Center for Urban
Science + Progress

New York University

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Civic Analytics and Urban Intelligence

New York Eletcric Taxi Transition Plan

December 2022

Executive Summary

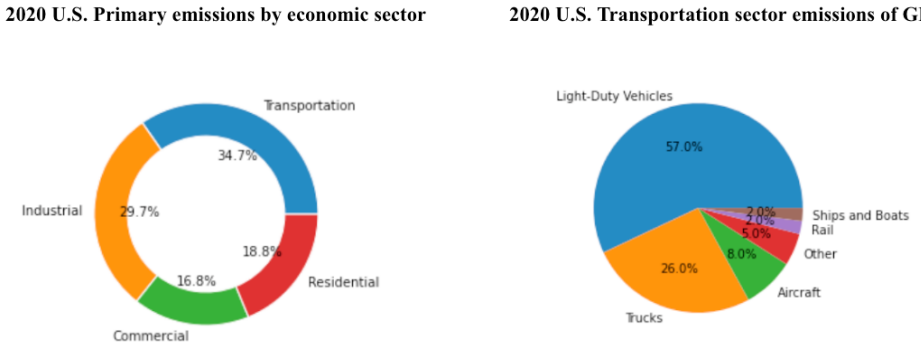
The New York City taxi industry is actively pursuing an energy transition in response to the climate crisis. The move to electric vehicles, however, is going slowly right now. We have created a transition plan that is suitable for New York City by carrying out a case study of the city of Shenzhen. We also offer construction and operating methods for charging stations employing tools of data analysis and visualization. The estimation of carbon reduction goals and the possible advantages of this transition strategy is further examined in the report. This plan will aid New York City's taxi industry transition to electric taxis, according to the analysis above.

Section 1: Introduction

Subsection 1.1: Paris Agreement and U.S. Carbon Emissions

In 2015, as a response to the climate change crisis, countries from around the globe signed the Paris Agreement. In an effort to decrease the rate of global warming, nations have created strategic programs to cut carbon emissions. As the engine of world economic expansion, the United States creates enormous carbon emissions. The United States should actively implement its strategy to reduce pollution. In 2020, the United States emitted more than three times the world average and 1.8 times that of China, or 13.5 tons of CO2 per person(World Bank 1). Carbon emissions in the United States are well above average. The United States lacks long-term stable policy regulations and has not yet s optimized its energy system. Reduction of carbon emissions is still a lengthy process for The U.S.

Figure 1



*The data is from U.S. Ministry of Industry and Ministry of Energy

According to the U.S. Department of Energy, the transportation sector is responsible for 35% of U.S. carbon emissions, followed by the industrial sector at 30%. This implies that the transportation sector is the major contributor to carbon emissions in the United States(EPA 1). The majority of the transportation sector's emission sources are small and light cars, according to a review of the sector's emission sources (Fig. 1). Therefore, tiny vehicles in the transportation sector become an essential component of the effort to reduce emissions. Small cars are used a lot in the taxi business. On a daily basis, taxis are also a common mode of commutation. In addition, the development of the taxi sector has a significant impact on economic growth. Energy

transition and emission reduction efforts in the taxicab industry have become one of the sector's most prominent concerns.

Subsection 1.2: New York Taxi Carbon Emissions

In recent years, the New York City government has established various strategies to address the climate crisis. This covers electric car development as a significant development objective. Since 2015, the TLC sector, which is the taxi industry in New York, has suggested policies to promote the transition to electric taxis.

According to the study, nitrous oxide and particle emissions from New York taxis decreased by an estimated 82% and 49%, respectively (Columbia 2). The taxi sector in New York has made slow progress toward the new carbon-neutral emissions target. To attain this objective more effectively, electric taxis will be a key factor.

This article examines the issues and current status of electric taxicab development in New York. Through a case study of Shenzhen's cab electrification reform and the use of data technologies, we will also present policy recommendations and program options for New York. We will also assess the relevant organizations and investigate possible partnership programs.

Section 2: Overview and Challenges – New York Electric taxis industry

Subsection 2.1: Scale of fleet

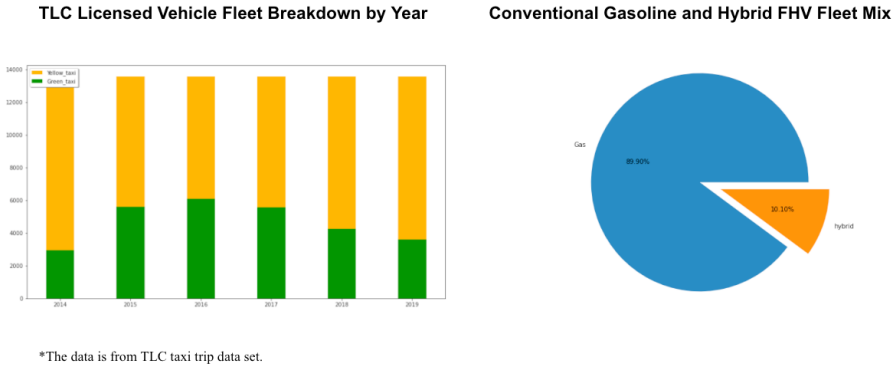
There are numerous taxicabs and drivers in New York City. As of the beginning of the year 2020, New York City has 126,562 licensed taxis and 174,924 licensed drivers (Table. 1). Medallion Taxicabs, Street Hail Liveries, and For-Hire Vehicles are the three classifications of taxicabs in New York City. The taxicab is Medallion Taxicabs. The green taxis are Street Hail Liveries. FHV stands for third-party vehicles for hire. The TLC division is primarily responsible for these vehicles' management.

Table 1

Types	Explanation	Vehicle Licenses by 2021
Medallion Taxicabs	Yellow Cabs	13587
SHV	Street Hail Liveries, aka Green Taxi (Boro Taxi)	3,004
FHV	For-Hire Vehicles, including Black car, Livery and Luxury Limousine	109,971

Subsection 2.2: Energy structure for taxis

Figure 2



*The data is from TLC taxi trip data set.

Yellow taxis refer to conventional fuel automobiles. Green taxis include electric, low-emission, and hybrid vehicles. The distinction between green taxis and yellow taxis is their lower carbon emissions. In New York City with 13,587 yellow cabs, there are just 25 electric taxis. However, more electric taxis are anticipated as New York transitions to zero-emission vehicles in response to rising worries about climate change and air pollution. Analyzing the sources of carbon emissions in the New York taxi business reveals that conventional fuel vehicles are responsible for more than 90 percent of emissions while hybrid vehicles are responsible for barely 10 percent. The effect of electric taxis is even more negligible (Fig. 2).

Subsection 2.3: Obstacles to electric taxi in new york

The development of the electric cab industry in New York City is still in its infancy, and the existing industrial chain relating to electric cabs in New York City is imperfect, the relevant rules are insufficient, and government involvement is inadequate (Kamga 24). Although the New York City electric taxi transition plan has achieved some success, it is still in the power hybrid transition phase, and more impetus is required to convert to pure electric taxis. It is evident from the above analysis that the contribution of electric taxis to the strategy to reduce emissions is minimal and the electric taxi transition plan is slow.

Section 3: Case study of Shen Zhen

Shenzhen is the first major city in the world to completely electrify its taxi industry. There are currently about 18,000 taxis in Shenzhen. Essentially, they are all electric taxis. Shenzhen is therefore a significant case study. By summarizing and analyzing Shenzhen's experience in achieving full taxi electrification, this report will help provide ideas and solutions for the taxi industry in New York City.

Shenzhen has created a comprehensive strategic plan. The electrification process is carried out in steps. In 2010-2015, it is the exploration period for the Shenzhen taxi business, which will involve cooperation with BYD and other automakers, the production of taxi-appropriate vehicles, and the installation of charging piles. In 2015-2019, the electric taxi industry enters a phase of significant growth, and the government enacted several laws to foster this growth. For instance, car buyers receive subsidies to lessen the cost of acquiring a vehicle. Incentives in the

form of tax cuts are granted to taxi businesses to encourage them to implement their transformation plans. Shenzhen's taxis were fully electrified by 2020, and the government requires electric taxi companies to meet the related targets through administrative means. Through our analysis, we find that the Shenzhen municipal government gives incentives to various stakeholders to achieve the aim of 100% electric taxis.

Subsection 3.1: subsidies

- **Subsidies to taxi driver**

The taxi industry operation model in Shenzhen is that cab drivers lease licensed cab drivers from taxi companies. The driver must pay a security deposit and rental fee to the taxi business. The city administration has decreased the security deposit from 90,000 to 40,000 yuan and the monthly rent from 15,000 to 10,000 yuan. The government also provided an extra $1,000 per month for drivers of direct electric taxis (Shenzhen 2). By subsidizing and reducing capital expenditure, the drivers reduced the operating costs of the taxis and boosted their own earnings. This encourages new drivers to opt for electric taxis. In addition, the Shenzhen government gives specific subsidies for vehicles that satisfy carbon emission reduction regulations. The money is handed directly to the drivers, which boosts their income without question.

- **Subsidies to company**

The acquisition of electric taxis is a significant expense for taxi companies transitioning to electric vehicles. In 2015, the scale of taxi replacement with pure electric vehicles reached 300 to 499, 500 to 999, 1000 to 1499, and 1500 or more cab firms, for which the government provided 5%, 8%, 10%, and 15% subsidies, respectively. In addition, the government grants price subsidies of up to 20,000 yuan for each electric vehicle purchased, even though the average electric taxi costs more than 100,000 yuan. By reducing the cost of vehicle acquisition, businesses will speed up their shift to electric taxis. Not only will carbon emissions be decreased for businesses, but the lower cost of electric taxis will also enhance cab firms' profitability.

- **Subsidies to customer**

To encourage more passengers to use electric taxis, the municipality has decreased the starting rate for electric taxis from RMB 13/2km to RMB 10/2km and eliminated the fuel surcharge for electric taxis. By reducing the cost of travel and boosting the availability of taxis, travelers will be more likely to choose electric vehicles over fuel-powered ones.

Subsection 3.2: Infrastructure construction

The development of electric taxis requires the development of a connected industrial supply chain. The local administration has a collaboration strategy with companies. To promote pure electric taxis in Shenzhen, the bus group planned to complete the construction of 3,000 charging terminals in all city districts by the end of 2019 to establish an intelligent charging network that would allow for the organized charging of taxis and the reduction of charging blocking. The first batch of 18 charging stations and 1,690 charging terminals was completed by the end of the year 2018, covering six districts in the city. Infrastructure development is significantly influenced by government and industry collaboration. Using data tools to develop a smart industry chain is also vital.

Subsection 3.3: Mandatory government policies

In addition to pushing the shift to electric taxis through subsidies and tax credits, the city is also implementing administrative regulations and engaging in strategic planning. The Shenzhen government coordinated the development and completion of the electric taxi transition plan through strategic planning by numerous government departments, including the Bureau of Transportation and the Bureau of Finance, and others. By implementing a comprehensive electrification strategy, the Shenzhen Transport Bureau mandates taxi businesses to meet the related transformation goals within a specified timeframe. The transition of Shenzhen's electric taxis is impossible without the significant contribution of government agencies.

Subsection 3.4: Conclusion of Shen Zhen case

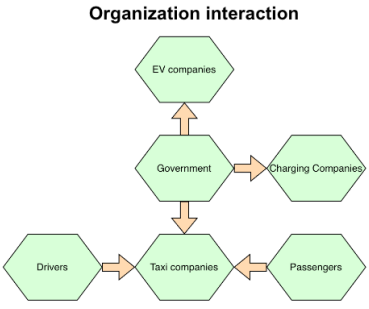
By evaluating the transformation of electric taxis in Shenzhen, New York City should concentrate on the following aspects: First, actively develop policies to benefit groups such as taxi companies, drivers, and customers, and offer them incentives to engage in the transition program. Second, subsidies and taxes can reduce the cost of purchasing a car. With electric cars being cheaper than fuel cars, the market is motivated to make the transition plan. In addition, the development of infrastructure is of the utmost importance; electric vehicles require charging and maintenance facilities, and the government and businesses must work together to improve these facilities. Lastly, the government should engage with several agencies for strategic planning, compelling businesses to make the change and identifying critical milestones administratively.

Section 4: Electric taxi industry transition proposals

Subsection 4.1: Organizations

According to the preceding case study, the essential stakeholders include:1. government 2. taxi companies 3. drivers 4. passengers 5. car-making companies and industry chain companies. Among them, the government plays an important role. We indicate the important functions of each organization and portray the interaction diagram of the relationship between organizations(Fig. 3).

Figure 3



Subsection 4.2: Partnerships

To improve the effectiveness of the NYC Electric Taxi Transition Program. Cooperation between the organizations should continue. Nevertheless, the following are the most essential forms of organizational cooperation: 1. The government is the center for maintaining communication with each organization, launching appropriate policies, organizing communication activities, and collaborating with various government agencies to develop and implement strategic planning. 2. The government can set up a joint venture partnership with car-making companies and industry chain companies by producing low-cost electric vehicles suitable for the cab industry and accelerating the construction of charging piles.

Subsection 4.3: Subsidies Policy and Taxes Reduction

The electric cab industry is capital-intensive. The transition from fuel-powered to electric vehicles requires a substantial financial investment. For taxi companies, the government can provide subsidies to reduce the cost of vehicle acquisition. The government can provide drivers with low-interest purchase loans, car purchase subsidies, and certain carbon emission reduction subsidies (Hu 17). In addition to subsidies, reducing taxes on car purchases and consumption taxes can reduce the cost of car purchases for taxi companies and drivers in a more direct and efficient manner.

Subsection 4.4: Industry Chain Construction

The electric taxi supply chain is complex. The construction of vehicles and charging piles are two of the most vital parts. The government can collaborate with automobile manufacturers to develop electric vehicles that are suitable for use in the taxi industry. From the perspective of passenger experience, range, manufacturing, and other cost considerations, the lowest-cost special vehicles must be produced. Companies and drivers will only purchase electric vehicles as opposed to fuel-powered vehicles at the lowest price (Jung 13).

Electric taxis do not require refueling, but they must be charged. The charging rate is much slower than refueling. Consequently, the construction of charging piles and the arrangement of charging are essential. Instead of leaving construction to private companies, the government should develop strategic plans. Strategically optimize the location of construction in the taxicab industry. This will increase the operational effectiveness of charging piles.

Subsection 4.5: Data application on the plan design

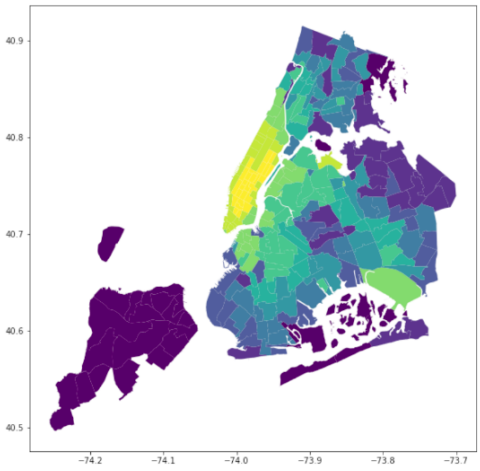
To increase the reliability of the scheme, we use the taxi dataset published by TLC and the travel mode dataset from the transportation department. Data includes information about each trip containing pick up and drop off times, fare information, number of passengers, miles traveled, and composition of transportation modes.

Through the data analysis, we provide suggestions for charging station construction site selection, charging station operation strategy, cost-benefit analysis, and carbon emission reduction estimation. We analyze mainly through data visualization, cost calculation, and machine learning.

4.5.1 Method of selecting the location of the charging pile

Figure 4

New York Taxi Trips Density Map



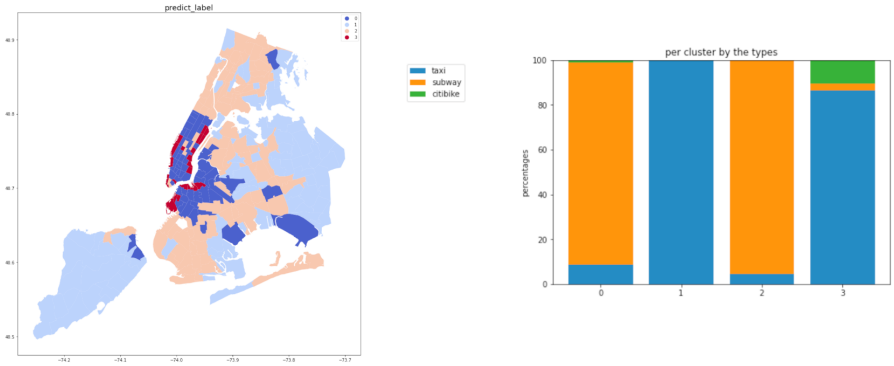
*The data is from TLC and the lighter color represents higher density.

By analyzing TLC's cab dataset, we created a map of the activity and density distribution of New York cabs. The visualization enables us to determine the distribution of the most densely populated taxi areas in New York and the distribution of activity density. The placement of the charging pile must be highly pertinent to taxi activity. Manhattan and Brooklyn are the areas with the highest taxi density, according to the graph (Fig. 4). Other regions have a lower taxicab density. Therefore, the construction of charging stations should focus on Manhattan and Brooklyn. In addition, the map's lighter-colored regions are where we should focus our attention.

However, the above method of selecting locations has significant flaws because taxi activity varies by region relative to the total number of travel modes in that region. We should prioritize regions where alternative modes of transportation are scarce. In this context, we attempted to classify and divide New York City to identify the areas where taxis are the predominant mode of transportation. We then proceed to allocate the charging pile resources in the zones based on this information. If we construct in areas where taxi trips are insufficient, we will waste resources.

Figure 5

New York Taxi Area Clustering Output



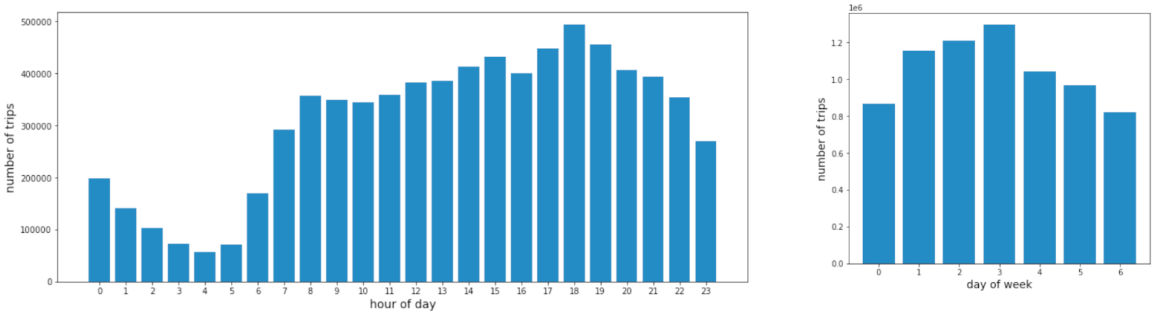
Using the clustering algorithm in machine learning and the New York City taxi traffic trip dataset, we can divide the city into four distinct areas(Deri 12). In conjunction with the above density distribution map, we learn that labels 1 and 2 correspond to areas where taxi activity is not dense and where the total amount and proportion of taxi activity are insufficient. Label 0 is the highest density area, but the area is smaller than expected. This is because most trips are short and there are numerous alternative modes of transportation in this area. Consequently, the range of this region is relatively expansive. The region represented by label 3 is the primary area of taxi activity; therefore, this region has a larger area of activity and longer trips. Therefore, the construction of charging stations is prioritized according to labels 3, 0, 2, 1 (Fig. 5).

By analyzing the preceding data set, we have a basic understanding of site selection. The areas where the density of taxi activity overlaps with our priority areas are the priority areas for charging station construction. In determining the final site selection, the New York City government should take into account regional economic priorities, carbon emission reduction targets, project urgency, and funding budgets.

4.5.2 Operation optimization of charging piles

Typically, charging takes several hours. With the current level of technology, the charging pile's scheduling arrangements must be further optimized to improve operational efficiency. This is optimized primarily in terms of time and space (Yang 31).

Figure 6



*The data is from TLC taxi trip data set.

Time dimension: Through analysis, we identified that there is a time peak for taxi trips. And requiring drivers to shift their charging during the peak becomes the primary objective. Every evening and every Tuesday and Wednesday are the peaks formed by vehicles (Fig. 6). Based on this information, we can advise drivers to stagger charging by using differentiated pricing (Ata 32). Drivers will choose the charging time that suits them according to their willingness to pay.

Spatial dimension: The government monitors the utilization rate of each charging station in real-time by installing sensors and other devices at the charging stations. This data will be processed and analyzed by the government, and a special app or website will be developed to announce the implementation. In this manner, drivers will be able to determine the optimal charging location.

4.5.3 Revenue Analysis

Electricity is less expensive than gas. Consumer Reports estimates that electric vehicles can reduce fuel costs by up to 60 percent. Taxis start at $2.50. Each additional kilometer is $1.26 more. 1.26$ per kilometer. Ideally, we anticipate a 60 percent reduction in the per-kilometer taxi fare. In reality, however, this percentage will be less than 60%, meaning the driver can earn more money while the customer enjoys a lower car price. Additionally, taxi companies can increase their profits through cost reduction. In addition, the company achieves its carbon reduction goals. Although on a short-term basis, the government will spend some funds on the development of the industry, the industry's growth potential and the company's increased profits can compensate for these expenditures through taxation in the long term. In conclusion, the vast majority of industry organizations will benefit from this electric cab reform plan.

4.5.4 Carbon reduction calculation

The carbon emission of conventional cars is approximately double that of new energy vehicles (16.25kg/100km vs. 7.93kg/100km), with a reduction of 8.32kg per vehicle and a 51% reduction in efficiency. TLC vehicles also include FHV, so our preliminary estimate for 2021 is that New York City will have 12.5% yellow and green taxicabs. Consequently, taxis produced carbon emissions by 187,500 units, assuming a total reduction of TLC vehicles of 1.5 million units in 2021. We recommend that 50% of vehicles be electric by 2025 and that all vehicles be electric by 2030. Based on this, we conduct predictive analysis. We anticipate 140625 tons of emissions in 2025 and 93750 tons in 2030.

Section 5: Conclusion and looking ahead

After the Paris Agreement, New York has been actively promoting cab emission reduction programs. However, the transition to electric cabs has been slow. Few pure electric vehicles exist and supporting measures like charging piles are inadequate. By evaluating the transition of electric taxis in Shenzhen, the New York City government department should take a stronger role in the transition.

The transition plan for electric taxis in New York City can be summed up in three aspects: 1. The government implemented suitable policies for subsidies and tax cuts. 2. Cooperation between the government and the private sector to support the installation of electric car charging piles and other industry chain infrastructure. 3. Utilizing digital and other methods to optimize the positioning and operation of electric taxi charging piles.

The electric taxi transition plan needs substantial capital expenditure, but in the long term, this transformation will be environmentally beneficial for New York. Additionally, it will increase the profitability of the taxi sector. As technology advances, New York City will gain a lot from the electric taxi transition plan.

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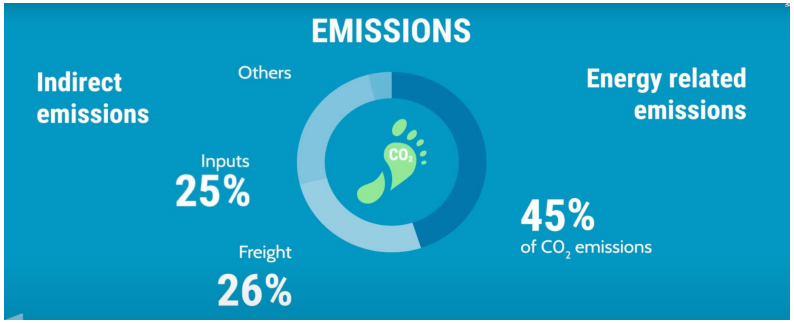
New York Electric Taxi Transition Program

Promoting the growth of the electric taxi industry

PRESENTED BY Zihao Wu

12/05/2022

Background



The Paris Agreement addresses energy neutrality goals. The energy transition of the taxi industry is important. But progress on the New York taxi industry's energy transition plan has been slow.

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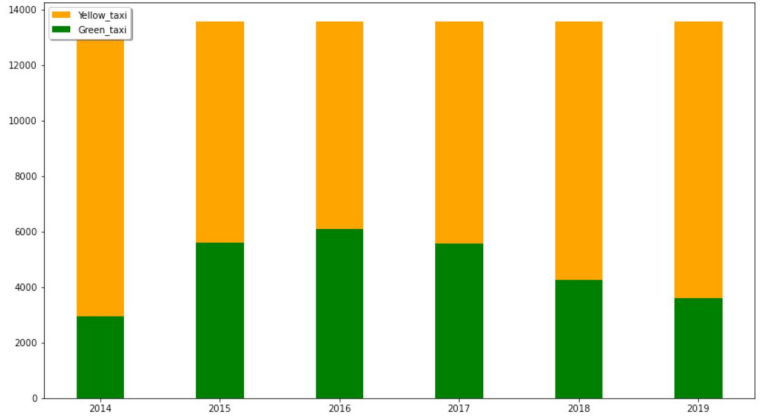
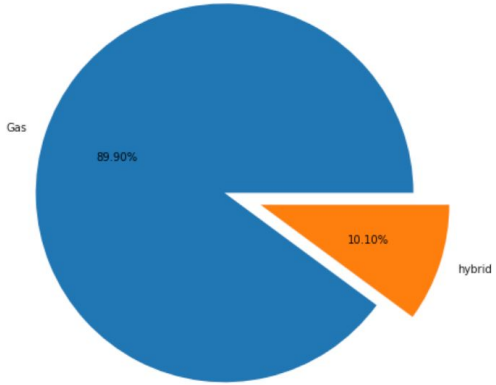
Overview and Challenges

TLC Licensed Vehicle Fleet Breakdown by Year



Instead of an increase in the number of green taxis licensed by TLC, there has been a decrease. The New York taxi industry's plans for a green transition have been thwarted.

Conventional Gasoline and Hybrid FHV Fleet Mix



Gasoline models make up ninety percent of the overall fleet, and hybrids are less than ten percent. There is still much room for growth in green and clean energy vehicles.

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Solutions to the transition

Infrastructure Building

Building infrastructure such as charging stations switching stations and maintenance points is the key to the development of this industry.

Policy Making

The government develops subsidy policies and tax policies to incentivize industry development.

Data Dashboard

Use the data panel to track your carbon footprint. Demonstrating the use rate of charging station and providing guidance to drivers.

The FUTURE:

Goal: 50% electric taxi

INCREASE SINCE 2022

Better New York:
By boosting electric taxis to more than fifty percent, carbon emissions are expected to be greatly reduced, which will make New York a much cleaner city.

Better Taxi market:
Electric taxis are not only good for the environment, but will also provide new growth for the new york taxi industry. Lower travel costs and increased driver income.