Mobi: the service for sustainable mobility

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Preface

This is the graduation report on Mobi: a service encouraging the use of active transport, written by Mitchel Trap.

This project started with looking for a graduation project in the field of mobility. This is a subject that I am interested in but had never been offered during my studies. By combining my studies, Design For Interaction, with mobility and urban design, a great opportunity arose to start this project.

I learned a lot of new information about mobility, policy and urban design. Besides the subject itself, I also learned how to conduct interviews and tests on a more professional level. Being fully responsible for a project and communicating with all stakeholders was still a challenge at times. In the end, the project turned out well, where I was often searching in the beginning. I did spent a lot of time researching existing literature and linking it all together. As a result, I did end up with a project that I am satisfied with.

I am also very grateful to Advier for guiding this project. For providing a nice working environment and expertise in abundance. I felt at home as a designer and was able to work on Advier's professional work floor.

Enjoy and get inspired by this report.

Summary

Context

The topic of this graduation project is sustainable mobility. Sustainable mobility in urban areas can be achieved by using active transport. Cycling and walking is called active transport and is sustainable due to the lack of emissions. Passive transport such as cars and pedal bicycles produce a lot of emissions, which are bad for people's health and the climate.

Advier, the client of this project, is a consultancy working on innovative and sustainable mobility. Together, we looked at the future of mobility inside the city. How to make a green world in 2040.

Aim of the project

To design for the year of 2040, first I researched what the future will look like. A future that is as green as possible through technological but also behavioural developments. To eventually move towards this green world, the following research goal was drawn up: Design a service to encourage more sustainable mobility in and around urban areas in 2040.

To accomplish this goal, the research through design method was applied. For the three different phases, this design method was applied in an exploratory way. As a result of the analytical, conceptual, and conclusion phases, a service was designed. This service, called Mobi, will motivate people to use more sustainable mobility and inspire sustainable mobility projects.

Analysis

Throughout the project, I built on a strong foundation of background knowledge. This knowledge was built from literature research and was built up from three topics.

Mobility
This chapter has looked at present and future mobility. The impact of mobility on behaviour, rearranging mobility inside the city by giving priority to cyclists. By looking at this development of mobility, means such as electric vehicles and low-traffic cities seem to be the solution, but I believe the solution lies mainly in changing people's behaviour.

City
The city adapts to mobility and vice versa. How differently a city functions when a 15-minute city philosophy is applied. It is important to take the city into account when designing for it. How communities emerge and streetscapes change will influence the criteria for designing a future-proof service.

Future visions
What the future will look like no one knows, but by looking at the extremes of future worlds, design possibilities will emerge. By taking a green world as a starting point, the service created within will lead to a more sustainable world. Thus, this project is focused on making a green world a reality.

Concept

To come up with the broadest possible solutions for the project, behavioural change was researched. To practice sustainable behaviour, you do need to know how sustainable behaviour looks like and, more importantly, what it does not look like. There is demand for more knowledge around mobility emissions, research has shown. To create a green world, it has to be clear how we get there. That is why Mobi has been devised that will ensure a green world for the future.

Conclusion

The Mobi service consists of three elements: bike, car and overview. For each element, I looked at providing the necessary information on sustainability and investigated what the appropriate form of communication would be. In this way, Mobi primarily offers a form of information to the user. The communication is in a playful way to keep the user motivated and make more use of active transport.

Towards the end of the project, the designed service proved to be most suitable for an application for the smartphone and a implementation of an existing mobility provider. It will be deployed in combination with vehicles and technologies. The service was also tested among users and experts in the field of mobility and MaaS; Gaiyo, Advier and SJEES. This evaluated the service as an inspiring resource for future mobility and possibilities for implementation.

Table of contents

Introduction

Introducing the context and structure

The next chapter will provide the background information for the project. Starting with the context of the project, where the research method and question is mentioned. The stakeholders and what they expect will be explained. The structure for this project differs a bit from the traditional design project. Within the structure the different phases are explained. Starting with the analytical phase, then the conceptual phase and closing with the concluding phase.

Chapters:

- Context, discussing the team, research goal and method, and the plan with Advier.
- Structure, discussing the structure of the project and the three phases: Analytical, Conceptual, and the Concluding phase

Context

This chapter will explain the context of the report. This chapter provides the basic information on the topic, research question, method, and parties involved.

Assignment

This study is about the future of mobility. Here, mobility is specified as the movement of a person from point A to point B. This movement adapts to the conditions of the person. The vehicle, the city, behaviour, availability and distance influence the movement. The mode of travel adapts over time and can be predicted to some extent. Therefore, I looked at mobility in the future and whether it is moving in the right direction. After all, a sustainable future is a good future. To conduct this research, one question must be answered first: What will the world look like in the future and how will people deal with it in terms of mobility. Therefore, this research starts with a future picture of the world and of mobility. From there, the goal comes to look at an opportunity, related to mobility, for an innovative product or service system. Ultimately, the main focus of this research is on making mobility more sustainable.

Team

This report was written in collaboration with Advier and TU Delft.

Client Advier

Advier is an innovative agency working on the (re) design of mobility, space, and organizations. They do this entrepreneurially; based on clear insights, tangible impact, connecting people, and innovative initiatives. Advier puts people in motion toward a sustainable society. One that is smart, robust, livable, inclusive, and future-proof. Advier is the main stakeholder in this project and provided the needed expertise on mobility. Jip Schelling, an employee of Advier, was asked for his expertise in design thinking and mobility.

Chair and mentor

The two supervisors from TU-Delft were Suzanne Hiemstra-van Mastrigt who has been the Chair (the supervisor in charge of all formalities) and Peter Kraaijeveld as a Mentor. Suzanne was asked for the project because of her knowledge of mobility. Peter was asked because of his experience in coaching and design thinking.

Plan with Advier

Before starting this project, Advier had been consulted on what the plan was. First, the plan was to draw up a vision of the future, a city that would be completely car-free. For this, a system would be designed that would bring together forms of shared transport. This was later adjusted to look at a future vision in 2040. This would show a opportunity and a design possibility would be found there. In this, there was room to look in a direction myself, Advier would provide advice and expertise. This resulted in a sustainable mobility project, to support active transport.

Method: Research trough Design

This research began by looking at mobility in the future. How will people move and how will this change over time. Will people move more or less, over longer or shorter distances? In other words, will people behave differently? To answer this question, future visions have been made. Based on these future visions, concepts were created. The goal of these concepts was not to completely solve the problem found, but rather to find a possibility to mitigate the problem in the short term. This method of gaining unique insights for a complex and future-oriented issue is called: Research through Design. Using this method, this report consists of 3 phases. The first phase is the analytical phase, the second is the conceptual phase and the last phase is the conclusion phase. The different phases will be further highlighted in the next chapter structure.

Design goal

I started this project with the research purpose to design a system in a low-traffic city (2040) where healthy mobility is still possible. Thereby, shared mobility seems to be the solution and a system will be designed where everyone within the city will have access to shared mobility (Appendix H). Figure A illustrates the knowledge before I started this project. Later in the project the design question was adapted to: design a service to encourage more sustainable mobility in and around urban areas (page 17).

Low-traffic city

The place of the car in cities is changing. Many municipalities are no longer emphasizing car facilitation in their mobility plans, but are implementing low-traffic policies. This focuses on improving the quality of the living environment, encouraging walking and cycling, improving traffic safety, and making mobility more sustainable. Making way for other urban functions such as green space or lodging instead of giving the car priority.

When fully committed to a low-traffic city, alternatives to the car must be available. This will require structured public transportation and available shared vehicles, but also more space for walking and cycling.

Shared mobility

The current streetscape is changing and it looks like it is becoming less and less attractive to the car inside the city. Parking standards are getting lower per dwelling and parking costs are rising. In other words, owning a car is becoming less attractive and perhaps unnecessary. Thanks to improved public transportation, the car is needed less and less.

In addition, people are increasingly opting for shared mobility to get around. Think of shared cars for longer distances and shared bicycles for shorter distances. This shift is very plausible as we move more and more toward a shared culture. The preference today is to have access to a service over being the owner of a product.

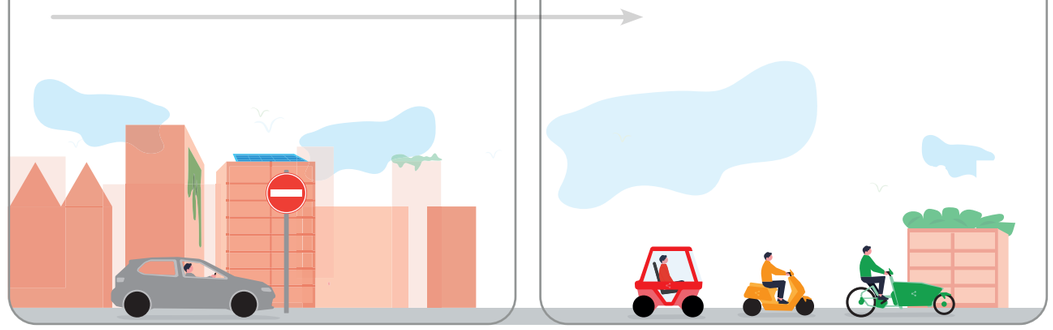


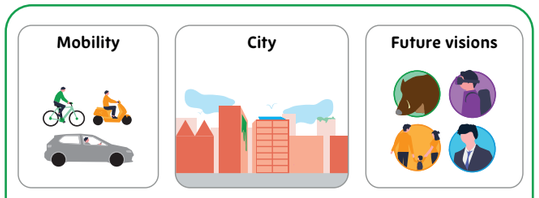
Figure A (Existing ideas for making mobility more sustainable)

Structure

This chapter will explain how this report is structured. This chapter provides the basic information on the different phases and the thought behind them.

Structure the project

At the beginning of this project, there was no clear design direction. Designing for the future is different from designing for the present. When looking at the future, one often looks at developments and trends. Assumptions are often made about where people think things are going in terms of innovation. By combining all these elements, a coherent vision of the future can be created. Therefore, the project is split into three phases. It will start with the Analytical phase:
Naming important developments and trends around mobility, but also around behavioural change and how the city responds to them or vice versa. Using this, four visions of the future were made.



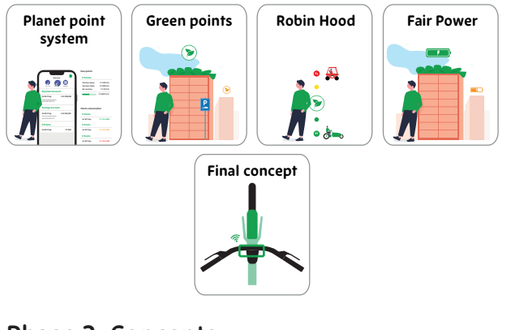
Phase 1: Analyse

This project will start with the analytical phase. This phase will examine the current mobility and cityscape and what developments will take place in the short and long term. How certain techniques produce behaviour change and how humans are slowly changing. All these developments affect what the city will look like in the year 2040.
Future visions were then drawn up using found developments. These visions each describe a world of extremes. These are the green world, the regional world, the fast world and the business world.

After the analytical phase, four concepts were designed in the Conceptual phase: each tackling a found possibility: Planet point system, Green points, Robin Hood and Fair Power. The Fair Power concept was selected to iterate further..

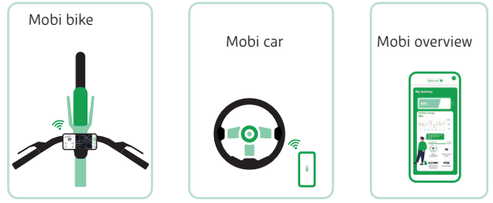
After selecting Fair power, the service Mobi was developed in the Concluding phase. This service is tested via users and experts

These phases can be read separately but will form a cohesive story when read in chronological order. Thus, all decisions and/or design choices will be based on previously identified developments and/or decisions.



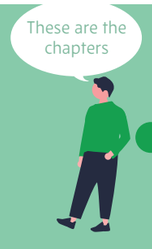
Phase 2: Concepts

The concept phase continues after the analytical phase. Four concepts have been drawn up based on the future visions. These four concepts address a opportunity or problem from the four future visions. The planet points system is mainly focused on behavioural change and consciously working on sustainability. The green points concept is mainly focused on group unity and sustainability is achieved by common interests. The Robin hood concept is mainly based on true pricing and therefore rewards the more sustainable choice. Finally, the fair power concept focuses on actively encouraging an active form of transport instead of a passive form. Via criteria the concept of Fair Power was chosen and further tested. These tests looked at Fair Power to evaluate the different elements and the opinion of the user.



Phase 3: Conclusion

At the conclusion of this project, a conclusion, recommendation and reflection will be written. This will be the final chapter, discussing the final service called: Mobi. All the three elements of Mobi, car, bike, and overview. Whether the project was a success by evaluating with the users and experts. Finally, whether the intended outcome of the project was achieved. Recommendations will reflect on a time line discussing further possibilities on this project. Last will be the reflection, which will reflect on the ups and downs of the project. How the project went and the cooperation with the client Advier.



Analyse	Future world	Concepts	Introduction battery	Mobi	Mobi service	Evaluation	Conclusion
Analysing current city layout, mobility and the road to sustainable mobility	Describing four different extreme and futuristic worlds in 2040, with the ultimate Green world	Discussing Planet point system, Green points, Robin Hood, and the chosen concept Fair Power	Testing the effectiveness of the battery and service screens	Introducing a new service to encourage active mobility called Mobi	The Mobi service consisting out of Mobi bike, car and overview	Evaluating the Mobi service with users and experts	Concluding with the implementation of Mobi and its impact on the 2040 world
1	2	3	4	5	6	7	8

Discover — Design — Deliver

00 Information

Information blocks
These information blocks will be at the beginning and end of each chapter. These will briefly describe in advance what can be read in the chapter and how it is relevant to this project. Afterwards, possible changes to the project and or important insights are discussed. The structure of the project will be seen at the beginning of each chapter, as visualized below.

Analyse
Analysing current city layout, mobility and the road to sustainable mobility

Future world
Describing four different extreme and futuristic worlds in 2040, with the ultimate Green world

Concepts
Discussing Planet point system, Green points, Robin Hood, and the chosen concept Fair Power

Introduction battery
Testing the effectiveness of the battery and service screens

Mobi
Introducing a new service to encourage active mobility called Mobi

Mobi service
The Mobi service consisting out of Mobi bike, car and overview

Evaluation
Evaluating the Mobi service with users and experts

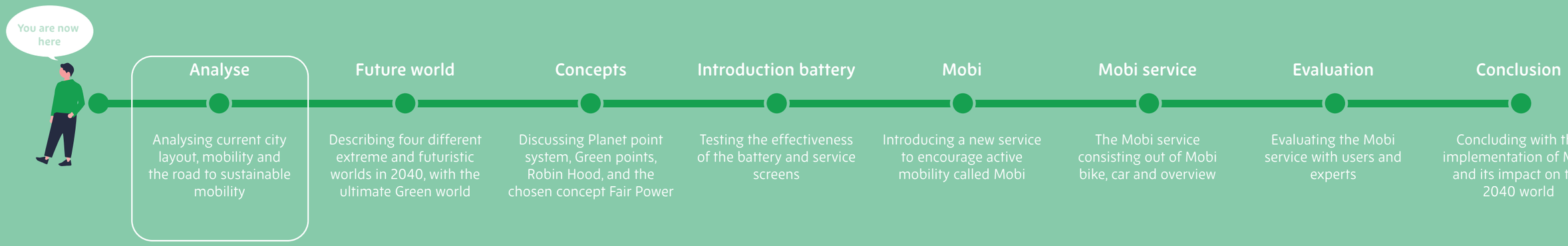
Conclusion
Concluding with the implementation of Mobi and its impact on the 2040 world

Phase 1: Analyse

Exploring future mobility and finding direction

Chapters:

- 01. Analyse
- 02. Future world



01 Analyse

Analyse for mobility in 2040
This first phase of this project is about analysing trends and developments around mobility and the city. What will the city look like in the future and will certain developments change mobility in 2040. This information is compiled from literature research and interviews with experts.

Chapters:
- Mobility, discussing how the current mobility is operating. And how a city layout principal like the mobility pyramid can cause low-traffic and change of behaviour, supported by electrification.
- City, discussing how a 15-minute city will look like, with its share community and change of street scape.
- The road to sustainable mobility, discussing the 8 factors to achieve the mobility of the future, talking about behaviour change and to inform people about green mobility.

1.1 Mobility

This chapter will explain the need for mobility. How transport has become so much a part of people's lives that it is hard to remove the car from this picture. And how innovations can change this picture in terms of sustainable mobility.

Current mobility

Mobility is part of everyday life. Whether there is talk of a hyperloop or a 15-minute city, much revolves around how people move from point A to B. In fact, compared to the past, we have started travelling much faster and over longer distances. It is in human nature to spend 1.5 hours on the road, whether this is fast or slow transport (Verkade, 2020). One law describes that no matter how fast people travel they are still 1.5 hours on the road. This so-called BREVER law together with the innovation of faster vehicles has resulted in more and more cars and wider highways to cover distances. Together, these cars produce a lot of emissions and create nuisances. Inside cities, there is air and noise pollution (Macharis, 2021). One way to get fewer cars is to create a car-free city, share vehicles or make other vehicles more attractive. Yet the solution seems easier than it actually is. People are creatures of habit and the car has become so commonplace that it is very difficult to change this behaviour just like that. Moving around in a car is so much the norm that cities are designed for it and adapting to it takes time. In spite of this, there are many adaptations and innovations that will bring about this shift from the car to cycling or walking. These innovations will be explained further in this and the next chapter City.

Electrification

The rise of electric vehicles, also known as EV's, is already visible. This electrification is increasingly popular among e-bikers, e-moped bikes, and e-cars (Van de Weijer & Steinbuch, 2022). This move mainly means fewer fossil vehicles in circulation and more and more being driven electrically. This increase is mainly due to the following advantages for the user and environment:

• Km price: driving on electricity is cheaper per km than on fossil fuel.
• Expansion of the charging network: more and more charging stations are available for charging.
• Health and well-being: EV's cause less emissions per km driven and produce less noise pollution.

There are also some drawbacks to electrification:

• Purchase price, the investment of buying an EV is on average higher than a fossil car or normal bicycle.
• Limited range, the range of an EV is currently still limited.
• Long charging times, EV charging time is currently still considerably long for a trip that cannot be fully driven on a battery charged overnight.
• Power grid capacity, the current grid cannot handle the rising demand for electricity at peak hours.

When looking to the future, many drawbacks will no longer matter. For example, some cities are already being set up for EV-only access (Oerlemans, 2023). This will ensure that EV's become the norm and thus even more innovative. Currently, work is already underway on a battery that lasts longer (Castelvecchi, 2021), has a higher range, and is more affordable (Grutters, 2024).

Mobility pyramid

The mobility pyramid is a model representing the different levels of mobility in a city or region (Figure 1). Meaning, the top layer will have the most direct route. Going by walking will have a shorter path than by car (Figure 2). The pyramid is divided into four layers, with the most sustainable and efficient forms of mobility at the top and the least sustainable and efficient forms of mobility at the base. Also, the distance to a mode of transport should be inversely proportional to the mobility pyramid for healthy mobility ("Netwerk duurzame mobiliteit" n.d.).

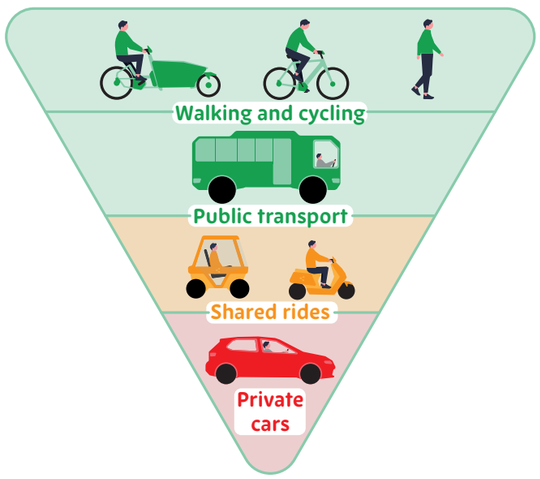


Figure 1 (Mobility pyramid within the city)

The four layers of the mobility pyramid in the city are:

• Walking and (shared) cycling: these are the most sustainable and efficient forms of mobility, as they produce no CO2 emissions and take up little space.

• Public transport: this is an efficient form of mobility that can transport many people with minimum space and emissions.

• Share mobility: this all forms of mobility where people share vehicles.

• Private cars: cars are a less sustainable form of mobility as they emit CO2 and take up a lot of space.

When cities are classified according to the mobility pyramid, this would also have consequences for the streetscape and the city. When active transport comes first, streets will have much wider brown pavements and almost no space for the car. Shared mobility may also be given a high priority which would result in more mobility hubs and shared vehicles but also shared parking spaces (Walvius, n.d.).

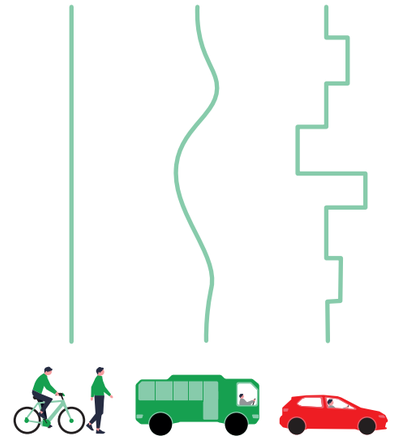


Figure 2 (The influence of city planning on mobility)

Low-traffic

A low-traffic city is a city where car traffic is restricted or even banned. This can apply throughout the city, or in certain areas, such as the city centre or residential areas.

The goals of a low-traffic city include improving air quality, reducing noise pollution, and making it more attractive for pedestrians and cyclists. The city will then have more space for greenery and public spaces (Nieuwenhuijsen & Khreis, 2016).

A low traffic city can be achieved in various ways: car-free zones, speed bumps and bollards, one-way traffic, and parking restrictions. Encouraging alternative forms of mobility can also help, the city can promote cycling, public transport, and shared mobility. The disadvantages of a car-free city are:

• Limited accessibility for cars.
• Difficulties with provisioning and loading/unloading.
• Possibly higher costs for parking.

Well-known examples are Houten and Amsterdam city centre (Van de Weijer & Steinbuch, 2022). The cities offer good alternatives to the car through shared transport and active transport infrastructure. By largely eliminating passive transport, there is more space for greenery and the streetscape will also change in cities. The changing streetscapes will be elaborated in the next chapter.

Behaviour

Behaviour change is a challenging task for humans. On one side there is nature, which conveys the hereditary part such as genes, diseases and personalities. On the other side, there is nurture, which is the learning part that conveys habits but also movement about your body. It also contains the cognitive part, which is used to think and it is quite full (F. Jongsma, interview, 2024 January 30). The brain is therefore full of information and would prefer not to think too much. This influences human behaviour. Human behaviour is built on many aspects, including habits, upbringing, and place in society. People are often so stuck in their habits that it is difficult to change their behaviour. So, this starts with being open to change; there must be a reason to change. This reason must be wanted, doable and understood. If one of these three aspects is not met, people will drop out and not change. Then, when the change is implemented, the person must persevere so that it becomes part of their behaviour and does not take much attention to implement. This loop for behavioural adaptation is called the Balm model (Mulder, 2022). Behaviour change can be stimulated by rewarding good behaviour and when implemented well lead to long-term behaviour change without reward (Erwin, 2022).

People will always be on the move. Therefore, it is good to make mobility more sustainable and redesign cities for instance, for low-traffic. These low-traffic cities will prioritise active transport and EV's. Still, the most important step to switching to sustainable mobility is behavioural change.

1.2 City

This chapter will explain the transformation of the city. How developments are changing the layout of the city, such as the share community and the 15-min city.

15-minute city

The 15-minute city is an urban planning concept. The idea is that every resident of a city should have access to all essential facilities, such as shops, employment, education, healthcare, nature, sports, and culture, within 15 minutes on foot or by bike (Figure 3). The 15-minute city aims to make cities more liveable, sustainable, and social (Khavarian-Garmsir, Sharifi, & Sadeghi, 2023). Bringing all amenities within easy reach reduces the need for car traffic. This is good for the environment, air quality, and the health of residents. Moreover, using bicycles and public transport promotes social interaction and cohesion in the neighbourhood. Realizing a 15-minute city is complicated, especially if an existing city wants to become one. It requires thoughtful urban planning, paying attention to the following aspects:

• Mixing functions: living, working, recreation, and other functions should be mixed rather than separated.
• Densification: the city should be densified so that more people can live within a small area.
• Priority for pedestrians and cyclists: infrastructure should be adapted to promote cycling and walking.
• Good public transport accessibility: public transport should be efficient and reliable.

The 15-minute city has several benefits:
• Health and well-being: less car traffic means improved air quality, reduced emissions and noise pollution. Encourages active mobility: more people go cycling or walking. Accessible green spaces: more parks and gardens in the neighbourhood promote relaxation and social interaction.
• Sustainability: more efficient energy use. Local facilities mean less travel and energy loss. Circular economy: sharing and reusing products and services is encouraged.
• Social cohesion: stronger neighbourhoods. More interaction between people in the neighbourhood promotes a sense of belonging. Diversity and inclusion: accessible facilities for all residents, regardless of age, mobility or income.

Disadvantages of a 15-minute city:
• Centralised planning: limited freedom of choice. Residents are less free to choose where they live, work and spend their leisure time.

Figure 3 (15 minute city principal)

• Loss of identity: local cultures and traditions may disappear due to centralisation.
• Gentrification: rising prices in popular 15-minute neighbourhoods may lead to displacement of lower-income groups.
• Bubble-formation: people will not need to leave their 15-minute bubble daily, whereas people naturally want to be on the road for at least an hour.
• Pressure on infrastructure: traffic congestion. Cycling and pedestrian infrastructure may become congested, leading to unsafe situations. Parking problems: limited parking space can lead to conflicts between residents and visitors. Overcrowded facilities: schools, hospitals and other facilities may become too crowded.

A 15-minute city offers an attractive vision of a sustainable and liveable future. The benefits in terms of health, sustainability and social cohesion are significant. However, there are also disadvantages that should not be ignored, such as pressure on infrastructure, safety issues, and potential centralised planning.

Developing 15-minute cities requires careful consideration of the advantages and disadvantages, and inclusive planning that takes into account the needs of all residents.

Share community

In a share culture, also known as a sharing economy, people share goods, services, and spaces (Celata, Hendrickson, & Sanna, 2017). This can be done in various ways, such as:

• Peer-to-peer platforms: online platforms that allow users to connect directly with each other to share, such as Airbnb for sharing homes or Uber for sharing rides.
• Membership models: companies that offer subscription services to access a shared pool of goods or services, such as Netflix for sharing movies and series or Cyclists' Union for sharing bikes.
• Collaborative consumption: people working together to share goods or services, such as car sharing or renting a garden shed through a neighbourhood app or a drone (Figure 4).

Share culture has several benefits:

• Sustainability: sharing reduces the overconsumption of products and services.
• Efficiency: goods and services are optimised, resulting in less waste.
• Savings: sharing can save money and place, as users share costs and place.
• Convenience: sharing can be convenient, as users have access to a wide range of products and services without having to own them themselves.
• Social interaction: sharing can lead to more social interaction between people.

Besides advantages, there are also some disadvantages to share culture:

• Loss of control: people have less control over the products and services they use as they share them with others.
• Uncertainty: the availability of products and services may be less guaranteed than when people own them themselves.
• Quality issues: the quality of shared products and services may vary.
• Regulation: share culture is a relatively new phenomenon, so there is still uncertainty about regulation.

Share culture is a good way for people to share products and services together where everyone benefits. However, it is important that people continue to feel part of the community, otherwise trust is lost and the system collapses. This often happens when people lose the personal feeling with the community when it grows too big. For example, Airbnb needed to link personal ratings to hosts and only let people leave a review when they have actually used the service. This way, it stays personal within a growing community and continues to work. This is one of the reasons why more and more mobility hubs are emerging and share vehicles continue to rise (CROW & Advier, 2024).

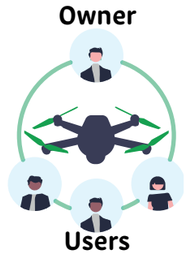


Figure 4 (Sharing a drone)

Streetscape

The streetscape is currently still dominated by the car. Three-fifths of a classic layout street consists of concrete roads and car parking spaces. One-fifth is concrete pavement for pedestrians and bicycle spaces and only one-fifth is green space (Felixx, n.d.). This part consists mainly of the median strip between the carriageway and the service road, in other words, this is not something that can be walked on or played on. Yet there are shifts in the layout of the streetscape. For instance, there are examples in Houten (Van de Weijer & Steinbuch, 2022) that has taken the bicycle as its main mode of transport. Here, cars are parked outside the neighbourhood and the city can be explored much faster by bike. Here, there are no cars at the door but green cycle paths with space for children to play. Also in the French quarter of Le Marais, where parking spaces have given way to planters. Yet there are much more ambitious plans, such as making only one-seventh section available for cars. There will be much more space for greenery and recreational opportunities. Cars will be parked underground and there will be space for brownways for cycling or walking. Houses will be able to be closer together and have even more green space, when there will be no need to fit a road between them (Walvius, n.d.). Currently, there are already initiatives where streets are closed to car traffic and make space for greenery. These are viewed positively and have the added demand for shared mobility. The new generation is used to sharing and thus will also accept and even welcome a change in the streetscape (Walvius, n.d.).

A 15-minute city is plausible for a city in 2040. In this, everyone moves with an EV coming from the shared community. Shared mobility hubs will become the norm, with more focus on active forms of transport for getting around. More attention will be paid to green streetcapes, allowing the car to slowly disappear from the streetscape.

1.3 The road to sustainable mobility

This chapter will explain how sustainable mobility can be achieved. This also called mobility of the future must meet several factors before it works or is achieved.

Behaviour change

Sustainable mobility can be achieved in many different ways. Thus, many experts have their own opinions on how to achieve it. Where one expert is more confident about water-borne transport and another is fully committed to the disappearance of the car (De Jong, 2022). Yet there is a commonality that all experts agree on. Man himself, that is the most important factor that needs to change. Human behaviour is the most important and best way to achieve sustainable mobility. But also the most difficult, since, as described earlier, we are creatures of habit. This results from a report in which eleven Dutch experts, from ANWB, 9292 and the Ministry of Infrastructure and Water Management, among others, give their views on the future of mobility (Visie Op Mobiliteit: Op Weg Naar 2050, 2020) (Appendix K). The so-called model: 8 factors to achieve the mobility of the future (Figure 5), describes 8 factors including change (Macharis, 2021). This addresses human behaviour that must change otherwise mobility will remain stagnant. The other seven factors are also important to achieve innovative mobility, but change is the factor where the most gains can be made. Sustainable mobility is already there, only many people do not yet opt for it. This can be an unconscious or conscious choice.

According to Macharis' model (2020), the mobility of the future can be achieved by meeting 8 factors. The 8 factors consist of:

• Inform: it is important to inform users how many emissions a product or service has caused.

• Reduce: it is important to minimise short and unnecessary trips. For example, people often take the car to do small shopping trips, even though this is just as fast as by bike.

• Shift: it is important that public and shared transport is readily available and is also a good and possibly better alternative to one's own car use.

• Green: it is important that when passive transport has to be used, it should be made as sustainable as possible. Here, electrification is a very good start.

• Accelerate: the government must establish clear frameworks and rules. A regulation for banning fossil fuel vehicles, working together with local municipalities, or the regulation around autonomous vehicles.

• Connect: all stakeholders must be involved. This should involve users but also municipalities and government working together.

• Change: it is important that people's behaviour changes. Here, especially the car should be removed from daily habits.

• Love, it is important that people embrace the change and stand behind it together as a whole, and believe in the change.

When the first 6 factors are met in Macharis' (2020) model, Change comes. Behavioural change often occurs after a crisis. For example, after corona, there was much more demand to work from home and to host events online. With the high need to meet climate goals, mobility must also change. This change starts with knowledge, despite knowledge about emissions and climate change being quite low, concern about the climate is high with three quarters of the population (Macharis, 2020). Emotions are very important because people need to have faith that there is hope and that the goal can be achieved. When there are clear climate goals, they will be achieved if there is also a clear path on how to achieve them. Next, it is important that the path to the goals is perceived as positive, otherwise people will drop out. Sustainable mobility should be made as attractive as possible so people will get out of their cars and go by bike. When the goals are achieved together, people feel more motivated to do their best and are willing to embrace sustainable mobility to meet the last factor.

Inform

For behavioural change to take place, the user needs to understand the consequences of their behaviour first. How many emissions is a short trip to the supermarket, or what exactly does 1 kilogram of CO2 emissions mean? After people gain an understanding of what the consequences of these emissions are, they need to know what they can then improve. This especially involves explaining why some alternatives are now more expensive than others. Why a car-free city is healthier and how that would work, its advantages and disadvantages. Here, information is therefore an important step towards behavioural change.

The factor on which this project will focus most is behavioural change. This is where most gains can be made. Whereas many factors depend on time or innovation, behaviour will not change when there is no clear reason to do so. Changing behaviour can immediately result in more sustainable mobility without the need of innovative techniques. To enable behavioural change, the user will need to be informed. Informed about the consequences of their behaviour and how they can become more sustainable.

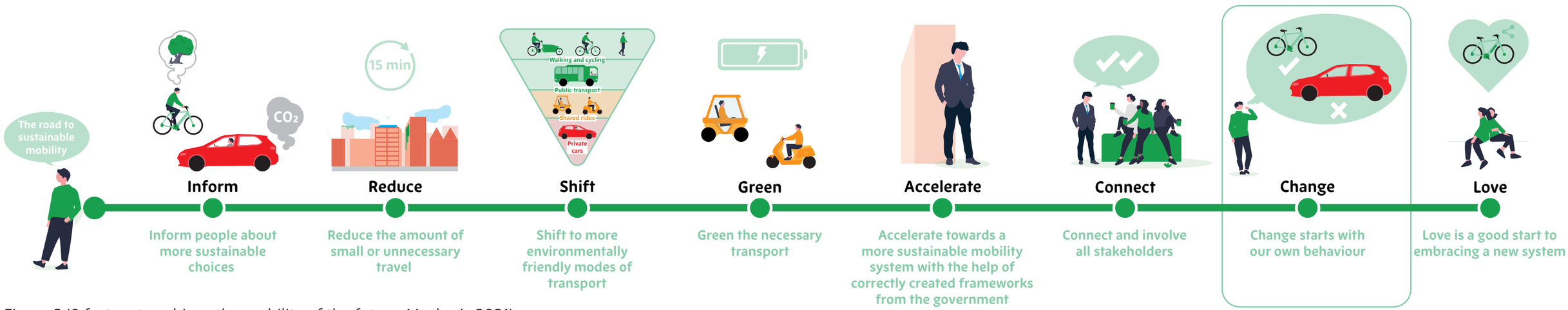


Figure 5 (8 factors to achieve the mobility of the future, Macharis 2021)

01 Analysis conclusion

Iteration

The purpose of this research changed somewhat over time. It began to design a system in a low-traffic city where healthy mobility was still possible. Thereby, shared mobility seemed to be the solution and a system would be designed where everyone within the city would have access to shared mobility. After further research, the focus was placed on becoming aware of people's emissions in terms of mobility. Here the best solution seemed to be getting people to share mobility. And so people would use shared mobility more when they were more aware of their emissions. To describe the ultimate goal of this research; to get people both consciously and unconsciously to engage in more sustainable mobility. In this regard, travel by bicycle and or walking is seen as ultimately sustainable. These forms of mobility are described as active transportation and would be an ideal aspiration for the city of the future. The purpose of this report is therefore to design a service to encourage more sustainable mobility in and around urban areas. This encouragement will happen by responding to human behaviour. This behavioural change is the most important factor in encouraging active transport.

Low-traffic city

The place of the car in cities is changing. Many municipalities are no longer emphasizing car facilitation in their mobility plans, but are implementing low-traffic policies. This focuses on improving the quality of the living environment, encouraging walking and cycling, improving traffic safety, and making mobility more sustainable. Making way for other urban functions such as green space or lodging instead of giving the car priority.

When fully committed to a low-traffic city, alternatives to the car must be available. This will require structured public transportation and available shared vehicles, but also more space for walking and cycling.

Shared mobility

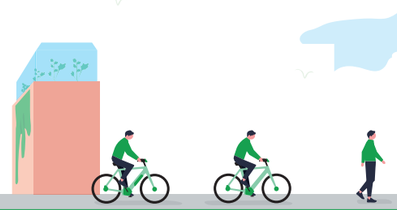
The current streetscape is changing and it looks like it is becoming less and less attractive to the car inside the city. Parking standards are getting lower per dwelling and parking costs are rising. In other words, owning a car is becoming less attractive and perhaps unnecessary. Thanks to improved public transportation, the car is needed less and less.

In addition, people are increasingly opting for shared mobility to get around. Think of shared cars for longer distances and shared bicycles for shorter distances. This shift is very plausible as we move more and more toward a shared culture. The preference today is to have access to a service over being the owner of a product.

Active transportation

With an increasingly important concern for dealing with the climate, active transportation is becoming increasingly popular. People are trying to be more and more concerned with the climate and make themselves more sustainable. Think of eating less meat but also exercising more. Currently, more and more cities want to move to a so-called 15-minute city. All primary and secondary necessities are within 15 minutes by active transportation. In such a city, it is also more economical in terms of costs and amenities to get around by bike or on foot.

With the ever-improving electric bicycle, active transportation is becoming increasingly attractive. People have greater range on a battery and can park the e-bike anywhere. Beyond that, it is also healthier for people and a cheaper option than the car.



Analyse
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Concepts
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02 Future world

Future visions

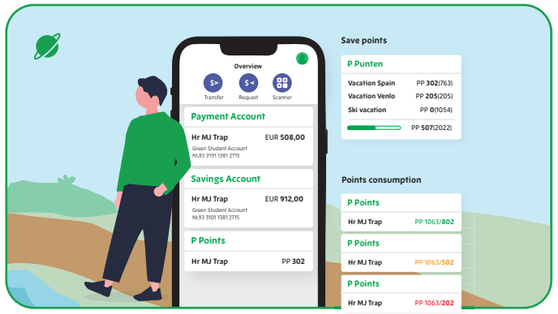
This second phase of this project is about making future visions. Based on the developments found in the analysis phase, in the field of mobility and the city, and the PBL (Planbureau voor de Leefomgeving, 2023) future visions have been drawn up. This is to paint a picture of how the yet-to-be-designed concept will operate in the future. This picture will help to put into perspective the users' needs and habits. What the user's life will look like and what pain points they will encounter in the year 2040. These visions of the future each represent a future of qualities. Each world deals with sustainable mobility in its way. Each world describes eating habits, city layout, mobility, a signature event and a form of a planet point system.

Chapters:
- Green world, discussing the futuristic world where people see themselves as part of nature
- Regional world, discussing the futuristic world where people live and provide in communities
- Fast world, discussing the futuristic world where people mostly live in a digital domain
- Business world, discussing the futuristic world where people pay to cover their emission

2.1

Green world

In the Green world scenario, people see themselves as part of nature. They see greening as a collective public task and urge the central government to take the lead in this. In this future, respecting ecological boundaries is priority number one, even at the expense of freedom to consume. Natural solutions dominate, for example by giving nature more space. Building in this future takes place as much as possible within the existing city and is concentrated around public transport hubs.



Vegetarian
People will eat vegetarian or even vegan. People will consume less exhaustive products. No pesticides will be used in the production and cultivation of food and thus will be completely organic. CO2-neutral and circular agriculture will put less strain on nature and allow it to take its course more.

City
In the inner city area, there will be transit-oriented development. The city is designed to be nature-inclusive and climate-adaptive, and there is plenty of room in the public space for walking and cycling. The urban periphery is characterized by green-blue city-countryside connections.

Mobility
Mobility will decrease for longer distances and increase for shorter distances. Movement will be primarily within and around the city by bicycle or walking. Electric powered vehicles will be the norm, but the city is primarily set up for bicycles. There will be access for shared vehicles in the city in addition to public transportation, but private cars will not be welcome.

Repair and recycle
Through a sharing community, people will repair and reuse more and thus consume less. Products will be up-cycled and produced in hubs and the most sustainable option will always be chosen for production.

Planet Point System
The planetary points system will be introduced. This system will introduce a personal emissions wallet. Using a personal emissions credit, people will be allowed to consume until their points run out. This personal credit is based so that if everyone abides by it the climate will recover. A skiing vacation will then cost more points than a camping vacation in Venlo.

Green world
The green world is completely dependent on behavioural change, making the moral choice. People will have less choice in consumption, living and travel, and put nature back on one. The low-energy demanding city will be powered by clean energy generated by the sun, water, geothermal, and wind. In this world, asphalted roads will disappear and there will be more space for nature.

Example city: Oslo
Oslo is the capital of Norway. Oslo is known as one of the most sustainable cities in the world (Modeshift & Chipilska, 2023). Sustainable will be described as; the ability to give future generations the same opportunities. Hereby, sustainable cities are in the ability to solve economic, social, and climatic problems. Generally, sustainable cities are labelled as green and smart. Innovative technologies such as emission reduction, renewable and clean energy are central to this.
Based on the above criteria, according to The Arcadis Sustainable Cities Index, Oslo is the leader in being the most sustainable city. Followed by Tokyo and Seattle. One of the reasons why Oslo ranks number one is the degree of government influence in achieving sustainable and climate goals. In Oslo's Climate Budget, is described to make Oslo a greener, more socially inclusive, fair, as well as moving toward newer, innovative practices that will make it a smart city.

Oslo is known for its investment in preserving green spaces. In total, more than one million trees grow within Oslo's urban zone. Of this, two-thirds of the area lies within the city and consists of forests, parks, and lakes. This greening contributes to clean air and also explains why Oslo falls within the target air pollution set by the World Health Organization.

The city makes the greatest use of renewable energy. Most of this energy is generated by hydropower. With current developments, Oslo will likely achieve its goal of nearly zero emissions by 2030. By investing in green alternatives, the city is moving away from fossil-based solutions. The city aims to achieve a car-free city centre and focus on promoting electric vehicles such as bicycles and public transportation. Credit is given to electric bicycles and tax breaks for electric cars.

Oslo is investing in fossil-free production. This applies to construction but also to growing food. The city has established certain criteria to promote zero-emission machinery. This will make fair-trade groceries more attractive and make them more popular.

Thanks to all these measures, Oslo is one of the leaders when it comes to achieving the sustainability development goals by 2030.

Oslo Airport City
A new city, Oslo Airport City (OAC), which is claimed to be the most sustainable city in the world ("Oslo Airport City," 2023), is being built next to the airport. The city is to be completely self-sufficient in energy and ultimately energy-positive. Relying on renewable energy, autonomous electric cars, and access within 5 minutes of public transportation. The city will allow only electric cars and even no cars at all in the city centre.

Autonomous cars Car-less city centre Electric cars only

2.2

Regional world

In the Regional World scenario, local and regional communities call the shots. People know each other, feel interconnected and take pride in their neighbourhood, district and landscape. Together they take care of their immediate environment. In this future, urbanization is spread across the country; large cities have expanded on a small scale, smaller towns and villages have grown organically. Local and regional mixing of functions are the norm. People find what they need in their own region.

Local
People will eat locally produced food. This means that people will eat less meat and more vegetables. People are largely responsible for their own food provision, which is why there are more vegetable gardens. These gardens produce organic products on a small scale.

City
The inner-city area contains urban neighbourhoods with different identities. There is a lot of small-scale urban activity. The city is set up for a lot of rainfall through its sustainable drainage system. The urban periphery is characterized by hubs, horticulture, green living, allotments, food forests, urban agriculture and recreation.

Mobility
Mobility will decrease for longer distances and increase for shorter distances. Movement will be primarily within and around the urban areas by small vehicles or walking. Fossil-powered vehicles will still be around, but the regions support light electric vehicles. Shared vehicles will be available in addition to public transportation. These forms of transport will extend to just outside the region.

Repair and take care
Hubs are used as social gathering places and repair centers. Through a close-knit community, people will repair and reuse. Because some products are very scarce, people will not consume them unnecessarily. This also applies to energy consumption because there is a limit to that. Each region is connected to the energy grid and will be cut off when there is no positive energy balance.

Planet Point System
The planetary points system will be introduced. This system will introduce a personal sustainable wallet. Using a personal sustainable credit, people will generate points by choosing the more sustainable option. These points can be transferred to voting points and will decide the infilling of public space.

Regional world
People will make decisions based on what is best for their region and will feel connected to it. Decisions about public space will be made collectively within the region. People will be able to choose local consumption and housing. People will flock more to urban areas, balancing purchasing power by region. In contrast, the balance will be more disturbed at the national level. The city will be responsible for its own clean energy and will become more sustainable at the urging of its residents.

Example city: Reykjavik
Reykjavik is the capital of Iceland. Iceland is an island that is part of Scandinavia. Iceland was not so long ago a country with a low population and few resources ("Icelandic Society," n.d.). Reykjavik was a smaller fishing village that grew its food and fished to survive. In these times, families who lived there helped each other to survive. With few animals and influence from other cultures, Icelanders had to figure out their ways. Because of this, Iceland is one of the most inclusive and tight communities that does not exclude anyone.
Today, Iceland is a developed country and has already set its goals, namely to become the first country to be completely self-sufficient (agreenerlifeagreenerworld, 2018). In doing so, the country wants to run entirely on renewable energy. Currently, Icelanders still have very high fossil emissions, since all fuel for transportation must be imported (Samgöngustofa, n.d.).

The energy supply for the entire country, on the other hand, is self-generated from hydro-power and geothermal activity. This is used to heat homes, schools, and roads. In addition to electric driving, hydrogen-powered driving is being explored as an alternative to fossil fuels.

There is access to public transportation on the island, although buses do not run much and vary greatly by season. On the other hand, carpooling is very popular and there is a simple website where one can register for each ride on the island. It describes the ride and sets certain conditions. Indeed, there is a very good chance that someone will have to go in the same direction since the island is not too big and there are relatively many cars driving around. In Iceland, seven out of ten people own a car.

Japan
In Japan, a system was introduced where people received ecopoints when purchasing products with energy label A (Yagi, 2010). The points could be redeemed for gift cards, prepaid cards, regional specialties, and energy-efficient/environmentally friendly products, they could also be donated to 181 environmental organizations selected from public submissions. After success, the government also introduced an ecopoints system for households. Under this, people received points for making their homes and or businesses more sustainable. The purpose of the points system was to draw attention and make people more aware of nature and thus more conscious of their purchases.

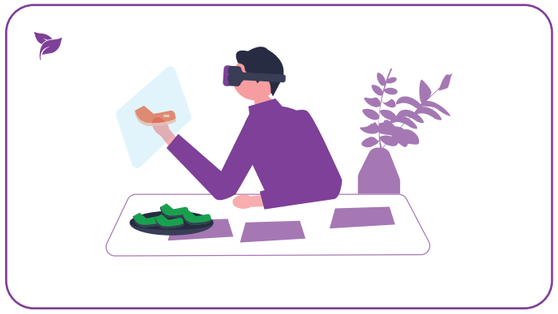
In the points system, people receive points by making purchases from certified companies that actively contribute to sustainability. Hereby 1% of the purchase amount is automatically invested in climate causes. In addition, people also get points if they take the electric bus and do volunteer work for climate causes.

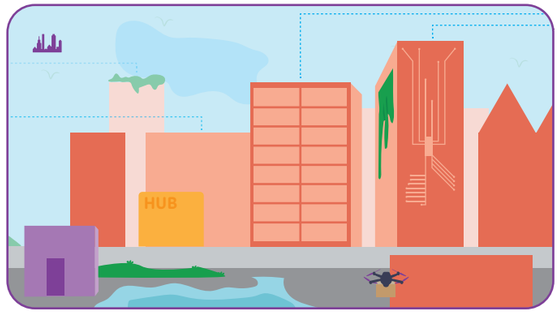
Later after implementing the system, the rules were tightened a bit. The results showed that people used the points mainly for their interests in the form of prepaid. As a result, it is now possible to save for family outings instead of just for yourself. This encouraged people to exchange points for joint activities, which ultimately resulted in a closer community among users and residents.

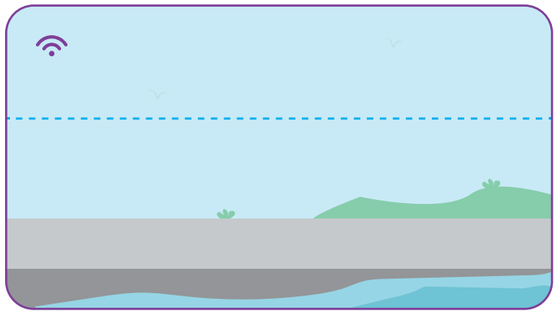
2.3

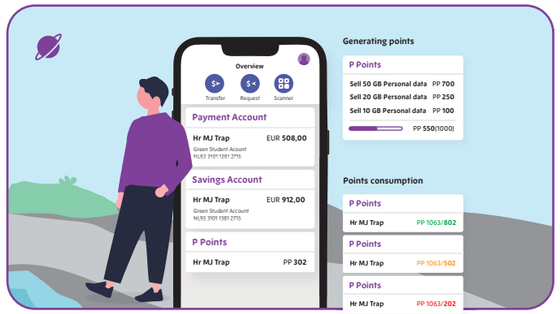
Fast world

In the Fast World scenario, society breaks down into a variety of lifestyle groups. These bubbles find it important to distinguish themselves from one another. Most of life takes place in the digital domain; physical space loses importance. Alliances of smaller, innovative companies and lifestyle groups are taking the lead in this future. They value flexibility. One consequence of this is a somewhat cluttered and changeable spatial layout of the country.









Digital
People will eat vegetarian or vegan. People will place less value on their food and so their eating behaviour will change in the process. Consuming food will be consumed more out of necessity than pleasure. Hereby, the idea of rich food will be digitally presented. This will be achieved through technologies such as augmented or virtual reality.

City
The inner-city area is characterized by temporary, flexible use of buildings, including through digital (re)programming of spaces. Public space is functionally designed and moderately maintained. The urban periphery shows erratic urbanization with low building density. The transition between city and country is fragmented and changeable.

Mobility
Mobility will be greatly reduced as location loses its significance. People will lose the need to move around and experience everything from the digital world. Working from home will become the norm and traveling for social contact will take place online. All vehicles still in circulation will be electric and autonomous. These personal autonomous vehicles will be connected to the public network and provide fully personalized rides.

Voting for public
By submitting voting points, you have a greater say in how public space is filled. The layout of the public space will be mainly consulted with the residents. The voting will take place digitally and will only take into account those who were able to vote online. Because the infill of the public space will be online, adjustments and changes will also happen faster.

Planet Point System
The planetary point system will be introduced. This system introduces a personal sustainable wallet. Using a personal sustainable credit, people will generate points by sharing data. These points can be converted into voting points and determine the infilling of public space. People will lose privacy in exchange for greater influence.

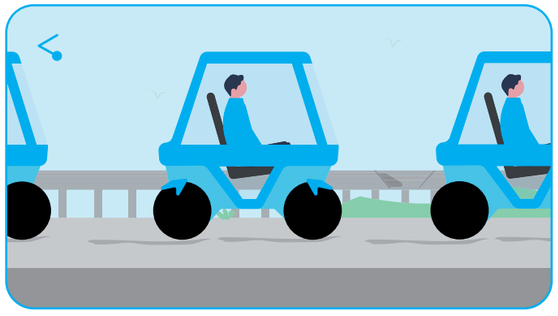
Fast world
The fast world is mainly focused on like-minded groups of people. Living in an online world presents an opportunity for total isolation. People will come to value their online lives higher than their physical lives. As a result, public spaces will be visited less and nature will be given less attention. As a result, public space will be cluttered, and much attention will be paid to building digital and electricity networks. These networks will provide the needed data to make a connected city. Within this high-power demanding city, the energy will be raised by solar and wind energy.

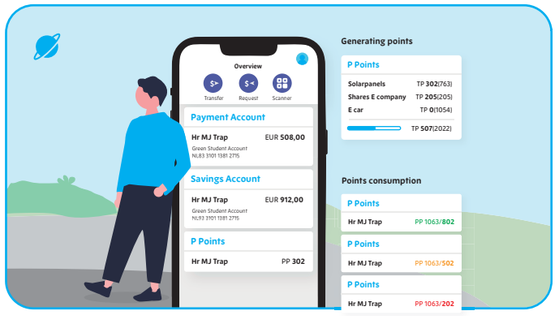
Example city: Beijing
Beijing is the capital of China. Beijing is known for high developments in technology and big companies. The development of technologies in China has many advantages, but also disadvantages. In this, it is an advantage for the government and a disadvantage for the residents. The issue here is camera surveillance. After the pandemic, camera surveillance greatly increased throughout China and Beijing (Yang, 2022). With this, many camera images are in the cloud and many residents are monitored. The government plans to have full access to the online lives of its residents so that all personal information is available. This will allow the government to see what is in demand among residents and thus base administrative choices on it. The question is whether this development will be perceived as positive or negative. For instance, camera surveillance can be used for good deeds to find criminals or missing persons. But the question these days is whether it is also misused. With the development of AI having an online system with face recognition, there is more and more talk of a safe city instead of a smart city.

2.4

Business world

In the business world scenario, society is individualistic, and market thinking dominates the economy. Large companies take the lead. Personal responsibility is paramount, including for sustainability. One of the characteristic developments in this future world is a greater contrast between further urbanization in the central city and tranquillity elsewhere in the world.





Cultured meat
People will still feel the need to eat meat. This is mostly about the idea of consuming meat, so cultured meat will be a very good substitute. There will be much investment in technology focused on imitating food in a more sustainable way.

City
The inner-city area is characterized by high-end urban campuses, many offices, and both green and engineering measures against heat stress and flooding. In the urban periphery area, the city greets the land. The emphasis is on the separation of functions and inequality between neighbourhoods.

Mobility
Mobility will rise overall. A lot is being invested in additional infrastructure such as fast lines and projects like the hyperloop. This covers long distances and should minimise travel time. People largely move around in their own electric and autonomously driven vehicles.

True pricing
A True Price is the market price plus the social and environmental costs of a product. This involves looking at underpayment, climate impact, land use and water use for a pepper, for example. The aim of true pricing is not to make your products more expensive, but to make them more sustainable. The extra amount paid will go to the producer so that the production process can become even more sustainable, which will ultimately balance the true price with the retail price.

Planet Point System
The planetary points system will be introduced. This system introduces a personal sustainable wallet. This involves offsetting emissions by investing in sustainable projects. This includes examples such as solar panels but also investing in companies developing sustainable projects. When one invests big, one can also consume big.

Business world
The business world is an individualistic society that invests a lot in offsetting its emissions. Here, sustainability is strongly linked to income through true pricing. It invests heavily in innovative projects such as the hyperloop and cultured meat. This does not require a strong behavioural change. People with equal incomes will gravitate towards each other and an affluent middle city will emerge. In the process, rising pressure on the ecological system will be offset by green technology.

Example city: Singapore
Singapore is the capital city of Singapore. This city is best known for its technological development in recent times. In this regard, Singapore Airport Changi is a very good example. This airport is equipped with green areas, attractions and large shopping malls. The airport of the future has many features, including the ability to fly, of course. The plane now is very emissive, and so are terms like flying shame a thing. There are two options to remove the shame. One is choosing to travel by another less emitting mode of transport or to fly but offset it. There is the option of compensating for the flight by paying extra (“Changi Carbon Offsets,” n.d.). Based on the flight, it is calculated how many kg of CO2 is emitted (footprint), thus comparing how many trees are needed to absorb the mentioned amount of CO2 over one year. A price is then put on this and the flight should be compensated. The money is then invested in environmental organisations working for nature conservation, animal welfare and clean energy. Offsetting your emission is becoming more ordinary, KLM is for instance also a provider of this service. The act of paying for emissions is the definition of true pricing. Whereas flying will take a long time to become a reasonably sustainable mode of transport, cars will do so more quickly.

Calculate your travel carbon footprint

Purchase carbon credits to offset your footprint

View your offsets processed on the Carbon Registry

02 Future world conclusion

Future vision

The world of 2040 is outlined in this chapter. The city of the future and how its mobility plays a role in it. These extremes of future visions all illuminate a different turn on mobility. By having outlined these visions of the future and relevant projects, it is clearer what the future might look like. Using this vision of the future, it is also clearer where there is demand and where certain problems can be addressed. There are possible expectation about mobility, it will vary from no more physical traffic at all but online movement to extremely large highways where people pay to offset their emissions. In between are the options of taking responsibility as an individual to become more sustainable or as a community. Based on these insights, concepts will be developed and discussed in the next chapter. These concepts will be drawn up based on the analysis phase and the Green world. This world is believed to achieve sustainable mobility and encourage active mobility above passive mobility.

Based on the discovery in phase 1 the following design objective was stated for phase 2:

What? Who?

Design a mobility service that encourages residents in and around urban areas to become more sustainable by providing informative and behavioural changing insights during daily travel.

How? When

Phase 2: Concepts

Design concepts and deliver a direction

Chapters:

- 03. Concepts
- 04. Introduction battery

Analyse
Analysing current city layout, mobility and the road to sustainable mobility

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03 Concepts

Concept development for the future

Based on the analysis phase and future visions, concepts were drawn up. In doing so, some concepts are more in line with the development of electrification, community feeling, or behavioural approach. The following four concepts will be discussed: Planet Point System, Green points, Robin Hood, and Fair power. All these concepts contribute to moving towards a green world as described in the previous chapter. Today's technology was examined to take a first step towards the described future vision. These concepts will eventually lead to behavioral changes and will become part of everyday life by 2040. These concepts were devised using the HKJ method (Appendix M) Van Boeijen, Daalhuizen, Van Der Schoor, & Zijlstra, 2014). The question was asked how can you move towards a green world and encourage active transport.

Chapters:
- Planet point system, discussing the concept of giving people a fixed amount of emission
- Green points, discussing the concept of giving apartments a label for their sustainability
- Robin Hood, discussing the concept of making people pay for their mobility behaviour
- Fair Power, discussing the concept of making people generate their own power via cycling
- Concept selection, discussing the concept selection via a Harris Profile for Fair Power

3.1 Planet point system

The Planet point concept is mainly focused on behavioural change and consciously working on sustainability. By making more sustainable choices people will improve the climate.

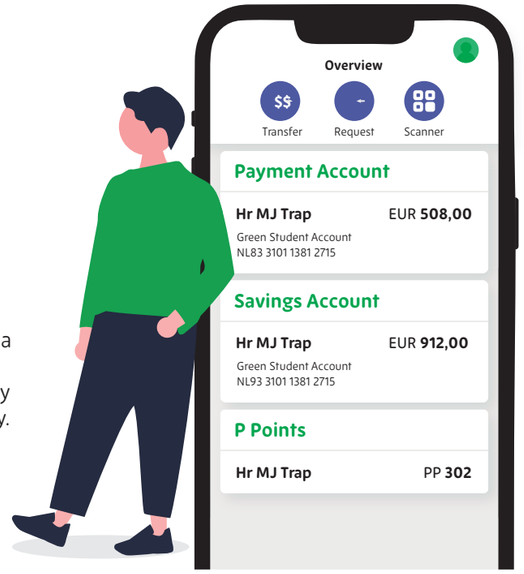
Concept

The Planet point system is a points system based on an emissions limit. Here, points are debited from a personal emissions wallet. Per year, there is 1072 kg of CO_2 to spend per person. This budget is set up so that if everyone sticks to it, the climate will recover (de Volkskrant (n.d.). This budget is linked to a person's spending and bank details (Figure 6). Here, every vehicle trip is recorded. For shared vehicles, this is by location and for fossil fuel vehicles by refuelling. For example, skiing holidays are much more emitting than holidays in the Netherlands. The points system is originally from PBL (Planbureau voor de Leefomgeving, 2023) and would be linked to all spending from groceries to the number of kilometres driven. This concept will focus only on mobility. By linking the number of points to emissions, it makes it much more tangible for users to determine their emissions. By getting instant feedback on emissions, more insight is created into how much a particular vehicle emits. A yearly budget will make the user realise that going to work by car every day is not feasible, and even less so for a flying holiday. By gaining clear insight into the points, users will have to make trade-offs and be more aware of their budget.

Inspiration

• PBL, the original concept comes from the planbureau van leefomgeving's future visions. This is also what the previously conceived variants of the planet points system in chapter 2 future visions are based on.

• 15-minute city, a city in which primary and secondary necessities of life are accessible within 15 minutes by active forms of transport. As a result, it is reasonable to state that active forms of transport are seen as the norm and the passive forms as mostly unnecessary.



Save points

P Points

Vacation Spain	PP **302**(763)
Vacation Venlo	PP **205**(205)
Ski vacation	PP **403**(1054)
	PP **910**(2022)

Points consumption

P Points
Hr MJ Trap PP 1063/**802**

P Points
Hr MJ Trap PP 1063/**502**

P Points
Hr MJ Trap PP 1063/**202**

Figure 6 (Planet point system)

Problem

• People have little idea how much emission a daily tour takes with the car, public transport or even the electric bike.

Solution

• By giving emission a number in the form of points, will make it tangible. Providing people a fixed amount of points to spend limits the overall consumption and emission. Providing the insight for peoples personal wallet will give them insight and make them aware of certain expanses.

Pro's

• It has an enormously high impact. If everyone sticks to the number of points, it will reduce a huge amount of emitting traffic. Since people still want to move around, all this traffic will be active transport.

• The points system creates visibility and tangibility of emissions. Over time, the connection between passive transport and points reduction will be made. This will result in additional consideration for using passive transport.

• A lot of variation can be made inside the system when it comes to the points. For instance, several variants were drawn up in Chapter 2 (Figure 7). These can be used to make it more attractive to stick to the budget (Yagi, 2010).

Con's

• The threshold will be very high when there are no clear rewards attached. It requires extreme self-discipline from the user himself. Users who meet this are not the users who need to be persuaded to use more active transport.

• Privacy, when every movement has to be translated into points, the location should always be known. Banking transactions will all be monitored and this will cause many users not to start or drop out.

Generate points within the Regional world

By helping out the community

Generating collective points

P Points

Upgrade playpark	PP **302**(763)
Upgrade school	PP **205**(205)
Plant trees	PP **0**(1054)
	PP **507**(2022)

Points consumption

P Points
Hr MJ Trap PP 1063/**802**

P Points
Hr MJ Trap PP 1063/**502**

P Points
Hr MJ Trap PP 1063/**202**

Generate points within the Fast world

By selling your personal data

Generating points

P Points

Sell 50 GB Personal data	PP **700**
Sell 20 GB Personal data	PP **250**
Sell 10 GB Personal data	PP **100**
	PP **550**(1000)

Points consumption

P Points
Hr MJ Trap PP 1063/**802**

P Points
Hr MJ Trap PP 1063/**502**

P Points
Hr MJ Trap PP 1063/**202**

Generate points within the Business world

By investing in green energy

Generating points

P Points

Solarpanels	PP **301**(763)
Shares E company	PP **207**(205)
E car	PP **10**(1054)
	PP **518**(2022)

Points consumption

P Points
Hr MJ Trap PP 1063/**802**

P Points
Hr MJ Trap PP 1063/**502**

P Points
Hr MJ Trap PP 1063/**202**

Figure 7 (Variants on the Planet point system from the future worlds)

3.2 Green points

The Green points concept is mainly focused on group unity and sustainability, achieved by common interest and effort. People can work together to get a sustainable green label for their building.

Concept

The green points system is a collective initiative. Users within a community work together to get a greener label (Figure 8). The label within a community is determined according to its sustainable mobility. The community is responsible for the layout of their apartment complex or street. This layout is limited to mobility and then involves changes to parking spaces. Choosing a bicycle parking space over a car parking space will be rewarded with a greener label, as well as new decoration within the community (Figure 9). This may involve choosing additional greenery or recreational opportunities. Users within the community will be driven to achieve the greenest possible label. In doing so, they will be rewarded by the system to become more sustainable as a community. Gradually, the sustainable community will focus more on active forms of transport and thus have more room for greenery.

Inspiration

• Community, from the regional world. Here, people are proud of their community. Making the community better is the biggest resilience to improvement. Everyone will feel responsible to demonstrate sustainable behaviour.

• 15-minute city, a city in which primary and secondary necessities of life are accessible within 15 minutes by active forms of transport. Here, a sharing system would work that consists largely of bicycles instead of cars. Active forms of transport are therefore realistic within a 15-minute city.

• Streetscape, the streetscape is changing in favour of cyclists and walkers. For this, more and more space is being made for active transport and this is at the expense of passive transport.

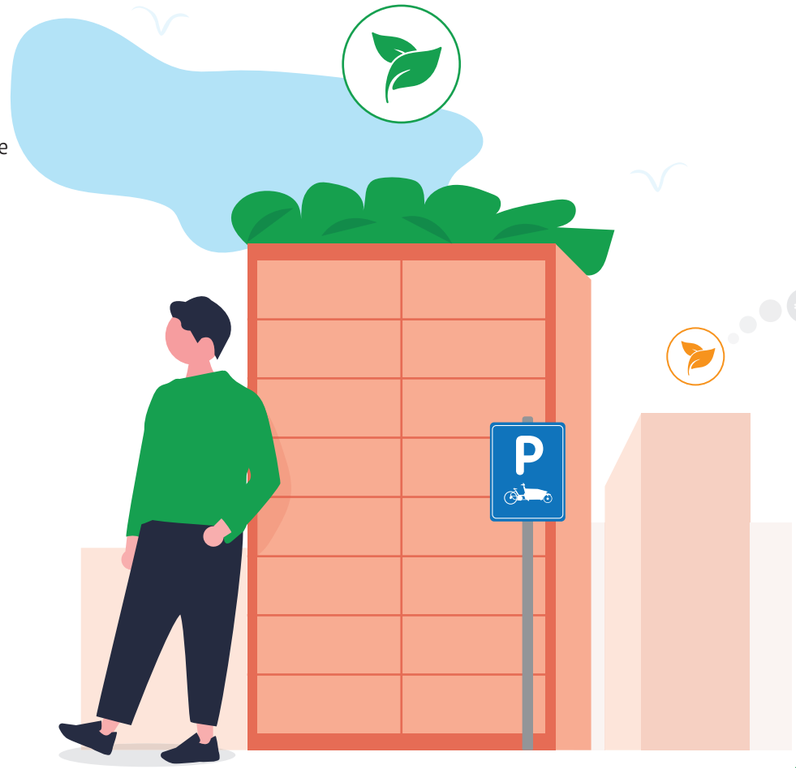


Figure 8 (Green label per community)

Pro's

• People will try to be as sustainable as possible because of their labels. Users will see the score within the community and feel the need to do better than other communities.

• Good behaviour is rewarded. People tend to maintain good behaviour longer when it is rewarded (Mulder, 2022). As well as being rewarded with a greener label, people will also be rewarded with an upgraded community.

Con's

• At one point, a community will not be able to green much more. After turning car parks into green, there is a limit to rewards. At that point, the label will not turn more green and the community will not be able to green much more. When the good behaviour can no longer be rewarded, cooperation and motivation to stay sustainable will drop.

Problem

• People have little idea how much emission certain habits require. Having a car in front of the door on a large grey concrete car park.

Solution

• By offering people a choice to become more green, people will see the potential and the influence of trading in those emitting habits for green. Besides a green environment people will also be rewarded with a more green label for the community.

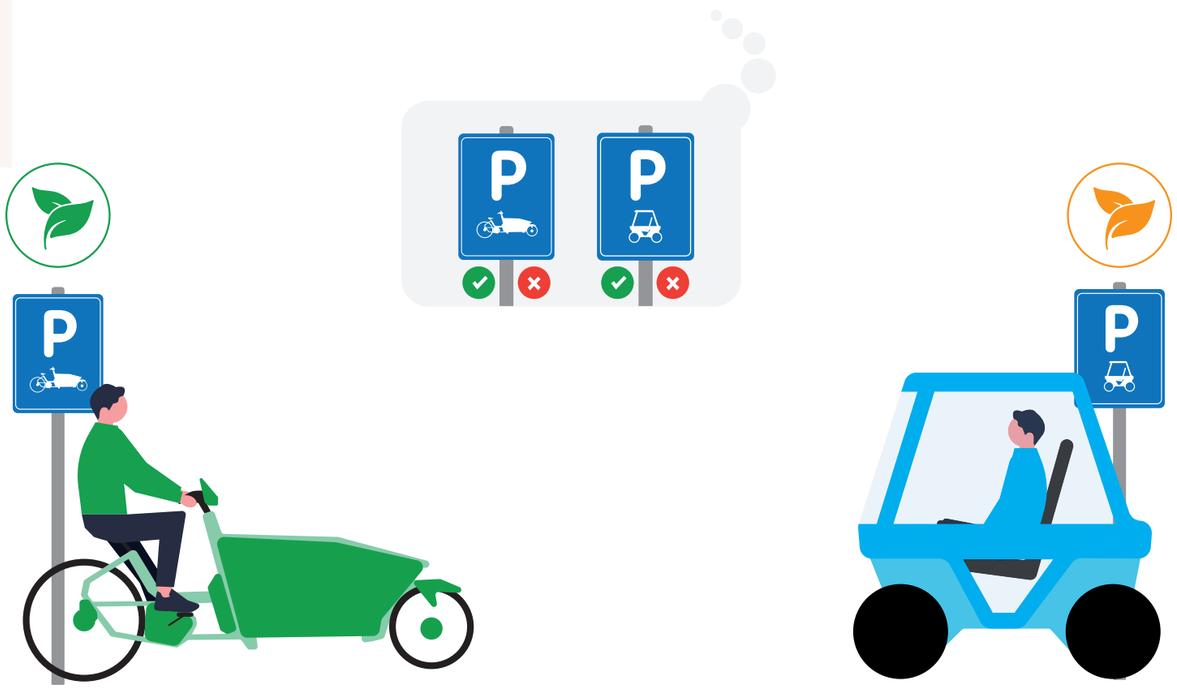


Figure 9 (Green point options)

3.3 Robin Hood

The Robin Hood concept focuses on real prices. People are rewarded for using more sustainable mobility by paying a lower monthly fee.

Concept

The Robin Hood concept is based on the stories of the folk hero Robin Hood. This hero stole from the rich and distributed it to the poor. This concept takes place in a future where all mobility is connected, a large network. This means that all mobility is monitored and all vehicles and their drivers can be tracked. Vehicle sharing has become the new norm and people pay a variable monthly fee to use mobility. This amount can vary according to people's driving behaviour. Individuals who demonstrate sustainable driving behaviour will be charged less, while those who do not will be charged more. For example, driving a car during rush hour and parking it in the city centre to go to work will result in a higher charge. On the other hand, using an electric cargo bike to run errands in the city centre will result in a lower charge (Figure 10). Besides the choice of transportation, people's driving habits will also be charged. Users can gain insight into their sustainable driving behaviour and potential extra costs based on their extra costs. They can modify their behaviour to pay less or pay more without changing their behaviour. Non-sustainable driving behaviour result in additional charges, resulting in reduced charges for sustainable users.

Inspiration

• Robin Hood, the movie. In the film, money is stolen from the rich and given back to the poor. The word give back is used because the poor have to pay unreasonable taxes to the rich. Robin Hood makes sure that the money is distributed fairly again. In this concept, there is no literal stealing, but the less sustainable users have to pay more so that it is redistributed fairly. So here the system acts in the name of Robin Hood, the poor are the sustainable users and the less sustainable users are the rich. One person who decides to act unsustainable will make it possible to reward several sustainable users with a lowered monthly charge (Figure 11).

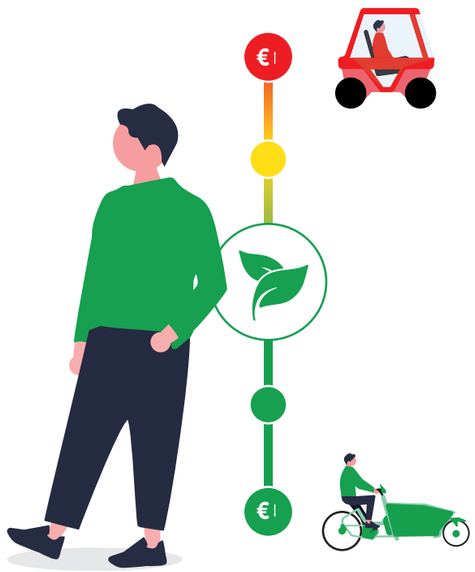


Figure 10 (Robin Hood pricing)

• True pricing, from the business world. This principle is applied literally. True pricing also takes into account the climate impact of a product or service. The Robin Hood concept applies this even more extensively. For example, you have to pay more for the car than for the moped bike, but on top of this, they will have to pay an extra amount for unsustainable driving behaviour. These additional costs will increase exponentially and thus will be relatively more severely punished.

• Share community, from the regional world. Here, people increasingly value access to a product or service more than owning it. Hereby, within a community, more people will share vehicles and fewer people will buy a vehicle for themselves.

Pro's

• People will try to be as sustainable as possible because of the cost. Monthly costs are lowest when people choose a cleaner vehicle and travel outside rush hour. In the end, sustainable mobility will pay off for users and for the climate.

• Good behaviour is rewarded. People tend to maintain good behaviour longer when it is rewarded (Snyder, 2020). As well as being rewarded with a lower monthly cost, people will also be reassured that they are doing a good and sustainable thing.

Problem

• People have little idea or choose to ignore mobility emission. Parking within in city centre is already expensive for instance, because of its low rate on sustainability and going by bike is mostly free.

Solution

• By making people pay per mobility action they will develop a sense for green mobility. This way people will get rewarded by acting green and punished for acting red. These rewards will be given in the form of flexible mobility prices.

Con's

• Bad behaviour is punished. People tend to reject something if they are repeatedly punished for bad behaviour (Snyder, 2020). As a result, the urge to adopt more sustainable behaviour will be slow to emerge, if it emerges at all.

• All active forms of transport are not taken into account in the system. These forms are the most sustainable and will not reduce the monthly charge. For example, someone who walks to work five days a week and drives their elderly neighbour to the shops once a week will be penalised by the system.

• Private cars are not taken into account. If people do not pay a monthly fee, it cannot increase or decrease based on sustainable driving behaviour.

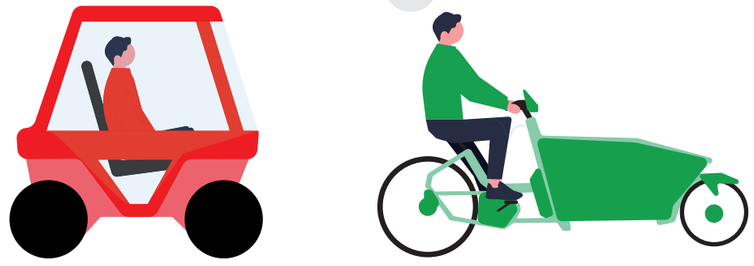


Figure 11 (Robin Hood principal, the emitting users enable the low costs for the sustainable users)

3.4 Fair power

The Fair power concept focuses on actively encouraging an active form of transport instead of a passive form. By using active forms of transport people's energy level will rise.

Concept

In a world where renewable energy is becoming increasingly important, mobility also changes. More and more vehicles are running on renewable energy and this has implications for people's driving behaviour. This is because these vehicles need to be charged with electricity to cover distances. Despite the fact that an electric car emits less than a car running on fossil fuel, it still emits more than a bicycle. To put these things in perspective, the concept of fair power comes into play. Here, the line between a physical battery and a symbolic one becomes very small. People within a community have a shared battery that drains by using the shared vehicles. Within this community, all users can use shared vehicles ranging from bicycles and cargo bikes to moped bikes and cars. This community located in an apartment complex or a residential street, can recharge the symbolic battery by using active transport (Figure 14). The battery drains again by using passive transport. So the battery level can be recharged by going on a share bike and drains again by going on a share car. The battery will drain relatively faster if a car needs to be charged because they consume more energy. Charging a bicycle, on the other hand, provides symbolic energy and also provides additional energy per kilometre ridden. There is also a personal battery that provides insight into each user's behaviour. This allows each user to gain insight into their consumption and progression. The overall battery consists of all the individual batteries added together (Figure 13). With this, each community will have a different level in battery and some will have a more sustainable battery than others (Figure 12).

Inspiration

• Share community, from the regional world. Here, people increasingly value access to a product or service more than owning it. Hereby, within a community, more people will share vehicles and fewer people will buy a vehicle for themselves.

• Electrification, from the business world. With the rise of electric vehicles, it makes sense to look at energy consumption in terms of emissions. Energy consumption is an insightful and tangible indicator of users' sustainable mobility.

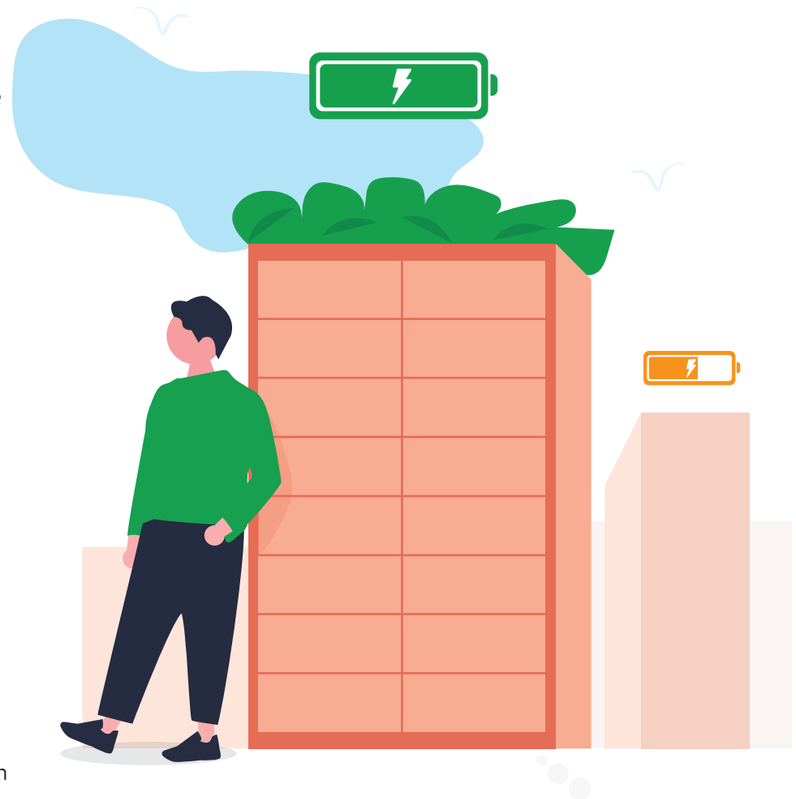


Figure 12 (Battery per community)

• 15-minute city, a city in which primary and secondary necessities of life are accessible within 15 minutes by active forms of transport. Here, a sharing system would work that consists largely of bicycles instead of cars. Active forms of transport are therefore realistic within a 15-minute city.

• Mobility pyramid, In a city built for active transport, it will be faster to get around by bike or walking.

Pro's

• People will try to be as sustainable as possible because of their personal score. Users will see the scores within the community and feel the need to perform equally or better than their fellow users. By naming and praising, users will try to improve their scores and become more aware of the benefits of active transport. By choosing active transport over passive, the health of the user and the climate will improve (Macharis, 2020).

• People will try to be as sustainable as possible because of their batteries. Users will see the score within the community and feel the need to do better than other communities.

Problem

• People have little idea how much energy it takes to drive a car from A to B compared to a bicycle. As a result, they consume a lot of energy.

Solution

• By allowing people to generate energy themselves, it suddenly becomes much clearer how much effort it takes to generate energy themselves with active transport and how quickly it disappears with passive transport.

Con's

• Active forms of transport cannot be monitored when driven by personal vehicles. Cycling and walking are the most sustainable forms of mobility and should be rewarded the most. When this is not done with a shared vehicle from the community, there is no way to monitor how many kilometres have been driven. Users can only generate energy when they share their location during the ride.

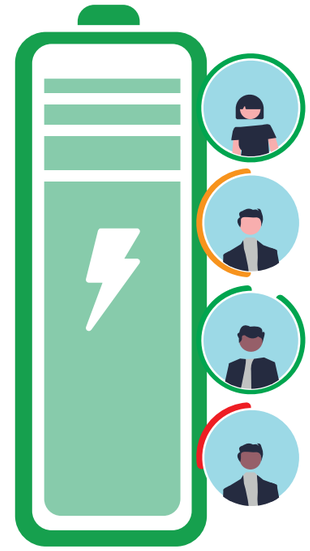


Figure 13 (Battery per user)

Figure 14 (Battery costs per vehicle)

3.5 Concept selection

This chapter will explain the selection between the concepts discussed earlier.

Impact and success rate

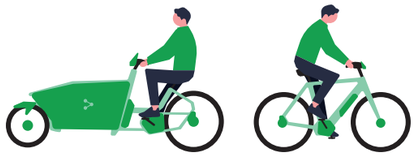
To choose between the concepts discussed earlier, certain criteria were considered. A trade-off was taken between the impact of the concept and the success rate. The impact the concept has is about the impact to make people more aware of sustainable mobility and use active transport more. This means that the ideal impact would result in everyone preferring active over passive transport. Such an ideal impact would be perfect for this project but is often unrealistic. Therefore, the success rate of the concept was also taken into account in the choice consideration. This means that the concept is accepted by the users and it is eventually integrated.

Change

The criteria on which the choice was made were inspired by Macharis' six Es (2020). These factors were drawn up for successful change. This project focuses on changing people in terms of mobility. Therefore, the six factors will be discussed first:

- Estimate: set and formulate clear goals.
- Engage: engage everyone emotionally.
- Educate: inform about how to achieve it.
- Enable: the way to achieve the goal should be easy.
- Encourage: encouragement through positive rewards.
- Embrace: how to speak to different target groups,, everyone is different.

When a concept meets these six factors, it will positively influence its impact and success rate.



Criteria

These criteria have been drawn up to achieve the aim of this project. Here, the criteria are numbered from most to least important. The most important goal is to encourage active transport (1). It was found that this goal is best achieved collectively (3) (CROW & Advier, 2024). By motivating each other, the goal will become a group effort and has a lower change of failing (Andrews, Tildesley, Hops, & Hakamies-Blomqvist, 2002). It is also important that the concept makes people think about their impact on the world and how they can improve it (2) . By becoming aware of the importance and affect of mobility, behaviour is more likely to change (Macharis, 2020) . It is important that people easily accept and use the concept (5) and continue to stay motivated (4) (Macharis, 2020). The bigger the target group the more impact it has. By making the concept as inclusive as possible, it will attract a lot of followers (6) (Macharis, 2020). Finally, it looked at whether it can be implemented in the short or long term (7) (Macharis, 2020), speaking about technologies and user habits. By implementing it on the short term, it is more likely to succeed because of its total impact. These criteria are based on Macharis' six E's (2020) and self-appointed criteria from the analyse phase that are important to meet the design goal: To design a service to encourage more sustainable mobility in and around urban areas. From this, the following criteria emerged for the Harris Profile (Figure 15):

(1) Encourages more active than passive transport

(2) Raising awareness about sustainable mobility

Success rate:

(3) A shared goal to work towards

(4) Motivated to make mobility more sustainable

(5) Low barrier to entry

(6) Inclusiveness, is everyone involved

(7) Short-term implementation

Harris Profile

A Harris Profile (Van Boeijen, Daalhuizen, Van Der Schoor, & Zijlstra, 2014) is a graphic representation of the strengths and weaknesses of design concepts with the respect to predefined design requirements. It is used to evaluate design concepts and facilitate decisions on which concepts to continue with in a design process

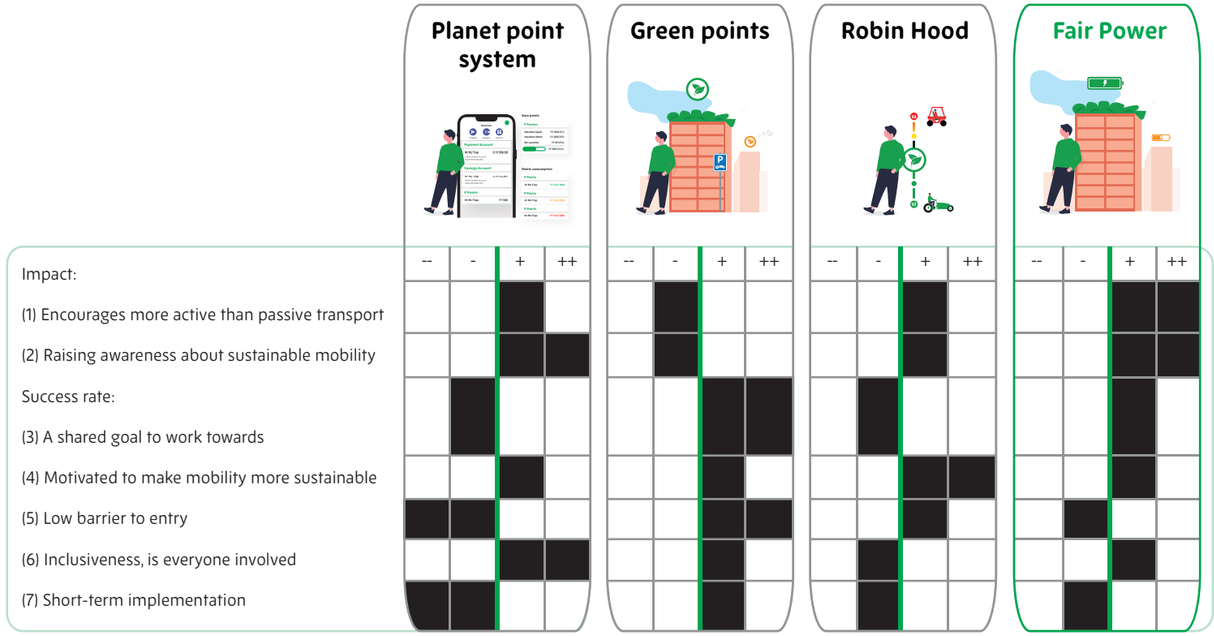


Figure 15 (Harris Profile, choice of concept Fair power)

Fair power

Based on the impact and success rate, the concept of Fair power was chosen. This concept rewards the use of active transport by handing out rewards within the community. Contributing to a green battery will generate something for the community and the personal score will motivate them to keep their own generated power as high as possible. At the same time, this personal battery also generates awareness about how much battery is needed for a car ride compared to a bike ride. By being responsible for recharging the battery, the user will think twice about whether to take the car for a short ride, as usual or to take the bike to recharge both his personal and collective battery. The personal battery and the linked ranking will provide extra motivation to have one's name as high as possible. This phenomenon is also known as naming is praising (Snyder, 2020). The concept has a relatively low threshold for participation, as it is not mandatory. Nevertheless, the analysis phase showed that by 2040, share culture will be the norm, making it likely that people will use shared vehicles within their communities. Similarly, electrification will become the norm within transport. In electric vehicles, the battery will therefore become a good and universally understood indicator of the energy it takes to drive. Since these mentioned developments will take time to become the new standard, the concept will be able to be implemented in the long run. Still, a vast majority of the necessities are already in place, for instance, mobility hubs are growing and more and more neighbourhoods are being built with share culture ("Limiting Private Parking Lots," 2021).

It does not mean that the other concepts are completely forgotten, quite the contrary. It will look at lowering the barrier to enter from Green points, where people are part of the system and do not actively have to enter any competition. People will drop out when the onboarding process is to long or intensive.

It will also look at applying the concept in the short term, by getting people ready for the relative new concept. People are not used to getting their emission presented to them, and get feedback on their mobility consumption.

So, Fair Power will have to be implemented on a shorter term with a lower barrier to get in. This will improve the Fair Power concept.

The Fair power concept was selected based on the criteria. This concept best meets the requirements and wishes and will be complemented by other concept ideas, to improve the low barrier to entry and short-term implementation.

03 Concepts conclusion

Concept: Fair power
The future of sustainable mobility is bound to come. This project tries to achieve it with active transport. Encouraging people to change their behaviour and getting users to cycle and walk more by means of a battery. Four concepts were developed for this purpose and of these, Fair power was chosen, based on its impact and success rate. This concept will serve as a foundation for the rest of the project and will be supplemented with strengths of the other concepts. The battery of the Fair Power concept will be explored and further developed.

04 Introduction battery

Battery
The next chapter consists of evaluating the battery from the Fair Power concept. To test whether the battery connects and is understood by the user, tests were carried out. The connection of the battery to the user was tested using context mapping and a subsequent interview under the heading of battery exploration. Next was looked at how the battery is communicated to the user in the form of a service using interviews under the heading introduction service.

Chapters:
- Battery exploration, discussing the effectiveness and the need for the battery. Testing the knowledge of mobility emission
- Introduction service, discussing the setup for the service. Testing different interface layouts

4.1 Battery exploration

This chapter explains battery evaluation in the fair power concept.

The concept of Fair power is based on charging an external battery. This battery charges when walking and cycling. The battery runs down when moped bikes and cars are driven. This rewards the use of active transport and punishes passive transport. The battery should be a simpler version of the emissions of a person's mobility behaviour. The battery should clarify how many emissions a car ride entails and make the concept of emissions more tangible.

Evaluation

To say with certainty that the battery appeals, a test has been conducted. This survey should provide insight into whether there is demand for a sustainability battery or not. This test consists of a diary (Appendix A) where participants were given a battery to take with them. In this diary they were asked to record their mobility into the battery. After the diary was completed a interview was conducted with further more in depth questions (Appendix B).

• Preconceptions
People find it hard to put emissions into perspective how much a kilo of carbon dioxide is, for example.

• Preliminary research
People have little idea of the impact of emissions. The impact of carbon dioxide to some extent is not well understood in terms of its impact on the climate. (Andersson & Wallin, 2000)

This test was conducted among the age group of 18-35 N=6. This group is set to become the most prominent passive transport users. Targeting this group of (young) adults, who were used to cycling a lot and using public transport, should lead to a decrease in the amount of passive transport in the near future (Centraal Bureau voor de Statistiek, n.d.). This generation is used to digital support and is open to changing their behaviour when it is well-founded (Worldwide, 2001).

Test participants
18 25 y.o.

Goal: Determine whether the battery offers change and insight into mobility behaviour and the overall appeal and meaning of the battery.

Method: Contextmapping is a user-centred design approach that involves the user as the 'expert on his or her experience'. By providing the user with generative tools, he or she can express personal experiences in which a product or a service plays a role. (Visser, Stappers, Van Der Lugt, & Sanders, 2005).

Participants were asked to fill in a battery (Appendix A) in advance based on an average day in the week. In doing so, they were asked to reason out how many kilometres they travelled per day by vehicle. Here, passive transport was represented with red, public transport with orange and active transport with green. They were then asked to enter the reasoned distances using Google Maps to note the actual distances. This initial process was guided and then the participant was asked to keep a battery in their own time for two days based on their movements. After two days the participant would have a filled-in diary. The diary will be discussed based on interview questions (Appendix B). This interview occurred quietly after the interviewee was asked to complete the consent form.

Interviews are face-to-face consultations that can be useful for understanding consumer perceptions, opinions, motivation and behaviour concerning products or services, or to gather information from experts in the field (Van Boeijen et al., 2014).

• Materials
Battery (Homework)(Appendix A)
Question list (Appendix B)
Consent form (Appendix C)

Results: Direct results from the Context mapping in term of mobility
• People have varying idea of how many kilometres they cover.
• People have hardly any idea of how much they emit
• People have no idea what the ratios between different vehicles are in terms of emissions
• People estimate themselves to be more sustainable than they actually are

Results: Direct results from the interviews (Figure 16)
• People are very curious about what their battery will look like
• People feel the need to justify their emissions
• The battery generates a form of pride when it turns green
• The battery generates desire to improve

Insights: People indicated that they acted on their own assessment of how sustainable they are doing. If people cycled every day, it did not matter if they only drove a car on weekends. The battery gave insight that more cycling was needed to offset the car ride. These insights were an eye opener for all those interviewed and already drew their own conclusion that they were less sustainable than they thought. They almost felt guilty and were immediately interested in how to keep the battery as full as possible.

Insights: People indicated that their personal situation plays a big role. In fact, it is most fair if everyone was compared to each other with their battery. But in practice, people who can cycle to work will come out much better than people who have to go by car because they would otherwise have to cycle for more than an hour. This would leave only the users who already cycle motivated with a fuller battery and the other users only demotivated by an ever-depleting battery. By looking at a mobility behaviour profile, a much more personal and accurate sustainability score can be shown. Not looking at age, but looking at personal situations will present a much more accurate battery.

Conclusion: Based on these insights, it can be concluded that people are interested in their mobility emissions and the battery is an understandable representation of that when it is personalized.

Figure 16 (Quotes from participants during the tests)

The battery is a clear indicator for people that allows them to monitor their mobility behaviour. The battery does need to be personalised as everyone is in a different situation. The focus will be mainly on people within urban areas, open to improvement in sustainable mobility consumption.

4.2 Introduction service

This chapter explains the creation of the service after the battery concept was confirmed. This involved exploring how the user would like to receive the battery and what a service of it would look like.

To properly communicate the battery with the user, it is necessary to test whether the user is comfortable with the battery. Are the statistics clear and are they well taken care of. The user is taken through the various demo screens on this test. This was done in the form of an interview supported by visuals (Appendix D).

Evaluation

The test was conducted with a diverse audience. There was a departure from the previously mentioned target group. Because, age does not have much to do with someone's mobility behaviour. It looks much more at other factors that are not age-related. Therefore, a target group as diverse as possible was selected, ranging from people between 18-60, students as well as working young people and working old people, living in larger cities to small villages and owning or not owning a car N=5.

People were told beforehand that the screens were about a mobility battery, but nothing else. Thus, while some awareness about the concept was outlined, there is still much for the participants to discover. This was chosen because when the user would use the service in real life they do have knowledge about the subject before going to use it.

Goal: Determine how the battery should be communicated to the user and what it will look like.

Method: Interviews are face-to-face consultations that can be useful for understanding consumer perceptions, opinions, motivation and behaviour concerning products or services, or to gather information from experts in the field (Van Boeijen et al., 2014).

Participants were asked to go through the screens (Appendix D) one by one. They were asked to explain what they thought it was about and give their direct feedback. The main question here was whether they would use it themselves and then why or why not. To explain why it would not be clear, whether this had to do with the design of the interface or whether there was no interest in it. The following screens were presented: onboarding, battery, statistics, and the battery % per vehicle (Figure 17.2).

• Onboarding, to make the battery personal, people were asked to fill in personal information. This asked for work, home, and study addresses

• Battery, to see what interested users, the battery and two labels were visualised. Labels presenting the current electricity price and the current Mobi score.

• Statistics, to see what kind of statistics the progress of the Mobi battery interested the users, the following statistics were presented. The goals achieved, where users could set their own goals and see their progress. An example of a goal is, for example, cycling 3.5km every day.

• Battery % per vehicle, to give additional insight into how the battery was created, a graph is showing the battery charging and discharging.

As final question the overall impression was asked.
• Materials
Mobi introduction (Appendix D).
Consent form (Appendix C)

Results: Per screen feedback was given.
• Onboarding
It turned out that this was a long process and its usefulness was not immediately clear.

• Battery, the users liked that their sustainability score was so present to see in a glance whether they were more sustainable than last month. Here, the electricity price and the Mobi score appealed less. These labels created too much confusion.

• Statistics, many were interested in the money saved by cycling instead of driving. Yet people were curious how this was calculated.

• Battery % per vehicle, the graph was not all clear without additional explanation. Participants doubted if they would like this insight so prominent on the screen.

• Overall impression, comments into the statistics differed per person (Figure 17.1), but people were interested in the overview. Based on the images of the service, there were a few comments that came back more often. For instance, there was a general request for tips on how to ensure more sustainable mobility themselves. There was also general doubt about how often the user would actively want to see the battery as it would only be visible in an overview.

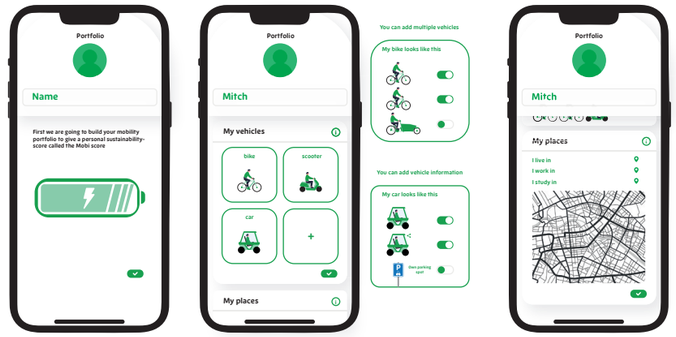
Insights: People had a general demand for help with certain statistics and help with improving their mobility consumption. There was a demand for a Buddy system, which translates incomprehensible emissions into a logical simple story to the user. Provides additional explanation on how the battery is calculated and how the user can improve.

People are not likely to go into the overview on their own accord to see how their battery is doing when there is no immediate reason to do so. Unless a notification or the battery comes along at multiple touchpoints when using mobility. Here, connection to the bicycle or car, for example, was already considered.

People do not feel like going into an onboarding process. This takes too much effort and will cause many people to drop out. An automatic system would work much better so people can search for their battery immediately. The mobile can already generate a lot of information to make the onboarding process as short and smooth as possible.

Conclusion: The battery can be well communicated through tested screens. There is still demand for a smoother onboarding process. The battery should be in sight of the user multiple times for higher success. The battery should be in conjunction with a virtual buddy system to communicate the battery and what the user can do to improve their battery score.

Figure 17.1 (Quotes from participants during the test)



Onboarding screens

Battery overview screens

Figure 17.2 (Screens for onboarding and battery overview)

Providing an overview of mobility consumption generates user interest, but requires even more support beyond an overview. Personal support and progress is needed in the service and is the base for the Service called Mobi in the upcoming chapters.

04 Battery conclusion

Fair Power battery
The battery strikes a chord with the user, according to multiple interviews and context mapping conducted with 11 test persons. The target group focuses on people's situations, which the battery needs to take into account. The focus will be mainly on people within urban areas, open to improvement in sustainable mobility consumption. There is demand for a supportive buddy system that explains the battery and gives tips for improvement. People like to see their progress and would like to see this beyond just their mobile, so at different touchpoints when using mobility. The threshold for using this service should be as low as possible so that people can quickly and clearly see if they are engaging in sustainable mobility. After all, tests have shown that people act on how sustainable they rate themselves. Sharing a realistic and clear representation of their mobility consumption will automatically ensure more sustainable mobility.

Phase 3: Conclusion

Final service design and evaluation

Chapters:

- 05. Introduction Mobi
- 06. Introduction Mobi service
- 07. Mobi evaluation
- 08. Conclusion

05 Introduction Mobi

Mobi
The next chapter consists of introducing the Mobi service. This service is inspired by the concepts described earlier, especially Fair Power. The battery that recharges through active transport and drains through passive transport is central. The operation of this battery is explained under the heading Battery. The battery is different for everyone but remains motivated to become more sustainable. This encouragement is presented under the heading Buddy Mobi. Mobi has a buddy system that explains the service and takes the user by the hand.

Chapters:
- Battery, discussing the calculations behind the battery
- Buddy Mobi, discussing the buddy system within Mobi. Helping the user and celebrating progress

5.1 Battery

This chapter explains what the battery is based on, how it charges and discharges.

The battery of the fair power concept gives a quick insight into how sustainably someone travels. The idea is that a passive form of transport drains the battery while an active form recharges it. It is also important in what proportion the battery is charged or discharged. Where a car costs more electricity than a moped bike and a bicycle costs no electricity at all. As explained in the previous chapter, beyond these variables of vehicle choice, there are also personal variables. For instance, one person lives 1km from work and another lives 50km from work. To rectify this, the battery is set to multiple variables.

Variables

It is not simple to calculate emissions from a ride, unless it is by bicycle. That has no emissions while riding. On the other hand, the bicycle delivered a lot of emissions at the time it was made in the factory. And what all is included in emissions: carbon dioxide emissions, but also nitrogen oxide emissions and there have also been emissions when the cycle tracks were built. These are already the variables for just a bike ride. Not to mention the car, which has emissions while driving but also takes up a lot of space when parked. In addition, an electric car has fewer emissions per kilometre driven, but a fossil fuel car has fewer emissions during the making of the car (Volvo Cars, 2021). In other words, just for the vehicle itself, there are many variables that may or may not be taken into account.

Beyond transport choice, there are other variables as named in the intro to the chapter. For instance, whether someone needs a car for work or can use a bicycle, it matters whether someone has an alternative in the form of public transport or not. For instance, a student has a free travel product and an employee again has a shared car from work. Someone can charge his electric car with his own solar panels or recharge his car during off-peak hours when there is a power surplus ("Vattenfall," n.d.).

To fill in all this information for users would take a lot of time. Therefore, a general battery contribution per vehicle and variables was put together with advice from experts in the field of mobility (A. Brugman and R. Straathof, interview, 2024 January 30). The battery consists of the selected variables:

• Essential and non-essential trips
This considered the user's home, study and work location. Based on the test (Battery Exploration) personal situations need to be taken into account. An essential ride from home to work or study location will be judged less severely than a non-essential ride with passive transport. Based on the distance travelled, the margin will become increasingly lenient.

• Ownership
This relates to taking up space outside private property for vehicles. A car idling in a parking space on the public road occupies space where green plants could also be located or a wider cycle path ("Sustainable | Future. Green," n.d.). In contrast, not owning emitting vehicles will be rewarded with a +1% per day.

• Alternatives
This looks at whether a driven journey could also have been made in a more sustainable way. A short car journey will be counted relatively more severely than a long car journey, when it could easily have been reached by bicycle. By punishing these journeys, awareness will be raised (Macharis, 2020). Therefore, the alternative road % will be variable, depending on the severity of the ride.

• Energy
When electricity is generated during off-peak hours or with the help of your own solar panels, this will be rewarded. This so-called sustainable energy produces fewer emissions ("Vattenfall," n.d.) and will be rewarded with +0,5% per kWh.

• Travel circumstances
When people drive together or use a shared car, this will be punished less severely than when a journey is made alone. Sharing cars or rides will lead to less emissions ("Sustainable | Future.Green," n.d.). This will be rewarded with +1% per km.

• Vehicle
As discussed earlier, the choice and type of vehicle influences emissions. For emissions, carbon dioxide emissions per passenger driven kilometre were taken into account (Milieu Centraal, n.d.). This only looked at electric vehicles with a view to 2040. The production and recycling process was not taken into account. It was decided not to include public transport in the battery, as this offers a more sustainable alternative to the car (Klein & Kersten, 2022). Speaking about a more sustainable option in terms of space efficiency, air pollution and carbon dioxide emission. Public transport is a means of completing the journey by bicycle and will demotivate if this is also punished, despite the fact that it is a passive form of transport ("Uber Newsroom," n.d.). Based on these assumptions, the following transport scheme has been drafted (Figure 18).

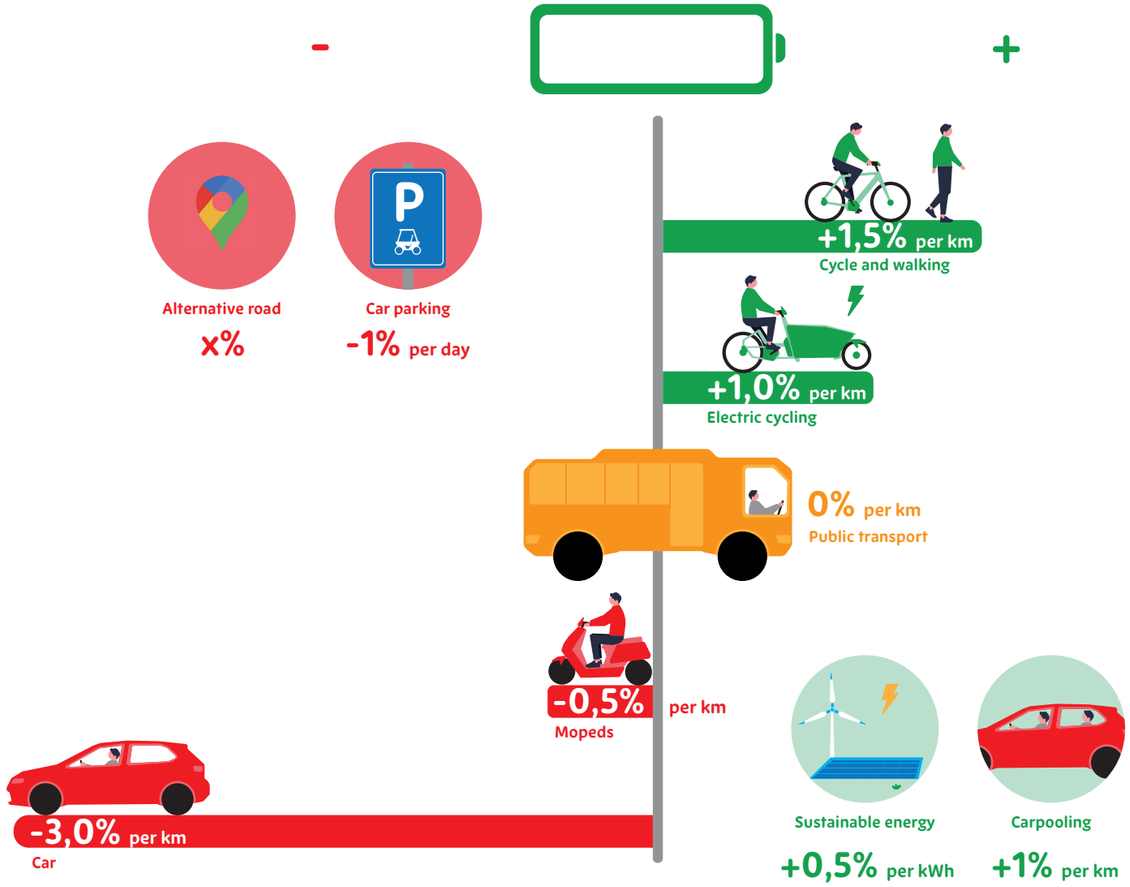


Figure 18 (Battery contribution per vehicle)

Accuracy

To display a correct battery, the user's location via GPS is used. Thus, the user's movements are mapped and corrected by the aforementioned variables. To skip an onboarding process, the battery will learn by starting to recognise movements and link them to vehicles. This is done by speed and location and movement ("Geosite," n.d.). Users will need to give permission to track their phone for this data, such as with many applications these days (Klosowski, 2022)
The battery will recognise fixed routes and begin to see patterns and map relevant alternative routes ("Types of Self Learning Artificial Intelligence: Which AI Learns on Its Own?," n.d.). This method of analysing data and making predictions is called machine learning. Machine learning is a form of AI (Staff, 2024). By letting machine learning do this, the user has to do as little as possible to keep up with the battery and can focus entirely on improving their battery. This should lead to a lowered barrier to entry, as concluded as one of the weak points of the Fair Power concept.

In addition, machine learning can also adjust the battery when the user makes progress but it is barely visible. In this case, the battery can charge faster to confirm the user's more sustainable behaviour. Similarly, the battery will be boosted when 0% has been reached after a month without active travel. After reaching 100%, a passive activity can be hardly punished to keep the user focussed. The user will be tested and motivated to keep improving their battery score every time. This is to re-emphasise the purpose of the battery, besides giving insight into one's mobility consumption, it should encourage more active travel.

The battery is set up using fixed ratios per vehicle combined with personal variables that put the battery in perspective for the users' situation.

5.2 Buddy Mobi

This chapter explains the introduction of the buddy system called Mobi.

Emissions are a tricky subject and, similarly, interviews (Chapter 4.1) revealed that users have little knowledge in this area. People sometimes need someone to tell them that they are not as sustainable as they think they are. And especially someone who can give tips on how to do it better. There was a demand for support to assist the user in the process. Not just offering insight into statistics, but also encouragement. A buddy system was devised for this purpose (Andalibi & Flood, 2021). This will encourage the user and provide additional explanations on statistics, progress and tips for more sustainable mobility. The buddy called Mobi will explain the Mobi system at an appropriate speed. This will include an onboarding process at the bike, car, and overview. Buddy Mobi will always be present for additional information and can also be quickly clicked away when there is no need.

Mobi is so designed to always be friendly, playful, positive, helpful and always within reach.

• Friendly
Mobi is friendly so it appeals to people. He will celebrate progress with you.
• Positive
Mobi is positive so people see progress and are always encouraged to improve. Even when the battery has run down, Mobi will always approach it from a positive light, but subtly let people know through colour that you have used passive transport (Figure 19).

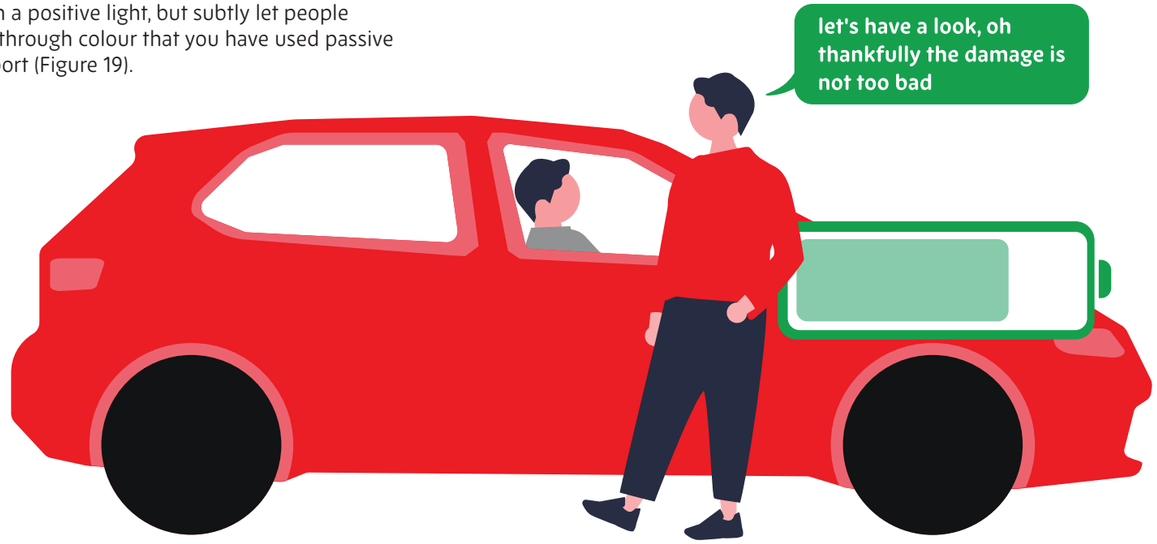


Figure 19 (Mobi communicating loss of battery)

• Playful
Mobi is a playful little guy, so people won't find him too pedantic or scientific. People are less likely to tire of him
• Helpful
Mobi is always there to help the user. He will explain all functions and always be there to help the user (Figure 20).
• Within reach
Mobi is always within reach and will be there within a swipe on the bike, in the overview and in the car at a safe distance (Figure 21).

Fair Power

Incorporating a buddy system will make the concept stronger. For instance, the Fair Power concept scored badly on barrier to entry and on short-term implementation. By taking the user by the hand and explaining everything, it will be perceived as less demanding to learn a new service. Also, by explaining a lot to the user, more knowledge about emissions will emerge and it will take less time to accept the service by the user.

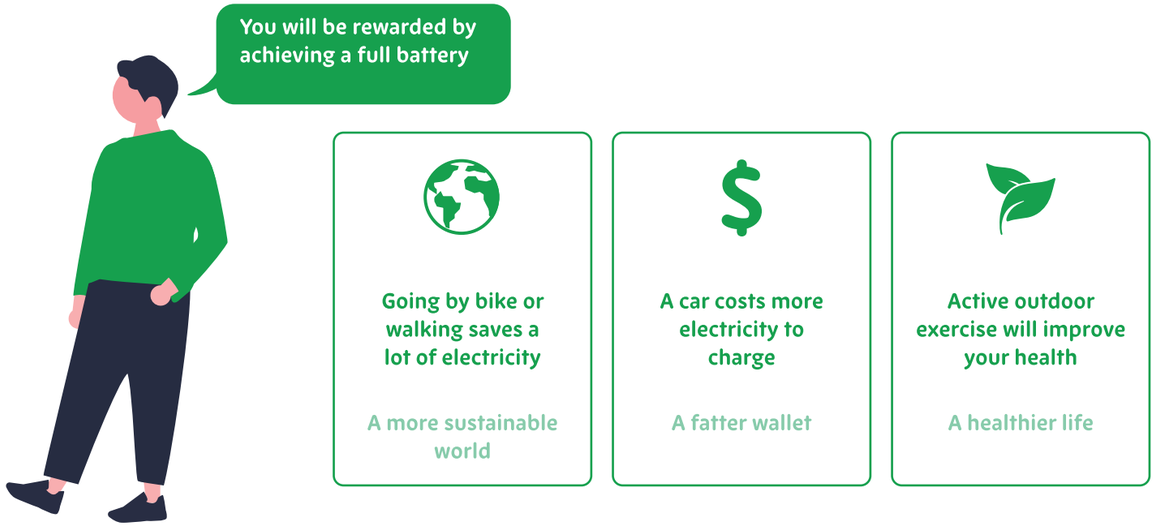


Figure 20 (Mobi will explain everything)

Buddy inspiration

Buddy is inspired by the little owl from Duolingo. Duolingo's success with the character comes through neuromarketing methods (Van Ham, 2022). This keeps people motivated to play it. The following methods have been applied to Buddy Mobi:

• The goal gradient effect, in which an indication is given of how the user is doing. Mobi will always show a battery of the user's score. This will motivate them to reach the end, or in this case a filled battery.
• Motivating with compliments, by reminding the user of her good behaviour, is motivating.
• Reminders, Mobi will notify the user of her battery status in the form of a notification. This can be turned off or on by the user.
• Responding to emotions, Buddy Mobi will change colour when passive transport has been used. When active transport is used, Mobi is green and will automatically let the user know they are doing well again.
• Challenges, Buddy Mobi will set new goals with the user every day. This will give the user extra incentive to perform well.

Buddy exploration

• The form in which Buddy Mobi would take place was explored by making many different versions (Appendix L). The choice of a puppet came from Duolingo's inspiration. This puppet was not explicitly tested for its likeliness but was not labelled as irritating during any test moment. As a result, it was assumed that Buddy Mobi serves as an appropriate form to provide information and help to the user.

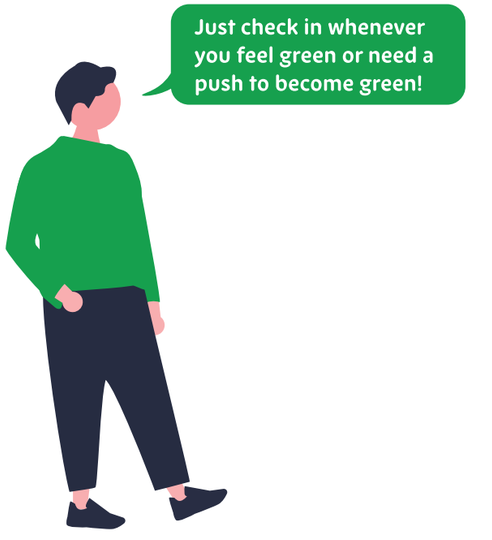


Figure 21 (Mobi is always within reach)

Mobi is a buddy system that supports the user and explains the battery. Mobi explains emissions in mobility in a simple but clear way, making it a more tangible subject for the user.

05 Mobi conclusion

Mobi battery

To represent a realistic battery, many variables were included. Writing down all these variables is difficult, so a battery was presented. However, the battery still has to take all variables into account. For instance, choices were made to reward walking and cycling with the most, then electric cycling and excluding public transport. This is because public transport enables active transport, while cars and mopeds are not. Besides vehicle choice, the battery is also influenced by travel conditions, energy, alternative routes, ownership, and the distinction between essential and non-essential trips. To communicate this battery to the user, a buddy Mobi is present. He explains the use of the service and is always friendly, positive, playful, helpful and nearby. This is partly to give the user the benefits of maintaining a positive battery.

06 Introduction Mobi service

Mobi
This chapter will explain the designed service: Mobi. A service that encourages users to use sustainable and active transport. This service consists of Mobi bike, car, and overview. Mobi will teach the user about sustainable mobility and will do this by linking emissions to a battery. This battery recharges when active transport is used, like Mobi bike. It will discharge when passive transport is used, as in Mobi car. To clarify, the battery will always be visible in the Mobi overview. This can be viewed via a smartphone. Mobi is linked to a smartphone and will serve as universal mobility proof. With this, Mobi will track where the user is, whether by car, bike, or public transport.

Chapters:
- Mobi service, discussing the service, the three elements and the touch points for the user
- Mobi bike, discussing the element of Mobi by bike to charge the battery
- Mobi Car, discussing the element of Mobi by car to discharge the battery
- Mobi Overview, discussing the element of Mobi on the smartphone to see all the changes of the battery
- Mobi, discussing the total service

6.1 Mobi service

This chapter explains how the Mobi service works

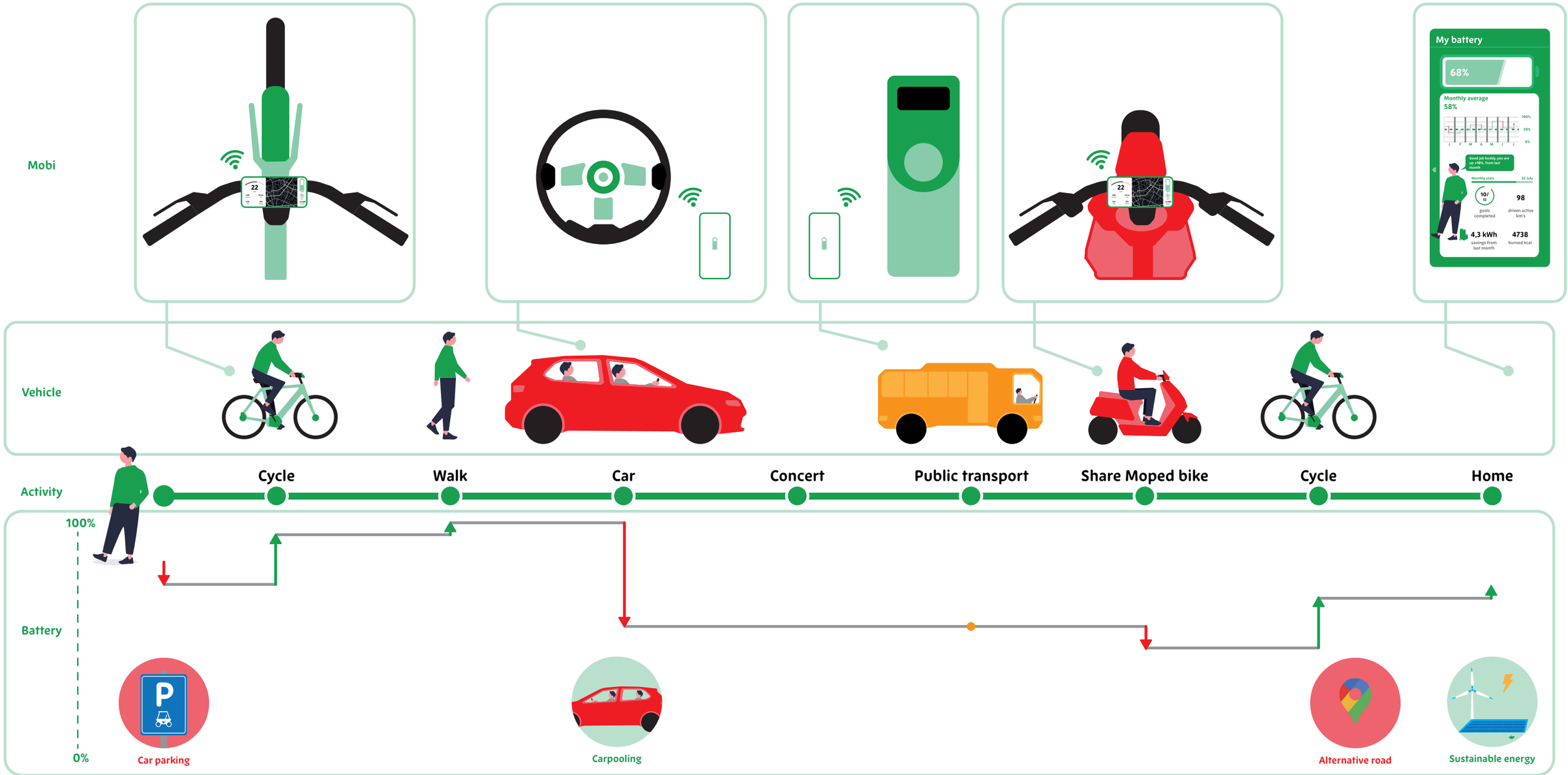


Figure 22 (Mobi system)

The figure above gives an overview of the Mobi system (Figure 22). It shows a possible route of different vehicles how this affects the battery and how Mobi deals with this. Here, Mobi is more present in some situations than in others. To give an example, a journey to and from a concert looks like this.

The Mobi system can be used through a smartphone. This was chosen so it does not depend on which vehicle you are driving. In addition, several vehicles are increasingly equipped to use the smartphone as an extra dashboard. The appearance of Mobi is different for each element. Mobi will have three main elements: Mobi bike on the bike, Mobi car in the car, and Mobi overview on the smartphone. Mobi will be used for different vehicles such as the bike, car, pedal bike, and public transport. With Mobi can be checked in and it will automatically provide the needed information at the right time.

The Mobi system consists of three components. Where Mobi is present during active transport, passive transport and when there is a demand for insight. The following chapters will explain all three components in more detail.

6.2 Mobi bike

This chapter explains how the bike part of Mobi looks like

Mobi's main goal is to encourage active transport. This involves recharging the previously mentioned battery by using a bicycle or walking. To offer the user insight into the battery, the option will be there to check the battery status while cycling. Inspired by newer bikes like the VanMoof S5 and the Veloretti Ace Two, bikes have a dashboard on the bike. In some cases, it is built in and in others the option to use the smartphone as a dashboard. This shows navigation, speed, time, duration and distance. So Mobi capitalised on this dashboard after the interviews (N=6, Battery exploration test) showed that the majority experienced this as convenient. Besides this traditional dashboard, the battery is placed on the side which can be swiped more and less in sight (Figure 23). This shows the progress of the battery and, if necessary, more statistics. This dashboard can be accessed through a smartphone, this was chosen to keep it optional. You can choose to click the dashboard into the bike's built-in holder on one ride and not the other (Figure 24). Mobi will always tell you at the start of the ride that the user is doing well and at the end of the ride, it will communicate the progression.

For Mobi to be a constant factor of motivation, the concept was reviewed with an expert from SJEES, B. van Ardenne. SJEES is a company dedicated to increasing bicycle mileage of company employees. Here, money works as the best motivator for employees to cycle to work instead of driving. At Mobi, the choice was made not to hand out money because it has to work in the long run as well, it has to become part of the user's pattern and bring lasting behavioural change. This is why it was chosen to display health gains and energy saved on the dashboard. Indeed, after money, these are the best motivators for behavioural change to cycle. In addition, active goals and battery progress can also be seen. By sharing these stats with the user, there will be a good chance of raising the 7km limit to stop cycling and contribute to more active transport (B. van Ardenne, Interview 11 April 2024).

Mobi bike can also be used on moped bikes. This will slowly drain the battery and also has the option of swiping the displayed stats completely out of the picture. The interviews showed that Mobi does not need to be present all the time and will otherwise be perceived as irritating (N=6, Battery exploration test).

Interview

Interviews are face-to-face consultations that can be useful for understanding consumer perceptions, opinions, motivation and behaviour concerning products or services, or to gather information from experts in the field (Bryne, 2001).

• Goal
Determine whether the battery offers change and insight into mobility behaviour and the overall appeal of the Mobi bike.

• Materials
Mobi screens (Appendix G).

• People
B. van Ardenne, SJEES

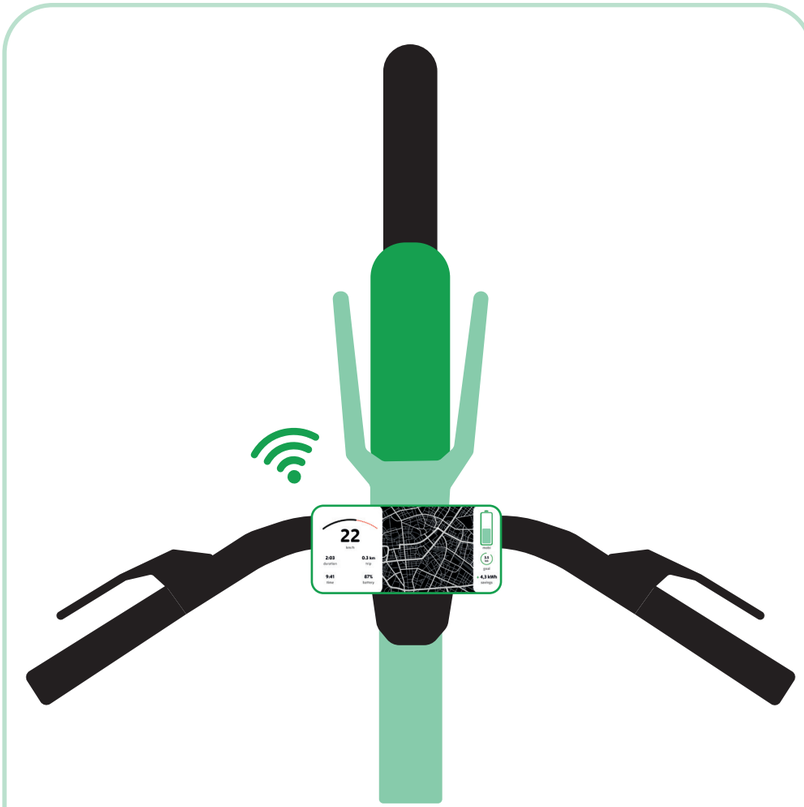


Figure 24 (Mobi on bike)

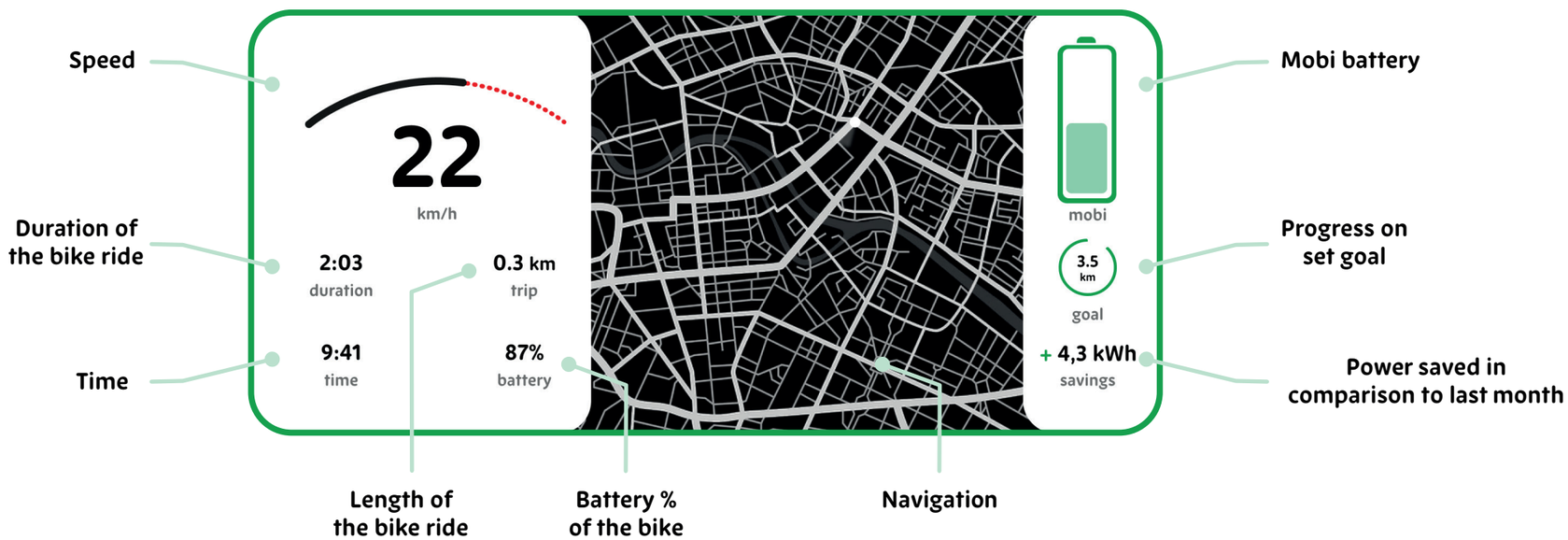
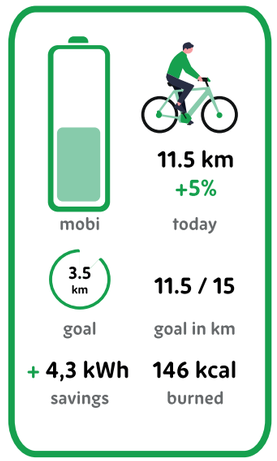


Figure 23 (Mobi bike)



Additional stats

Mobi bike is the component used on the bicycle and complements the traditional bicycle dashboard

6.3 Mobi car

This chapter explains how the car part of Mobi looks like.

Despite Mobi aims to encourage active transport, it is not realistic to say that passive transport will no longer take place. As mentioned earlier, people do not often take their bikes for distances over 7km. Long distances far above this will not be cycled easily, although sometimes it is better to use a combination of public transport. Often, these routes are unknown to the user and it does not occur to him to take an alternative route. This is where Mobi car jumps in. Besides the fact that buddy Mobi will turn red (Figure 25), it will offer an alternative route to the car. This will be displayed on the cars screen (Figure 26). By integrating it into car systems such as Carplay. Compared to the Mobi bike, it will be less extensive with the car. During the ride, the user has to pay extra attention to the road when riding faster, and will not need an extensive dashboard on the phone (Figure 27). As a result, the alternative route will be communicated up front after typing in the navigation. When there is no navigation typed in, the alternative route will be generated in the screen. Just like all the applications on Carplay, they can be swiped away and be muted. Mobi Car will show the active stats (Figure 25) to provide the alternative route and can be extended for more detailed information.

To communicate with the user what the alternative route could have been, the missed stats are also displayed. These are the stats that motivate the user the most and will therefore feel like a miss (Figure 28). B. van Ardennen says that translating to recognisable stats such as kcal burned and time makes it more appealing to the user and increasingly affects user behaviour these days. Thus, this way of urging and raising awareness can raise the 7km limit, besides the long range and low effort of the electric bike. As a result, cycling distances can be covered faster and, in some cases, travel time by bicycle will be faster than by car. This way, going by car will feel like a missed out opportunity to work on the battery and to work on health. Becoming aware of the alternative will be the first step, and later actual behaviour change will come in the picture.

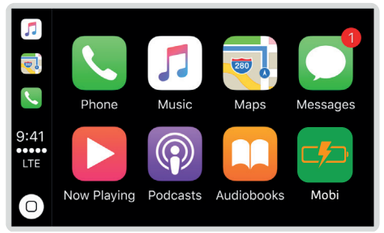


Figure 26 (Mobi car in Carplay)

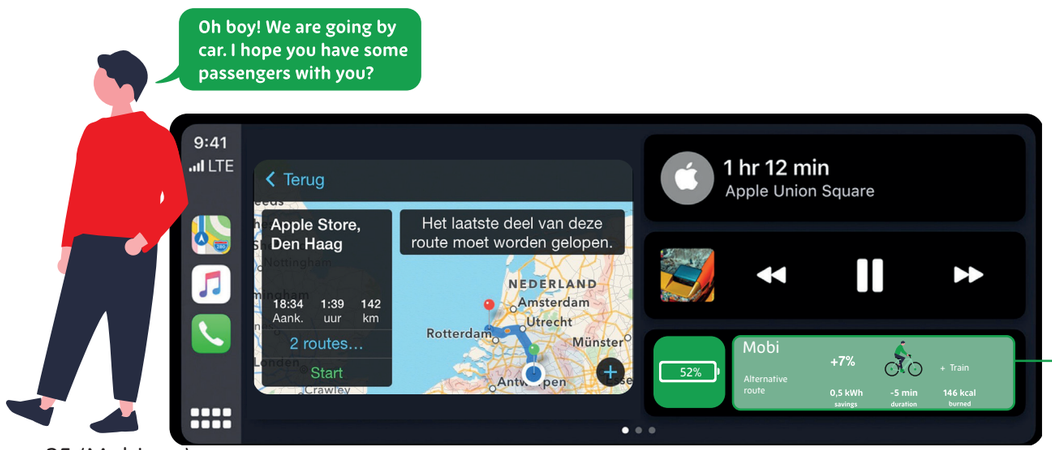


Figure 25 (Mobi car)

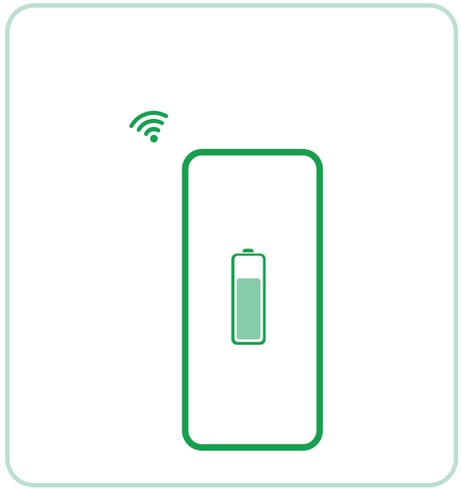
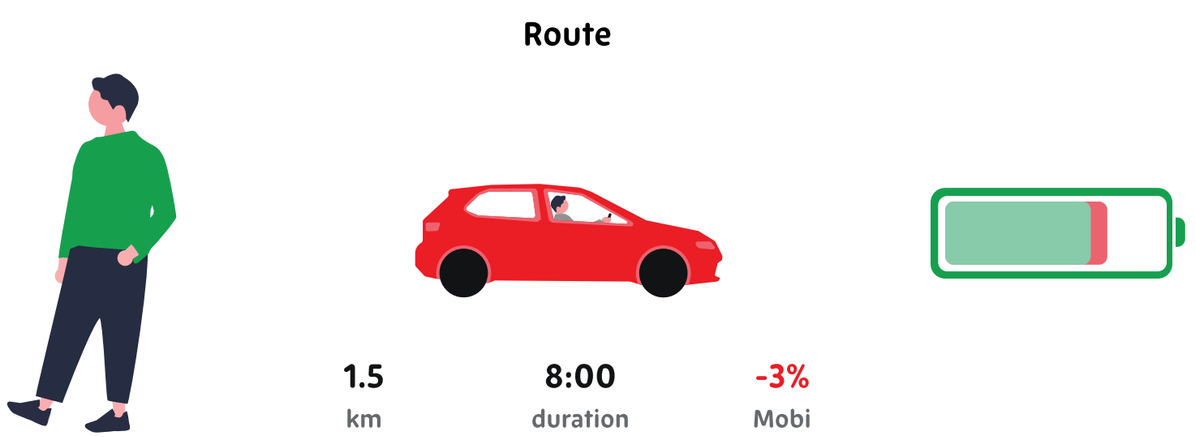


Figure 27 (Mobi on car)



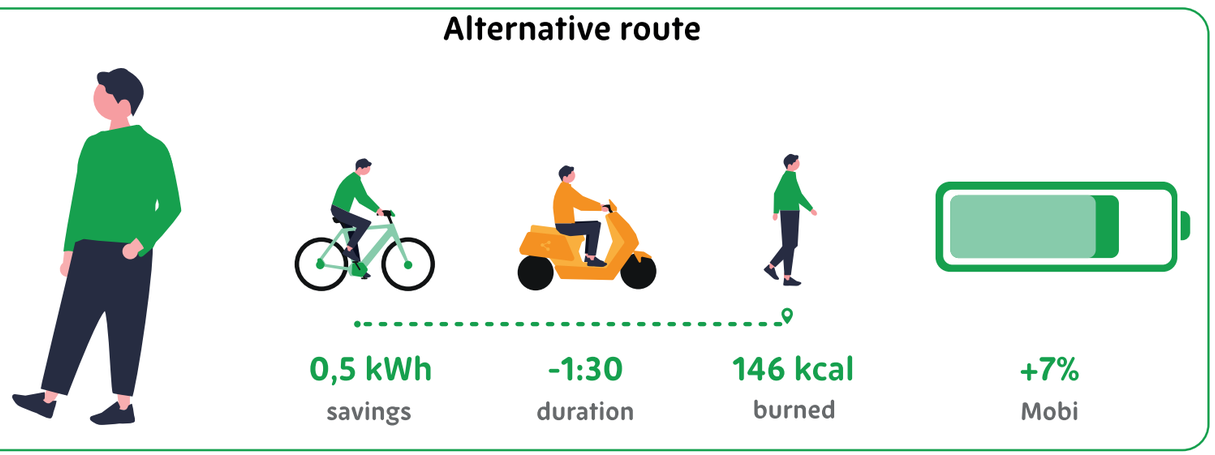


Figure 28 (Mobi car alternative routes)

The Mobi car is the component used in the car for extra information about alternative routes. This will give the user insights on how to improve their battery and travel more sustainable in the future.

6.4 Mobi overview

This chapter explains how the overview part of Mobi looks like

To give a more comprehensive insight into mobility consumption, there is Mobi overview (Figure 30). This can be viewed from the smartphone and will display all the user's trips. It consists of the battery and its build-up (Figure 29). This build-up is in the form of a waterfall chart. Here, the trips are made red and green, indicating whether the transport was active or passive. In addition, individual trips can also be clicked for more information such as time location and specific stats about that trip. The overview will default to monthly and can also be zoomed in to daily. The statistics will automatically shift with the zoomed-in month or day. These statistics consist of achieved goals from Mobi bike and actively driven kilometres. In addition, the number of calories burned and energy saved are shown. To give an indication of the amount of energy saved, a currency amount is shown next to it. This saved energy consists of the energy saved to go by active transport instead of passive transport. When one of these statistics is higher than the previous month, a + will appear in front of it. This will be extensively named by buddy Mobi who will be on screen to give the user tips and celebrate achieved goals. As with Mobi bike, buddy Mobi can be swiped away when it becomes too much. Buddy Mobi will go through several functions during initial use for explanation. Mobi overview can be viewed at home and on the road. It differs per person who will check it regularly per day or several times a week. And users who do not check it every day are able to set push notifications when they exceed a certain battery %. This way users will become aware when they are being less sustainable. At a certain time users will behave according to their set battery %. When they do not receive a notification, they get confirmed of their sustainable behaviour and becomes part of their habits.

Competition

It was chosen not to add a competition at Mobi. Despite this being one of the strategies that works well to keep people motivated. This was chosen based on an interview with B. van Ardenne (11 April 2024). This would deter the user when a lot of progress have been made in their situation but still finish last in the competition. Different levels could then be allocated, but the choice was made to put personal progress first. That is why the overview shows a + when a statistic is higher than the previous month. This also compares whether the battery is higher or lower each month. This should motivate users to improve themselves time after time.

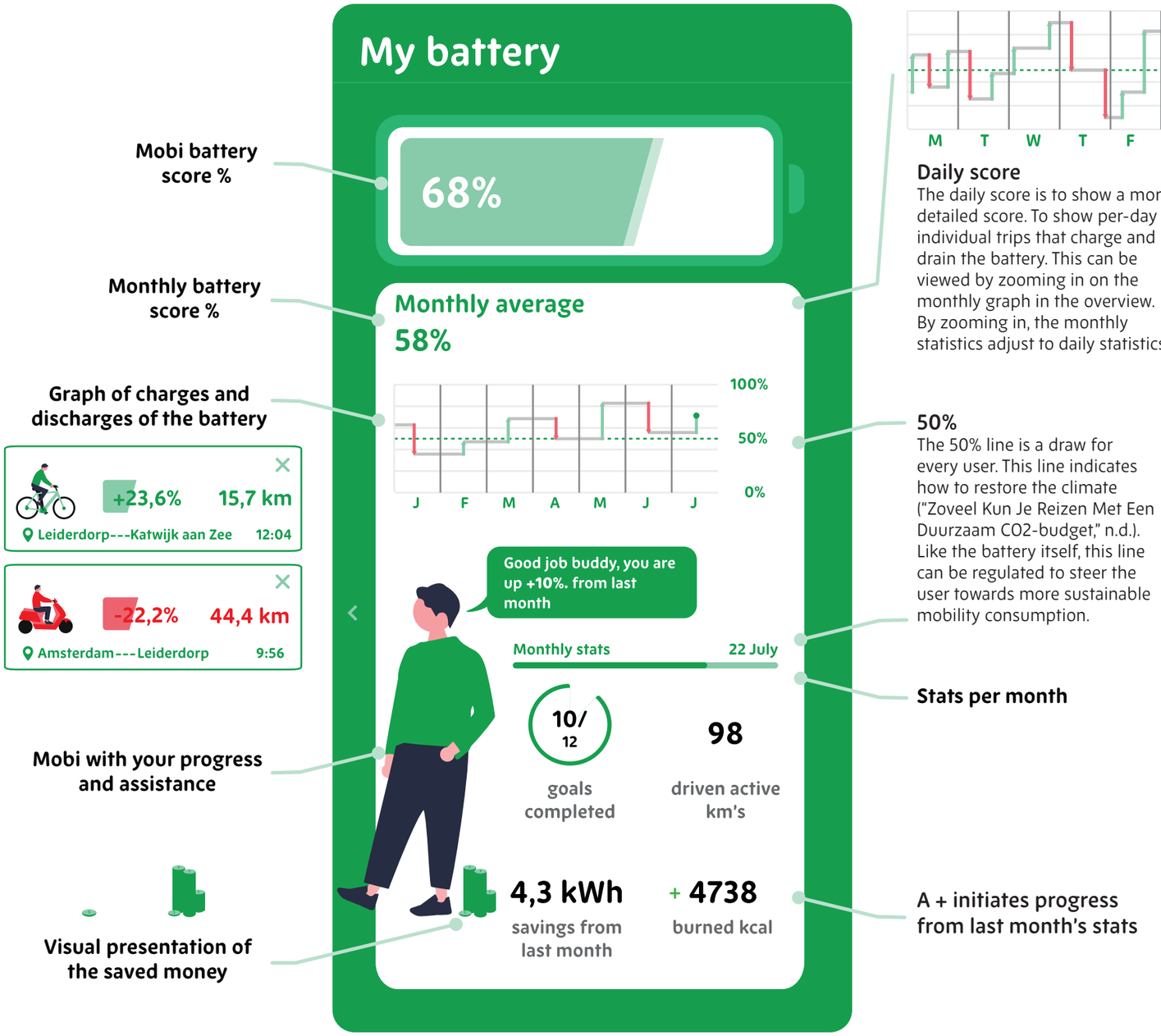


Figure 29 (Mobi overview)

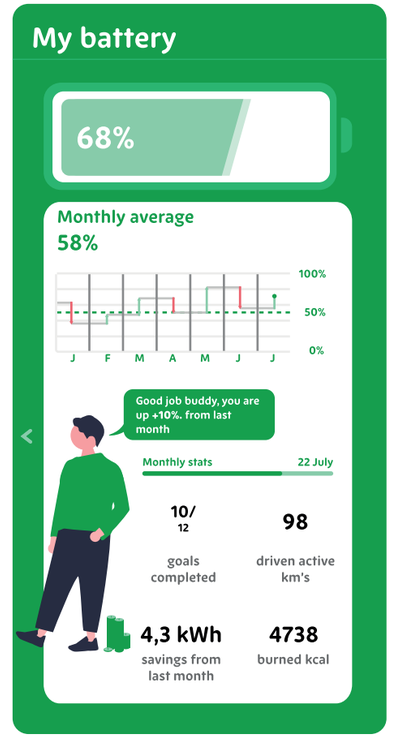


Figure 30 (Mobi overview)

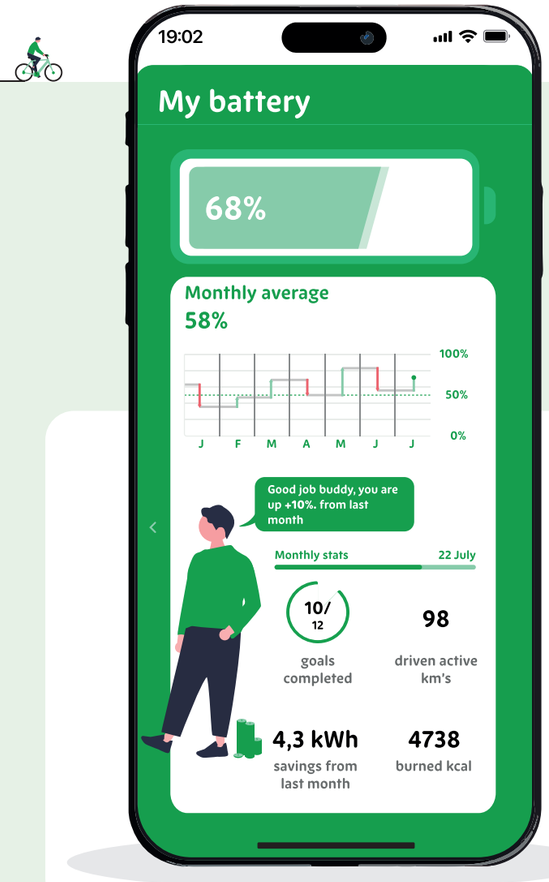
Mobi overview is the component used on the smartphone and provides insight for the user in their mobility stats

6.5 Mobi

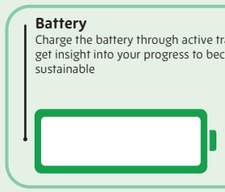
Mobi: the service that encourages sustainable mobility for everyone.

Mobi is designed to encourage residents in and around urban areas to become more sustainable. Mobi will provide **informative** and **behavioural-changing** insights during **daily travel**. Translating the complex emissions in mobility to a **manageable battery** to show your **sustainability score**. The battery score will charge when using active transport and drains when using passive transport. Raising awareness of how different vehicles have an impact on the environment. Motivating the user while traveling and afterwards to use the bike or walk instead of going by car and moped.

To provide the fullest possible insight, journeys will be tracked using the smartphone. Mobi will be present when needed for the user. Challenging you to **cycle** more and further to achieve your daily set goals. Offering **in-car** advice on more sustainable alternatives. Using public transport, it will be used to check in. Finally, the **overview** provides insights and tips on how to become more sustainable.



Battery
Charge the battery through active transport and get insight into your progress to become more sustainable

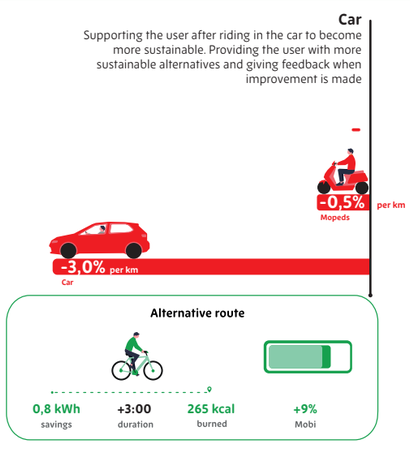


Overview
Supporting the user with insights into their daily mobility consumption. Supporting the user with their progress on their battery score and helping to become even more sustainable

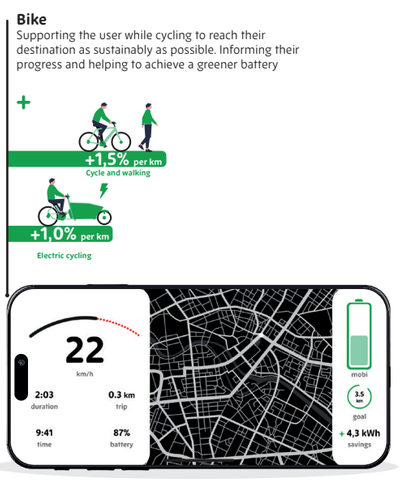
Try it out

1. Download the Figma app
2. Scan the Qr-code
3. Click View prototype
4. Switch between different flows

Car
Supporting the user after riding in the car to become more sustainable. Providing the user with more sustainable alternatives and giving feedback when improvement is made



Bike
Supporting the user while cycling to reach their destination as sustainably as possible. Informing their progress and helping to achieve a greener battery



06 Mobi

Mobi conclusion

Mobi will motivate the user while traveling and afterwards. By making Mobi present in a way, when the user moves around. By showing the battery on the bike and setting active goals. Offering in-car advice on more sustainable alternatives and displaying a visually draining battery. And then by providing insight and help in the overview on the mobile afterwards. People will become more aware of how much battery drains on a particular vehicle or trip. Creating this awareness and setting goals to keep the battery as full as possible will create more sustainable mobility. To provide the fullest possible insight, journeys will be tracked using the smartphone. This is largely with the user. While fitting, it will be in the pocket or serve as a dashboard. When driving a car, it will charge in the centre console and when using public transport, it will be used to check-in.

07 Mobi evaluation

The evaluation of Mobi by users and experts

To conclude whether Mobi is a success, testing must be done with the user and the expert. Mobi has one goal: to encourage active transport in urban areas. A PrEmo test was conducted with the user and interviews with experts to say whether this has been achieved. This PrEmo test was done after a full walkthrough of the Mobi service with the user. After this, the user was allowed to express what emotions they had experienced after using it and conclude whether they would use the service. After this, experts from Advier, GAIYO, krakeel, and SJEES were interviewed to see if Mobi could be implemented. Among users, Mobi was named motivational and proud, indicating user acceptance and use. Among the experts, it was mainly seen as a tool for inspiration and possible implementation in the near future for its translation of the battery to make emissions more tangible.

Chapters:

- Mobi evaluation user, discussing the tested service Mobi among users via a PrEmo test and walk trough
- Mobi evaluation user service, discussing the evaluation with the user of Mobi's effectiveness
- Mobi evaluation experts, discussing the implementation of Mobi among Advier, Het krakeel, and SJEES
- Mobi x Advier implementation, discussing the implementation with Advier in Australia Springfield
- Mobi x Gaiyo implementation, discussing the implementation with Gaiyo the app

7.1 Mobi evaluation user

This chapter explains how Mobi is evaluated with the user.

Behavioural adaptation is a long process that cannot be assessed from an interview whether it has been triggered or not. Therefore, the emotion that Mobi elicits after experiencing the service is considered. By achieving the selected emotions Mobi will be set up to succeed in the long term use (Ladhari, Souiden, & Dufour, 2017). By looking at the emotions the service raises, it determined if the service is successful or not. A PrEmo test has been used to measere these emotions (Desmet, 2003). The PrEmo test aims to experience satisfaction, desire and pleasant surprise after using Mobi.

• Satisfaction
As B. van Ardennen pointed out, an important factor for the user to stay motivated is progress. Seeing how much the impact is of behavioural modification, does it make sense to keep adapting one's behaviour or does the user fall back into old habits? It takes satisfaction to keep using Mobi to be able to say that Mobi can guarantee long-term success.

• Desire
Just like the feeling of satisfaction the need for desire is important. The desire to achieve progress and set goals will motivate the user to keep an using Mobi on the longterm. As the conducted interviews stated (Introduction service test), users will stay motivated when they have insight in their mobility and their personal progress.

• Pleasant surprised
Mobi needs to feel charmfull and joyful. Mobi needs to inform the user in a friendly way and celebrates the users progress. Conducted interviews stated (Introduction service test) that updating the user about their mobility consumption, in a fun way, would keep them motivated to more sustainable.

Goal: Determine if Mobi accomplishes to evoke the emotions of satisfaction, desire, and pleasant surprise. To acquire longterm use and behavioural change for mobility consumption

Method: The product emotion Measurement Instrument (PrEmo), is a non-verbal self-report instrument that measures users' emotional responses to products and services. (Desmet, 2003).

To evaluate Mobi's final design, a combination of methods was chosen. A walktrough session (Appendix F) was chosen, in which the user was asked to perform his daily routine without additional commands. The user was asked to use Mobi when it was found appropriate. Thus, tests were carried out with six users where the user went out by car and bicycle. This was done with the support of Mobi without any further explanations. The user was allowed to decide for himself how and what Mobi was used and for what purpose. After the user experienced it himself, he was asked to assess the three elements of Mobi (Appendix G). This assessment of Mobi bike, car, and overview was done using the PrEmo method (Appendix E) to evaluate how Mobi comes across to the user.

• Materials
PrEmo (Appendix E)
Consent form (Appendix C)
Mobi prototype (Appendix G)

Test group selection: People were asked at random for this test. These varied in age between 23 and 65. Varying between student and working, living at home and living out. This was done to test the service among as diverse an audience as possible.

Results: As a result of the test, Mobi was received positively (Figure 31). Here, emotions such as joy, pride, motivated, and satisfaction were mainly named. Although different words were used, these fit very well with satisfaction, desire and pleasant surprise. After further explanation, the playfulness of the Mobi character and its clarity were mentioned. It was also said that Mobi would be used to see how much mobility consumption could be improved over the days. One statement from the interview was, "I won't go shopping by car from now on then." and "I'm going to grow my saved money pile as high as possible". In addition, the emotional confusion also occurred a few times. These were mostly confusions at the detail level. For example, there was some confusion at Mobi car about the statistics of the alternative route. There was also confusion around the goals at Mobi bike whether they apply per day or in general.

Insights: The confusing can be eliminated by changing the interface of the overview a bit. For instance, the graph in Mobi overview was not clear at a glance. People who were not familiar with a waterfall diagram did not recognise it. They mentioned additional indication in the form of arrows indicating whether there was a decrease or increase in the battery. Another confusion acquired when displaying the alternative route on Mobi car. it was not clear whether the individual statistics belonged to the vehicle above it or in general. This has been adjusted and clarified with a route line indicating that the statistics belong to the entire route instead of per vehicle

Conclusion: From the interviews, the findings were positive about the condition it had to meet for a long-term behavioural change to occur. Besides enthusiasm from B. van Ardennen, the users were largely enthusiastic. It was then assumed that Mobi is a successful product service system to encourage more sustainable mobility in and around urban areas. In doing so, there is room for many improvements in line with a future world. Mobi will contribute to a green world, even though it will still take time and effort to get there.

Test group: The final service was eventually tested with 6 people. This is the minimum for a test like this, yet it was chosen to be seen as a full test. This is because the results were much the same and no new insights surfaced.

Figure 31 (Emotional association Mobi from PrEmo N=6)

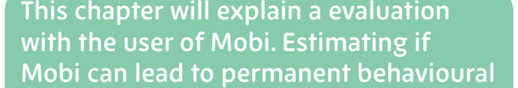
Across the board, Mobi has been positively received. Positive emotions towards Mobi indicate long-term use and will lead to greater understanding and awareness of mobility emissions. This is the best step towards behavioural change that will lead to a green world.

7.2 Mobi evaluation user service

This chapter will explain a evaluation with the user of Mobi. Estimating if Mobi can lead to permanent behavioural change.

Behavioural change is a long process as described earlier. Here, it starts with short-term changes and later if these changes persist also long-term ones. Only if users stick to the changes will real change take place by the time of 2040. The previous test showed that people are willing to change their behaviour. It is important that the user not only says it but also acts on it and knows why they are doing it. These three levels go deeper and deeper and will have more impact when all three are reached (S. Visser , 2005). So the user says that he is willing to use Mobi. This research should show that the user also acts accordingly and knows why change is important.

This research focuses on breaking the user's daily rhythm. This is because it takes effort to make changes and is therefore often not done (Mulder, 2022). Changing the rhythm once is seen as an exception and requires little effort. When these changes become more frequent, it takes the most effort but has the highest success rate for lasting behavioural change. This study will show whether users will change their behaviour once for this study or change their behaviour more often.



Goal: Determine whether Mobi has a long-term impact on user behaviour, after providing more sustainable travel advice.

Method: Context mapping is a user-centred design approach that involves the user as the 'expert on his or her experience'. By providing the user with generative tools, he or she can express personal experiences in which a product or a service plays a role. (Van Boeijen et al., 2014).

To determine whether Mobi works and encourages long-term behaviour, another context mapping test was conducted. Users were asked to pick a day that looked roughly the same in terms of travel each week. This route had been shared by WhatsApp and was assessed by Mobi at the end of the day. This included advice on how to travel even more sustainably if possible and an update on the Mobi battery score based on the day. Mobi's advice was communicated back the same day via WhatsApp. The following week, users were asked if they had adjusted their behaviour based on the Mobi messaging to travel more sustainably. Then a final time was communicated via Mobi messaging whether the user scored higher than the last time or not. This concluded the test for most users. The car users with good alternative travel advice were asked unannounced a third time whether they followed the Mobi advice or fell back into their old habits of going by car after 3 weeks.
• Materials
Appendix Q: Evaluation with user Mobi results

Results: Of the 8 participants, 3 always went by car, 3 by bicycle, 1 by a combination of bicycle and public transport and 1 by public transport. Here Mobi offered 4 alternative routes, 2 of which were followed (Figure 32.1).

Mobi led to behavioural change among 2 of the 3 car users. After a third unannounced control, 1 car user changed his behaviour still after 3 weeks.

Mobi led to behavioural change among 3 bicycle users to achieve higher percentages. This occurred by cycling more kilometres on the sport bike or switching to the regular bike instead of the electric bike.

Mobi led to behavioural change among 5 participants. This varied from taking a racing bike to cycling extra kilometres to taking a bike instead of a car or an electric bike.

Insights: People can adjust their behaviour very easily when it is a one-off. In this regard, people even went further by not only taking a more sustainable mode of transport but also cycling more kilometres. As the behaviour has to change more often, the threshold becomes higher and higher to choose the more sustainable option. This threshold will lower again as time goes by and form a new rhythm (Figure 32.2).

Awareness of the relationship between the emission of different modalities has become very insightful through this test. People become aware of how many emissions a mode of transport generates and can quickly adjust their behaviour accordingly, if possible.

Insights: Mobi especially appeals to users who can make some changes when this falls between the options. If a journey takes much longer by going with a more sustainable option, the user will not take action for behavioural change.

People enjoy interacting with Mobi. They see it as a game to be better than the others, but mostly to improve themselves. This is mainly because of the playful way was said.

Conclusion: Mobi encourages behavioural change. This behavioural change is mainly short-term and becomes less and less effective in the longer term when not actively encouraged. Mobi is more effective if there is regular encouragement to travel more sustainably and tips on how to do it better. This gives people a better understanding and sense of their consumption and they will adjust their behaviour accordingly. Mobi is especially effective for people who are in a position to make their behaviour more sustainable. By offering insight, users will become more aware and more willing to adjust their behaviour accordingly.

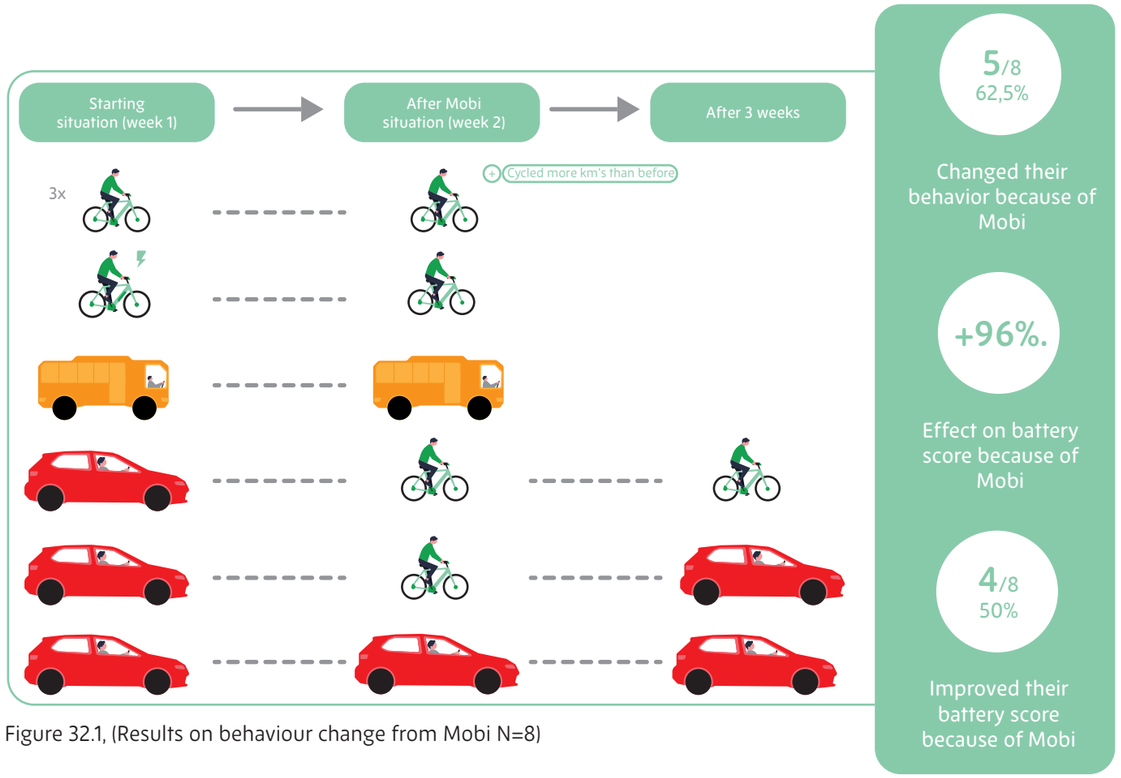


Figure 32.1, (Results on behaviour change from Mobi N=8)

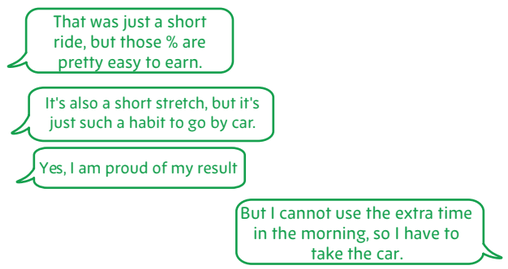


Figure 32.2, (Quotes on behaviour change from Mobi N=8)

Mobi is a successful service in terms of short-term behavioural change. Getting users to travel more sustainably is more successful when the behavioural change is as small as possible. Nevertheless, Mobi encourages awareness of how many emissions a person produces. In the long run, this will lead to more sustainable choices in small steps, such as switching from a car to an electric bike or a regular bike.

7.3 Mobi evaluation experts

This chapter explains how Mobi is evaluated with the experts from Advier, Het Kakeel, and SJEES.

ADVIER (NL)

The company
("Advier," n.d.)
Advier is an innovative agency working on the (re) design of mobility, space, and organizations. They do this entrepreneurially; based on clear insights, tangible impact, connecting people, and innovative initiatives. Advier puts people in motion toward a sustainable society. One that is smart, robust, livable, inclusive, and future-proof.

Evaluation of Mobi
Mobi's service is a nicely devised system. The philosophy behind it fits Advier very well and represents their values. Making people aware of the impact on the world with mobility consumption is just hard. By communicating this with the residents, a small portion will change their behaviour. What could involve the biggest change? To look at municipal or provincial level. Here you will run into a lot of regulations and that is very difficult in the Netherlands. In the Netherlands, Mobi will probably not survive on its own. Mobi would fare better when implemented in a system already existing. With a MaaS system that is literally inclusive for all mobility within a region, city or country. Where it could inspire is in Australia, Springfield.

Implementation of Mobi
Implementing Mobi could be done in Springfield. This is a relatively young city that is behind the mobility of the Netherlands by and number of years. There are no MaaS apps and MaaF thinking here yet ("Mobility as a Feature (MAAF): Rethinking the Focus of Mobility as a Service (MAAS)," 2022). This could actually introduce a service that is truly inclusive and therefore also takes into account the emissions of a trip, for example.
By taking Mobi's thinking as a starting point, newer systems will emerge than in the Netherlands, despite the fact that they are currently behind in Springfield. "Making a future where transport is shared, affordable, and carbon-free, sparking conversations. Aussies help to rethink their relationship with their car is a crucial step for this" ("Uber Newsroom," n.d.). Mobi could take the first step in this thinking process.

Het krakeel

Reasoning of choice
Het Krakeel has the ideal users for Mobi. The users will stay motivated to improve their battery, without dropping out.

The organization
("Het Krakeel" n.d.)
Their aim is to create an innovative housing complex for 50 to 150 residents of different generations, backgrounds and incomes. The sense of community with each other and the neighbourhood plays an important role within their housing cooperative. The complex will consist of different types of housing: independent housing, cluster housing and housing groups. The degree to which facilities are shared with each other varies in this - from complete privacy to a communal bathroom and kitchen. In addition, various communal indoor and outdoor areas are available in the building for all residents. They aim for an energy-positive and climate-resistant complex, equipped with sustainable and innovative materials and installations. Such as shared electrtic vehicles or tools.

Evaluation of Mobi
The Krakeel is set up in such a way that they already offer a sustainable choice, share cars and many share bikes are in front of the building. It is therefore also an easy option for its residents to make use of this, instead of having their car parked further down the road in the garage. The people who come to live here are already very conscious of sustainability. An obligation of Mobi would not suit the Krakeel, but there will be users interested in the use of Mobi. Its residents are already aware of sustainability and will be happily advised to take the most sustainable travel.

Implementation of Mobi
It would be interesting to see what the lifestyle of the Krakeel does for the battery compared to other communities, to see how much effect the lifestyle has on sustainable living. It would serve more as a kind of confirmation for what they are doing at the Krakeel.

SJEES

Reasoning of choice
SJEES has the same mission as this project, to make more people go by bike. Their application already gives insight in peoples cycling activity.

The company
SJEES is a company committed to healthier mobility for employees. This involves campaigns to increase active transport. These include offering free E-bikes for a trial period, as well as organizing cycling challenges. The main aim is to convince employees that cycling is a very good transport option to get to work. Through the trial period and challenges, employees find out how convenient the (E) bike is. These challenges are tracked in the SJEES application.

Evaluation of Mobi
"Yes, I always get excited about this" was the first reaction about Mobi. This is very much in line with what we stand for. We aim to work more from the employer's point of view though, but this is a nice concept. Our cycling campaigns always work very well, but that's also because there are real prizes to be won. In doing so, you motivate people to keep cycling for themselves. So it's very important to show progress and remind people that they are doing well. This way, people can also be encouraged to cycle to work. The playful way always appeals when it comes to difficult topics such as emissions.

Implementation of Mobi
Implementation of Mobi can be seen as part of SJEES perhaps. There are already many similarities, but this would be an extension of the current SJEES app. By making it broader than just cycling, people will get much more involved. From SJEES, it is mainly aimed at employees and not so much at other people, but there is no reason why it couldn't be done. Funding for such a project would have to come from other parties that would benefit from it, but they can always be found.

Advier Australia x Gaiyo

After discussing Mobi with Advier (NL), Het Krakeel and SJEES, it was decided to speak to more experts. Speaking with Advier Australia and Gaiyo would tell with certainty whether Mobi could be implemented with a suitable stakeholder. The conversation with Advier (NL) revealed that Mobi fits better with their vision in Australia. Gaiyo was also written up as a potential stakeholder because of its broad platform for offering shared mobility. In the following chapters, a detailed interview with Advier Australia and Gaiyo was conducted to discuss the implementation of Mobi.

The Mobi service is generally well-received among experts at Advier, Het Krakeel, and SJEES. Still, the implementation of the service would not be directly applied. It is seen more as an interesting means of integrating the service into an existing system, e.g. for MaaS apps.

7.4 Mobi x Advier implementation

This chapter explains the possible implementation of Mobi with Advier in Australia, to assess whether Mobi is desirable and viable.

This project was done in collaboration with Advier. Advier is expanding their knowledge to other countries. Australia is one of those countries. Advier believes in a more sustainable society that can be achieved. Advier stands for a trustworthy relationship, enthusiastic, expert, down-to-earth, creative/innovative, and achieving sustainability together. This last point is also why Advier wants to share its knowledge with Australia. Through this cooperation, they both learn and benefit from each other.
To see if Mobi can play a role in Advier's plan in Australia, an interview was conducted with E. Kroft of Advier. She is currently Advier's point of contact in Australia.

Advier has three goals in Australia

1. Advier organises funding for setting up an international consortium of impactful organisations (private, public and knowledge) to exchange their knowledge and action willingness on robust future proof sustainable societies.

2. Advier can work/advise on a possible city of the future, use the knowledge gained by international cooperation for many years and the lessons learned in Europe.

3. Advier gives regional cities (car orientated) advise on how to work/make the first steps on taking on (sustainable) transport challenges.

These three goals are mainly set in collaboration with Springfield.
Springfield is a town in Australia with a relatively low population and limited facilities. This town was created by a few landowners with the idea of building a new town with a high quality of life. Although the sustainability of mobility in Australia is not as far advanced as in the Netherlands, they are thinking ahead in Springfield. They would like to apply knowledge from Europe, but also be innovative. Here, there is room to test innovation in the field of shared transport, which is much more difficult in the Netherlands. Because Springfield does not belong to the municipality, they can implement innovative plans quickly, unless this involves building public roads. For example, tests are already being done from Uber ("Uber Newsroom," n.d.) where Australians have to give up their cars and go by public transport only. This is a big challenge as public transport is less set up to accommodate this behaviour. The car is always seen as the first mode of transport and the infrastructure is set up for that. In the Netherlands, this process is much further along, which is why Advier will share its knowledge and work with innovative Springfield on new plans to make Springfield a sustainable community.

Goal: To find out if there is demand for Mobi in Australia. Does Mobi fit within one of the goals from Advier.

Method: Interviews are face-to-face consultations that can be useful for understanding consumer perceptions, opinions, motivation and behaviour concerning products and services , or to gather information from experts in the field. (Van Boeijen et al., 2014).

To elavuate the implementation of Mobi, an expert interview is conducted with E. Kroft from Advier. The questions about the plans in Australia and thoughts about Mobi are in Appendix P. Hereby the interview questions were asked and sparked a conversation about the implementation of Mobi in Australia.

• Materials
Interview questions Advier (Appendix P)

Results: Implementing Mobi in Australia can be done in a shorter period than in the Netherlands due to more lenient regulations. Advier sees a city like Springfield as an opportunity to share knowledge and, more importantly, innovate. In Springfield, there is an initiative to improve and implement new and existing systems from Europe. This would be a suitable place to test Mobi at city level. When building new infrastructure and mobility systems, Mobi can be introduced. This will mainly be in cities where there is demand for sustainability but lack the knowledge and impact on a large scale.

In Australia, there are not yet many shared transport initiatives like in the Netherlands. They are 10 to 15 years behind in that field. Yet there is a lot of demand for sustainability among businesses and city dwellers. Implementing a Mobi battery in new mobility systems is a novel idea and contributes to making a more sustainable society.

Results: The battery is a novel idea. Climate change awareness is increasingly prevalent in Australia's cities. Implementing a battery in mobility services increases awareness of why it is important to use it. In Australia, companies will be interested in it for sustainability.

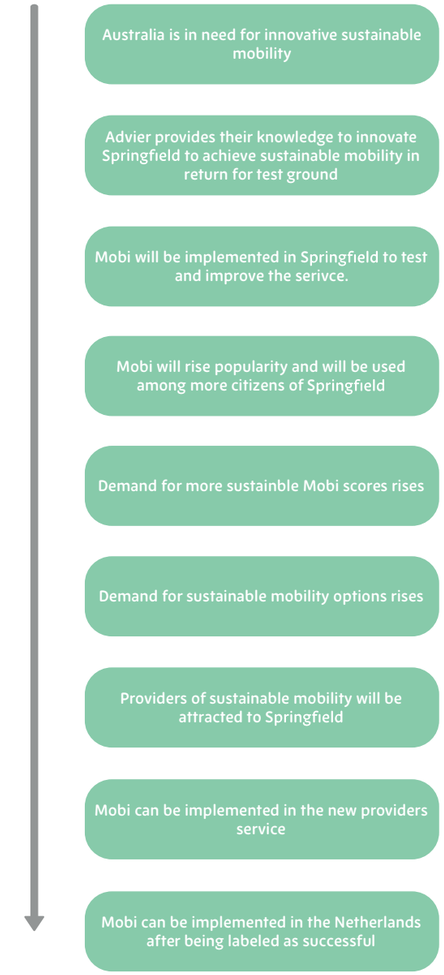
Insights: In Springfield, they are keen to set an example of how things can be done differently. So in collaboration with Advier, they will not directly implement existing services from Europe without trying to improve them. For example, a MaaS-app will not work in Australia as there are not enough shared transport services in Australia in or outside cities. Springfield can be reached by train or car. So switching to shared transport at once will not work. But companies will likely start asking employees to track their battery through Mobi. This is a form through which employers will gain insight into how sustainable their employees are. Companies like to become more sustainable but often don't know how. Making people familiar with the service will result in quicker adoption and implementation of a new service for shared transport.

It is a slightly different story in the Netherlands as there are already so many shared transport options. People will not quickly use a separate service for their sustainability but will accept it when it is implemented in an existing service like Gaiyo.

Conclusion: The philosophy of the Mobi service suits Advier in Australia. The service will mainly serve as a starting point for building sustainable mobility in Springfield, among other places. Here there is a demand for sustainability but not enough knowledge yet. Mobi's battery will be a nice and convenient base to make the sustainability story understandable and eventually start acting on it. Thus, the demand for more sustainable share mobility will grow and reinforce the usage of Mobi.

In the Netherlands, Mobi will mainly be seen as an implementation tool in existing mobility services. The battery from Mobi will provide many people with insight into sustainable mobility. A growing interest in sustainability will also ensure an increasing demand for these kinds of sustainability tools like Mobi.

Advier is currently not in application to implement a service like Mobi, but sees Gaiyo as an interesting and relevant partner for this. On the other hand, Advier does see many opportunities in Australia, for experimenting with new services. Springfield and Advier both stand for innovation, and Mobi's battery fits that bill. The collaboration in Australia is currently achieved. E. Kroft of Advier sees Mobi as a potential project in Springfield.



Advier aims to share its knowledge in Australia and build a future city with sustainable mobility. This city of Springfield could be a great opportunity to test Mobi among willing users. The rich testing opportunities in Springfield will allow Mobi to be properly evaluated before it can be applied in the Netherlands.

7.5 Mobi x Gaiyo implementation

This chapter explains the possible implementation of Mobi with Gaiyo, to assess whether Mobi is desirable.

To say whether Mobi is realistic to implement in an existing MaaS app, an interview was conducted with A MaaS-app. Gaiyo is a provider of different modes from different mobility providers in an app and a possible stakeholder. In it, travel alternatives are displayed in combination with renting vehicles. The so-called: search, plan, book, and travel app.
Gaiyo could be an ideal partner for implementing Mobi. The Gaiyo app displays all the different travel recommendations with different modalities. Here, travellers can book a modality from there smartphone and travel as usual without the Gaiyo app. The traveller does not yet get informed about the alternatives to travelling by more sustainable modes than the car. Mobi could be an addition for the Gaiyo app to give insight in sustainable modes of travel.
To see if Mobi fits within Gaiyo's app, an interview was held with M. Lijkendijk of Gaiyo. M. Lijkendijk is responsible for Gaiyo's business sales and has a background at Advier.
In preparation for the interview with Gaiyo, the current app was analysed and searched for traces of sustainability encouragement, as Gaiyo claims to be committed to sustainability (Appendix O). Based on the interview, the implementation of Mobi within Gaiyo was drawn up.

Goal: To find out if Gaiyo is a suitable partner for implementing Mobi within the service. This involves looking at whether Mobi is an accepted service and whether it can secure a place within the existing Gaiyo app and ensure behavioural change.

Method: Interviews are face-to-face consultations that can be useful for understanding consumer perceptions, opinions, motivation and behaviour concerning products and services , or to gather information from experts in the field. (Van Boeijen et al., 2014).

To elavuate the implementation of Mobi, an expert interview is conducted with M. Lijkendijk from Gaiyo. The questions about the current service, app and thoughts about Mobi are in Appendix N. Hereby the interview questions were asked and sparked a conversation about the implementation of Mobi in Gaiyo.

• Materials
Interview questions Gaiyo (Appendix N)

Results: Gaiyo itself is not actively working to get people to travel more sustainably. They are not in the behaviour change position. They do believe the future needs to be more sustainable. Through their current offerings of modalities, they believe in contributing to this, offering electric vehicles, shared mobility and also being transparent about other options like cycling. They believe in accomplishing more sustainable travel options by offering an overview of all alternatives. Yet for Gaiyo, sustainability is an important side issue, but cost remains the main issue. As a result, while Gaiyo believes in raising awareness of sustainable alternatives, they do not see any major behavioural change in the short term. Showing sustainable alternatives will lead to behavioural change in the long term. Because, there is demand from customers and partners to display emissions per trip.
Additionally, Gaiyo believes in a standalone service Mobi that collects data on an individual's sustainability. Mapping someone's mobility portfolio and helping them improve it. Such a service like Mobi could be drawn even more broadly about someone's entire energy consumption and not just mobility.

Mobi can be seen as a relevant partner for Gaiyo. The features of becoming more sustainable can be implemented in the Gaiyo app with goal to change behaviour on the long term.

Insights: For a MaaS app like Gaiyo, there is demand for displaying emissions per trip. A possible metaphorical battery would be a nice feature. This is to make people aware that there are more sustainable travel options than the car. Still, sustainability remains an ideal aspiration as a choice consideration for the user and cost will weigh most heavily.

Mobi will fit within Gaiyo as a component by integrating the metaphorical battery. Yet Gaiyo also believes heavily in a standalone service that works with MaaS apps to collect data. This data will then provide a nice overview of one's personal energy consumption in general. Here, a Buddy system is in high demand for sustainability.

Conclusion: Mobi is suitable to be implemented in the Gaiyo app. Mobi will not be implemented as a full service, but more as a sustainability feature. It provides additional sustainability information per modality. According to Gaiyo, displaying the more sustainable option could lead to behavioural change in the long run.

Mobi implementation Gaiyo:

Based on the interview with Gaiyo the following additional features were made:

• Travel order
The travel order has been added as an addition to the ranking. Here, the order in which trips are recommended can be linked to the most sustainable travel option. Here, the most sustainable will always be at the top and can be chosen first by the user. Hereby, after long use, the user will become increasingly aware that the first option helps to recharge his battery.

• Battery
The battery is added for the user to maintain their sustainable mobility behaviour. The battery was seen as a nice metaphor from Mobi. It was assessed that people would benefit from a statistic like the battery score, which helps improve the score after each use. This will lead to a more conscious and sustainable mobility choice. The score was seen as not too intrusive and like all implemented options, the option to switch them off.

• Battery gain/loss
Battery is added for the user to see how much the trip impacts their battery score. As with Mobi, the battery is green when charging and red when draining. This sticks to the current colour choice from Gaiyo as it matches with Mobi's. Public transport is neutral and therefore blue. The size of the battery also indicates its impact. Here, is chosen not to show the battery percentage directly to keep it clear.

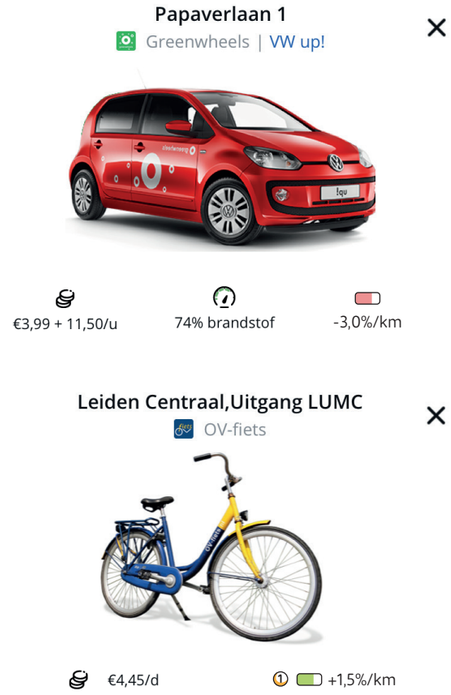
• Ranking
The ranking has been added to subconsciously help the user choose the most sustainable option. A points system can be linked to this to let the user collect as many points as possible to choose the most sustainable option. This point system would result in a higher battery score and will encourage choosing the most sustainable travel option more often. This option can be switched off if it is deemed irrelevant by the user.

• Battery score per vehicle
The battery score per vehicle has been added to remind the user during booking what the impact is on their battery. This is a realisation moment to link sustainable vehicles to charging and vice versa.

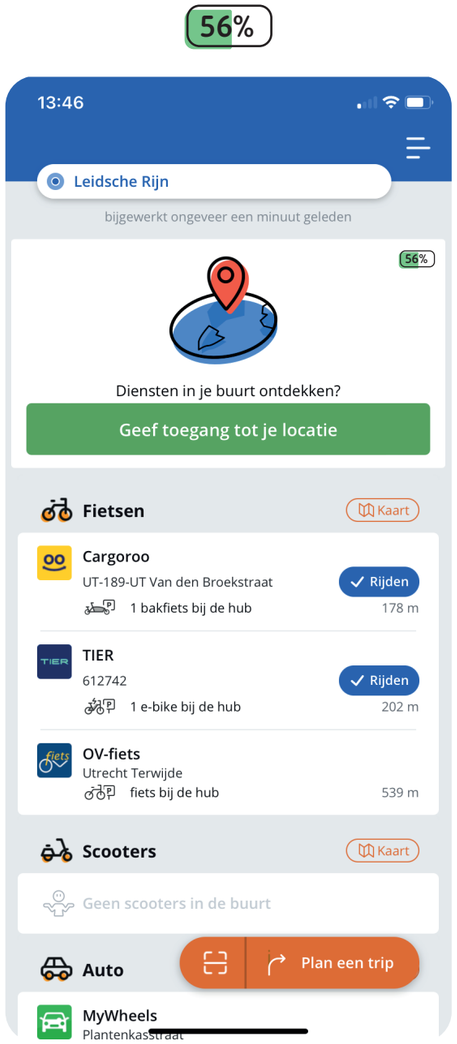
All these adjustments will lead to greater awareness of sustainable travel. Just as Gaiyo says, this is a long process where people often tend to choose the fastest or easiest travel option. This is by no means always the most sustainable one. Providing many subtle hints from Mobi would lead to long-term behavioural change. Thus, implementing Mobi in Gaiyo would be an appropriate step to educate people about sustainable travel. As mentioned earlier, this informing step is the first step towards a more sustainable future, in which Gaiyo can play an additional role beyond just offering sustainable vehicles.

Battery score:

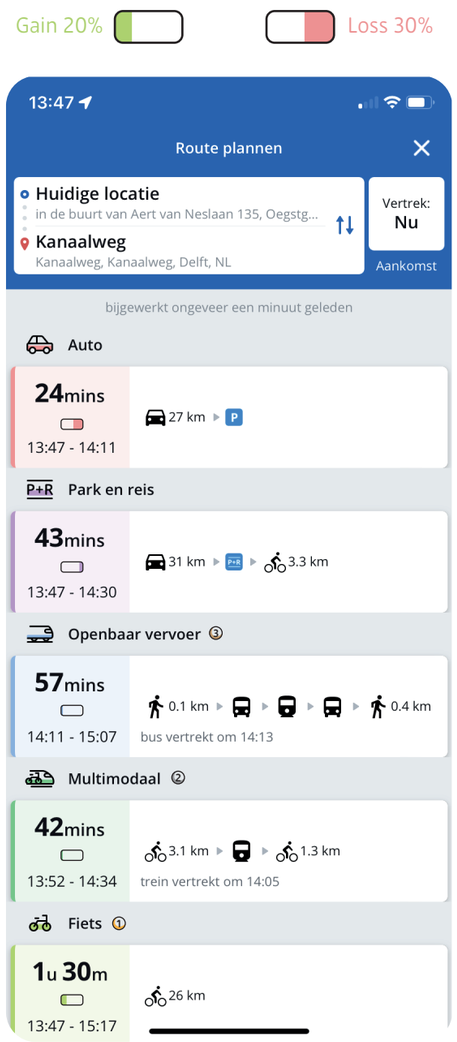
Inside the detail information of vehicles will be displayed the battery loss or gain per km. This will help to choose the best travel based on price, time and sustainability score.



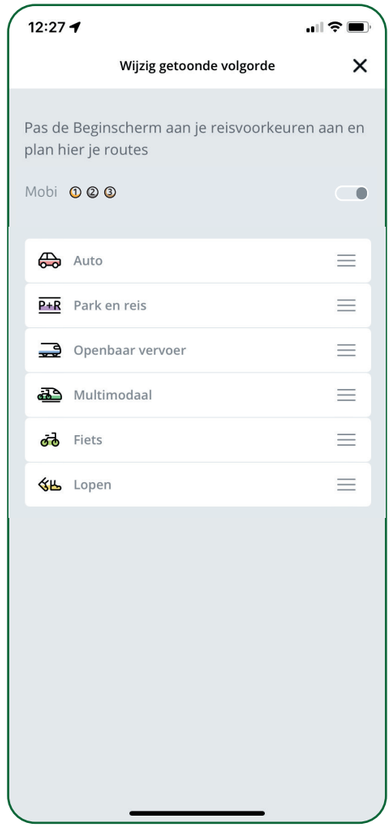
Battery:
To show the user how they are performing, talking about their sustainable battery score. This will be small, but always in the opening screen of Gaiyo to see for the user. This battery score will be asked to improve per month just like the Mobi battery.



Battery gain/loss:
To show the user the gain or loss of the battery will be presented inside the battery. Just like the Mobi battery, the battery turns green when charging and red when losing energy. This corresponds with the type of vehicle, cars being red and bikes being green. The amount of colour will indicate the amount of battery %.

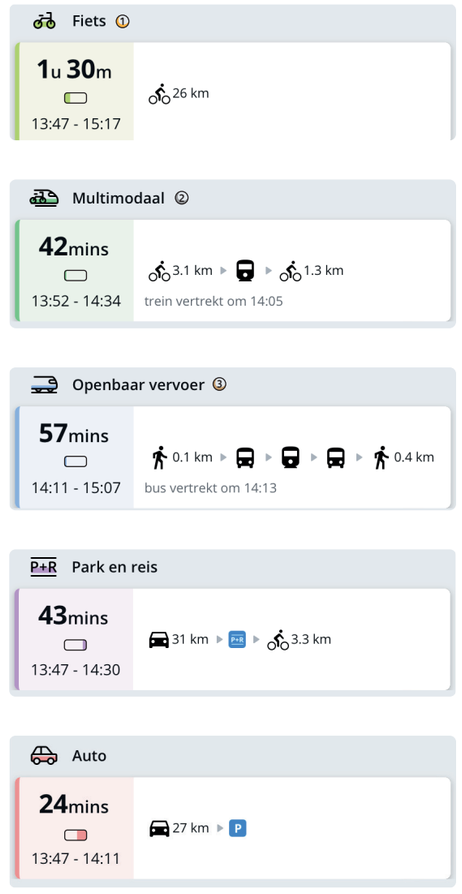


Travel order:
To help the user choosing the most sustainable travel, the ranking of a top three most sustainable travels can be added. A 1,2, and 3 will appear behind the top three most sustainable travel. People will tend to choose number 1 first as it is seen as the best. (Van Ham, 2022).



Ranking:
To show the user the top three most sustainable travel options. This will help to choose the user to make the more sustainable option.

① ② ③



The interview resulted in a positive evaluation of the possibility to implement Mobi in the Gaiyo app. Mobi will provide the user's battery score and will help to choose the more sustainable travel option. This will cause behavioural change in the long term, because currently the cost and time of a trip are still the most important considerations. Mobi will also be a realistic service in itself, when data is collected and provides insight into someone's entire energy consumption.

07 Mobi evaluation conclusion

Mobi evaluation with users and experts

Mobi was experienced among users as positive. The words Motivated and Pride came out of the PrEmo test and was thus labelled a success. The test aimed to achieve Satisfaction, Desire, and Pleasant Surprised. Even though the outcome of the emotions did not have exactly the same name, the intention was the same. From this, it was concluded that Mobi brings long-term of persistence and sustainable mobility. Among experts, a brief evaluation of the service was done and labelled as inspiring. Translating emissions into a battery was seen as innovative. Implementation was seen mainly in existing applications and as inspiring for area development. Mobi, on the other hand, fits well with Gaiyo's plans to give its users more insight into more sustainable mobility choices. Advier also sees opportunities in Springfield for Mobi to test its battery on a large scale to market more sustainable mobility and attract providers.

08 Conclusion

Final conclusions

This final chapter will conclude this project. Discuss how, over the years, Mobi will evolve into not just mobility, but will be involved across the lifespan. People have by now got such a good sense of emissions and know by heart how much battery a car ride costs and a bike ride yields. All the developments like sharing culture and electric vehicles will ensure that the rather futuristic world will become a reality. The ideal green world already achieved in 2040 by starting with a small step in the right direction. This first step is Mobi and will lead to understanding and awareness in the short term and behavioural change in the long term.

Chapters:
- Recommendation, discussing the implementation of Mobi using a timeline
- Conclusion, discussing the project and its conclusion
- Reflection, discussing the course of the project

8.1 Recommendation

This chapter will explain the recommendations on the Mobi service using a timeline.

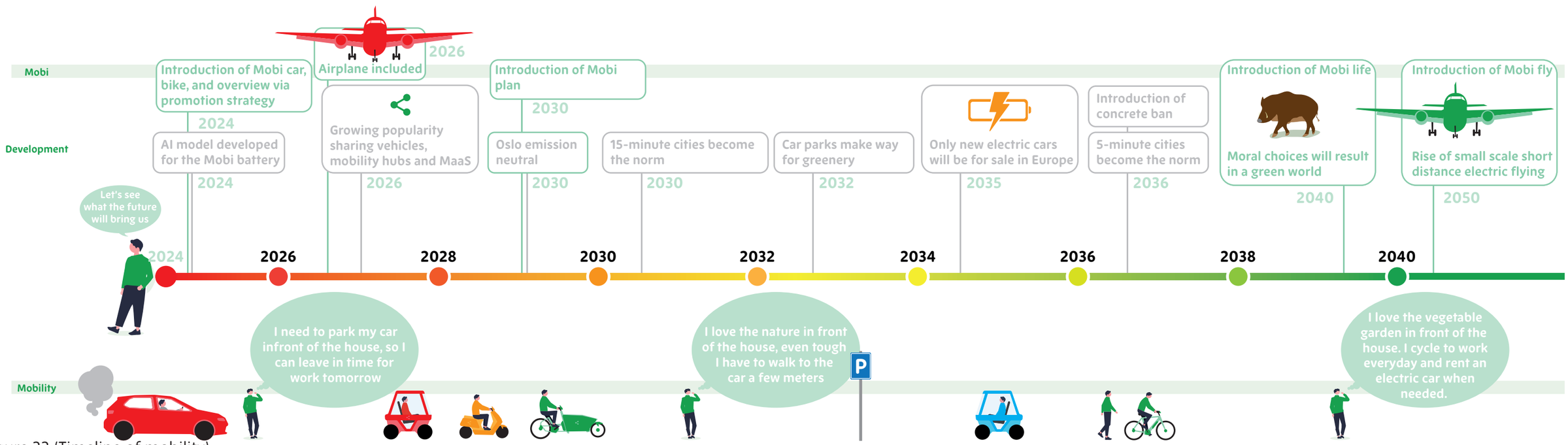


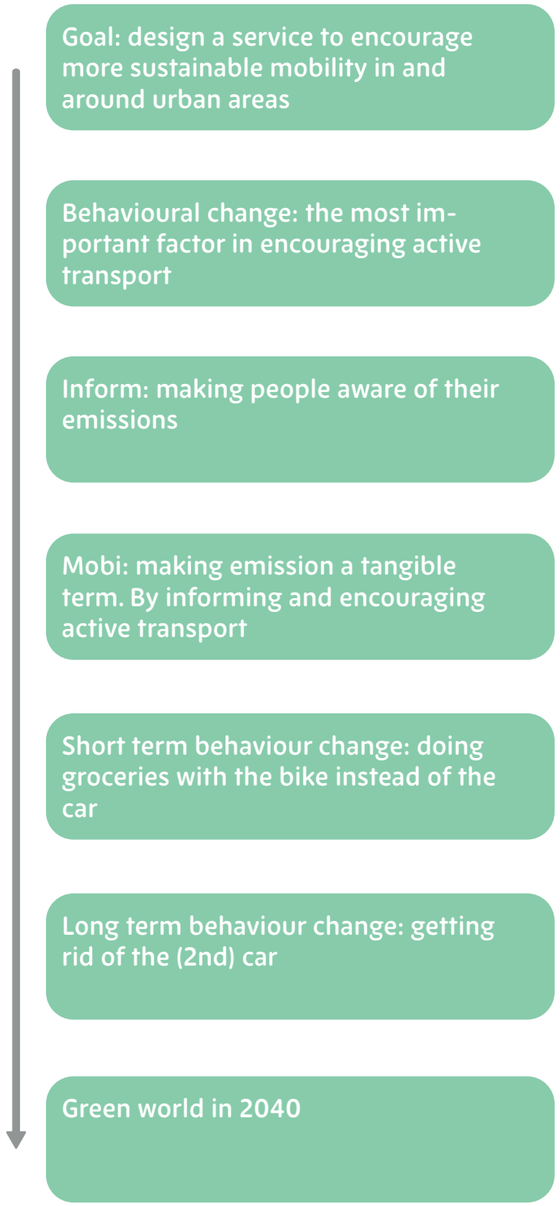
Figure 33 (Timeline of mobility)

Based on this project, a timeline was drawn up (Figure 33). It consists of relevant developments in the field of mobility and for the Mobi service. These developments must all be taken into account with the continued development of the Mobi service. These relevant developments have all been discussed in earlier chapters. The developments in the field of Mobi will be explained in this chapter.

The timeline will begin in 2024 in which Mobi will be introduced to users. This will be possible by introducing the service on a bike to work day ("Fiets Naar Je Werk Dag," n.d.). In addition, Mobi could be financed by companies that want to achieve a higher cycling rate among their employees. This is beneficial for both parties financially and health-wise (B. van Ardenne, SJEES, Interview 11 April 2024). It is also interesting for area development, where placing fewer parking spaces finances the development of Mobi, which in turn makes the parking spaces redundant (A. Brugman, Advier, Interview 20 May 2024). Finally, it will be interesting at the municipal level and national level with the connection to MaaS. This will create awareness around the service and increase the user base. As awareness grows, the AI model for the battery will be developed as described earlier. The growth of Mobi will be slow in the beginning due to user habits. The habit of having the car(s) parked in front of the door will not soon fade away. Yet this process will be accelerated by popularity of shared transport. Thus, there will be more and more mobility points and MaaS will become more and more part of travel. Mobility as a Service will ensure that Mobi plan will be in demand. Mobi plan will become a component where users can plan their journey in advance, where emissions will come in addition to the usual factors of price and time including the airplane. This planner will give options on how much emissions a journey entails and what the alternative is for a more sustainable journey. This will be linked to the battery so that it is tangible how much emissions a trip entails. By then, there will be more understanding of sustainable mobility. For example, cities like Oslo are almost emissions-free and the 15-minute city has become part of everyday life. Thus, people are becoming a bit more lenient about parking policies and are more likely to opt for green on the doorstep rather than a car. Besides people's habits changing, European rules will also change. No new fossil fuel cars will be allowed to be sold and electric driving will become the norm. Together with a concrete ban in urban areas, a 5-minute city will become possible. Within these cities, former transport will take place by bicycle or on foot. Here, the battery can be filled in completely absolutely, as there will be no reason to permanently drive to work or study. Because of this development, people are finding out what emissions really are and Mobi life is in demand. Mobi life will map not only emissions from mobility but also from life. This will help people make more moral choices and will lead to a green world. Out-of-town travel will still take place. This will be done with energy-efficient vehicles that are highly developed. For instance, on a small scale, electric flights will be used for relatively short distances. In which the plane itself will last longer than the battery, not because it breaks down quickly, but because a better battery with more range will have been developed. At the end of the timeline, people will have changed their habits to become more aware of mobility emissions and act accordingly.

Mobi will contribute to a green world, but to do so successfully, developments must be taken into account. Developments in vehicles, behaviour, policy and technology. Each of these developments will lead to the adaptation and addition of the Mobi service.

8.2 Conclusion



Based on the evaluation, it is concluded that the design proposal, Mobi, achieves the design goal and the overarching goal: Design a product service system to encourage more sustainable mobility in and around urban areas. Through testing and research, it has been shown that behavioural adaptation is an essential factor in achieving sustainable mobility. By starting to encourage sustainable mobility today, a green world will be achievable by 2040.

It has been chosen to achieve sustainable mobility by encouraging active transport and reducing passive transport. Here, people are more encouraged to walk and cycle instead of going by car or moped bike. Public transport is a means of enabling active transport and will also fall under sustainable mobility.

Tests have shown that people especially have little or no knowledge about emissions and which transport is more sustainable. But more importantly, how can they become more sustainable? Therefore, the choice was made to inform people about sustainable mobility. What does it mean, am I sustainable myself and what can I do about it? By offering these insights to people, interviews have shown that people are more aware and motivated to change their mobility consumption when it is made tangible for them.

Mobi plays an important role in informing. By offering insight in a manageable way, Mobi will help people become more sustainable. By going through mobility choices afterwards and offering insights during the journey. Instead of talking about a kilogram of carbon dioxide emissions per passenger kilometre, which does not include the manufacturing and recycling process, Mobi translates it into a manageable battery.

This behaviour change will not occur within a few days, but it will lead to a small behavioural change in the short term. Leaving the car at home and going shopping by bike once a week is already a start. This change, when motivated and celebrated by Mobi, will slowly creep in and become part of the behaviour. This short-term behavioural adherence will lead to a pattern in daily life and will occur more and more frequently.

This is also known as long-term behavioural adaptation. Mobi will highlight the benefits of sustainable mobility and continue to motivate the user to go greener. After long-term use, the user will be able to make a good estimate of how much battery loss is associated with a vehicle per trip. This will make emissions much more tangible and so will the goal of becoming more sustainable. This insight will impact bigger choices such as getting rid of a second car or the car entirely.

Mobi has been tested with multiple tests and interviews with users and experts in the field of mobility and confirms its desirability through its impact behaviour and thus on the world and its society. Developments make Mobi feasible, through rapid developments and its possible launch through multiple platforms such as companies like SJEES and also in area developments. Although, Mobi will rather serve as a inspiration for new project to make mobility more sustainable. Mobi seems to be inspiring with the translation of a battery to make emissions tangible. Mobi could be implemented in MaaS apps, such as Gaiyo, as a function to display sustainable travel consumption. Mobi is focused on long-term behavioural change to make it viable.

Mobi will help to achieve a green world by letting people make the moral choice in terms of sustainable mobility. By using today's technology to influence future behaviour, a green world will be possible by 2040, and that is where Mobi will be the first step in the right direction.

This project is now complete, yet there are always recommendations for more research. For instance, a stakeholder interested in the whole service Mobi could be looked into. This could include a smartwatch company where statistics are part of the display. Feedback can then be communicated throughout the day. The target group of this smartwatch will have a lot of interest in the data Mobi keeps. Besides another stakeholder, there could be looked at involving public transport more in the Mobi story. Public transport is now left fairly neutral as it enables active transport. Still, Mobi's role while travelling could be more prominent, helping it progress or figure out the right trip or display emissions in addition to the well-known time, cost and track number. This would make people choose the sustainable option and thus also achieve the goal of this project, encouraging people to make the sustainable choice. Although it was decided to focus on individual progress during the project and drop community, further research into this could lead to a different outcome. After all, a more sustainable community and world is what we will achieve together, not alone.

8.3 Reflection

Looking back on this project, I am satisfied with the final result. I learned a lot about mobility, but also about writing a report and what this involves. Communicating with experts and users. Noting results and drawing conclusions from them. I was able to both apply and expand my skills during this final project.

I would also like to thank Advier for facilitating my graduation. Providing a cosy workplace, but especially their expertise and willingness to help and guide me. Especially thanks to my supervisors within Advier who supported me along the way where necessary.

I would also like to thank my supervisors from TU Delft. Who were willing to guide me during this graduation period. I was able to make use of both their expertise and will take this with me for later.

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