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ELECTRIC VEHICLE IMPACTS ON UTILITY AND REGULATORY INTERVENTIONS

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1.ABSTRACT

The electric vehicle market is an increasingly important aspect of the automotive industry. However, as a relatively new technology, several issues remain present within the industry. An analysis is utilized to examine these issues, along with how they affect the industry and how they can be tackled. Several key issues that affect the electric vehicle market, as well as how efforts to address these issues influence the market, are identified. The analysis also includes the examination of ethical issues, with the issues that arise from the production of raw materials for electric vehicles. The analysis and examination of ethical issues display a wide range of problems in the industry. However, it did highlight the efforts being made to lessen the effect of these problems by various groups, such as regulation by EU and US governing bodies on the materials mined. From this analysis, this paper identifies that many of the other factors examined are directly or indirectly influenced by political and economic factors, also examined in this review.

2. INTRODUCTION

The automotive industry has become one of the most important world-wide industries, not only at economic level, but also in terms of research and development. Increasingly, there are more technological elements that are being introduced on the vehicles towards the improvement of both passengers and pedestrians' safety. In addition, there is a greater number of vehicles on the roads, which allows for us to move quickly and comfortably. However, this has led to a dramatic increase in air pollution levels in urban environments (i.e., pollutants, such as PM, nitrogen oxides (NOX), CO, sulfur dioxide (SO2), etc.).

In addition, and according to a report by the European Union, the transport sector is responsible for nearly 28% of the total carbon dioxide (CO2) emissions, while the road transport is accountable for over 70% of the transport sector emissions [1]. Therefore, the authorities of most developed countries are encouraging the use of Electric Vehicles (EVs) to avoid the concentration of air pollutants, CO2, as well as other greenhouse gases. More specifically, they promote sustainable and efficient mobility through different initiatives, mainly through tax incentives, purchase aids, or other special measures, such as free public parking or the free use of motorways.

3. Vehicle Regulations

Vehicle regulations play an essential role in ensuring sufficient availability of electric vehicles. These include direct electric vehicle regulations requiring increased deployment of electric vehicles, and strong vehicle greenhouse gas emissions or vehicle fuel economy standards. In 2020, governments in Europe, China, and North America adopted or began to develop regulations targeting these areas.

For light-duty vehicles, China adopted a policy document in June 2020 to extend its new energy vehicle (NEV) regulation for passenger vehicles from 2020 to 2023.13 Based on the new NEV credit requirements, the electric vehicle share of China's new passenger vehicle sales is likely to at least double between 2020 and 2023, from 5.3% in 2019.14 In July 2020, British Columbia adopted regulation which requires automakers to hit increasing annual levels of electric vehicle sales of 10% of new light-duty vehicle sales by 2025, 30% by 2030, and 100% by 2040, which is the first electric vehicle regulation worldwide mandating a 100% electric vehicle sales share.15

California also began to develop new post-2025 ZEV requirements, with the aim of 100% ZEV share of new light-duty vehicle sales by 2035.

4. Financial Incentives

Financial Incentives Bridge the initial price gap between electric vehicles and ICE vehicles before cost parity with ICE vehicles is achieved. In 2020, governments around the world continued to leverage financial incentives to stimulate electric vehicle uptake.

Several leading European markets of electric vehicles, such as Germany, France, and Italy, increased the values of financial incentives in 2020 as a part of their recovery packages in response to COVID-19.22 In May 2020, France increased the maximum subsidies for purchasing new BEVs from €6,000 to €7,000 and revived the subsidies for purchasing new PHEVs, capped at €2,000. A subsidy of €1,000 was also offered for the purchase of used electric vehicles with a maximum CO2 emission rate of 20 g/km.23 In June 2020, Germany increased the maximum subsidies from €6,000 to €9,000 for purchasing BEVs and from €4,500 and €6,750 for purchasing PHEVs, including a car manufacturer share of €3,000 for BEVs and €2,250 for PHEVs.24 In August 2020, Italy increased the maximum subsidies from €4,000 to €6,000 for purchasing BEVs and from €1,500 to €3,500 for purchasing PHEVs, including a car manufacturer share of €1,000.

5. Existing EV-Related Surveys

In the last decade, there has been a significant progress in several aspects that are related to the production of electric vehicles, and the use of new technologies as well as their sales. Similarly, the research efforts have also increased, which has caused a significant increase of new jobs and proposals that are related to electric vehicles. Within this section, a short compilation of the most relevant topics related to EVs, which have been addressed by previously available works in the literature, are introduced. In addition, the more notable differences with this survey are highlighted.

Some of the studies published to date deal with general aspects, such as the evolution of electrical vehicles throughout history, give diverse classifications according to the manner in which they have been designed and the characteristics of their engines, or analyze their impact on the electrical infrastructure. For instance, Yong et al. review the history of EVs from their creation, in the middle of the nineteenth century, until present. Additionally, they carry out a classification of the vehicles according to their *powertrain settings. Finally, their work analyzes the impact of charging electric vehicles on the electric grid. Likewise, Richardson studies the effects that EVs can produce in the required productivity, efficiency, and capacity of the electric grid. Furthermore, he reviews the economic and environmental impact of electric vehicles. Habib et al. present a review of charging methods for electric vehicles and analyze their impact in the power distribution systems.*

6. Subsidies and Market Position

Despite the fact that the purchase price of electric vehicles is higher, when considering the internal combustion engine edition of the same vehicle model, the EV sales volume has experienced a significant growth, especially in the last years. Additionally, many countries are preparing the mobility transition, discouraging the use of fossil fuel based cars, and stimulating electric mobility. Evidence of this is the fact that, after the Paris Agreement, there has been an increase of the public aids to this kind of vehicles.

In fact, practically all of the governments of the developed countries are continuously applying new support and fostering policies for the use of electric vehicles in order to promote sustainable and environment-friendly mobility. Based on the report from, for instance, Belgium offers 4000 e of purchase aid, and these types of vehicles pay a road tax of only 74 e, instead of the 1900 e that traditional vehicles pay. In France, the users who purchase an EV receive a bonus of between 4000 e and 6000 e in the case of BEVs, and of 3500 e in the case of purchasing a PHEV. A discount between 50% and 100% is also offered in the registration fee. In the United Kingdom, an incentive of a maximum of £4500 will be offered with the purchase of an EV and, if its worth is less than £40,000, the vehicle is exempted of circulation taxes.

In Germany, buyers receive a bonus of 4000 e to purchase a BEV, and of 3000 e in the case of PHEVs. Additionally, BEVs do not pay property taxes, while PHEVs have a reduction of 50%. In the case of Spain, an aid of between 1300 e and 5500 e is offered to purchase BEVs and HEVs, according to their autonomy. In Norway, the property tax for BEVs and PHEVs is of 47 e, while, for petrol-driven cars, such tax varies from 290 e to 340 e. In addition, BEVs do not pay circulation fees or tolls, and they do not pay for parking in the preferred parking areas. Finally, in the USA, the federal government provides $2500 for purchasing electric vehicles and an additional $417 for every kWh of their batteries from 4 kWh, to a maximum of $7500.

7. Charging of Electric Vehicles

Besides the autonomy, another important aspect is the duration and the characteristics of the charging process of the batteries. In order for the EVs to definitely succeed, it will be necessary that the users can charge their vehicles in a fast and simple way. To do so, it will be fundamental to have an infrastructure deployment that allows such fast and simple charge. This implies charging at homes, and the creation of electric charging stations that provide quick charges during long commuting. Below, the different standards or rules that are created for electric vehicles charging technology are presented. In particular, we detail the different charging modes that are defined in the current standards, as well as the connectors.

When charging electric vehicles, we can find different standards, which are determined, mainly, by the region in which they are being used or applied. More specifically, in North America, and in the Pacific zone, the SAE-J1772 standard for loading electric vehicles is used. However, in China, the GB/T 20234 standard is used, whereas, in Europe, the IEC-62196 standard was introduced. The main difference between these three standards is that while the two former ones classify the charging modes according to the power type (DC or AC power), the latter one classifies such modes by the charging power involved.

8. Power Control and Energy Management

The energy management is a critical factor for EVs and PHEVs. Hence, the battery management system (BMS) is a key system that is designed to manage and control the battery unit in this kind of vehicle. More specifically, BMS is responsible for managing the energy that is provided by the batteries with the aim of guaranteeing their safety and reliability. Current BMSs comprise of multiple blocks, such as power delivery unity, sensors, and communication channels, integrated together.

The prime task of BMSs is to manage the power delivery trying to reduce the battery stress due to charges and discharges. BMS is the central controller preventing sudden abruption in current, and thus avoiding high discharge rates.

Cell balancing is also critical for EVs' high-powered battery packs, because a long series of individual cells is only as reliable as the weakest cell. According to this, the

BMS maintains cell balancing by compensating the load of the weaker cell. In particular, it equalizes the charge on all cells in the chain to extend the overall life of the battery pack. In this way, BMS prevents individual cells from becoming overstressed.

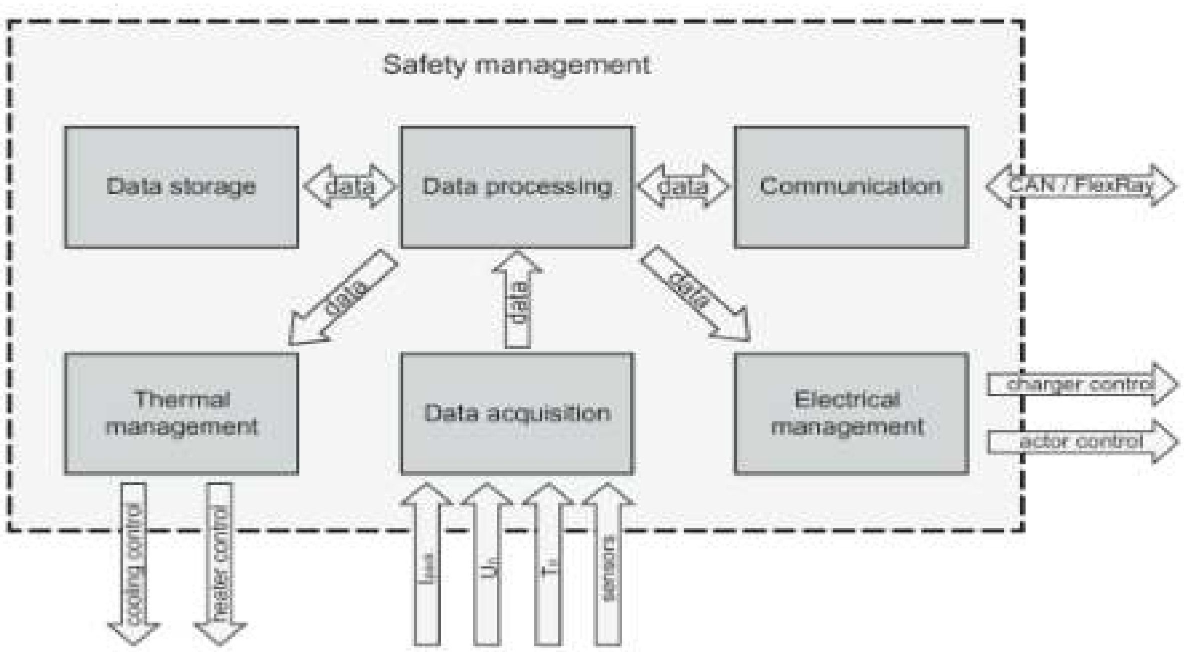

Fig.1 Main components of battery management system

9. Conclusions

In this paper, we analyzed the types of EVs, the technology used, the advantages with respect to the internal combustion engine vehicles, the evolution of sales within the last years, as well as the different charging modes and future technologies. We also detailed the main research challenges and open opportunities. Regarding EVs, batteries are a critical factor, as these will determine the vehicle's autonomy. We analyzed several kinds of batteries, according to these features. We also presented the possible technologies that can be used in the future, such as the graphene, which is expected to be a solution that enables the storage of higher amounts of power, and charge in shorter periods of time. The EV could also benefit from this type of technology, reaching higher ranges, something that could help its adoption by drivers and users.

TOP 10 BIGGEST CAR COMPANIES IN THE WORLD

MOHAMED ANWAR T.A.
20408120
DME

BALAJI R
20408100
DME

VOLKSWAGEN

1. Revenue: $263.6 billion .
2. Year of Foundation: 1937.
3. Based in: Wolfsburg, Lower Saxony, Germany
4. Cars produced last year: ~ 8.9 million .
5. Number of employees (worldwide): ~ 307,000 .
6. Owned Car Brands: VW, Audi, Porsche, Lamborghini, Bentley, Bugatti, SEAT, Skoda, MAN

Volkswagen company
CEO HerbertDiess

TOYOTA

1. Toyota Motor Corporation.
2. Revenue: $258.7 billion.
3. Year of Foundation: 1937.
4. Based in: Toyota, Aichi, Japan .
5. Cars produced last year: ~ 9.5 million.
6. Number of employees (worldwide): ~ 366,000.
7. Owned Car Brands: Toyota, Lexus, Ranz, Daihatsu, Hino.

Toyota company CEO
Akio Toyoda

MERCEDES-BENZ

1. Mercedes-Benz AG.
2. Revenue: $182.5 billion .
3. Year of Foundation: 1926.
4. Based in: Stuttgart, Baden-Wurttemberg.
5. Cars produced last year: ~ 2.8 million.
6. Number of employees: ~ 288,000.
7. Owned Car Brands: Mercedes-Benz, Smart.

Mercedes-Benz

Mercedes benz comprny
CEO - OlaKallenius

FORD

Ford motor company CEO
Jim Farley

1. Ford Motor Company.
2. Revenue: $127.1 billion.
3. Year of Foundation: 1903.
4. Based in: Dearborn, Michigan, USA.
5. Cars produced last year: ~ 4.2 million.
6. Number of employees: ~ 186,000.
7. Owned Car Brands: Ford, Lincoln.

HONDA

HONDA

1. Honda Motor Company.
2. Revenue: $125.2 billion.
3. Year of Foundation: 1948.
4. Based in: Tokyo, Japan.
5. Cars produced last year: ~ 4.4 million.
6. Number of employees: ~ 211,000.
7. Owned Car Brands: Honda, Acura.

Honda company CEO
ToshihiroMibe

GENERAL MOTORS

1. General Motors Company.
2. Revenue: $122.5 billion.
3. Year of Foundation: 1908.
4. Based in: Detroit, Michigan, USA.
5. Cars produced last year: ~ 6.8 million.
6. Number of employees: ~ 155,000.
7. Owned Car Brands: Chevrolet, Cadillac, Buick, GMC.

GENERAL MOTORS

1. Bayerische Motoren Werke AG.
2. Revenue: $117.1 billion.
3. Year of Foundation: 1916.
4. Based in: Munich, Bavaria, Germany.
5. Cars produced last year: ~ 2.3 million.
6. Number of employees: ~ 133,000.
7. Owned Car Brands: BMW, Mini, Rolls

SAIC

1. SAIC Motor Corporation Ltd.
2. Revenue: $107.6 billion.
3. Year of Foundation: 1955.
4. Based in: Shanghai, China.
5. Cars produced last year: ~ 5.6 million.
6. Number of employees: ~ 145,000.
7. Owned Car Brands: SAIC, Maxus, Roewe, Nanjing, MG.

GENERAL MOTORS

1.Stellantis N.V.
2.Revenue: $104.8 billion.
3.Year of Foundation: 2021.
4.Based in: Amsterdam, North Holland,
5.Cars produced last year: ~ 6.2 million.
6.Number of employees: ~ 300,000.
7.Owned Car Brands: Fiat, Chrysler, Peugeot,
8.Stellantis company CEO - Carlos Tavares

HYUNDAI

1. Hyundai Motor Company.
2. Revenue: $93.2 billion.
3. Year of Foundation: 1967.
4. Based in: Seoul, South Korea.
5. Cars produced last year: ~ 4.9 million.
6. Number of employees: ~ 105,000.
7. Owned Car Brands: Hyundai, Kia, Genesis, Ioniq

PUZZLE

RAJA J
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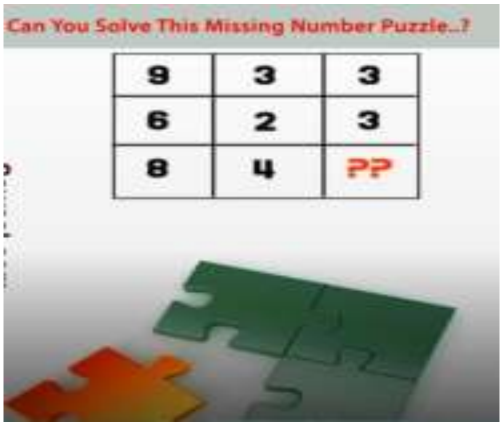

RAJASEKAR C
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A) 3 B) 2

C) 1 D) 0

Answer & Explanation

Answer: B) 2

Explanation:

Here in the given number puzzle, the logic is

column 2 x column 3 = column 1

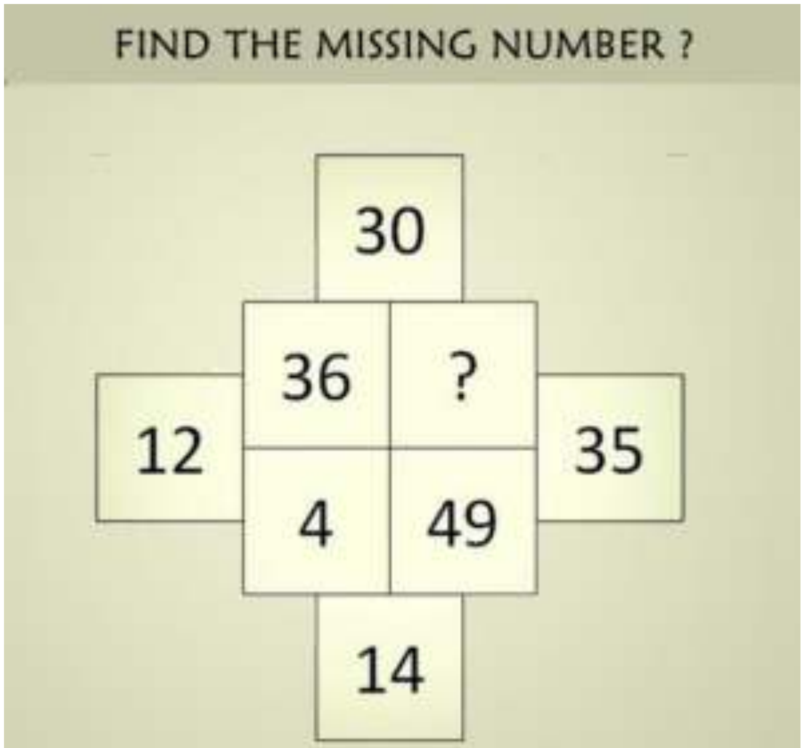
3 x 3 = 9

2 x 3 = 6

Similarly,

4 x ? = 8

=> ? = 8/4 = 2.



$36 = 6^2, 4 = 2^2$

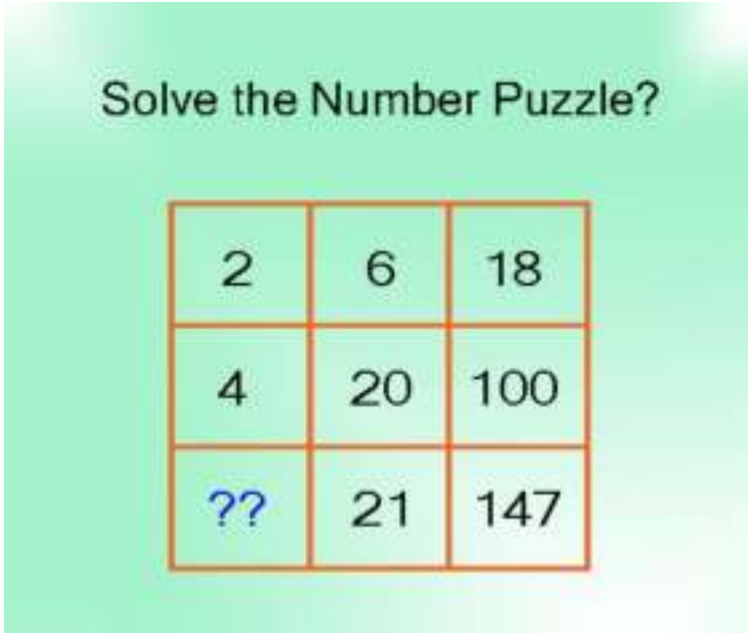
$=> 6x2 = 12$

$7^2 = 49, ? = 5^2$

$=> 7 \times 2 = 14$

$=> 6 \times 5 = 30$

$=> 7 \times 5 = 35$



Explanation:

The given number puzzle can be solved in two ways.

Logic 1 ::

Row 1 *- 2 x 3 = 6 , 6 x 3 = 18*

Row 2 *- 4 x 5 = 20 , 20 x 5 = 100*

Row 3 *- 3 x 7 = 21 , 21 x 7 = 147*

Hence, the missing number could be ***3.***

Logic 2 ::

Row 1 *- 6 x (2+1) = 18*

Row 2 *- 20 x (4+1) = 100*

Row 3 *- 21 x (6+1) = 147*

Hence, the missing number could be ***6.***

Therefore, ***3 or 6*** *is the right answer.*

Scientist study the world as it is,

Engineers create the world that never has been.

- Theodore Van Karmant

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