Study of Solar Pavement for National 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".

Keywords: Electric Vehicles, Fossil Fuel, Intelligent Roads, Smart Gird, Solar Panels, Solar Roadways

I. INTRODUCTION

Hearing the concerns about global warming and knowing our dependency on fossil fuels the solar roadways imagined to develop roadways with solar panels. This innovation is begun in early 2009 and later the company was established by name Solar Roadways in U.S. and awarded a contract by federal government.

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 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 to half.

Solar Roadways is proposing a long-view paradigm-shift solution to major infrastructure, energy and climate challenges. 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 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.

Asphalt works, in many ways, and is convenient to lay-down, compared to other methods. It has carried our automotive infrastructure into the 21st century. But there are hidden costs that are making it increasingly difficult and expensive to continue favoring asphalt as the predominant road- paving model for the entire nation. That's why asphalt is not ideal for road construction.

Solar Roadways can pay dividends for the public budget, making our spending on infrastructure more efficient and significantly reducing electricity costs to consumers and businesses. They can make the emerging electric vehicle economy far more affordable, and easier to manage. They can help us eliminate hundreds of billions of dollars per year, or more, in externalized costs of burning fossil fuels. And, we can lead the world in powerful clean energy technology exports, capable of rolling back massive pollution and greenhouse gas emissions.

Perhaps 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 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.

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. Clean energy jobs are also expanding rapidly and have still more potential for major long-term growth. They are paying significantly higher wages than the national average, and are built into local economies. Solar Roadways is one way to capitalize on and expand this trend, and shows how quickly we can make the shift to an economy rooted in abundant, domestic, clean energy resources.

II. FEATURES OF SOLAR ROADWAYS

A. Intelligent Highways

Every country tries to barely keeping up with the costs of maintaining the roads and bridges as it is, and the cost of construction materials is skyrocketing. New materials and technologies have to be found to replace these current archaic systems.

The Solar Roadway is an intelligent road system that provides clean renewable energy, while providing safer driving conditions, along with power and data delivery. The Solar Roadway will 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 the Solar Roadways. Then, since coal-fired and nuclear power plants will no longer be needed, the costs of all electricity generation plants can also be rolled back into the Solar Roadways.

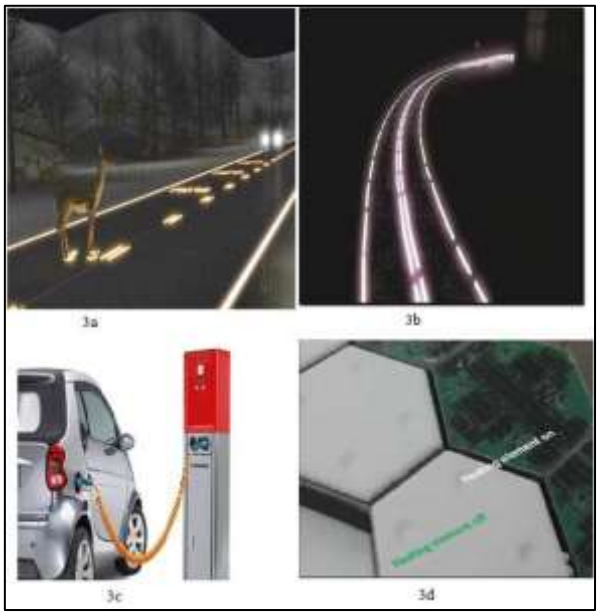
A steady rise in congestion and ongoing deterioration of decades-old roads and bridges, funding agency of government is failing to keep up with the need to maintain existing infrastructure and increase capacity. And the cash shortfall is only going to get worse.

There is a much better way. Imagine a highway infrastructure that relieves the financial obligations of funding agency of government and instead pays for itself. The Solar Roadways will generate electricity – approximately up to three times more than the entire country currently uses. The electricity generated pays for the Solar Roadways. Additional revenue can be acquired by leasing the conduit within the Solar Roadways to service providers such as the telephone, cable TV, and high-speed internet industries.

If United States of America is considered; the nation's highway transportation system includes 3.8 million miles of roadways and 582,000 bridges. Significantly, the highway system supports 86 percent of all citizens' personal travel, moves 80 percent of the nation's freight (based on value), and serves as a key component in national defense mobility. Despite widespread redundancies, there are critical junctures with limited capacity for additional traffic. Freight volume is projected to double by 2020, stretching ability to manage limited capacity and growing security concerns.

"Security concerns" includes terrorism. We've 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 address. Think of the 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 always know exactly where they were at all times.



Different features of Solar Roadways

B. Illuminated roads

Accidents drastically reduced unlike the dark roads we drive on by night today, the Solar Roadways will have LEDs which will "paint" the lanes, and can be instantly customized as needed.

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 over come from this problem & also accidents at night time will get reduced henceforth the night-time driving will be safer for all.

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 70%.There is no need to expend energy lighting desolate roads when no cars are traveling, so the intelligent roadways will tell the LEDs to light up only when it senses cars on its surface - say 1/2 mile ahead and 1/4 mile behind the vehicle as it travels. This way, drivers will know an oncoming car is ahead when they see the lights on the other side of the road begin to light up ahead.

The LEDs can also be programmed to move along with cars at the speed limit and it gives warning to the drivers instantly when they are driving too fast or the speed of the car increases beyond the speed limit. 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. Central control stations will be able to instantly customize the lines and words in real time, alleviating traffic congestion and making the roads more efficient as well as safer.

C. Accident can be avoided:

The roadways can protect wildlife and motorists. The load cells in the solar panels can detect if something is on the surface of the panel. It acts like a weigh machine[15].

D. Electric Vehicles:

Electric vehicles are on the way. More and more car manufacturers are offering electrical option. EVs can be rechargeable at any convenient located rest stop or at any parking lots. Owners can plug their car in and recharge while not driving.

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F. Snow/ ICE Management:

The roads heat themselves with their embedded heating elements and melt away all the snow.

III. Conclusion

Solar Roadways has taken the first step to creating the world's largest solar panel. For roughly the same cost of the current systems (asphalt roads and fossil fuel burning electricity generation plants), the Solar Roadways can be implemented. There would be no more Global Warming in solar roads. No more power outages (roaming or otherwise). When compared to conventional roads, solar roads have safer driving conditions. Solar roadways are having far less pollution when compared to other roads. Even though the initial cost is high, as it is a system that pays for itself it is a better choice. For under developed and developing countries, it might seem impractical now. But it can be adopted in stages, in future. With technological up gradation in this field, jobs, clean energy and a safer transportation system can be made.

Generally the Solar Pavement will:-

- Create an intelligent, secure highway infrastructure that pays for itself.
- Create an intelligent, secure, decentralized, self-healing power grid.
- Eliminate the need for coal-fired or nuclear power plants.
- End our dependency on oil and other fossil fuels (oil, coal and natural gas).
- Cut our nation's greenhouse gas emissions by over 50%.
- Provide safer driving conditions.
- Snow & ice management
- Traffic management
- Wild life protection
- National security

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