

A Study Report on the Utilization of Green Energy in Smart Highways in Future Time

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Abstract— Now a days, the globalized world, highway is the means to join countries, cities, towns etc. In recent years all the old technologies changed into new technology like fridge, TV, Washing Machine, cooler etc. so that the all the things are changed but highways are not changed. The "Smart Highway" is the concept to make highway roads smarter, safer, and more energy efficient for generating electricity using solar energy, vibration energy, wind energy, for charging the vehicles using these energies, for lighting, and for monitoring the condition of the road. The vehicles moving on roads generates large amount of energy in form of vibration that is completely wasted additionally they produce greenhouse gases which ultimately leads to global warming and depletes ozone layer. So, there is a need to make some revolutionary changes in concept of highways. We can use the vibration energy produced by vehicles that is converted into electricity. Similarly, by using different techniques, wind energy, solar energy and other type of green energies produced on highway are also converted into electricity. So, in this paper we are trying to throw some light on techniques of utilizing green energy on highway in fruitful manner.

Keywords: - Wind energy, Smart highways, Vibration energy, LED lightning, Solar energy,

I. INTRODUCTION

Highway from the name it is very clear that any public street or other public path on land. It is mainly used for major roads but also includes public ways and public routes. Indian road network of 33 lakh kilometers is second largest in world and consist of the road network but carry about 40% of total road traffic.

HIGHWAY	LENGTH (in km)
Expressways	200
National highways	96,265.72
State highways	1,31,699
Major district highways	4,67,793
Rural and other roads	26,50,500
Total Length	33 Lakh Kms

Table .1: Indian Road Network

Number of vehicles has been growing at an average of 10.16% per annum over the last five years [1]. As the number of vehicles are increasing simultaneously fuel (petrol, diesel etc.) consumption by them is also increasing. Fuels used in vehicles produces harmful gases like hydrocarbons, nitrogen oxides, carbon monoxide, sulfur dioxide etc. and these fuels

are limitedly available in nature. Today or tomorrow these fuels (used as energy source for vehicles) are for sure, going to be vanish off the face of earth. So, there is a need to make some revolutionary changes in concept of highways. So, in this paper we are trying to throw some light on techniques of utilizing green energy on Indian highway in fruitful manner. We will try to discuss various methods which will ultimately give us electrical energy by harvesting green energy on highways. In this paper we will talk over various productive strategies to transform green energy into electric energy and by using it making smart highways.

II. SMART HIGHWAY

"Smart Highway" is the concept to make highway roads smarter, safer, and more energy efficient for generating electricity using solar energy, vibration energy, wind energy, for charging the vehicles using these energies, for lighting, and for monitoring the condition of the road.

III. GREEN ENERGY

The word 'Green' make our mind to think about a world without pollution and eco-friendly. So, the green energy reflects the idea about generation of energy from natural resources like sunlight, wind, rain, tides, plant, algae, geothermal heat, etc. having no or less impact on the environment and can be renewed. These energy resources are renewable, meaning they're naturally replenished [2]. In case of energy sources, there are two types of sources available in the world: renewable energy sources and nonrenewable energy sources. Renewable energy is defined as energy that comes from natural resources like sun, wind, rain, tides etc. and not drained when used. Renewable energy is also known as green energy. Non renewable energy sources are not ecofriendly and are finitely available in nature i.e. natural gas, oil, coal etc. An extensive amount of nonrenewable energy is utilized by vehicles and its availability is very less comparatively, that's ultimately leads to rise in price of fuels.

IV. SMART TECHNOLOGY USED ON HIGHWAY

Green energy like solar energy, vibration energy, wind energy can be converted into electricity and then we can use this electricity in many applications on highways such as for charging the vehicles using these energies, for lighting, and for monitoring the condition of the road etc. Vibration produced by vehicles can be converted into electricity and further can be used for charging the electric cars or for lightning the street lights, or can be stored in any charge storing devices. There is abundant amount of free space available between lanes and in both right and left side of lanes, which can be utilized by placing windmills and solar plates.

VI. SOLAR ENERGY

The solar energy is an uninterrupted renewable and clean source available for the entire nation at least for a few hours. Solar

power is available from 9am to 6pm during the day hours. We can use this energy on highways. There is none street lights placed in a shady area, but only in the middle. Though the solar panel is in middle there will no fluctuation in the power generated by panel it will remain as a default output. Sun is the source of enormous energy. Energy emitted by sun in the form of radiation is the solar energy. Solar energy can be utilized in three ways I. By converting it into thermal energy. II. By converting it into electric energy. III. By Photo synthesis. Sun can be used to produce thermal energy using a solar collector. In solar photovoltaic system, electricity is directly generated from solar energy. It's working is based on the principle of photoelectric effect.

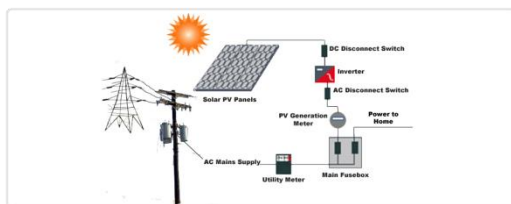


Fig.1 Solar system

VII. WIND ENERGY:

Wind energy is one of the oldest sources of energy used by mankind. Wind represents the kinetic energy of the atmosphere. Wind is caused by a force developed due to differences in atmospheric pressure. The energy which is generated by the flow of wind using wind turbines is called wind energy. It is a renewable source of energy which can be used as an alternative to fossil fuels. Wind energy is a clean energy which does not create pollution or releasing any harmful gases i.e. greenhouse gases [2]. I. Working of wind energy at Highways there is availability of wind by the motion of moving vehicles. When a free moving air particle is disturbed by forceful object succeeding in its path a pressure is developed at the body of the object and it is delivered to the surrounding near objects. By this phenomenon wind turbine is placed on the top of street light [6]. Generally, all the large wind turbines have same structure consists of a horizontal axis wind turbine having upwind rotor with three blades. Today in wind turbines we use the combination of variable speed generators and partial or full-scale power converter between the turbine generator and the collector system. A wind turbine is a device that converts kinetic energy from the wind into electrical power [2].



Fig.3 Wind Energy system

When the running vehicles on highway are crosses each other from left and right direction and then a forceful wind can be obtained when two vehicles cross the blade evenly. The blades of wind turbine are connected to synchronous generator to maintain the rotational RPM (Rotation per minute) as constant and its Wind has energy because of its motion that can be used to generate electricity. Thus, wind turbine converts kinetic energy into electrical energy.

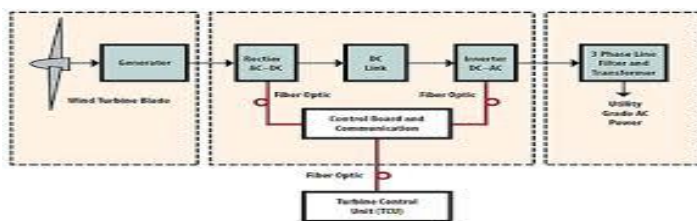


Fig. 2 Wind energy system

VIII. OTHER TECHNOLOGY SUPPORTING GREEN ENERGY

People are working on other technologies to develop highway into safe and fast mode of travelling, major hurdle is light on the roads, and many times due to fault in the electricity supply the road light are gone and that causes danger of meting accidents, to prevent this people are using dynamic paint that absorbs light in day time and reflects back illumination in night on the roads. Other upcoming technologies in communicating the data or message in-between at the faster pace without human intervention is data transfer in between machines like IoT, this can be again useful in communication or sending.

Smart Road Technologies

The “Roads that Honk” system uses Smart Life poles just before sharp turns and hairpin bends. These poles wirelessly communicate with each other and exchange data on incoming traffic. They gauge the speed of the vehicles and alert the drivers of approaching traffic by sounding a horn, as shown in the figure aside. The product is called Smart Life Pole.

Advantages

- The solar powered system is especially useful in hilly areas where this system is currently deployed.
- It is a simple and effective concept of alerting the drivers with sounds and honks that they are familiar with.
- This system is an innovative application of Iot to road safety to save lives.
- The use of K-band ensures that there is minimal interference and the best signal-to-noise ratio is ensured.



Fig.4 Smart road

1. **Innovative Paints-** Nowadays, transformational paints have been developed that glitters up accordingly. They are very useful as very low maintenance is required for them and are

cheaper than any of their substitute.

- 2. Glowing Highways-** Photo-luminescent paint is used to paint markings on highway. This paint charges during the day through sun light and then illuminates tarmac for up to 10 hours overnight. Photo-luminescent paint is the best substitute for street lights and can save a huge amount of electricity.



Fig-5: Glowing highway through photoluminescent

- 3. Dynamic Paint-**When temperature falls down below zero degree Celsius, temperature responsive dynamic paint shows ice crystal pattern for drivers. Whenever snow fall takes place roads becomes slippery and vehicles crashes down causing a lot of accidents. Paint is temperature responsive so as soon as it observes that temperature falls down its pattern starts illuminating showing correct path to travelers.



Fig-6: Ice crystal pattern due to snow fall on highway.

IX. FUTURE SCOPE

Roads now no longer remain as a medium to travel from one place to another. We can now use it to charge electric cars and harness solar energy due to its large exposed surface area. There is also technology to keep portions of the roads well-lit with more energy-efficient and environment friendly technology and methods. Hopefully there will be more upcoming technology to make our roads smarter and safer to travel on. A Smart highway is the need of present time because a lot of energy is required to illuminate the highway at night we can use Green energy and other supportive technologies like 5G, IoT, Cloud computing for faster data communication and rapid action taking as and when demanded, altogether there is a lot of scope on highways specially to be converted into smart highway.

X. CONCLUSION

Mankind has started its journey to cover long distance by foot, slowly they invented wheel and that gives mankind the speed and power to shorten the long distances the travel time was cut down to days and month from months to year. After the inventing the wheel the second-best idea was to develop roads on which the vehicle can travel easily as the advancement of time, we have fast moving vehicles all over

the world and world class highways to ride on it. Now, there is a need to make the highways a smart highway. A Smart highway is the need of present time because a lot of energy is required to illuminate the highway at night we can use Green energy and other supportive technologies like 5G, IoT, Cloud computing for faster data communication and rapid action taking as and when demanded, altogether there is a lot of scope on Indian highways specially to be converted into smart highway, as it is well placed geographically it has abundant sunlight and other green resources, population can also be used as a source of power generation like the vibration energy that can be generated through moving on the “green path” so that the power can be collected into storage batteries and that could be used at night. It is not a new concept people in the other part of the world are already using these technologies.

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