



PUTTING ELECTRIC LOGISTICS VEHICLES TO WORK IN SHENZHEN

Business Model Volume: Improving Utilization of ELVs through Innovations in Business and Ownership Models

BACKGROUND

POLICY

INFRASTRUCTURE

VEHICLE
QUALITY

**BUSINESS
MODEL**

SUMMARY



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Operating Association**

Shenzhen Electric Vehicle Operating Association engages in six sectors

including public transportation, taxi, logistics, rental, charging, and technical services and establishes communication platforms for government and enterprises, organizes industrial investigations and key discussions, develops industrial standards and specifications, and participates in policymaking. It strengthens the integration and cooperation between upstream and downstream players of the new energy vehicle industry chain, and promotes the healthy and orderly development of the new energy vehicle operation industry in Shenzhen.



**National Engineering Laboratory for
Electric Vehicles**

Authorized by the National Development and Reform Commission in 2008, the National Engineering Laboratory for Electric Vehicles was established on the basis of the Electric Vehicle Engineering Technology Center of Beijing Institute of Technology. The National Testing and Management Platform for New Energy Vehicles built by the Laboratory provides data support for the research of new energy vehicles technology and the making of industrial policies.

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EXECUTIVE SUMMARY



EXECUTIVE SUMMARY

This report is the fifth volume in a six-part series which examines the status quo of utilization and performance of electric logistics vehicles (ELVs) in Shenzhen as well as identifies opportunities to improve utilization and drive adoption of those vehicles. The focus of this report is on vehicle ownership models and how outright purchase versus various forms of vehicle leasing affect vehicle adoption and use.

As the first city in China to pursue massive adoption of electric logistics vehicles, Shenzhen has made significant achievements in vehicle deployment, policy formulation, and infrastructure build-out. One under-appreciated element of Shenzhen's efforts in ELV adoption has been innovation in vehicle ownership and leasing models.

This report carries out in-depth analysis of the costs and benefits of and leasing models with a focus on cost-effectiveness, impacts on vehicle utilization, and the procurement of vehicle services, such as charging and maintenance. As with other reports in this series, the research team used data analysis paired with surveys and interviews of ELV operators in Shenzhen to arrive at conclusions about how the system operates.

Based on this analysis, the research team reached the following conclusions:

- Vehicle leasing is currently preferred to ownership in the urban logistics market in Shenzhen.
- Ownership and leasing do not lead to substantial differences in how a vehicle is operated, but leasing is the dominant ownership model. Currently only a small number of the large-scale logistics companies with relatively consistent vehicle use patterns choose to purchase rather than lease vehicles. To the extent that differences exist in how leased and owned vehicles operate, it is typically a conscious economic optimization by vehicle users.

- In the long run, the total cost of ownership for a purchased vehicle is projected to be lower than the total cost of leasing. The support system, especially maintenance and charging, offered by leasing companies creates substantial value in the short-and medium-term.
- Leasing is particularly important in the early stages of a city's ELV market development when vehicle purchasers are risk-averse and there is a less robust supporting ecosystem of maintenance providers.

STATUS QUO OF ELV OWNERSHIP IN SHENZHEN



STATUS QUO OF ELV OWNERSHIP IN SHENZHEN

PREVALENCE OF ELV LEASING AND OWNERSHIP IN SHENZHEN

To date, the operating model for urban logistics has been simple.¹ An operator buys a vehicle, fills it up with gas at a nearby gas station, and delivers freight. However, with the advent of ELVs as a major player in Shenzhen's urban logistics market, that straightforward model has become more nuanced.

Now, logistics companies can select an ELV or an internal combustion engine (ICE) vehicle, they can select leasing models of various types and durations, and they can choose to own their own charging or to use public charging. They can even choose whether they want to hire a driver or have one provided as part of a lease package. These leasing models have been a major enabler for vehicle operators to cope with the more complex ownership dynamics of ELVs.

At a high level, there are two types of leases available in Shenzhen's ELV market—direct leases and lease-to-purchase agreements. In direct leases, the lessee contracts with the leasing company to use the vehicle on a monthly or annual term in exchange for a fixed fee. In a lease-to-purchase agreement, a leasing company signs a lease agreement with a vehicle user for a defined duration, after which the ownership transfers to the lessee.

At present, leasing in all forms is the most common arrangement in Shenzhen, with a market share of more than 95%, and the most common form of lease is a simple direct lease. According to the 2019 statistics of the National EV Data Platform, only about 5% of the total number of vehicles on the platform are self-owned.² The rest are all owned by leasing companies.

For the 5% of vehicles that are owned, currently two main categories of ELV buyers exist. The first are owner-operators and small- to mid-sized enterprises (SMEs) that deliver their own products. These users typically prefer ELVs to ICE vehicles because their routes can include deliveries to areas in the city center where ICE operation is heavily restricted. These users also prefer ownership to leasing because the ELV can double as a personal vehicle, which is typically not permitted under ELV leasing arrangements.

The second are very large logistics, express, and transportation companies such as SF Express and STO Express. These large companies have abundant capital and cash flow, in-house maintenance teams, and a large vehicle fleet with relatively fixed duty cycles—the proportion of time a vehicle is in use—all of which support ELV ownership. Furthermore, large companies expect that the license plate issuance policy of ELVs in Shenzhen will be gradually tightened in the future. Because a license plate number may be transferred to a new ELV when an old one is sold, these companies are effectively ensuring that they will not be adversely affected by any changes in license plate issuance policy in the future.³

Minivans comprise 75% of the small share of vehicles in the market that are self-owned (<5% of the total fleet), while the remaining 25% are light trucks. This is mainly due to the difference in upfront cost. At present, the price of a light truck is about ¥200,000 (US\$29,000)—about twice the price of a minivan.⁴

MAJOR DECISION FACTORS IN LEASING VERSUS PURCHASE

According to interviews with vehicle operators and leasing companies in Shenzhen, there are six primary reasons why leasing has come to dominate the ELV market.

- **Upfront investment:** The price of an ELV is substantially higher than that of an ICE delivery vehicle, while the operational cost of ELVs is substantially lower. Leasing models allow large companies with strong balance sheets to finance the high upfront cost and package that along with low operating expenses into a monthly payment that is manageable for many small and medium-sized companies.
- **After-sales support:** As discussed in the *Vehicle Quality Volume: Identifying Pain-points in ELV Performance that Reduce Utilization*, ELVs are a developing technology that at times experience costly failures—especially with batteries. Furthermore, the vehicle maintenance market is not yet fully developed. Both skilled and experienced technicians, as well as the vehicle parts and specialized equipment needed for ELV repair, are scarce. In Shenzhen, leasing companies have established strong relationships with manufacturers that provide direct access to both vehicle parts and maintenance services. Leasing companies also often own thousands of ELVs, giving them the scale to invest in maintenance expertise and facilities.
- **Flexibility:** Another advantage of leasing is that the lease terms are short and can be adjusted according to the needs of the lessee. A more flexible lease term is helpful for transportation companies because it allows them to choose a vehicle according to short-term needs rather than investing in a vehicle that can handle all eventualities over a five-year life.

From the perspective of the lessor, while the needs of any one customer may fluctuate, the needs of the overall delivery fleet in Shenzhen are relatively predictable. This diversification of customers allows leasing companies to own a smaller, more efficient fleet than if all users purchased their own vehicles. Similarly, customer diversification enables leasing companies to better handle battery degradation than individual owners. Leasing companies offer older vehicles with reduced range at low prices to customers who have low range requirements while offering new longer-range vehicles to customers with higher range requirements.

- **Risk management:** As an emerging technological product, ELVs at times have technical issues which, when combined with their high upfront costs, make fleets and transportation companies uneasy. The leasing model allows logistics companies to use ELVs without taking the risks of ownership. If problems emerge in the use of an ELV that are not a result of improper vehicle use and are not routine maintenance such as tire changes, they turn it over to the leasing company for repair and get a replacement vehicle.
- **Residual value recovery:** As discussed in the *Vehicle Quality Volume* in this series, residual value after first-life applications for ELVs is low and a robust used vehicle market does not exist.⁵ Due to their ability to maintain and refurbish vehicles, combined with an array of customers with differing needs, leasing companies are less exposed to loss of residual values. Rather than needing to sell a vehicle that is no longer suitable for long-range first-life applications, they simply refurbish and lease that vehicle to customers in need of lower cost, shorter-range vehicles. By being able to extract value from a vehicle throughout its entire life, leasing companies do not need to sell the vehicle at a loss into the second-hand markets.

- **Policy:** As discussed in the *Policy Volume*, Shenzhen's operational subsidy policy requires that any subsidy recipient own more than 300 urban distribution vehicles, including no less than 100 electric vehicles, or no less than 50 electric refrigerated vehicles or container tractors.⁶ This means that it is impossible for small and medium-sized logistics companies to obtain the subsidy. However, leasing companies, which own thousands of vehicles, are eligible. This government support further reduces the total cost of using leased ELVs relative to self-owned ones for fleets that are unable to meet the requirements and qualify for the subsidy on their own.

RESEARCH APPROACH



RESEARCH APPROACH

As with other reports in this series, the research team combined data analysis with stakeholder interviews to arrive at a holistic evaluation of ELV ownership approaches and their relative strengths and weaknesses.

The data presented in this research was obtained from China's National EV Data Platform. The ELV data was used to compare the utilization rate of vehicles that are self-owned and vehicles that are leased to analyze the effects on utilization of the two ownership models. This database houses detailed records of electric vehicle operations at 30-second intervals. Data used for this report includes vehicle key on/off, GPS location, vehicle battery capacity, battery state of charge, odometer readings, speedometer reading, name of company that owns the vehicle, and more.

One of the data challenges we faced was a relatively small population of self-owned vehicles, especially in the light-duty truck (LDT) segment, limiting robust data-driven comparisons. To help mitigate this challenge and complement the data-driven analysis, this report relies more heavily on targeted interviews of transportation companies to understand the differences between the two ownership models.

The industry interviews supporting this research were conducted with the cooperation and support of the Shenzhen Electric Vehicle Operating Association. The team prioritized interviews with firms that use both self-owned vehicles and leased vehicles (e.g., SF Express), so as to compare the differences between the two models in operational efficiency and cost-effectiveness. The team also interviewed major ELV leasing companies (e.g., DST) to understand the leasing model from the lessor perspective, in addition to the lessee perspective.

COMPARATIVE ANALYSIS OF LEASING AND SELF-OWNERSHIP MODELS IN THE ELV MARKET



COMPARATIVE ANALYSIS OF LEASING AND SELF-OWNERSHIP MODELS IN THE ELV MARKET

Given that vehicle productivity and cost-effectiveness are the key long-term drivers of ELV adoption, we focus here on those two topics. Regarding cost, we consider both direct financial costs of both ownership models as well as implicit costs. Additionally, we look at how Shenzhen's operational subsidy policy framework influences costs to the operators and the preference between leasing and ownership.

COMPARISON OF UTILIZATION RATES OF ELVS UNDER OWNERSHIP AND LEASING MODELS

According to the National EV Data Platform data, the utilization rate of self-owned vehicles is significantly lower than that of leased vehicles. The average daily driving distance of self-owned electric minivans is 51 kilometers (km) and the distance for electric light trucks is 57 km. In comparison, the average daily driving distance of leased vehicles is 90 km for vans and 77 km for light trucks.⁷ Without the operational subsidy, utilization of self-purchased vehicles may have been even lower as it appears that daily driving distance is calibrated to meet the minimum mileage requirements for subsidy eligibility. Based on interviews with vehicle operators, the research team found that two factors drive the difference in the utilization rates of leased and self-purchased ELVs:

Differential costs of vehicle idling

When leasing a vehicle, transportation companies pay the lessor ¥3000–¥5000 (US\$440–\$740) depending on the vehicle model and other lease terms.⁸ They pay that monthly fee regardless of whether they use the vehicle or not. Under self-ownership model, the allocated monthly cost of a vehicle is ¥2000–¥4000 (US\$300–\$600).⁹

However, because vehicle depreciation is the largest component of that cost and because vehicle depreciation is closely linked to battery degradation, that cost does vary substantially with use. That suggests that for a company that both leases and owns vehicles, such as the large fleets, leased ELVs are assigned to the longer, more demanding routes whereas self-owned vehicles are typically used in applications that maximize vehicle useful life.

Furthermore, because leasing companies have many customers, if a single customer experiences a decline in demand and discontinues an ELV lease, the leasing company can quickly lease that vehicle out to a different client rather than idling the vehicle. This ability to align demand for vehicles with supply on very granular time frames supports a relatively high utilization of ELVs under the leasing model.

Seasonality of vehicle utilization

The quantity of goods distributed in Shenzhen and the demand for vehicle kilometers in the urban logistics sector varies across months and has distinct low and high seasons. For example, the busiest months for express delivery are November, followed by May, June, and July, whereas August and September experience relatively low demand. The terms of ELV leases are typically monthly, which allows transportation companies to lease ELVs as a supplement to their owned vehicles in high seasons, and return the leased vehicles in low seasons.¹⁰

This pattern is detectable in the data as well. The overall average daily mileage of self-owned vehicles is relatively low, but their number of operational days is higher than that of leased vehicles. In contrast, many leased vehicles are heavily used in high seasons and completely out of service in low seasons, with higher average daily mileage but fewer operational days than that of self-owned vehicles.

COMPARISON OF ELV COSTS UNDER LEASING AND SELF-OWNERSHIP MODELS

Explicit costs

Explicit cost refers to the direct payment costs of purchasing, leasing, and using ELVs borne by transportation companies. They are primarily composed of:

Self-purchasing	Leasing
1. Purchase cost (vehicle + license)	1. Rental
2. Maintenance, repair, and insurance costs	2. Charging cost
3. Charging cost	3. Routine maintenance and repairs from abnormal vehicle use
4. Installation cost of chargers	
5. Maintenance cost of chargers	

The research team estimated the total explicit costs of ELVs under both models through interviews with transportation companies. Since purchasing a vehicle represents a one-time upfront cost that will not increase with time, the monthly cost for self-owned vehicles will decrease as duration of ownership increases, while under the leasing model it will remain the same each month. A minivan typically costs around ¥90,000 (US\$13,000) when purchased outright and has an annual maintenance and insurance cost of about ¥3,000 (\$440). It also has an annual charging cost of about ¥6,000 (US\$880) for 14,600 km of driving, which represents 57 km average per day and usage on 75% of the days each year.¹¹

Logistics companies often choose to install charging facilities in their own depots to charge self-owned vehicles. If one vehicle is paired with one charger, the cost of installation is about ¥4,000 (US\$590) and the annual maintenance cost of the charger is about ¥100 (US\$15). If the service lives of the vehicle and the charger are both five years, without consideration of residual value, the final monthly cost of a single vehicle would be about ¥2,300 (US\$340).

Based on interviews with leasing companies, the cost of leasing the same vehicle is about ¥2,500 (US\$366) per month, and the total cost to the lessee including charging and maintenance not covered by the leasing company is ¥3,100 (US\$460) per month.¹² As a result, even if there is no residual value to a self-owned vehicle, the total cost of a self-owned ELV is typically lower than that of a leased ELV, as long as the total service life of the vehicle exceeds three to four years.

EXHIBIT 1

Cost Comparison for Minivans



For more expensive LDTs, the dynamic is broadly the same although slightly more favorable to leasing models. In Shenzhen, an average electric light truck costs approximately ¥200,000 (US\$29,000) and has an annual maintenance cost of about ¥5,000 (US\$740). The annual mileage of a self-owned electric light truck is slightly higher than that of a minivan at approximately 15,000 km and the charging cost is about ¥6,300 (US\$930). Other costs, including construction and maintenance of chargers, are much larger for LDTs as they require fast charging (¥20,000 [US\$2,900] for installation and ¥1,000 [US\$150]/year for charger maintenance).

Under these assumptions, the monthly cost of a self-owned light truck is about ¥4,600 (US\$680). Meanwhile, under a leasing model, the monthly rental of a light truck is about ¥5,000 (US\$740). When charging and non-covered repairs are included, that monthly cost grows to about ¥5,300 (US\$780).¹³ In this case, assuming zero residual value, ownership becomes preferable to leasing when vehicles have a service life of about four to five years.

EXHIBIT 2

Cost Comparison for LDTs



When comparing the direct costs of self-owned and leased vehicles, it appears that self-ownership results in lower total costs over expected vehicle lifetimes. However, this comparison does not include the other hidden costs of ownership, referenced here as implicit costs.

Implicit costs

Implicit costs are costs that may not appear anywhere on an invoice but are real nonetheless. Under a direct ownership model, the transportation company is responsible for all aspects of vehicle operation, including all implicit costs. However, under a leasing model, the transportation company only pays the agreed upon monthly lease fee and the lessor pays all implicit costs. These implicit costs, which are born by vehicle owners but not lessees, include:

Cost of an oversized fleet: As mentioned above, there is strong seasonality in the demand for goods transport in Shenzhen. Under a direct ownership model, the size of the logistics fleet is fixed and it must be sufficient to meet customer demand. This results in an oversized fleet in which some vehicles are not fully utilized year-round. Under a leasing model, logistics companies can adjust the size of their fleets by renting more vehicles during high seasons and fewer vehicles during low seasons. Leasing companies can effectively manage this seasonality by having customers from an array of sectors that experience different seasonal patterns and reallocating vehicles to customers who will be able to use them at a given time.

Financing costs: In the direct cost analysis above, an implicit assumption was that vehicle users are indifferent to paying a lump sum at purchase time or a recurring payment over the life of a vehicle. In practice this assumption does not hold. In order to purchase a vehicle, a company will either borrow money to buy the vehicle, in which case it pays interest. Or it will pay cash, in which case it loses the ability to invest that cash back into the company and foregoes the returns that investment would have created. This is particularly true in the case of small enterprises.

For example, if a small company financed and purchased a minivan that cost ¥90,000 (US\$13,000) with a 20% loan over a five-year financing period, its monthly payment for that vehicle, including maintenance and charging, would be approximately ¥3,083 (US\$454). This is roughly equal to the ¥3,100 (US\$457) monthly lease fee. On the other hand, a large company which had access to finance at 8% would pay only ¥2,453 (US\$361) per month, explaining why only large companies choose to purchase ELVs.

Risk cost: When a vehicle is purchased, that vehicle and the costs of operating and maintaining it are the sole responsibility of the owner. Since ELVs have a limited market history, and since many early ELV models in China experienced technical problems, vehicle operators do not have the same confidence in ELVs that they do in ICE vehicles in terms of safety, reliability, and cost-effectiveness. Given this risk, a long-term commitment to ownership, especially by small owner-operators that do not have access to maintenance services or readily available spare parts, is not desirable. In contrast, leasing operators are able to better manage life cycle risks through economies of scale and preferred relationships with manufacturers.

Finally, as discussed above, individual owners of ELVs take a risk on the residual value of an ELV after its first-life application. In practice there is only a weak second-hand market for these ELVs and residual values of ELVs are low. Leasing companies are better positioned to manage this risk by leasing vehicles to second-life users and continuing to derive value from the vehicle without ever having to sell it.

DIFFERENTIAL EFFECTS OF POLICY ON ELV OWNERSHIP MODELS

In surveys and interviews, companies also mentioned that the operational subsidy policy is another factor informing the decision to purchase or lease a vehicle. According to that policy, companies can receive the operational subsidy only if they meet the kilometers driven and fleet scale thresholds (for more detailed analysis on the operating subsidy policy, please refer to the *Policy Volume*). In this way, the ownership of a vehicle determines its eligibility for the subsidy.

Under the Shenzhen operational subsidy policy framework, transportation companies that purchase vehicles can obtain the subsidy as long as they are in compliance with the subsidy conditions. Under a leasing model, the owner of the vehicle is the leasing company, not the vehicle operator, and the leasing company collects the subsidy. Leasing companies are under no obligation to transfer that subsidy to the vehicle user. The research team learned through interviews that, under a leasing model, leasing companies only pass on part of the subsidy to vehicle users in the form of reduced lease fees, and only do so to the extent needed to maintain competitiveness.

Furthermore, if the users failed to utilize the vehicle in a way that positioned it to win the operational subsidy, leasing companies sometimes charged an additional fee at the end of the lease term to compensate for the lost subsidy. In this way, policy favors vehicle ownership, but only for fleets that are large enough to qualify for the subsidy. Otherwise leasing ELVs provides user-operators some access to subsidy funds, although that access is opaquely intermediated by leasing companies.

MAIN CONCLUSIONS



MAIN CONCLUSIONS

Based on the above information, the research team arrived at the following conclusions:

- The leasing model is currently preferable to ownership in the urban logistics market in Shenzhen on a total cost basis. According to the above analysis, although the direct average monthly cost of vehicles under an ownership model is lower than under a leasing model, only the largest fleets consider vehicle ownership after factoring in implicit costs. Under a leasing model, ELV leasing operators can not only provide more flexible and convenient services, but they also provide benefits such as access to preferential financing rates, access to parts supply chains, and access to professional maintenance capabilities. When evaluated holistically, the value of extra services provided by leasing companies dominates the lower monthly direct costs of ownership.
- Direct ownership currently is only suitable for a small number of large-scale logistics companies with relatively consistent vehicle use patterns. For these companies, self-ownership often made sense because they were able to obtain the economies of scale that leasing companies enjoy (e.g., maintenance, financing, and preferential policy treatment), and through direct vehicle purchase were able to avoid paying the leasing companies' margins. Furthermore, buying vehicles allowed large fleets to hedge against expected future policy developments, such as greater restrictions on ELV vehicle license-plate issuance.

- In the long run, vehicle ownership may become preferable to leasing in some segments of the market while leasing will continue to dominate others. Leasing adds on a layer of intermediation and cost, which in some cases vehicle operators only elect to pay because they do not have confidence their own ability to manage the risks of vehicle ownership. With a more mature supporting ecosystem (e.g., after-sales support, a viable second-hand market, improved access to financing) some owners may elect direct ownership of vehicle leasing. However, in situations where leasing companies serve a variety of clients with differing patterns of seasonality and can monetize the benefits of this diversification through increased utilization, leasing will likely continue to be the preferred choice of vehicle operators.
- Leasing models are important for nascent ELV markets. As the ELV ecosystem matures, users of ELVs are increasingly able to shoulder the risks of ownership, and the value added by leasing companies may be diminished. However, for cities that are just beginning to deploy ELVs, the risk management services provided by leasing companies can greatly accelerate operator confidence and ELV fleet growth as a universal supporting ecosystem develops.

ENDNOTES



ENDNOTES

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