International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2015): 6.391

Solarization of Petrol Pumps in India: An Environmental-Friendly Alternative and its Role in Creating Awareness

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Abstract: ***The transport and logistics division is a significant fundament that is vital for the advancement of a nation like India.As per the World Bank report, in the vehicle and logistics industry segment, India demonstrates predominant development and roadways hold an estimated share of 80% of the land transport in India. An effective road system is required for national amalgam, for financial enhancement and to support Indian monetary development. As a well–knit and composed arrangement of transport assumes a vital part in the development of a nation, necessity and interest of the petrol pumps are likewise increment. With the help of solar power solution for petrol pump, we can utilize the power of innovative renewable technology such as solar in providing uninterrupted power to customers and businesses in various applications. Since climatic states of India give copious sunlight based radiation amid most part of the year there is tremendous potential and additionally scope for solar electrification of the country. Thus, if we look at the renewable energy potential, solar energy provides a great opportunity for India to have a sustainable energy scenario. Hence, in this article an effort is made to identify the impact of solarization of petrol pumps and their role in creating awareness about Solar Energy systems.***.

Keywords: Solar energy systems, Photovoltaic, Petrol Pumps, Environment, Awareness

1. Introduction

Roads are the key way to the improvement of an economy. A decent roadways system constitutes the fundamental framework that quickens the development procedure through availability and opening up of the backwards area to trade and business. Road networks play a key part in between modular transport advancement setting up connections with air terminals, railroad stations and ports. They have a vital part in advancing national coordination, which is especially vital in an extensive nation like India. Since freedom, there has been an enormous increment in the volume of road activity, both traveler and cargo. The annual growth of motorized vehicles during the last decade was around 10%. Compared to 48.7 million vehicles in 2000 the number of vehicles nearly increased in 2013 with 182 million [1]. Figure 1 gives an overview of the development of the motorized transport vehicles from 2000 to 2013. The extensive road network in India consists of 4.6 million km and is the second largest road network in the world [2]. About 61% of the freight and 85% of the passenger traffic is carried by road. The annual growth of cargo traffic is 15-18% and that of passenger traffic is 12-15% [3]. Since there is tremendous rise in the number of transportation vehicles, thereby, it results in the insatiable need of petrol and others petroleum products, which further has led to a steady rise in the number of petrol pumps in the country. Although India, which as of now has the most astounding number of petrol pumps on the planet, will soon get another 35,600 retail outlets in next 2-3 years as government sets out on a huge development plan to support oil item accessibility [4]. An All India Study conducted by *M/s Nielsen (India) Pvt Ltd* for *Petroleum Planning and Analysis Cell (PPAC)* of Petroleum Ministry has thrown up interesting data about use of diesel and petrol sold across various states. As per the All India study report submitted to PPAC, 70% of diesel and 99.6% petrol is consumed in the transport sector alone.

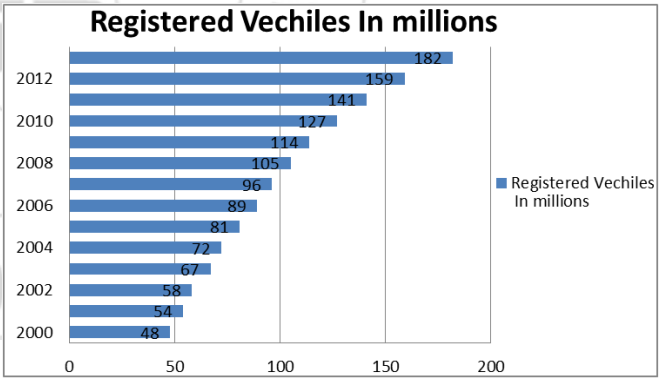

Figure 1: development of the motorized transport vehicles from 2000 to 2013.

At present, the nation has 51,870 petrol pumps with Indian Oil Corp (IOC) being the business sector pioneer with 23,993 outlets, trailed by Hindustan Petroleum Corp Ltd (HPCL) with 12,869 pumps and Bharat Petroleum Corp Ltd (BPCL) with 12,123 outlets.[3] Private segment has small nearness with Reliance Industries and Essar Oil owning around 1,400 outlets each and Shell working three.

Although there is huge number of petrol pump stations catering to the fuel demand of the country, however reliability and operational efficiency of most of petrol pumps severely affected by power shortages, as most of petrol pumps usually located in either rural areas or outskirts of

urban areas. Petrol Pumps adjacent to national highways or express ways usually face power shortages for period of 8 to 10 Hrs a day as they are located in rural areas where there is always a significant gap between electricity demand and supply. Since these petrol pumps need 24 X 7 significant measure of power every day for their day by day operational exercises, and are commercial units hence charged steep electricity rates. Most petrol pumps endure real misfortune because of unpredictable supply which results in loss of fuel, time and cash. This situations bound them to maintain expensive DG Set for uninterrupted power supply which have various environmental impacts and health hazards.

Albeit Over the years, Indian power sector has encountered noteworthy development - a hop from 30,000 MW in 1981 to over aggregate capacity i.e, 210951.72 MW (as on 31/12/2012) in India [5]. Yet at the same time there is a tremendous crevice demand and supply.Thus should be set up more generation plants ideally to be originated from renewable sources by administrative and additionally different private cooperation. In this way emerging and most recent solar photovoltaic advances can be created as future potential option for power generation on individual level furthermore at group and community level too in India.

2. Solar Energy Status and Current Scenario in India

If we attempt to take a gander at all the renewable energy sources, it is seen that India is among the main 5 destinations for application of solar energy systems on the planet according to Ernst and Young's Ernst & Young's renewable energy attractiveness index. Because of its unique position area between the Tropic of Cancer and the Equator, India has a normal yearly temperature that reaches from 25°C to 27.5 °C, which implies that India has an enormous sun based potential . Most parts of India have 300 - 330 sunny days in a year, which is comparable to more than 5000 trillion kWh every year—more than India's aggregate energy consumption every year [6]. India is expected to have installed solar energy capacity of 20,000 MW by 2022 [7]. Solar radiation levels in various parts of the India are given in Figure 2. It can be watched that in spite of the fact that the most elevated yearly worldwide radiation is gotten in Rajasthan, northern Gujarat and parts of Ladakh area, the parts of Andhra Pradesh, Maharashtra, and Madhya Pradesh likewise get genuinely extensive measure of radiation when contrasted with numerous parts of the world [8]. Since climatic circumstances of India give inexhaustible sun powered radiation amid most part of the year and provincial India needs supply of sufficient customary matrix power, there is immense potential and also scope for sun based zap in rustic zones of the nation. Consequently, on the off chance that we take a gander at the renewable energy potential, Solar energy gives an incredible opportunity for India to have a sustainable energy scenario. Hence, Solarization of Petrol Pumps can be considered as an environmental friendly initiative for ensuring the uninterrupted power supply in India.

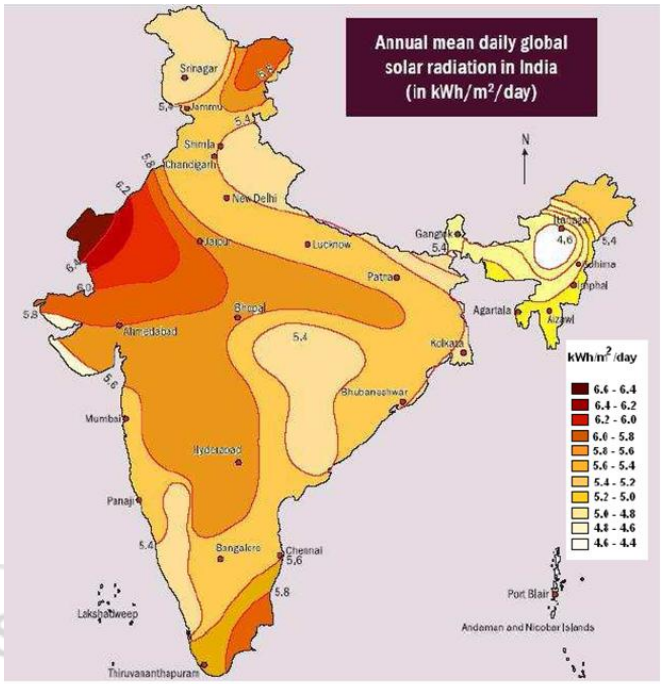

Figure 2: Annual Mean Daily global solar radiation in india. (As per MNRE)

2.1 Solar PV System for Petrol Pumps

The idea of solarization of petrol pumps offers an alluring answer for prolonged blackouts. Standalone solar system for petrol pumps are more proficient because of lower transmission losses as they are introduced close to customer premises and specially designed for jerk starting of pumps. To carry out the research following two systems were used. One petrol Pump belongs from rural area and another one is very closed to the *National Highway 57* in *Jhanjharpur area of Madhubani* District:-

Table 1: System Specifications

Specification	System Type -1	System Type -2
System for Outlets	Suitable for Highways outlets	for Outlets in Rural area
Solar PV Power System	6 kWp Solar PV Power System	4 kWp Solar PV Power System
Dispensing Pump	4 DUs – 2 of 1 HP & 2 of 0.75 HP) (3.5 HP motor). – 5 hours/day on Solar	(1 HP motor). – 4 hours/day on Solar (0.75 HP motor). – 4 hours/day on Solar
Fan (80 W)	1 no – 10 hours/day	(80 W) 1 no – 10 hours/day
LED (12 W)	6 nos. – 12 hours/day (for canopy)	4 nos. – 12 hours/day
Inverter Size	6 kVA 230V, 1-ph, 50Hz inverter * 2 nos	3 kVA 230V, 1-ph, 50Hz inverter * 2 nos
System voltage :	96 V	48 V
Autonomy	2 days (1 + 1 –No Sun Day")	

2.2 Operation of the system

The schematic diagram of solar PV system for the solarization of Petrol pumps are shown in figure number -3. Solar Photovoltaic array produces DC electricity directly

from the sun light. The Power Conditioning Unit (PCU) will provide conditional output to support load as it's consist of MPPT charge controller and bi-directional inverter to supply continuous power to the dedicated local load with support (power) to the load coming either from the solar array, battery bank or grid/DG in that order of preference. The existing battery bank is required to support the load in case of longer power cuts or grid/DG un-availability

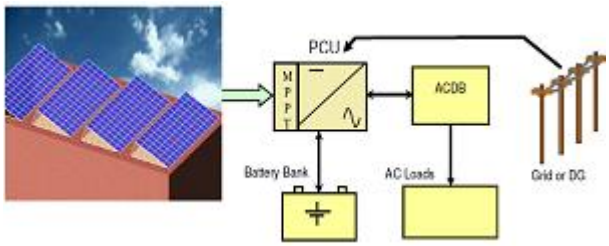

Figure 3: Schematic diagram for the solarization of Petrol pumps

2.3 Theory of Operation

The 1-phase system incorporating a bi-directional inverter is designed for capability to supply continuous power to a dedicated local load with the power to the load coming either from the solar array, battery bank or grid/DG in that order of preference. It is capable of operation in a –grid interactive or grid charging" mode and will automatically change over to –stand alone" operation with no break in power in the event grid moves out of range in its individual phase voltages or frequency. When the grid does come back into range, the system will change over to –grid interactive" mode. Under the grid interactive or grid charging mode the battery bank is kept at its nominated float voltage with the required charge coming from the solar array or the grid. However, the local load, up to the full instantaneous available capacity of the solar array and limited to the maximum capacity of the inverter, will be supplied from the inverter with the balance of the energy coming from the grid/DG. Apart from it, under STANDALONE MODE· The local load will be supplied directly from the inverter with the energy coming from the solar array and the battery bank in the event the load is greater than the available array power.

2.4 Methodology

The petrol pump station was visited both during daytime and night time to get an overview of the consumption pattern by different electrical gadgets and to conduct the survey. The broad objective of the study was to estimate the stakeholders' opinions about their thinking about solarization of petrol pumps. The questionnaire, which is used for this survey comprised 21 questions, mostly multiple-choice, but also some open questions. The questions were on the stakeholders' general perceptions about Solar Photovoltaic Energy, their opinions about the credibility of Solar PV technology, potential impacts of solar electrification and their significance, their current preparedness to energy security and its impacts, and the need to solarization and the needed measures to be taken. Stakeholders are those who have interests in a particular decision, either as individuals or as representatives of a group [9]. They are people who influence a decision, or can influence it, as well as those affected by it. In this study, stakeholders were drivers of Cars & Utility Vehicles (UVs) as well as Commercial, Buses, Light Commercial Vehicles (LCVs) & Heavy Commercial Vehicles (HCVs) and Agriculture vehicles like Tractors, Pump Sets, and Other Agri Equipment). For both the petrol pumps, this exercise was carried out for 12 hours (6 hrs. in day and 6 hrs. in night for 15 days. This questionnaire was administered to the outlet owner/manager by the supervisor on duty along with researcher teams.

2.5 Key Finding

During the study, in-depth survey had been carried out of those who are coming to the petrol pumps for taking fuel in the tanks of their vehicle. The survey had been carried out both in urban and rural petrol pumps with a limited sample size. The total number of observations was 4000 i.e. 1000 in each round. The major findings are enumerated below:

1) 83% of vehicles owner feel happy to know that the particular petrol pump is running through solar.
2) 94 % of vehicles owner said that they will inform other colleagues or family person about the solarization of particular petrol pumps.
3) 87% percent of vehicles owner confirmed that solarization of petrol pumps, assured them to believe in this technology and they will use solar PV based technology for their house hold or personal purpose too.
4) 72.5% of vehicles owner who comes on rural petrol outlet, said that it will help them in emergency situation, as earlier there was no fixed time for closing of petrol pump.
5) 60% person of Light Commercial Vehicles (LCVs) & Heavy Commercial Vehicles (HCVs), who spend their nights in Petrol Pump area visited to Solar System, and confirmed that this sytem makes them believe in potential of Solar energy.
6) Although only 20% vehicles owner know about climate change and global warming, but 94 % confirmed that solarization of petrol pumps is a environment friendly initiative.

3. Other Findings

After 15 days of Solarization of rural petrol pump, it is found that there is a 10% more vehicle coming to petrol pumps for getting fuel. It is found that news of solarization of petrol pumps from other colleagues; ensure them about getting the fuel. Hence they came particularly to that petrol pump instead of going other petrol pumps. It is also confirmed by petrol pump owner that he received 5000.00 less in electricity bill, within 15 days of solarization of petrol pumps. It is also evident from open interaction with the employees of petrol pump, that after solarization of petrol pump, working condition improve significantly as there is no noise due to DG set , less smoke and as there is not DG is running and also there is no conflict among them for operation of DG set. Most of them feel that, after solarization of petrol pump their income will increase, because now petrol pumps can work 24 X 7. In this way it is feel that this solarization of petrol pump is also enhancing job security.

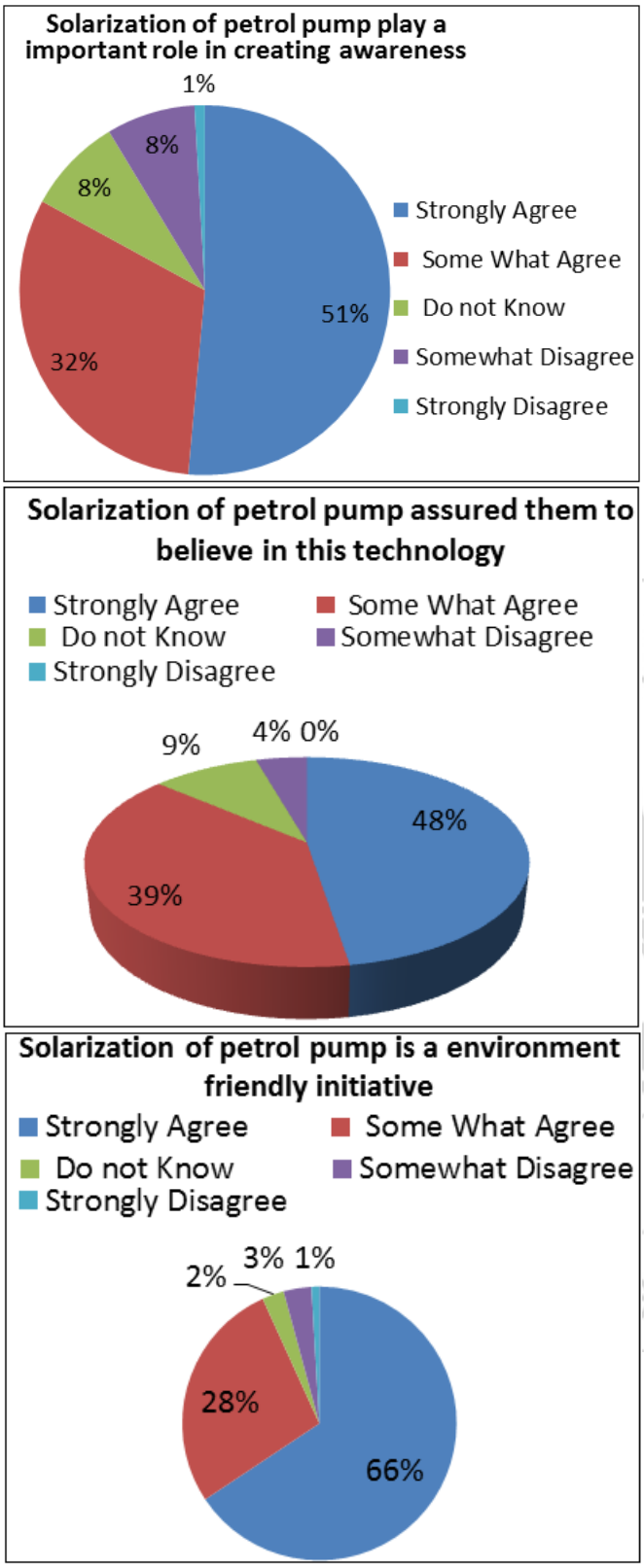

Figure 4: Key findings graphic illustration

4. Conclusion

The main objective of this research is to identify the impact of solarization of petrol pumps and their role in creating awareness about Solar Energy systems. It is intended that a greater understanding of it, will make it easier for government and other petrol pumps owner to take steps for solarization of petrol pumps. It is found that increasing the awareness, knowledge and experience of solar energy is the key area which will influence the use of solar energy. As well as increasing knowledge for its own sake, greater knowledge has the ability to influence the other key areas affecting solar energy such as: Changing the perception of cost as a barrier to solar energy. Greater knowledge is required to change negative attitudes and mindset toward solar energy. It is also evident that awareness is a vital component of implementing new technologies The level of knowledge of stakeholders involved in solar energy decisions impacts all aspects of using solar energy. This includes how and what stakeholders perceive to be the barriers to solar energy, whether they translate this into action in the current environment.

However, this research provides a starting point for closer examination of the role of live example like solarization of petrol pumps, in awareness of solar energy. Also for future research, it would be interesting to determine whether awareness and knowledge are disseminated differently and the most effective channels for distribution. Recent national and subnational policies highlight India's commitment to meeting transportation demands while promoting development and minimizing environmental impacts. Following the Copenhagen Accord, India has endorsed the goal of limiting greenhouse gases to a target corresponding to 2°C temperature stabilization while following the national sustainable development goals. It would also be interesting to examine the differences in awareness created by solarization of petrol pumps held by individuals and by organizations and how organisations in the Petroleum Industry can promote greater use of solar energy despite the limitations of the project by project nature of the industry.

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Kundan Sagar is a Post Graduate research Scholar at Nalanda University, Rajgir, Bihar. After completing Bachelor Degree in Electrical & Electronics Engineering in 2010, he gained four year of experience in the field of solar energy, where he had executed various project on rural electrification in the Sundarban delta area and the Himalayas regions. Currently his research work is focused on ~~r~~ole of Solar Energy in Disaster management and its contribution to climate change Mitigation".