Recent Developments and Future Scopes of Electrical Vehicles in Power Market on Covid-19 Pandemic situation

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Abstract: - The largest source of climate pollution in the world is transportation. To solve the climate crisis, we need to make the vehicles on our roads as clean as possible. We have only a decade left to change the way we use energy to avoid the worst impacts of climate change. Emissions from cars and trucks are not only bad for our planet; they’re bad for our health. Air pollutants from gasoline- and diesel-powered vehicles cause asthma, bronchitis, cancer, and premature death. The long-term health impacts of localized air pollution last a lifetime, with the effects borne out in asthma attacks, lung damage, and heart conditions. As the COVID-19 pandemic — a respiratory disease — continues to spread, a study by Harvard University found “a striking association between long-term exposure to harmful fine particulate matter and COVID-19 mortality in the United States” One of the primary causes of fine particulate matter pollution (PM2.5) is combustion from gasoline and diesel car engines. So in this paper we are mainly focused on development of Electrical Vehicles and what are problems to implementation in India. We have discussed different types of Government policies and future scope policies which have been taken by government. From this paper researchers will get clear idea of future of Non Pollutant Vehicles. So this paper is very important in Covid-19 pandemic situations because we will safe and secure from these types of pandemic disease only if our environment will be free from air pollution which creates by conventional vehicles.

Keywords: - Environment Effects, Problems of EV, Recent Developments, Problems, Government policies, New technologies development.

1. Introduction
Rapid urbanization coupled with adoption of mechanized transportation modes has resulted in high emissions of Green House Gases that goes on to impact Global warming. The IPCC has warned that world will see catastrophic climate change. India’s per capita emissions are still considered low at 1.9 tonnes (2013) but its total emissions are next to China and the US and is likely to overtake those EU by 2019 and get first position within 2025. Now it is time to save environment to save our green earth. For that reasons EV will plays a vital role to reduced emission of pollutant gases from conventional gases. So lot of developments are going for EV and its charging station that this transportation will become lifeline of our transportation. This paper will be highlighting about this facts and figures of development of “EV”. As While comparing the Indian cities for their emission scores, Delhi is on top as the biggest emitter at over 38.38 million tonnes of carbon dioxide equivalent overall emissions, followed by Greater Mumbai at 22.7 million tonnes and Chennai at 22.1 million tonnes, Kolkata at 14.8million tonnes, Bangalore at 19.8million tonnes, Hyderabad at 13. 7 million tonnes and Ahmadabad at 9million tonnes were the other cities whose emissions for the year were calculated sector wise,[1] As per the statistics of Transport Department (GNCTD), total number of vehicles in Delhi is more than the combined total vehicles in Mumbai, Chennai and Kolkata. Delhi has 85 private cars per 1000 population against the national average of 8 cars per 1000 population. In terms of CO2 emissions due to motor vehicles, Delhi emits about 12.4 million tonnes while the city of Bangalore emits about 8.6 million tonnes. For this statistic it is necessary to switch our transportation to “EV” in every states of India. Now it comes the requirement of proper design of charging station. If charging
station is not available then implementing and replacing of our old polluted transportation will not be changed, it will be changed only pen and paper not physically. Research will be going on and in this paper; we are discussing structural development of EV and new rules and regulations and try to give a new idea, which can be implemented in EV for practical uses.[1,2,3,4,5]

2. Objectives:
- Enable faster adoption of electric vehicles in India by ensuring safe, reliable, accessible, affordable charging infrastructure and reliable eco-system. Due to huge environment pollution, it is very difficult to get rid of this type of pandemic situation (just like as Covid19 pandemic), for that reasons govt has given more focused only on EV. It will develop and growth of Indian economy by generating employment income opportunities for small entrepreneurs.
- To proactively support creation of EV Charging Infrastructure in the initial phase and eventually create market for EV Charging business.
- To encourage preparedness of Electrical Distribution system to adopt EV Charging Infrastructure.

3. Research and Analysis:
Indian Govt has taken lot of policies on EV. After researching we seen that govt has taken lot of policies like
- The Ministry of Power has issued Guidelines and Standards for setting up Charging Infrastructure for Electric Vehicles [Ministry of Power (MoP) Guidelines dated 14.12.2018] for charging infrastructure to be installed at every Public Charging Station (PCS).
- Guidelines and Standards notified by Ministry of Power, dated 14 December 2018 for "Charging Infrastructure for EVs" (at Annexure II),
- Guidelines issued by Ministry of Power (MOP) in Model BBL-2016
So in this paper we are analysis of govt policies and generate new real time some methodology, if We implement in society, a new revolution will be come on EV. [6,7,8,9]

4. Electrical vehicle Supply Equipment (EVSE):
An EVSE is a wall mounted box that supplies electric energy for recharging of EV batteries. Also EVSE have a safety lock-out feature that does not allow current to flow from the device until the plug is physically inserted into the car. EVSEs can be customized with added features like authentication, integrated payment gateways, software for remote monitoring. As electric vehicle charging technology continues to advance, several standards and guidelines have become widely accepted across the industry. This section paper gives a brief overview of charging infrastructure technology, standards, and terminology in modern years. This research is totally based on Indian EV market.

II (Research and Analysis of EV policies)

5. Research of Different types of EV:
Our country has given more focused in EV. If research will stay only pen and paper that never be improved our society/country. For that reasons what we have seen that we have to more focus on Charging of EV. Nowadays our automobile sector invest huge capitals their business in EV (Tata, Mahindra, Toyota, Hero, Honda, Hyundai etc). Union Road Transport Minister Nitin Gadkari (Webinar :-“India’s Electric Vehicle Roadmap Post COVID-19”, 15-16th June) stated that India will be a manufacturing hub for electric vehicles within the next five years, adding that several countries do not want to deal with China after the COVID-19 crisis which can be an
opportunity for India. The minister addressed to Indian automotive companies to boost their electric vehicle technology and also to focus on finding alternatives to lithium-ion battery tech to help make India the next global manufacturing hub for electric vehicles because China is the top in terms of electric vehicle production in the world with it producing over 80 percent of all EVs globally. The country has the fourth largest reserves of lithium in the world hence giving it a monopoly in the lithium-ion cell market. Lithium-ion battery packs are currently used the most for powering from small electric two-wheelers to electric commercial vehicles. So Govt has taken a policies of EV National Electric Mobility Mission Plan 2020 (2013 taken), National Energy Security Plan, Parish Agreement etc by targeting year 2030. We know that this a new Concept, so we have tried to do integrated and collaborative research with different agencies which reflects in this paper.[10,11,12,13,14]

6. Electric Vehicles in Indian Market:-

The automobile industry and Indian car manufacturers are working on Make in India mission of electric Vehicles under the National Electric Mobility Mission Plan by GOI. EV industry in India will produce more number of bikes, electric cars and electric three-wheelers over the next two decades. According to NEMM plan India is much more focused on hybrid and EV in country with an aim to reduced fuel consumption, pollution of Environment. Automobile sector as well as environment can be survived if focused only on EV. Some companies are already started their business on EV, just like

6.1 Tata Electric:-

Tata Motors launched Hybrid and electric Star bus from manufacturing facility in Pune under its zero emission mass transport solution. Tata offers a wide range of electric vehicles and contributing to the electric vehicle industry in India with Tata Tigor electric car, Ultra Electric bus, Star bus Hybrid Electric Buses for cleaner and greener public transportation.

6.2 Mahindra Electric:-

Mahindra Electric Mobility Limited is based in Bangalore, sells electric vehicles in the segments of passenger and cargo as well as into the manufacturing of compact electric vehicles.

Earlier Reva electric company was acquired by Mahindra & Mahindra and today the company has launched Mahindra e2o, electric hatchback e2oPlus, eVerito sedan, commercial electric e-Supro and upcoming electric version of the KUV100.

6.3 Ashok Leyland Electric:-
Ashok Leyland is one of the largest bus manufacturer in the world and market leader of trucks in India. The company has already launched fully electric bus called Circuit in India, advanced non-plug-in version of HYBUS, Electric Euro 6 Truck and announced iBUS.

6.4 Olectra – BYD Green E-Bus:-
Olectra Greentech is one of the market leaders of manufacturing electric buses, designed with BYD for Indian roads. The electric bus manufacturer BYD venture with Olectra has introduces electric buses in Hyderabad, Pune, Telangana and Delhi plus continue to electrify Indian E-BUS market.

6.5 Ola Electric:-
Ola has launched multimodal electric vehicle project in Nagpur under the Mission Electric and also running electric public transport vehicles in India. The home-grown company is also plans for launching 10,000 e rickshaws in India as well as invest in setting up charging stations of electric vehicles in major Indian cities.

6.6 KONA Electric:-
Kona Electric vehicle by Hyundai is India’s first fully electric SUV priced at 25.3 lakh (ex-showroom, India). The SUV is loaded with Android Smartphone connectivity, Google navigation system and USB entertainment features along with wireless phone charging. Hyundai is not only offering power packed driving experience of KONA Electric SUV but also planning to install EV charging facilities in India by Partnering with IOCL at fuel stations.

6.7 Hero Electric:-
Hero Electric is the biggest manufacturer of electric scooters in India with a vision of providing electric mobility to nation. The market leader of the Indian Electric industry in Two Wheeler segment, offering wide range of electric vehicles to Indian such as Photon, flash la, optima and hero electric nyx.

6.8 Emflux Motors:-
producing high performance electric motorcycle named as Emflux One, The superbike hasn’t launched yet in the country but expected to launching in India around December 2019.

6.9 Okinawa Electric :-
Okinawa Auto-tech is a popular Indian electric two wheeler manufacturing company with an aim of contributing absolutely zero emission to the green society and new technologies in Indian automobile industry

6.10Menza Motors
A Menza motor is an electric automobile company based in Ahmadabad city has launched its first electric motorcycle, the Lucat in India.

6.11 Lohia Auto
Lohia Auto is one of the leading e-rickshaw companies in India along with Mahindra, TVS, Bajaj and Atul Auto. Electric Rickshaw has become very popular In India .There are other companies also launching e-scooters and electric bikes in India such as Another Energy, Okinawa Electric, Atom Electric, Emflux Electric, 22 KYMCO iFlow, YOBykes, TVS Electric and Menza Motors ,turers are Bajaj E Rickshaw, Mahindra electric e-Alfa Mini rickshaw etc.[15,16,17,18,19]

7. Upcoming Electric Cars in India
Electric cars are becoming more popular in India with energy stored in rechargeable batteries as well as plug in electric variety of charging stations. Nissan Leaf and Tesla are the top two best selling electric car in the world, here is the list of upcoming electric cars in India.

- Tata Altroz EV
- Mahindra eKUV100
- Maruti Suzuki WagonR EV
- Nissan Leaf EV
- MG eZS
- Tesla Model S
- Audi e-Tron
- Ford Aspire EV

But EV will be popular among the peoples only when proper EV charging system will be established everywhere of country where it is required just like liquid fuel filling stations. So now our research will be focused on EVEC.

III-(Research on:-Electric Vehicle Supply Equipment (EVSE))

8. The main requirement of develop and practical implementation and popular of EV, we have to main focused on Charging station and battery chargers. In this paper we have to focus on charging station. After research we seen that maximum EV used in 3W, which are charged by private home based slow charges which creates uneconomical to owners.

8.1 Charging speeds-
Charging power, which determines the time required to charge a vehicle, Can vary by orders of magnitude across charge points, as shown in the table 1.
A small household outlet may charge as slowly as 1.2 kW, while the most advanced rapid charging stations can charge at up to 350 kW. Charging infrastructure is broadly broken into three categories based on speed: Level 1, Level 2, and direct current (DC) fast charging (sometimes referred to as Level 3). *(Source: "Emerging Best Practices for Electric Vehicle Charging Infrastructure", Oct' 2017)*

| Charging Process | Private Charging | Public Charging | DC "Fast" Charging | IOT based Auto charger |
|------------------|-----------------|-----------------|-------------------|------------------------|
| Charging batteries of privately owned cars through domestic charging points. Billing is mostly part of home/domestic metering | AC "Slow" Charging: The home private chargers are generally used with 230V/15A single phase plug which can deliver a maximum of up to about 2.5KW of power. The EVSE supplies AC current to the vehicle's onboard charger which in turn converts the AC power to DC allowing the battery to be charged. | For charging outside the home premises, electric power needs to be billed and payment needs to be collected | DC current is sent to the electric car's battery directly via the charge port. FC chargers (usually 50 KW or more) can supply 100 or more kilometres of range per hour of charging | Highly economic, reliable, secure and fast charger(Solar Power) | Any where ( still in research ) |
8.2(b) EVs charging "modes" and 'availability' 

| Vehicles Type     | Slow charging(Private) | Fast charging | Public Charger |
|-------------------|------------------------|---------------|----------------|
| 2 Wheelers(2W)    | Y                      | N             | Yes/Limited    |
| 3Wheelers(3W)     | Y                      | N             | Yes/Limited    |
| PVs(Cars)         | Y                      | Y             | Yes            |
| PVs(Buses)        | N                      | Y             | Yes            |

8.3(c) charging options for EV types (by ownership)

| Vehicles Type     | Private CS | Public CS | Place of Charging                  |
|-------------------|------------|-----------|------------------------------------|
| 2 Wheelers(2W)    | SC/BS      | SC        | Public CS Predominant place of charging |
| 3Wheelers(3W)     | SC/BS      | SC        | Point of residence / Work          |
| PVs(Cars)         | SC/BS      | FC        | Residence/ Point of work/ other public places |
| PVs(Buses)        | x          | FC/BS     | Bus Terminals/Depots               |

9. Govt initiatives on EVCS:-

Policies development for Public charging Infrastructure (PCI) for long distance

After research some policies can be implemented

Public charging stations for long distance EVs and/or heavy duty Evs (Like trucks, busses etc) shall have the following minimum requirements:-

- At least two chargers of minimum 100 KW (with 200-1000 V) charging infrastructure required in every EVCS.
- Onboard charging of Fluid Cooled Batteries
- Swapping facilities for batteries should be there
- FCS also implemented in every liquid fuel filling station.

9.1 Location of Public Charging stations

- At least one charging Station should be available in a grid 3KM X 3 KM.
- One fast charging station is set up at every 25Km on both sides of highways roads.
- Priority should be given existing in retails outlets(ROs) of Oil Marketing companies(OMCs) for Fast Charging station
- New entrepreneur should be given preference for LFCSEV

9.2 Maintained Data base

- Central Electricity Authority (CEA) shall create and maintain a national online database of all the public Charging Stations through DISCOMs.
- Big data and cloud computing should be implemented for proper monitoring for security purposes.

9.3 Tariff for supply of electricity to EV Public Charging Stations:

- The tariff for supply of electricity to EV Public Charging Station shall be determined by the appropriate commission, provided however that the tariff shall not be more than the average cost of supply plus 15 (fifteen) percent.
The tariff applicable for domestic consumption shall be applicable for domestic charging [20,21]

9.4 Priority for Roll out of EV Public Charging Infrastructure

After extensive research and consultations with State Governments and different Department/Agencies of Central government, phasing as follows are laid down as national priority for rollout of EV Public Charging Infrastructure:

Phase I (1-3 Years):

- All Mega Cities with population of 4 million plus as per census 2011, all existing expressways connected to these Mega Cities & important Highways connected with each of these Mega Cities shall be taken up for coverage.

Phase II (3-5 Years):

- Big cities like State Capitals, UT headquarters shall be covered for distributed and demonstrative effect. Further, important Highways connected with each of these Mega Cities shall be taken up for coverage.

- The above priorities for phasing of rollout shall be kept in mind by all concerned, including, different agencies of Central/State Governments while framing of further policies/guidelines for Public Charging Infrastructure of EVs, including for declaring further incentives/subsidies for such infrastructure and for such other purposes.

9.5 List of Corridors where govt has taken initiatives for fast charging

- Mumbai –Pune Express, Ahmedabad–Vadodara Expressway, Delhi–Agra Yamuna Expressway, Delhi–Jaipur, Bengaluru–Mysore, Bengaluru–Chennai, Surat–Mumbai Expressway, Eastern Peripheral Expressway, Delhi–Agra NH2 expressway. 5 connected highways to each megacity

Megacities are

Mumbai, Delhi, Bangalore, Hyderabad, Ahmadabad, Chennai, Kolkata, Surat, Pune

10. An Overview of EV progress in West Bengal:-

i) West Bengal CM Mamata Banerjee has said the state government has been emphasising on e-buses to protect the environment and reduce air pollution. West Bengal Chief Minister Mamata Banerjee has said the state government has been emphasising on electric buses (E-Buses) and ferries as modes of transportation to protect the environment and reduce air pollution. The West Bengal Transport Corporation (WBTC) has recently introduced a fleet of e-buses to connect the city to its suburbs and the department has plans to have as many as 5,000 e-buses by 2030, an official said.

ii) These buses would help in bringing down the per annum carbon dioxide emissions by 7,82,560 tonnes. In September, it was reported that the West Bengal State Electricity Distribution Company (WBSEDCL) had forwarded a proposal to the Ministry of Power for setting up of 241 electric vehicles (EV) charging stations in West Bengal at an upfront installation cost of Rs 125 crore. According to the proposal, nearly half of these charging stations (116) will come up in the state and national highways at a distance of around 25 km each.

iii) In August, we reported that the West Bengal Urban Development Ministry is planning to introduce a new policy for electric vehicle (EV) charging stations in the state. And that the state government is also planning to introduce 500 electric buses under the second phase of the FAME (Faster Adoption and Manufacturing of Hybrid & Electric Vehicles in India) scheme.

IV (Data Analysis)
11. A research statistics are given below how maximum states are changing their policies in transportation by adopting EV plan.

11.1: Commissions of purchasing EV in India

| Name of Cities | Purchase of EV (EV Buses) (Tentative) | Plan Name | Commission completion | Investment (cores) (Tentative) |
|----------------|--------------------------------------|-----------|-----------------------|-------------------------------|
| Delhi          | 1000                                 | FAME      | 2016-2022-2025         | 300                           |
| Mumbai         | 10000                                | FAME      | 2016-2022-2025         | 500                           |
| Kolkata        | 5000                                 | FAME      | 2016-2022-2030         | 350                           |
| Chennai        | 5500                                 | FAME      | 2016-2022-2030         | 400                           |
| Pune           | 200                                  | FAME      | 2016-2022-2025         | 120                           |
| Ahmedabad      | 1500                                 | FAME      | 2016-2022-2025         | 250                           |
| Surat          | 500                                  | FAME      | 2016-2022-2025         | 200                           |

11.2: World markets EV scenarios

| Country | % of EV of total Vehicles (2020) | % of EV of total Vehicles (2025) | Investment (trillion) | Future Growth (Investment of Total Finance) |
|---------|---------------------------------|---------------------------------|-----------------------|--------------------------------------------|
| USA     | 2.1                             | 10.5                            | 4                     | 75%                                        |
| UK      | 2.5                             | 11.2                            | 5                     | 65%                                        |
| China   | 4.4                             | 12                              | 2                     | 85%                                        |
| India   | 1.2                             | 15                              | 1.7                   | 74%                                        |

11.3 World Market EV senario

![World Market EV Senario]

11.4: Distribution Chart of Hybrid and Electrical Vehicals in India.
11.5: Chart of EV Sales in India (Tentive)

**EV Sales in India (Tentive)**

| Year | Number of Vehicles (Thousand) |
|------|------------------------------|
| 1    | 0.4                          |
| 2    | 0.9                          |
| 3    | 0.6                          |
| 4    | 1.1                          |
| 5    | 2                            |
| 6    | 3.1                          |
| 7    | 3.9                          |
| 8    | 4.5                          |
| 9    | 5.5                          |

BEV: Battery electric vehicles; PHEV: Plug-in hybrid vehicles

Source: 2017, Global Electric Vehicles Outlook, International Energy Agency (IEA)

11.6 Global Growth of EV
V Future Aspects

12. Scopes (Advantages):-

- Electric Vehicles are around 3-5 times more efficient than internal combustion Vehicles in utilising energy.
- Electric Vehicles save energy by regenerative braking. Around 30-70% of the energy used for propulsion can be recovered with higher percentages applicable to stop and go city driving.
- Air qualities of different megacities are no longer healthy due automobile related pollution and it also creates green house gas effects also. Solution is only replacement of automobile industry by EV because EV run on electricity produced from non-polluting sources of energy like hydro, solar, wind, tidal and nuclear; they reduce emissions due to vehicles almost zero.
- The need to be independent off a fossil-fuel based economy. India import crude oil imports for 2014-15 was 112 billion dollars (Approximately 7, 00,000 cores rupees and 2017-18 is 48, 00,000 core rupees. So India can become a global provider for clean mobility solutions and processes that are affordable and scalable that is EV Industry.
- EV reduces noise pollution which is a nuisance in metro cities.
- Through smart charging, EV can help to balance the balance supply variations in the electricity grid and provide a buffer against electricity supply failures.
- Electric vehicles have much fewer moving parts as compared to vehicles with IC engines. Thus being simpler, they are cheaper and easier to maintain.
- Electric motors can deliver high torque at low speeds. As a result; electric vehicles deliver much better performance while starting Off and on slopes than IC engine-power vehicles.
- Huge business can be established in Electric Vehicles, Hybrid Vehicles in Automobile Industry thus increasing our GDP.

13. Limitations:-

Switching to our automobile industry in clean, clear, green industry is today’s first priority to survive and save green environment, green earth, and its creatures. Only solution to switchover Electrical Vehicles Industry but some problems are still remaining.

- Lack of Charging Infrastructure:-The charging infrastructure for electric vehicles in India has not been fully developed. So practical implementation is essential otherwise our dream will be only dream to save our earth from pollutions.
- Cost: - The cost of EVs is very high mainly due to the cost of Li-ion cells. The battery packs are imported and a cost a lot, about $275/KWh in India. Then GST 28% is applicable which increases cost of batteries. So lot of research is required in battery efficiency and FSEV. Most of EV (4W) cost between Rs 6-50 lakhs(depends of company, facilities), 3W(0.6 -2.5 lakhs). So Govt needs to take some action plan just like solar industries to reduce this cost.
- Lack of renewable energy and grid infrastructure: - In India electricity is mainly produced by burning coal, which produces a great amount of greenhouse emissions. With the introduction of EVs and charging infrastructure, the electricity demand will go up a lot and the whole point of introducing EVs to reduce GHG emissions would be ineffective, if all this electricity was produced by burning coal. Moreover, India’s Distribution companies hold debts and are unable to suffice the energy requirement of the whole country adequately. If EVs were to enter this equation, the sudden increase in electricity requirement would put extra load on these companies. Moreover, there are a lot of factors that would go into deciding pricing of the electricity as well the demand on the EV.[21-28]
14. Conclusion

To develop EV industries in India proper planning is require with practical implementation with in target year. So we can concluded here by highlighting government initiatives

The Indian government is gunning for its goal of making 30% of Indian vehicles electric by 2030. The steps taken in 2019 to promote electric vehicles in the country include: Special policy measures such as slashing GST on EVs to 5% versus 28% for combustion engine.

➢ The Indian government has set ambitious targets to accelerate the adoption of electric vehicles (EVs). By 2023, it wants all three-wheelers to run on batteries. By 2025, the rule will be applicable to most two-wheelers.

➢ Overall, India's transition to electric mobility is not only about fighting air pollution and reducing our dependence on import-dependent fossil fuel, it's also about augmenting jobs, growing the economy, creating the necessary infrastructure for supporting ICE and BS VI and retaining a competitive global advantage

➢ In the report, BNEF outlines that electric vehicles (EVs) will hit 10% of global passenger vehicle sales in 2025, with that number rising to 28% in 2030 and 58% in 2040. According to the study, EVs currently make up 3% of global car sales.

➢ Even if your city is using a lot of dirty energy, EVs are MUCH more efficient than gasoline powered vehicles. So, even if you EV is charged with coal, the overall net emissions will be lower because the EV motors are more efficient.[25-28]

VI. References & Acknowledgement

15. References:-

1. Amendments in Model Building Bye-Laws (MBBL - 2016) for Electric Vehicle Charging Infrastructure
2. https://en.wikipedia.org/
3. EV policies of West Bengal Govenernents-Review
4. www.google.com/growth of Electric Vehicals.
5. Review reports of automobile industries
6. "Technologies of Broad Benefit: Power". Retrieved 6 September 2018.
7. "Soviet Union Lunar Rovers". Retrieved 6 September 2018.
8. "Oceanvolt – Complete Electric Motor Systems". Oceanvolt.
9. Stensvold, Tore. "Lønnsomt å bytte ut 70 prosent av fergene med batteri- eller hybridferger" Teknisk Ukeblad, 14. august 2015.
10. "S-80: A Sub, for Spain, to Sail Out on the Main". Defense Industry Daily. 15 December 2008.
11. "Contributions to Deep Space 1". 14 April 2015.
12. Ronald J. Cybulski, Daniel M. Shellhammer, Robert R. LoveII, Edward J. Domino, and Joseph T. Kotnik, Results from SERT I ion rocket flight test, NASA Technical Note D2718 (1965).
13. "CleanTechnica". CleanTechnica.
14. "CNBC World record". CNBC World record.
15. "Motor 1 News". Motor 1 News.
16. "Blick Swiss record". Blick Swiss record.
17. "All-Electric Vehicles". www.fueleconomy.gov. Retrieved 19 January 2020.
18. "GreenFacts summary of the IARC Evaluation of Static and Extremely Low-Frequency (ELFs) Electric and Magnetic Fields". Greenfacts.org. 19 December 2010. Retrieved 26 December 2010.

19. Jump up to: a b Liasi, Sahand Ghaseminejad, and Masoud Aliakbar Golkar. "Electric vehicles connection to microgrid effects on peak demand with and without demand response." In Electrical Engineering (ICEE), 2017 Iranian Conference on, pp. 1272–1277. IEEE, 2017.

20. "PNNL: Newsroom – Mileage from megawatts: Study finds enough electric capacity to "fill up" plug-in vehicles across much of the nation". Pnl.gov. 11 December 2006. Retrieved 26 December 2010.

21. Dower, Gordon (2012). "US Patent: Docking bay for conditionally supplying battery recharging energy to a vehicle utilizing non plug-in electrical contact between a pair of docking bay contacts and a pair of vehicle contacts".

22. Dallas Kachan (20 January 2010). "'Disaster' scenarios for electric cars". Cleantech Group. Archived from the original on 23 January 2010. Retrieved 9 March 2010.

23. Hubbard, Nate (18 September 2009). "Electric (Car) Company". Wytheville News. Archived from the original on 11 January 2013. Retrieved 19 September 2009.

24. Jim Motavalli (26 February 2010). "Evatran Hoping To Cash in on Plug-Free Electric Cars". CBS Interactive Inc. (bnet.com). Retrieved 9 March 2010.

25. "London charges ahead with wireless electric vehicle technology". Source London, Transport for London. 10 November 2011. Archived from the original on 11 January 2013. Retrieved 11 November 2011.

26. "First Electric Vehicle Wireless Charging Trial Announced for London". Qualcomm Incorporated. 10 November 2011. Retrieved 11 November 2011.

27. Kintner-Meyer, M.; Schneider, K.; Pratt, R. (November 2007). "Impacts Assessment of Plug-in Hybrid Vehicles on Electric Utilities and Regional U.S. Power Grids Part 1: Technical Analysis". Pacific Northwest National Laboratory: 21–24. CiteSeerX 10.1.1.105.663.

28. "The Future of Gas Stations, Electric Battery Swap Station". Retrieved 12 February 2010 – via YouTube.

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