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Survey on Smart and Efficient Transportation (Use of Solar Panels on Highways)

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ABSTRACT: The Solar Roadway is a series of structurally-engineered solar panels that are driven upon. The idea is to replace all current petroleum-based asphalt roads, parking lots, and driveways with Solar Road Panels that collect energy to be used by our homes and businesses. The renewable energy generated by solar road panels will replace the current need for fossil fuel which is used for generation of electricity as also oil used for driving the vehicles which in turn reduces the greenhouse gases nearly to half. The implementation of Solar Roadways Technology will create the clean energy boom, spurring private investment on a massive scale, with relatively little extra cost. An intelligent highway infrastructure and a self-healing decentralized power grid that will eliminate our need for fossil fuels. Solar Roadways will also features wildlife preservation, the elimination of impervious surfaces, law enforcement, DUI detection, counter-terrorism, etc. It provides a decentralized, secure, intelligent, self-healing power grid which pays for itself. So it's time to upgrade our infrastructure (especially roads & power grids) with the 21st century technology i.e. "Solar Roadways".

I. 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. The roadways can also communicate with drivers, alerting drivers with visual messages to the presence of pedestrians in a crosswalk. The most important element of the Solar Roadways technology is that its power-generation capacity demonstrates the base load viability of renewable energy sources. Clean energy technology existence can power the entire countries economy and more. But the required is a commitment to major investment and incentives in building the infrastructure. If up-gradation is done with this technology, we can create jobs, and a clean energy boom, spurring private investment on a massive scale, with relatively little extra cost. A solar roadway is a road surface that generates electricity by solar power photovoltaic cells.

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II. LITERATURE SURVEY

Stephy Johny and Keerthi Susan John [1] Hearing the concerns about global warming and knowing our dependency on fossil fuels the solar roadways imagined to develop roadways with solar panels. This paper presents the concept of Solar Roadway which is a series of structurally engineered solar panels that are driven upon. The idea is to replace all current petroleum-based asphalt roads, parking lots, and driveways with Solar Road Panels that collect energy to be used by our homes and businesses. This renewable energy replaces the need for the current fossil fuels used for the generation of electricity which in turn reduces the greenhouse gases. Keywords- Fossil fuels, Solar Roadway, Solar panel, Smart grid, intelligent highway.

Alark A. Kulkarni [2] The Solar Roadway is a series of structurally-engineered solar panels that are driven upon. The idea is to replace all current petroleum-based asphalt roads, parking lots, and driveways with Solar Road Panels that collect energy to be used by our homes and businesses. The renewable energy generated by solar road panels will replace the current need for fossil fuel which is used for generation of electricity as also oil used for driving the vehicles which in turn reduces the greenhouse gases nearly to half. The implementation of Solar Roadways Technology will create the clean energy boom, spurring private investment on a massive scale, with relatively little extra cost. An intelligent highway infrastructure and a self-healing decentralized power grid that will eliminate our need for fossil fuels. Solar Roadways will also features wildlife preservation, the elimination of impervious surfaces, law enforcement, DUI detection, counter-terrorism, etc. It provides a decentralized, secure, intelligent, self-healing power grid which pays for itself. So it's time to upgrade our infrastructure (especially roads & power grids) with the 21st century technology i.e. "Solar Roadways"

III. METHODOLOGY

WORKING PRINCIPLE : A solar roadway is a series of structurally engineered solar panels that are driven upon. The idea is to replace current petroleum abased asphalt roads, parking lots, and driveways with solar road panels that collect energy to be used by homes and businesses, and ultimately to be able to store excess energy in or alongside the solar roadways. Thus renewable energy replaces the need for the current fossil fuels used for the generation of electricity, which cuts greenhouse gases and helps in sustainable development. Parking lots, driveways, and eventually highways are all targets for the panels. If the entire United States Interstate Highway system were surfaced with Solar Roadways panels, it would produce more than three times the amount of electricity.

The solar panels are divided into three basic layers:-

1. Road Surface Layer.
2. Electronics Layer.
3. Base Plate Layer

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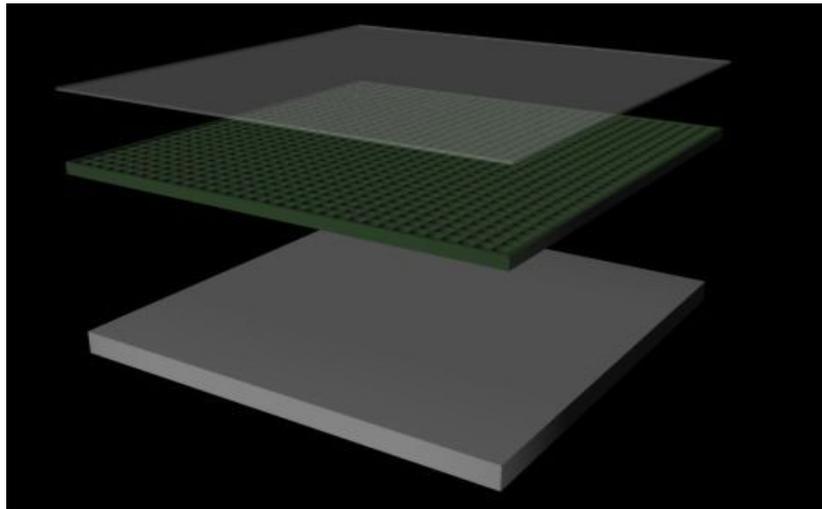


Fig.1. Road surface layer showing the top layer of the assembly from this solar rays will reach to photovoltaic cell.



Fig.2. Electronic Layer use to capture solar rays and is converted to electrical energy through various circuits

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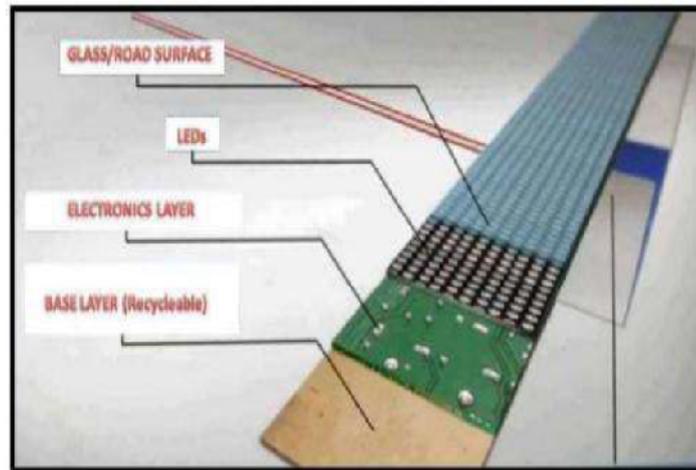


Figure 4: Construction Layers Solar Roadway

Fig.3. Construction of various layers of Solar Roadway showing translucent glass layer on top & photovoltaic cell layer below it.

While the 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. The base layer is made weatherproof so that it can provide the electronic layer above it.

SOLAR ROADWAYS FUNCTIONING :In order for solar roadways to be successful, the three layers of solar road panels need to work in unison. The road surface layer needs to be clear enough to let the sunlight pass through it to the electronics layer. The electronics layer collects solar energy. It consists of photovoltaic cells which converts this energy into electricity. This energy received is transmitted to the base plate layer and also it keeps the road functioning properly, and the base plate layer determines where the energy is supposed to go and distributes power (collected from the electronics layer) and data signals (phone, TV, internet, etc.) to all homes and businesses connected to the Solar Roadway. Due to the fact that the road lines on solar roadways are actually LEDs, the base plate layer needs to ensure that the roadway has enough energy needed before sending the rest of the energy out towards the grid. Solar cells produce DC energy. Homes and businesses currently use AC energy, so the DC solar energy is converted to AC energy by a DC-to-AC converter or solar micro inverter and then is fed to the homes and other places.

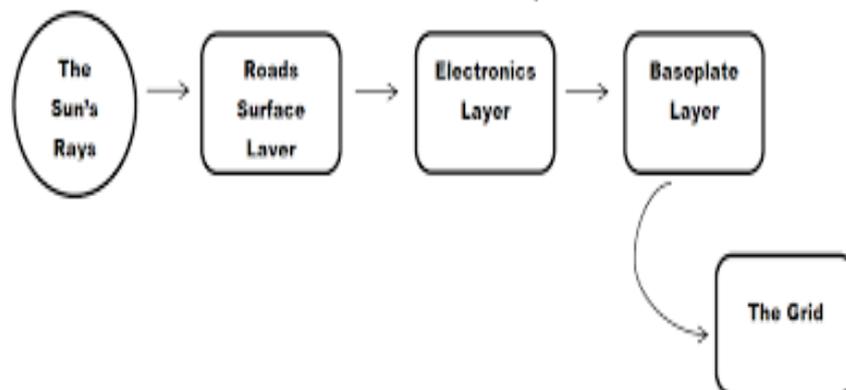


Fig.4. Flow chart showing the complete process of working of solar roads.

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SOLAR ENERGY: Solar roadways are the light and radiant heat from the sun that influences Earth's climate, weather and sustains life. In the environmental context, it is also used to refer to the process of generation of electricity by tapping the solar energy.

PHOTOVOLTAIC CELL: Photovoltaic is a method of generating electrical power by converting solar radiation into direct current electricity using semiconductor that exhibit photovoltaic effect. The photovoltaic power generation employs solar panels composed of a no of solar cells containing a photovoltaic material. Due to the increased demand of renewable energy sources that manufacturing the solar cells and photovoltaic arrays has advanced considerably in recent year.

WHY SOLAR: Solar power generation has emerged as one of the most rapidly growing renewable sources of electricity solar power generation has other advantages over other form of electricity generation.

INITIAL COST: The average cost of asphalt roads in 2016 was roughly \$30 per square foot. The cost does not include maintenance (pot whole repair, repainting lines, etc.) or snow/ice removal. The average lane width is 12 feet, so a 4 lane highway would be 12' (width per lane) x 4 (lanes) x 5280' (one mile) = 253440 square feet. Multiply this by \$30 per square foot and your one-mile stretch of asphalt highway will cost \$7603200.00 and will last an average of seven years. The design of Solar Roadways is to last at least 21 years (three times that of asphalt roads), at which time the panels would need to be refurbished. Adding no additional cost to the current asphalt system, this will allow us to invest about \$48 (\$16 x 3) per square foot. This means that if each individual panel can be made for no more than \$6912.00, then the Solar Roadway can be built for the same initial cost as current asphalt roads. However, asphalt roads don't give you anything back.

ADVANTAGES:

1. It provides electrical power to all business and homes.
2. It can replace our current centralized power stations and become the smart grid for each nation.
3. It is environment friendly and causes no pollution, produces no greenhouse gases.
4. It has greater life span, for around 20-30 years while the life span of an asphalt road is 7 to 8 years.

DISADVANTAGES:

1. It has very high initial and maintenance cost.
2. The average efficiency of the solar panels is currently 20%.
3. Due to high initial cost, it cannot be constructed in the poorest developing nations.
4. Due to fewer amounts of sun rays, it becomes less efficient in winter season.
5. Initial cost of construction and maintenance such roadways may be extremely high.
6. The average efficiency of solar panels is still a matter of concern.

IV. CONCLUSION

The Solar Roadways can be implemented roughly the same cost of the current systems (asphalt roads and fossil fuel burning electricity generation plants). No more Global Warming. No more power outages (roaming or otherwise). The Safer driving conditions & 70% reduces the accidents. Solar roadways are non polluted or less polluted. The new secure highway infrastructure which pays for itself .The decentralized, self-healing, secure power grid. No more dependency on foreign oil. Also, solar roadways are eco-friendly. Solar roads are feasible.

FUTURE SCOPE:

1. In future, normal roads can be replaced by the solar roadways but huge initial investment is required.
2. The solar roadway alternative could be made at less cost with an energy return while phasing out the old system. As old roads are scheduled to be under maintenance, the process of solar roadway placement could occur seamlessly.
3. The alternative of airports and parking lots are under varying timelines. Whenever fiscal dilemmas become the primary motivating factor for a state or municipal budget, the option of solar roadways should be presented and defended. With respect to solar roadways being future proof asphalt roads are a dead end. There are no redeeming features to asphalt that should hinder the progress of a new model.

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