Sustainable and Efficient Electric Vehicle and Charging System

Sireena AlTawil (CVE) Hilal Noori (CHE) Alreem Ahmed (ELE) Samir Itani (MCE)

Situation

Global warming is a major problem the world is facing, and the main contributors to it are greenhouse gases. Gas operated cars and electricity generation using fossil fuels are the major greenhouse gas emitters. So our project suggests the use of a modified version of electric vehicles (EV) that are charged using electricity generated by sustainable energy.

Problem

Charging limitations of current EV:

- Charging time (6-8 hours) [1].
- Mileage (AVG: 90 miles) [1].
- Difficulty of recharging in the middle of a trip.
- Shortage of electric vehicle charging stations.

Greenhouse emissions sources related to EV:

- Generating electricity for EV.
- Metal based batteries being currently used in EV [2].

Solution

In order to make the EV and the charging system as sustainable and efficient as possible. The solution proposed consists of five parts:

Road Material and Structure:

Concrete is chosen as the road material because:

- It can withstands high temperature [3].
- It is Recyclable [3].
- It will hold the primary coils in place well.

As for the structure, we chose the rightmost lane (slow lane) as the charging lane. Since time and power transfer are proportional to each other [4].

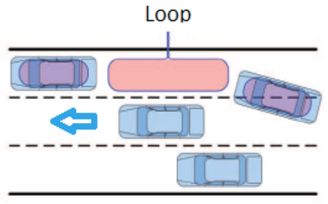

Fig 1. Illustration of rightmost lane as charging lane [5].

Eco-Friendly Battery:

Because the metal based batteries that are currently being used in EV contribute to greenhouse gases' emission, we chose the Biological Cell battery because it:

- Allows fast charging at it utilizes enzymes [2].
- Safe as it is not prone to exploding and leakage[2].
- Reduce environmental burden [2].

Dynamic Inductive Power Transfer (DIPT):

- Install secondary coil underneath the car [see fig. 2].
- Install multiple primary coils on the road [see fig. 2].
- Install magnetic sensors to sense EV [see fig. 2].

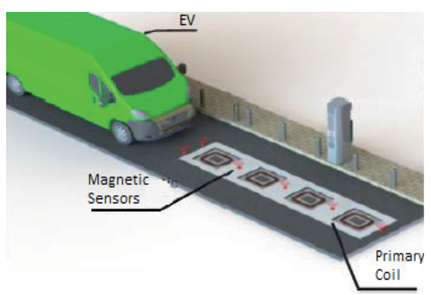

Fig 2. General concept of DIPT [6].

The specifications for coil size and spacing that assure maximum efficiency of power transfer are shown in figure 3.

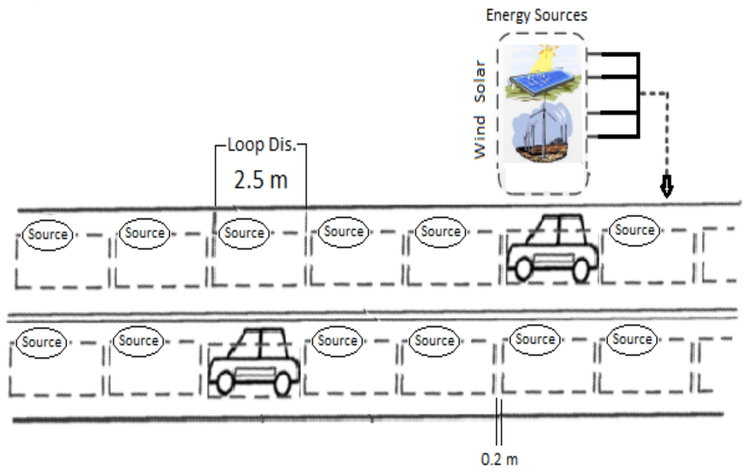

Fig 3. Setup of road and source [4].

Sustainable Energy sources:

- Solar panels [see fig. 3].
- Wind turbines [see fig. 3].

Analysis of types of motors:

Table 2. EV motors comparison [7].

Motors	Permanent Magnet Motor	Inductive Motor
Efficiency	94%	75%
AVG losses over 120,000 miles	1100 kWh	2000 kWh
Weight (kg)	25 kg	40 kg
Price ($)	700-900	300-500

Although the Permanent Magnet Motor is more expensive, we chose it for our project because it is more efficient than the Inductive motor.

Evaluation

The proposed solution has several constraints which are:

- Change of infrastructure.
- High costs of the charging system, Biological Cell batteries , and Permanent Magnet motor.

However, this solution will pay off in the long run and will reduce greenhouse gases' emission which will reduce the risk of Global Warming.

References

[1]R. Boagey, "Automotive Electric Vehicles", *Professional Engineering*, vol. 28, no. 11, pp. 43-46, 2015.

[2] S. Manzetti and F. Mariasiu, "Electric vehicle battery technologies: From present state to future systems", Renewable and Sustainable Energy Reviews, vol. 51, pp. 1004-1012, 2015.

[3] "Asphalt Concrete | Types of Asphalt | Advantages and Disadvantages of Asphalt", QsArticle.com, 2012. [Online]. Available: http://www.qsarticle.com/asphalt-concrete/. [Accessed: 16-Mar-2012]

Further references are available upon request