

SOLAR ROADWAYS: Answer to Our Deteriorating Highway Infrastructure, Crumbling Power Grid and Global Warming Crisis

Surekha Kshirsagar
Assistant Chief Engineer
Public Works Region Nagpur

Abstract: -- As the day by day, asphalt roads are deteriorating more and more and petroleum products are getting huge hike and resources are very less, there will be no longer feasible material such as asphalt for our road surface. Hearing the concerns about global warming and knowing our dependency on fossil fuels, the idea is to replace all current petroleum-based asphalt roads, parking lots and driveway with solar road panels that collect energy to be used by our homes and businesses which will also eliminate power interruption caused by fallen or broken electric lines or poles. Limitation of petrol, diesel and other fossil fuel in nature will create a resource crisis in near future. It's hazardous pollution and global warming is creating a severe environmental problem even for the survival of humanity. So this has attracted attention all around the world and alternative resources and technologies are becoming significant today. Solar energy collected from radiant light and heat from sun had given a range of ever-evolving technologies such as solar voltaic, solar heating, solar thermal energy, solar architecture, satellite-based solar power plants and artificial photosynthesis.

I. INTRODUCTION

India has the second largest road network in the world after the US and is blessed with about 300 days of sunny weather. We talk about smart city in the 21st century, a smart city is an urban area that uses different type of electronic data collection sensors to supply information which is used to manage assets and resources. Smart roads are the part of smart city which will do the work of generating energy, improves the operation of autonomous cars, solve the electricity problem and monitors the condition of road along with its main purpose of transportation. The renewable energy generated by solar road panels will replace the current need for fossil fuel. Solar roadways will also features wildlife preservations, the elumination of impervious surfaces, counter terrorism etc. It provides decentralized, secure, intelligent, self healing power grid which pays for itself. This in turns reduce the massive pollution to half. You might know how Delhi, capital of India became the most polluted city on earth in November 2017. In this month breathing in Indian capital was like smoking 50 cigarettes a day. Pollution surged so high that some monitoring stations reported as Air Quality Index of 999 way above upper limit of worst category on 8th November 2017. Hence, it's a time to upgrade our infrastructure especially roads and power grids with the 21st century's technology i.e. Solar Roadways.

II. SOLAR ROADWAYS

Energy generation using solar photovoltaic requires large area. As cost of land is increasing day by day, there is a strong requirement to use the available land as efficiently as possible. As the cost solar photovoltaic is continuously decreasing, the major challenge now lies on land cost. Land is becoming a scarce resource in India in recent years, and per capita land available is low. Land is often considered as the topmost challenge for deploying solar energy technology. Here we explored the potential of energy generation using the land above road highways by constructing roof structure..This space can contribute to the energy generation without extra cost for the land. In Asphalt roads, there are hidden costs and hence it is difficult and expensive to continue favouring asphalt as the predominant road paving material for entire nation. Solar roadways is one way to capitalize on and expand this trend and show how quickly we can make shift to an economy rooted in abundant, domestic clean energy resources by storing energy in or along side of the solar roadways. The solar roadways system would might at present cost about three times what it costs to install an asphalt roads, but would be more durable, more easily replaced in modular fashion and able to pay for itself by generating more electricity than our economy can consume. It has an additional benefit as well, which is built in a smart grid, major new investments and job

creation. It ultimately generates returns because the resource is not burned and lost. The solar roadways can also communicate with drivers alerting with visual messages to the presence of pedestrians in crosswalk. Solar roadway have each panel (roughly 12' x 12') of interlocking panels that have their own LED lights and can also be used to spell out words "Reduce speed" or "Traffic Ahead" to help the flow of traffic. Better visibility at night with the road lines illuminated, it will be like driving on a well-lit runway. Solar roadways can pay dividends for public budget making our spending on infrastructure more efficient and significantly reducing electricity cost to consumers and businesses. If up-gradation is done with this technology, we can create jobs and a clean energy boom. The solar road panels heat themselves for snow and ice removal in northern climate, no more need for school/business cancellations. The solar roadways being an "electric road" will also make all-electric vehicles more practical; recharging stations can be placed in all parking lots and rest stops.

The solar roadways can save the wonderful countries in the world. The day by day the human beings are looking for the answer to our deteriorating highway infrastructure, our crumbling power grid. and the global climate crisis. For all such questions the answer is "SOLAR ROADWAY".

III. SOLAR PANELS

The solar roadways are composed of three basic

layers

- i) Road surface layer
- ii) Electronic layer
- iii) Base plate layer

a. Road surface layer

As this is the top most layer of the assembly and also from this layer the solar rays will reach up to photovoltaic cells; they should be translucent and high strength. It has traction so vehicles do not slide off the road and it is made water-proof so that it can prevent electronics layer beneath it

b. Electronic Layer

The electronic layer contains a mini microprocessor board that helps control the heating element of the panels. This technology can help to melt the snow that lands on the panels so that hazardous road conditions will no longer be issue in northern regions. This layer can sense how much weight is on the panels. The on-board microprocessor controls lightening, communication, monitoring, etc. which are fitted at every 12 feet distance, which prove the Solar Roadways as an "Intelligent Highway System"

c. Base Plate layer

Base plate layer is the layer that collects the energy from the sun and distributes the power to the homes and businesses that

are connected to solar Roadways. This will also be used to transfer the energy to cars as they drive over the strips to recharge the battery.

IV. SMART HIGHWAYS

When we think about Smart Highways, we see the cost of construction material is skyrocketing. New materials and technologies have to be found to replace these current systems. The solar road will Solar Roadways pay for itself through the generation of electricity along with other forms of revenue. The same money that is being used to build and resurface current roads can be used to build solar roadways. plants will no longer be needed much more of all electricity generation plants can also be rolled back in to solar roadways. The solar roadways will generate electricity – approximately up to three times more than the entire country "Security Concerns" includes terrorism. We have all seen the news reports about suicide bombers boarding crowded buses and detonating themselves. Vehicles such as fuel trucks are also potential targets. Currently it's difficult to track these vehicles other than by radio. The solar roadways form a wide area network, with each individual solar road panel containing a microprocessor board with its own

V. ILLUMINATED ROADS

Many people face the problem during the night driving as they face the trouble seeing the road lines at night, particularly when the oncoming headlights are blinding them or when it's raining. By implementation of these illuminated roads, the country can overcome from this problem & accidents at night time will also get reduced.

A recent study shows that the solar road studs to light-up the lines of roads during night time in an area of England, which has reduced night time accidents by about 70%. There is no need to expand energy lightening desolate roads when no vehicles are travelling. So the smart roadways will tell the LEDs to light up only when it senses vehicles on its surface – say half mile ahead and one-fourth mile behind the vehicle as it travels.

The LEDs will also be used to paint words right into the road; it gives warning to drivers if an animal arrives on the road, a detour ahead, an accident, or construction work. Think on solar roadways as the internet, with each individual solar road panel acting as an online computer. If we place RFID (Radio Frequency Identification) tags on high risk, vehicles that we want to track, the solar roadways would track them in real time and we'd exactly where they were at all times.

VI. OIL INDEPENDENCY

We own only 2percent of the world’s reserves, but we use 25 % of the world’s oil. If we could wean ourselves off of internal combustion engines, we’d have no further need for foreign oil. The world survey says that nearly we own more than 1000 million road vehicles – one vehicle for every person in the country –and we travel 15,000 to 20,000 miles per each year. Virtually all of these vehicles are powered by petroleum based fuel. Until by replacing our deterioration highway infrastructure and crumbling power grid with the “Solar Roadways”, we’d create a system that will support the recharging of all electric vehicles. Using all-electric vehicles will eliminate oil depedancy & internal combustion engines. The removal of internal combustion engines eliminates our need for oil.

VII. ELECTRIC VEHICLES

Electric vehicles have been never very practical, due to the fact that they have to be recharged and there has never been an infrastructure for that. The solar roadways allow electric cars to recharge at any rest stop or business places that have parking lots made up of solar road panels. Drivers can recharge their vehicles while eating at a restaurant or shopping at a mall. More and more car manufactures are offering electric vehicle options. Engineers are even investigating ways to use mutual induction to charge electric vehicles while they are driving down the solar highway. It’s good thing too. Roughly 25% of greenhouse gases come from the exhaust pipes of internal combustion engine vehicles. It can be concluded that power for the fleets will have to come primarily from coal and natural gas. If you live in a place where natural gas is dominant, electric vehicles will reduce carbon di oxide emissions. By the using electric cars would eliminate half of the cause of global warming and could virtually wean the world off oil entirely. Now a days businesses replacing coal power with solar power, drivers/car owners replacing their internal combustion engine vehicles with all electric vehicles charged by renewable energy. And this will be beginning of the end our dependency upon fossil fuels.

VIII. SMART GRID

Our current power grid is based on centralized power stations. Distribution of power is handled through transmission lines (overhead and underground), relay stations and transformers. When a line goes down (ice, lighting, wind, trees, utility pole hit by car etc.), everyone on the wrong end of the line loses power until the damage is repaired. If a power station goes

down, an entire section of the country goes dark. The solar roadways on the other hand, replaces all current centralizred power stations including coal and nuclear powered electricity generation plants. With the solar roadway, the road becomes power grid, eliminating the need for unsightly utility poles and relay stations. Power is generated every where –every road, parking lot, and driveway. .No more power outages, roming or otherwise. The Solar Roadway is completely decentralized. Every solar road panel can generate and pass electricity “down-line” to home and businesses. No loss to heat, no carbon footprint, and no spent fuel rods. Each solar road panel measures 12 feet (about 4 meters) by 12 feet and contain a microprocessor board for control, monitoring, and communications.

IX. ADVANTAGES

Table 1: Advantages over concrete & asphalt roads

SURFACE FEATURES	SOLAR ROADWAYS	CONCRETE	ASPHALT
Flat place to walk and drive	✓	✓	✓
Provides parking	✓	✓	✓
Provides traction	✓	✓	✓
Doesn't soften at high temperatures	✓	✓	
Generates energy	✓		
Intelligent	✓		
LED lights for lines and signage	✓		
Remains snow/ice free	✓		

Impervious to potholes	✓		
Can protect animals	✓		
Modular for faster maintenance	✓		
Requires no paint	✓		
Aesthetic benefits	✓		
Has ROI	✓		
Facilitates energy independence	✓		
Can charge EVs with clean energy	✓		
Water can be stored, treated or moved	✓		
Provides a "home" for cables, wires	✓		
Can provide emergency warning system	✓		
Expandable Technology	✓		

X. DISADVANTAGES

In spite of these advantages ,initially the start up and maintenance costs of building such roadways and parking lots may be extremely high.(However, advances in this technology will (hopefully) cause the cost to fall)

Another issue to deal with is the efficiency of solar panels. The average efficiency is currently a matter of concern.

Another disadvantage is that it cannot be constructed in the poorest developing nation due to the high initial start-up cost.

Road surfaces also accumulate rubber, salt etc., which block sunlight.

XI. FEASIBILITY

Solar roadways may not be feasible and economical as it initial and installation cost may be three times more compared to our convectional roads, but if this is evaluated as a long term investment this may prove to be much more economical as it pays us back. 100 % solar roadways would produce three times the total electricity demand.

Solar power sources are rapidly becoming cheaper and more ephemeral making it feasible to talk about. Solar PV becoming the leading cost reducing trend in the energy sector.

XII. CONCLUSION

We can't wait until it's gone to decide what to do next. We have the technology to solve this problem in a relatively short period of time which may be all we have left. In developing countries instead of implementing the higher target roads to be developed per day such countries can reduce the target and develop solar road so they could improve economy with infrastructure. It should be started from the Capital of India i.e. Delhi where pollution problem is hazardous.

"Let's make thinks to happen rather than waiting things to happen""It's better late than never""let's go greener"

XIII. FIGURES



Fig 1: Solar roadway showing messages.

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XIII. FIGURES

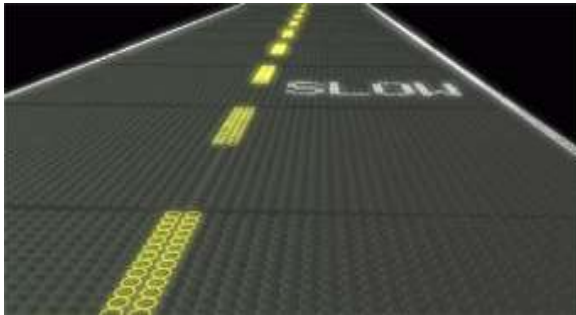


Fig 1: Solar roadway showing messages.

Source: www.vidafine.com

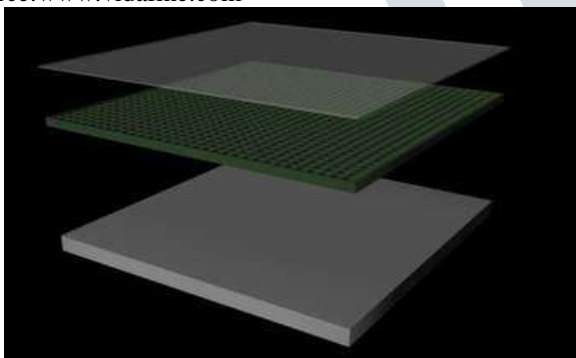


Fig 2: Solar Road Plates

Source: media.treehugger.com



Fig 3: Illuminated Roadway

Source: www.greenlaunches.com

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