# M - Charge Pile

A new charge pile with a mobile ability. Reserve the original way of providing service - serving one parking space with one charging point

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Product design engineering

# Contents



# Background

Electric vehicle market is huge in every country and growing quickly in the 10 years. From tesla to BMW Group, more and more new or traditional car manufactures has joined this to share the market and consumer have multiply choice on electric vehicle.

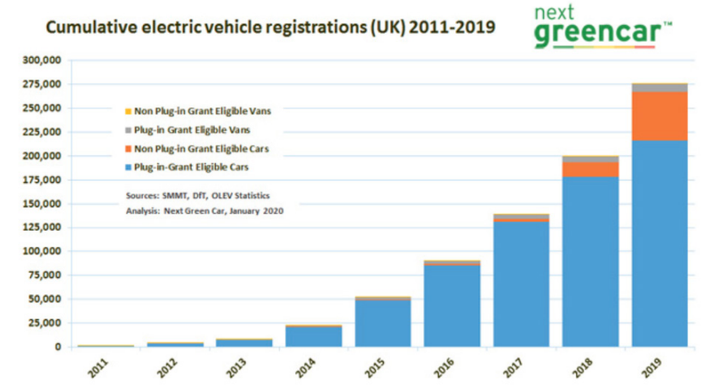
News story

**New 'league table' reveals electric car charging availability across UK as Transport Secretary calls on local authorities to do more**

Local authorities urged to take advantage of electric car funding as 'league table' of charging infrastructure released.

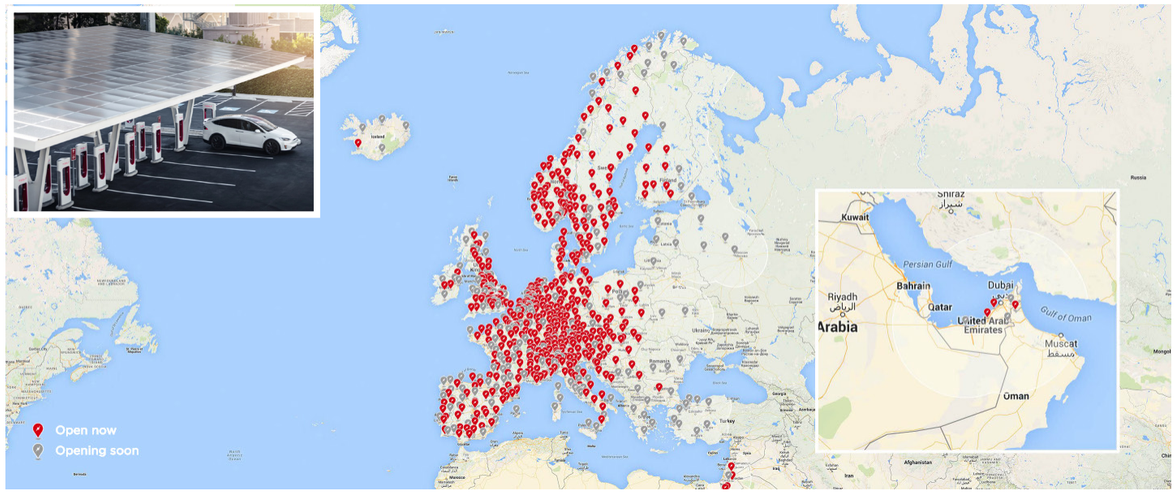
Published 2 November 2019
From: Department for Transport, Office for Low Emission Vehicles, George Freeman MP, and The Rt Hon Grant Shapps MP






**SOURCE**: SMMT, OLEV, DfT Statistics; Analysis: Next Green Car, January 2020.(Chart)
GOV.UK,News story,Published 2 November 2019(News)

With the fast development of market, the requirement of charging is growing as well. As a result, electric vehicle charging market has become a new profit cake for many companies. Charging demand is increasing while more and more charging points are under construction.




**SOURCE:** TESLA,2020, https://www.tesla.com/en_GB/supercharger

however, users do not feel charging at public is convenient. One of the reasons to the problem is the bad distribution of commercial charging resources.

The chaging situation is complex and then the consumer become puzzled to choose the right charging product of that company. Some consumer even hard to parking on an available place to charge their vehicle. Although the government like UK invest millions of pounds on charging infrastructure to meet the needs of public, it is impossible to build one charging pile in front of the whole parking lot especially based on the rapidly grow situation.

# Research

Due to the impact by COVID-19, the main method of research is based on online.

## Electric vehicle basic information

### Batteries

According to wikipedia, the range of an electric car depends on the number and type of batteries used, and as with all vehicles, the weight and type of vehicle, performance requirements, and the weather. The reported range of production electric vehicles in 2017 ranged from 100 km (60 miles) (Renault Twizy) to 540 km (340 miles) (Tesla Model S 100D). Real-world range tests conducted by What Car in early 2019 found that the highest real-world range was 417 km (259 miles) (Hyundai Kona).

Table 1: Typical  electric vehicle real- world range

| Car | Range | Real-world range |
|---|---|---|
| **Tesla Model S** | 393 miles (NEDC) | 320 miles |
| **Tesla Model X** | 351 miles (NEDC) | 233 miles |
| **Jaguar I-Pace** | 292 miles (WLTP) | 253 miles |
| **Kia eNiro** | 282 miles (WLTP) | 253 miles |
| **Mercedes EQ C** | 280 miles (WLTP) | TBC |


**SOURCE:** BUYACAR TEAM, Jul 29, 2020, https://www.buyacar.co.uk/cars/economical-cars/electric-cars/726/electric-car-range-how-far-will-they-really-go-on-a-single

### Charging choice

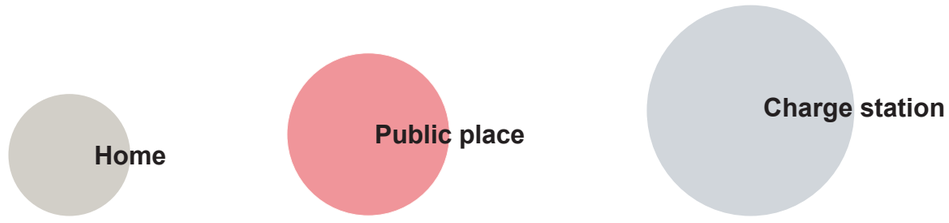
For the charge speed,an overnight charge of 8 hours using a 120-volt AC outlet will provide around 65 km (40 miles) of range, while a 240-volt AC outlet will provide approximately 290 km (180 miles). Charging an electric vehicle using public charging stations takes longer than refueling a fossil fuel vehicle. Connecting a vehicle that can accommodate very fast charging to a charging station with a very high rate of charge can refill the vehicle's battery to 80% in 15 minutes.

Table 2: Empty-to-full time to charge with different chargepile speeds

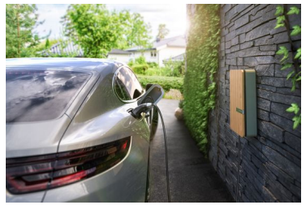
| Vehicle | | | Empty to full charging time*** | | | | |
|---|---|---|---|---|---|---|---|
| Model | Battery | Pod Point Confidence Range* | 3.7kW slow | 7kW fast | 22kW fast | 43-50kW rapid | 150kW rapid |
| Nissan LEAF (2018) | 40kWh | 143 miles | 11 hrs | 6 hrs | 6 hrs | 1 hr | *Can't charge on this kind of charger* |
| Tesla Model S (2019)** | 75kWh | 238 miles | 21 hrs | 11 hrs | 5 hrs | 2 hrs | <1 hr |
| Mitsubishi Outlander PHEV (2018) | 13.8kWh | 24 miles | 4 hrs | 4 hrs | 4 hrs | 40 mins | *Can't charge on this kind of charger* |

**SOURCE:** Pod-pile, https://pod-pile.com/guides/driver/how-long-to-charge-an-electric-car

## Avaliable place to charge a vehicle




At present, user has multiply choice to charge their vehicle. They do normal speed charge in home with home charger, in workplace and parking lot with commerial charge poing or do a fast charge in charge station with supercharger.



Home

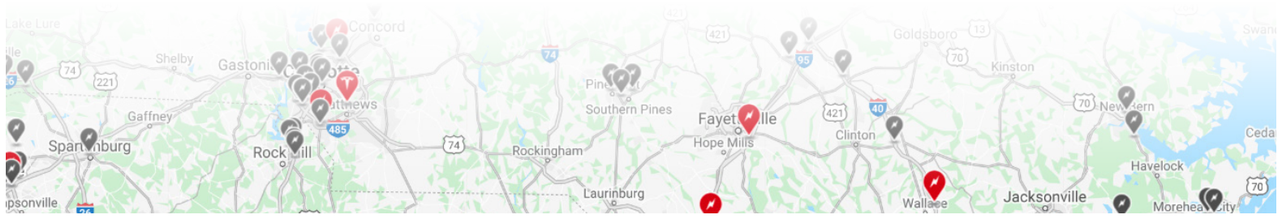
Workplace

Charge station

From the interview and shared video of the experience of electric vehicle and charge pile, most of users have developed a habit of charging at home while occasionally they need to charge in the public area. When they come back to home, they will plug in their vehicle right away. Unlike petrol vehicle cost lot on petrol fee, they just need to pay for electricity and the install fee with home charger. The charge process is easy and vehicle could go a long way with a full charge. User just need to charge vehicle every few days if they drive car for commuting.

However, setting up charging piles in public places is a require by people. One reason is that even if users have a home charging device, they still need to use a commercial charging pile to make an emergency charge for their car occasionally.Another reason is that not all users can install charging devices in their homes, such as people live in apartments, and they need to use commercial charging piles to charge.Commercial charging pile exactly deal with their problem. They could charge vehicle at night or in the working time.

For the long tour trip, many companies have built a supercharge electric grid to deal with it and a vehicle could be fully charged in 30 mins which is fast enough for the trip. For the short trip like commute, the government and commercial parking lot owner began to use charge pile in their indoor or outdoor parking lot.



# Persona

In order to understand the detail of requirement of these three charging addresses, a character model is seted up with different scenarios in each charging location.Although the scenario is fictional, we can understand the user's needs for each charging location through the scenario.With the association of the situation, analysis and discovery of design opportunities from the scenario.

Ben Jackie

Commuter

Experience of EV owner

2 Years

Feature of user

Ben works in a business company. Because the high traffic in the city, he drive his car to take a subway every morning.

Charging habit

Ben’s EV average range is 400KM which result in he just need to charge his vehicle once a few days for commuting. Usually, the charge stage is did in the night.

Ben like to do a shopping every week. A supercharge station is nearby the market, he could do a fast charge when shopping

Ben work in office from 10am to 5pm in weekday. His company have their own parking area could charge vehicle.

Ben lives in a apartment. Thus, he need commerial charge pile to chage vehicle few days.

Sometimes, Ben need to charge in the public parking lot near the subway as he can't find an avaliable charge pile in his apartment

EV Route

Public trans.

Ben’s house

Market

Company

# Design opportunity

Charging demand is increasing while more and more charging points are under construction, however, users do not feel charging at public is convenient. One of the reasons to the problem is the bad distribution of commercial charging resources.

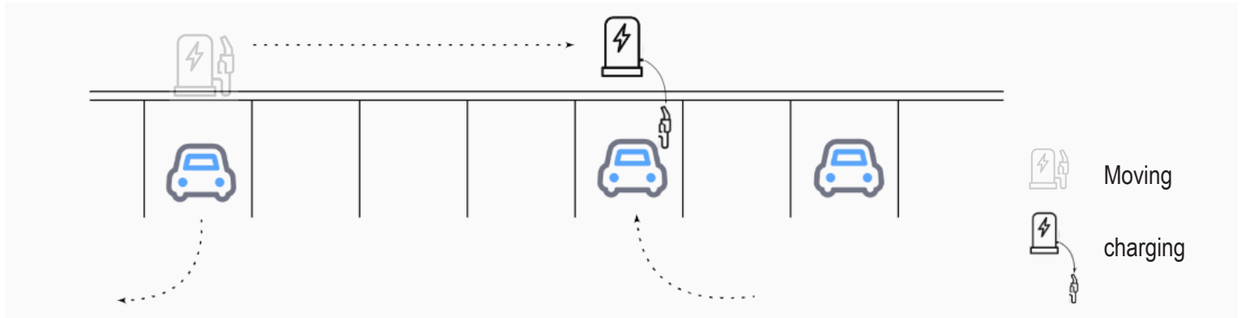
### Problem 1 : Charger resouce waste


User is hard to find an available one to use which is like the situation of parking problem in a big city. A more general case is that when the user comes into the parking lot for charging, they find another car park in front of the charge pile while it is not charging at all which is totally wasting the resource of public. Thus, the design opportunity lies in the workplace charging area. These areas do need a well-designed charge pile to deal with the problem of resource wasting. Some company decide to charge extra fee on this kind of behaviour.

| Country | Currency | Idle fee (per minute) | Idle fee (per minute) when the station is 100% occupied |
|---|---|---|---|
| United States | USD | $0.50 | $1.00 |
| Canada | CAD | $0.65 | $1.30 |

### Solution : New way of allocating resources

Instead of vehicle move to find an avaliable charge pile, the initail concept is change the way of finding. charge pile could move along the line in front of the parking lot. Because the modern parking lot distribute in a row, it is easy to build a rail in the parking lot and the device could move on the rail like the train. Thus, the user could rental it in any position in the parking lot as it could move through the rail. Once a vehicle ends up the charge process, other user could book it and move to their vehicle position to do a charge.



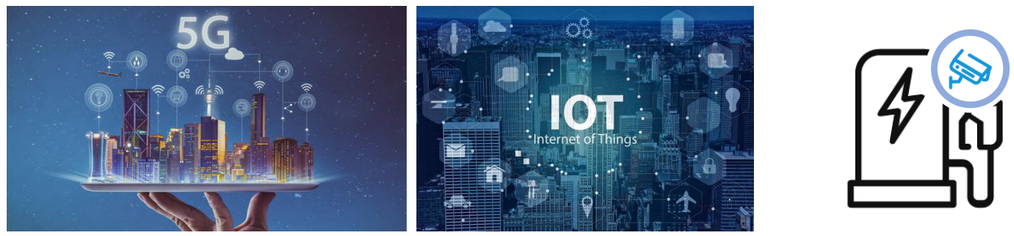

#### Removable charger station

What if public charger station could move? It's a massive cost if charger station was installed on the whole parking lot. One device could meet the needs of multiple user.

### Problem 2 : People's worry about vehicle

In addition, unlike the home charging, when people charge their car in public, they do care more about the safety of vehicle partically it is a charing process. From the phone to vehicle, people do care about the safety of charging process particularly after some charging accidents were exposed on the news.

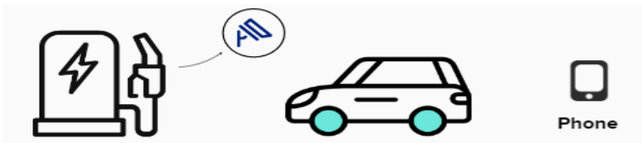
### Solution : Individual access to monior




By setting a camera on the charging pile, the user can gain the right to monitor the charging process of the vehicle. Now in the era of rapid development of the network, 5G is getting closer and closer to our life. The arrival of 4G has allowed us to watch dynamic videos on mobile phones at any time.With the advent of 5G, IOT will become a part of people's lives.Users can monitor the condition of the vehicle via online video at any time, even via VR.

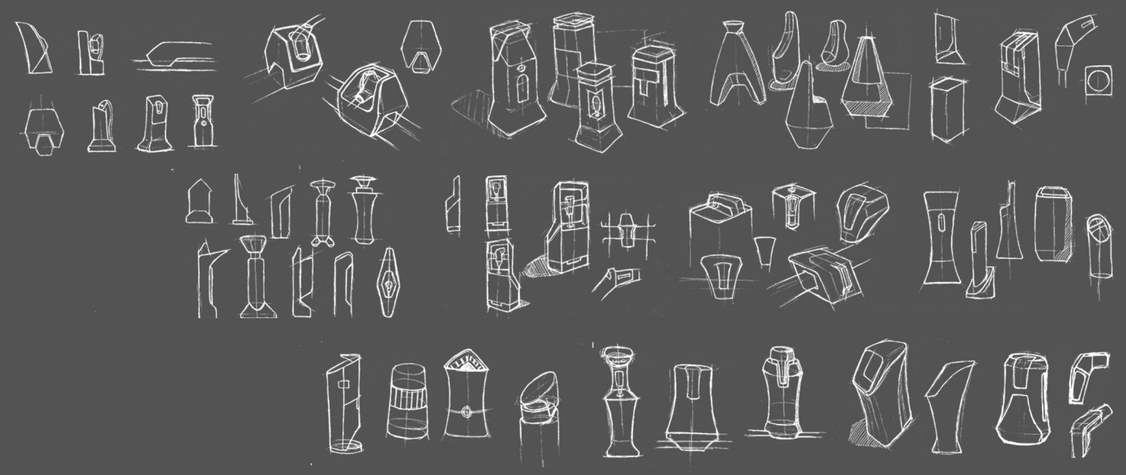

#### Vehicle monitor

What if the charger station could monitor the vehicle? User could watch the live on their phone once they get the access and the security could check the parking lot without blind area.

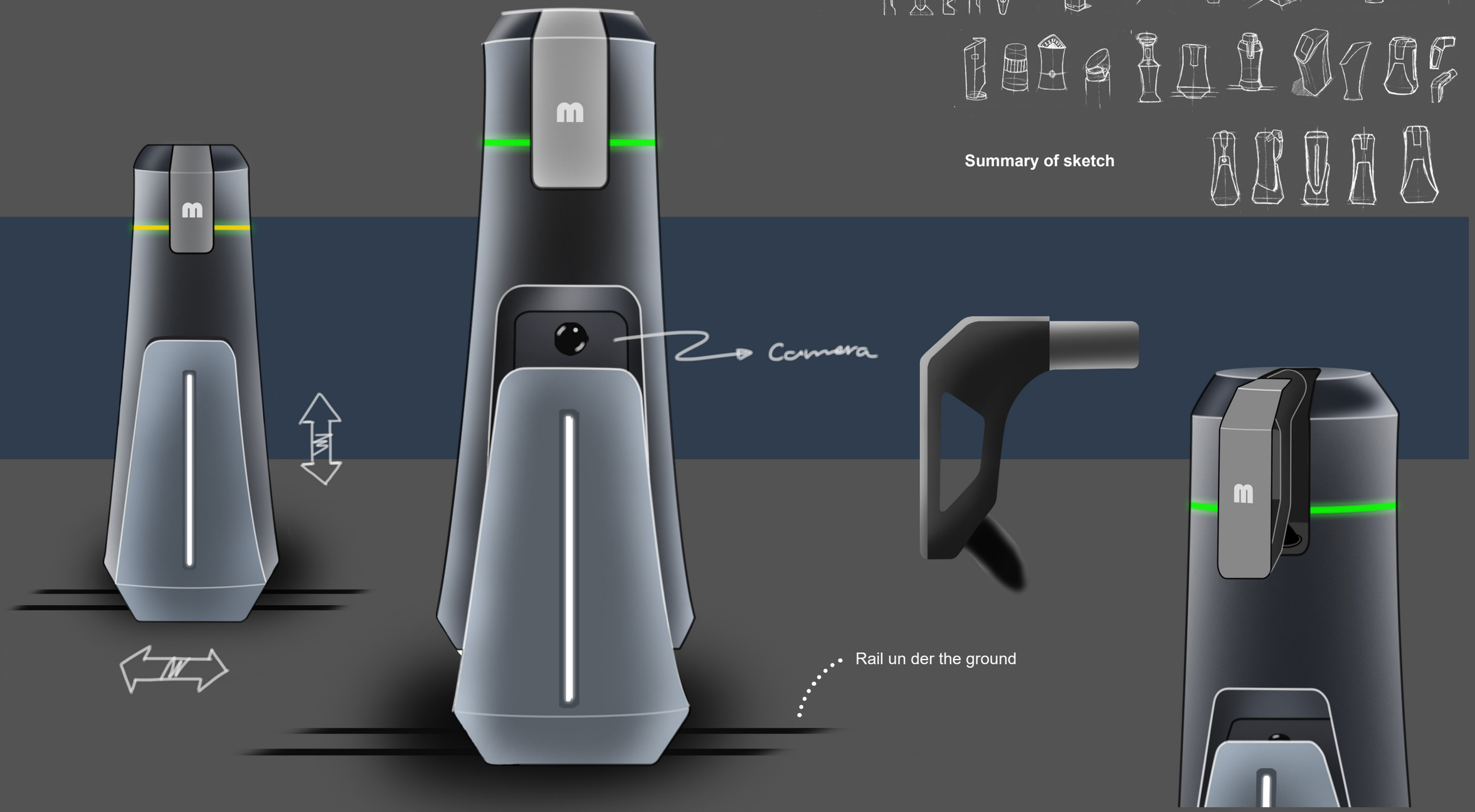


# Sketch

Based on the intial concept, I draw tons of sketch on notebook and the scan these page into photoshop to do the 2D rendering work. The current skech is selected by  the reliability of concept and aesthetic.



**Summary of sketch**



# Prototype

In order to understand the detail of the design concept, a 3D prototype is made to visualize the external and internal structure.

From the first perspective, it is a simple cylinder. When it is on the standby/idle mode, the green light around the cylinder show it is available by the user. When it is on the work state, the charger will popup and a half part of cylinder will rise which the camera shows up to monitor. The light turns to blue states it is in use right now.

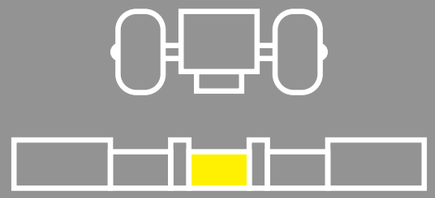
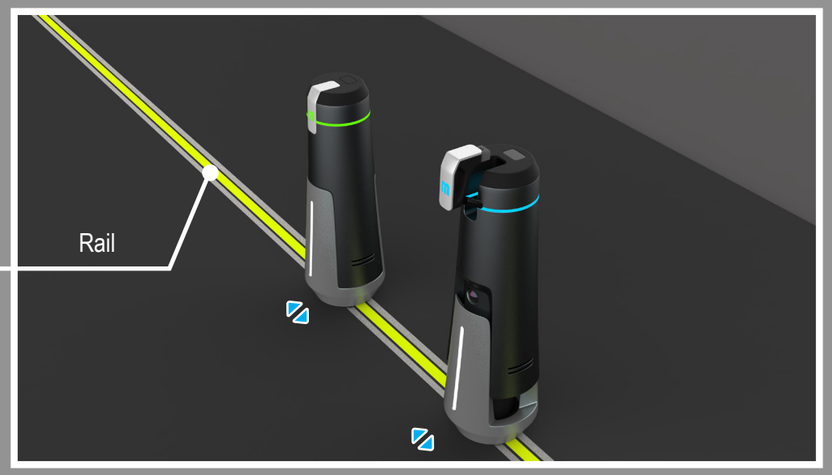
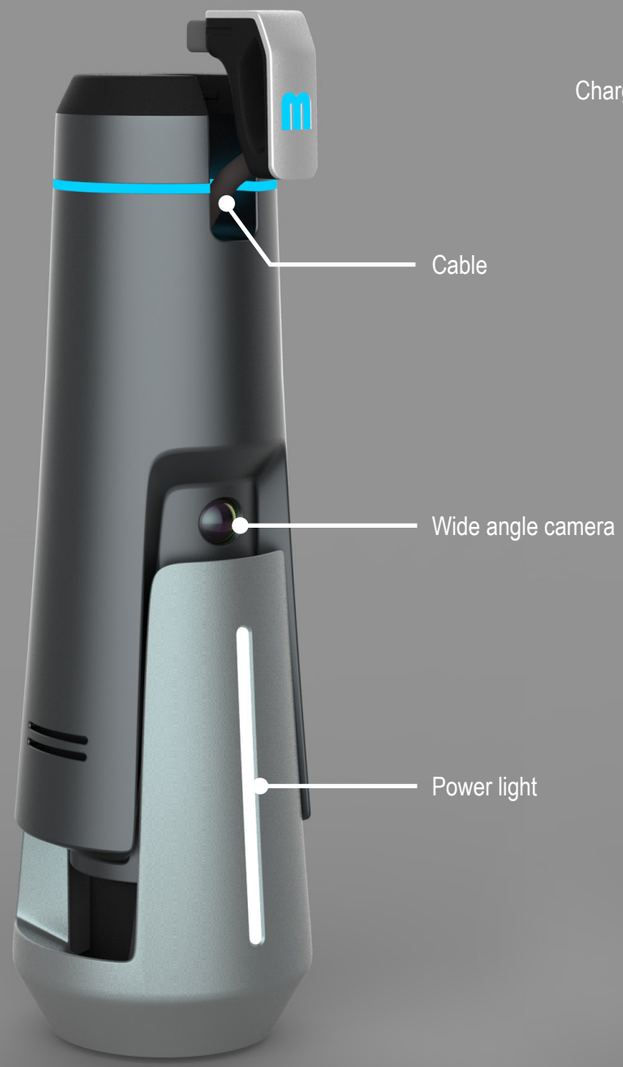


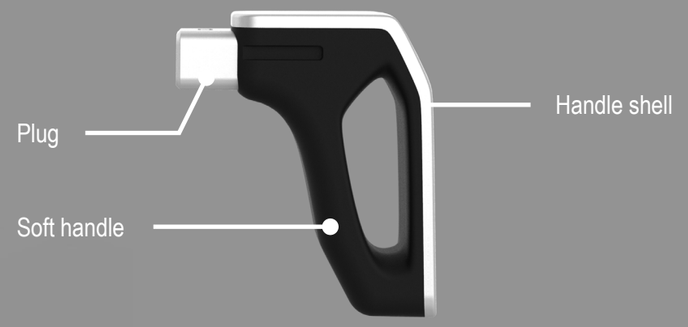
Diagram : APS electricity transfer




Charge pile could move along the rail. The construction of rail is similar to rail of subway. Two of rails are used for lead to direction of whell. Between them is the third rail which is used for transfer electricity. (Diagram : APS electricity transfer)

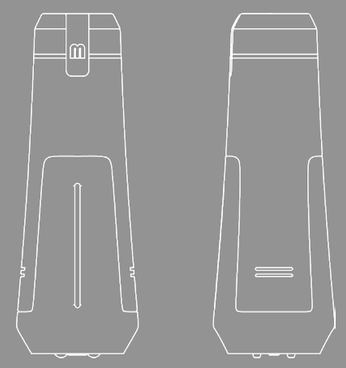







Device is charging

Device is idle/avaliable



# Technical challenge

For the design concept, the technical challenge is how to provide the electric for the charging unit and considerate the safety about the process of electric transfer.

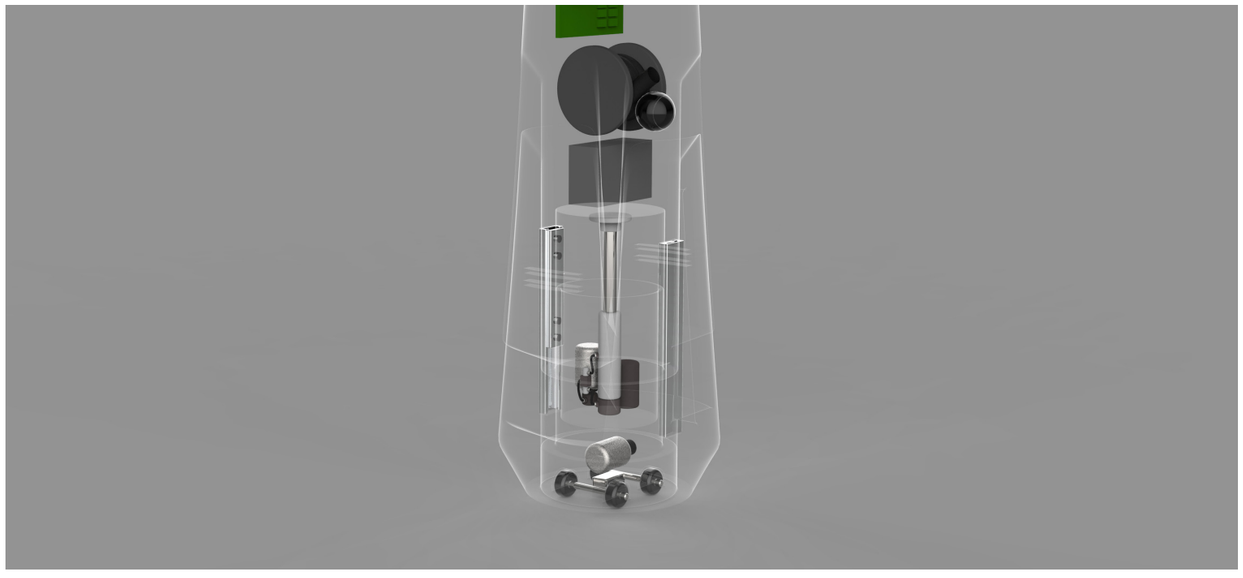
### Electric transfer: Alimentation Par le Sol(APS)

With the inspiration of train, the concept of third rail could be adopted. When we talk about the third rail, we mean the live rail which provides electric power to a train through a conductor placed alongside the rails. (networkrail, n.d.) The third rail provide 750V electric for the trail, although, the charge pile needs only around 230V. It is easily enough to kill an adult, so how to guarantee the safety of third rail when it works is essential in the project.

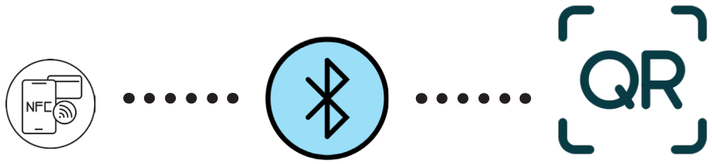
**SOURCE:** wikiwand, n.d. wikiwand. [Online] Available at: https://www.wikiwand.com/en/Ground-level_power_supply [Accessed 6 8 2020].

A new technical called APS could be used in it, which avoid the electric shock when people walk on the rail. Alimentation Par le Sol (APS, which literally means feeding via the ground) is a modern method of third-rail electrical pick-up for street trams instead of more common overhead lines. Unlike the track-side third rail used by most metro trains and some main-line railways, APS does not pose a danger to people or animals and so can be used in pedestrian areas and city streets. (wikiwand, n.d.)

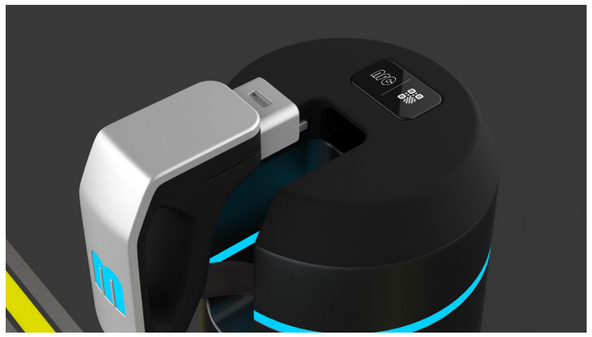
APS uses a third rail placed between the running rails, divided electrically into ten-metre rail segments with three-metre neutral sections between. Each tram has two power collection shoes, next to which are antennas that send radio signals to energise the power rail segments as the tram passes over them. At any one time, two consecutive segments under the tram will be live. (wikiwand, n.d.)



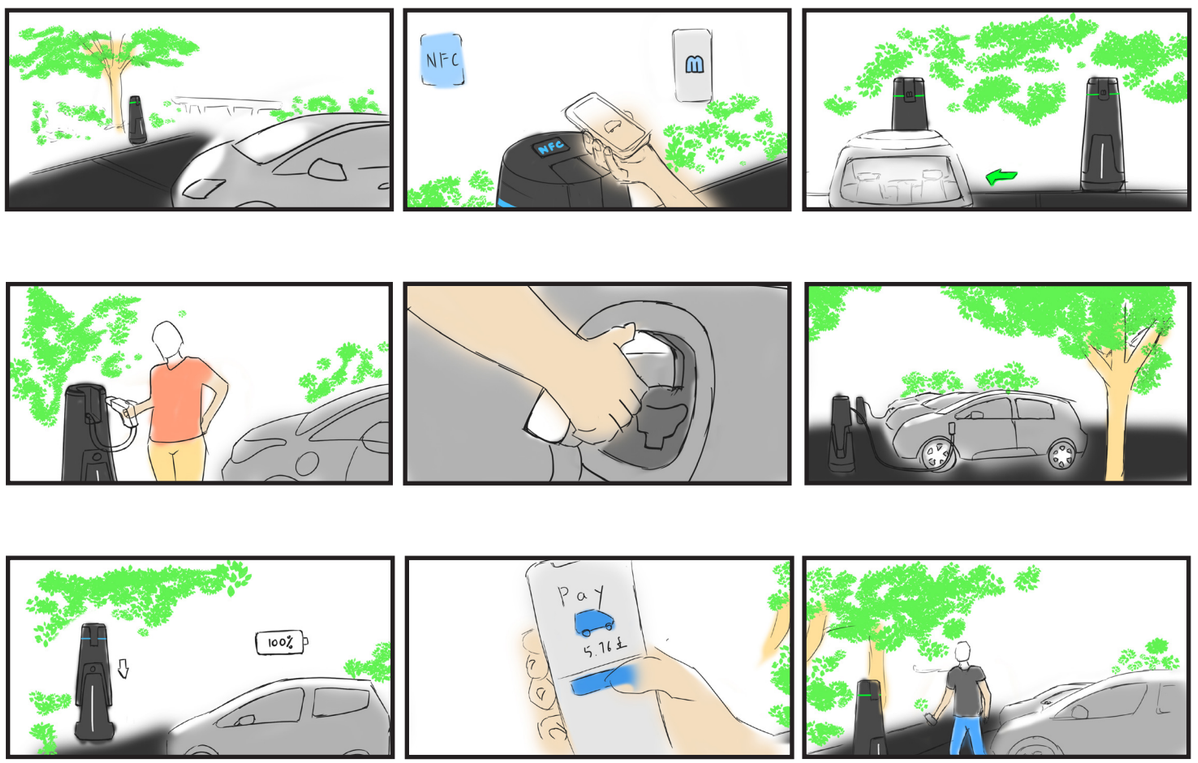
**Charge pile connection : NFC/BT/QR Code**




In product interaction design, the simpler the interaction mode, the more dependent the user will be on the use of the product. Users can easily connect to the product through the phone's NFC function, Bluetooth and QR code.Users can complete a series of charging, monitoring, payment and other functions on the APP.




# Storyboard



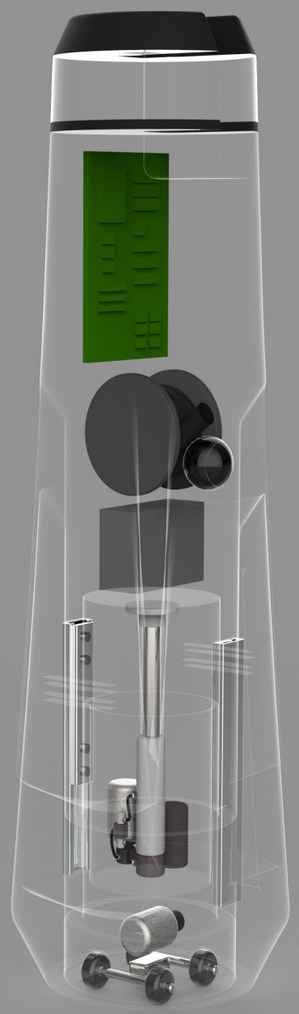

# Product design speculation

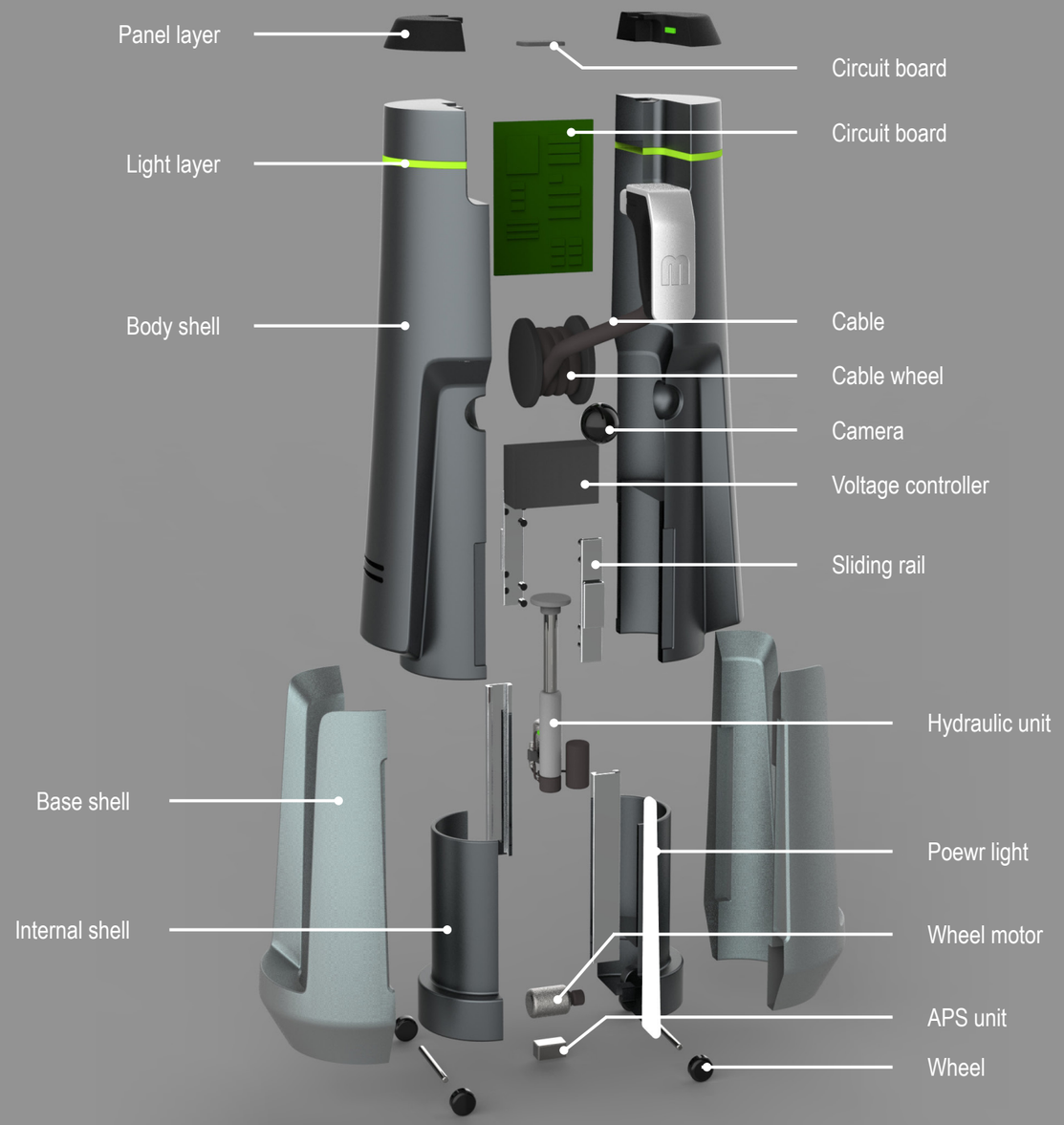
## Mobility charge point design specification

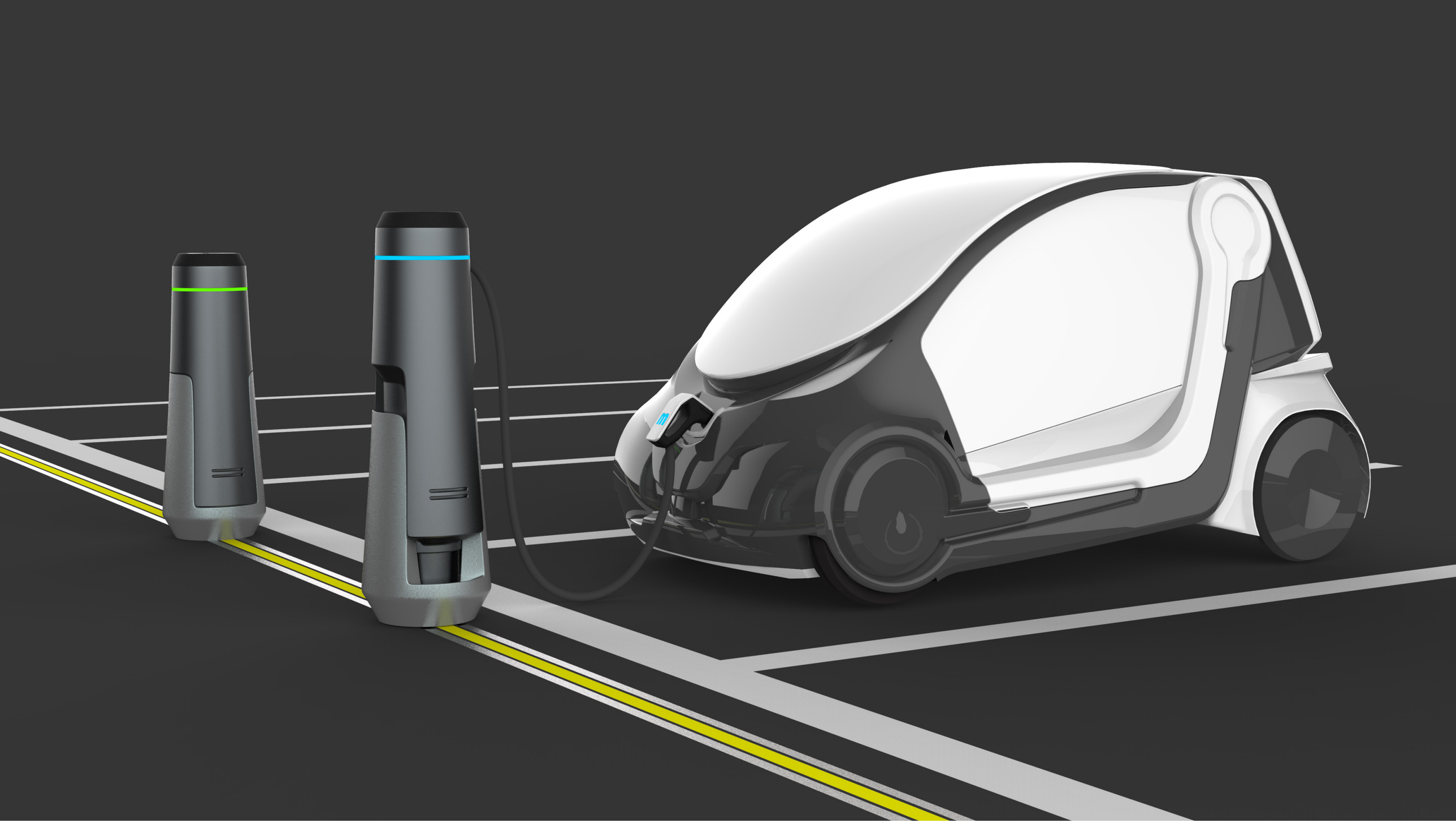
| | | | |
|---|---|---|---|
| Product | M-charger point | Product type | Mobile charge points |
| Designer | Yongxin Lyu | Stakeholder | User/owner of parking lot |
| Product function requirement | Charging for electricity vehicle<br>Charger availability display<br>Mobility of charging point<br>Internet connected<br>Charging state managing (user)<br>Vehicle surrounding monitor (user) | | |
| Product requirement | Product design aesthetic<br>Good interaction between user and device<br>Installed in indoor and outdoor parking lot | | |
| Notes | No cost limited<br>Normal charging speed like workplace charger<br>No thinking about weather influence (waterproof...) | | |
| Chart maker | Yongxin Lyu | Date | 2020/7/5 |

# Design for manufacture

All individual components are easy to hold and install. Most of parts are symmetry or obvious asymmetry which decrease the time of check the position of components. The size of part is big enough to do assembly. The external parts all connected by screws while some internal unit fixed by the plastic construction.





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