

ARE THE ELECTRIC VEHICLES THE SOLUTION FOR SUSTAINABLE TRANSPORTATION?

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Abstract

When the electric vehicles and hybrid vehicles were firstly introduced the majority of people was reluctant about buying such vehicles as they were considered to be more an inconvenience than a viable clean transportation solution. But, during the recent years as the technology evolved, the advantages of owning such an automobile became more noticeable. As a result, the sales figures increased dramatically, to almost double, at the global level in 2021.

Although the stats and figures look very promising, when put into context the situation changes a bit as the shortcomings of owning such a vehicle are revealed. They include the high buying costs, not enough range, the underdeveloped charging infrastructure, not to mention that recent studies have revealed that producing all the necessary batteries for all the electric cars, can lead to a global shortage of water.

Keywords: electric vehicles, environmental impact, increased sales.

JEL Codes: F01, F15, F18, F23

Introduction

Although the electric cars were not the first solution of improved mobility as the steam powered automobiles were invented first, in the 17th century, they had some important advantages over their competitors: a smoother ride, no noise or smell produced by the motor running, like the gas powered cars did and there was no preparation required before the drive, as the steam powered cars did. In a word, a far more user-friendly automotive experience. Of course, there were a lot of drawbacks as well, the most important one being the very low range, especially for the early models that did not benefit from the use of rechargeable batteries, since they were invented a few years after the birth of electric cars. But the biggest obstacle in conquering the market was the price. These cars, and all cars for that matter, were reserved for the rich only, who were not put off by the small range of electric cars, as they bought them mainly for city use.

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In the following decades, the technological discoveries, as well as improved methods to produce better fuel for internal combustion engines, the gasoline powered automobiles, and later, the diesel ones, allowed for more affordable vehicles, that had better range, were faster than the electric vehicles and way easier to use than the steam powered ones. This meant that the domination of the internal combustion engines had started.

Through time, the electric powered vehicles became less and less attractive, as passenger cars, due to the fact they did not offer comparable advantages, the main drawback remaining the limited range, the long hours needed to recharge the batteries and mainly the non-existent charging stations network.

During the more recent era, car manufacturers tried to include in their product range an electric vehicle, which generally was nothing more than a conventional automobile that was converted to use an electric motor and the trunk, or luggage compartment was filled with battery packs. This solution, although efficient in terms of costs, due to the fact that the manufacturer did not develop a new vehicle from scratch, just repurpose one from the existing range, it was not that attractive for the customers, because the practicality of that vehicle was sacrificed and the performance as well, since the battery packs were so heavy.

The first attempt to build a fully electric vehicle was the EV1 (which stands for Electric Vehicle 1), built by General Motors in the last half of the 90s in United States of America for the domestic market. GM took a different road than any other manufacturers as they designed and built that automobile as an electric vehicle right from the start. The American manufacturer spared no expense in creating its first electric vehicle as it was packed with the latest technology, as well as ground-breaking solutions in terms of constructing process. The EV1 was the first automobile to use a composite body wrapped around a lightweight, but very strong aluminum chassis, which meant that the car weighed close to nothing. And GM did not stop there, as they added creature comfort options, like electric power steering, keyless entry and keyless ignition, automated tire pressure loss system and so on. Today, we take these features for granted but back in 1996, they were unheard of. Even the buying was different, as General Motors offered its customers these cars only through a limited lease option as the manufacturer considered that the customers who opted with that lease, were just participants in a study and there was no option of buying any of the leased EVs. The results of the conducted study were favorable, but, despite all, GM decided to pull the plug on its EV1 and the EV program all together and took all the cars back and crushed them. GM motivated its decision as a business strategy, since its EV1 cars and the entire EV program were not profitable, but they served their purpose as being the development platform for their future electric and hybrid cars.

EV1 also helped other car manufacturers into developing and manufacturing their own electric automobiles, so it is only fair to consider General Motors as a modern pioneer for exploring the partially uncharted electric vehicles' territory.

Electric and hybrid vehicles' impact on the global market.

The eco-friendly movement started to make its way into the automotive industry during the 2000s, but nowadays it is fair to say that it is at high levels and it doesn't show any sign of slowing down. There is a race between major manufacturers to expand their product range with more green vehicles. This frenzy caught up even with the commercial vehicle manufacturers as they try to implement the newest technology in order to reduce the impact on the environment. Of course, sometimes it is quite difficult to implement these solutions, especially for heavy commercial vehicles which need to maintain their carrying capacity with reasonable operating costs.

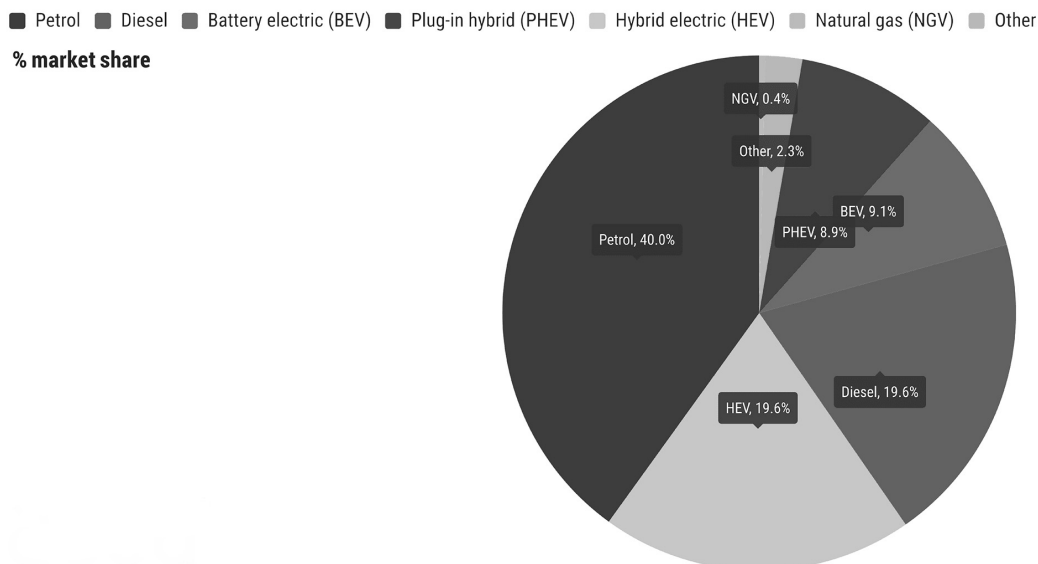
2021 represented the best year, up to date, for the car manufacturers that have electric vehicles in their product range, with China being the global performer in terms of sales growth. The sales doubled in 2021, compared with 2020, totaling almost 7 million electric cars sold worldwide. These sales volumes includes light commercial vehicles and light trucks.

As mentioned before, China recorded the biggest growth, of 155%, compared with the previous year, which in absolute figures translates to 3.4 million cars. Europe came in second, place in terms of volume growth, with almost 70%, which means 2.3 million vehicles. This increase in new car registrations was even more surprising as the semiconductor crisis was affecting the global economy.

More than 700.000 people opted for buying a new electric vehicle in the United States, which is almost double compared with 2020. These figures, although encouraging for the industry, become less optimistic when put into context: due to the second year with the pandemic and the chip crisis, the new car sales grew only by 4% at the global level and only 9% of all cars sold were, in fact, electric vehicles.

The European market, although the second biggest market at the global level in terms of sales growth for electric vehicles, was still a traditional one, in terms of preferences for the fuel used. This means that almost 60% of the Europeans that decided to buy a new car in 2021 opted for a car with an internal combustion engine (ICE), the gasoline powered vehicles had 40% market share, while the diesel ones covered only 19.6%. 2021 was, unfortunately another bad year for the diesel cars as the reduction in sales was of more than 50%, which translates to identical sales volumes with hybrid electric vehicles (HEV).

Figure 1. Car sales by fuel type 2021



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In 2021, the battery electric vehicles' (or BEVs) sales, within the EU market, increased with 63,1%, but way smaller than 2020, which recorded a massive increase of 216,9%. That spike in sales was the result of national governments' programs to stimulate sales of zero or low emission cars which is part of European Union's plan to ban all sales of fossil fueled cars by 2035.

The plug-in hybrid cars sales (PHEVs) recorded the second biggest increase out of all alternatively powered vehicles, of 70,7%, which corresponds to 867,092 vehicles sold in 2021, compared with 2020.

The hybrid electric cars (HEVs) were also in an upward trend in 2021, as 60,5%, or more than 1,9 million Europeans opted to buy such a vehicle and thus gaining a slight advantage compared with the diesel powered cars, which were a more traditional choice for the EU's consumers.

When analyzing the sales volumes by car manufacturer, the figures become a bit surprising, as the world renowned groups do not get the best positions. As such, the biggest increase in 2021, was recorded by Tesla, who sold almost one million cars worldwide. These figures include the Model 3, which was the bestselling EV, and Model Y.

¹ Source: "New car registrations by fuel type, European Union"- The European Automobile Manufacturers' Association

The Volkswagen Group came in second place with almost 800.000 sold vehicles, BEVs and PHEVs combined, the German group having one of the modest increase in volumes, compared with the previous year.

General Motors, who ranked the fourth most successful automotive group in 2021, had a three digit increase in sales of APVs, (mainly BEVs, as there are not that many plug-in hybrids vehicles in their range) of 142%, which stands for just a bit more than 500.000 cars.

For Toyota Motor Corporation, the Japanese automotive group who is the pioneer of hybrid electric vehicles, 2021 was not that successful in terms of sales figures, compared with the other competitors. It turned out that approximately 150.000 consumers decided in favor of the Japanese vehicles, but on a positive note, this was one of the strongest increase of 122%.

Other European automotive groups that made it in top 10 are the BMW Group and Daimler AG which managed a very respectable 7th and 9th place, respectively, as they sold 310.000 vehicles and 280.000 vehicles for the latter, which corresponds to a 66% and 53% increase when compared with the previous year. For both these manufacturers the sales are mainly plug-in hybrids.

The drawbacks of electric vehicles.

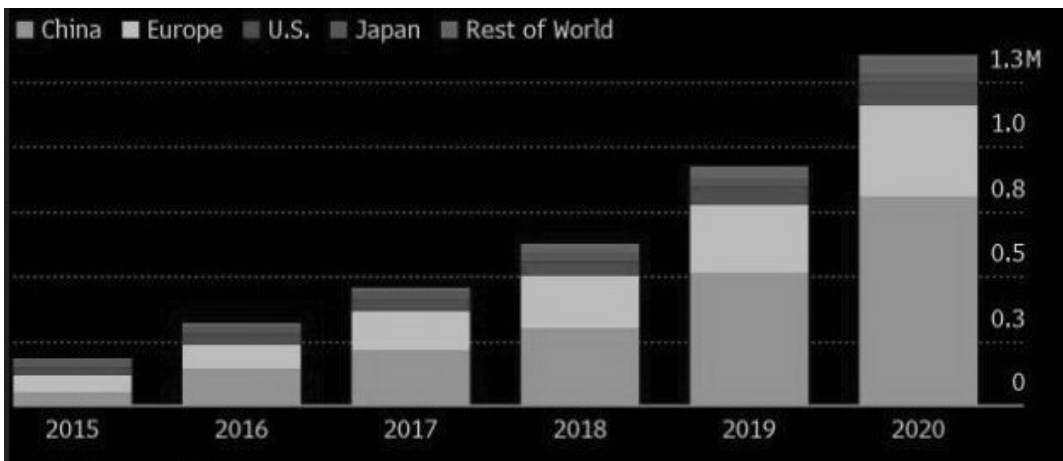
Probably the most noticeable one is the price. All these electric or hybrid vehicles, due to the large amount of built-in technology, do not come cheap. Usually, the BEVs and PHEVs are derived from regular vehicles that use internal combustion engines, so a direct comparison can be made. And the difference in prices is important. For instance in Volkswagen's vehicle range, we can find the Golf model, which is the company's most successful product and the ID3 model, which is the manufacturer's BEV and the electric equivalent of the Golf. The prices, on the German market – Europe's largest car market – for the Golf start at 28.500 euros, while the ID3 has a starting price of 36.960 euros. The difference in prices gets even deeper when comparing prices in other European countries. Romania can be such an example, where the Golf has a base price of 24.337 euros, while the ID3 has a base price of 44.019 euros, which is almost double the price.

Unfortunately, this will only get worse as the electric cars' prices trend is an upward one. Although the technology used mainly in the battery packs used today is the best due to the high demand in EVs and PHEVs and the initial cost penalty for the battery packs (which is regulated globally since the battery packs are more pollutant for the environment and need to be disposed of properly), the costs per kilometer/mile for the end consumer is somewhat similar to the conventional vehicles. Another reason for the increase in prices is the high demand for raw materials, which is so high that the mining capacity is now smaller than the demand. The current semi-conductor crisis is also

another factor of the upward trend in prices and not only for APVs, but for all types of vehicles, the difference being the fact that in the case of the ICE cars, some manufacturers have discovered solutions to surpass this crisis in the form of discontinuing different interior equipment options (like multi-zone climate control, high fidelity multi speaker audio systems and so on). As such, the predictions that the prices of electric cars will go down, do not apply and probably will not apply any time soon.

Another important problem of electric vehicles is the charging infrastructure and the fact that its development does not keep up the pace with the sales. As a result, the governments tend to get involve in creating and extending this infrastructure as a way to reduce the transport's negative impact on the environment. In China, for instance, the government claims that 20 million EVs will be charged from new charging stations until 2025. This objective can be attained by offering direct financial subsidies and more favorable banking policies to companies that build these charging stations. Apparently, China has learnt its lesson from the recent sales volumes, as the government plan is to try to develop the infrastructure with a slightly faster rate compared with the sales.

Figure 2. Charging infrastructure throughout the world



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In Europe, the current situation for the charging infrastructure, is also unbalanced as the EVs and PHEVs sales increased four times faster than the infrastructure did between 2017 and 2021. This is also concerning for a number of reasons, first one being the fact that on a long term this could result in a reduction of sales, negatively affecting the entire

² Hill Joshua S. – China dominates rollout of EV charging stations – 4000 a day in December

market and the developing objectives. The pandemic alone affected the car sales in Europe, but APVs somewhat managed to balance the situation.

Within the United States of America, the charging infrastructure for EVs and PHEVs is even more underdeveloped than in Europe. According to the Department of Energy, in 2021, “there were 47.142 publicly accessible electric vehicle charging stations”³. If we take into consideration that the fact that last year alone, more than 700.000 EVs were sold on the North American market one can easily conclude that this upward trend in sales is not going to be maintained for a long period of time. As such, the solution came from the government, in the form of a \$5 billion investment program that ensures a number of more than 500.000 new charging stations to be built and installed across the United States, within the next five years.

Recent studies have revealed that the construction of EVs and EV related components and sub-assemblies can lead to water shortages across the globe. Producing the semiconductors that are used on a massive scale in electric vehicles requires large amounts of water as in every production stage the components need to be washed thoroughly. For instance, producing one single chip requires approximately 100 liters of water. The biggest chip manufacturer in the world, Taiwan Semiconductor Manufacturing Company, uses 156.000 tons of water every day. If collaborated with the fact that Taiwan produces 70% of the chips used by the automotive manufacturers throughout the world, one can see the potential for natural disaster. The battery packs that EVs and PHEVs use, also uses large amounts of water, but not during the production, as for the lithium extraction. Mining for lithium, which is the main component in the batteries used by the APVs, requires anywhere from 41.000 to 1.9 million liters of water for every ton of extracted ore.

Conclusions

Electric vehicles and plug-in hybrid vehicles have been presented to the global market as the sustainable solution for the future of mobility, but the real-life testing and manufacturing proved otherwise. The best characteristic of cars is the freedom and independence they offer to their owners, as long distance travelling in reasonable time can be achieved without too many obstacles. In the case of BEVs due to insufficient range on one charge, the lack of charging infrastructure and the long periods of time needed to charge the batteries are cancelling that positive trait that has been and still is the ICE vehicle's edge.

Compared with their traditional competitors, BEVs and PHEVs have bigger price tags. Of course, the governmental programs that offer buying incentives sugar-coat this bitter pill, but only by little, as these vehicles still remain out of reach for the average

³ Aaron Gilchrist, Alex Tabet – U.S. to provide \$5 billion to help states build network of EV charging stations

buyer. Furthermore, the technology used for the batteries, unfortunately will not bring important cost reductions in the future, because it is based on rare and highly priced raw materials. Moreover, due to the increased demand of lithium as a result of the upward trend in sales, the prices will continue to rise.

Extracting all the raw materials needed for producing these vehicles is also an important issue that must be taken into consideration when analyzing the electric vehicles' impact. It is a well-known fact that the areas where mining operations have been performed are destroyed from the environmental point of view and it is nearly impossible to recover those areas. Furthermore, the process itself uses a lot of water resources, which can lead to draughts in those respective areas.

Although these innovative transportation methods have a lot of benefits, their shortcomings cannot be easily and cheaply surpassed, especially their negative impact on the environment.

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