Compare And Analyze The Popularity of Fuel Vehicles in China and The United States—An Overview And Perspective of Fuel Cell Vehicles

Longqi Wu *

Muhlenberg College, Seeger Union 2614, 2400 Chew St. Allentown, PA, USA

* Corresponding Author Email: lwu@muhlenberg.edu

Abstract. Fuel cell vehicle machinery has substantial repercussions for energy policy and ecological protection. In the last era, China and the US have shown diverse progress in fuel cell vehicle manufacturing as the management's strategy issuances and enterprise's manufacture. Conversely, there are still roughly technical and expense difficulties impeding the commercialization of fuel cell automobiles. In this research, the position of China and the US fuel electric vehicles research method is analyzed comprehensively from various perspectives. Furthermore, the results of the fuel-electric vehicles are discussed and compared. The unique features and major concerns of each manufacturing segment are highlighted. Additionally, the performances of fuel cell electric vehicles perspective are reviewed on pre-existing works and information. With the combination of the fuel cell vehicle of business status and machinery performances, it is emphasized those technological developments in fuel cells and the optimization of the production methods for fuel cell structures are vital in manufacturing fuel cell vehicles.

Keywords: Fule vehicles, business status, machinery performances.

1. Introduction

Energy storing and transformation is a significant connection amid the procedures of energy production and its depletion. Native relic fuels are an ordinary, unmaintainable energy-storing intermediate. They are minimized assets and are disreputable pollution challenges, thus challenging an advanced option to preserve and use green and renewable fuels. Fuel and environmental challenges need a pure and resourceful tactic of utilizing the energies. The energy cell operates to capably transform oxidant and chemical fuel stored in the fuel straight into DC electric, water and heat being the byproducts. Fuel cells are referred to as operational electrochemical converters, and electricity generation technology has enlarged concern because of the desire for pure energy, the restraint of remnant fuels, plus the proficiency of an energy cell to produce voltage without linking one moving mechanical sector. The energy cell skills that have the higher demand are polymer electrolyte coverage energy cells, straight methanol energy cells, and compacted oxide fuel cells [1]. The optimal proficiency for the energy cell does not rely on the code of the Carnot series as linked to other native power engines that are typically dependable on current cycles like air turbines, internal combustion engines, as well as steam turbines. Though, fuel cell uses are disadvantaged by the high cost required to finance them [2]. The fuel cell system designs minimize the prices and expand cell productivity, reliability, and resilience, permitting them to contest with the native incineration machine. This study compares and analyzes the popularity of fuel vehicles in China and the United States.

2. Framework theory

2.1. Fuel Electric Vehicles

Recently, universal electric passenger care delivered one million components, and roughly 7 out of 10 were for China or USA [3]. Apart from being the two biggest international power-driven vehicle markets, the nations have had incredible electric car growth in recent times and an energetic market environment.

2.2. Present Status

Electric cars can transform the automobile sector in China and are seen to reduce ecological aspects [4]. Although electric vehicles have a lengthy history, they have only begun to spread widely. Several drawbacks prevent the widespread use of electric cars when related to traditional automobiles with gasoline-powered engines. Primarily, electric vehicles have drawbacks because of their increased overall cost of ownership and original cost prices. Additionally, they have less developed technology than cars with internal combustion engines. The cars' cells need significant technological advancements. Due to a shorter radius and slower recharging, this technical drawback results in decreased usefulness. Additionally, charging points are less common than petrol outlets for traditional automobiles. Clients consider the shorter radius and potential absence of charging points to be two significant drawbacks.

On the other side, the US sector encourages the growth of the facilities required to manufacture alternative fuel vehicles (AFVs), a sustainable transit choice, and works to improve local neighborhoods by promoting the use of AFVs. To assist localities in getting ready for hybrid cars and charging stations, the U.S. Department of Energy financed 16 powered motor initiatives in 24 states and the District of Columbia. PHEVs and EVs are currently offered in a variety of car classifications. Over 50 PHEV and EV vehicles are now available, and more automobiles are anticipated to be produced in the next years. Certain PHEVs run entirely, or almost entirely, on power up until the batteries are somewhat completely depleted [4]. The propeller then burns gasoline to generate more power. A wide-ranging infrastructure of charging points, from home-based AC recharging to DC-driven ultra-charging points, will be necessary for the broad adoption of EVs.

2.3. Market Features of Fuel Electric Vehicles in the US and China

Around 2.4% of new car purchases in 2020 were electric, up from 2% in 2019 roughly. Improved power-efficient automobiles, such as hybrid and electric models, assist the US industry and contribute to the fleet's diversification [4]. For the powered segment of the automotive market, the numerous fuel sources utilized to produce electricity lead to more reliable power generation. All of this increases the power security in the nation. Since they utilize power-drive technology to increase vehicle economy via reformative braking—restocking power that would otherwise be wasted while braking—hybrid electric cars (HEVs) made by the US electric sector often consume less gasoline than comparable normal cars. Both battery-powered and all-electric automobiles, also known as battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs), can run entirely on the grid power generated in the United States from sources like nuclear power, solar power, coal, hydro energy, and wind.

Batteries constitute one of the essential parts of rechargeable cars in China and makeup 40% of the overall price of the automobile. China has a lot of rare earth elements needed for electrodes. China will produce 1.5 million tons of lithium in 2021, or 6.8% of the world market. Chinese firms own a significant portion of the globe's major lithium reserves, primarily in Australia and South America [5]. Three essential parts of a gasoline vehicle are the engine, the transmission, and the chassis. Nevertheless, the first two have not been utilized in EVs lately. As a result, multinational manufacturers' competitive edge is no longer as relevant in the EV market. This makes it easier for China to compete fairly with other nations. Quality is the main priority among Chinese high-end powered vehicles.

2.4. Overall Market Drift

China and the US have been experiencing a notable increase in electric vehicle sales in the latest decade. The US market share started in the early 2010s, roughly two years prior to China. However, the market of China grew at a much swift rate, particularly afterward 2014. The evolution frequency in the US reduced after 2013 in contrast to the past double years, though it stayed balanced. As of 2013, the China has attained incredible evolution in innovative energy vehicles, the battery electronic vehicles, the plug-in electric automobiles, and the fuel cell vehicles [5]. With a yearly growth

frequency of approximately 45 percent for six straight centuries, China has appeared to be the leading nation among the main electric vehicle popularity internationally. According to statistics, China reached above 500000, contributing about half of the general sales globally and more than double that of the United States [4]. In the US, the popularity of new electric vehicles stood between 20 to 30 percent, and the whole sales were approximately 190000.

3. Historical Annual Transactions of Fuel Electric Automobiles in China and the US

3.1. Fuel Electric Cars and Market Segment in China and The United States

In both markets, China and the United States, popular vehicle transactions are focused in a minor sum of towns. In China, the upper most 30 towns jointly represent 72 percent of the whole state electric car market according to statistics, whereas subsidizing to merely 36 percent of the customer transactions. In United States, the best 30 towns generate roughly 74 percent of fuel electric car transactions, subsidizing to 42 percent of commuter deals [6].

More major towns had an upper fuel electric car popularity segment in China compared to the United States, whereas China's universal range endorsement is somewhat lesser. The normal market diffusion of rechargeable vehicles in these towns is roughly 4.5 percent then 2 percent, considerably superior than the state regular of 0.9 percent and 1.2 percent in China and the United States, correspondingly [7]. The major towns in the United States stood relatively steady, with the mere change existing in the two towns on the lower sector of the list; Kansa and Providence towns, whereas Indianapolis and Dallas plunged out. The coverage statistics on which the deals sum is located do not correctly replicate the trades in that town since the actual auctions sum is minor. This is because of the difference in subsidizations in various provinces. For example, Shandong traders, who had no sponsorships, selected to attain indemnity internally but get an authorization in other regions to get subsidizations.

3.2. Popularity by Brand

In both China as well as the United States, a minor number of electric vehicle brands add to the popularity of the fuel electronic car marketplace portion. Below 10 trademarks comprise up to 90 percent or further of the entire electronic vehicle market portion in equally nations [8]. In China, these brands are all internal; some have created joint schemes with oversea brands, while the United States is more exposed to universal brands.

China had 34 electric car manufacturers, and the 9 leading enterprises still composed 89 percent of the entire sales as shown in Table 1. BAIC surpassed BYD and was the leading brand, and outdated vehicle companies like Changan progressed to take up a great electronic vehicle marketplace. Some such as Zhidou vehicles were manufactured below Jiangnan. The changes were perhaps because of strategy modifications within an auto team or company.

Table. 1 Electric vehicle brand market shares in China [9].

Car brand	BASIC	BYD	Geely	BASIC	Jiangnan	JMC	JAC	Changan	Dongfeng	Others
Market share	21%	17%	13%	11%	7%	7%	6%	4%	3%	11%

Tesla is the prevalent brand in the United States, having roughly a quarter of the whole market share. The Chevrolet is in the 2nd position, with around half of its trades from its Bolt classical as shown in Table 2. Toyota got 11 percent of the market portion from its Prius Prime, thus securing the third position [10]. From statistics, BMW, Nissan, and Ford lost some market popularity as Mercedes and Volkswagen fell from the top list.

Table. 2 Electric vehicle brand market shares in the United States [9].

Car brand	Chevrolet	Toyota	Ford	BMW	Nissan	Fiat	Chrysler	Kia	Others
Marketshare	23%	11%	10%	10%	6%	3%	2%	2%	9%

3.3. Popularity by Technology Trail

In the China, the transactions and classical accessibility of battery electric vehicles are extreme much better than plug-in electric vehicles, though there is not a great dissimilarity in the marketplace share creation of these dualistic machineries in the United States.

Due to the impact of China's advertising of battery electric vehicles as a main tactic in the reform of the vehicle manufacturing, their sales and accessibility far outweigh plug-in hybrid electric automobiles. The customer preference for battery electric automobiles is 83% of trades being battery electric automobiles and 17 percent plug-in hybrid electric automobiles.

In comparison, though some United States cities and states provide inducements for battery as well as plug-in hybrid electric vehicles, the two technologies have similar models and sales accessibility [11]. The battery and plug-in electric vehicles roughly divided the market portion equally. However, the model accessibility of plug-in hybrid electric automobiles offset that of battery electric vehicles. A larger part of the US aim cities had the same shares of battery and plug-in electric automobiles.

Table. 3 Popularity by Technology Trail [9].

Country	China	United States
Sales: battery electric	68 percent	63 percent
Plug-in hybrid	32 percent	37 percent
Models: battery electric	85 percent	52 percent
Plug-in hybrid	15 percent	48 percent

3.4. Popularity by Vehicle Segment

The comparison of the China and the US battery electric vehicle and plug-in hybrid marketplace shares is based on vehicle size as shown in Fig.1. In China, the battery electric vehicles segment is led by microcars, since they are economical and have a littler electric scope compared to other models. According to statistics, approximately 68 percent of the battery electric vehicles were microcars [12]. By division, cars accumulated roughly 27 percent, and the rest, such as MPVs, SUVs, and vans, shared. The vehicle division composition of the plug-in hybrid subdivision was like that of the United States, having more than 75 percent of transactions being cars and the remaining percent being SUVs [6].

In comparison, the market share divisions for battery as well as plug-in hybrid automobiles are the same in the United States, where cars add up above eighty percent of the entire transactions. The SUVs models have a bigger segment of the plug-in hybrid souk share in China compared to the United States [13]. There are numerous more representatives in the battery electric vehicle and the plug-in hybrid automobile market segment in China, whereas in the United States the variance is not so important. The 10 great popular battery electric vehicle models represented 59 percent of the sales in China. However, the top ten great battery electric vehicle models in the United States signified roughly 97 percent of the general sales [14].

In contrast, plug-in hybrid vehicles are ruled by a little brand in China: BYD and SAIC, which add up to above 90 percent of the entire plug-in hybrid automobiles. In China, both the battery electric vehicle as well as plug-in hybrid vehicle markets have become more split, with the former leading brands taking fewer market portion. The market segment of the top ten battery electric vehicle prototypes reduced from around 80 percent to 59 percent in China [9]. More representatives and vehicle make arose and became prevalent, like the numerous models from JMC, BAIC, and JAC companies. In plug-in hybrid vehicles, though BYD, together with SAIC, still ruled the arcade share, there is extra accessibility, as well as SAIC erodes BYD's leading market segment [11]. The United

States market share inclines to be balanced and has more offerings in the plug-in hybrid division as per statistics.

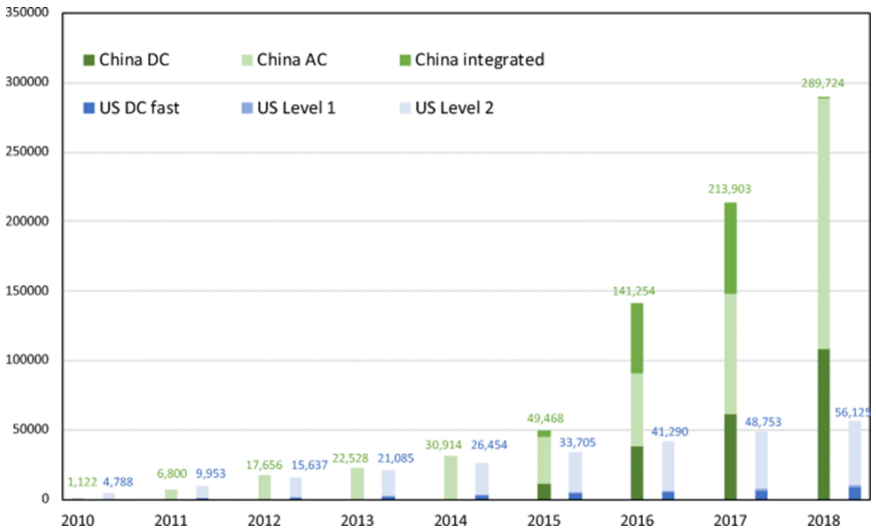


Fig. 1. Popularity by Vehicle Segment in China and US [15]

3.5. Model Availability

Generally, advanced model availability provides clients with more options, thus increasing rivalry in the electric automobile market share as shown in Fig.2. It is a vital factor in electric vehicle market endorsement [16]. There is no deep connection visually between China's make availability market segment. Towns and cities with greater population and sales are Shenzhen, Hangzhou, Beijing, and Shanghai, which have more makes accessible and therefore do not have a great market share [17]. Additionally, some towns with minimized model accessibility still have comparatively extraordinary electric vehicle market segments, like Liuzhou.

In the US, urban regions with extra makes accessible tendency to have comparatively greater electric vehicle transactions and transactions share. The topmost rank 5 regions in market share accounted for relatively half of the whole country's transactions and were the highest 5 in the category of model accessibility, having twenty-eight to thirty-seven models [18]. Additionally, there are more models in the United States urban areas as compared to Chinese towns, with a range of 17 and 13, correspondingly (Liu et al,2018, p. 22617). Again, the prominent 5 towns in China have nineteen to twenty-three models accessible, against 28 to 37 replicas accessible in the United States [11].

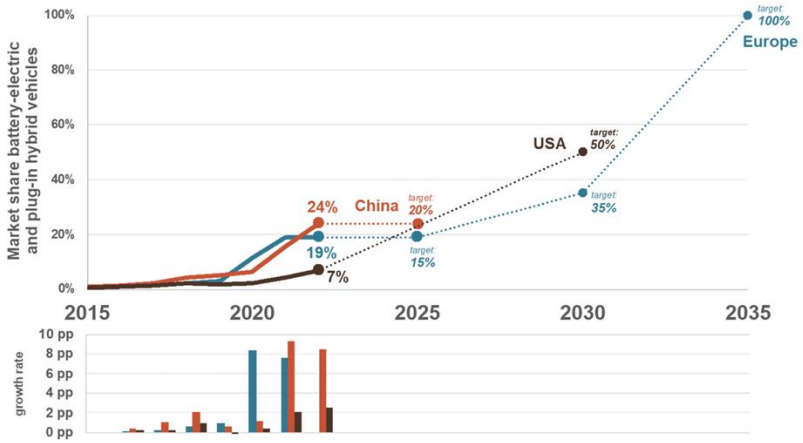


Fig. 2. Model Availability in China and US [19].

3.6. Leading Manufacturers by Region

Regional China and the United States popularity by manufacturers have very diverse patterns. In China, companies always comprise a greater portion of the market portion in a region in case their engineering plant control center is situated there [20]. For example, BAIC is in Beijing, as well as SAIC is in Shanghai. This criterion is not equally vital as in the United States since equally internal as well as oversea automakers have solid international supply and franchise connections. Unique exclusion is Tesla, which is further concerned on the West Coast perhaps as is a different firm [21]. Some companies perform interestingly in all market shares, like General Motors and Tesla; some have a greater share in chosen states, for instance, Ford and Toyota, and the rest have a tiny market segment in every market, like Mercedes and Hyundai-Kia.

4. Technical Characteristics of Fuel Electric Vehicles

4.1. Top Models

Customers in China have a habit of preferring inexpensive and shorter-range microcar battery electric automobiles, yet plug-in hybrid SUVs. In contrast, United States customers desire cars for both battery electric vehicles as well as plug-in hybrid vehicles [22]. The top battery electric vehicle models are apt to have a longer scope, and plug-in hybrid vehicles tend to have a diminutive all-electronic scope in the United States compared to China. Seven out of the 10 topmost battery electric vehicle models in China are cheaper, shorter-scope microcars [23]. In the United States, 9 of the uppermost 10 selling battery electric vehicles are entirely cars, with merely single SUV, the Tesla Model X. The three greatest-vending United States makes altogether have lengthier-than-average sort, above 200 loads.

The SUVs, BYD Song, the SAIC Roewe Erx5, and BYD Tang, symbolize above half of the plug-in hybrid electric vehicle transactions in China. In the US, the BMW X5 xDrive 40e as well as the Chrysler Pacifica, the merely two SUV makeups appearing in the uppermost 10 lists, accounted for just 10 percent of the whole plug-in electric sales according to statistics [24]. The structures of the plug-in hybrid of SUV make in the binary marketplaces are exact diverse. The BMW X5 provides a precise small electric collection at moderately great energy depletion, cooperating with every luxury structure of the vehicle. By contrast, all the three SUV makes in China have a lengthier all-electric array than the US models plus are cheaper. The two BYD models have a 50-mile all-electric array.

4.2. Performance Metrics

In both China and the US, the models covering wider performance metrics are increasing, though the distribution patterns of the metrics vary. Key expansions have been in the offerings of battery electronic automobiles with diverse vehicle ranges as well as types. Though microcars with a scope of roughly 100 miles continue to be common in China, there are substantial sales of higher-range SUVs and cars [13]. For example, the BYD E6, which has an electric scope of about 250 miles, is more popular with Chinese customers. In the United States, extra models with a scope marginally above 100 miles and a sophisticated range of about 250 miles, like the Tesla Model and the Chevrolet Bolt.

Like the tendency for battery electric vehicles, there are extra plug-in electric vehicle models and ranges to select from. In China, there has been a diversity of models oscillating from 30 miles to 72 miles, and clients have a minimized choice of plug-in hybrid vehicle models existing, plus no make had an all-electric scope of above 50 miles [25]. In the United States, though the variety of most plug-in hybrid models is also typically below 50 miles, there are further models accessible.

The distribution array of model structure clusters matches the design of the core new energy vehicle subsidizations in China. The Chinese battery electric vehicles are crowded or beyond, in 50 miles' increments, and plug-in hybrid vehicles have an electric variety of 50 miles round 31 miles or extra. Battery electric vehicles are qualified for three subvention tiers according to electric variety

and other performance metrics. Simply plug-in hybrid vehicles with a 50 km all-electric scope or beyond can get a subsidy [18]. That is the same as a battery electric vehicle with a limited range of 150 miles. A battery energy density ranging from 90 to 120 wh/ kg would get the next tier of subvention of 360 thousand yuan. This is a major leap from the initial-tier rank of 200 thousand yuan if it is for the battery electric vehicles with electric distances beyond 100km with a similar battery energy mass [7]. The third tier is applied to battery electric vehicles with a limit range of 250 km, and there is a collection of models marginally beyond that variety.

The US battery electric data show a distinct bipolar distribution when considering the electric car driving scope, having one peak at roughly 50-130 miles and the extra other at closely 250 miles majorly driven by the both Tesla and Chevrolet Bolt models [26]. The US national income tax debt for battery electric vehicles gauges depending on battery capacity. To get the extreme $7500 inducement, the vehicle should have a 16-kWh battery capacity and, therefore, not eligible for the full $7500 revenue tax credit [16]. Though, most cities like California provide the availability of high-occupancy lanes to plug-in hybrid vehicles, which can be a significant benefit to some drivers.

Generally, industrialists vending battery electric vehicles in China provide a better diversity of car models considering all-electric variety than companies marketing battery electric vehicles in the United States. The full electric range coverages of battery electric vehicles in the two market shares are handy, extending from around 50 miles to about 300 miles [9]. Compared to the Chinese plug-in hybrid vehicle market share, the US market segment has more plug-in hybrid vehicle makes with lesser all-electric variety.

4.3. The perspective of Fuel Electric Vehicles

In equally Chinese and the US market shares, customers in a minority of towns add up the significance of electric car transactions, and little towns are very effective in advertising electric vehicles. The topmost 30 towns in both nations' electric car market segment add to above 70 percent of the universal electric car market share, adding up to roughly 40 percent of the passenger vehicle transactions [17]. These two nations should focus on closely increasing electric passenger vehicle sales to balance with electric car passengers, thus maximizing market shares. In both nations, a lesser sum of vehicle companies adds to the popularity of the electric car market segment. Below 10 brands add up to roughly 90 percent of China's electric car market share; all these are internal brands or joint ventures having oversea brands, whereas a segment of both electric and hybrid vehicle auctions in the US imports [4]. Maximizing the market share of the brands for the two nations should be done by venturing into both local and foreign brands; China should venture into international brands, whereas the US should venture into local brands.

The regional market portions by company in the US and China show a very diverse pattern. For China, brands tend to perform better in market shares where the headquarters or manufacturing plant is located. In the US, prominent models are the same across cities as automakers have strong countrywide supply and dealership links; thus, China should improve on ensuring that its distribution patterns are uniform across the cities to increase its vehicle popularity [27]. In China, the deals and model accessibility of battery electric vehicles is greater than plug-in electric vehicles, whereas, in the US market share, there is no noticeable difference between the two technologies; with that, China should improve the two-vehicle technologies to range in close as it would grow the market share in sales and models number.

There is no perfect connection amid model accessibility and electric vehicle shop segments in China. In contrast, in the US, regions with extra models accessible incline to have comparatively advanced electric vehicle auctions and transactions share. Generally, the US has more models accessible compared to China in prevalent city regions. This warrants more analysis of latent confounding aspects and how model accessibility affects electric vehicles' popularity in China [3]. For this case, China should work towards ensuring a connection between model accessibility and the vehicle market share in metropolitan areas.

5. Criticism and Vision of Fuel-Current Electric Vehicles

The charging batteries for electric vehicles are rare since they use lithium, the agilest solid element in ordinary conditions [8]. Since these metals are rare, there is a struggle to develop a large sum of electric vehicles in China and the US. The ecological effect of electric vehicles depends considerably on the electricity charging its battery. That means if a car is renewed utilizing renewable dynamism, its harmful effect on the atmosphere is far lesser than uncertainty it is charged utilizing current from a coal-fired point. Electronic vehicles cannot drive for far distances despite the battery technology improvement. The vehicles are suitable for cities and towns. Recharging them needs a minimum of half an hour.

6. Conclusion

Fuel cells and electricity have a bigger potential to determine the future of mobility. Zones such as China and the US are identifying the tendency and aiming the strategy efforts on rising fuel cell equipment, like supply chain as well as substructure on various facades. Because of features like fast refueling and high energy density, fuel cell electric vehicles are particularly attractive for heavy-duty and commercial automobiles. The economies of fuel cell electric vehicles are forecasted to outdo battery electric vehicles for applications. Generally, the fuel electric vehicles are estimated to drop by roughly 50% in the subsequent 10 years depending on aspects like fuel-cell structure cost drop, frugalities of purchase and utilization of renewable dynamisms to generate electricity, and maturation of electric structures. Fuel cell electric vehicles show the last lifespan conservatory emissions because of better usage of renewable energies in current production. Population increase, the diminuendos of urbanization, enhancing the standard of living, and the swift increasing depletion of large populaces evolving in renovating economies add to an extremely-geared rise in energy requirements. The irrefutable environment effect of prevailing fossil use is becoming simple and unbearable. Fuel-current electric vehicles are perceptible than shortly. Users of vehicles across the globe are satisfied with their benefits of them. Again, the fuel cell electric vehicles are clean and environmentally friendly throughout their lifespan, and they have more improvements since electric generation has moved to a wider role in renewable energy development.

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