Sustainability Innovation

Analysis And Improvement Of The Phenomenon That Petrol-powered Cars Occupy The Charging Space Of Electric Vehicles In The Public Parking Spots Of Beijing Asian Games Village.

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Summary

Please view the attachment.

project summary

Choose the Topic

Identify the Challenges

1. Fuel truck occupying
Among the 23 charging stations in the public parking lot we investigated, only 5 are not occupied at all, and the parking spaces of four charging stations are occupied by fuel vehicles. The total occupancy rate is 23.7%, but this includes three charging stations far away from residential areas and basically completely vacant. There are 11 charging stations, that is, about 50%, with a occupancy rate of more than 50%. The median occupancy rate was 0.6.
2. Staying after charging
Of the 23 charging stations, 8 have the phenomenon that electric vehicles do not charge or do not leave after charging. Most of them are not charged. Most of these car owners feel that there are still vacant spaces in the charging station, so they can park the car in the charging space. However, through our observation, after the charging traffic becomes larger, other vacant spaces will be occupied. At this time, there is a problem that cars need to queue up for charging.
3.waiting in the line
About 5 charging stations are waiting in line for charging. Among them, the charging station of Jinmeng building is the most serious. Because the entrance of the parking lot is narrow and the charging parking space is located at the corner, the electric vehicles entering from the entrance are blocked in the narrow channel, and the fuel vehicles in the back can not park through the aisle.
4.No charge
Among the 23 parking lots, nearly 20 parking lots are fully automated management. The license plate is recognized by the camera to get in and out, and the owner pays for it by himself. The remaining parking lots only have staff at the toll booths at the entrance and exit to collect fees. In this case, the code for Operation and Management of Electric Vehicle Charging Station and the code for Operation and Service of Parking lot (garage) issued by Beijing municipal government can not be implemented and supervised at all.
5.Unusable “available” space
During our field trip, we found that the design of two charging stations was very unreasonable. There is not enough distance between one adjacent parking space, resulting in insufficient parking space in the middle of the three side-by-side parking spaces, and the spacing between the left and right rows of parking spaces is very small. The other charging station did not mark the parking space, resulting in only three vehicles corresponding to the five charging piles.
6. Rubbish on parking lot
In the parking lot of Longdu building, two of the five charging spaces are occupied

by fuel vehicles, and one parking space is occupied by building materials, which can not be charged

7. No phone number

Among all the fuel vehicles occupying parking spaces, less than 10% of the fuel vehicle owners left their phone on the vehicle, while more than 90% of the vehicle owners did not leave their phone, resulting in the inability of electric vehicle owners to contact them

8. Space locked

In the charging stations we investigated, two charging stations locked the parking spaces for unknown reasons. One charging station locks three of the 10 positions, and the other charging station locks 13 of the 15 parking spaces (the other two parking spaces are occupied by fuel trucks)

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Challenges we met

Identify a Root Cause

1. Infrastructure construction

1.1 For convenience

Of the 23 charging stations we investigated, about 20 are located at the entrance to the parking lot. Such an arrangement will make the charging pile more obvious, but it also leads many fuel vehicle owners to park their cars directly in the parking lot for convenience, resulting in a large number of charging spaces being occupied.

1.2 Unreasonable Design

In the 23 charging stations we investigated, the unreasonable design of facilities is very common. The parking space of some charging stations is very narrow, and two vehicles cannot be parked side by side. The parking space of some charging stations is divided obliquely, but the charging pile is not built at one end of the parking space, but strangely built in the middle of one end of the two parking spaces, resulting in sometimes the charging line is not long enough to connect the charging interface. There is even a charging pile that directly occupies part of the parking space, so the car must be parked obliquely in order not to occupy the crosswalk, making the charging pile too far from the vehicle interface to charge.

2. Lack of Management

2.1 don’ t know

Usually, electric vehicle owners will check whether nearby charging stations have spare charging spaces on the "charging pile" software. However, the software can only check whether there are vehicles using the charging pile for charging, but can not check whether there are fuel vehicles and electric vehicles occupying the parking space but not recharging. Therefore, only when they arrive at the site in person can they know whether there is still a charging space, resulting in congestion near the charging station.

2.2 No sign

The Beijing municipal government clearly stipulates that in the charging station of public parking lot, there shall be obvious signs to inform that fuel vehicles cannot occupy the charging space. However, of the 23 parking lots we visited, only two have such signs.Even some people with indifferent consciousness will directly ignore these signs.

3. System Loopholes

3.1 no punishment

In the charging station management regulations issued by the Beijing municipal government, the government clearly stipulates that fuel vehicles are not allowed to occupy the charging space for parking. However, the regulations do not specify any punishment measures in case of occupation, which leads to many fuel owners not

complying with the regulations because it will have no impact on them.
3.2 Automatic management
In the regulations on the management of charging stations issued by the Beijing municipal government, the government clearly stipulates that electric vehicles shall not occupy the charging space to continue parking after charging. If they continue to park, the parking lot can charge them by 1.5 times of the normal parking fee in hours. However, due to the few staff in the parking lot, most parking lots are now fully automatic management, and there is no means to identify whether electric vehicles occupy the charging space and continue to park, so there is no way to charge more for them.
4. Display Error
4.1 mysterious location
In the application of charging pile, we found a place called Ivey charging station, which was available at that time. However, according to the information on the map and on-site inquiry, we never found the charging station at the location on the map. This situation will obviously cause inconvenience to those looking for charging stations.
4.2 Unknown damage
At Kaixuan City charging station, the charging pile application always shows that all 5 charging piles are available. However, after arriving at the site, we found that not only four parking spaces have been occupied, but five charging piles have been damaged in different aspects and can not be used because they have not been repaired for a long time, but we can't know this situation in advance.

Root cause

Generate Solutions

1. Separate the parking lots for ordinary cars and the parking lots only for electronic cars so that each group only allows cars that fit in its category. Set up conspicuous signs to indicate which parking lot is for electronic cars only. Impose a fine on the owners of non-electronic cars who have parked in the parking lot for electronic cars only.

2. Divide the parking places clearly so that one car cannot occupy too much place and other cars can’ t park in.

3. For the parking lots for electronic cars only, charge parking fee not based on how much time the car has spent charging but how much time it has spent parking to solve the problem that some cars are occupying parking places when they have finished charging.

4. Install the function of contacting the people in charge of the parking lot in the app required to charge electronic cars so that if the car owners have some advice or the devices break down, the people in charge will be able to know and make immediate changes.

5. Inform people that the sundries that occupy parking places will be thrown out. Employ people to tend to the parking lots-to throw away the sundries.

6. Provide parking spots near electricity chargers with QR code locks and establish an online identification system, where e-car owners can register to unlock charge spots when needed by scanning the codes. The system prohibits those who do not have e-cars from registering either by requiring users to upload their e-car liscence or by some other identification methods.

7. Determine whether an e-car or a none e-car is parked by establishing a RI (recognition & identification) system. The RI system entails electro-monitors to detect entering vehicles, pressure sensors in charge machines to decide whether a car is charged, and parking meters with a time limit of 3 minutes. Once the monitor detects a car entering the parking spot, the timer starts, followed by occupation fine for the car owner if the pressure sensor tells no sign of the driver actually using the charging pile.

8. Let people know the side effects of occupying charging spots for no reason through education and advocacy.

Identify the Criteria

1.The effectiveness of the change: what is the increase in the average rate of charging cars after the solution has been put into action? The more increase the better. If the solution doesn’ t lead to any increase or it leads to decrease, it has to be passed out.
2.The willingness of people in charge of parking lots: how many parking lots are willing to put our solution into action? The more parking lots the better.
3.The willingness of electronic car owners: what is the proportion of car owners that are willing to charge their cars at a parking lot where our solution has been put into action? The bigger proportion the better. If the proportion is less than fifty percent, the solution cannot be put into action.
4.Feasibility concerning technology: is the technology nowadays advanced enough to do what we want? The solution is only practical if the answer to this question is “yes” .
5.The cost of the change: how much does the change cost? The lesser money the better.
6.Time issue concerning the changes: how long does it take to make these changes that are mentioned in our solutions to parking lots of different sizes? The shorter time the better.
7.The willingness of the people living or working nearby the parking lots: what is the proportion of these people who are willing to let the parking lots make the change? The bigger proportion the better.
8.The willingness of the government: is it going to support the changes? It’ d be better if the government support the changes.

Evaluate the Solutions

1. Provide parking spots near electricity chargers with QR code locks and establish an online identification system, where e-car owners can register to unlock charge spots when needed by scanning the codes. The system prohibits those who do not have e-cars from registering either by requiring users to upload their e-car liscence or by some other identification methods.
EVALUATION: Meets all the criteria mentioned in the "Identify the Criteria" catagory.

2. Determine whether an e-car or a none e-car is parked by establishing a RI (recognition & identification system. The RI system entails electro-monitors to detect entering vehicles, pressure sensors in charge machines to decide whether a car is charged, and parking meters with a time limit of 3 minutes. Once the monitor detects a car entering the parking spot, the timer starts, followed by occupation fine for the car owner if the pressure sensor tells no sign of the driver actually using the charging pile.
EVALUATION: Meets the interest of all kinds of people mentioned in the "Identify the Criteria" category, but needs much time and money to produce successfully. Also, this solution needs great effort to put into use on a large scale.

3. For the parking lots for electronic cars only, charge parking fee not based on how much time the car has spent charging but how much time it has spent parking to solve the problem that some cars are occupying parking places when they have finished charging.
EVALUATION: Meets the interest of those in charge of the parking lot, which is very good because it'll be easier to convey the parking lot to use our solution plan. However, although this solution is aimed at punishing non-e-car owners to park their cars, it can also harm those parked with e=cars in some occations. If e-car owners go to sleep and leave their cars overnight after charging, we shouldn't charge them a fee equal to that of non-e-car owners.

4. Separate the parking lots for ordinary cars and the parking lots only for electronic cars so that each group only allows cars that fit in its category. Set up conspicuous signs to indicate which parking lot is for electronic cars only. Impose a fine on the owners of non-electronic cars who have parked in the parking lot for electronic cars only.
EVALUATION: Easy to maintain but produce low improvements, or in other words, doesn't meet with the criteira of the effectiveness of change. Car owners may disregard the signs and park wherever they like.

5. Divide the parking places clearly so that one car cannot occupy too much place and other cars can’ t park in.
EVALUATION: Easy to maintain but produce low improvements, or in other words, doesn't meet with the criteira of the effectiveness of change. Car owners may disregard the parking areas and occupy an area of two parking spaces.

6. Inform people that the sundries that occupy parking places will be thrown out. Employ people to tend to the parking lots-to throw away the sundries.
EVALUATION: Takes great money and manpower to maintain with a low outcome. Worth to consider as a solution but we don't recommend to do so.

7. Install the function of contacting the people in charge of the parking lot in the app required to charge electronic cars so that if the car owners have some advice or the devices break down, the people in charge will be able to know and make immediate changes.
EVALUATION: Easy to maintain and meet with the need of people running the parking lots and people who use the parking lots. This is a very convenient way to exchange advice between people.

8. Let people know the side effects of occupying charging spots for no reason through education and advocacy.
EVALUATION: Worth to try but with a low effectiveness of change, because words aren't enough for people to obey the rules.

Make an Action Plan

Design an online system to let e-car owners register using e-car liscense and scan QR codes on charge spot locks to park their car and charge.After that,select particular parking spots in the city and ask for car owners to use the system for testing.Improve the system's effectiveness based on their feedback.Also,propose the RI system mentioned earlier in the "Evaluate the Solutions" catalogue to the government for the betterment of monitor and punish system.In particular,a new charging spot has just established in the neighborhood of one of the team,which may be our testing spot.We can start from working with the neighborhood community to set up our online system in the neighborhood community to see the outcome of our system before applying it to a broader environment.

过程思维导图
Make an Action Plan (Formal)

Prototype and Test

Prototype Design

New QR code locks at the charging space of EV in public parking spots

1. Mini Program: The Mini Program is called “EV Locks”, which can be found in WeChat. To login the program, a EV user need to type his name, identity card number, and license plate number in it. After logined the Mini Program, the EV user can use it to scan the QR code on the parking lock. After that, the program will show the page with the word “Unlocked” on it, meaning that the lock is successfully unlocked. Then the EV user can drive into the charging space to charge their cars. Consequently, this can prevent the petrol-powered cars users from occupying the parking space.

2. QR code locks: The parking locks are in the shape of “A”, with a QR code and an electric lock on it. To open the lock, users of EV need to use their Login the Mini Program called “EV Locks” in WeChat. After using the Mini Program to scan the QR code on the parking lock, the charging space will be unlocked.

(For more precise explanation, please look at the attachment)

New QR code locks at the charging space of EV in public parking spots

Feedbacks learnt from users

1. Feedbacks from an electric car owner.
I am an electric car owner. While enjoying the convenience of electric car travel, I am also worried about charging my car. Due to limited conditions, the community I live in cannot install its own charging pile. I need to go to a public charging station to charge my car. Fortunately, there is one near my home. However, due to the shortage of parking spaces in this area, there are often fuel vehicles parked at the charging pile, which makes me anxious and helpless. Sometimes electric vehicles are not driven away in time after they are fully charged, and charging resources are wasted.
Add the storage lock to the charging parking space, and only the electric vehicle owner can unlock the charging space after scanning, so as to avoid being occupied

by the fuel vehicle. In addition, fully charged vehicles will drive away in time to avoid fines. This greatly improves the use efficiency of the charging pile and solves the problem that it is difficult for me to charge my car. Thank you very much!

2. Feedbacks from a middle school student
I'm a middle school student. My family doesn't own an electric car but there are some electric cars in my community. I've heard the owners complaining the charging problem. I like your idea of making a wechat program to prevent petrol cars from occupying the charging spaces. Though I'm a little concerned because I think it's difficult to combine the EV lock with all parking locks. It's definitely going to be a huge project. Anyways, I love the creativity in your plan. I'm sure you are doing something awesome to change our community.

3. Feedbacks from a parking lot manager
As a manager of parking lot, not only did I see that fuel vehicles occupying the charging space, but I also recognized that some electric vehicles do not leave in time after charging, which greatly reduces the use efficiency of the charging pile and affects the income brought by charging in the parking lot. Some electric car owners are very angry when they see that the charging position is occupied and deliberately block the car at the exit, which will also cause disputes.
This small design is very creative and easy to operate. It can avoid the occupation of charging parking space. I believe it will also be welcomed by electric vehicle owners.

4. Feedbacks from a software designer
I'm a software designer. In my opinion, your views on this issue are unique and the prototype that you have designed is novel. I would like to support this mini program if it is publicized.
At the same time, I would suggest that the layout of this mini program can be more beautiful and contain some bright colors except red and yellow, so people will be willing to use it. Also, because this mini program has many functions, you can add an instruction menu in it, so that more middle-aged or old car owners can use this program independently and easily.

5. Feedbacks from a sales consultant
I m a sales consultant of a electronic vehicles’ store. We had plenty of customers every day who want to purchase our automobiles but concern about the charging problem. Many of them are complaining about no enough space to charge since many of the charging spaces were occupied by the fuel cars and some of them were always broken. I think your plan will be effective for solving this problem and eliminating concerns of many of the potential customers. I am sure that it will help accelerate the development of the electronic vehicles and much less carbon dioxide

will be produced in the future. It will have a huge impact on our community and can definitely change it.

Improvement for next iteration

(Please view the attachment.)

New QR code locks at the charging space of EV in public parking spots

Team Credits

Ding Jiayi is responsible for writing the summary and prototype and test as well as conducting offline investigations. She is also the leader of this team.
Kan Xiaoqiong is responsible for two parts: identify the challenges and identify a root cause. He also conducts offline investigations.
Zhang Zirou is responsible for generating solutions and identifying the criteria.
Xie Xinyang is responsible for evaluating the solutions and making an action plan.
Wang Yuxin is responsible for team credits and onsite conference file.

Onsite Conference File

Judge Comments

" I applaud the team for working on a very real world issue, perhaps one that is a harbinger of issues to come when electric vehicles are common and the infrastructure to support them are still catching up. The summary presentation developed was a very helpful tool to highlight the issue, and how you have arrived at your solutions. It does need to be pointed out that the issue you are aiming to solve is largely an urban planning and management issue, with somewhat limited implications to sustainability or the environment outside of ensuring that the infrastructure keeps up in a good way to promote more EV sales.
It would also be helpful to explore the role enforcement has to play in here. An example case study to further explore could be how handicapped spots are enforced to prevent non-handicapped from users from using it. What commonalities can be drawn to the EV landscape to prevent this problem from happening? As always, financial incentives or fines usually also have a strong role to play in workable solutions in this space.
Great job in identifying and exploring a very specific topic. The team has developed some good ideas and I encourage them to pursue these further, especially with an added link to understand how it also benefits the environment.
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