

Optimal Charging Points

Final report of Explorelab 2 Part of the Minor Sustainable design

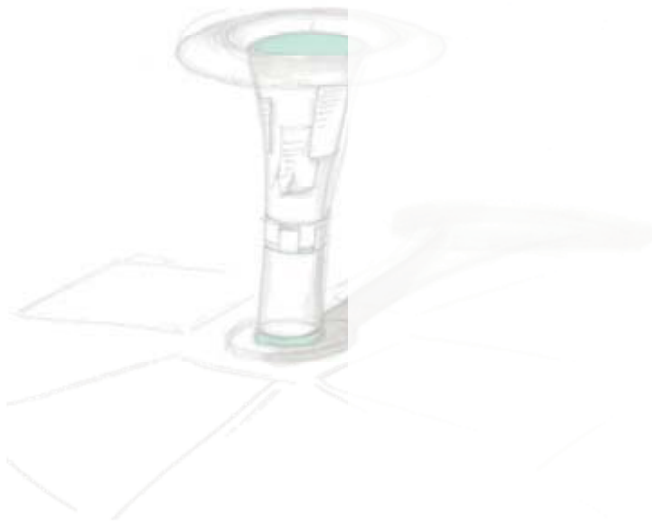


Penelope Rammos
Bart Noordstrand
Jordy Schuijlenburg
Mei Ying Deng
Christopher Bellingwout

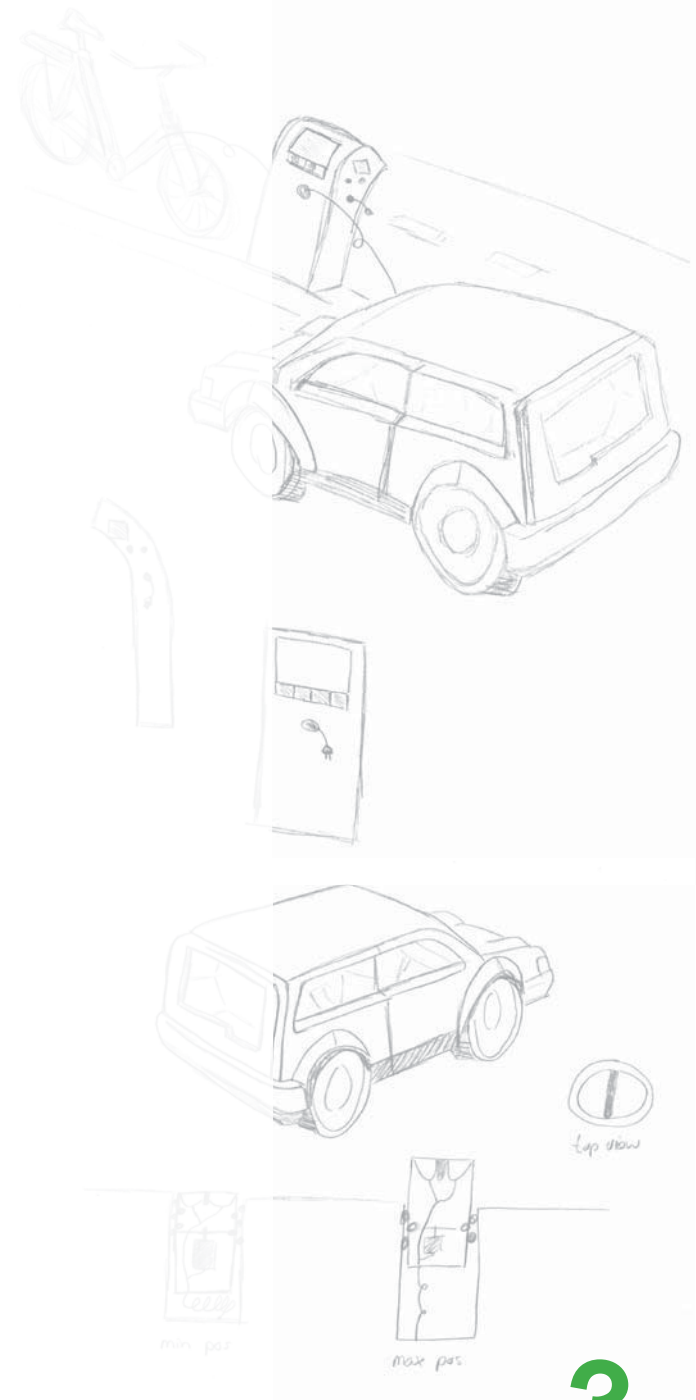


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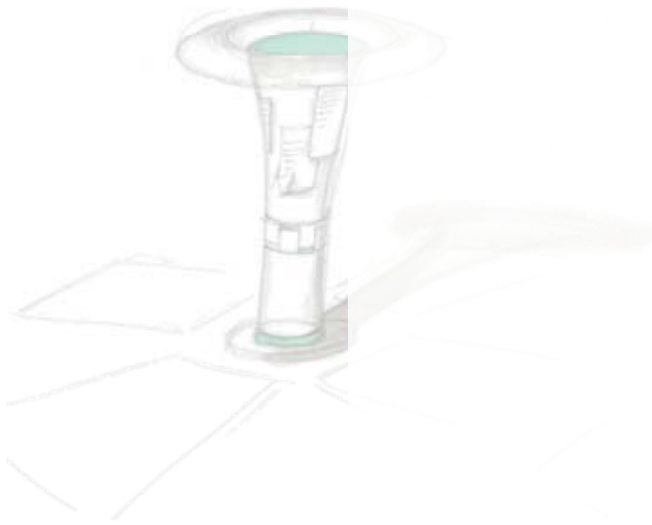
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Individual Designs

Introduction

In this part of the report, the individual designs of the JUICE! members are presented. Every group member designed in the first three weeks of explore lab some concept designs, making use of what is learned in the first period and the design requirements made in the first part of Explore Lab. In this chapter of the final report the designs are presented in the alphabetical order according the second name of the group members.



List of requirements

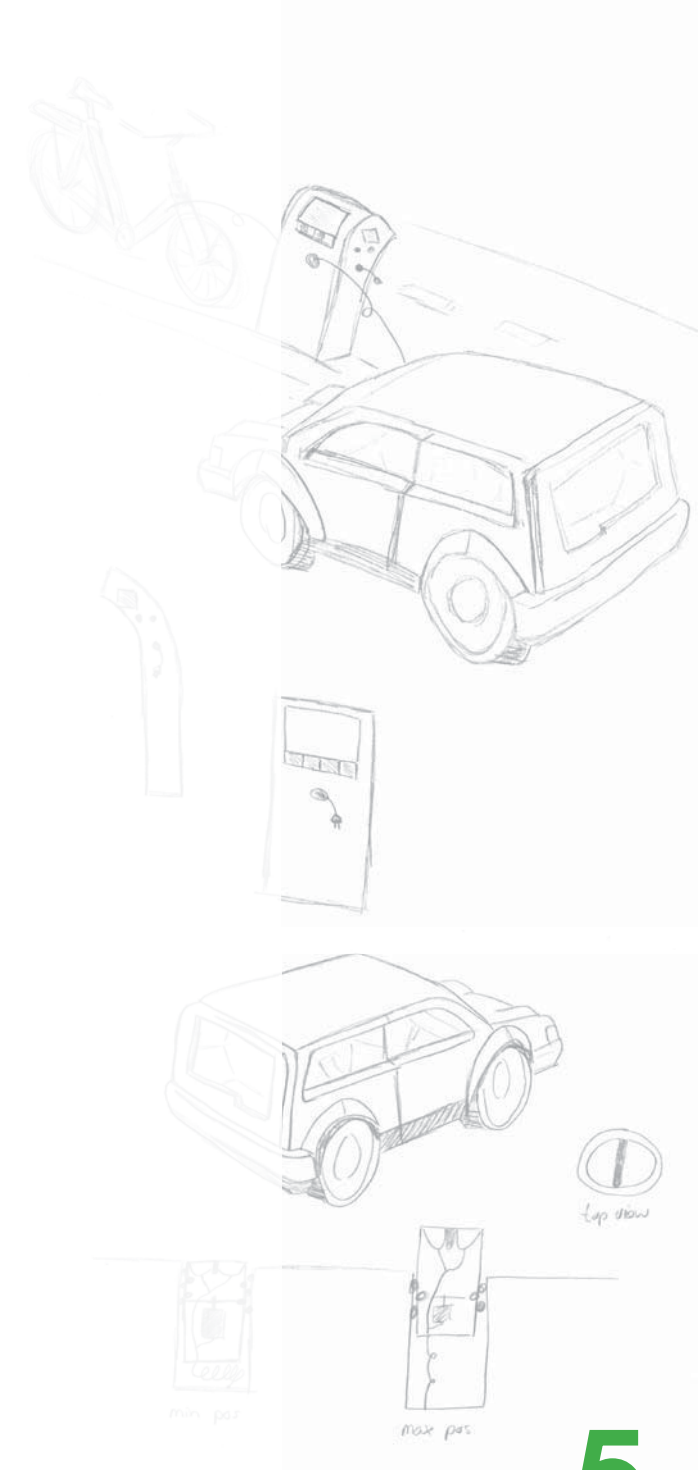
The requirements and preferences arranged in the first period were the following:

Requirements

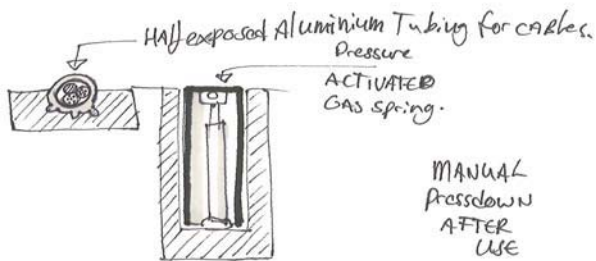
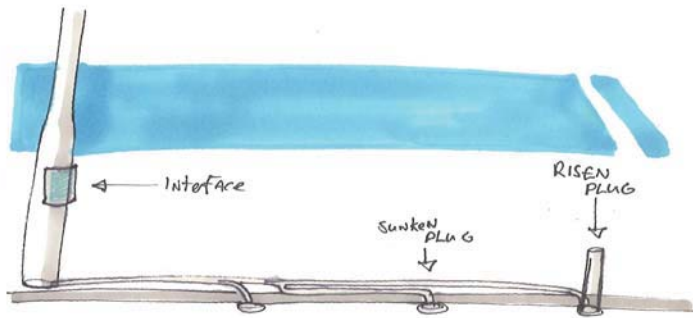
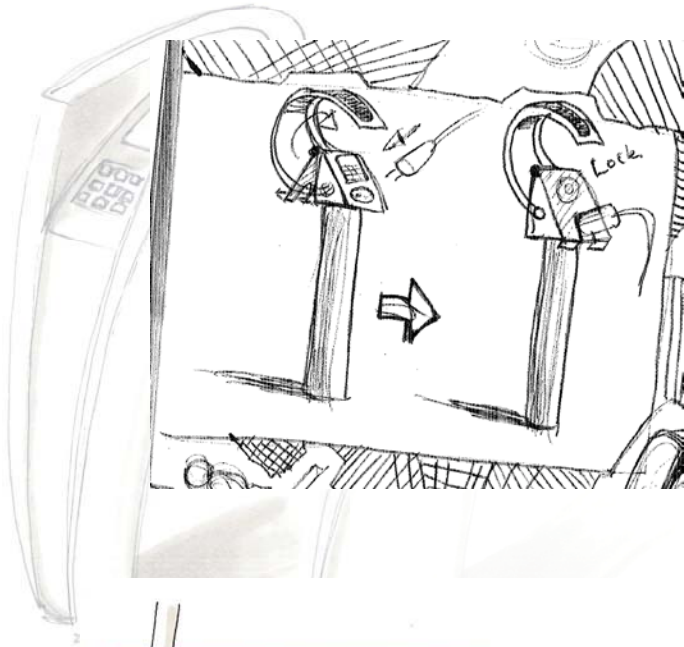
- Able to charge electric vehicles
- Safe to use and install
- It has to be waterproof
- It has to be water resistant
- It will not get rusty
- Standardized authorization and connection
- Impossible to 'steal' energy
- Suitable for quick mass production and installation (8,4 million produced and installed by 2020)
- Convenient for major energy users such as municipalities and companies
- Allow for easy use of green energy

Preferences

- It fits to the surroundings
- Connecting your car has to be attractive
- Attractive payment system
- It must not invite vandalism
- Exclusive design for EV only parking spots
- Low maintenance
- Design with cradle to cradle in mind
- Possible to redeliver to grid (this preference is removed, the reason is described in the chapter of the improved business plan)



Christopher Bellingwout

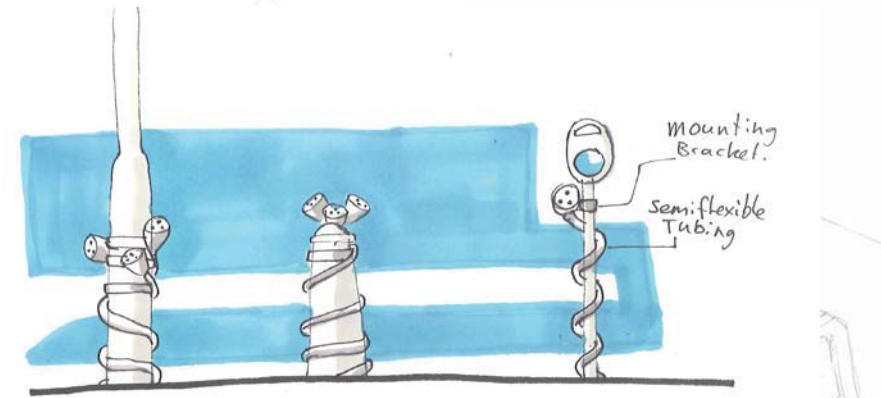


Introduction

My first impulse after a design assignment is to sketch a number of ideas and then lay them along the list of requirements. The main requirements I kept in mind were that it had to be cheap, easy to install and that it must complement the urban landscape. The design should not drastically alter the surrounding to reduce possible resentment toward the design and the idea it stands for. Namely that driving electrically is nearly the same as driving combustion engine powered, and that charging is as easy as parking; no revolutions are needed just small adaptation in your way of life. So in the beginning there were a multitude of ideas and options, mainly finding their origin in different kinds of shapes and objects that can be found on our streets such as bollards, posts, dustbins and the like. These evolved into more and more elaborately thought out designs until there were three which I selected to choose between for my final design. They were three different types of charging point.

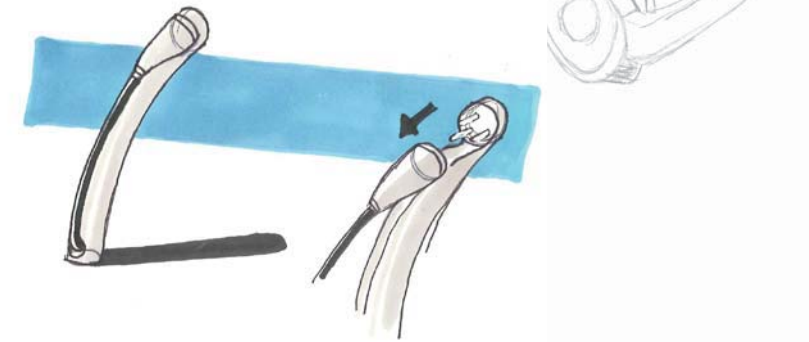
Concept 1

The first is an urban guerilla style add on for any street furniture at hand. The idea being that it can easily be installed and it reduces clutter on already very full streets.



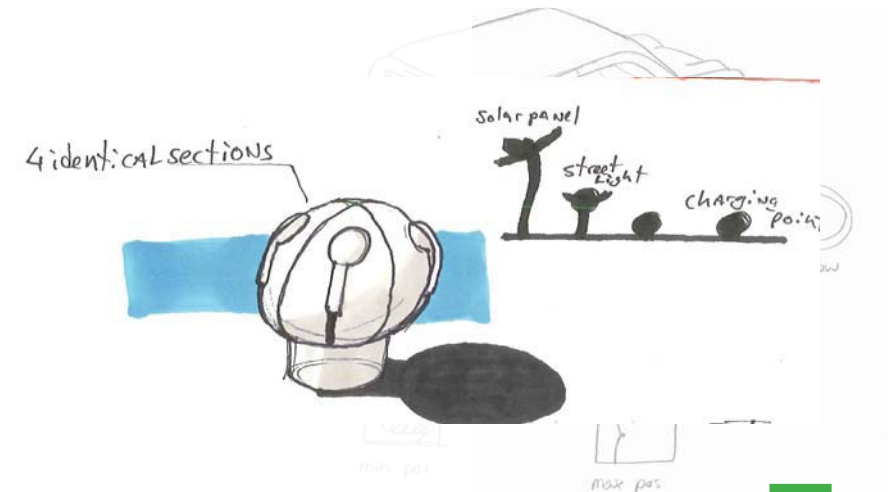
Concept 2

The other was a slightly altered post. Again in a shape which fits into many modern city centers.



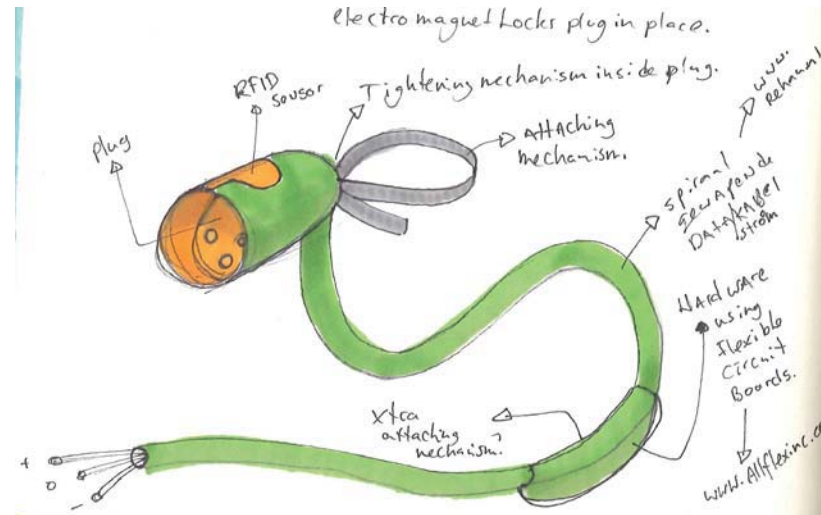
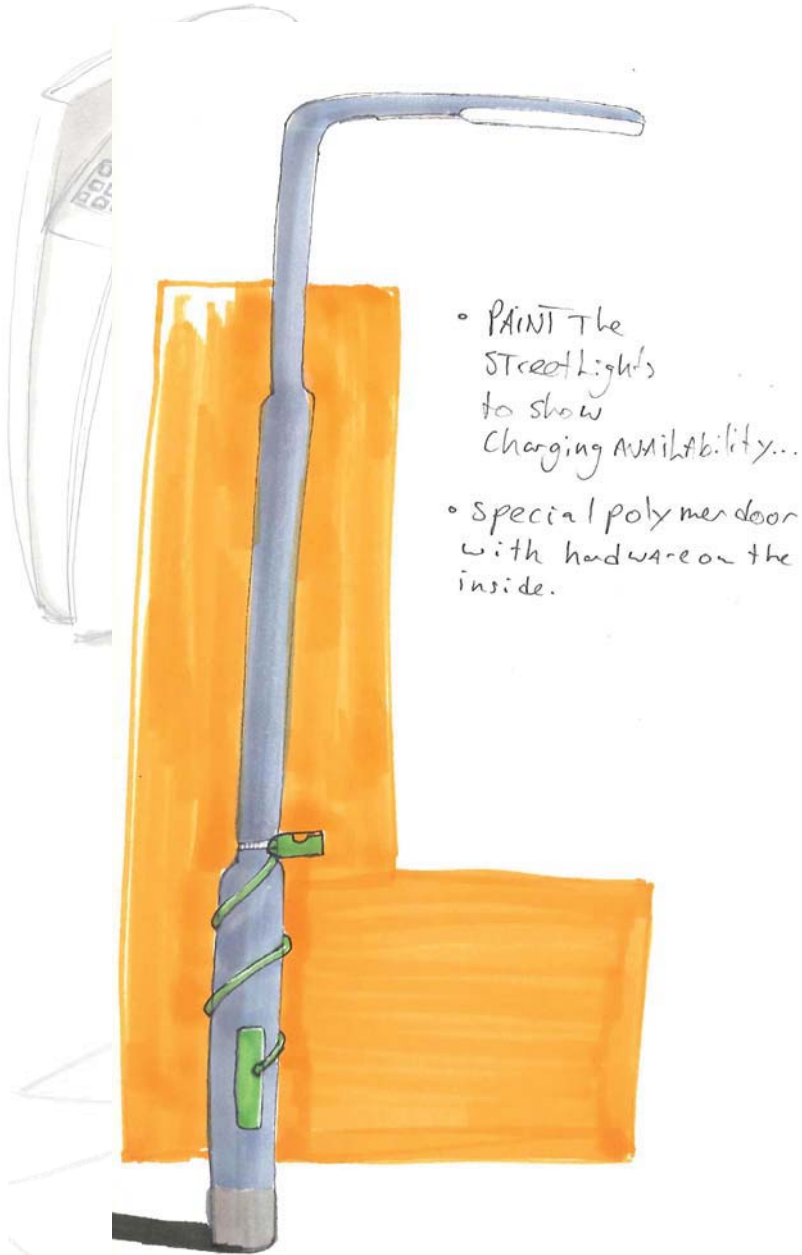
Concept 3

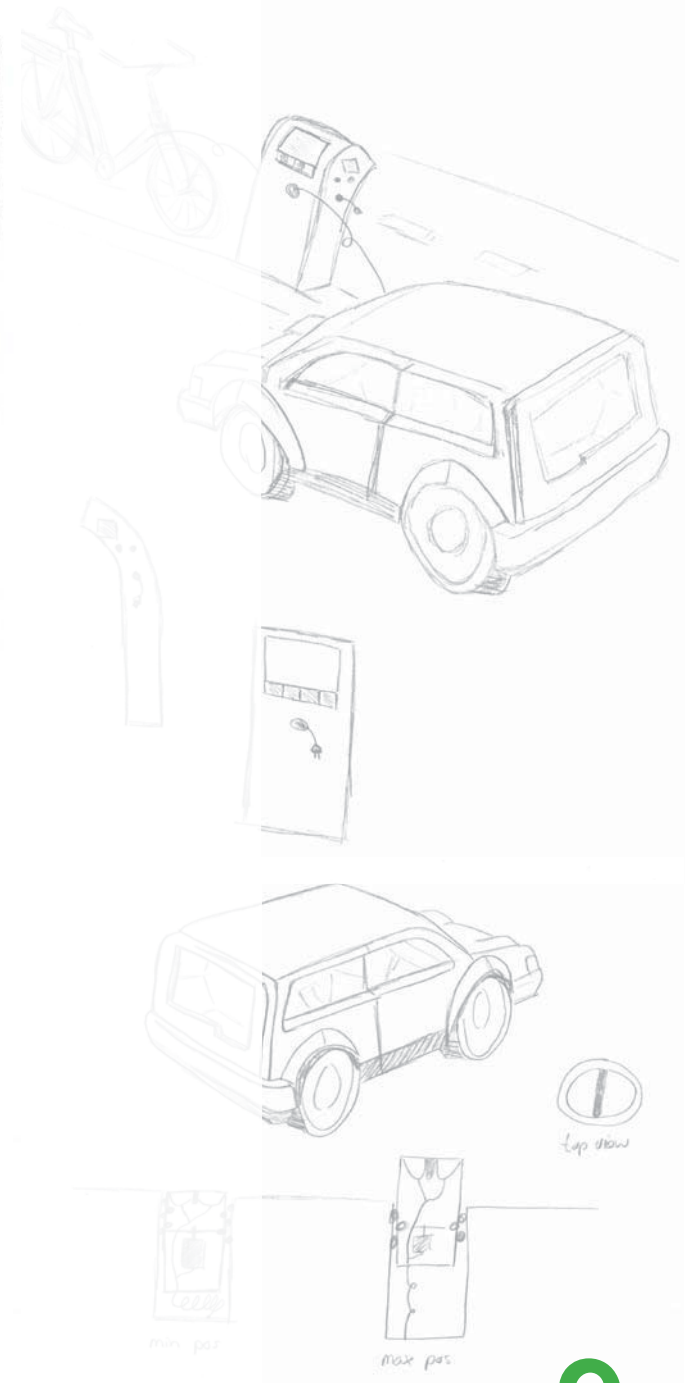
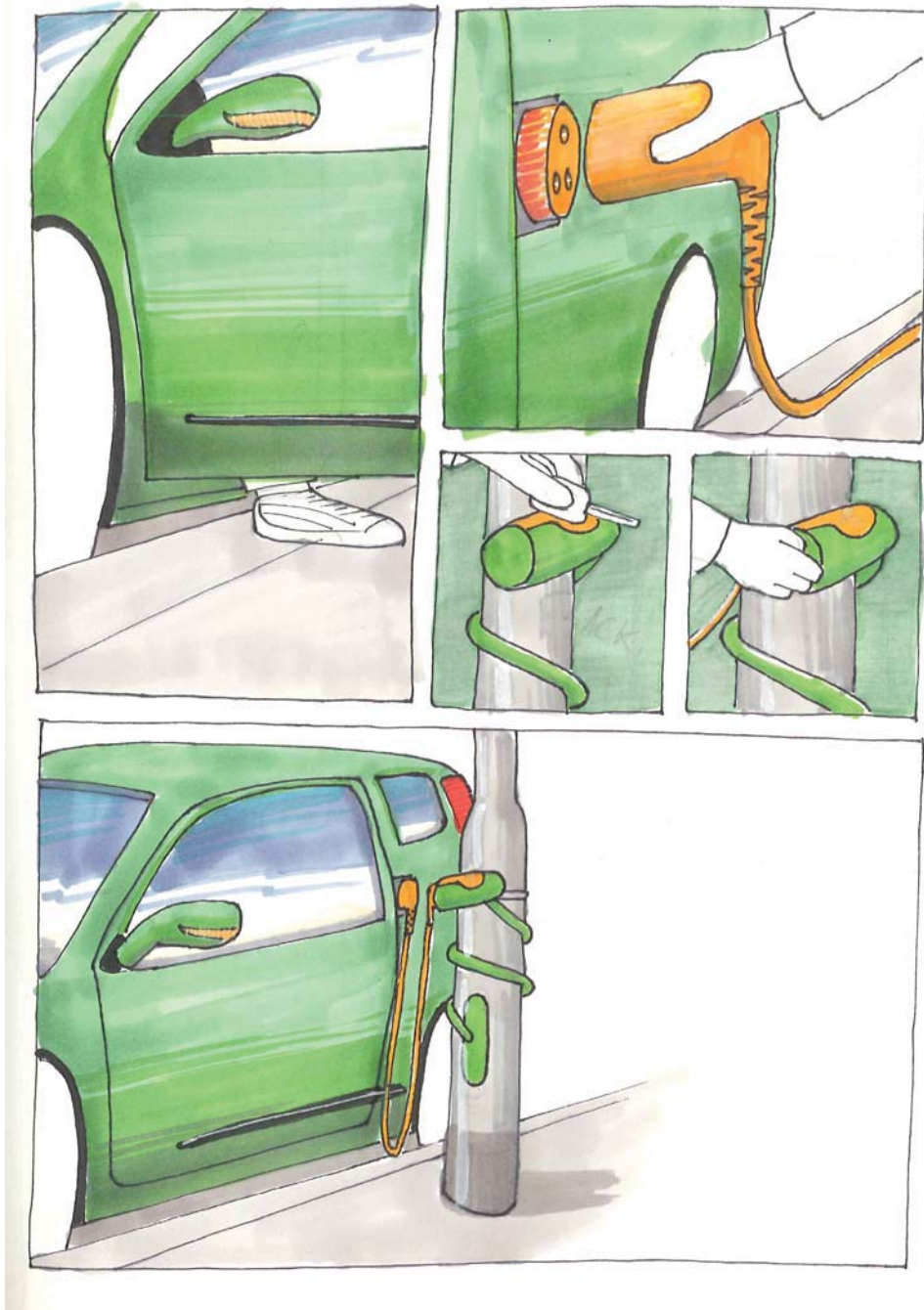
The third was a bollard design. The bollard is already a familiar shape when you park your car, so changing it to also use it for charging seemed safe. It would give the user a reassuring feeling.



Final Choice

These designs all have their good and bad points. But the final choice I made was for the guerilla style add on for street furniture. Realizing that it was the essence of all my other designs, changing a familiar shape into a new product by adding a socket and some hard ware. The guerilla add on made it possible to change any familiar object into a charging point, instead of sticking only to only one kind of shape.





Mei Ying Deng



To start with designing, there are factors that are relevant and related to the designs. These factors are:

- Advantages and disadvantages of manual and automatic use

Manual:

- Users will trip over the wire
- cheaper than automatically
- Possible to charge more than one EV at the same time
- Cannot be underground which means it will get dirty easier

Automatic:

- No extra work for users (not necessary to touch the Charging point)
- Can be underground, disadvantage is that it is necessary to take the positioning of parking cars into account
- Wireless charging possible

- What aspects are related to the charging points

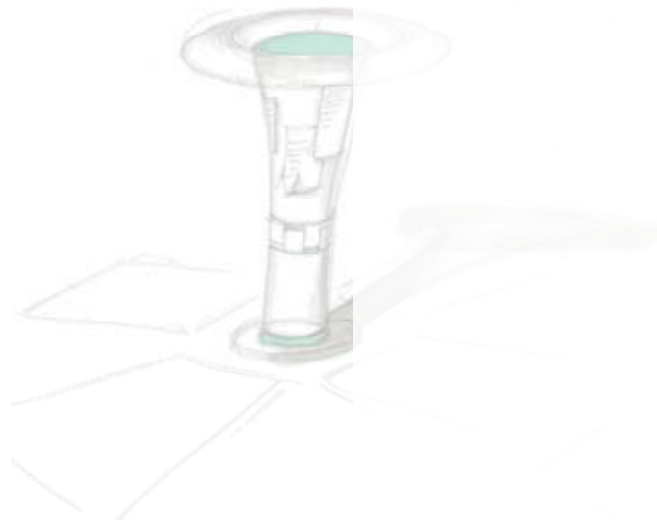
Colour must not be too conspicuous; it should fit into the surroundings, which are also important to take into account for the design. The positioning of the charging point must not hinder drivers and pedestrians. Other aspects that are relevant for the design are the shape, working of Charging Point etc.

Requirements and preferences

Requirements:

It has to be safe for everyone; it especially needs to be waterproof

Easy in use and understandable



The cost has to be less than €1000 per charging point

- Preferences

Also charging for hybrid cars

Cost as low as possible

Charging for more than one EV

Use is automatic

One hand needed for use

Does not get dirty easily

Easy to clean

Sustainable

Ergonomics

Elbow height

o Male: 1134mm

o Female: 1034mm

Eye height (standing)

o Male: 1705mm

o Female: 1563mm

Shoulder height

o Male: 1494mm

o Female: 1365mm

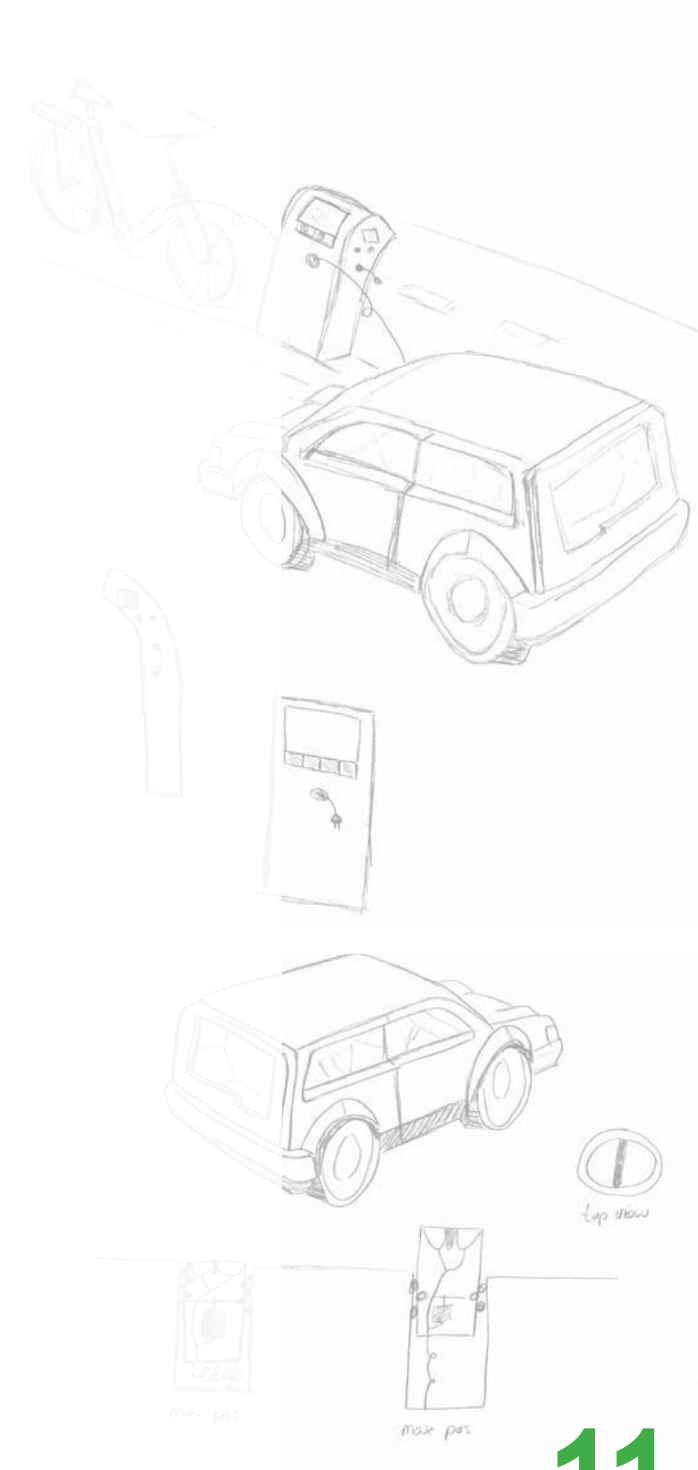
Forefinger breadth

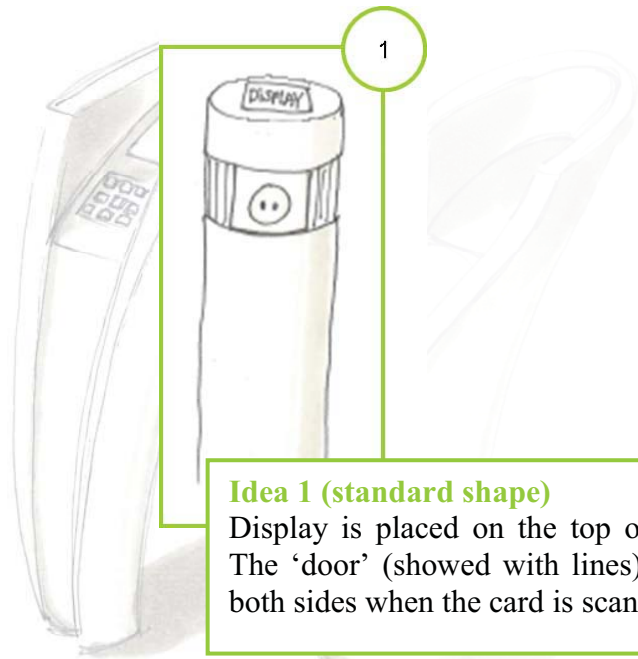
o Male: 18mm

o Female: 16mm

Besides these, there was a research about the existing CP's and EV's. Therefore, I have a more clarified view about CP's. I also have received photos of surroundings of parking spots from Chris, so I can consider these in my designs.

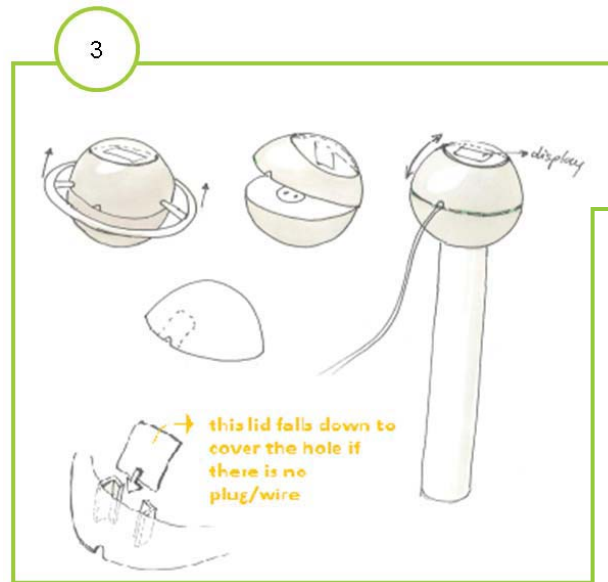
Then I started with designing. I have thought about the payment system first, I assume that there is a card installed with user's data and when the charging point scans this card, it pays automatically when the plug connects to the socket. I also focused more on the design and how the socket can be covered in the best way.





Idea 1 (standard shape)

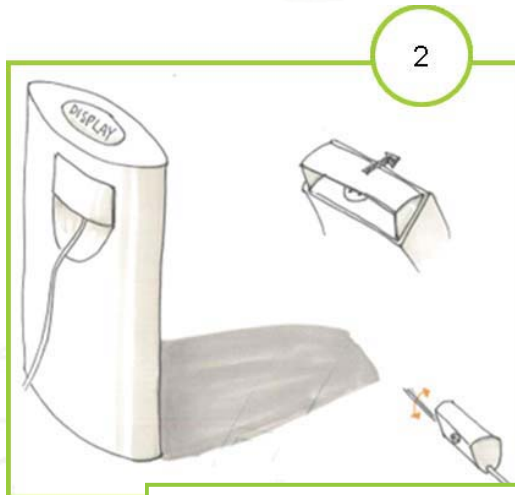
Display is placed on the top of the CP. The 'door' (showed with lines) slides to both sides when the card is scanned.



Idea 3 (sphere shape)

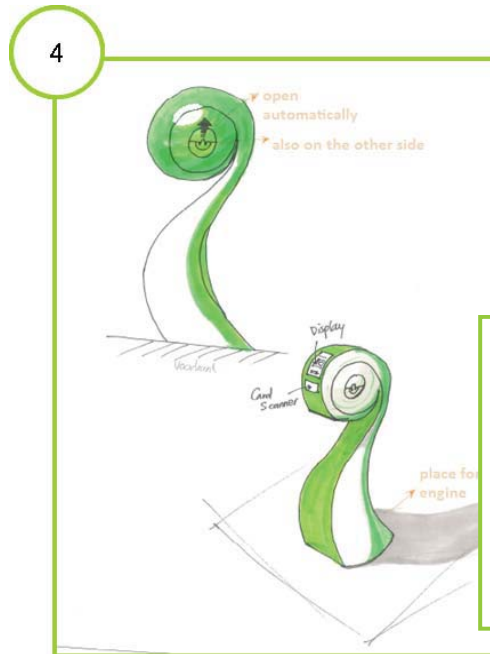
Display is placed on the top of the CP and is masked by a transparent cover. This idea can be manual and automatically used. Manually it is possible to open the sphere with the circle rod. The top half of the sphere opens and inside there is the socket. Of course, there is a hole for the cable, so it will not be crushed.

To be sure, that people are not going to put things in the hole, there is a lid that falls down when there is no cable.



Idea 2 (elliptical shape)

Display is placed on the top of the CP. The lid turns inside and the socket will appear after the card is scanned.

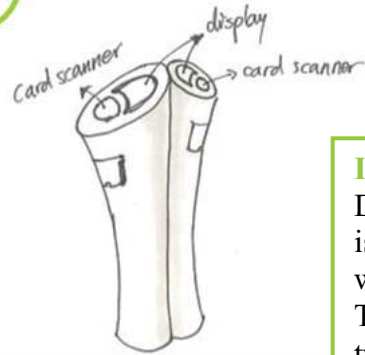


Idea 4 (spiral shape)

Display is placed on the top of the CP. The lid can be opened automatically or manually after the card is scanned.

There are sockets on both sides, so 2 EV's can be charged at the same time. This idea comes from the design spiral of biomimicry.

5



Idea 5 (twins shape)

Display is placed on the top of the CP. There is a click system behind the lid; it is unlocked when the card is scanned.

There are two parts, each part has a socket, so two EV's can be charged at the same time.

6



Idea 6 (CP with plant)

This idea is based on sustainability. The upper part is 2 or more sockets possible and the lower part is a pot where plants are cultivated. The display is placed on the prism that covers the socket as well. The socket will be covered more, just like the other ideas.

This idea doesn't need to have a lamp post, it can also be stand alone. This is nice, because not every parking spot has a post.

This idea can even give a clear sustainable image for customers.



Harris Profile

To choose a concept from these ideas, there is a Harris profile made. This helps me to find out which idea satisfies most of the preferences.

Other ideas are not very interesting to talk about, these are placed in the appendix.

Preferences	1	2	3	4	5	6
Also for charging hybrid	Red	Green	Red	Green	Green	Red
Cost as low as possible	Green	Green	Green	Red	Green	Red
Charging for more than 1 EV	Red	Green	Red	Green	Green	Green
Use is possible to be automatic	Green	Green	Green	Green	Green	Red
One hand needed for use	Green	Green	Green	Green	Green	Green
Don't get dirty easily	Green	Green	Green	Green	Red	Red
Easy to clean	Red	Green	Green	Green	Red	Red

From this table we can see that idea 2 and 4 satisfy most of the preferences. However, I still think idea 6 with the plant pot is a nice idea. Maybe that can be a concept of the future charging point whereby we have a higher budget than now.

Bart Noordstrand



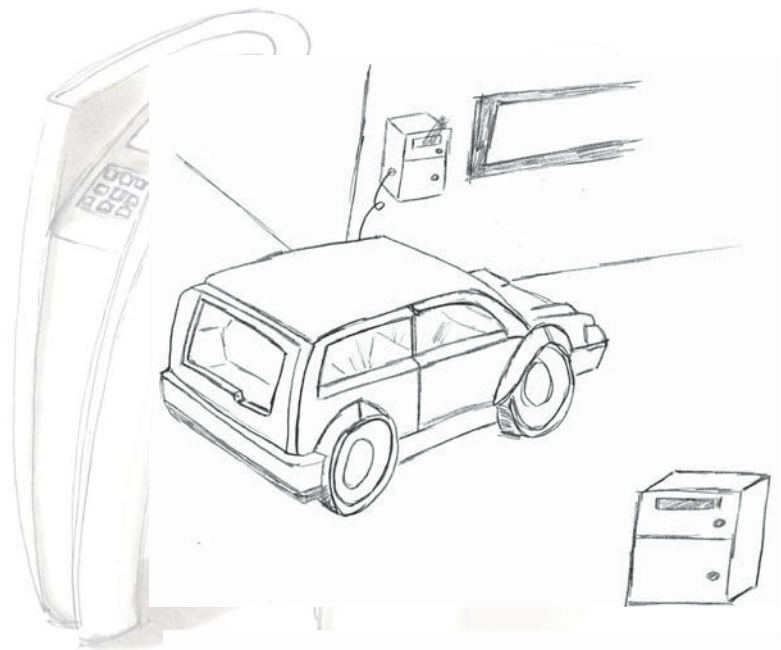
At the start of the designing process I looked around to see some differences and similarities in a wide variety of parking spots and parking areas. I discovered that at basically every parking spot is at least a sewer entrance and a light post present. My first sketches made use of this sewer entrance, to be a cheap electricity possibility without opening the road. After the first meeting with the coordinator I realized that although it is theoretically possible it will never be used in reality.

In my opinion light posts were not an option, because light posts are not present at every location for example at a parking garage and their shape changes per location. The result of this is that it is not possible to have the same concept used at every location which will make the product more expensive.

I also realized that there are a wide variety of different parking spots, from parking at home until parking at an airport. The conclusion I made was to design only for parking spots at locations which could be easily adopted towards an charging spot parking place, without wasting too much money and time. The possibilities I found were at home, at big parking areas, along roads where houses are and in parking garages.

To have a better chance to be accepted by ordinary people, I thought of combining the charg-





ing point with something ordinary. In this way a charging spot is not only useful for electric vehicle owners, but also for other people. The possibilities I came up with were bikes, electrical bikes, garbage bins, post boxes and small posts which are often standing near parking spots. The combining option could also deliver new ways of earning money, what can be very useful off course.

Concept 1

My first concept design is a combination with a post box. The idea is that people can combine the post box with a charging spot. If people buy one of our subscriptions they can also buy or get for free a post box charging combination. In this way new clients are certain to have a charger at home. It also gives the possibility to cheaply get a lot of charging spots, what is needed to reach our goal in 2020 to have several million charging spots.



Concept 2

My second concept is a charging point in a parking garage. The idea is that it can be installed very cheaply, because the concrete does not need to be destroyed for electricity cables. There are a lot of parking garages in the Netherlands; every city has one or multiple, so it is a good opportunity to reach the 2020 goal.

Concept 3

The third concept consists of a parking place at a shopping street or an ordinary street in a city. The idea is that an electric vehicle can be charged but also one or two electrical bikes. It is a relatively expensive solution. The idea is to only install this type of charging spot in relative expensive shopping streets where our first groups of customers are shopping. In this way our clients are reached without placing charging spots all over the city, which makes this option a little cheaper.

Concept 4

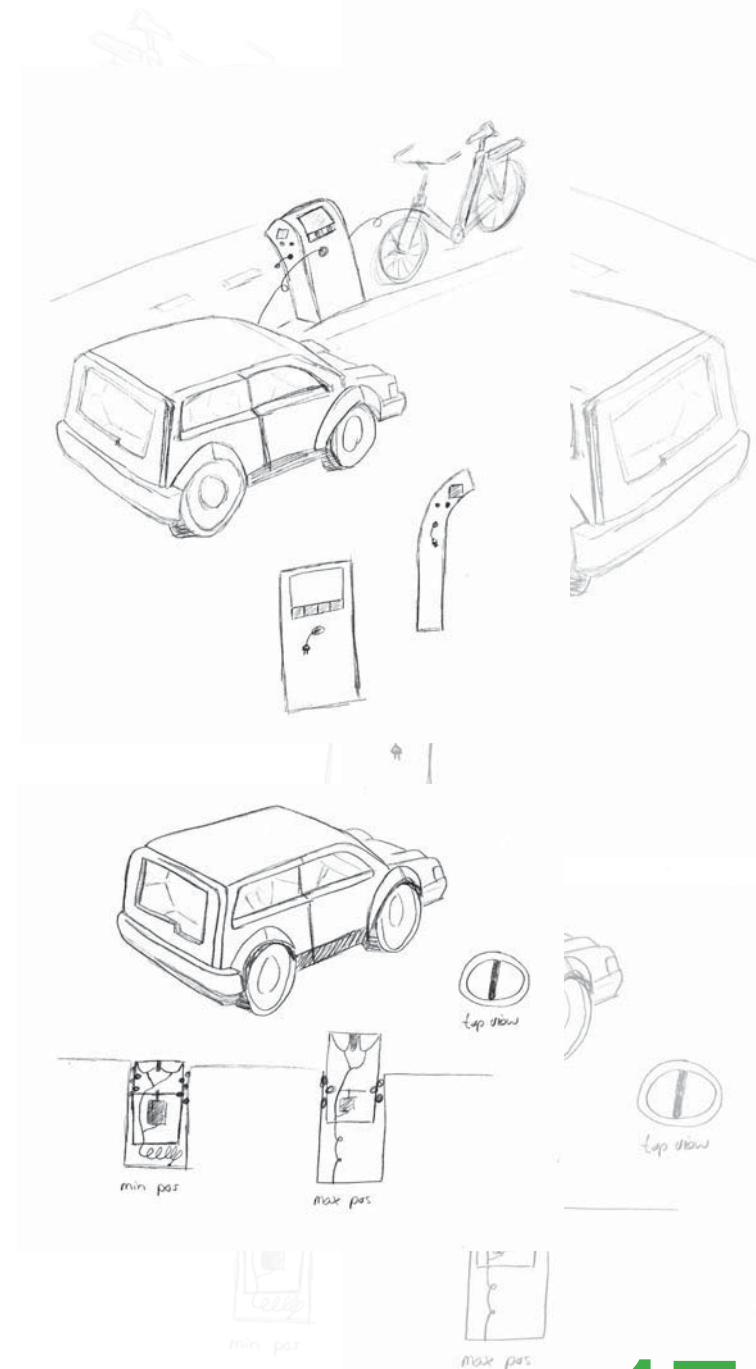
The fourth concept consists of a charging spot which is installed under the ground and so it is not visible. The charging module should only come up if an electric vehicle is parked on top of it and wants to be recharged. It is an expensive solution, mainly due to the complexity of the system and the complexity to install and maintain it.

Harris Profile

To decide which concept is the best concept I used a Harris profile. On the vertical scale the most important aspect of the design are mentioned and the Harris profile gives an easy and comparable overview of the best aspect per concept.

As can be seen in the profile concept 1 is having the greenest content and concept 4 is the most user-friendly concept. In my opinion concept 3 is the best, because it is green on the most important aspects, like userfriendliness and safety.

Harris profile	Concept 1				Concept 2				Concept 3				Concept 4								
	2	1	1	2	2	1	1	2	2	1	1	2	2	2	1	1	2	2	1	1	2
price																					
manufacturing																					
maintenance																					
user friendliness																					
safety																					
environmentally friendly																					
possibility of combination																					



Penelope Rammos



Requirements and preferences

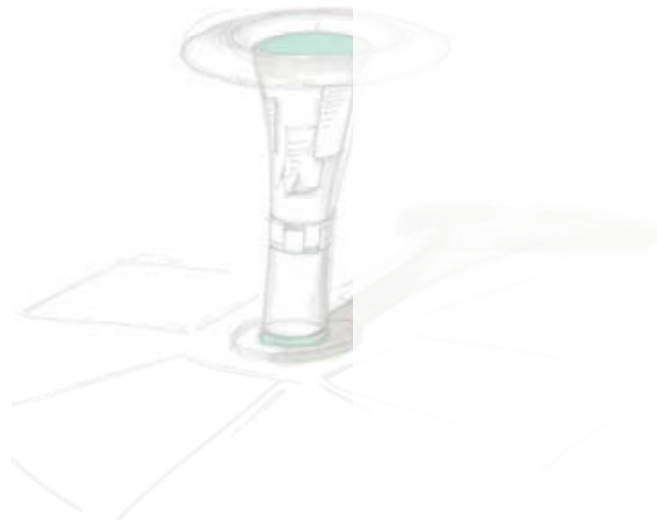
In order to begin with the idea creation phase I started by laying out the requirements and preferences first.

Requirements

- CP's charge both EV's and Hybrids
- Not possible to 'steal' energy
- Waterproof and weatherproof
- Easily accessible
- Ease in use and convenient (ergonomic dimensions)
- Safe
- € 500-1000 per CP
- Accepted by the general public

Preferences

- Non conspicuous (fit into town architecture)
- Low maintenance
- Radiate reliability and quality
- Attractive to use



System has little or no interference with car designing
Simple

The process was continued with a thorough brainstorm of aspects that should or can be considered in the design. Out of these I considered the following the most important factors.

Ergonomics

Ergonomic measurements of man

It is significant that the user does not feel uncomfortable or exerts any unnecessary strains on his body when using the product. Hereby I considered the average elbow height an important factor, because that's the most comfortable height to place the plug socket.

- Elbow height man 1153mm
- Elbow height woman 1050mm

Average elbow height for women and men aged 20 to 30 is thus 1101.5mm.

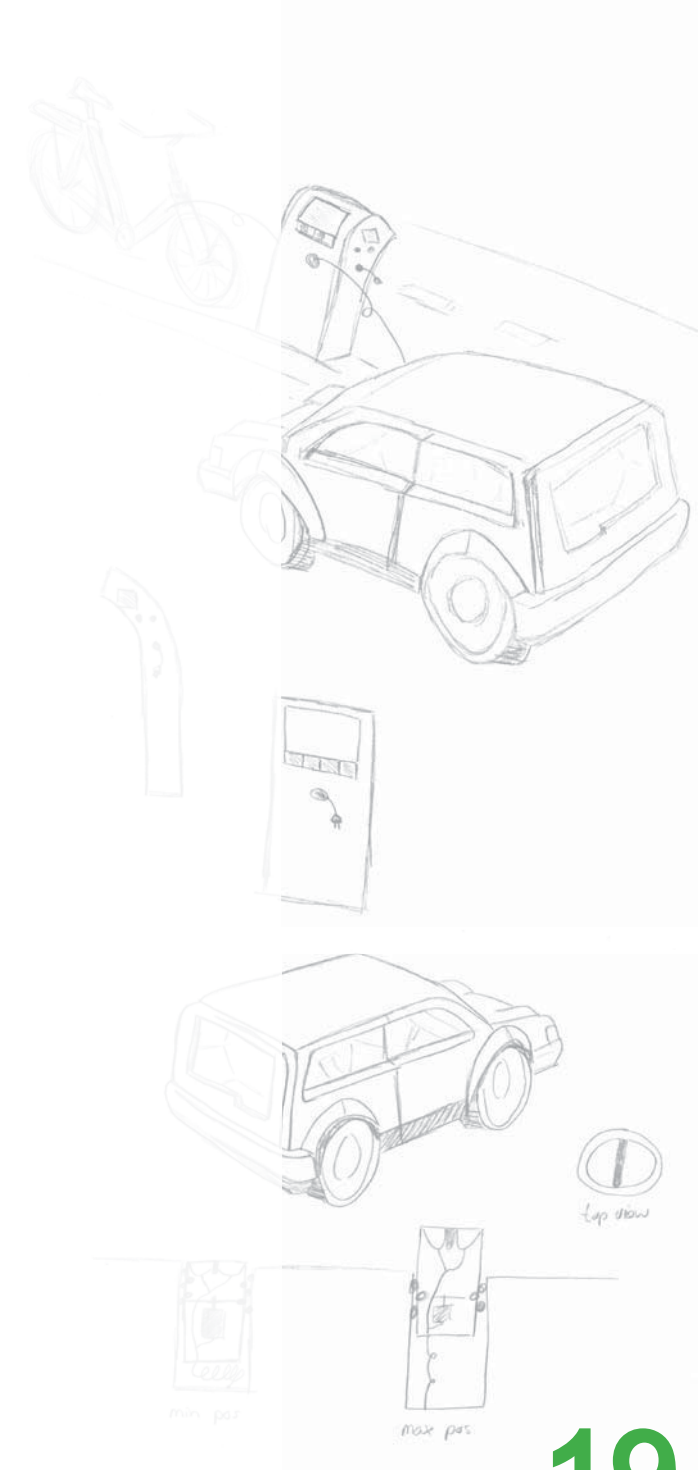
Architecture

Analysing town architecture is important because the charging point should not produce shock to the inhabitants. It should not be over conspicuous but it should also not be too non conspicuous because the users do need to know where there is a charging point. In analysing architectures I looked particularly at 4 cities of the Randstad; Rotterdam, Utrecht, Amsterdam and the Hague. I realised that The Hague and Utrecht are quite traditional, particularly in the centres and that going out to the suburbs it becomes more modern. Rotterdam has a more modern architecture and Amsterdam mostly traditional. The important conclusion is that the charging point should fit in all of these architectures, so either the CP has a neutral design or multiple designs should be made for each city.

Charging point usage

Through analysis of already existing charging points it became clear that the following aspects were necessary in a CP:

Indication that the charging point is charging
Interface or instructions of use





Space for the plug wire
Socket lid

In the case of our Juice charging point there also needs to be an identifier of some sort to be able to identify the user. It is also important that the interface of the charging point is universal, so that any user, regardless of what language they speak can understand what to do.

Concept 1

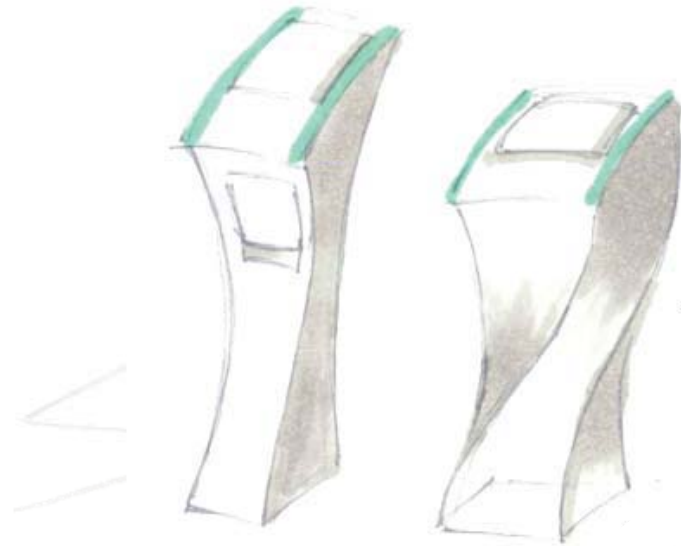
Streamlined designs

I started off with making my designs as streaming or twisted as possible to give the charging point a modern appearance. However, street furniture design is sensitive to various factors, one of them being the suitability of such a modern design in the city architecture.

Concept 2

Streamlined designs without rounding's

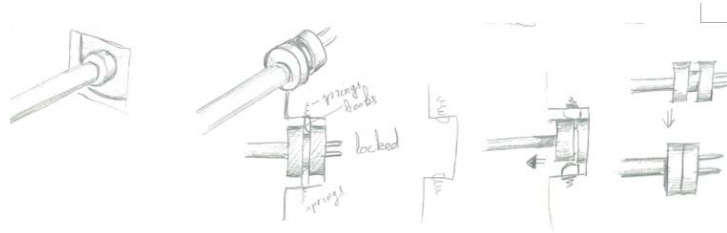
The process continued with several more streamlined designed but with ellipses and rounding's excluded. All of the concepts during this phase possessed a digital interface. In the 2nd concept however also lights were included to show the user whether the charging point is charging or not.



Concept 3

Designing solutions against vandalism

Another factor that street furniture is sensitive too is vandalism. It is frustrating if a by passer just plugs out your plug for no apparent reason. For this I started looking into ways to secure the plug into the socket. This involved either lids that would lock over the plug and can only be opened with identification of the user. Other systems involved the plug itself whereby the plug would lock itself into the socket. The problem encountered here is that we need to cooperate with the plug producing company to produce special plug heads.



Concept 4

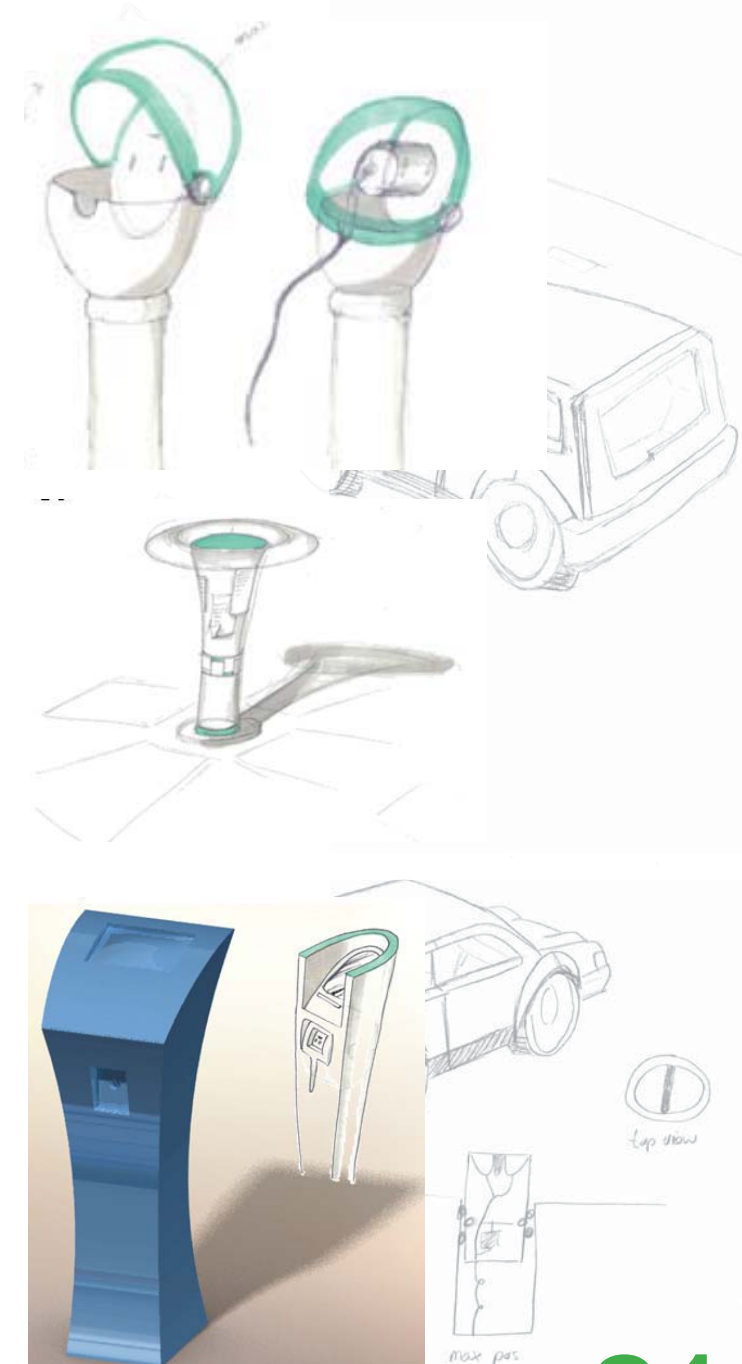
Integrating other functions into the charging point

The process continued by integrating other functions then charging into the charging point. For instance, by adding additional space to be able to post information about electric driving, sustainability and/or the progress of JUICE to educate the public. Another function that can be integrated is a waste disposal compartment for batteries. Every week this compartment could be emptied. The idea behind this is that the people begin to realise how they contribute to sustainability.



Chosen concept

In the end the direction of choice lay between concept 1 and 2. I decided to choose concept 2 because concept 1 is more likely to be unsuitable for the city architecture. However, concept 2 does have sharp edges and these are a disadvantage to the user.



Jordy Schuijlenburg



Introduction

From the analysis we did earlier, it has become clear we need a lot of charging points and they need to be everywhere. Therefore we need a solution which doesn't cause a lot of annoyance upon installation and which is cost effective, vandalism proof and a recyclable, durable, low maintenance and a number of other things. During latter research we have added the requirements easy to recognize from a distance and Fit into street view. To start with I have done field research and have taken a lot of pictures.

Street views

I have made a lot of street view pictures in Delft, Woerden and Harmelen.

Plug/charger

It is really unclear what kind of plugs car manufacturers will put on their cars. 3.3 kW chargers fit into regular sockets. For 6.6 kW chargers we need power current which uses different plugs/sockets. Market leader Better place wants to use 3.3 and 6.6 kW chargers. When you supply 6.6kW to a 6.6 kW charger the charging efficiency is 90%. When you supply 3.3 kW to a 6.6 kW charger the efficiency drops to 75%. Chargers will be onboard.

Payment

The payment also needs attention. It is preferred if the people who want to charge their car don't have to enter their pin code every time they charge their car. However, at places with a parking meter somebody could pay for the charging with an extra fee. Currently the cost of a kWh is 17-22 cents. On one kWh you can drive 5-8 km. Average distance travelled per day is 41 km. People are not expected to buy an electric car if they can't plug it in at least once a day. Therefore payment for one charge is $41/7 * (0.20 \text{ for electricity} + 0.20 \text{ for infrastructure}) = \text{€}2.40$. This is for people who don't lease a battery. The cost for a parking meter is €8000 so building a parking meter for the sole purpose of paying for charging won't be cost effective until everybody drives electric. Furthermore the parking meters often need to be replaced after 8 years or so. Therefore some kind of RFID or other identification method is preferred. Payment could be done per month with a Navigation system registering the amount of km's you drive. This will be a good selling point because people don't have to worry about their drive style. Another idea is a central server which tracks the amount of energy you use and sends you a bill at the end of the month.

Electrical circuitry

To charge in lampposts, circuitry in the lampposts needs to be altered. For some lampposts an extra cable needs to be placed from the ground cable to the lamppost. However the current lamppost circuitry can only charge at a 3.3 kW rate with a factor of 0.1. This means less than 10% of the lampposts at the same time. In some places there is an extra fase which alters things. Therefore the application in lampposts is limited. 4.6 Million Lampposts are placed in the Netherlands, often near parking lots.

3 different groups

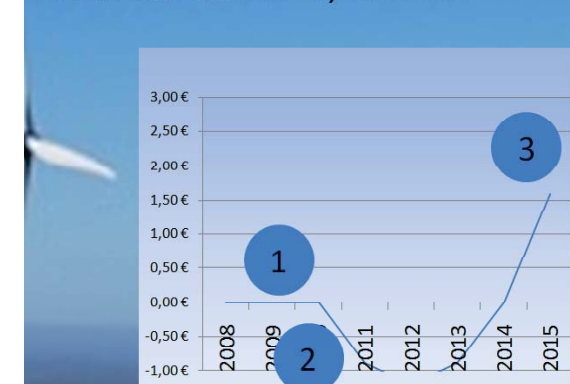
After the really rough sketches concepts can be divided in 3 different groups. The first group is the lampposts group. The second group are stand alone concepts. The 3rd group are automated concepts. We can start with installing charging points on lampposts. The second group comes in to play when all suited lampposts already have a charging point installed. The 3rd group is mainly to differentiate from upcoming competitors when we have enough income.



Initial sketches



Financial balance, billions



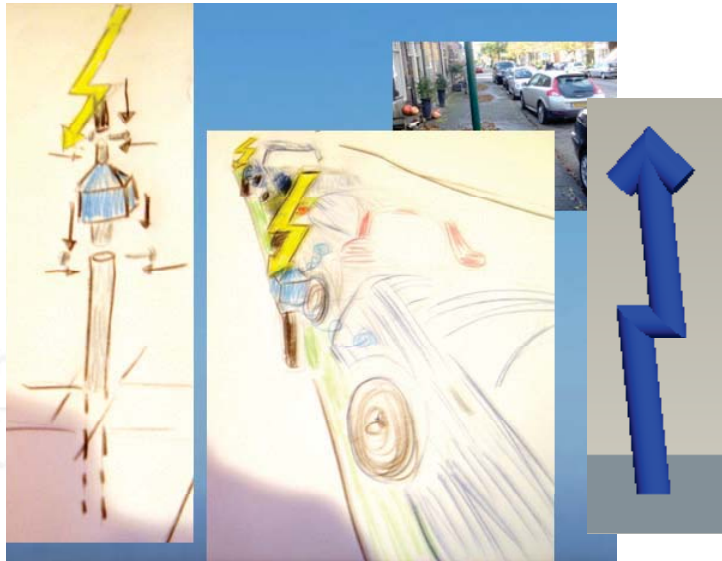


Concept 1

There are five million lampposts in the Netherlands. Several hundreds of thousands of them can be used to charge electric vehicles. The yellow charging point sign makes the charging points easy to recognize when you are looking for a parking lot.

This concept requires no digging and is very easy to install. In the future you might see solar panels being installed on every lamppost, collecting energy to charge electric vehicles. The charging point consists of two parts and installation will only take minutes. The shape of the charging point neatly fits around the lamppost door. Upon installation the door can easily be removed.

For lamppost maintenance the charging point can be removed by unscrewing 3 screws. However, you can't take 3.3 kW from 3 lampposts in a row. This is because the ground cable can't handle it. The electric circuitry inside the lamppost also needs to be altered. On some lampposts an extra cable needs to be put into the ground. Most cars will have a 3.3 or 6.6 kW charger. We still need to find out whether we can charge with 6.6 kW.



Concept 2

The second concept is similar to the first. Driving around, you can see the yellow signs from a distance and conveniently plug your car in. Plugging in your car requires no effort. Your integrated car key transmitter will automatically lock your plug to protect against vandalism. Your car key unlocks the plug whenever you want to stop the charging cycle. The modular design allows for easy upgrades and maintenance.

Alternatively, the entire charging point can be one big yellow sign. This has aesthetic advantages. The concept can also be placed in between 4 parking lots to further improve the cost effectiveness.

Concept 3

The 3rd concept is an automatic charging point. Disadvantages are high maintenance and cost because it is high tech and you can only cover one parking lot with it. There are no car manufacturers making compatible cars.

If it rains or snows the point could be short circuited. A charging point will also be hard to recognize when it is buried into the ground.

Furthermore there are also a lot of legal issues.
Definitive concept choice

As a Group we have decided to combine the strengths of different designs into one concept. The concept will be easy to recognize from a distance without significantly altering the way the street looks. It will be easy to implement, low maintenance, cheap and good looking. Furthermore the charging point will make for an easy promoting campaign. The concept will look like a plant growing around a lamppost. Slowly but steadily they will grow everywhere

