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## How to Plan and Strategically Manage an Electric Vehicle (EV) Charging Station

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*Strictly as per the compliance and regulations of:*



# How to Plan and Strategically Manage an Electric Vehicle (EV) Charging Station

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**Abstract-** The struggle to replace fossil fuel with clean bioenergy has come to an end. The possibility of electric batteries opens a new era for the transportation sector. This revolution is causing a great impact on the automobile sector by replacing fossil fuel with hybrid batteries. As such, there is a huge marketing potential for electric vehicle (EV) charging stations as the popularity of electric vehicles continues to grow. Aside from the potential revenue of owning one, planning and strategic management plays an important part. This research attempts to prove the flexibility of owning and managing an electric vehicle charging station, as with the current pace of the technology revolution it is believed to be a potential major field and a worthy investment.

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## I. INTRODUCTION

With the over exploitation of fossil fuel energy in the automobile sector, avoiding the exhaustion of this resource, substitution energy must be found. With the assistance of today's scientific advancement, out of all the possible energy resources the use of electric energy was proven to stand out more from the point of stability and reliability. The use of electricity as a substitute for fossil fuel unbolts a new era for the automobile sector. Since hybrid batteries were introduced, the numbers of plug-in hybrid or battery electric vehicles began to increase drastically. Henceforward, a number of electric vehicles (EV) charging stations must be a growing need.

## II. TYPES AND LEVELS IN ELECTRIC VEHICLE CHARGING

There are two types and three different levels of electric vehicle charging stations (Saxton, 2011). Both alternating current (AC) and direct current (DC) carries the same purpose in charging electric vehicles, however the differences between them is the amount of current it delivers which directly affects the duration of electric vehicle charging (Evsolutions.avinc.com, 2012). The level 1 and level 2 electric vehicle charging methods are AC charging. Level 1 charging involves plugging the car into a normal household socket in order for the car to

recharge (Doom, 2013). Since it only carries 120volts, the expected duration is 8-9 charging hours. The level 2 charging is the most common found in most EV charging stations. It carries 240volts, which is capable of recharging an electric vehicle from flat to full in almost 5hours (Doom, 2013). As for level 3, also known as DC Fast Charging or "fast charging", it carries 480volt which makes them the fastest type of charging the market currently offers. Since the level 3 is capable of carrying a huge amount of energy, it significantly shortens the length of charging time to a mere 30min (Saxton, 2011). Besides that, it benefits industries with machinery in the big batteries segment such as airplanes, busses and other heavy industrial machinery (Saxton, 2011). The level 3 charging stations were meant to be set up in public charging infrastructures with the intention of minimizing the possibility of stations breaking down (Teslamotors.com, 2009). It stands to reason that in order to shorten the duration of charging these electric vehicles, adopting the level 3 DC fast charging stations were the best course of action.

## III. POSSIBLE SOURCE OF ENERGY TO POWERS THE ELECTRIC CHARGING STATIONS

There are many ways to generate electric energy and it varies according to the national policies as well as geographical and strategic location of each country. The methods available to us via modern technology are electrical generation through burning coal, oil and gas, adapting the energy of hydro, thermal and solar, gathering the movements of winds and tides and etc. By categorizing them into two segments, the electric vehicle charging station sources their energy based on how their countries generate electricity (Breslin, 2011). In order to fully fulfill its purpose as an EV charging station and that of the creation of the electrical vehicle, both fossil fuel and renewable energy sources were obtained from their countries power supplies. Since the era of clean, renewable energy plays an important role in the economy and the future of the US, studies regarding the application and the potential of the solar charging are being heavily supported and funded by the coalition of government sectors - Office of Energy Independence, Department of Energy, UI Facilities Management, UI Office of Sustainability, and UI Parking & Transportation. Research conducted by the Electric Power Research

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Institute (EPRI), shows that with constructed solar photovoltaic (PV) on the electric charging station, these solar boards are able to collect solar waves, which is predicted to GATHER an expected 70,000 kilowatts of solar energy annually. To put things into perspective, 70,000 kilowatts of solar energy is capable of reducing the usage of 15,686 gallons of fossil fuel. If these solar regeneration systems could be integrated into future solar EV charging stations, as well as being paired with greater battery capacity storage and a more advanced energy monitoring technology, the solar powered electric vehicle charging stations could potentially bring about the practical reality of using sustainable energy in our vehicles (Facilities.uiowa.edu, 2011). Researchers have predicted that by installing solar boards, improving the storage capacities of batteries and the introduction of more efficient energy monitoring systems on current electric vehicle charging stations, not only will we be able to power more electrical vehicles and machinery, we might also be capable of powering entire households as well as other essentials like lamp posts along the streets, without burdening the resident and the government.

#### IV. STRATEGICALLY TACKLE THE MARKET WITH THE INCREASING NUMBER OF ELECTRIC VEHICLES

In the United States of America (US), massive demand exists in the current electric vehicle market (AFDC. energy. Gov, 2013). According to the data provided by the Department of Energy United State of America, comparing the year 2011 and 2012, the demand for electric vehicle spiked from 17,735 to 52,835. During that period of time, car manufacturers such as Fisker, Ford, Chevrolet, Nissan and Tesla were the major electric car suppliers in the US market (Department of Energy United States of America, 2015). Hence, among all the company that produces EV charging stations, Charge Point is the world's biggest largest. It has won major awards such as "Global Cleantech 100" and Future Mobility Company of the Year", "CNBC's Disruptor 50 List" and "Sustania100" (Morton, 2013). With the increasing demand for electric vehicles, the EV charging infrastructures must keep up with the pace. (CLERCQ, 2014) In May 2013, the number of these charging stations reached 20 thousand throughout the US (Department of Energy United States of America, 2015). Spreading across the cities of the US, the number of usages of charging stations per day was recorded at a whopping number of 12 thousand daily (Lantero, 2014). Charging stations along some pathways and parking bays are easily spotted in the east of America (Kehoe, 2015). With the application of the level 2 AC charges in these infrastructures, people were encouraged to purchase electric cars due to the lower cost and the wide availability of charging stations.

Since these charging stations are powered by electricity, the cost of building one is lower compared to that of fossil fuel stations (Environmental Management & Sustainable Development News, 2014). Of course, the electricity powering these charging station depend on how each individual country generates their national electricity supply such as through solar power, wind power, nuclear power and etc. (Institute, 2014).

#### V. THE ADVANTAGES OF OWNING AND MANAGING AN ELECTRIC CHARGING STATION

The decision to select networked or non-networked electric vehicle charging stations is the most common problem faced by managers (Gibbs, 2013). A charging station with network requires internet which enables managers to manage their own charging station through a web based portal more effectively and efficiently (Kehoe, 2015). On the other hand, a non-networked charging station doesn't offer any management tools; it simply carries out the task of transferring huge amounts of electricity to electric vehicles without any additional access or control of the station (Millàn, 2011). Besides the electric vehicle segments, electric vehicle charging stations are also benefiting the built-in hybrid vehicle industry. With the difference in characteristics between both hybrid electric vehicles (HEV) and plug-in hybrid electric vehicle (PHEV), the plug-in hybrid electric vehicle (PHEV) requires a charging station to increase its performance from the regenerative braking system and because the internal combustion engine is not designed to charge the PHEV's battery to its maximum capacity (In.gov, 2015). Judging from the grade of energy consumption between both electric vehicles (EV) and plug-in hybrid electric vehicle (PHEV), the electric vehicle (EV) charging station's market was predicted to be profitable due to less management being required to run it and it generates passive income with each usage of these charging stations by EV and PHEV drivers.

#### VI. PROS AND CONS OF A NETWORKED AND NON-NETWORKED CHARGING STATION

A comparison between the advantages and disadvantages of both networked and non-networked charging stations are being evaluated according to their capabilities in generating the wattage needed and for observing the information and condition of each charging station (Raleigh, NC. Gov, 2015). There are tons of benefits in fitting the EV charging station with networks. With the ability for a charging station to go online, owners are able to receive prompt information regarding the current status of the charging station through a networked gadget. With these controls and the ability to remotely monitor the charging station's

system functionality, it simplifies the process of management. Besides that, a networked charging station is bundled with software advancement upgrades which can be conducted online and provides the facilities to easily charge each consumer by automatically calculating the amount of energy transferred into their electric vehicle or plug-in hybrids. Accompanied with certain mobile applications, a networked charging station can gain visibility on the digital map, which allows electric vehicle owners to detect the availability of charging station's in their area and to make electric vehicle charging reservations (Morton, 2013). In contrast, the non-networked charging stations require more on-site, manual processes in order to run smoothly. Non-networked stations do not come with any convenient management tool which includes the privilege of obtaining software updates for the station's facilities (Lilypadev.com, 2015). Besides that, it does not notify the station managers about the functionality conditions of the station; since it does not have the software that is in charge of dealing with transactions that are found in networked stations, meaning that the manager's actions are bound to be constricted by the collection of income after each EV is fully charged (Moloughney, 2014).

## VII. DISCUSSION

With the increasing population of humankind and the continuing deterioration of our environment, more and more environmentally friendly vehicles are required in order to meet society's demand for transportation. The era of fossil fuel transportation vehicles as well as society's general dependency on fossil fuel as their sole energy source, today the supply of fossil fuel is experiencing a major shortage. With the continuing and unhealthy global demand for fossil fuel, substitutions must be found in order to replace this environmentally harmful and non-renewable energy source. With the help of scientific and technological advancement, the application of electric energy as a substitute for fossil fuel opens a new era of clean energy for each and every possible industry. In addition, since the national market introduction of electric and hybrid batteries, the attentions of large industries have been intrigued. Due to years of research and development regarding the expansion competency of these batteries, hybrid and electric cars became more popular in the land transportation industry. The other reason for their surging popularity is the injection of these new selections of vehicles into the electric motor industry's market.. With the increasing number of on-road electric vehicles, the number of electric vehicle charging stations began to pick up its pace. Since the main energy sources of these electric vehicles are electricity, the electric vehicle (EV) charging station serves the purpose of generating and transferring loads

of energy into the electric vehicle's battery to charge. Therefore, during the pre-installation and selection of the nature of these EV charging stations, planning and strategical management of a charging station is crucial. As owning each level of an EV charging station serves as a long term investment that generates passive income, it serves to balance out the supply and demand between electric vehicles and electric vehicle charging stations in the market.

## VIII. CONCLUSION

With the continuous improvements being made to the technology behind electric batteries, the electric vehicle finds itself playing a very important revolutionary role in the motor sport industry as a result. With the rapidly increasing number of demands for electric vehicles, the supply of its energy sources was bound to keep pace with its advancement. As for electric vehicle owners, the electric vehicle (EV) charging station serves the purpose of recharging the aforementioned built-in hybrid batteries. With the help of government sectors, powering electric vehicle charging stations with solar energy is becoming easier as the technology to gather and adapt solar energy to electrical energy through solar boards integrated into these stations. Additionally, it brings about a cleaner environment and is a better solution to reduce the usage of fossil fuel. In the present day, owning a charging station is a long term investment with high returns on the rate of investment (ROI). It requires only a small patch of land and smaller capital in terms of managing and the provision of resources. Among the networked and non-networked electric vehicle charging stations, having a networked station is advisable as it offers far more benefits than the non-networked station. Networked stations are capable of generating prices, providing better health monitoring regarding the condition of the station, increasing the station's visibility on the map. Besides that, managing an EV station is less complex and more compact than managing a current fossil fuel station. It requires less manpower and is less of a hassle during refueling like fossil fuel stations. As for the benefit to the managers, the only thing that the charging station needs is software that upgrades the system and ensures the smooth flow of electrical supplies. Judging from the mentality of today's consumer and the market trend, it is predicted that it will not be long before society and businesses shift away from the use of fossil fuel. With the current pace of technological advancement, the potential of electricity as a substitute for fossil fuel is strong and it is better and more supplies more power than fossil fuel.

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