.

Design statement

Design a parcel drop off and collection point for high rise buildings in the city centre that meet customer needs.

Participants

Here, we are limited to the people that are already in contact with each other in the last couple of weeks.

Stephan Kapteijn

Tom Kempenaar

Dennis Mouwen

Manon van Eijkelenburg

Methodology

The used methodology for this brainstorm are the Brainwriting 6-5-3 method, followed by the C-box method.

With brainwriting, different 'How to' questions are written down on papers. The 6 participants all start with a paper, and have 5 minutes for generating 3 ideas but more is also welcome! Since we have only 4 participants, we call it the 4-5-3 method. After 5 minutes, they rotate the papers and start on a new

question. Repeat this until everyone worked with every paper. The C-box method is to classify the promising ideas. A framework is made with on the x-axis the feasibility and on the other axis how innovative the idea is. The most promising ideas are all placed somewhere in the framework. When the C-box is finished, you can drop the not innovative, not feasible ideas.

Step by step procedure

Step 1: Write down the problem statement

Step 2: Explain the methodology

Step 3: Warm up with fruit exercises

Step 4: 4 rules, Criticism is postponed, Freewheeling is welcomed, $1+1=3$ and Quality is wanted.

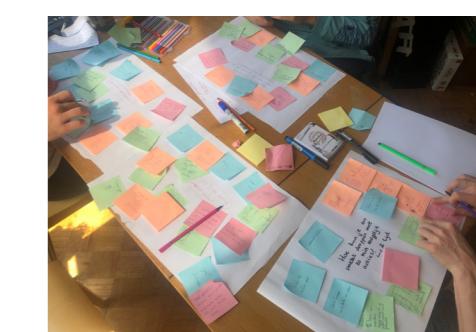
Step 5: Ask the question: "What is the worst possible project outcome from your perspective, and why?", or "How do our competitors handle this? Do we want to be the same, or different from them?"

Step 6: Diverge from the problem, 1. Set how to's.2. Choose the most promising how to's. 3. Brainwriting

4 participants 5 minutes 3 ideas

Step 7: Select the most promising ideas and write them down on post its. Use the criteria set for the design statement.

- The design should encourage the customer to do the pick up by foot or by bike.
 - The design should minimize the amount of unnecessary traffic movements from and to the apartment buildings.



Appendix C4: GO BACK

From ideas to concepts

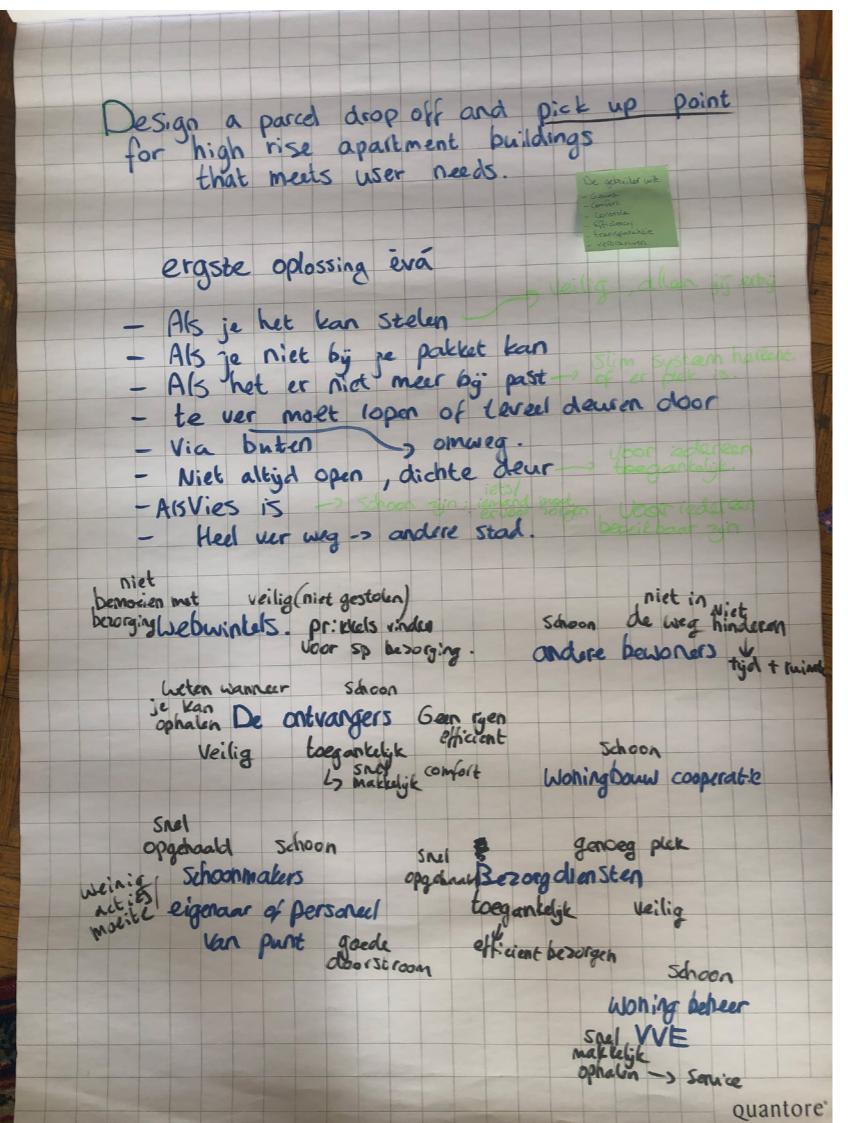
- The design should be feasible to integrate in a new built neighbourhood with car free zones.
- The opening hours are fitting to the wishes of the target group.
- The design can be placed in the second circle of the city: mixed apartments and office buildings.
- The design should include communication with the end consumer about the delivery of the parcel.
- The design is located on a spot where parcels are brought by electric vehicles.
- The collection point is white label: parcels from every delivery company are brought here
- The point is open for people to pick up and return parcels

Step 8: C-box. Create a framework with 2 axes. On the X-axis is the feasibility, from easy to difficult. On the Y-axis is how innovative it is from not innovative to very innovative.

Tools

The tools needed are:

- Pens
- Markers
- Empty sheets, preferably A3
- Post it notes



Structuring solutions

On the right, in figure 34, a variety of cards with ideas are shown. These solutions are shaped from the clusters and fully or partly meet the requirements set at the beginning of the creative process.

While creating the solutions, a structure could be recognized. On one hand, the solutions differ in amount of accessibility: with some ideas the parcels are always accessible for the customer, and with some the parcels are only accessible on specific moments. On the other hand, the solutions differ in the time that is needed to implement it. Some ideas are very disruptive and more for the future and some ideas lay close to the current situation. The years shown on the y-axis are a rough estimation based on the research of the analysis phase.

The two solutions showed on top are incentives to change the behaviour of the webshops and the customers. These can be combined with every other solution showed in the figure.

The requirements set in chapter 5 are used to rank these solutions. The concepts shown on the next pages are improved, more worked out versions of these ideas.

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Appendix C5: Concepts

Concept 1: The Green point

The parcel point is named Green Point to both inform the consumer that this is the most sustainable delivery option and to motivate the consumer to choose this option.

An additional service can be added where collaboration with biking couriers is expanded. The biking couriers are linked to the Green Points to deliver parcels to consumers home when desired. The partner that can be used for this part of the journey is Fietskoeriers.

The communication is done through an online platform to inform the consumer about the delivery status. The current existing software should be able to do this.

When home delivery is chosen, the parcels are first delivered to the green point. This place functions as a consolidation centre for the neighbourhood. From the Green Points, parcels are delivered by bike with the current partners of DHL.

Consumers receive a message about the delivery when the parcel is delivered to the Green Point. They can choose for pick up, or let it be delivered to their address. With this extra question for home delivery on a specific time, the customer can make sure he or she will be at home to receive the parcel. Otherwise, they can choose to pick up at a suitable moment.

Delivery man saves time on delivery because they deliver a larger amount of parcels at once to the Green Point. Also, the Green Points can be used as a pitstop for the delivery guys, to take a break.

The business model

DHL Parcel can start a new entity with the Green Points as white label hubs for city centres. They should hire locations in the city centre to create the Green Points. For every parcel delivered to



the Green Point or returned via the Green Point, they receive a contribution from the delivery company of interest. Webshops pay for the service of delivery to the pick up point. This will be cheaper than delivery to a home address. The new entity of DHL Parcel will pay Fietskoeriers per parcel delivered to the home address by bike. Also, the new entity will pay the personnel of the Green Points.

Although it saves time and thus money to delivery many parcels at once, this concept is probably not feasible as business model. This has to do with the expensive retail locations that are needed for the Green Points.

Hardware and software needed
In order to communicate the right information directly to the consumer, software is needed that couples orders from different delivery companies. At the moment the parcel from another delivery company is brought in, the label can be scanned and the software links the parcel to the right customer. The customer can then be informed about the last mile delivery of the parcel: either choose pick up or choose delivery by bike.

More physical locations are needed in order to create a dense network of Green Points. New built residences can be an opportunity for location of these physical spots since they often have retail locations below the apartment buildings.

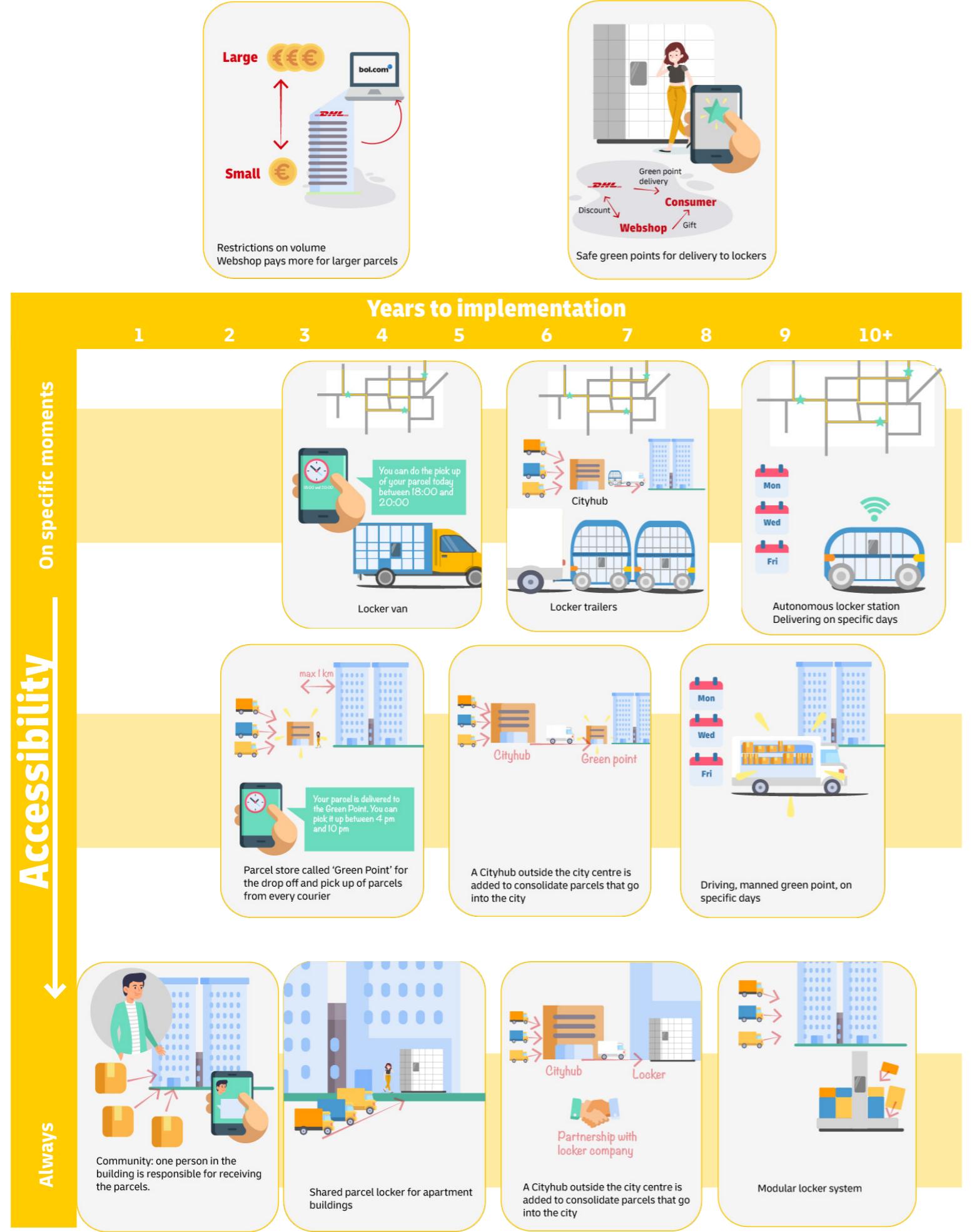


Figure 34: Framework with solutions for the collection and drop off point



Concept 2: The mobile lockers

The mobile lockers are placed outside the apartment buildings on a parking spot or open space near to the apartment building.

Since the lockers are filled outside the city beforehand, the company can respond to high volumes by upgrading the capacity of the lockers for a specific area.

In the evening, the locker is picked up and taken back to the city hub outside the city.

This solution can grow in total delivery efficiency if all delivery companies collaborate and bring the parcel to a hub outside the city.

Consumers will receive a notification when their parcel arrives at the city hub and will be placed in the locker for that day. For this solution, it is necessary that people pick up their parcel within a day, otherwise, you will have a lot of unnecessary traffic movements of parcels moving into the city and back. To motivate people to pick up their parcel within a day, they can save points when the pick up is done within a day. With these points, they can get a discount on specific products.

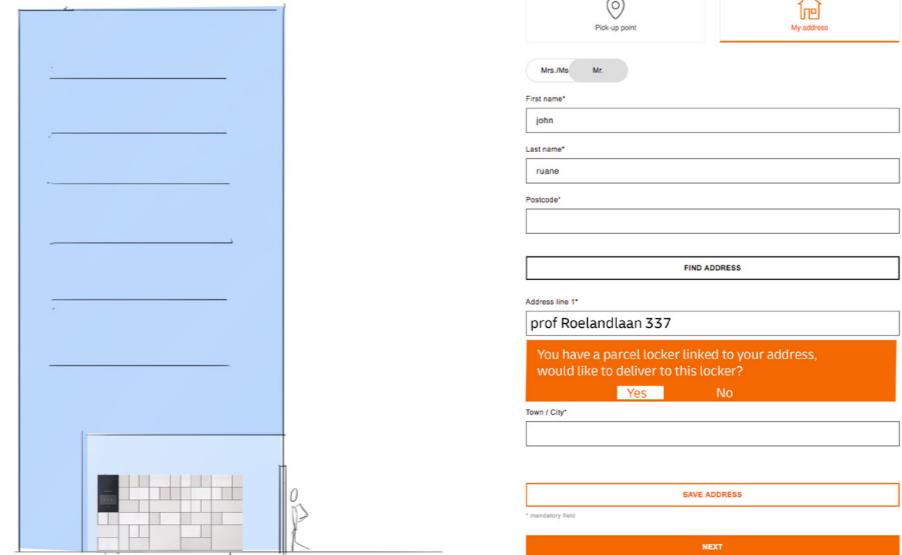
When this solution is implemented, it will save time for the delivery man to deliver the parcel to the apartments and thus increase delivery efficiency. Less delivery personnel is needed since multiple lockers can be brought into the city at the same time by one delivery guy.

In later stages, this whole process can be automated by driving the lockers with

autonomous vehicles into the city.

Business model

DHL develops the lockers and in collaboration with their current partner DeBuren, locations for the lockers can be found. Webshops are paying DHL for the delivery. DHL reduces costs in delivery vans and personnel driving to the lockers, since more can be delivered at once. These savings can be used to invest in the development of the lockers.



Concept 3: Platform for parcel lockers

A separate account is needed for delivery to the lockers or consumers still choose home delivery instead of delivery to the locker in their building. This should change and DHL can play its part in this transition by integrating the locker systems in their current system. The first step is to do this for all its own deliveries, but in collaboration with other delivery companies this can be implemented for all deliveries in the future.

By increasing the volume of parcels delivered to the parcel lockers, the locker companies can expand their network of lockers placed in apartment buildings. This is a win-win situation: DHL has a higher efficiency since the parcels can always be delivered to the lockers, and the consumer will know what to expect and will always receive the parcel in the locker.

Business model

DHL Parcel collaborates with locker partners as for example DeBuren and BringMe. The companies should share the addresses of the lockers in order to implement these in the

DHL system. DeBuren and BringMe receive a payment from the apartment buildings through a monthly fee or they buy a locker system. This service is provided from the real estate owners to the residents of these buildings. The fee is integrated in their service fee or owners association fee. The delivery service of DHL is paid by the webshop. In the end, DHL saves money when the delivery efficiency is increased due to a 100% successful first attempt delivery.

Software needed

For this solution, software changes need to be made. More integration of the parcel locker network with the DHL delivery network is desired. When the consumer types in his or her address, the system should recognize that the apartment has a locker station. This will then be the only option for delivery. The delivery will be done on home address and not on the name of the consumer. In this way, there is no registration for the locker needed to use it.





Concept 4: Mobile pick up station

This solution is based on the fact that people like to know what they can expect and want transparency in the delivery process. The solution is a driving pick up location that visits different neighbourhoods on a specific moment. Instead of receiving the parcel in a certain timeframe, the pick up location is parked in the neighbourhood for a specific time and people can pick up the parcel in this timeframe.

Software is needed to show the consumers when the parcel station is arriving in their street. To increase the amount of pick ups, neighbours are allowed to pick up for each other if needed. Clear communication between the delivery company and the customer is desired.

Business model

The driving parcel stations are runned by DHL. Webshops pay for the delivery to a driving pick up point. This is around the same price as the service point delivery. In the long term, different delivery companies can start delivering from a shared distribution centre at the edge of the city: a CityHub. From this CityHub, the mobile locker station can drive into the city. These mobile pick up stations can in collaboration with automotive companies be used to test autonomous driving in urban areas.

The investments for such a concept are high, and it asks a lot fromt he customer to offer only delivery on a specific moment.

Appendix D1: Ranking the concepts 2.0

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Choice of concept

Feasibility

Where

When

How

	Electricity hub	Integration smart shared vehicles	Pop up market
Fits the DHL brand	+	+	+
Increases customer (webshops) loyalty	0	0	++
Strengthens the core business of DHL	+	++	+
Creates a new business model for DHL	++	0	++
Realistic to achieve by 2030	++	-	0
Encourage customer to do the pick up by bike or by foot	++	++	+
Minimize the amount of unnecessary traffic movements from and to the apartment buildings	+	++	+
Be feasible to integrate in green zones of the city	++	++	++
Enable the customer to pick up at preferred times	++	+	+
The design can be placed in the second circle of the city: apartments and office buildings.	++	++	++
Include communication with the end consumer about the delivery of the parcel.	++	++	++
Parcels from every delivery company are delivered here	++	-	-
Enable the customer to pick up and return parcels	++	-	+

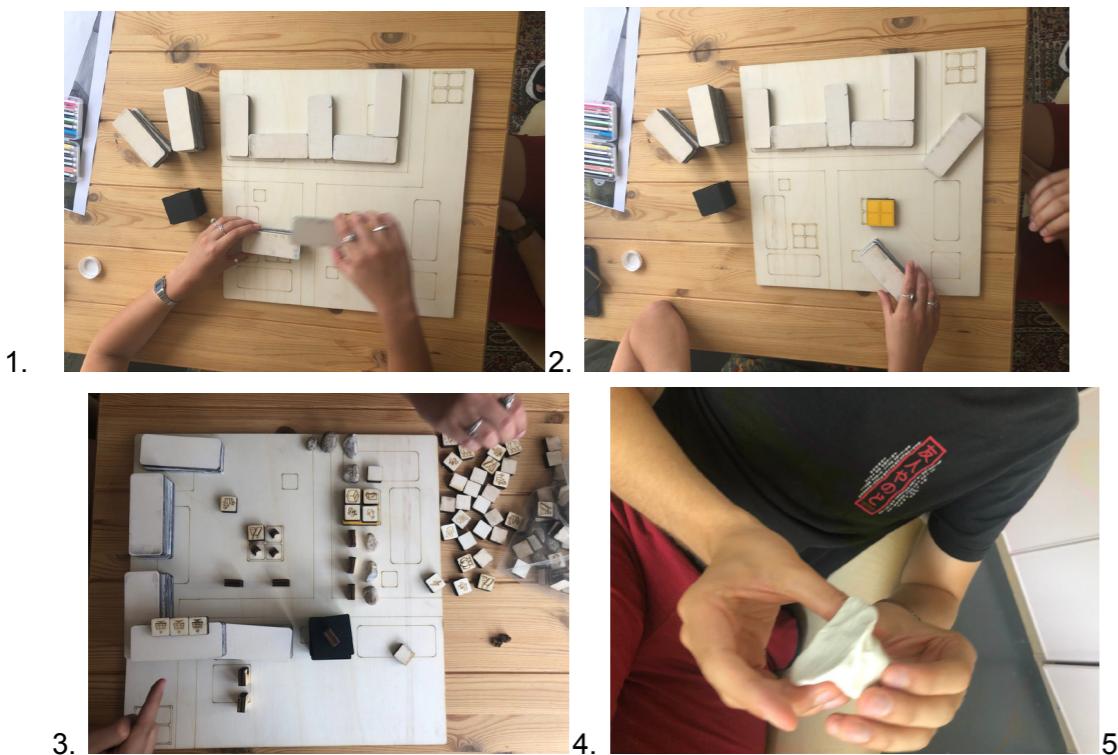
Appendix E1: Co-creation sessions for validation

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The co-creative sessions

For the co-creative sessions I visit residents of apartment buildings in Delft and Rotterdam. The aim of the session is to find out how the Powerhouse is fitting the neighbourhood of the residents, and which functionalities should be added to create an added value for their neighbourhood.

1. The first step of the co-creative session is to let the participant built their neighbourhood.
2. The participant places the powerhouse in the neighbourhood they build.
3. The participant adds functionalities to the powerhouse, which are the small blocks with the icons.
4. The participant is asked to create the shape they have in mind for the Powerhouse.
5. The shape is placed on the desired location.



While creating the location, functionalities and shape of the Powerhouse, a discussion is opened about the different aspects of the Powerhouse. This gave me insights in how to create an added value for this resident through the Powerhouse.

Session 1: Kees

Rotterdam Gedempte Maashaven

The participant of the first session lives in the Gedempte Maashaven, in one of the towers next to the Erasmusbrug. The resident looks out over the Erasmusbrug and over a square with a boarding place for the Spido (water transport). The park in front of this boarding place is only used for pedestrians.

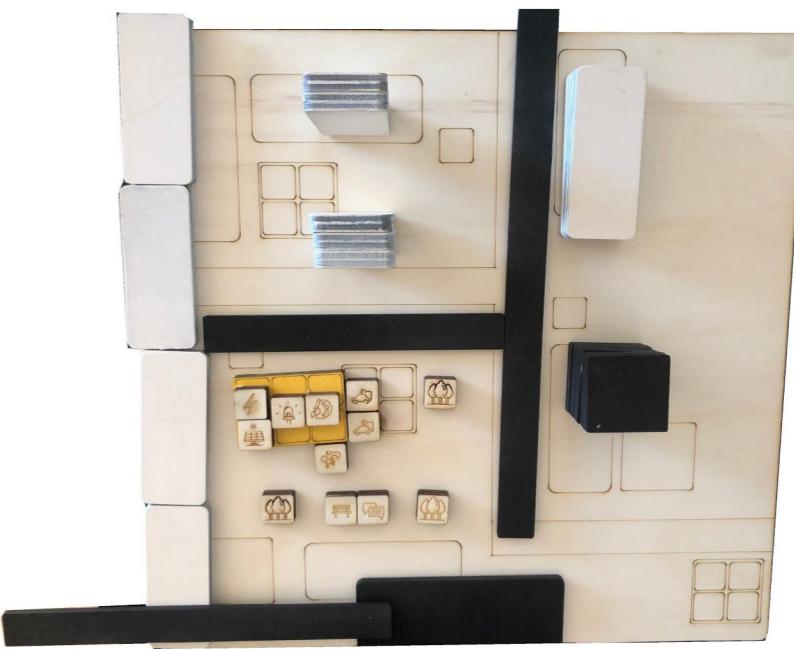


There are some benches placed in this area but it is not a very lively area. Also, there is a toilet house with a fresh water tap outside. It looks like this area is designed to be a lively place where people can gather. From this creative session is concluded that this park would be an ideal location for the Powerhouse because of the following reasons:

- This place is at walking distance from the apartment building.
- More apartment buildings are located around this park, so the Powerhouse can function for all of them.
- There is already a place created where people can rest and gather, the Powerhouse can create added value to this.
- The place is easily accessible by (delivery) car.
- The location would be ideal for a mobility hub including car charging spots, which the Powerhouse could provide.

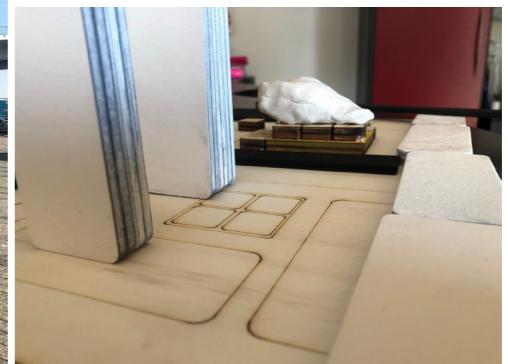


The participant designed the Powerhouse as follows:



For this user, it is important that the Powerhouse becomes an electricity hub, which stands out in the environment and creates a spot where people can come together. Charging cars and small electric vehicles are an important part of this concept. Other functionalities as for example lights and a design that stands out are 'nice to haves'.

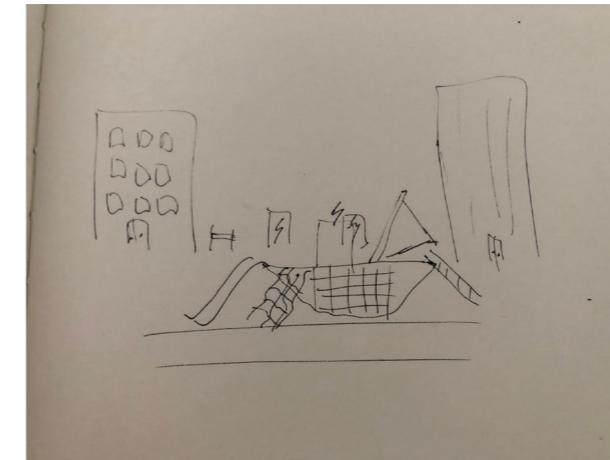
The shape should look like the house disappears into the water. This gives the Powerhouse the shape of a hill on one side. See the image.



Session 2: Sophia

The participant of session two lives on the Schoemakersplantage in Delft. This is a neighbourhood that is advertised with 'living green in the city'. Sophia put the focus for her design on green and multifunctional. Therefore, her design is focussed on a playground element from a playground in Utrecht, see the image. The Powerhouse should be of an added value in

the neighbourhood by creating a place for kids to play. It would be nice if the neighbourhood is involved in the design. Residents of this neighbourhood were also asked to design their own pedestrian tile a couple of years ago. It is a very collaborative neighbourhood where neighbourhood participation is highly appreciated.



Green, having a playground for kids and charging your electric bike are functionalities of the locker that Sophia pointed out as important.

Session 3: Jerney

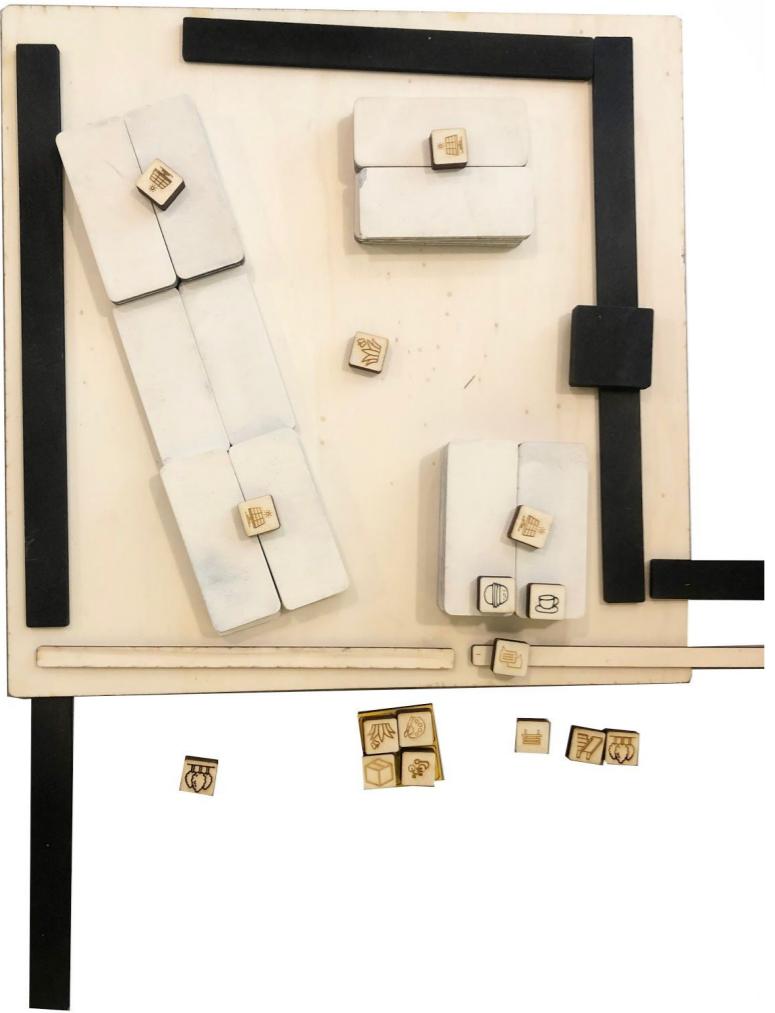
The participant of the third session also lives in the apartment building on the Schoemakersplantage in Delft. She is in favour of a place where people can meet and greet and where children can play, but the locker wall could be something practical: just a wall located close to the existing building on the terrain. Jerney already was in contact with the construction contractors for the Schoemakersplantage with the question if they could place a locker wall on the area of the Schoemakersplantage. She never heard back from her request, and until today, there is still no good delivery solution for their neighbourhood.



Session 4: Reinier and Robert in De Groene Haven

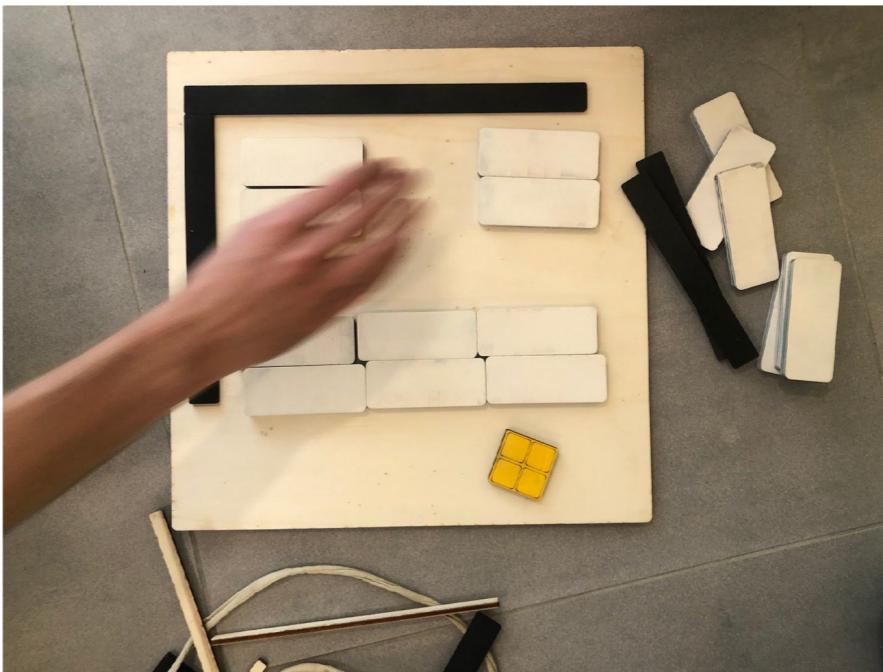


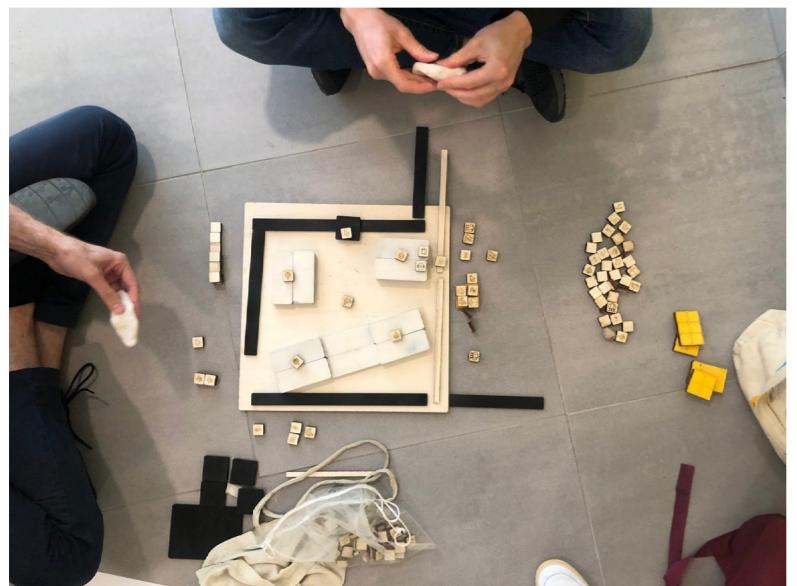
De Groene Haven is a very new built place in Delft with 130 apartments in a circle shape. Here, I held a session with two guys living here in two different apartment buildings. They do not know each other. I held a session with them both, to see if they were able to agree on a spot for the Powerhouse, and they did.



Reinier and Robert agreed on placing the Powerhouse at the back of the apartment building, where a green strip is planned to be developed. Also, building plans show that shops and cafes are planned to come on the ground floor of their apartment building. The Powerhouse can be placed close to the cafes for visitors to charge their bike. One of the participants named that it would be ideal if children can play here, and can charge their electric devices at the Powerhouse too. In this way, it becomes a lively place, with more functions integrated in one product.

One of the participants named that this neighbourhood is already built as a community with the needed functions to create this. So the only thing missing would be the parcel pick up point. For neighbourhoods that are already existing, as for example Tanthof in Delft, it would be more of an added value since the current design of that neighbourhood does not facilitate community feeling.





The chosen location of the Powerhouse.



Design of Reinier:



Design of Robert:

Appendix E2: Interviews

GO BACK

- adviseur stedenbouw o.a. Nieuw Delft
- adviseur stedenbouw o.a. Schie oevers, Delft campus.

Voor mijn afstuderen aan de TU Delft voor DHL ben ik een concept aan het ontwerpen die de vervoersbewegingen in een stad met betrekking tot pakket bezorgen zou moeten verminderen.

Het concept is een pakket kluis voor de openbare ruimte waar energie van omliggende appartementen in wordt opgeslagen en gedurende de dag kan worden gebruikt voor het opladen van (kleine) elektrische voertuigen. Dit vermindert de vervoersbewegingen van en naar het appartementengebouw voor pakket bezorging, en de buurtbatterij vermindert de fluctuaties in het elektriciteitsnet. Dubbel winnen!

Echter, onderzoek wijst uit dat pakket kluizen plaatsen in de openbare ruimte niet altijd mogelijk is in verband met regulering vanuit de overheid. Daarom ben ik voor het valideren van mijn concept aan het rondvragen bij gemeenten hoe zij hier tegenover staan en wat de regels zijn met betrekking tot het plaatsen pakket kluizen en buurt batterijen. Ik ben benieuwd wat het toekomstperspectief is en hoe er geanticipeerd wordt op dit soort innovaties in de stad.

Heeft u deze week een half uurtje de tijd om te bellen over dit onderwerp? Mijn agenda is nog leeg op dinsdagmiddag 23 juni, en donderdag ochtend en middag.

In gebouwen of bijgebouwen te passen, aan de rand van het openbaar gebied. Elke aanbieder heeft zijn eigen vormgeving. Prefet gedrocht. Honderden van die dingen. Een gedrochtje wegzetten kan in delft niet zo makkelijk.

Reclamemiddelen zijn ook een onderdeel hiervan. Er zijn een hoop claims.

Travo's, vrij grote dingen. Bij nieuwbouw standaard in het gebouw te doen. Trans Ruimte: energiebedrijf zegt jullie hebben veel woningen op een hoop.

Coendersstraat.

SC Delfland, daar zit een school. Vlakbij het transfo huisje.

Ireneboulevard, grote nieuwe weg. Nieuwbouw wordt hier geplaatst. Aan de achterkant, westzijde. Een gecombineerd huisje: warmte kracht en trafo, en trafo voor de tram.

Dingen gecombineerd. Bij het voorbeeld van van Blijswijk straat. Dat had wel groter gekund, als je dat bij het ontwerp doet. Niet later er tegenaan bouwen.

Het zou heel interessant zijn wanneer je iets bedenkt waarbij je een combinatie aangaat van dingen die je toch al moet doen. Het liefst integreren in het gebouw. Als dat niet lukt, dan in de tuin, aangrenzend aan de openbare ruimte.

Duo penotti, 2 functies. Transo huisje.

Nuts huisje: altijd een deur, vrachtwagen. Niet heel eenvoudig ontwerp. Roosters aan meerdere kanten. Niet gemaakt om mooi te zijn.

De truc is, om te kijken hoe je het dusdanig mooi kan maken. Sedum, heeft maar een hele beperkte groen waarde. Intensief groendak maken ipv sedum.

Elk groendak heeft op tijd en stond een onderhoudsbeurt nodig om het geheel onkruidvrij te houden. Hoe vaak dat nodig is, hangt af van het type groendak en de beplanting. Een intensief groendak - met een dikke substraatlagen en uit de kluiken gewassen planten en bomen - vraagt net zoveel onderhoud als een gewone tuin. Een extensief groendak - met uitsluitend kruiden en lichte planten - heeft maar eenmaal per jaar een beurt nodig.

Extensief groendak met een drainagemat van 2cm en extensief substraat van 6-8cm.

Waterverzadigd gewicht van 90kg (6cm) of 118 kg (8cm).

Waterbufferend vermogen van 27L /m² voor 6 cm substraat.

Afhankelijk van de hoeveelheid m², maar een klein dak ca 50eu/m².

<http://www.zinco.nl/systeemoplossingen/index.html>

Niet heel hoog gebouwtje, je kijkt op zo'n gebouwtje.

Er zal niet altijd een transformator zijn.

Tmobile, glasvezel.

Stedin, transfo huisjes.

Altijd kabels er naartoe en er vanaf. Vaak wel vanaf een kant. Maar ondergronds is heel druk. Je zou kunnen zeggen, in de openbare ruimte bij nieuwbouw gebieden, we weten dat die komen. Stedenbouwkundige integreren dit in hun plannen. Het is een opgave voor de stedin gebouwtjes. Een basisontwerp waar aan de stedin gebouwtjes aan de ene kant de parcel

Wat is het toekomstperspectief voor mobiliteit in de binnenstad?

Hoe en door wie wordt er bepaald of er objecten mogen worden geplaatst in de openbare ruimte?

Wat zijn hier de regels voor?

Hoe lang duurt een traject?

De grond rondom een appartementengebouw in de stad, neem als voorbeeld de groene haven(VOLT), is dit opgekocht door ontwikkelaar of is dit ruimte van de gemeente?

Wat zijn de kosten voor het plaatsen van dingen in de openbare ruimte?

Wat zijn de regels voor transformatorhuisjes plaatsen?

Openbare ruimte is mijn domein. De bouw, de bebouwing vormt de lading voor openbare ruimte. In de stad is er veel druk op de openbare ruimte. Ruimte is schaars. Zowel ondergronds als bovengronds. Ondergronds is het heel erg druk, leidingen en riolering. Funderingen van gebouwen. Bomen hebben alles wat ze boven hebben hebben ze ook beneden.

Nutsvoorzieningen: voor stroom, water, glasvezel internet, elektriciteit. Hebben ook allerlei kastjes nodig. Openbare ruimte: verplaatsen, wandelen, verblijven.

Nutsgebouwen maken het ingewikkeld om de openbare ruimte aantrekkelijk in te richten. De wat grotere. Voor het gasnet zijn er kasten van 1.5 meter hoog, 2 meter diep.

De transformator kastjes zijn klein en neutraal. Soms staan ze storend.

Glasvezel heeft ook zo'n aanvraag gedaan.

Zorgvuldig omgaan met de schaarse ruimte.

Bij nieuwbouw proberen we dat soort gebouwtjes in de gebouwen te integreren.

Nutsvoorzieningen. Gas water elektriciteit.

Telecom achtige dingen zijn daarbij gekomen.

lockers en de andere kant de transfo huisjes. Dit zou kunnen helpen om de combinaties in de bestaande stad te organiseren.

Stedin, netbeheerder er dus maar 1 aanbieder.

Tmobile.

Glasvezel gebouwtjes: groeiende markt.

Voor ons werk maken we onderscheid in bestaande stad en nieuwe locaties. Nieuwe locaties: handen meer vrij.

In de bestaande stad meer afhankelijk van of er nog een plekje vrij is. Eigendommen maken het ook ingewikkeld.

Kosten? De netbeheerder, dat weet ik niet precies. Netbeheerder zet het zelf neer. Weet niet of ze vergoeding betalen, maar ze hebben we een vergunning nodig.

Een aantal gebouwen hebben ze een omgevingsvergunning nodig.

Mobiliteitsprogramma Delft. Google op: RIS Delft. MPD Delft. RESdelft.nl.

We hopen meer ruimte vrij te spelen.

Strategie op gebied van klimaatadaptatie. Paar jaar geleden. Stad verder vergroenen. Twee inhoudelijke punten: meer water vasthouden: minder verharding meer groen.

Stad mag niet warmer worden: meer groen nodig.

Gebouwtje: geen platte daken bouwen. Zonnepanelen kunnen er nog boven en dan krijg je schaduw ruimte.

Ruimte nodig om de heuvel te kunnen maken. Ezelsoor, museumplein. Best veel ruimte voor nodig om het in te passen. Mekelpark: prettig gebruik van groen, niet te steil zijn.

1 rand om dit soort voorzieningen in te pakken.

Dakpark rotterdam. Aan 1 kant een woonmall, andere kant groen.

Meer ruimte inbouwen voor dingen die er nog bijkomen. Er ontstaat vanuit noodzaken om minder autos op straat te ontwerpen.

Parkeergarages die vrijkomen kunnen prima als buurt accu.

Accus zijn een goede oplossing voor de parkeergarages.

De kosten?

Wat is het toekomstperspectief voor mobiliteit in de binnenstad?
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Wat zijn de regels voor transformatorhuisjes plaatsen?

Pick up point hebben we wel eens als vraag langs gekregen, letterlijk.

Verschillende manieren van combineren. Supermarkt, of logistieke plek (minder dure grond) Het concept wat je zou moeten hebben als je over een hele stad kijkt, hebben we nog niet als idee gevormd.

Winkelcentra zijn logisch, want hier komt de gebruiker langs.

Wat bij ons terecht komt: mag je zomaar iets overal neerzetten.

Paviljoens, eraan toegevoegd. Strook is aangewezen waar vrij dingen mogen staan.

Papsouwselaan, aan de kant met de minste winkels. Een camper en dat is een nagelstudio. Mag ik daar een kiosk bouwen?

Bestemmingsplannen, geeft overal aan wat er gebouwd kan worden. Verkeersdoeleinden of verkeer en verblijf.

Niet generiek hoeveel grond erbij wordt gekocht, dus of het privé is verschilt per koop.

Transformatorhuisjes, voor een appartementen gebouw zoveel mogelijk in het gebouw zitten. Ziggo ofzo. Bij het hotel aan **de koepoortbrug**. Daarachter zit een parkeerterrein. Dat is een schakelhuisje van ziggo. Een concept met een leuke gevel.

10 of 20 of 12 t-mobile huisjes.

Openbare ruimte dat die facilitaire rommel zones hebben. Huisjes van verschillende maat.

Kosten voor de grond weten ze niet.

Delft heeft een soort grond brief, vierkante meter voor niet woningbouw.

Duurder om te kopen als je 10 verdiepingen gaat kopen dan wanneer

Anna paulownaplein in Den haag. Twee elektriciteitshuisjes, groter dan schakelkasten dan t-mobile. Een soort gaasachtig. Begroeid. Als idee heel leuk, maar uitwerking is niet per se goed.

Niet overal losse dingen, maar geïsoleerde stroken. Functies samen plaatsen.

Zoeken naar een logische sommering van staat. Je zult verbaasd zijn hoe los ze staan en hoe weinig ze rekening houden met elkaar.

Modules slim idee.

Conclusie:

Ze willen zo min mogelijk losse dingen in de stad. Geen vaste regelingen voor dingen als transfo huisjes etc.

- Enexis

Enexis Smart storage pilot in 2012.

[REDACTED], gepromoveerd en daarna in Azie microbits gaan opzetten.
[REDACTED]: project leider.

Kennismaking: vestigingsmanager in venlo?

Ik ben aan het afstuderen voor DHL Parcel. En mijn opdracht is om een duurzame bezorgoplossing voor steden te ontwerpen, in 2030. Zodat er minder onnodige vervoersbewegingen zijn en de leefbaarheid van de stad wordt vergroot.

Nu heb ik een concept ontworpen die pakket bezorging in de stad combineert met energieopslag voor buurten/ apartmentengebouwen.

Om een beeld te krijgen van wat ervoor nodig is om dit te realiseren en waar nog uitdagingen en kansen liggen ben ik het idee aan het checken bij mogelijke stakeholders.

Vragen:

Kunt u wat meer vertellen over deze pilot?

Ka

Aan de voorkant wisten we dat de business case niet rond zou komen.

2 dingen: demo subsidie. Er was maar 1 grote batterij in Nederland. In bronsbergen op een privaat net. Een bungalow huisje vol met batterijen.

Dat systeem wat ze daar hebben modulair ontwikkelen. Technologische stap maken.

In een contact station een module geplaatst.

Kosten en baten in het systeem. Mogelijkheden om lokale opwek lokaal op te slaan.

Een kabel leggen is relatief goedkoop. Een transformator erbij is nog wat duurder.

Een batterijsysteem is veel duurder.

Of een batterij of het net verzwaren. Los Geen incentive om niet terug te leveren.

In duitsland meerdere keren per jaar gebeurd dit wel. Dit had je dan niet begroot. Duitsland gaat over de grenzen heen, de stuwen vol pompen.

Op buurt niveau van de buurt maken. Het loont dan voor de buurt om lokaal op te slaan en er geen belasting over te betalen. Op huishuidelijk niveau of bij een grote klant.

Wat was de rol van Enexis tov de andere partijen in deze pilot?

Een batterijsysteem is een stukje van het net. Particulieren netten mogen het anders organiseren. Je hebt een netbeheerder nodig die het voor je aansluit. De rol is maatschappelijk. Kabel leggen of dit systeem. Voordelig als je zonneparken en windparken aansluit op plekken

die maatschappelijk het minste kosten. Kosten van een netbeheerder gaan naar de burger.
Kosten van het energiesysteem laag te houden.

Apartmenten complex, een VVE, zouden prima eigenaar van een systeem kunnen zijn. Een nuon vattenfal etc zitten er dan nog tussen. Voor de parijen is het aantrekkelijk om de onbelangs te regelen. Energieleveranciers: PV verantwoordelijkheid, als je iets teruglevert dan regelen zij de financien.

Monopolie op het net.

Waarom was er voor Etten-Leur gekozen?

Ja. Veel duurzame opwek. Criteria voor buurtbatterij: iets te balanceren hebben. Veel lokale opwek en afname. All electric wijk in nederland. 240 woningen ongeveer de helft zonnepanelen.

Praktisch: inpasbaar: vergunningen etc nodig. Welke gemeente willen meewerken?

2009 mee bezig.

Hoe groter, hoe meer onbelangs, hoe meer waarde. Wat is het minimum. Dat zal ook van de wetgeving 2020 afleveren. Het verschil tussen opwekken en salderings is duur. Dit uitrekenen.

Kunt u wat meer vertellen over de uitkomsten en verdere ontwikkelen na deze pilot? Wat heeft enexis hierna nog gedaan. Of is dit meer aan de partners?

Ja

Wat is Enexis momenteel nog aan het doen op dit gebied?

Ja

Weet u of het momenteel wel economisch interessant is om dit soort oplossingen te plaatsen ipv het net te vergroten?

Ja

Hoe is het gesprek met gemeentes voor dergelijke oplossingen, aangezien dit openbare ruimte inneemt?

Ja

Weet u welke partij een interessante partner zou kunnen zijn?

Ja

Er wordt momenteel meer ingezet op autos gebruiken als opslag, is dit een deeloplossing voor het probleem, of heeft dit potentie een overgroot deel van de pieken op te kunnen vangen?

Ja

De electrificatie gaat alleen maar verder. Op het moment van geen zon en geen wind moet er wel verwarmd worden.

In Duitsland, daar hebben ze een ander systeem, waar het salderen wat minder is. Daar zie je meer thuis accus. Afzet in duitsland en in Australië. Betrouwbaarheid van het net.

We hadden destijds met Saft, een Franse producent. Grote fabrikant van batterijen. Grote volumes pakketten goedkoper.

Muren: kluizen.

Bepaalde stroomvoorziening. Paar honderd euro per jaar.

Wat kost zo'n batterij per jaar? Voordelig als je kan zeggen: door het accupakket hebben we de aanpassing niet nodig. Hier bespaar je heel veel.

Bij de netaansluiting hebben ze er jaarlijk kosten aan.

Hoeveel vermogen hebben ze op een jaar nodig? Kun je dit ook voorzien met zonnepanelen? Alle netbeheerders in Nederland zitten in gebieden.

In Brabant altijd Enexis en Zuid-Holland altijd Liander/Stedin.

Of een VVE huurt een energiebeheerder in.

HIERopgewekt, cooperaties die verengd zitten.

In een dorp een aantal mensen samen.

Consumentenbond die gezamenlijk een energiecontract kunnen sluiten.

Investeren samen: net als bij een windmolenpark of

Hoe krijg je zo'n ding rendabel? Veel mensen die niet hoeven te salderen.

- Enexis

Project gedaan bij Strijp S.

Alles gecombineerd: laadpalen, etc, etc.

- PhD student

Topic of storage in the distribution grid.

Currently he is a PhD candidate in the DC systems, Energy conversion and Storage group in the Department of Electrical Sustainable Energy at the Delft University of Technology, The Netherlands.

What are currently the possibilities with neighbourhoods storage?

Is it viable to integrate such a system for apartment buildings? Since many people are on one spot together?

Who are the stakeholder when we talk about energy storage on the grid?

What if multiple households share one neighbourhood smart storage? How can you regulate their energy?

<https://equigy.com/> : balanceren van energienet. TSO's.

<https://www.elaad.nl/>

Ongeveer 250 tot 300 watt per paneel. 130 panelen, /3 of /4 is het aantal piek vermogen. 40 panelen, is 10 kw piek. Maximale energie die ik eruit haal is 8/9 kw.

Distribution energy operators. Storage is a new asset. And that might take some time.

They are conservative.

Stadium of Ajax.

What are different possibilities in the market for storage, so it becomes cheaper.

Other phd student more house level.

So far, the system was stable. New assets, pv systems and cars.

What is the energy use of the parcel station. What is the area you can use.

You can estimate. Bike charging and car charging.

elaad <https://www.elaad.nl/>

Charging of cars.

Make a model: study.

Seacontainers.

<https://alfen.com/en/energy-storage/product-range>

Prijs niet afhankelijk van hoeveelheid maar van het vermogen.

Nogsteeds geld voor terugleveren van energie, maar wel minder.

Wel minder en variabel.

Financiële aspect bij bedrijven: 250kwh, 3 teslas 80 kwh per stuk.

Aantal miljoen euro voor die batterij.

Het een min de ander, hoeveel kan de batterij opslaan. En hoeveel terug leveren.

■ - House level.

Gautham

Ram develops technology for conductive charging from solar energy and vehicle-to-grid technology. Venugopal Prasanth is developing the wireless inductive charging technology.

Waar houd je momenteel mee bezig?

10u zon. 10 uur lang 1kw leveren.

Hele hoge vermogens voor snelladen, paar honderd kw. 120 kw snelladen. 22 kw wat een gebruikelijk vermogen is.

Wat houd je over, voor de opslag?

Bij bedrijven neerzetten. Geen batterij kopen is goedkoper. Autos hebben een grote batterij.

Minder investeringskosten. Wie gaat het betalen, dat iemand het wil doen?

Derde partijen, die dit soort servicen gaan regelen. Aggregators. In zijn onderzoek aannemen dat zo'n partij er is. Juiste hoeveelheid capaciteit beschikbaar op juiste moment. Controle batterij rond 50 procent.

EDmij.nl > energieleverancier. Gebruik maken van opslag en groene energie.

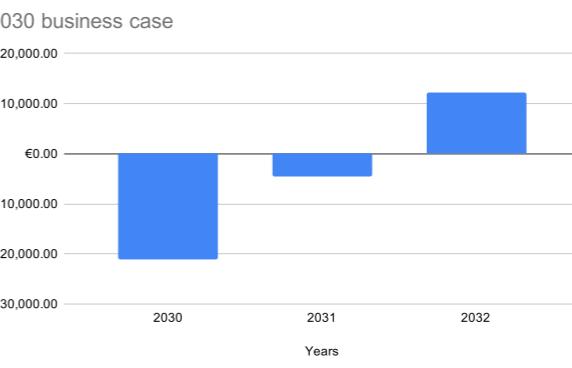
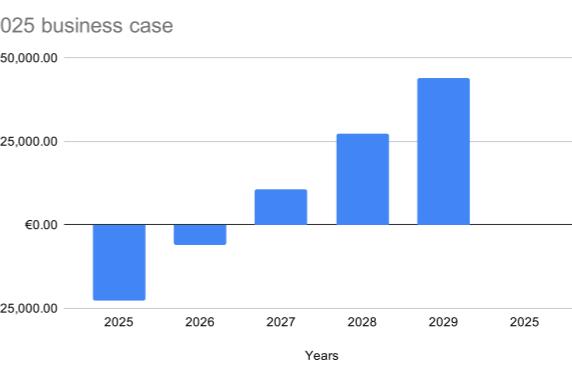
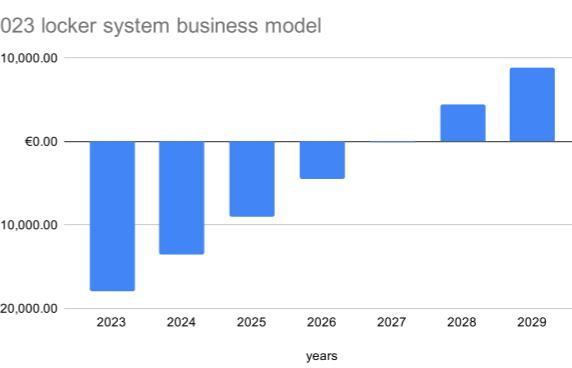
Appendix E3:

Price estimation sheet

[GO BACK](#)

Panels	Per panel (Watt)	Peak (kW)	Maximum electric production on sunny day	Amount of bikes charging		
314	250	78.5	62.8			
7	250	1.75	1.4	11.2		
14	250	3.5	2.8	22.4		
size of panel	1 m x 0.556 m					
area of panel	0.556 m2					
Fast charging						
Charging a car	50 kwh					
Charging a bike	0.4 - 0.8 kwh					
Storage	battery capacity (Usable capacity)	Power(kVA (25 C))	Power(kVA (40 C))	System Weight (kg) Off-grid option available Size Area Amount of panels fitting		
10 ft container	137	130	180	141 4400 No 2.6x2.4x3 meter 7.8 m2 14.02877698 7 panels		
20 ft container	274	260	318	249 7200 yes 6.1x2.59x2.44 m 15.799		
Solar panels	Amount of panels	Per panel (watt)	Piekvermogen (max vermogen(watt))			
	314	250	78500	62800		
	500	250	125000	100000		
	1000	250	250000	200000		
Amount of panels euro per WP	Power of system	Total price	source			
6	1.73 1800 WP	3100	Prijs en opbrengst zc (milieucentraal)			
10	1.58 3000 WP	4700				
10 kw peek systeem						
lifespan of the system which is approximately 12-15 years.						
230 kWh > buurtbatterij etten leur						
stel, 100ste dag. Dan doe je 100 maal 1440. En dan heb je alle stapjes van de 100ste dag.						
iedere dag bestaat uit ... minuten. Dus je moet de eerste minuut van een dag vinden.						
A typical electric car (60kWh battery) takes just under 8 hours to charge from empty-to-full with a 7kW charging point.						
For many electric cars, you can add up to 100 miles of range in ~35 minutes with a 50kW rapid charger .						
Introduced in August 2017, the Work XL is based on the Ford Transit, with a cargo volume of 20 cubic meters. This model has a 76 kWh battery, reaches 90 km/h and its range is 205 km (NEDC), carrying a payload of up to 1175 kg.[18] Currently, this largest model of the "Work" series is produced exclusively for Deutsche Post.						
This vehicle is equipped with lithium-ion battery packs and is powered by a permanent-magnet synchronous electric motor, giving 68 kW of peak power (58 kW of continuous power) and 205 Nm of torque. Battery capacity is 40 kWh; a smaller 20 kWh battery pack option was also offered earlier. The van's maximum speed is 120 km/h						
De totale capaciteit van de batterijen is zo'n 230 kWh. Het batterijsysteem 'kan een woning ruim twee weken van stroom kunnen voorzien. Of je kunt er vijf elektrische auto's mee laden.						
Door de lokale opwek van elektriciteit door PV-panelen (circa 150 kW) terug te leveren aan dit netstation is het mogelijk het slimme systeem te laden met duurzaam opgewekte elektriciteit.						
758 kWh batterij uit ding met zult	in juli					
20*130 panelen	2600 panelen					
In de energy balance graph, is alles wat omhoog gaat is wat je teruglevert aan het net. Dus je wilt dat dit wordt opgevangen door de batterij						
Paar systemen vergelijken, en kijken wat qua orde van grootte lijkt te koppen.						
650 kw piek systeem						
800 kwh batterij						
1000 Watts = Total Area x 1000 Watts/m2 x 0.18						
or						
Total Area = 1/0.18 = 5.56 m2						
If you are going to install all the panels in one line you would need a space of approximately 1 m x 5.56 m (each panel having a size of 1 m x 0.556 m) on your rooftop. There you go. You have a rough estimate of the space required by the solar panels of your system.						

Bedrijfseconomisch perspectief		2542											
		41652											
Prijs per locker		15252											
Costs	Price per kwh	Euros per kwh	Battery kwh	2020	2025	2030							
Investments	Storage unit	2020	138.84	50	€6,942.00								
		2025	89	130	€11,570.00								
		2030	50.84	200	€10,168.00								
Locker unit					€18,000.00								
	Price per WP	Panels per Powe WP											
Solar panels		€1.73	7	1750		€3,027.50							
fixed charges													
	Total				€27,969.50	€32,597.50	€31,195.50						
Income	Contribution year	Amount of households per powerhouse											
VVE households		€25.00	150			€3,750.00							
				Total		€3,750.00							
Shared investments	One time												
Third party investment		€10,000.00				€10,000.00							
Savings	Cases per day	Cases per day in 2030					Yearly savings per powerhouse						
Fuel	€16.72	2	4		€12,205.60	€24,411.20							
Efficiency	€0.20	10			€730.00								
			Total		€12,935.60								
Cost price estimation p Investments	Fixed charges	Income	Savings										
2023	-€27,969.50		€13,750.00	€730.00		-€13,489.50							
2025	-€32,597.50		€13,750.00	€12,935.60		-€5,911.90							
2030	-€31,195.50		€13,750.00	€24,411.20		€6,965.70							
Numbers													
Price per kwh		€0.22											
DHL car battery		76 kwh											
Price in dollars per kwh battery pack	Source												
2016	259	Tweakers. (2020)											
2017	209	Tweakers. (2020). 24 percent lower than 2016											
2018	168.5483871												
2019	156	Holland, D., & Hol 13% lower than 2018											
2020	138.0530973												
2021	122.1708826												
2022	108.1158253												
2023	95.67772152												
2024	94	A Behind the Sc											
2030	62	A Behind the Sc											
2023 Case													
Only charge bikes, no cars. 50kwh battery. 7 solar panels													
Investment lockers	-€27,969.50		2023	2024	2025	2026	2027	2028	2029				
VVE income yearly	€3,750.00		-€17,969.50	-€13,489.50	-€9,009.50	-€4,529.50	-€49.50	€4,430.50	€8,910.50				
Shared investment	€10,000.00												
Savings yearly	€730.00												
2025 case													
Bike charging and car charging. 130 kwh battery. 7 solar panels													
Investment lockers	-€32,597.50		2025	2026	2027	2028	2029						
VVE income yearly	€3,750.00		-€22,597.50	-€5,911.90	€10,773.70	€27,459.30	€44,144.90						
Shared investment	€10,000.00												
Savings yearly	€12,935.60												
2030 case													
Investment lockers	-€31,195.50		2030	2031	2032								
VVE income yearly	€3,750.00		-€21,195.50	-€4,509.90	€12,175.70								
Shared investment	€10,000.00												
Savings yearly	€12,935.60												
Sources													
container storage infor	https://alfen.com/en/energy-storage/thebattery-specifications												
lockers	https://cnc-global.com/lockers/parcel-lockers/												
Car charging info	https://pod-point.com/guides/driver/how-long-to-charge-an-electric-car#:~:text=Summary,with%20a%207kW%20charging%20point												
Pilot enexis	https://www.energiekaart.net/initiatieven/pilot-smart-storage/												



IDE Master Graduation

Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student's IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

! USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT

Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

STUDENT DATA & MASTER PROGRAMME

Save this form according the format "IDE Master Graduation Project Brief_familynamne_firstname_studentnumber_dd-mm-yyyy".
Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !

family name _____

initials _____ given name _____

student number 42916109

street & no. _____

zipcode & city _____

country The Netherlands

phone _____

email _____

Your master programme (only select the options that apply to you):

IDE master(s): IPD Dfl SPD

2nd non-IDE master: _____

individual programme: - - (give date of approval)

honours programme: Honours Programme Master

specialisation / annotation: Medisign

Tech. in Sustainable Design

Entrepreneurship

SUPERVISORY TEAM **

Fill in the required data for the supervisory team members. Please check the instructions on the right !

** chair Prof. dr. ir. Mugge, R.

dept. / section: DOS/MCR

** mentor Dr Price, R.A.

dept. / section: DOS/MCR

2nd mentor Dajo Fernandes

organisation: DHL Parcel The Netherlands

city: Utrecht country: The Netherlands

comments
(optional)

Ruth Mugge's expertise can help me during my research in (sustainable) customer behaviour, where Rebecca Price has expertise in business development and mobility. Therefore I want to have both of them in my team

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v.

Second mentor only applies in case the assignment is hosted by an external organisation.

Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.

Procedural Checks - IDE Master Graduation

APPROVAL PROJECT BRIEF

To be filled in by the chair of the supervisory team.

chair _____

date _____

signature _____

CHECK STUDY PROGRESS

To be filled in by the SSC E&SA (Shared Service Center, Education & Student Affairs), after approval of the project brief by the Chair.
The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total: _____ EC

Of which, taking the conditional requirements into account, can be part of the exam programme _____ EC

List of electives obtained before the third semester without approval of the BoE _____

YES all 1st year master courses passed

NO missing 1st year master courses are:

name _____ date _____ signature _____

FORMAL APPROVAL GRADUATION PROJECT

To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked **.
Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

- Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)?
- Is the level of the project challenging enough for a MSc IDE graduating student?
- Is the project expected to be doable within 100 working days/20 weeks ?
- Does the composition of the supervisory team comply with the regulations and fit the assignment ?

Content: APPROVED NOT APPROVED

Procedure: APPROVED NOT APPROVED

comments _____

name _____ date _____ signature _____

A sustainable last mile delivery solution that fits the customers needs

project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 17 - 02 - 2020

15 - 07 - 2020

end date

INTRODUCTION **

Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

In 1969, three men started the first international delivery service of the world named DHL which is now, 50 years later, the largest logistic company in the world. DHL operates in 220 companies where it delivers and receives parcels within two networks: to business clients (B2B) and to consumers (B2C) (DHL, 2020). In The Netherlands, DHL Parcel is behind PostNL the largest parcel deliverer company, with a market share of 30% in 2017. (Statista, 2018).

Recently, DHL Parcel set green goals, which are goals to steer DHL Parcel to an emission free delivery company. Their ultimate green goal is to become emission free in 2050. (DPDHL, 2020) Therefore, DHL is working on solutions with their 'Go Green' program to reduce their emissions. Examples are the electric vehicles which are developed in house (see figure 1) and the bikes which can be used for short distance delivery. But, mass consumption is far from green and DHL's customers are stimulating this behavior by optimizing the check-out of an online purchase. (Roggio, A., 2015)

The worldwide parcel industry is growing rapidly. (Mordorintelligence, 2019) This growth is mainly due to the growth of e-commerce. In 2012, the amount of domestic parcels was around 160 million, this was 208 million in 2015. (ACM, 2019) Due to this growth, several problems occur for both delivery companies as consumers. On the consumer side: Parcels not delivered on the right time or place, many delivery vans driving through the street multiple times a day and with high speed. And on the other side: large volumes that need to be processed on the servicepoints (VGP, 2015) (Ecommerce, 2019) while customers expect their parcels quick and with the least amount of effort. (Carollo, 2020) DHL parcel is working on these problems by opening more service points, allowing interventions in the delivery process and offering new delivery options. (ACM, 2016) See figure 2 for interventions options.

The combination of a growing parcel industry and the zero emission goals of DHL Parcel asks for a redesign of the last mile delivery system which is cost efficient, emission free and fits the customers needs (both webshop and parcel receiver).

Key stakeholders in this are: delivery companies (for this project this will be DHL parcel The Netherlands), web shops: who choose their delivery partner. And the customers, who are the clients of the webshops and receivers of the parcels. Also, the city municipalities have a large influence on the evolution of delivery solutions since they are writing policies for the transport within cities. Next to that, there are third parties involved in the current delivery system, as for example city hub owners and fietsbezorgd.nl. The customer needs will be investigated in this research project.

The limitation lies in the fact that webshops are the direct customers of DHL. Webshops want sales, while this is increasing mass consumption. But DHL should follow their wishes in order to keep them as customers. Further limitations lie in the fact that DHL Parcel is working with many subcontractors who have their own interests. Next to that, the process is much more than only the last mile: every change that needs to be implemented has an effect on the whole process.

Opportunities lie in the fact that there is room for improvement looking at customer satisfaction. (Mansens, E., Meijer, E., 2019) Another opportunity lies in the fact that DHL has large customers as for example Wehkamp who have an important role in the sector. They could work together towards sustainable solutions.

space available for images / figures on next page

Personal Project Brief - IDE Master Graduation

introduction (continued): space for images



image / figure 1: DHL electric street scooter

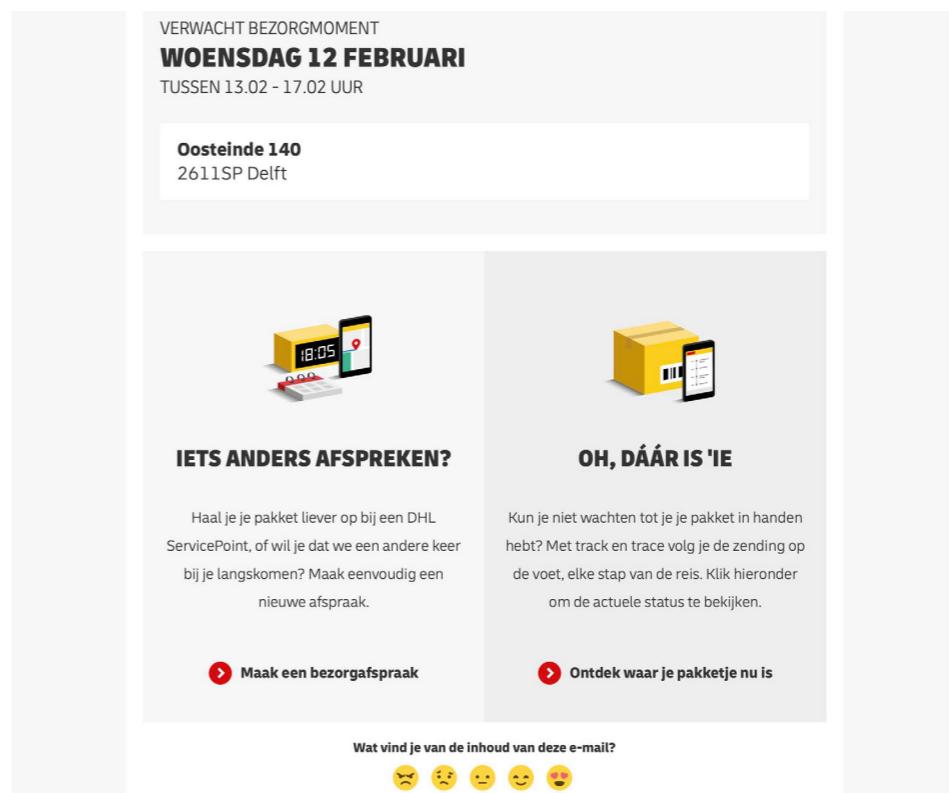


image / figure 2: The message for the receiver on the morning of delivery. On the left side: The intervention option.

PROBLEM DEFINITION **

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

DHL aims to have a zero emission business in 2050 but a growing e-commerce industry and demand for fast delivery are challenging them.

Next to that, consumer behavior is far from green: the buying behavior of people has grown ridiculously the past decades and businesses are stimulating this behavior with fast check out and free delivery options.

This paradox of businesses willing to be sustainable but also increasing sales by selling more needs investigation. What is the responsibility of a delivery company like DHL in this paradox and are they in a position to change this?

I will research what the customer needs in a sustainable last mile delivery system are and how DHL Parcel can take its responsibility in the transition from the conventional ways of delivery towards an emission free way of last mile delivery.

In order to answer these questions, I will research the current situation of last mile delivery. What characterizes this business and why are consumers choosing their preferred delivery options? In parallel, I will research what the characteristics of a sustainable last mile delivery system should be that contribute to the companies goals of zero emission delivery in 2050. I will make a scenario for a delivery system in 2030 which includes these insights. The data for this scenario is also collected through interviews of both users as professionals in this sector.

The 'last mile' is defined as the last part of the parcel's journey which is from the city hub to the end consumer. The research will be focused on the last mile of B2C (business to consumer). My solution will also be targeted on C2C (marketplace solutions) and retours of parcels, since these are growing industries and have a large influence on the CO₂ emissions. (thuiswinkel, 2019)

ASSIGNMENT **

State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

Design a last mile delivery solution that meets customers needs and contribute to a sustainable system. The solution will be based on user and literature research and the sustainable system will be defined in the beginning of the project based on desk research and interviews with users and key stakeholders.

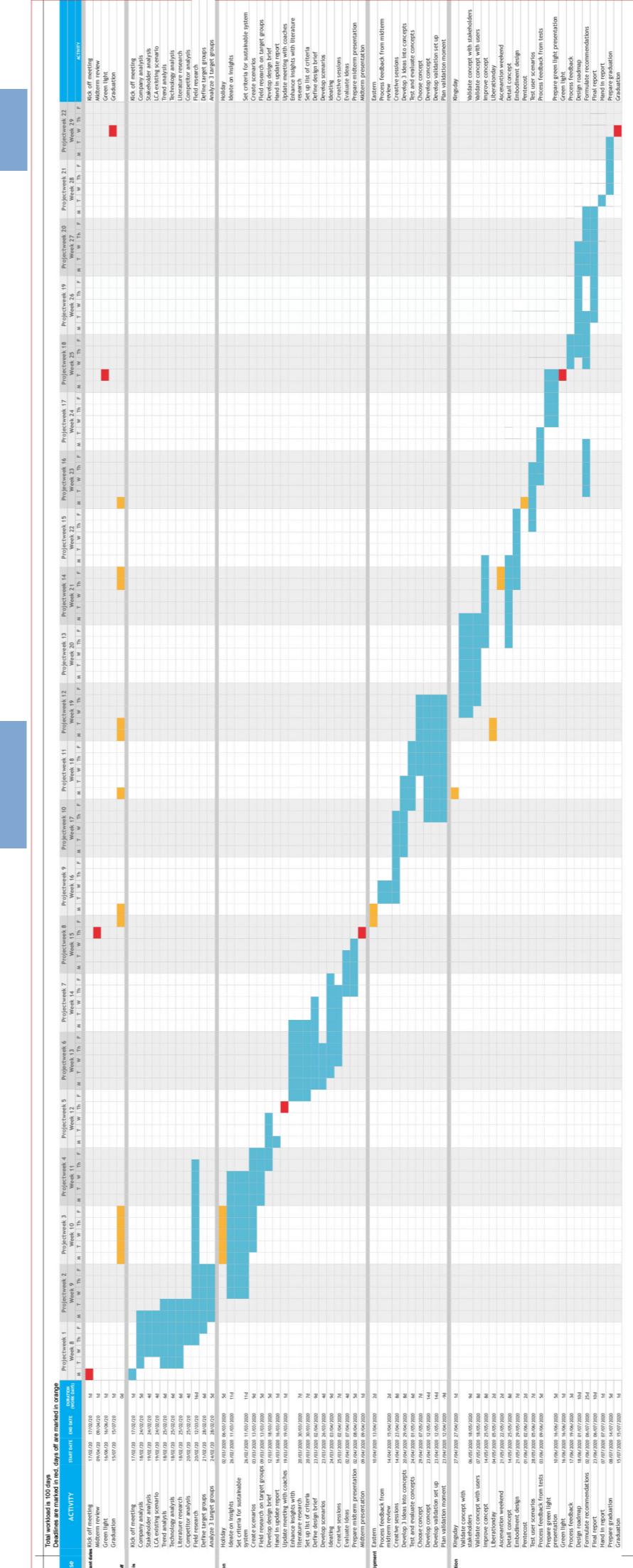
The goal of this project is to design a last mile delivery solutions that meets customers needs and contributes to a sustainable system.

My approach for this project is visualized on the next page. Here is shown that in the first phase, before the mid-term presentation, the design of the sustainable system based on user insights and analysis of company, trends, technology etc. is a parallel process.

The solution I expect to deliver is a product-service combination that full-fills the needs of the customer within the sustainable system I defined. The concept will be validated though user tests interviews with professionals. The tests will be simulated with prototypes of the concept.

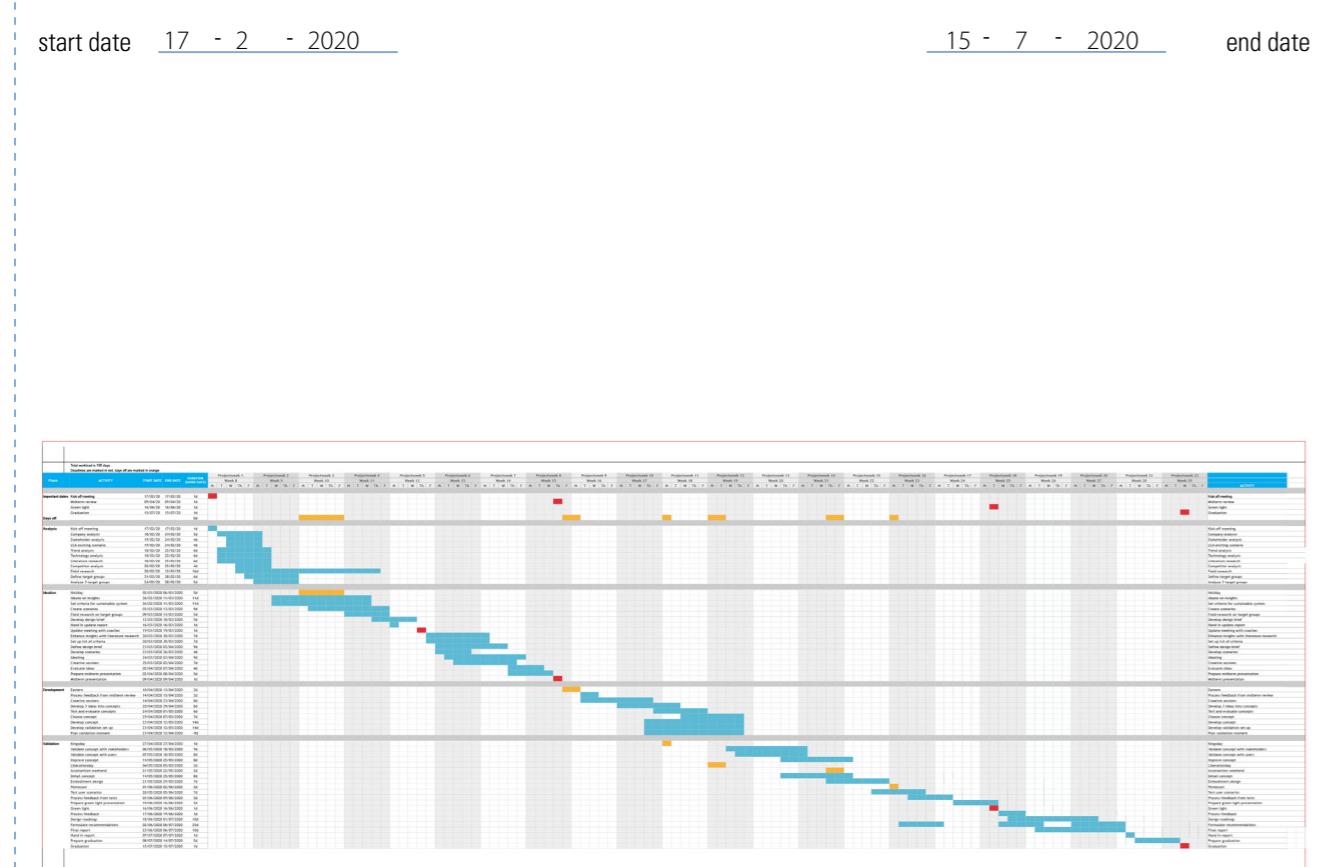
The final result will be a visualization of a concept which includes the needed technologies, materials and partnerships. The environmental impact of the concept will be calculated through a life cycle analysis. A roadmap will be constructed to show the steps towards the sustainable scenario of 2030.

I expect that this solution possibly asks for changes in the current delivery system of DHL. Therefore I will name the changes that need to be done before this solution can be realized as recommendations.



PLANNING AND APPROACH **

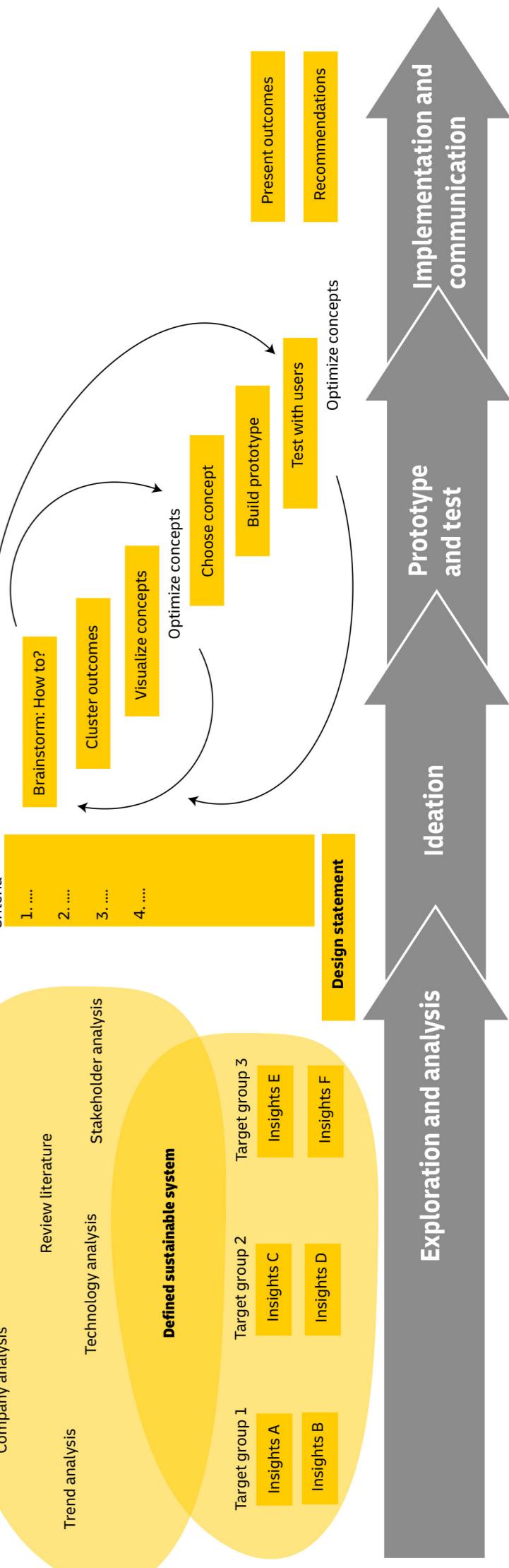
Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.



I am aware that the last day (15th of July) can shift if we plan the final date during the midterm review.
In this planning, the midterm review is on the 9th of April. The Greenlight is on the 16th of June and the final date is on the 15th of July 2020.

The project starts with an analysis phase in which I will research the developments in this field, the relevant trends, the stakeholders, the competitors and the customer needs in order to have a set of criteria to ideate with in phase two: ideation. In this phase, I will design a future scenario for a sustainable way of last mile delivery. Within this scenario, I will design a concepts based on customer needs. The development of these concepts is done in the development phase which will also include choosing a concept. This phase is followed by the validation and testing phase where I will built a prototype in order to test (sub) systems of the concept with the end users. Visualization and presentation are also part of this last phase.

Project approach



MOTIVATION AND PERSONAL AMBITIONS

Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge about a specific subject, broadening your competences or experimenting with a specific tool and/or methodology, Stick to no more than five ambitions.

My interest in sustainable mobility started in 2017 when I joined the Solar Boat team of the TU Delft. From here on my interest in sustainable behavior and sustainable design challenges grew. Therefore, I chose many courses that fitted this topic to gain knowledge. Next to that, I was selected for the Community of Energy Top Talents which is a scholarship from Dutch energy companies for technical students that have affinity with renewable energy technologies and sustainable design. The aim of this community is to accelerate the energy transition. With my background in industrial product design, I can contribute in this acceleration by looking at the user needs and how they can be met while moving forward with technology.

My ambition is to become more of an expert in this area and to share my knowledge with companies to solve complex problems in society. When I met Dajo Fernandes during the Energy day 2019, I became interested in solving the challenge their company is facing: becoming CO₂ neutral in 2050. Therefore I want to investigate what is needed to achieve these goals.

Although I was in contact with many companies during my Solar Boat year and during my scholarship, I never did an internship during my studies. I want to learn how I function within a company and what kind of company I would like to end up in after my graduation. Therefore I chose to do my graduation project at a large company in The Netherlands. I also chose deliberately for an international company so I can learn about the companies culture and the difference between the Dutch culture and company structures.

Because of my interest in the sustainability topic, I would like to map the emissions using a LCA tool. This can help DHL parcel to give insight in their current emissions and can also be used to compare the old situation with the new suggested situation.

Lastly, I expect this project to be a challenge and I am eager and enthusiastic to make the best out of it. It can be pretty hard to do a project on your own and therefore I promised myself to talk to fellow students on a weekly base. This can also help to reflect on my work and stay critical.

FINAL COMMENTS

In case your project brief needs final comments, please add any information you think is relevant.

References project brief

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- Thuiswinkel (2019) Net zo gemakkelijk weer retour. Of toch niet? . (2019). Thuiswinkel.org. Retrieved 02 February 2020, from <https://www.thuiswinkel.org/nieuws/3957/net-zo-gemakkelijk-weer-retour-of-toch-niet>



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