Innovative of Power generation with PV Technology on Solar Roadways

Monika B. Dhoke
PG Student
Department of Integrated Power System
TGPCET

Pratik Ghutke
Assistant Professor
Department of Integrated Power System
TGPCET

Abstract

This are other approaches and methods of using solar photovoltaic technology on highways, for example, using solar-powered LED roadway lighting, security lighting, highway changeable message, etc. Although these are very important applications, in terms of power generation or power saving, they are almost negligible in comparison to the approach that it has suggested in this paper. Also, one can see the cost-oriented modeling and design optimization for alignment to determine operation and engineering cost of the highway.

Keywords: Solar, LED, Cost-oriented, Optimization, Highway

I. INTRODUCTION

This Solar energy, radiant light and heat from the sun, is harnessed using a range of ever-evolving technologies such as solar heating, solar photovoltaic, solar thermal electricity, solar architecture and artificial photosynthesis. Solar technologies are broadly characterized as either passive solar or active solar depending on the way they capture, convert and distribute solar energy. Active solar techniques include the use of photovoltaic panels and solar thermal collectors to harness the energy. Passive solar techniques include orienting a building to the Sun, selecting materials with favourable thermal mass or light dispersing properties, and designing spaces that naturally circulate air. Energy generation using solar photovoltaic requires large area. As cost of the land is growing day by day, there is a strong requirement to use the available land as efficiently as possible. Here, we explored the potential of energy generation using the land above national road highways by constructing a roof structure. This space can contribute to the energy generation without extra cost for the land. It also results in energy efficiency, for example, improved vehicle movement and minimum energy for air conditioning of vehicles. Additionally, it also helps in minimum road repairs and longer vehicle tire life due to the effect of sun shade. Thus, the expenditure for wear and tear for road repairs is reduced considerably. From our modeling study, it is observed that the highway can generate 104 MW of electricity (163 G Wh of annual energy generation) and the A highway space can generate 61 MW of electricity (96 G Wh of annual energy generation) for single-layer solar panels. If there are two layers of solar panels one over the other, the annual energy generation of the same highways, can be increased to 229 G Wh and 140 GWh, respectively. If our concept is implemented throughout India, it not only increases the power generation to more than a few giga watts of electricity but also has other various fringe benefits including longer road life, employment generation, reduced CO2 emission in environment, etc. A solar roadway is a series of structurally engineered solar panels that are driven upon. The idea is to replace current petroleum-based 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. The Solar Roadway is an intelligent road 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. Solar roadways without training, which in turn will raise the overall cost of the project. This is one major detriment to the Solar Roadway concept. Our broad vision of the concept of solar roadways is to ultimately replace all drivable, impermeable surfaces, such as asphalt roads, with energy producing solar panels.

II. LITERATURE SURVEY

From the study of cost economics of a solar photovoltaic power plant, the PV module cost is about 45% and that of the other accessories like transformers, cables, Inverters, civil works, etc. comes to about 55%. Additionally, the cost of the power plant also depends on the land value. As the cost of solar photovoltaic is continuously decreasing, the major challenge now lies on the land cost. Land is becoming a scarce resource in India in recent years, and per capita land availability is low. Land is often considered as the topmost challenge for deploying solar energy technology. In view of the above, the study is based on using the available

land in an effective way. There are other approaches and methods of using solar photovoltaic technology on highways, for example, using solar-powered LED roadway lighting, security lighting, highway changeable message, etc. Although these are very important applications, in terms of power generation or power saving, they are almost negligible in comparison to the approach that it has suggested in this paper. Also, one can see the cost-oriented modeling and design optimization for alignment to determine operation and engineering cost of the highway. The rationale behind the proposed study is to explore the effectiveness of using the national highway and to enlarge all the factors to generate energy. The additional advantage of using the space above the road highways for installation of solar panels is the shading on the roads. This results in improved vehicle efficiency by reducing energy losses due to heat inside the vehicle and also improves the life of the tires of all vehicle wheels due to the shade derived from the road. One needs to take care of fixing the solar panels to the base firmly onto the structure. Fixing the solar panels at an elevated location, say about 9 to 10m above the ground level, is vulnerable to heavy wind during the storm or rainy days. It may pose a problem for the stability of the solar panels as compared to the ones close to the ground. With extra care of fixing, the panels may overcome this problem. Another problem may be from the dust and smoke particles due to movement of the vehicles. However, as many national roadways are wide and generally much cleaner than other roads, for example, village roads, narrow city roads, or state roads, in any case, one needs to make special arrangement of cleaning the panels on a daily basis as compared to normal panels on the ground away from the road traffic or remotely located panels, where cleaning of panels is done once in a week or 10 days

III. RESEARCH ANALYSIS

The primary objectives of this study can be summarized as follows.

1) An approach to utilize solar energy to meet the global challenges like climate change, pollution, and energy insecurity and also to address the biggest challenge for the photovoltaic technology, i.e, land cost.
2) Main objective of this road rooftop solar project is increase of the life of the road from wear and tear on the highways, and this helps to reduce the fund requirement for road repairs. Another benefit is rainwater harvesting at selected locations.
3) Some of the least talked about advantages up to this point, but perhaps the most impressive, are the wonders that solar roadways could accomplish for environmental conditions. For over 100 years, fossil fuels have made up about 80% of the United States' energy consumption, which can be viewed. If this trend continues, an impending oil crisis will be absolutely catastrophic given that experts estimate there is only enough oil left to last the world 53 more years at current consumption rates not to mention, the price of a barrel of oil would skyrocket years before that point. Also, climate change continues to occur at rates that exceed the estimates of scientists, with most believing this is directly caused by the exhaustion of fossil fuels.

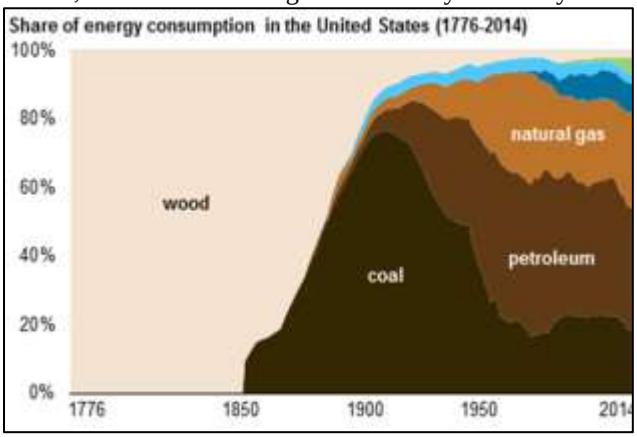

Fig. 1: Graph of energy consumption in the United States for each material per amount

Fig. 2: One hexagonal solar panel showing the inner PV cells and LEDs.

As mentioned previously, implementing a solar roadway system has been accomplished before in small prototype tests. A project known as Watt way, created by the French infrastructure company Colas, was executed near Normandy. This successful example of a Solar Roadway is one kilometre in length and contains about 30,000 square feet of solar panels which are used to power the local streetlights. Although the actual design of Watt way varies slightly from our previously proposed design, the method of installing and transforming existing asphalt roads mirrors our proposed method. Watt way was constructed by simply laying the prefabricated flat solar panels over asphalt roadway that was already in place. This is the most efficient way to install a Solar Roadway system since existing asphalt roads will not have to be removed or completely replaced so long as they are in decent condition. In the end, this will save construction costs, time, and amount of waste produced.

Fig. 3: Output power generation

IV. CONCLUSIONS

The In future, normal roads can be replaced by the solar roadways but huge initial investment is required. 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. The alternative of airports and parking lots are under varying timelines.

REFERENCES

[1] Lal, S, Raturi, A: Techno-economic analysis of a hybrid mini-grid system for Fiji islands. Int. J. of Energy and Environ. Engineering 3, 10 (2012)
[2] Oyedepo, S: Efficient energy utilization as a tool for sustainable Development in Nigeria. Int. J. of Energy and Environ. Engineering 11 (2012)
[3] Bhutto, AW, Bazmi, AA, Zahedi, G: Greener energy: issues and challenges for Pakistan—solar energy prospective. Renew. Sustain. Energy Rev. 16(5), 2762–2780 (2012)
[4] Dinçer, F: Overview of the photovoltaic technology status and perspective in Turkey. Renew. Sustain. Energy Rev. 15(8), 3768–3779 (2011)
[5] Zweibel, K: Should solar photovoltaic be deployed sooner because of long operating life at low, predictable cost? Energy Policy 38(11), 7519–7530 (2010)
[6] "Solar Roadways - Phase II Grant; Small Business Innovation Research." Small Business Innovation Research.
[7] "Alternative Uses of Highway Right – of - Way". Federal Highway Administration.
[8] Barry, Keith (2014 – 05 - 08). "This Parking Lot Is Paved With Solar Panels". Autopia. WIRED. Retrieved 2014 – 05 24
[9] Solar Roadways; Indiegogo; Crowd funding ended June 20, 2014.
[10] "The Centuries Old Technology Behind Solar Roadways, Indiegogo's Most Popular Campaign Ever" Forbes. 3 June 2014.