IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 1, August 2023

# Solar Roadway – A Significant Infrastructural Reform

**Ms. Swati Jaganaath More[1] and Ms. Shraddha Dipak Kawale[2]**
Assistant Professor, Chhatrapati Shivaji Maharaj Institute of Technology, Panvel[1,2]
swati.csmit@gmail.com, kawaleshraddha8@gmail.com

**Abstract:** *Solar roadways are basically structurally engineered solar panels, which can easily and effectively pose as conventional roads; the only difference being smartness and intelligence. These solar roads are very much intelligent by themselves and perfectly suited for the current era's development; hence, they have been appropriately termed as 'Smart Roads'. The main motive is to fairly minimize the use of conventional asphalt and concrete roads, parking lots, and driveways, and to supplant a majority of them with solar road panels. These panels will be responsible for generating clean renewable energy, which, in turn, will be used to power a specific area or even an entire developed city. An intelligent highway infrastructure and a self-healing decentralized power grid will effectively help in reducing the use of fossil fuels, and consequently, limit the emission of greenhouse gases considerably. This will result in a 50 % decrease in the air pollution of that particular area, where this technology is used. All these goals can be achieved by paying just a little extra. It is time to upgrade our infrastructure for the betterment of the not-so-distant future as this smart system pays for itself. These advancements in infrastructure will not only promote sustainability but also pave the way for a cleaner and more efficient transportation system.*

**Keywords:** Electric Vehicles, Fossil Fuels, Intelligent Roads, Smart Grids, Solar Panels, Solar Roadways

## I. INTRODUCTION

Reducing the distance between people, markets, services and knowledge or simply 'getting people connected' is a great part of what economic growth is all about. In today's world, virtual connectivity has gained significant importance with the emergence of various communication avenues. However, it is essential not to overlook the significance of a reliable transport network. A country's economic development is strongly correlated with the quality of its road network. Additionally, the sources of energy play a vital role in the growth of society. Over the last two centuries, energy consumption has steadily increased, driving prosperity and economic opportunities worldwide. Nevertheless, humanity now faces a substantial energy challenge. This challenge has two critical dimensions. Firstly, current energy consumption patterns are environmentally unsustainable, with the excessive reliance on fossil fuels posing a severe threat to the Earth's climate and vital human and natural systems. Secondly, a significant portion of the global population, estimated to be over two billion people, still lacks access to essential energy services, including electricity, clean cooking fuel, and adequate transportation. To address these issues, sustainable solutions are imperative in modern design practices. Society's over reliance on natural resources for energy generation and transportation infrastructure calls for innovative and creative design approaches. Emphasizing creativity in design is essential as traditional practices alone are inadequate to meet the challenges at hand. An excellent example of such creative design is the concept of solar road panels - modular road panels that double as functional solar photovoltaic panels. Implementing such innovative solutions can pave the way towards a more sustainable and energy-efficient future. A solar roadways is a series of structurally engineered solar panels that are drive on. The concept of replacing current petroleum-based asphalt roads, parking lots, and driveways with solar road panels is a compelling idea with significant potential for sustainable energy generation and utilization. By implementing solar roadways, we can harness renewable energy from the sun and utilize it to power homes and businesses, reducing our dependency on non-renewable fossil fuels and contributing to a cleaner environment. Thus renewable energy replaces the need for the current fossil fuels used for the generation of electricity, which cut greenhouse gasses and helps in sustainable development.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 1, August 2023

**OBJECTIVE**

To solve the problems of traffic disorientation, global warming, and nationwide illumination, we have come up with the optimum solution of Solar Roadways. Coal is responsible for 40% of carbon dioxide emissions from fossil fuels. Mining coal wreaks havoc on the environment and on the people who live there. Besides CO2, burning coal produces pollutants like mercury, sulfur dioxide, which is linked to acid rain, and particulate matter, which causes respiratory illnesses. Despite all of this, coal being used for electricity production is not doing a very good job since almost 31 million households in India are yet to receive electricity. India witnesses about 1.5 lakh deaths every year due to road accidents. There are many reasons for this, but the most highlighted ones are poor road conditions and poor traffic handling arrangements

**PROBLEM SATEMENT**

The utilization of non-renewable resources for energy production and infrastructure development has taken a toll on our environment and health. Pollution from these sources poses significant threats to the planet and its inhabitants. Moreover, the construction of poor quality and unsafe infrastructure compounds these issues, leading to various challenges, including safety risks and increased maintenance costs.

## II. METHODOLOGY

Electric vehicle technology is more practical in solar roadway. Recharging stations can be built in parking lots and rest stations, and also alongside the roads at equal intervals of length. Structurally, solar roads are divided into three basic layers. It will also make traveling and transportation cheaper due to the continuously increasing prices of petroleum products and the fact that electric vehicles are cheaper to use than combustion engine vehicles. They are road surface layer, electronics layer and base plate layer and are shown in Fig. 1. Transparent Layer 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. As the material is made rough but translucent, it still allows sunlight to pass through it to the solar collector photovoltaic cells embedded within. Along with LEDs and a heating element, these components are shown in Fig. 1.


**Figure1: Solar Road Panel and Transparent Layer**

**Material Selection:** The best materials for use in the structural layers of the solar road panel are steel, aluminium, and fibreglass. Aluminium is one of the most popular materials for use in landing mats, proving that structures made from the material are able to withstandmission critical static and dynamic tire loads. Due to the relative material properties of aluminium and steel it is known that steel should do abetter job of withstanding the loading from vehicle tires at a lower cost though also at a higher weight. Lastly, it was found that multiply fibreglass panels are able to withstand repetitive loading on poor sub-bases without failing. In addition to being low cost and light weight it isalso the easiest to build a research prototype for as either the aluminium or steel options would have required a custom casting operation, which is a very expensive and difficult process.

**Electronic Layer (Optical Layer):** Electronics Layer Contains a microprocessor board with support circuitry for sensing loads on the surface and controlling a heating element. The on-board microprocessor controls lighting, communications, and monitoring, among other functions, which are fitted at every 12 feet distance, proving the Solar Roadways as an "Intelligent Highway System. Fig 2 shows the optical layer. Since the base layer should be as thick a layer of fiberglass as possible, the optical layer was designed first as it has more detailed design requirements. To accommodate the solar cells within the panel, cut-outs need to be made from several of the fiberglass layers. This

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 1, August 2023

allows light to reach the cells embedded in the structure. The process is simple with a multiply fiberglass structure, as square sections can be cut from the fiberglass sheet before adhering the layers together.

**Interconnection Routing:** With the cells chosen, the next step is to connect them together to assemble the panel. Typically strings of solar cells will be connected in series to increase the voltage generated by the collector, as the current output is already reasonable (5 amperes) from each cell. In order to connect these together, the routing as shown in Figure 4.5, where the squares represent the solar cells, the two lines between represent the two power connection lines between the cell bus bars, and the positive and negative signs indicate the input and output lines from the solar road panel respectively as shown in fig.2.

**Figure 2: Optical Layer**

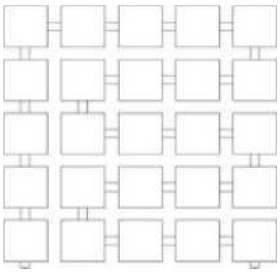

**Figure 3: Interconnecting Routing**

**Basic Plate Layer:** The electronics layer collects energy from the sun, while 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 to provide protection to the electronic layer above it. Constructing the base structure is straightforward, as it involves using multiply fiberglass as the bulk of the structure, which consists of layers of fiberglass adhered together. Willie some accommodations will need to be made for the cell compartments, interconnection routing, and panel housing, the main challengeof this section is determining the thickness required in order to withstand the desired loads. As the overall design of the solar road panel is a composite material between glass and fiberglass, it is important to make this thickness decision while bearing in mind. The performance of the glass layer it is known that glass is a very rigid material that, in compression, behaves very similarly to steel. As a result the design incorporatesa very rigid glass layer over a, comparatively, very elastic fiberglass structure. Since the panel will be contained by housing it is assumed that the glass' performance will govern the deflections within the panel with the fiberglass layer providing resistance to ensure the glass does not fail in tensile loading. For this structure, which needs to resist traffic loading on sand, a multiply fiberglass panel consisting of 4-ply fiberglass will be the lower limit for the number of whole fiberglass ply layers required in the design. While the appropriate upper limit is unknown, the design requirements specify that the panel must be made from readily available material, so the maximum available sizeof the housing will govern the number of layers of fiberglass used in the design.

## II. RESULT

Solar roadways utilize tempered glass and photovoltaic cells to create a fully smart and intelligent road system. The technology is currently in its primitive stage, but with adequate funding, small-scale prototypes have been constructed and successfully tested. China has already taken a step forward by replacing its main roads with solar road systems in real-time. Although the initial investment is high for this technology, it is an excellent replacement for fossil fuels, cutting later costs and also reducing environmental pollution.

Solar roadways are essentially structurally engineered solar panels, capable of seamlessly resembling conventional roads, with the only distinction being their smartness and intelligence. These solar roads are highly intelligent and perfectly suited for the current era's development, earning them the fitting title of 'Smart Roads.' An intelligent highway infrastructure and a self-healing decentralized power grid will significantly aid in reducing fossil fuel usage, thereby limiting greenhouse gas emissions considerably. This smart system has the unique capability of paying for itself. So, it is time to upgrade our infrastructure for the battlement of the not-so-distant future.

'Solar roadways' is a technology which can be an excellent replacement for fossil fuels, cutting later costs and also reducing environmental pollution. Hence, this is a great way to reduce pollution, create smart highways, and ensure a 24/7 electricity supply in India.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 1, August 2023

## III. CONCLUSION

In conclusion, solar roadways represent a promising technology with the potential to revolutionize our road systems and energy infrastructure. While still in its early stages, solar roadways have shown promise through successful small-scale prototypes and real-time implementation in countries like China. By harnessing solar energy and integrating it into roads, these smart and intelligent road systems can serve as a sustainable alternative to fossil fuels, reducing costs and environmental pollution.

The concept of solar roadways offers numerous advantages, including the generation of renewable energy, the potential for revenue generation, and the reduction of greenhouse gas emissions. With intelligent features and the ability to pay for themselves over time, solar roadways present an opportunity to upgrade our infrastructure for a more sustainable and efficient future.

However, it is important to recognize that solar roadways require significant investment, research, and careful planning for widespread adoption. Technical challenges must be addressed, and long-term effectiveness and cost-effectiveness need to be carefully evaluated. Despite these challenges, the potential benefits of solar roadways, such as pollution reduction, smart highways, and a continuous electricity supply, make it a technology worth exploring further and considering for future infrastructure development.

## REFRENCES

**[1].** Ayushi Mehta, Neha Agrawal, Anjali Tiwari (2015) "Solar Roadways -The future of roadways", International Advanced Research Journal in Science, Engineering and Technology (IARJSET), Vol. 2, Special Issue 1.

**[2].** Alark A. Kulkarni (2013), ""Solar Roadways" - Rebuilding our Infrastructure and Economy", International Journal of Engineering Research and Applications (IJERA),ISSN: 2248-9622, pp.1429-1436.

**[3].** A.Johny Renoald, V.Hemalatha, R.Punitha, M.Sasikala, M.Sasikala (2016), "Solar Roadways- The Future Rebuilding Infrastructure and Economy", International Journal of Electrical and Electronics Research,ISSN 2348- 6988.

**[4].** Harshil Shah (2014), "Scope of Solar Energy in India", IJSRD- International Journal for Scientific Research & Development, ISSN (online): 2321-0613.

**[5].** Karthik S (2015), "Feasible Design for Solar Highway Roads", International Journal of Advances in Marine Engineering and Renewables, Vol.l, Issue 2 pp:79 - 84

**[6].** Rajeev Ranjan (2015), "Solar Power Roads: Revitalising Solar Highways, Electrical Power and Smart Grids", International Journal of Engineering Research and General Science, ISSN 2091-2730.

**[7].** Shivam Prakash, Sapna Kumari, Varsha Palwade (2016), "Solar Roadways", International Journal of Advance Research and Innovative Ideas in Education, Vol-2Issue-3.