

Raleigh designing its future with “Bélib” Electric car plug-in stations¹

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ABSTRACT

In a world of constant evolution toward a sustainable environment, the electric car plug-in stations are becoming a common solution. In this paper, the objective is to design a hypothetical contract between Raleigh and Belib company. Therefore, the Compensatory method defined in the Multi-attribute method is shaped to define which solution is the best between doing nothing, creating plug-in stations with a solar panel, creating plug-in stations without solar panel, creating wall chargers or creating Portable chargers. According to the results, it appears that doing nothing is completely erased from the solution statement. Finally, the paper suggests two solutions which are creating plug-in stations with a solar panel, the preferred solution, and creating plug-in stations without solar panel.

Key Words: Stations, design, change, contract, electric cars, area, risks, plug-in stations

INTRODUCTION

According to some studies, sustainable environment is a problem that must be taken care of in order to preserve and enhance the future of this world. The different approaches about this concern are extremely divided and disputed. Points of view on the human impact on climate change are widely questioned. This leads us to the Paris Agreement that set some rules countries need to follow in order to change the future climate tendency. One hundred and ninety-five countries signed off this paper on December 12th 2015. Only two countries did not sign this document, the United States and Syria. United States decision to fallback in this agreement is highly discussed and it splits the citizen’s opinions in two. The main goal of this meeting is to, in the future, sustain the world temperature increase of two degrees Celsius by setting a general thread. The different countries are not pushed by this agreement but they are encouraged to follow its rules. No one is left behind and that is why the most influent ones are lead to help the developing countries.

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Those rules are constraints for the citizen and the goals to reach must not create problems for them. Following this agreement, many French cities took steps forward and developed some key tools that will help their citizen to change their habits and take part in this change. Paris decided to deploy the concept of electric car self-service and increase the frequency of the public transportation.

Today, a new level of sustainable energy has been reached by the self-service plug-in stations. They are designed for both professional and private use. People who want to benefit from this service will need to buy a card for fifteen euros and then pay the electricity they will consume at the station. The cost will depend both on the timeframe and on the hour people plug-in their car.

All those tools will give a range of new possibilities for people who want to participate in the global environment change. There is still no viable plug-in station in Raleigh. This situation leads this paper to create a hypothetical contract between Belib and the city of Raleigh in order to help this city to adapt itself to this new world.

Because of the lack of plug-in stations, the number of electric cars in this city is not increasing and this is not in line with the actual Paris Agreement rules.

The aims of this paper will be to:

- Get the general approach that will shape this hypothetical contract.
- Answer to the question: what are the limits of the owner’s responsibility?
- Answer to the question: what are the limits of the contractor’s responsibility?
- Answer to the question: which areas will be concern with this contract?
- Answer to the question: what will it cost to the citizen?

All of this will lead to the question “How will Raleigh be able to get an electric car plug-in stations contract?”

METHODOLOGY

In order to implement those new electric car plug-in stations, a contract between Raleigh city and Belib company has to be set. There are five feasible alternatives and six attributes to look at.

I. Feasible alternatives:

1) Do Nothing

In this situation, the city of Raleigh is deciding that no change has to be made. This option means that the city would not want to follow Paris agreement and

would have preferred to follow the lead of the actual president of the United States.

2) Plug-in station with solar Panel

This option will bring many possibilities for both contractor and owner. The aim of it is to be sure that the plug-in station is able to work by itself and to bring the customer a complete and viable charging process. The product is made with a solar panel, a battery bank and a charging connector. This solution will lead to free the contractor from area restrictions and cost problems since it will not need to link each station to any nuclear power station or other electrical power station. Therefore, the stations could reach any part of the city and its surroundings. Another benefit of this solution would be the price paid by the citizen to plug-in their cars to this kind of station. The cost of one of those stations is three thousand dollars according to the [setec-power.en.made-in-china](http://setec-power.en.made-in-china.com) website. In addition to this cost, the company will need to add the installation price.

3) Plug-in station without solar Panel

This option consists of deploying a charging process that needs to be plugged into an external source of energy. This solution leads to connect the stations to a constant and reliable energy power and oblige the company to restrain its deploying area. The outcome of this project will decrease the maintaining and buying station's costs. The cost of one of those stations is two thousand dollars without the installation process price which enables the company to save money for other purposes such as the number of stations.

4) Wall plug-in station

This station is fixed on a wall and therefore, it cannot be moved. It is quite difficult to find space on the curbside environment since it needs to have access to an outlet. This charging process is composed of the cable to plug the cars, the charging device and the cable to plug the station into the electric power source. This device is commonly used at home and will not be useful in a city environment.

5) Portable plug-in station

This station is not fixed on any wall or ground space which make it easier to steal. It is set on four wheels which makes it easy to move from one place to another, it has a cable to plug the cars and another one to link the device to the electric power. The advantage of this system is to make faster the charging

process. The consumer will, therefore, be able to charge his or her car in smaller time laps. It is commonly used in garages.

II. Attribute:

In this section, this paper will look at six different attributes. The initial cost will correspond to the price of the device by itself while the installation cost will add the price for the installation process. The possible area part will provide the different restrictive capability of each device. The charging quality will rank the devices from the capacity to deliver viable energy power. The electricity price will consider the funds needed to allocate to suppliers’ costs. Finally, the curbside attributes will define the range of Raleigh’s possibilities to make the devices available to the public.

<u>Selection attributes</u>	<u>Do nothing</u>	<u>With Solar panel</u>	<u>Without Solar panel</u>	<u>Wall charger</u>	<u>Portable charger</u>
<u>Initial Cost</u>	<u>None</u>	<u>\$3 000</u>	<u>\$2 000</u>	<u>\$300</u>	<u>\$100</u>
<u>Installation cost</u>	<u>None</u>	<u>\$3 750</u>	<u>\$3 750</u>	<u>\$500</u>	<u>No cost</u>
<u>Possible area</u>	<u>None</u>	<u>Anywhere</u>	<u>Near electricity power</u>	<u>Only on electricity power</u>	<u>Only on electricity power</u>
<u>Charging quality</u>	<u>None</u>	<u>Faire</u>	<u>Excellent</u>	<u>Fair</u>	<u>Fair</u>
<u>Electricity price</u>	<u>None</u>	<u>No cost</u>	<u>Depend on electricity price</u>	<u>Depend on electricity price</u>	<u>Depend on electricity price</u>
<u>Curbside Installation</u>	<u>None</u>	<u>Excellent</u>	<u>Faire</u>	<u>Poor</u>	<u>Poor</u>

In order to compare the feasible alternatives against the attributes, this paper will use the compensatory method from the Multiple Attribute Decision-making to set a quantifiable analysis. With all those alternatives, a criterion should be set and that is why this paper decided to only focus on options that have at least one green box in the matrix analysis table. The “do nothing option” will, therefore, be erased from the possible options.

FINDINGS

This section will focus on comparing all the alternatives. It will guide the paper to recommend the best option and present quantitative factors that will help in the decision process.

Selection attributes	Do nothing	With Solar panel	Without Solar panel	Wall charger	Portable charger
Initial Cost	0.00	0.33	0.33	1.00	1.00
Installation cost	0.00	0.33	0.33	0.67	1.00
Possible area	0.00	1.00	0.67	0.00	0.00
Charging quality	0.00	0.67	1.00	0.33	0.33
Electricity price	0.00	1.00	0.00	0.00	0.00
Curbside Installation	0.00	1.00	0.67	0.00	0.00
TOTAL	0.00	4.33	3.00	2.00	2.33

Multi-attribute method (Compensatory method)							
Attributes	Step One	Step two	Do nothing	With Solar panel	Without Solar panel	Wall charger	Portable charger
	Relative rank	Normalized weight					
Initial Cost	1	0.05	0	0.02	0.02	0.05	0.05
Installation cost	5	0.24	0	0.08	0.08	0.16	0.24
Possible area	3	0.14	0	0.14	0.10	0.00	0.00
Charging quality	4	0.19	0	0.13	0.19	0.06	0.06
Electricity price	6	0.29	0	0.29	0.00	0.00	0.00
Curbside Installation	2	0.10	0	0.10	0.06	0.00	0.00
Sum	21	1	0	0.75	0.44	0.27	0.35

Using the table below, this paper will suggest some recommendations. First of all, the solar panel system appears to be the better choice after comparing it to the wall charger device. It is 216.5% better. ($4.33/2 * 100 = 216.5\%$). The other important option that can be conclude from this table is that the plug-in station without solar panel is 150% better than the wall charger device. ($3.00/2.00 * 100 = 150\%$)

Based on those two preferred solutions, two main differences appear. First of all, the area constraint creates a risk of a dispute between the contractor and the owner. The most important point to keep in mind is that Raleigh is a two hundred and ninety-nine square kilometer city with four hundred and three thousand eight hundred and ninety-two citizen. This huge landscape with many roads could bring a problem to define which areas need to be selected. The electrical plug-in station with integrated solar system will provide the city a range of areas possibility and it will help Raleigh to provide the citizen reachable stations where the traffic seems to be the most important. Concerning the stations without a solar panel, Raleigh city will have the responsibility to set the main areas where it will implement the stations. Therefore, stations will have to be set in Raleigh city’s center or near main buildings that have access to energy power.

The choice between those two solutions will then depend on how Raleigh city wishes to be invested in the Paris agreement. In front of such alternatives, this paper will recommend the electrical car plug-in station with integrated solar system that will bring a realistic solution to face the landscape of this city and bring new possibilities to the citizen in order to use sustainable energy power. This solution will enable the city to deploy new attracting areas and bring the city beyond the Paris agreement.

In order to follow up this advice, it is strongly recommended to use the Pareto Analysis. This chart would be extremely useful to be designed before the project and after it was completed. The number of electric vehicles, the area traffics, the pollution data and the consumption of gasoline will help the city of Raleigh to scale the change.

CONCLUSIONS

Finally, this paper wants to answer the questions:

- 1) What are the limits of the owner’s responsibility?
- 2) What are the limits of the contractor’s responsibility?
- 3) Which areas will be concerned with this contract?
- 4) What will it cost to the citizen?

All along this paper, the features of the plug-in station have been analyzed and compared. Based on the results of the compensatory method, two solutions appear to be coherent for the realization of this contract. The first one consists of building an electric car plug-in station with a solar panel, which will give more freedom to the owner and the contractor’s responsibilities from area restriction in Raleigh city. This solution will also provide a lower price for the citizen’s use of those devices. The other solution consists of building an electric car plug-in station without solar panel which will lead to restrict areas in Raleigh city and bring responsibility to

the owner. The price for the use of those devices will depend on the electric power companies leading to a potential increase for the citizen.

All those suggestions lead to clearly identify the owner's responsibility, the contractor's responsibility, the areas concerned and the citizen's cost. Therefore, it is Raleigh leaders who will decide which solution they will choose even if the paper suggests the solar panel solution as the preferred one.

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