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Solar Panel Technology in Highway

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Abstract— solar energy has been the subject of great development in the past years, which led to the concept of Solar Roads. The solar roadway is a series of the structurally engineered solar panel that is driven upon. Solar roadway means the use of solar panel in road pavement. It also means replace current petroleum based asphalt road with a solar panel. A Solar roadway is a road surface that generates electricity by solar power using Photovoltaic and includes solar panels and LED signage, that can be drive on. Solar is a renewable source.

Keywords: *Solar, LED, Highway, solar highway, free electricity, smart power grid.*

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1. INTRODUCTION

The ultimate goal is to store excess energy in or along-side the Solar Roadways. This renewable energy replaces the need for the current fossil fuels used for the generation of electricity. This, in turn, reduces the greenhouse gases by half. The Solar Roadways system would might, at present, cost about three times what it costs to install an asphalt road, but would be more durable more easily replaced in a modular fashion, and able to pay for itself by generating more electricity than our economy can consume. At just 15% efficiency, far below what is expected, a 100% Solar Roadways enabled driving infrastructure would produce three times total electricity demand. There are additional benefits as well, which is a built-in smart grid, major new investment, and job creation, the economic benefits inherent in global leadership in building the most advanced clean energy infrastructure every dollar invested in renewable sources, ultimately generates returns, because the resource is not burned and lost.

2. SOLAR ENERGY

Solar energy is preferable as compare to another energy sources due following reasons**:**

- Reduce dependency on fossil fuel: As electric vehicles are growing we can reduce the amount of petrol and diesel vehicles and can reduce the dependency on fossil fuels. And one day fossil fuels are going to vanish off.

- Environmental friendly: Solar energy has least negative impact on the environment compared to any other energy source. It does not produce greenhouse gases.
- Flexible locations: As long as there is sunshine, solar energy can be developed anywhere. This is particularly useful for remote region with no access to any to any other source of electricity. Independent solar system could be developed in those regions and improve the lives of millions of people.
- It's free: As solar energy is a natural source of energy it's available for free for anyone. You can also make money by selling the unused electricity.

3. HISTORY

The company was founded in 2006 by Scott and Julie Brusaw. Solar roadway was invented in 2009 in France, Idaho. The proposed system would require the development of strong, transparent, and self-cleaning glass with the necessary traction and impact-resistance properties at competitive cost. French officials have opened the world's first solar road on 23rd December 2016 in the region of Normandy, unveiling a 1-kilometre-long (0.6-mile-long) route covered in 2,880 photovoltaic panels. The trial roadway, called Wattway, passes through the small town of Tourouvre-au-Perche. It's expected to be used by approximately 2,000 motorists daily during a two-year test period, to see just how much electricity it can generate. China has opened a 1-kilometer long solar road in Jinan, the capitol of Shandong province south of Beijing. The two-lane road covers 5,875 square meters and can generate up to 1 million kilowatt-hours of power annually — enough to power 800 Chinese homes, according to *XinhuaNet*. The electricity will be used to run street lights, billboards, surveillance cameras, and toll collection plazas. It will also be used to heat the road surface to keep it clear of snow. Any excess will be fed back into the local utility grid.

4. CONSTRUCTION AND LAYERS

Road Surface Layer: This is the top most layers of the assembly & also from this layer the solar rays will reach up-to the photovoltaic cells; they should be translucent and high-strength. Also, this is made in such a fashion that it is rough enough to provide great traction to avoid the skidding of vehicles. The material is made rough but the material used is translucent, it still passes sunlight through it to the solar collector photovoltaic cells embedded within it, along with LEDs & a heating element. And it is tough enough for handling today's heaviest loads under the worst conditions and it is made water-proof so that it can prevent electronics layer beneath it.

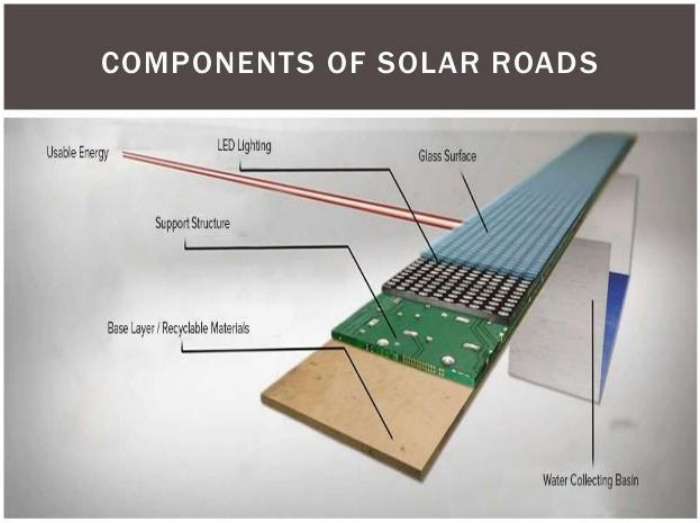

Fig. 4.1 Component of Solar Roads

Electronics Layer Contains a microprocessor board with support circuitry for sensing loads on the surface and controlling a heating element. By implementing this technology no more snow/ice removal and no more school/business closings due to inclement weather in the snow falling regions. Electronics layer collects energy from the sun, it is the base plate layer that distributes power (collected from the electronics layer) and data signals (phone, TV, internet, etc.) "down-line" to all homes and businesses connected to the Solar Roadway.

5. SPEFICATION OF SOLAR PANEL

Each panel's covers an area of about 4.39 square feet. The Solar panels generate 48 watt.15840 panels for 1 mile.414.984MWh produced per year for 1 mile. The glass has undergone both 3D Finite Element Method analysis and actual physical load testing at civil engineering labs. The results showed that Solar Roadways can handle trucks up to 250,000lbs (113,398kg). Originally, it was thought that Solar Roadways panels would need to support only about 80,000lbs (36,287kg), the maximum legal limit for a semi-truck. Upon further research, it became apparent that since logging trucks have no scales in the woods, which can be exceeded. The goal was then adjusted to 150,000lbs. It was subsequently learned that oil companies can get permission to move refinery equipment up to 230,000lbs on frozen roads, so the goal was increased to 250,000lbs.

6. SALIENT FEATURES OF SOLAR ROADS

- Smart power grid: A system of transmission medium that allow electricity to be transferred at different voltage from the point of generation to our homes.

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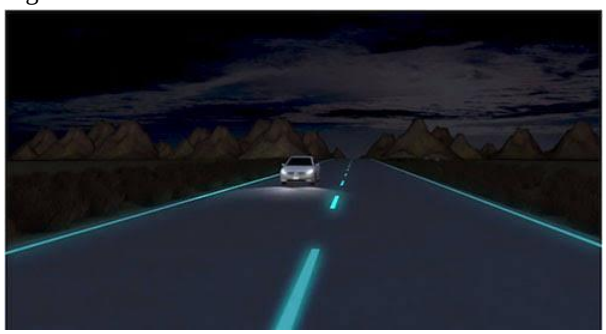
- Snow and ice management: The heating system in solar roadway maintains temperature above freezing point using pipes. The microprocessor has an uplink to a local weather station to predict precipitation events.
- Vehicle charging: Allow electric car to recharge at any rest stop made up of solar panel. Hard-wired EV charging stations that delivers up to 24 KWh charge in 4-8 hours.

7. ADVANTAGES

1. Renewability: Solar energy is renewable resource.
2. Lifespan 20-25 years: Life span of solar panel road is much greater than compared to asphalt roads.
3. Road illumination: Solar road lights up the road in the night properly.
4. Safer travel: As it keeps the road illuminated at night time also it makes travel safer.



5. Intelligent Highway System: It uses new way of technology in highways.
6. Reduce dependence on fossil fuels: As we can charge our electric vehicles on the go petrol and diesel vehicles will be reduced.

8. DISADVANTAGES

1. Maintenance cost: It requires yearly maintenance.
2. Seasonal efficiency: It does not generate as efficient electricity as it creates in summer season.
3. Needs a town planning: Before installing the solar panel roads, it requires a proper town planning.
4. Needs high revenue: The initial setup cost of the road is high.

9. CASE STUDY

- In 2017 China created a highway investing $2 trillion and within next 2-3 months the government had a revenue income of $2 billion.
- The initial cost is though 80% higher than regular asphalt but the lifespan of the asphalt road is just 7-12 years, whereas the lifespan of solar roadways is 20-25 years.
- Government can also generate revenue by charging the commercial buildings where the people can happily pay the electric bills.
- After setting up the solar roadways the city can generate 3 times more the power required.

10. CONCLUSION

- Replace ordinary asphalt: We replace the ordinary asphalt by solar panels.
- Produce electricity: Solar roads produce electricity and that can be used to supply to our houses and industries.
- Designed with LED lights: It is designed with inbuilt LED lights to indicate the roadways.
- Jobs vacancy for society: It creates vacancy for jobs as solar roads fixing requires high skilled persons and engineers.
- Good for the environment: It does not pollute our environment as it is ecofriendly and does not have any effects on human health.

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