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"Solar Roadways" – Rebuilding our Infrastructure and Economy

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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. SOLAR ROADWAYS

The Solar Roadways consists of structurally engineered solar panels that we drive on. Each Solar Road Panel (roughly 12' by 12') interlinks with neighboring panels to form the Solar Roadways system. The Solar Roadway replaces our crumbling petroleum-based asphalt highway infrastructure with an intelligent road that pays for itself through the generation of electricity. The Solar Roadway generates electrical power from the sun and becomes our nations decentralized, intelligent, self-healing power grid, replacing our current deteriorating power distribution infrastructure.

The Solar Roadway distributes its electrical power to all businesses and homes connected to the system via their parking lots and driveways (made up of Solar Road Panels). In addition to electrical power, data signals (cable TV, high-speed internet, telephone, etc.) also travel through the Solar Roadways, which acts as a conduit for these signals (cables). This feature eliminates the unsightly power lines, utility poles, and relay stations we see all over the countryside. It also eliminates power interruption caused by fallen or broken electrical lines or poles.

Each Solar Road Panel uses some of its own power to light up embedded LEDs, which "paint" the road lines from beneath the road surface. This feature also allows messages to be spelled out on the road surface, such as "SLOW DOWN", or "ACCIDENT AHEAD". Road lines can be instantly "repainted" to direct traffic to a single lane or to detour. This eliminates the need for cones or flares. Better visibility at night with the road lines illuminated, it will be like driving on a well-lit runway.

The Solar Road Panels heat themselves for snow and ice removal in northern climates. No more need for snow removal or school/business cancellations. These safer driving conditions (roads lit at night, no snow/ice, etc.) will prevent many accidents and allow for reduced insurance rates – both health and automotive.

All additional power (unused by the panels themselves) is sent "down line" to homes and businesses. We could produce three times the total electrical power used by the country and almost enough electricity to power the entire world. No more power outages, roaming or otherwise.

The Solar Roadway produces clean, renewable energy. No pollution, no greenhouse gases, no by-products, and the Solar Road Panels are completely recyclable or reusable. The main cause of global warming is creation of electricity by fossil fuels which will contribute to production of green house gases and effect on ozone layer. The Solar Roadways eliminates this (half of the cause of Global Warming) entirely.

The Solar Roadway, being an "electric road", will also make all-electric vehicles more practical; recharging stations can be placed in all parking lots and rest stops. This will allow the all-electric vehicles to have the same driving range of current internal combustion gasoline- or diesel-powered vehicles. Elimination of internal combustion engines, which would now be feasible with the Solar Roadways, would wipe out most of the rest of the causes of greenhouse gases. There are many other features, including wildlife preservation, the elimination of impervious surfaces, law enforcement, DUI detection, counter-terrorism, etc.

An intelligent highway infrastructure and a self-healing decentralized power grid that will eliminate our need for fossil fuels and also it will lead to less invest in antiquated technology viz asphalt and overhead power lines.

As the day by day the price of petroleum products are getting huge hike & resources are very less there will be no longer feasible material such as asphalt for our road surfaces. When Solar Road Panels are refurnished, the solar cells will be upgraded to newest technology, which will allow keeping up with population growth and increased energy needs. Also if such technology is furnished in any of the country; the country will require approximately five billion solar road panels for covering roads, parking lots, drive ways etc. & also such technology will create millions of "Green color" jobs.

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

III. SOLAR PANELS

The solar panels are divided into three basic layers:-

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

3.1 Road Surface Layer

As 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. As 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 and 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.

3.2 Electronics Layer

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. The on-board microprocessor controls lighting, communications, monitoring, etc. which are fitted at every 12 feet distance; which can prove the Solar Roadways as an “Intelligent Highway System”.

3.3 Base Plate Layer

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.

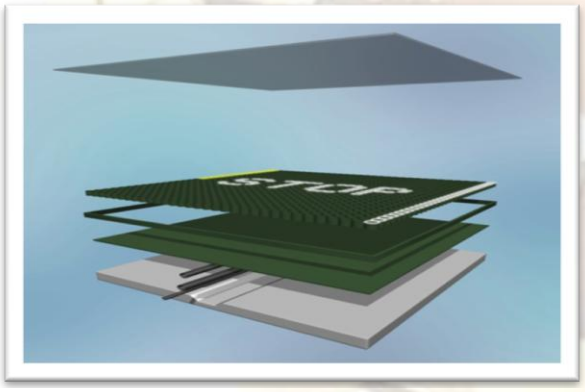

Fig: 1 Different layers of a distinct Solar panel

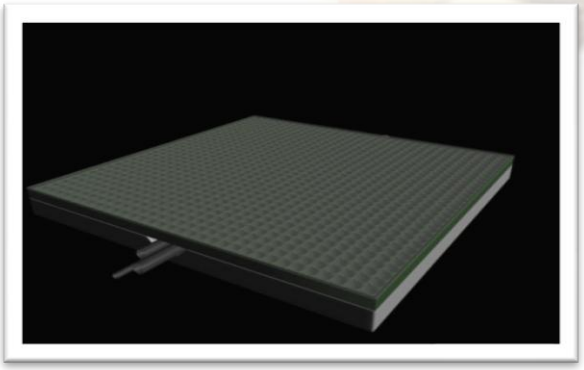

Fig: 2 A single assembled Solar panel

IV. INTELLIGENT HIGHWAY

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.

V. 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.

Fig: 3 Illuminated Highway at Night

VI. OIL INDEPENDENCY

In 2010 alone, we've lost thousands of lives in coal mine and oil rig disasters and gas line explosions. The Gulf of Mexico has become a nightmare: lives and jobs lost - ways of life gone. What (more) is it going to take to drive us to wean ourselves off of our dependency on fossil fuels?

In order to continue at today's pace, we'll have to increase our world supply from 80 million barrels a day to 120 million barrels a day by 2030.The U.S. light-duty vehicle fleet (automobiles, pickup trucks, SUVs, vans and small trucks) currently consumes 150 billion gallons (550 billion liters) of gasoline a year, or 1.3 gallons of gasoline per person a day. If other nations burned gasoline at the same rate, world consumption would rise by a factor of almost 10.

The number of vehicles worldwide, now 1000 million, is expected to triple by 2050, thanks largely to the expanding buying power of customers in China, India and other rapidly developing countries.

While only 3 percent of America's electricity is generated using oil, it supplies virtually all of our transportation needs. We own only 2 percent of the world's reserves, but we use 25 percent of the world's oil. If we could wean ourselves off of internal combustion engines, we'd have no further need for foreign oil. This will require going with all-electric vehicles.

The Americans says that "we love to drive our cars". 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 vehicle each year. Virtually all of these vehicles are powered by petroleum-based fuel.

As the vehicles are increasing the demand of oil is also increasing. Only the America is consuming 25% to 30% of oil for road transport, European Union is consuming nearly about 20% to 22% for road transportation. So the sources of fossil fuel are not sufficient to supply such a huge demand world-wide.

In the early 70's, over half of the globe essentially didn't use any oil. Today, everyone is hooked on trying to create a society that looks luxurious. All people want to live the luxurious life; they want cars and a nice house, air conditioning and refrigeration. And why shouldn't they?

Daily use of petroleum worldwide is 53 million barrels a day for transportation overall; from which 29 million barrels a day for land transport for people, 19 million barrels a day for land transport for freight, 5 million barrels a day for air transport for people and freight.

So what will happen when the world runs out of oil? We know that we've got about another 50 years before this happens, but there are many reasons to believe otherwise; there's a lot of speculation and disagreement on the topic "peak

oil", but one fact is not debatable, oil has a very finite supply.

Suburban's are already in trouble. The whole concept behind suburban life is that you commute to work 30, 40, 50 miles. That's only viable if you have cheap gas. The massive farms that feed the world are worked by internal combustion vehicles.

In the absence of fossil fuel, how many people can the world support? Many people believe 1.5 to 2 billion people. Our planet's current population is now approaching 7 billion people. So again, what will happen when the world runs out of oil?

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 the need for internal combustion engines. The removal of internal combustion engines eliminates our need for oil.

VII. ELECTRIC VEHICLES

Electric cars have actually been around for a long time. They've just never been 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 a parking lots made up of Solar Road Panels. Drivers can recharge their vehicles while eating at a restaurant or shopping at a mall.

Electric vehicles (EVs) are on their way. More and more car manufacturers are offering electric vehicle options. It's a good thing too. Roughly 25% of greenhouse gases come from the exhaust pipes of internal combustion engine vehicles, which we've been using for well over 100 years.

As wonderful as they are, electric vehicles have a major problem, due to their relatively short range (generally less than 180 miles) they have to be recharged regularly, typically at the owner's home. This means that they would be fit for running to the local grocery store and back, but it wouldn't be feasible to take a cross country trip. Basically, with EVs we can just go as far as our EVs initial charge would take us.

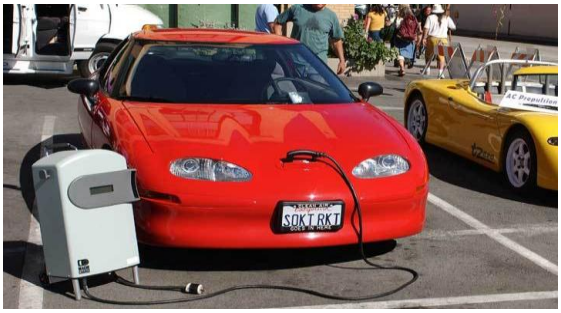

Fig: 4 A model of electric car charging at a parking lot

6.1 How are EVs charged currently?

Fig: 5 Currently the electric vehicles are charged from electricity produced from power plants

The scientific survey in America says (as per July 2010) that the EVs are not ecological in many areas due to less supply or restricted supply of electricity to the areas.

A true accounting of the environmental consequences of these cars would have to include the emissions of the power plants that supply their energy. When Department of energy researchers carried out such an analysis, they found that the results are very considerable with geography.

By dividing the country into different regions as per the power sources within each region - generally, a combination of coal, natural gas and nuclear energy, with a smattering of renewable energy thrown in. And check how a new fleet of electric cars would alter that supply. Nuclear and renewable, which together account for less than a quarter of the electricity supply, are "always on" sources. Their energy gets used up quickly for routine tasks, leaving little to no green energy left over to help charge a burgeoning fleet of electric vehicles. In practical terms, this means that even if you live down the street from wind farm, its energy is already spoken for before you plug-in your plug.

With nuclear and renewable taken out of the equation, 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 dioxide emissions - in some cases by as much as 40 percent below that of an ordinary hybrid. In regions powered mostly by coal - a much dirtier fuel - electric vehicles will lead to an increase in the amount of carbon dioxide released into the atmosphere. The zero-emission tour may have ended this spring, but the controversy over what zero really means is just getting under way.

Since the Solar Roadway creates and carries clean renewable electricity, EVs can be recharged at any conveniently located rest stop, or at any business places that incorporates Solar Roadways Panels in their parking lots (restaurants

for instance). Owners can plug-in their cars in and recharge while they're eating or shopping. Engineers are even investigating ways to use mutual induction to charge EVs while they are driving down the Solar Roadway! By the way using electric cars would eliminate most of the other half of the cause of global warming and could virtually wean the world off oil entirely.

For instance, let's say an EV leaves California and embarks on a road trip to Florida. Let's say the all-electric vehicle gets 180 miles on a single charge. That's about three hours worth of driving on the interstate. By then, most drivers would be about ready for a bathroom break or a snack. They could find a restaurant that incorporates Solar Road Panels in its parking lot. They pull into a parking space, plug their car into the "hitching post", and go inside. By the time the driver/passengers are refreshed their car is recharged and ready to go. They could do the same thing at a rest stop or a shopping mall.

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 the beginning of the end of our dependency upon fossil fuels.

VIII. SMART GIRD

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, tress, 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 centralized power stations including coal and nuclear-powered electricity generation plants. With the Solar Roadway, the road becomes the power grid, eliminating the need for unsightly utility poles and relay stations. Power is generated everywhere - every road, parking lot, and driveway. No more power outages, roaming or otherwise.

The Solar Roadways generates "secure" energy; it can't be deliberately shut down. Not by terrorists, not by power companies, it simply can't be shut down.

The grid is wondrous. And yet - in part because we've paid so little attention to it, as we are in 21st century the grid are becoming old & out dated. It's reliable but not reliable enough, especially in the developed countries & for countries whose population is reached up-to saturation level. Blackouts & power outs costs loss of billions of dollars to such countries so it needs to become more reliable, the rid needs dramatic upgrading to handle a different kind of power, such as transmission of wind power and solar power from remote places to big cities through transmission lines.

Most important, the grid must get smarter. The precise definition of "smart" varies from one engineer to the next. The gist is that a smart grid would be more automated and more "self-healing," and so less prone to failures. It would be more tolerant of small-scale, variable power sources such as solar panels and wind turbines, in part because it would even out fluctuations by storing energy.

Let's consider country like America; in this country more than 150,000 miles of high-voltage transmission lines carry power from 5,400 generating plants owned by more than 3,000 utilities. Most of those lines carry alternating current (AC), but 1.9 percent of them carry direct current (DC), which loses less power over very long distances. The grid works 99.97 percent of the time - but power interruptions still cost the American economy about $80 billion each year. Moreover, our electricity is anything but clean. Most of it comes from burning fossil fuels, about half of it from coal. Hydroelectric, wind and solar power account for less than 8 percent.

"If we don't expand our capacity to keep up with an increase in demand of 40 percent over the next 25 years, we're going to see healthy grids become increasingly less reliable." Demand for electricity has increased steadily for decades, yet transmission lines that transport power from generation plants to customers have not been added or upgraded at the same pace.

Even if transmission capacity is increased, blackouts will still occur. The entire power grid has to be refurnished, because the existing control technology – the key to quickly sensing a small line failure or the possibility of a large instability – is antiquated. To remain reliable, the grid will have to operate more like a fighter plane, flown in large part by autonomous systems that human controllers can take over if needed to avert disaster. Using networking technology to monitor - and react to - what's happening in the grid at each moment can improve efficiency and prevent outages.

We still seem to thinking inside the box; the solution should not be to continue repairing an antiquated system of centralized power stations and distribution methods. Change is hard, but the engine and transmission are like using 40-year-old car, so as the vehicle is to be replaced with new vehicle the transmission is also to be replaced. Decentralizing the production of electricity can make the grid more resilient and save some of the current while when it flows through long-distance transmission lines to the nation's households.

The Solar Roadway is completely decentralized. Every Solar Road Panel can generate

and pass electricity "down-line" to homes and businesses. No loss to heat, no carbon footprint, and no spent fuel rods.

A self-healing smart grid can best be built if its architects try to fulfill three primary objectives. The most fundamental is real-time monitoring and reaction. An array of sensors would monitor electrical parameters such as voltage and current, as well as the condition of critical components. These measurements would enable the system to constantly tune itself to an optimal state.

Each Solar Road Panel measures 12 feet (about 4 meters) by 12 feet and contains a microprocessor board for control, monitoring, and communications. It means that you have a microprocessor (a small computer) located every 12 feet in your power grid. It monitors everything that takes place within its 12 feet perimeter. It tracks voltage and current that it generates, uses, sends to or receives from neighboring Solar Road Panels, etc.

The second goal is anticipation. The system must constantly look for potential problems that could trigger larger disturbances. With a microprocessor located every 12 feet, we'll know when a problem first presents itself. Each of the neighboring (physically connected) Solar Road Panels communicate with each other. If one of them stops communicating, then something is wrong (panel is damaged from lighting strike, overturned truck, etc.). Neighboring panels will still be able to communicate & can send the information to a central control station.

For example, let's say lighting strikes the road and does some significant damage; a hole is blown clean through a Solar Road Panel in the middle of an eight-lane highway. Let's go even deeper and say that a path to ground has been created and massive amounts of current attempt to drain through the damaged panel. Each side of each Solar Road Panel is equipped with a GFI (Ground Fault Interrupter), which would shut off as soon as a current surge was detected by the microprocessors in the undamaged neighboring panels. The lightning damaged panel would be electrically isolated and the surrounding panels could toggle the LEDs bordering the damaged panel. This would "paint" a square around the damaged panel to warn drivers of the danger. Oncoming drivers would be warned of the brief detour. No power outage. Not even a disruption of services to any electrical customers.

The third objective is isolation. If failures were to occur, the whole network would break into isolated "islands," each of which must fend for itself. Each island would reorganize its power plants and transmission flows as best it could.

This objective isn't necessary with the Solar Roadway, albeit certainly possible. The roadway is the power plant and the transmission line. If a tanker truck blows up and severs a road completely in half, no power is lost anywhere (except for the damaged panels). Electricity will just go around on a different road, in the same manner that a vehicle would during a detour. Again, the undamaged neighboring panels would disconnect from the damaged panels and call the problem in.

A self-healing transmission system would minimize the impact of any kind of terrorist attempt to "take out" the power grid. The Solar Roadways can't be "taken out" - not by terrorists, not by utility companies, not by anyone. It provides a decentralized, secure, intelligent, self-healing power grid.

IX. ADVANTAGES & DISADVANTAGES

9.1 Advantages

9.1.1. Renewability and life-span

The main advantage of the Solar Roadway concept is that it utilizes a renewable source of energy to produce electricity. It has the potential to reduce our dependence on conventional sources of energy such as coal, petroleum and other fossil fuels. Also, the life span of the solar panels is around 30-40 years, much greater than normal asphalt roads, which only last 7-12 years.

9.1.2. No requirements to develop environmentally sensitive lands

Another advantage of the Solar Roadway is that it does not require the development of unused and potentially environmentally sensitive lands. This is currently a very controversial issue with large photovoltaic installations in the Southwestern US and other places. But since the roads are already there, this is not an issue. Also, unlike large photovoltaic installations, new transmission corridors -across environmentally sensitive land- would not be required to bring power to consumers in urban areas. Transmission lines could simply be run along already established roadways.

9.1.3. On-the-go charging

With induction plating embedded inside these roads, all electric cars can be recharged while in motion on top of these roads. This would reduce the costs and the time-inconvenience to wait at a charging station.

9.2. 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 costs 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 nations due to the high initial start-up costs. Road surfaces also accumulate rubber, salt, etc., which block sunlight. Salt might be

easy to wash off, but not rubber. It would also be quite costly.

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.

X. CONCLUSION

We can't wait any longer to find a replacement for oil, which is rapidly disappearing. Our dependency on oil has long been a matter of national security and we don't want to 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 counties the major part of the geographical area is to be explored in terms of road connectivity. So instead of implementing the higher targets roads to be developed per day such countries can reduce the target and develop solar road so they could improve economy with infrastructure.

Generally the Solar Roadways will:-

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

"Let's make things to happen rather than waiting things to happen"

"It's better late than never"

"Let's go greener"

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