

GRID CONNECTED SOLAR POWERED CHARGING STATION FOR ELECTRIC VEHICLES

Project Report

Submitted to:



DIRECTORATE OF ENVIRONMENT AND CLIMATE CHANGE
പരിസ്ഥിതി കാലാവസ്ഥ വ്യതിയാന ഡയറക്ടറേറ്റ്
GOVERNMENT OF KERALA

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ABSTRACT

Extreme Climate change is a topic widely being discussed throughout the world. The main cause for climate change is due to the excess release of pollutant from automobile sector. As we all know that the future of transport sector is developing towards the Electric Vehicle technology. Kerala now has over 25 lakh licensed vehicles on the road. It is expected to have a large number of electric vehicles in the near future. EV requires regular charging which in turn increases the demand for charging stations. This demand will encourage the government to depend on generating station with fossil fuels as the driving fuel. This project proposes the installation of Grid connected Solar Powered Charging Station for Electric Vehicles to deliver sufficient charging of electric auto's. Automated control of lights near the Charging station and the total cost of charging station is reduced by the elimination of batteries. Project encourages the usage of renewable energy to reduce the impact of generating stations to the environment.

PREFACE

GREEN CHARGING STATION AT KOLLAM -A Grid connected Solar Powered Charging Station for Electric Vehicles is getting inaugurated at the Municipal building at the heart of Kollam City next to Chinnakkada Over bridge. This project worth **Rs 6.78 Lakhs is funded by the Directorate of Environment & Climate Change (DoECC)**. The project has been implemented by the Department of Electrical and Electronics of TKM College of Engineering, Kollam. The team consisted of **Dr Sheeba R, Dr Sheikh Mohammed S, Mr Varun S Prakash and Mr Abhiraj** worked towards the realization of this dream project.

The project is currently implemented with a 6kW On Grid Solar Power plant on the rooftop of the Thankappan Memorial Municipal Building. The expected generation per day is approximately 25 kWh (25 Units) with absolutely “ZERO” emission. The charging station is placed on the ground floor and the primary source for the charging unit is the solar PV system. The On-grid solar power plant is connected to the KSEBL utility grid also. Therefore, the power balance is achieved with the help of KSEBL utility supply as follows. When no vehicles/ less number of vehicles are connected for charging during daytime, excess power will go to the grid. In the same way, the required amount power will be drawn from the utility grid during night time or when the generation is lesser or no generation. Hence, generated power will be effectively utilized. This reduces the overall cost of charging from the charging station and reduces the environment pollution effect.

The charging station is equipped with three 3.3kW (AC 001) charging port. Three electric vehicles can be charged from this station at a time with a charging rate of 3.3kWh.

The Fast charging stations being setup by the Government agencies as well as by KSEBL, draws the power from the grid which will certainly be increasing the generation demand as the number of EVs increase in the future. As the generation increases, CO₂ emission also will increase and will lead to climate changes and other environmental issues. But, the Solar Powered Grid connected charging system will feed power into the grid from the system when there are no vehicles and then will draw the power back from the grid whenever required. Although currently, it is made with 6kW, the capacity can be enhanced to 10kW in future.

The complete project is being handed over to the Kollam Corporation and the kiosk will be run by the Corporation, which will give employment for at least two persons.

The Directorate of Environment and Climate Change had called for projects meant for saving the environment and safeguarding our atmosphere from the climate change. The projects were to be sustainable also.

Climate change and environmental pollution are the major threats to the living organism on the earth. The key reason for environmental pollution and climate change is utilization of fossil fuels. The **Paris Agreement** is an agreement within the United Nations Framework Convention on Climate Change (UNFCCC), mainly dealing with greenhouse-gas-emissions mitigation. The Paris Agreement's long-term temperature goal is to keep the increase in global average temperature to well below 2 °C (3.6 °F) above pre-industrial levels; and to pursue efforts to limit the increase to 1.5 °C (2.7 °F), recognizing that this would substantially reduce the risks and impacts of climate change. Electrification of transportation and utilization of renewable energy are recommended as the critical solutions to accelerate the reduction of Green House Gas Emissions which significantly reduces the temperature rise and environmental pollution.

The above stated problem has directed to develop a combined solution which fulfills the charging needs of EVs in a sustainable way and a Solar Powered Charging station for EVs is proposed. The researchers behind this idea, Dr Sheeba R and Dr Sheik Mohammed S has reported that the whole scheme ensures a completely sustainable model for the Kollam Corporation, where the money earned from the charging of EVs can be used for paying the salary of the persons employed for running the kiosk. These are the points which made them eligible for the award of this project.

The major outcome of the project is to reduce the carbon footprint from the energy usage which makes the idea truly of international standard. This will also promote people to use more Electric Vehicles and thus reduce the environment pollution.

Kollam Corporation has made a formidable step in promising a greener world to the people here. TKM College of Engineering has always devoted time and effort for building Kollam Safer, Greener and Beautiful. This project reinforces the drive even more and will certainly pave the way for such collaborations in future also.

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Abbreviations and Notations

1. EV - Electric Vehicle
2. PV - Photo Voltaic
3. EHV - Electric and hybrid vehicle
4. KAL - Kerala Automobiles Limited
5. DISCOMs -Distribution companies
6. SAE - Society of Automotive Engineers
7. PCS - Public Charging Stations
8. PMAO - Public Metered AC Outlet
9. MPPT - Maximum Power Point Tracking
10. LDR - Light Dependent Resistor
11. BEVC - Bharat Electric Vehicle Charger

Chapter 1

INTRODUCTION

1.1 General Background

There has been a rapid growth in the use of Electric Vehicles as an alternative to gas-powered vehicles due to the increase in awareness towards a sustainable lifestyle. Traditionally, the Electric Vehicle charging has been grid-based but the technological advancement in the field of solar energy has led to the use of solar powered chargers for the Electric Vehicle charging. These pollution free solar chargers provide clean electricity to the Electric Vehicles and additionally results in a green environmental effect. Furthermore, the introduction of these charging stations would enable the people to rethink their means of transportation choices and thus switching to zero-emission vehicles [1].

By every year Electric Vehicles are becoming more and more affordable this leads the investors to start investing on charging station due to its increasing demand. At present, Electric grids are more dependent on fossil fuels than that of the renewable energy. Though EV's are electrically driven, they also will contribute to harmful emissions as electrical energy production for charging stations should also be taken into consideration are going to be additional generation from fossil fuels. Thus, in order to reduce the impact of the harmful emissions; renewable energy particularly solar energy based electric vehicle charging stations can be built [2]. This project provide the design of a charging station that uses conventional grid supply for commonly available vehicles, to design and develop a solar fed charging station, to collect power details of electric vehicles, to implement the charging station that has the capability to utilize solar energy when it is available and switch to grid supply otherwise[3]. A charging station powered by the conventional grid supply has got many limitations and disadvantages and hence we use solar energy for the charging purposes. The switching circuit enables the switching of circuits and the implementation of MPPT (maximum power point tracking) enables the tracking of maximum solar energy.

1.2 Objective

- Design a suitable charging station for electric vehicles.
- Design a solar powered charging station to eliminate the over usage of fossil fuel which increase air pollution and lead to climate changes.

Raised demand forces the government to depend on the thermal power plants, which uses coal as its driving fuel. The main emissions from coal-based power plants that contribute to air pollution include sulphates, nitrates, mercury, and secondary particulate matter (which is largely formed by SOX emissions). Coal, fly ash, and secondary particles from thermal power plants and industries in Delhi contribute 35% of PM_{2.5} in the winter and 41 %s of PM_{2.5} in the summer. Since Delhi has 13 thermal power plants with a capacity of over 11,000 MW within a 300-km radius, these emissions are often blown into the NCR by the north-westerly winds.

- Design a user interface for electric vehicle charging.
- Design automatic control circuit for streetlight near the local station.
- Design of mobile phone charging circuit.

1.3 Scope

Grid connected solar fed Charging station, this is a renewable energy harvesting by the use of PV Panels, which would enable the charging of electric vehicles. Grid connection of such energy will help the sharing of energy with economic benefits. Usage of this smart charging reduces the cause for climate change in certain manner. Recently there are some electric rickshaws are in roads, and increase the number of these. The focus of this charging station is these electric rickshaws. Mobile Phone Charging Facility can be implemented in the Station for the Public. Automated control of Street Lights around the Local Station will useful during the night.

1.4 Outline of the Project

This project is a focus of exposing the necessity of sustainable energy sources in the current energy sector of the country. The severe requirement of large amount of energy discusses the issue of new energy infrastructures. The project expresses its idea of modularising the energy source as whole to single sustainable charging station which an act as a network of energy source or as independent. The idea here is to provide a Solar system, which is suitably selected considering the load that would receive in the near future. The solar panel system is a grid-connected system thus enforcing to supply energy to and from with the network. This would encourage the flexibility of energy within the network. Charging station is a smart user-friendly station, which can provide sufficient energy to be fed to the user's vehicle through proper channel of user interface screen. The system also provides provision for updating the charging and related data, with the internet cloud storage systems. The charging

station also is occupied with a mobile charging circuit, which enhances the comfort of the user and automatic lighting system for the station itself.

1.5 Conclusion

The current scenario in the Kerala's power generation is that, of the total power generation about 73.06 % is produced from hydro power plant. Hydropower has the ability to generate electricity without emitting greenhouse gasses. However, it can also cause environmental and social threats, such as damaged wildlife habitat, harmed water quality, obstructed fish migration, and diminished recreational benefits of rivers. The other option of production is from thermal power plants, which is a major threat of producing environmental pollution.

By the effective implementation of proposed a Grid connected solar powered charging station can reduce problems caused due to the future demand crisis. Economically this would enable the public sector to improve the project through protection against environmental pollution. The project can be implemented through a cost effective, pollution free technique by the elimination of batteries in the operation. Grid connected Solar Powered Charging Systems helps in sharing power to the main supply covering the demand for electricity to some extent.

Chapter 2

LITERATURE SURVEY

2.1 Introduction

From recent reports, Kerala Automobiles Limited's (KAL), and Mahindra Trio introduced a three-seater environment- friendly auto rickshaw which is the first public sector undertaking to get approval in the country. The KAL has planned to commercially produce e-autos across Kerala, with limited public charging stations. Demand for the charging stations indicates the importance of our Project in the present situation.



Figure 2.1: Electric auto developed by Kerala automobile Ltd(KAL), and Mahindra Trio

2.2 Contemporary Review on Charging Station Development

The design of charging station infrastructure relies on the standard of electric vehicles available in the area of implementation. Various charging techniques can be incorporated on analysing the requirement of the connected load. Charging of the Electric Vehicle battery is generally achieved by three methods: Conductive charging method [4,5], Inductive charging method [6,7] and Battery swapping technique [8,9]. Electric auto rickshaws, which favour conductive charging, is our focus of study. Conductive charging techniques are classified as Level one charging, Level two charging, DC Fast charging, based on the charging time and supplied power.

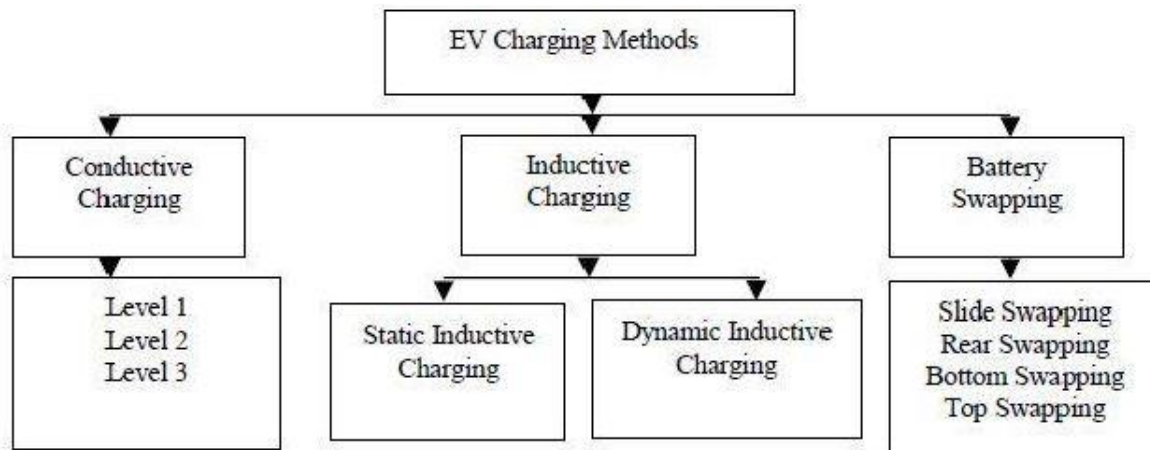


Figure 2.2: Different EV charging techniques

Level 1 charging uses a 120 Volt, which creates lesser impact on electric utility peak demand charges. This is a slow charging method, typically ranging 3-5 miles per hour.

Level 2 charging uses 240-volt power to enable faster regeneration of an EV's battery system. This type of charging needs the installation of an EVSE unit and electrical wiring capable of handling higher voltage power. This is a popularly used method of charging for EV's. It has a faster charge time capacity, ranging 10-20 miles per hour. This method of charging has a 3% gain in efficiency than level 1 method of charging. Apart from the discussed benefits, the Level 2 charging method is more expensive than Level 1.

DC fast charging provides compatible vehicles with an 80% charge in 30-60 minutes by converting high voltage AC power to DC power for direct storage in EV batteries. Automakers currently accept the Society of Automotive Engineers (SAE) J-1772 plug for level 1 and 2 charging, except for Tesla, which has an adapter. For DC fast charging there are three plug types used by different manufacturers: the CHAdeMO, SAE Combined Charging System (Combo/CCS), and Tesla supercharger. Nissan and Mitsubishi vehicles use CHAdeMO while current and upcoming vehicles from the US and European manufacturers and US have SAE CCS ports [10]. It is as quick as refuelling a gasoline vehicle. Significantly more expensive than Level 1 or Level 2 equipment and high voltage 3 phase power connections to utilities further increases installation costs. In [11] author describes a DC Micro grid charging station with bulk storage Li-Ion batteries and the integration of renewable energy sources like wind energy and solar energy. The paper discusses a control logic method to absorb maximum power from the DER's. In [12], charging strategy is developed to manage the charging plan of vehicles using binary and linear programming.

This model was capable of reducing the cost to 60 %s without management. The charging station was grid connected charging time is divided into intervals to minimize the peak consumption. The paper [13] presents the impact of EV's on the power network. The study is performed for the worst-case scenario, by connecting depleted EV's with the power network for analysis.

2.3 Different Charging Configurations and Connectors

Figure 2.3 shows the SAE charging configuration and rating terminologies.

SAE International				SAE Charging Configurations and Ratings Terminology	
AC level 1 (SAE J1772™) 	PEV includes on-board charger	*DC Level 1	EVSE includes an off-board charger		
	120V, 1.4 kW @ 12 amp 120V, 1.9 kW @ 16 amp		200-450 V DC, up to 36 kW (80 A)		
	Est. charge time:		Est. charge time (20 kW off-board charger):		
	PHEV: 7hrs (SOC* - 0% to full)		PHEV: 22 min. (SOC* - 0% to 80%)		
	BEV: 17hrs (SOC - 20% to full)		BEV: 1.2 hrs. (SOC - 20% to 100%)		
AC level 2 (SAE J1772™) 	PEV includes on-board charger (see below for different types)	*DC Level 2	EVSE includes an off-board charger		
	240 V, up to 19.2 kW (80 A)		200-450 V DC, up to 90 kW (200 A)		
	Est. charge time for 3.3 kW on-board charger		Est. charge time (45 kW off-board charger):		
	PEV: 3 hrs (SOC* - 0% to full)		PHEV: 10 min. (SOC* - 0% to 80%)		
	BEV: 7 hrs (SOC - 20% to full)		BEV: 20 min. (SOC - 20% to 80%)		
	Est. charge time for 7 kW on-board charger	*DC Level 3 (TBD)	EVSE includes an off-board charger		
	PEV: 1.5 hrs (SOC* - 0% to full)		200-600V DC (proposed) up to 240 kW (400 A)		
	BEV: 3.5 hrs (SOC - 20% to full)		Est. charge time (45 kW off-board charger):		
	Est. charge time for 20 kW on-board charger		BEV (only): <10 min. (SOC* - 0% to 80%)		
	PEV: 22 min. (SOC* - 0% to full)				
	BEV: 1.2 hrs (SOC - 20% to full)				
*AC Level 3 (TBD)	> 20 kW, single phase and 3 phase				
*Not finalized Voltages are nominal configuration voltages, not coupler ratings Rated Power is at nominal configuration operating voltage and coupler rated current Ideal charge times assume 90% efficient chargers, 150W to 12V loads and no balancing of Traction Battery Pack					
Notes: 1) BEV (25 kWh usable pack size) charging always starts at 20% SOC, faster than a 1C rate (total capacity charged in one hour) will also stop at 80% SOC instead of 100% 2) PHEV can start from 0% SOC since the hybrid mode is available.					
Developed by the SAE Hybrid Committee			ver. 031611		
Copyright SAE 2011					

Figure 2.3: SAE charging configurations

AC Charging: The given figures gives the information about AC charging. SAE J1772 is mainly used for AC charging in Electric vehicles such as cars.

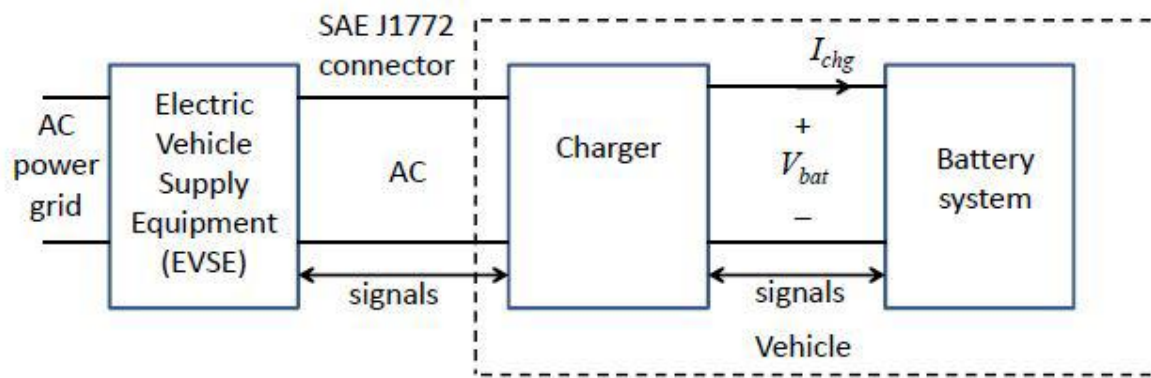


Figure 2.4: Block diagram of AC charging

SAE J1772 Connector: This connector contains 5 pin configuration such as: AC line 1, AC line 2, Ground, Control pilot, Proximity detection. Proximity Detection: to prevent movement of the car while connected to the charger. Control Pilot: a 1 kHz square wave at +/- 12 volts is generated by the EVSE on the pilot pin to detect the presence of the vehicle, communicate the maximum allowable charging current, and control charging.



Figure 2.5: SAE J1772 conductive charge coupler.

DC Charging: The given figures give the information about DC charging. The standards for DC fast charging are still under development phase. SAE combo connector and CHAdeMO are the commonly used DC fast charging connectors/guns so far. The table 2.1 shows the different levels of DC charging. The figure 2.6, figure 2.7 shows the basic block diagram and charging coupler for DC charging.

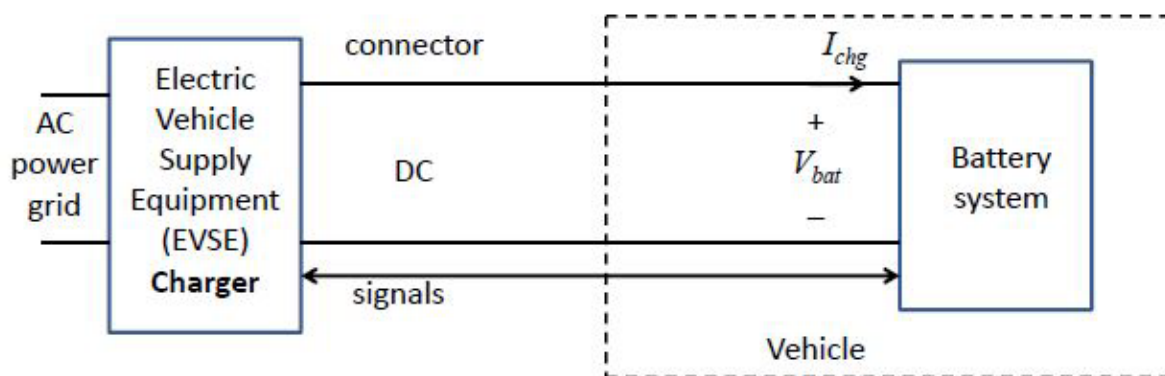


Figure 2.6: Block diagram of DC charging

Table 2.1: DC Charging

	Voltage(DC)	Maximum current DC)
DC level 1	200-450 V	80 A
DC level 2	200-450 V	200 A
DC level 3	200-600 V	400 A

2.4 Standardisation Protocols

In this section, the guidelines and standard specified by the Government of India are described. The general guidelines released by Ministry of Power, Government of India, on 1st October 2019 is as follows:

- Private charging at residences/offices shall be permitted. Distribution companies (DISCOMs) may facilitate the same.
- Setting up Public charging station shall be a de-licensed activity and any individual/entity is free to set up public charging station.
- Any person seeking to set up a public charging station may apply for connectivity and he shall be provided connectivity on priority by the distribution company license to supply power in the area.

Every public charging station (PCS) will have the following infrastructure.

- An exclusive transformer with all related substation equipment included safety appliances, if required.
- 33/11 KV line/cable with associated equipment including line termination, if required.



Figure 2.7: DC charging coupler

- Appropriate civil works.
- Appropriate cabling electrical works ensuring safety.
- Adequate space for charging and entry/exit of vehicles.
- PCS shall have, any one or more chargers or any combinations of chargers from the figure 2.8
- Charging stations for e-two/three Wheelers shall free to install any charger other than that specified above subject to compliance of technical safety standards laid down by CEA.

- Tie up with at least one online network service providers (NSP), to enable advance remote/online booking for charging slots.
- Share charging station data with appropriate DISCOM.
-

2.4.1 Bharat EV AC charger (BEVC-AC001)

This section presents the specifications of a Public metered AC outlet (PMAO) which is to provide AC input to the vehicle which has on-board chargers. This applies to electric road vehicles for charging at 230V standard single phase AC supply with a maximum output of 15A and at a maximum output power of 3.3kW. PMAO is a slow charger for low-power vehicles.

General Requirements: The EV shall be connected to PMAO for conductive energy transfer function. The system will have following general specifications,

Charger Type	S. No.	Charger Connectors*	Rated Output Voltage(V)	No. of No. of Connector guns (CG)	Charging vehicle type (W=wheeler)
Fast	1	Combined Charging System (CCS) (min 50 kW)	200-750 or higher	1 CG	4W
	2	CHArge de MOve (CHAdeMO) (min 50 kW)	200-500 or higher	1 CG	4W
	3	Type-2 AC (min 22 kW)	380- 415	1 CG	4W, 3W, 2W
Slow/Moderate	4	Bharat DC-001 (15 kW)	48	1 CG	4W, 3W, 2W
	5	Bharat DC-001 (15 kW)	72 or higher	1 CG	4W
	6	Bharat AC-001 (10 kW)	230	3 CG of 3.3 kW each	4W, 3W, 2W
*In addition, any other fast/slow/moderate charger as per approved DST/BIS standards whenever notified. Note :Type -2 AC (min 22 kW) is capable of charging e-2W/3W with the provision of an adapter					

Figure 2.8: Some standard charger

- PMAO is supplied with three phase AC power and outputs single phase AC power.
- Energy Transfer Mode is Conductive.
- Each outlet will have up to three independent charging sockets.

- The PMAO has built-in metering, safety monitoring.

Input requirement:

- A.C. Supply System is 3 phase, 5 wire AC system (3 phases + N + PE)
- Nominal Input Voltage is 415V
- Input Frequency is 50Hz

Output Requirements

- Number of Outputs: 3
- Type of each output: A.C., 230V (+6 and -10) single phase
- Output Details: 3 Independent charging sockets.
- Output Current: Three vehicles charging simultaneously, each at 15A current.
- Limiting Output Current: Circuit breaker for each outlet limited to 15A current output. Breaker should be reset to resume operation.
- Socket readiness: An LED to indicate that the socket is ready.
- Isolation: Input and outputs should be isolated. Outputs should be isolated from each other.

2.5 Conclusion

Various charging station infrastructures are studied. According to the demand and type there are different kinds of EV chargers. The different charging efficiency levels are compared and the suitable one is selected according to the need. Different charging techniques such as level 1 charging, level 2 charging, DC fast charging and AC charging are studied and a comparison between their voltage power and time taken for charging are noted. The guidelines and standardization protocols are studied and according to that only charging station can be implemented.

Chapter 3

METHODOLOGY

3.1 Introduction

Domestic motor vehicle sales in India during 2016-17 included 3.05 million passenger vehicles, 0.71 million commercial vehicles, 0.51 m three Wheelers and 17.59 two-Wheelers. The luxury car segment is relatively small with sales of just over 40,000 cars in 2018. The total number of registered motor vehicles reached approx. 230 million in March 2016 [14]. The India government envisage the number of EV's to be rapidly increase and also expecting the achievement of complete electric mobility by the year 2030. Rapid growth in the sales of EV's correlate to the rising demand of electricity, which would encourage the government more likely to implement fossil fuel, powered generating stations. Hence, this act would also contribute to harmful emission to the environment. The primary solution for the above crisis would be the dependency on renewable energy resources. Therefore, here in this project a solar powered grid connected system with charging capabilities for electric auto rickshaw is designed. The project discusses the effect of solar generation through proper result analysis. Distribution of PV Modules is studied. Load profile of electric vehicle is established to prepare the dependency to the grid power.

3.2 Overall Picture

The Proposed project includes a charging point mainly focused for Electric Vehicles (e-auto's, e-bikes), Mobile Phone Charging Circuit, and Automatic controlled Lights in the Bus Station. E- Auto produced by the Kerala Automobiles Ltd is equipped with 5.4 kWh (ranging from 2 kW to 5.4 kW) Battery capacity. Capacity of PV Panel to be installed = 6kW, Minimum of 3 kW is required to connect to the Grid. There for assuming 5 hours as the Peak Sun Hours, a capacity in the range of 24-30 kW per day can be produced in a day. As the PV Panels produce 24-30 kW per day, 2-3 e-autos can completely be charged from the renewable generation. Additional demand can be compensated by utilizing the Grid power. 2-3 Street Lights in the Bus station can be automated to operate in the evening, which includes three 100W Street LED Lights, with a required capacity of 300W. Hence the system is capable of covering a demand of approximately 6-7.5 kW. The figure 3.1 shows the overall picture and the figure 3.2 shows the block diagram of the PV plant. The usage of such kind of automatic street lights can avoid unwanted loss of energy from the human errors. The motive

of the project as a whole is to preserve the energy generated and to replace the existing system with collective sustainable sources.

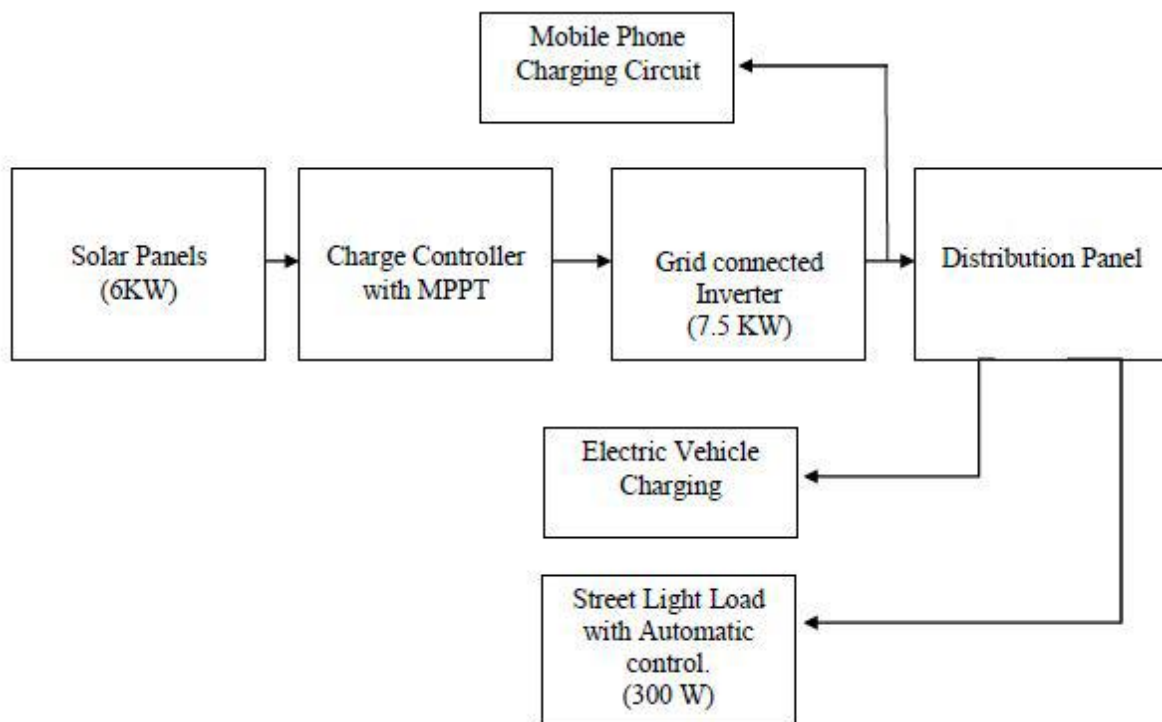


Figure 3.1: Block diagram of the proposed system

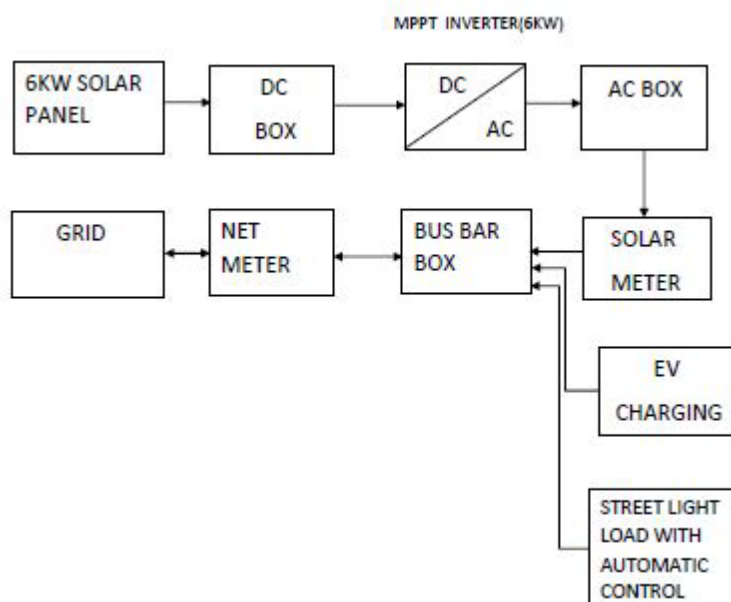


Figure 3.2: Block diagram of PV plant

Lights in the Bus station can be automated to operate in the evening, which includes three 100W Street LED Lights, with a required capacity of 300W. Hence, the system is capable of covering a demand of approximately 6-7.5 kW. The figure 3.1 shows the overall picture and the figure 3.2 shows the block diagram of the PV plant. The usage of such kind of automatic streetlights can avoid unwanted loss of energy from the human errors. The motive of the project as a whole is to preserve the energy generated and to replace the existing system with collective sustainable sources.

3.3 Conclusion

Electric vehicle industry as a rising field of technology enhances passages for other sectors to build up with this. Here come the importance of the charging infrastructure development and its priority in maintaining the life cycle of electricity production. The system as proposed indicates a green energy signal through which incorporates sustainable energy to a charging infrastructure. The design explained here induces a profound importance of integrating such sustainable sources and providing customer friendly necessary services within them. As part of this section, it is evidently put forward the idea of developing such a charging infrastructure which could be in par with the nature. The system also provides Mobile phone charging outlet and automatic street light system with it.

Chapter 4

SIMULATION

4.1 Introduction

The primary solution for the crisis would be the dependency on renewable energy resources. Therefore, here in this project a solar powered grid connected system with charging capabilities for electric auto rickshaw is designed. The project discusses the effect of solar generation through proper result analysis.

4.2 Simulation of Solar System

A Solar Powered Grid connected Charging station is considered, where a 6 kW solar system is selected for performance study. The system is to be installed Chinnakada, Kollam, Kerala India for facilitating provision for charging of electric auto rickshaw operators. The integration of Solar panel compensates the energy supplied to the load from the grid. The 6kW system is chosen considering the load profile of the electric auto available within the described area. The system is capable of extending the capacity to meet future demand.

4.2.1 Simplified schematic diagram

PV Array is capable of generating a certain required demand. As the system is grid tied, excess requirement is compensated by utilizing sufficient power from the grid supply. The overall schema is distributed into three subsystems P Array, System, User/ Load.

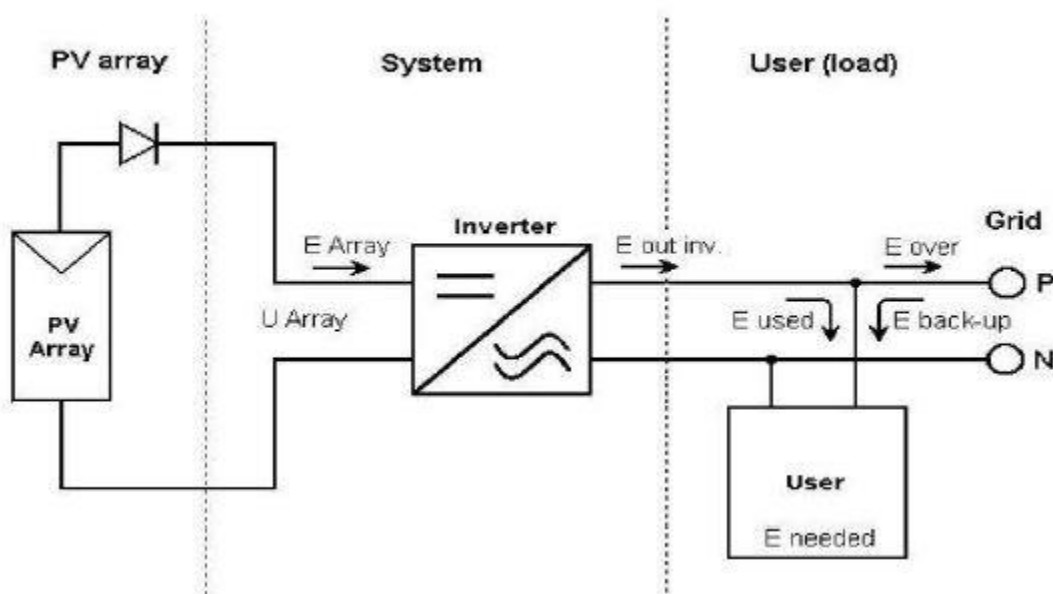


Figure 4.1: Simplified Schematic Diagram of the System

4.2.2 Geographical location selection and orientation of panels

The proposed Solar Powered Charging station is to be implemented on the location Chinnakada, Kerala, India as mentioned in Table 4.1

Table 4.1: Geographic location

Geographical site	Chinnakada	Time zone	UT+5.5
Latitude	8.89_N	Longitude	6.59_E

4.2.3 Load profile

The charging station is designed to suit for electric auto's, load profile varies between 4.8 to 5.4 kW. Simultaneous usage of multiple load was also considered with a maximum value up to 10.8 kW. The daily load profile of e-autos from our observation is shown in the Table 4.2. Figure 42 represent the daily load graph.

Table 4.2: Load profile

Time	0	1	2	3	4	5	6	7	8	9	10	11
Load (KW)	0.0	0.0	0.0	0.0	0.0	10.2	0.0	0.0	0.0	0.0	0.0	5.4
Time	12	13	14	15	16	17	18	19	20	21	22	23
Load (KW)	4.8	0.0	0.0	0.0	0.0	0.0	5.4	4.8	0.0	0.0	0.0	0.0

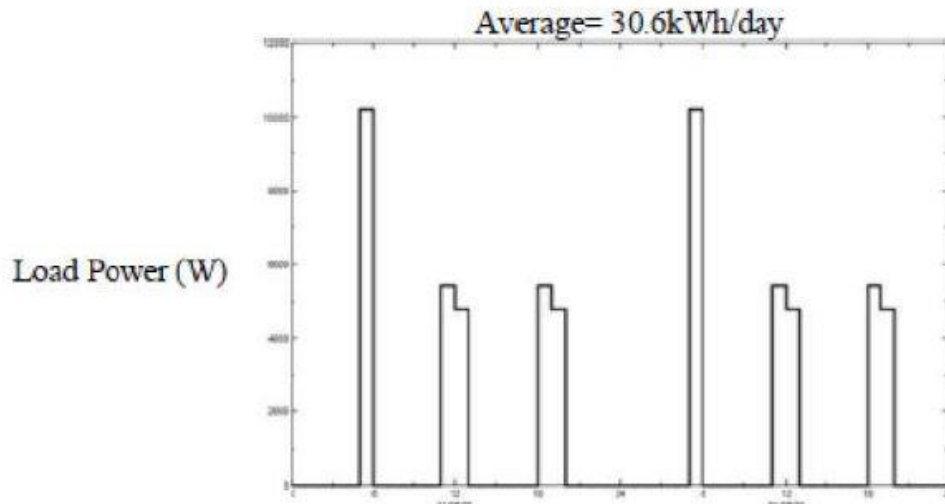


Figure 4.2: Daily load graph

4.3 Conclusion

The Table indicates energy distribution over whole year, representing the Horizontal Global irradiation, Ambient Temperature, Effective Energy at Output of Array, Energy supplied to the user, Energy from the sun, Energy injected into Grid and Energy from the Grid.

Global Hour	: Horizontal Global irradiation
TAmbient	: Ambient Temperature
EArray	: Effective Energy at output of array
Euser	: Energy supplied to the user
ESolar	: Energy from the sun
EGrid	: Energy injected into the Grid
EFrGrid	: Energy from the grid

Table 4.3 indicates energy distribution over whole year, representing the Horizontal Global irradiation, Ambient Temperature, Effective Energy at Output of Array, Energy supplied to the user, Energy from the sun, Energy injected into Grid and Energy from the Grid. Annual Array output is obtained to be 12.017 MWh, Energy supplied to the User as 11.169. Energy injected to the Grid is 8.620 MWh/year and Energy from the Grid as 8152 MWh/year.

Table 4.3: Result of the Simulation

	Global Hour KWh/m2	T- Ambient °C	E- Array MWh	E-User MWh	E-Solar MWh	E-Grid MWh	EFrGrid MWh
Jan	168.5	27.17	1.151	0.949	0.287	0.829 0	0.522
Feb	167.3	27.78	1.086	0.857	0.271	0.782	0.585
Mar	195.2	28.72	1.150	0.949	0.288	0.865	0.661
Apr	176.3	28.29	1.025	0.918	0.257	0.735	0.661
May	165.7	28.56	0.940	0.949	0.240	0.670	0.708
Jun	137.1	26.58	0.787	0.918	0.206	0.554	0.712
Jul	151.2	26.62	0.866	0.949	0.222	0.616	0.727
Aug	163.9	26.65	0.962	0.949	0.251	0.680	0.698
Sept	167.0	26.48	1.019	0.918	0.244	0.743	0.674
Oct	157.8	26.85	1.005	0.949	0.251	0.723	0.698
Nov	137.3	26.48	0.918	0.918	0.235	0.653	0.683
Dec	154.8	27.10	1.068	0.949	0.266	0.769	0.683
	1942.0	27.27	12.017	11.169	3.017	8.620	8.152

Chapter 5

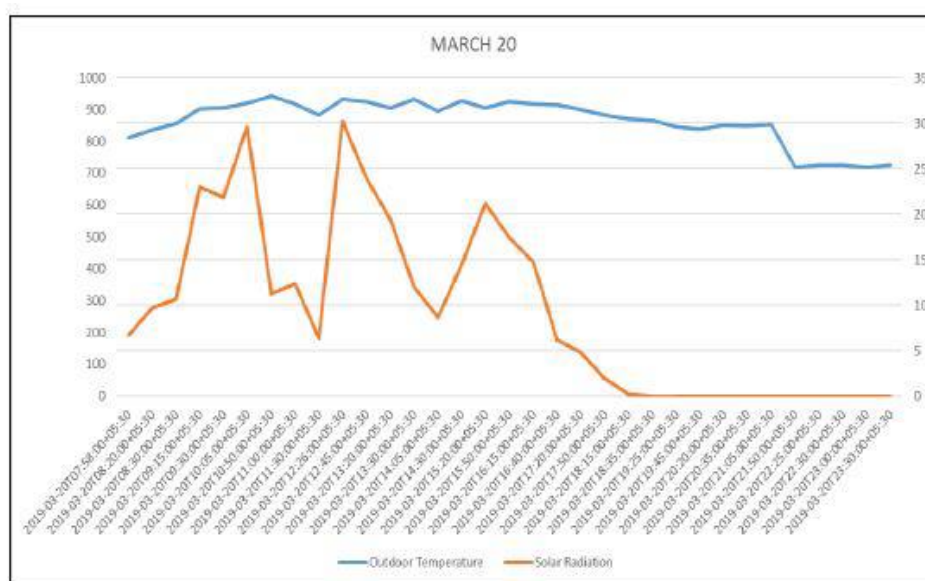
SURVEYS

5.1 Introduction

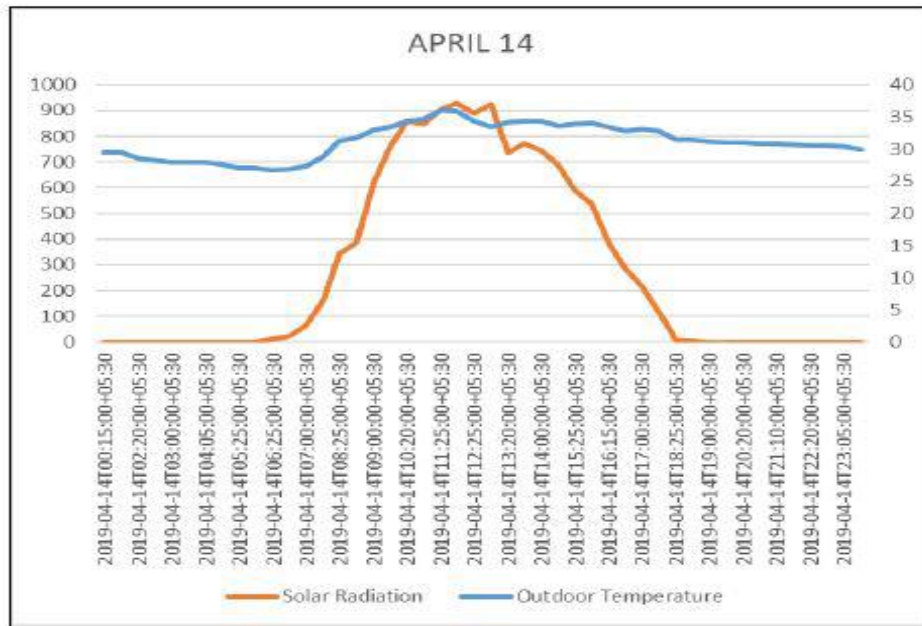
In this chapter we are discussing about the solar radiation and the number of vehicles registered in Kerala in different years based on their fuel type. The solar data is collected from the department of mechanical engineering, TKMCE where they installed an environment monitoring system inside the campus of TKMCE. The vehicle data is collected from the website of Ministry of road transport and highways, Government of India, <https://parivahan.gov.in/>.

5.2 Solar Radiation in Different Months

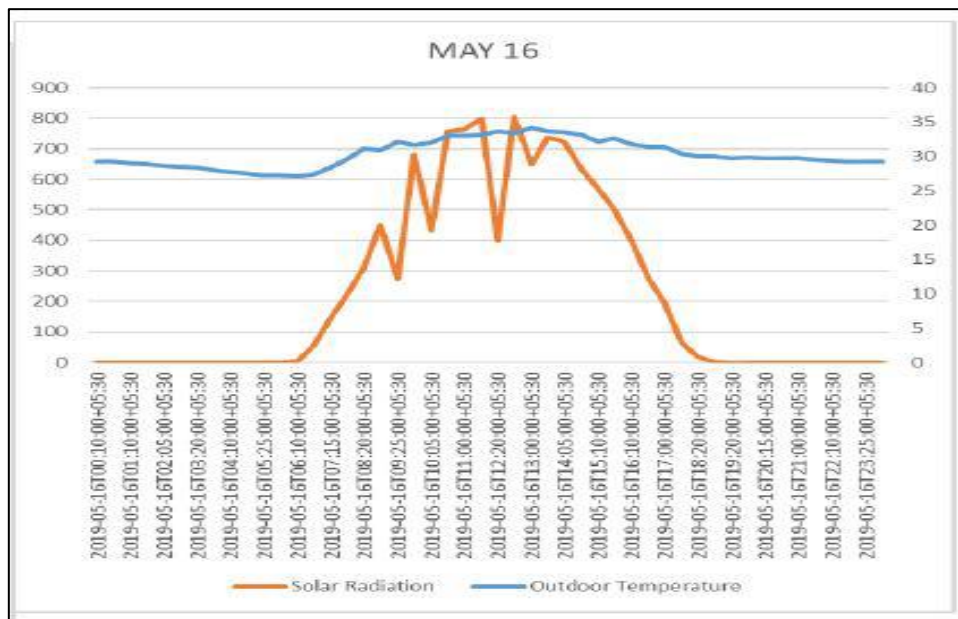
We plot the graph between solar radiation, temperature to the time in a day. Chose the random date in a month from march to October and presented in this report. These data are used for the simulation of solar system using PvSys software. These graphs leads to some findings about solar radiations and temperature in the environment in different times in different days' in different months.



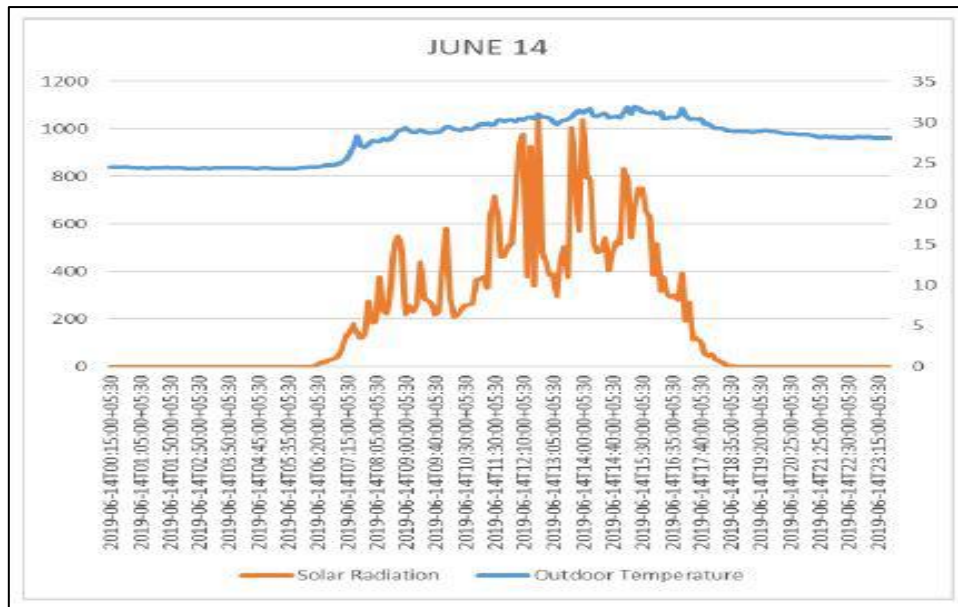
(a)



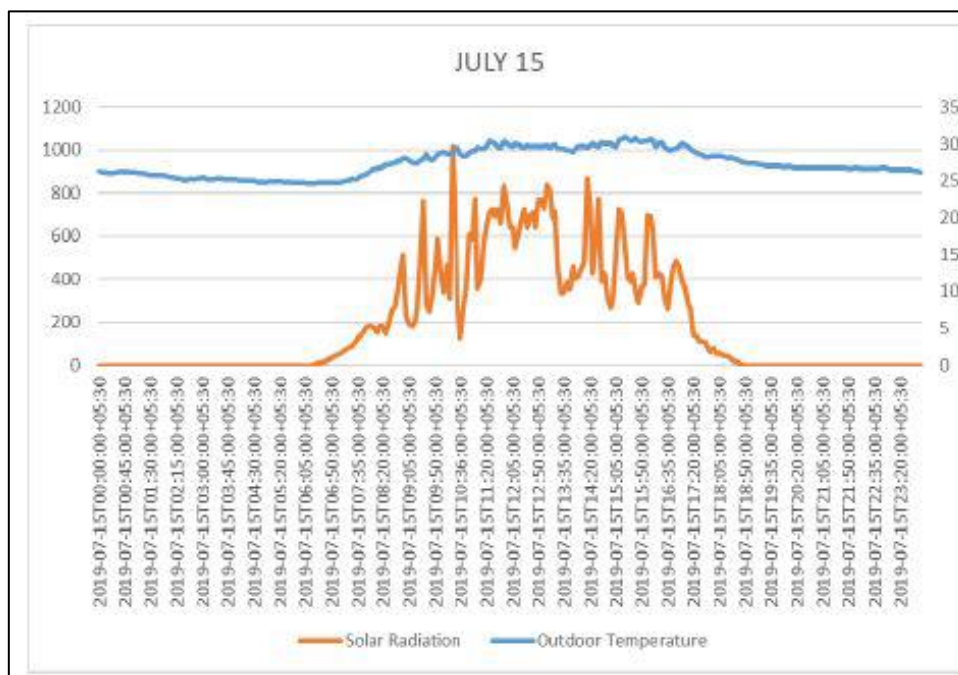
(b)



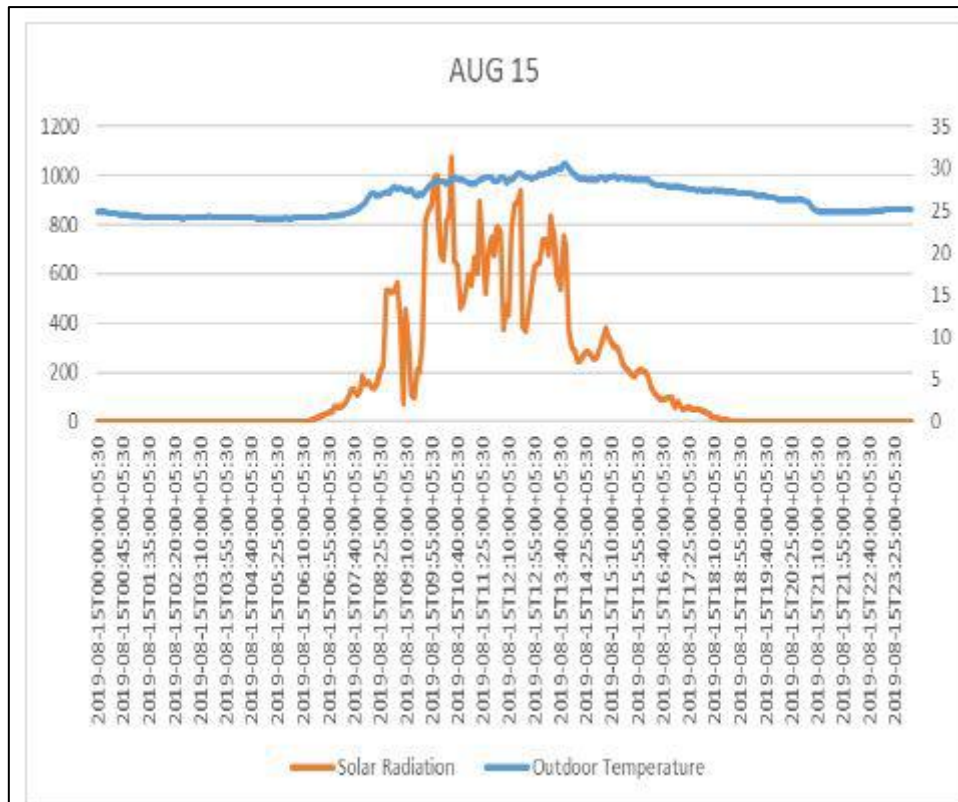
(c)



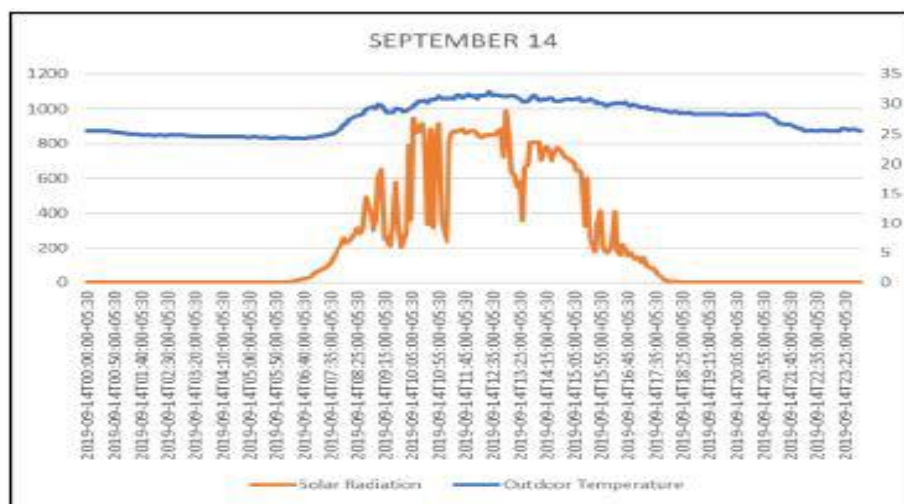
(d)



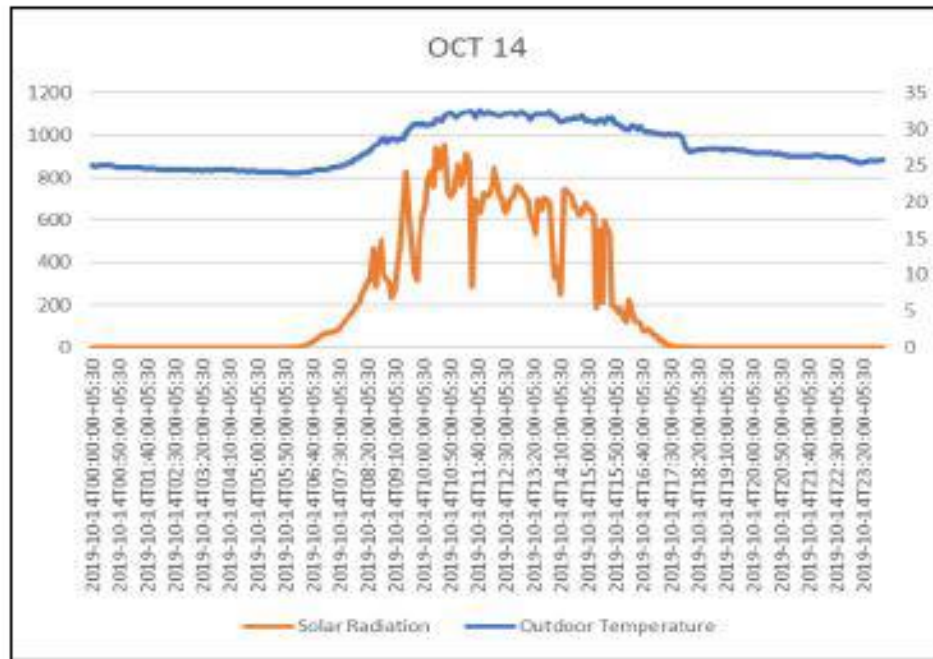
(e)



(f)



(g)



(h)

Figure 5.1: Solar radiation in (a) March (b) April (c) May (d) June (e) July (f) September (h) October

5.3 Number of Vehicles in Kerala Based on Fuel

In this section we looking for the trending/number of the registered vehicles in Kerala these days. From the collected data mainly focused on petrol, diesel and electric vehicles. The table 7.1 shows the year wise data of vehicles, and the figure 6.2 and figure 6.3 shows the graphical analysis on this trend.

Table 5.1: Based on fuel

Year	Electric	Diesel	Petrol
2015	33	121619	764538
2016	19	110021	818950
2017	64	118125	891395
2018	242	129215	913893
2019	465	106108	791622

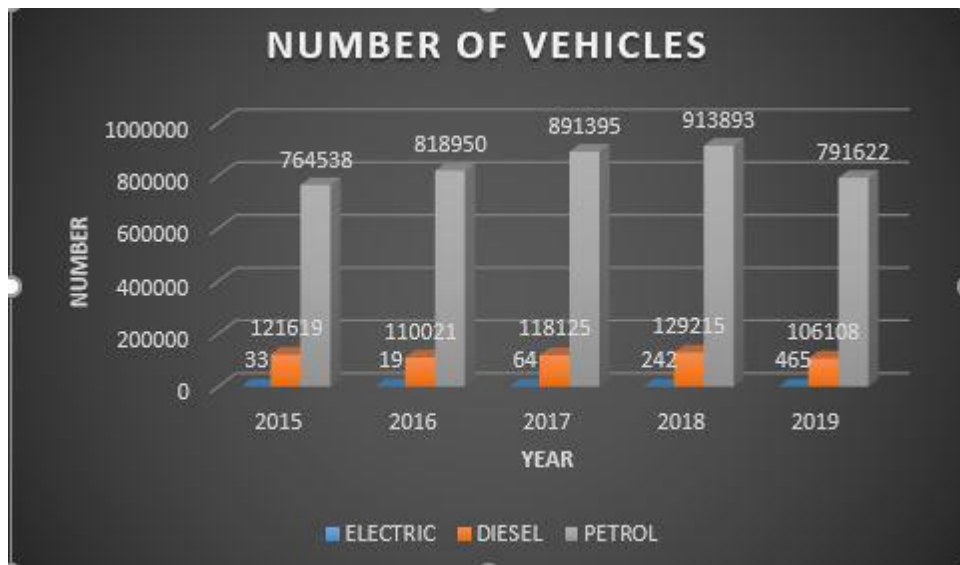


Figure 5.2: Number of vehicles registered in Kerala

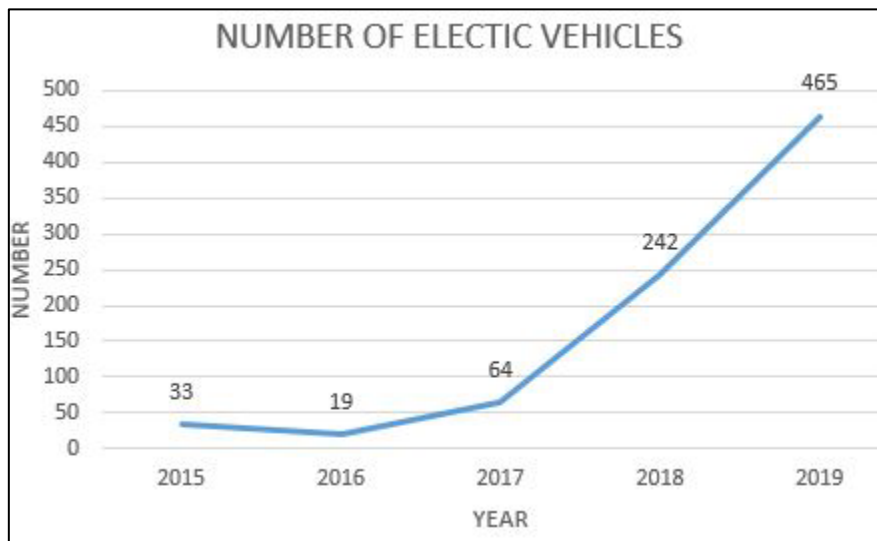


Figure 5.3: Number of EV registered in Kerala

5.4 Conclusion

The changes in the solar radiation throughout the day was plotted and the time in which radiation is maximum and minimum was able to be found out. The different variations that can occur in the production of electricity from solar could be predicted which enable us to calculate the peak time and the demand can be easily satisfied. Comparison of the number of electric, petrol and diesel vehicles produced year wise is also done which gives us an accurate idea of the increasing demand of the charging station.

Chapter 6

REGRESSION BASED ELECTRIC VEHICLE COUNT PREDICTION MODEL

6.1 Introduction

Due to the increased public awareness on the benefits of the sustainable energy the number of electric vehicles users are increasing drastically. This creates an increased demand for the charging stations as well as the power to charge these electric vehicles. Also there will be a need to know the amount of electric power to be produced for all these. It is a necessity to predict this increase in the production of electric vehicles, the electricity needed as well as its charging stations for the market. Year wise count of electric vehicles sold in Kerala is collected and a graph is plotted. This gives us an incremental graph and using different methods we are able to predict the futuristic value of demand for the electric vehicles. For the year wise statistical analysis and predictive modelling, linear and polynomial regression techniques are

used. Regression analysis enables curve fitting, thus constructing a curve that has the best fit to the collected data. Therefore, we are able to enter a year and are able to forecast the electric vehicles number of the corresponding year. We are benefitted a lot by forecasting this number as this will enable us to know the future electricity demand and the demand for electric vehicle charging stations too.

Table 6.1: Values received from database

Sl.No	Year	Count
1	2005	55
2	2006	175
3	2007	353
4	2008	928
5	2009	333
6	2010	189
7	2011	147

8	2012	120
9	2013	80
10	2014	34
11	2015	33
12	2016	19
13	2017	64
14	2018	242
15	2019	465
16	2020	800

6.2 Proposed design

Here we discuss the possibility of forecasting future Electric Vehicle distribution in Kerala district, thereby understanding and analysing the future demands of electric energy and the charging infrastructures. The energy requirement in the near future will be a large drastic rise, therefore proper planning is required to be considered in order to feed supply for the same. We used python language with certain package of its to determine the forecasting of electric vehicle production. The electric vehicle distribution within the state is collected from the Kerala motor vehicle department database which has been used to determine the predictive analysis of the curve.

Python packages like Numpy, Matplotlib, pandas etc were used for the study of given data through linear and polynomial regression methods. Python comprises of multiples libraries and models to help the developers to efficiently plot and spontaneously finding a preferable outcome for the different parameter inputs. The table 6.1, shows the data value received from the Kerala Motor vehicle department database. The normal distribution of resultant count to the respected year is shown in the figure 6.1. The graph explains the sudden trend in electric vehicle industry for a short span of time. Mostly the trend is set to the production of electric auto rickshaws as the initial step towards electric mobility. Proposed design look forward to create a predictive model through mathematical regression and thereby comparing the linear and polynomial regression dependencies with the given dataset. Model thus created could be used in understanding the energy demand forecasting and energy infrastructure to a large body dealing with it. This model contributes to the upcoming energy demand predictions thus

to prepare sufficient lump of load expected in the future. Therefore, we can accurately determine to an extent the rightful amount of energy required.

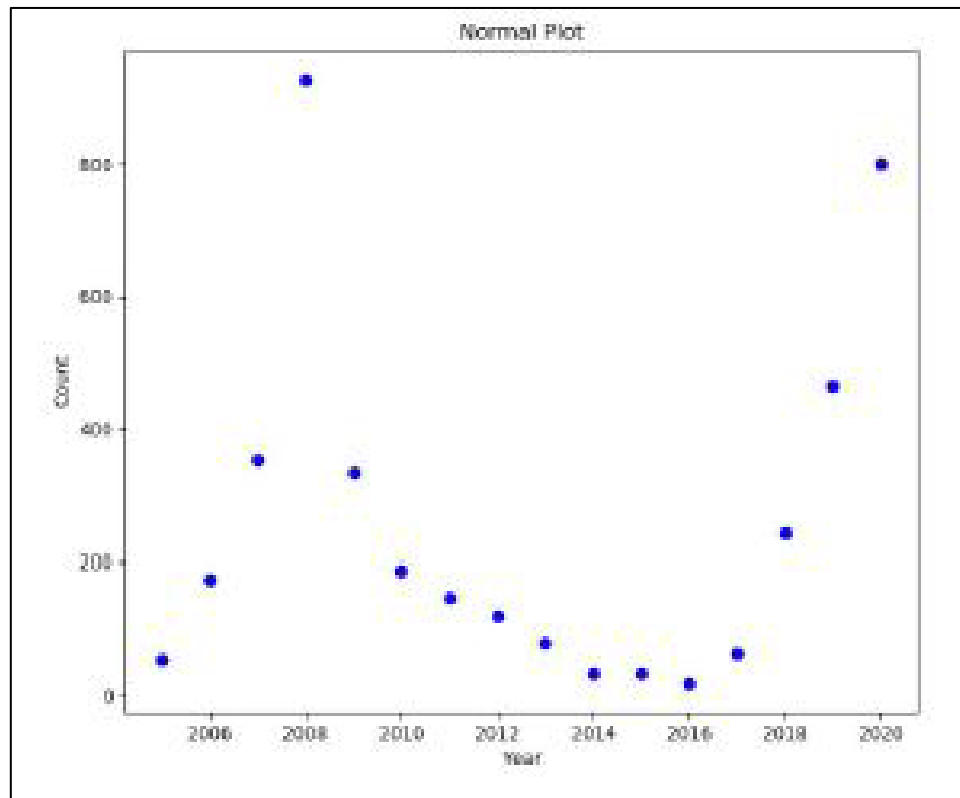


Figure 6.1: Normal plot

create a predictive model through mathematical regression and thereby comparing the linear and polynomial regression dependencies with the given dataset. Model thus created could be used in understanding the energy demand forecasting and energy infrastructure to a large body dealing with it. This model contributes to the upcoming energy demand predictions thus to prepare sufficient lump of load expected in the future. Therefore, we can accurately determine to an extent the rightful amount of energy required.

The aim of this regression is to model the expected value of dependent variable i.e., annual year in terms of the value of man independent variable count of electric vehicles. In simple regression methods, the equation 6.1 is being used.

$$y = a + bx + e \quad (6.1)$$

Here, y is the dependent variable, a is y intercept, b is the slope and e is the error rate. In many cases linear model doesn't work out thus we can use quadratic equations in certain cases.

$$y = a + b_1x + b_2^2 + e$$

In general, we can model it for the nth value.

Importing necessary Regression required packages

Initial stage for the creation of regression requires the import of libraries and data sets.

```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
datas = pd.read_csv('data.csv').
```

Here data.csv is the excel file which contains the dataset of electric vehicle count dependent on the year from 2005 to 2020 as in table 6.1.

Dividing the dataset into two different components.

The dataset is divided into two different arrays distinguishing the dependent and variable data values.

```
X = datas.iloc[:, 1:2].values
y = datas.iloc[:, 2].values
```

Linear Regression fitting

Linear regression fitting is found within the two different dataset values X and y

```
# Fitting Linear Regression to the dataset
from sklearn.linear_model import LinearRegression
lin = LinearRegression()
lin.fit(X, y)
```

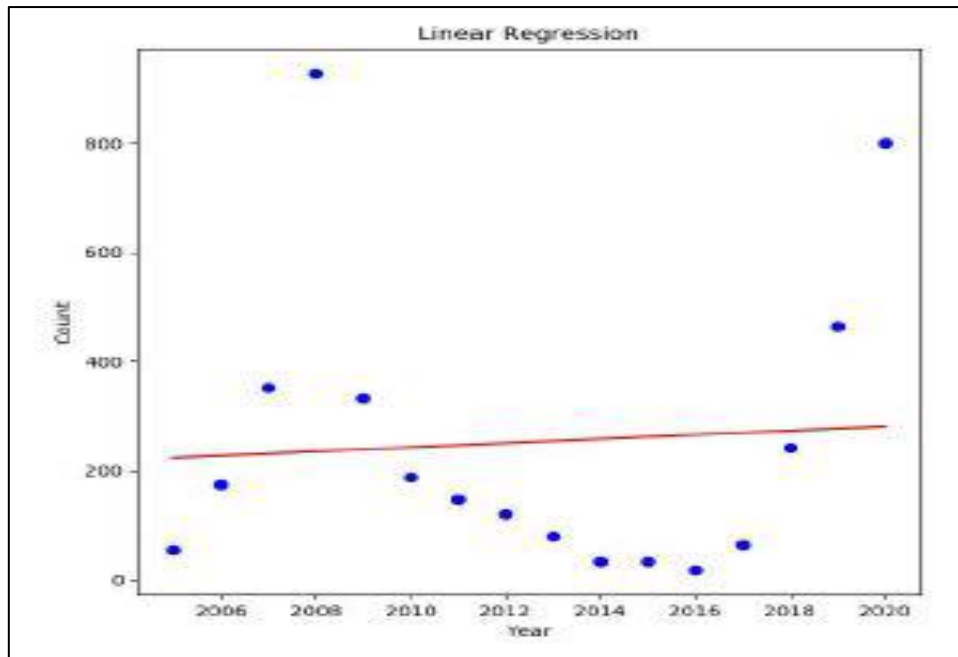


Figure 6.2: Linear regression plot

Polynomial Regression fitting

```
# Fitting Polynomial Regression to the dataset
from sklearn.preprocessing import PolynomialFeatures
poly = PolynomialFeatures(degree = 4)
X_poly = poly.fit_transform(X)
poly.fit(X_poly, y)
lin2 = LinearRegression()
lin2.fit(X_poly, y)
```

With the help of matplotlib package the curve plot both linear and polynomial regression

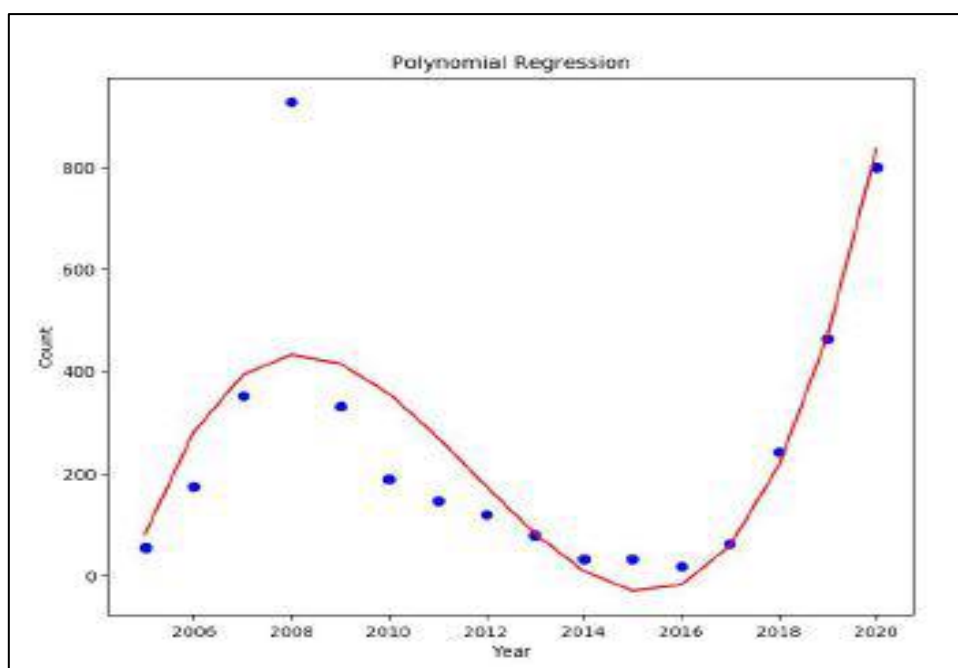


Figure 6.3: Polynomial regression plot

were produced, shown in figure 6.2 and figure 6.3. Hence it can be deduced from the regression graphs that the linear regression prediction curve is descending where the polynomial regression curve rises with large variations. Prediction of the required value can be analysed through the same sklearn package, where the random predicted values of linear and polynomial regression can be compared.

6.3 Result

Linear and Polynomial relation of the data points have been deduced from the figure 6.2 and figure 6.3. On analysing the curve formation in the both cases, it can be understood that the linear regression plot shows slow increase in the prediction curve whereas an exponential increase at the end points can be observed in the polynomial regression. Therefore, polynomial regression based prediction model can be concluded to possess better efficiency than the linear model. The comparison of prediction through both linear and polynomial regression methods are shown in the table 6.2. Predicted values of Linear and Polynomial are distinguished for a range from 2021 to 2049. The plots of predicted values of both Linear and Polynomial are

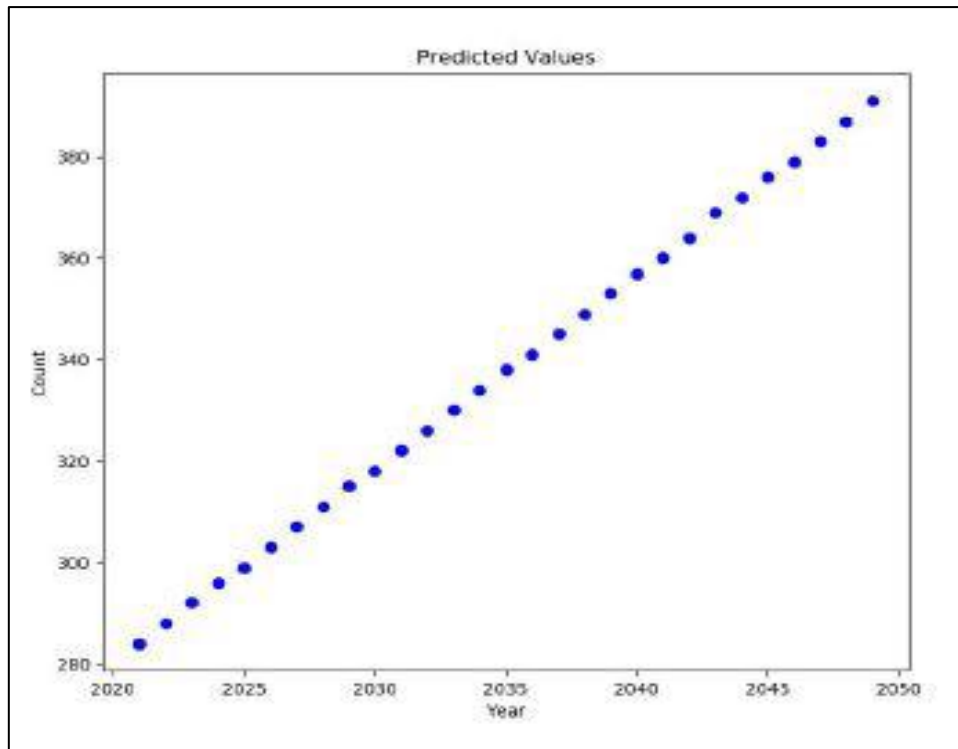


Figure 6.4: Predicted graph using linear regression

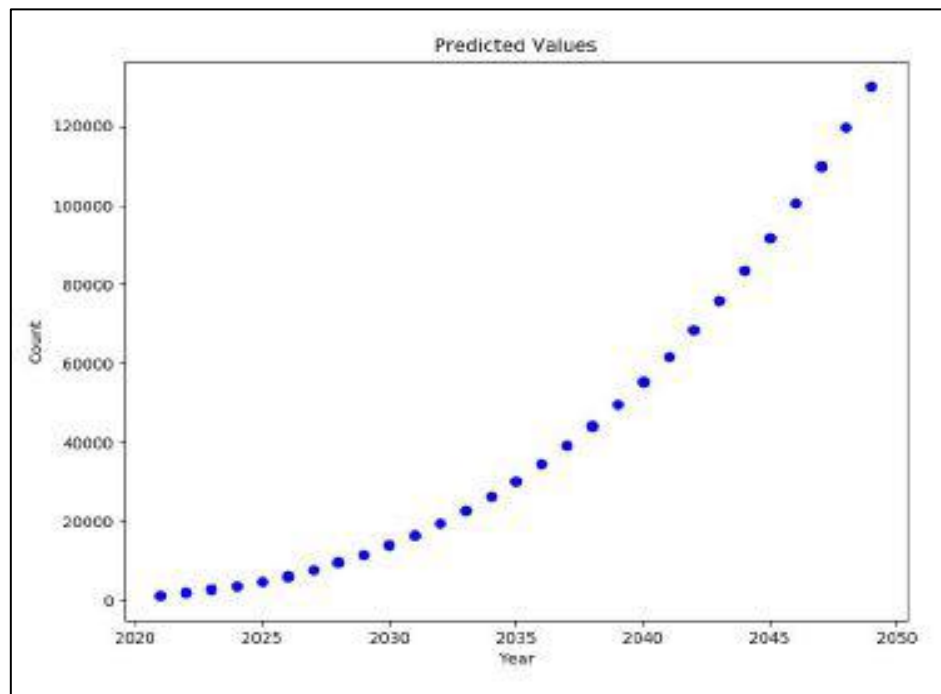


Figure 6.5: Predicted graph using polynomial regression

shown in figure 6.4 and figure 6.5, respectively. With the mathematical representation of both the curves it could be easily able to predict the upcoming forecasted values.

Table 6.2: Comparison of predicted values

Year	Linear regression value	Polynomial regression value
2021	284	1326
2022	288	1961
2023	292	2753
2024	296	3719
2025	299	4873
2026	303	6232
2027	307	7812
2028	311	9626
2029	315	11693
2030	318	14026
2031	322	16642
2032	326	19556
2033	330	22785
2034	334	26343
2035	338	30247
2036	341	34512
2037	345	39154
2038	349	44190
2039	353	49634
2040	357	55503
2041	360	61812
2042	364	68579
2043	369	75817
2044	372	83545
2045	376	91776
2046	379	100528
2047	383	109817

2048	387	119619
2049	391	130069

6.4 Conclusion

This chapter describes the predictive model creation of electric vehicle count within the state of Kerala. The dynamic increase in the emergence of electric vehicles within the market, implies the upcoming energy demand in the form of electricity. Thus we can have a proper prediction of electricity and also the number of Electric Vehicle charging stations to be implemented for the public. The chapter points out the immediate actions to be taken by the authorities to compensate the huge rise in this demand. Thus so much of the energy calculation can be directly found out from the prediction model of electric vehicle and the count that can be observed in the coming future. The paper brings the idea of polynomial regression as a source for finding the predictive value with the help of suitable python tools. It also manipulates the difference to be observed between the linear and polynomial regression model while considering the precision of different predictive models

Chapter 7

REVIEW OF SYSTEM COMPONENTS

7.1 Solar PV system

The items required for Solar PV system is listed in Table

Table 7.1 List of items for Solar PV System

Description of Supply Items	Qty	Make	Uo M
Solar PV module: Multi crystalline Silicon	6 kWp	Tata Power Solar Approved	Set
Module Mounting Structure.	01	TPS Approved Vendors	Set
Grid Connect Solar String Three Phase Inverter- 6 KW	01	Growatt / TPS Approved vendor	Nos .
Data Monitoring System	01	TPS Approved vendor	Set
Array Junction Box	As Required	TPS Approved Vendor	Set
AC Distribution Board with Isolators	As Required	TPS Approved Vendors / Elegant / Eqv.	No
Cables	15 Mts	Siechem /KEI/TPS Approved Vendor	M
Earthing Kit, Earthing Wire & GI Earth Strip	01	TPS Approved Vendors	Set
Installation kit (Comm. Cable, Inverter Canopy etc)	01	Tata Power Solar	Set

7.1.1 Solar Panels

A PV module is an assembly of photo-voltaic cells mounted in a frame work for installation. Photo-voltaic cells use sunlight as a source of energy and generate direct current electricity. A collection of PV modules is called a PV Panel, and a system of Panels is an Array. Arrays of a photo voltaic system supply solar electricity to electrical equipment. By considering our 6kW requirement we are installing 18 solar panels of 335W rating each and the optimum tilt angle for the panel is 15 degree.



Figure 7.1 Solar Modules, 325W/330Wp Multi crystalline (TATA)

7.1.2 Solar Inverter

A solar inverter or PV inverter, is a type of electrical converter which converts the variable direct current (DC) output of a photo voltaic (PV) solar panel into a utility frequency alternating current (AC) that can be fed into a commercial electrical grid or used by a local, electrical network. Here we use a 6KW On-Grid Connected, Three Phase Solar Inverter with inbuilt MPPT. Maximum power point tracking (MPPT) is a technique used commonly with wind turbines and photo voltaic (PV) solar systems to maximize power extraction under all conditions. Figure 3.6 shows the Growatt Grid Connect Solar String Three Phase Inverter- 6 KW.



Figure 7.2: Growatt Grid Connect Solar String Three Phase Inverter- 6 KW

7.1.3 Three phase net meter

Net metering is an agreement that allows the solar PV system owner to sell excess solar energy to the utility company or buy deficit energy from the utility company using a meter to track this energy exchange. The loads can run on solar power as long as there is sufficient energy available from the sun during the day. Any deficit is taken care by the main utility supply. However, if the solar energy production is in excess as compared to the load requirement at that moment, the excess energy can be transferred back to the utility grid. This difference of energy is tracked and maintained in Net Meter. Range: 10-60A in Accuracy Class-1. 4 quadrant meter with pulse output LED's for kWh & kVAh. Separate readings for Active Energy kWh, kVAh Import & Export. Net Energy kWh with sign. Figure 3.7 shows the picture of Net meter.

The net meter is tested and waiting for connection. It will be connected only after submitting a service agreement to the KSEBL.

Figure 3.8 shows the drawing for the **implementation of ongrid solar power plant at KSEBL**



Figure 7.3: Net meter

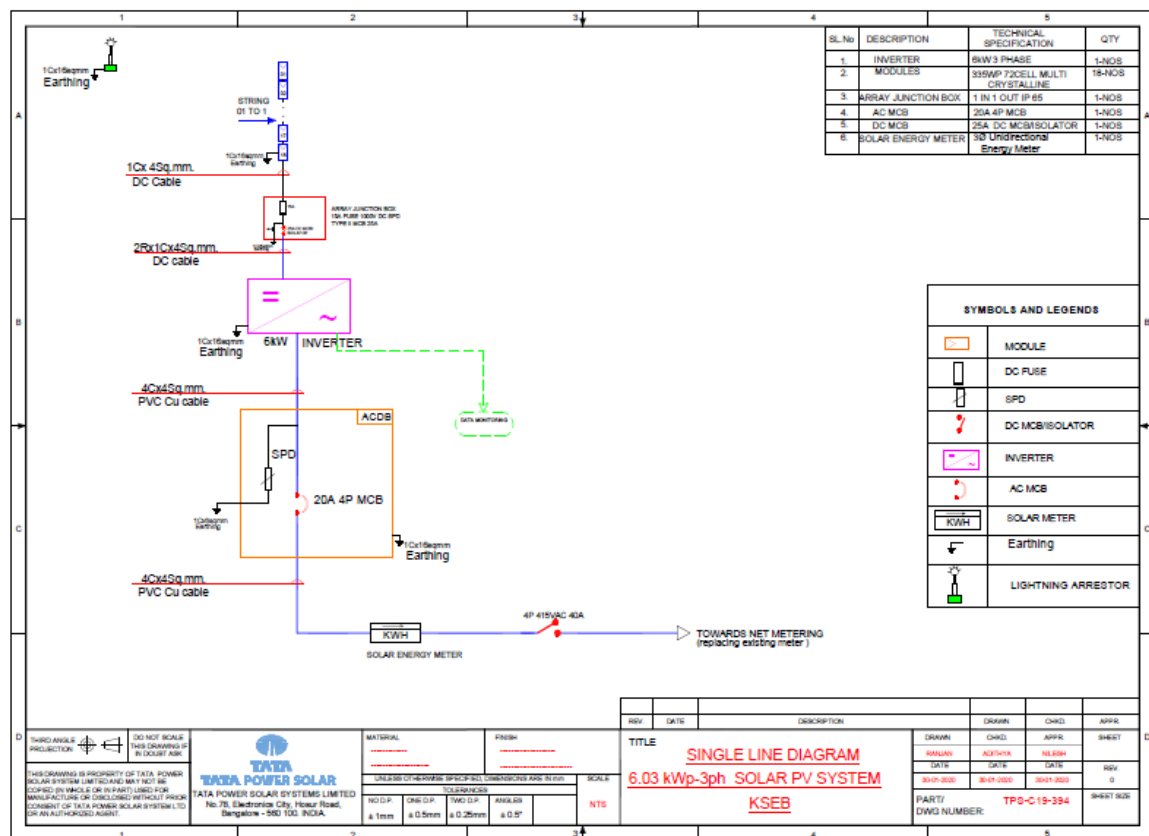


Figure 7.4: Drawing submitted at KSEBL for grid integration

7.2 EV Charger

The figure 3.9 shows the image of the charging unit. In this unit contain the following things,

- _ Compliant with Bharath EV Charging Standards
- _ Number of Outputs: 3, 230V -15A single phase each
- _ IEC 60309 based charging connectors
- _ Metering using certified Energy Meter for compliance with Indian Standards
- _ Large 7-inch Touch Screen display for a straight forward user experience
- _ Ingress protection category: IP-54



Figure 7.5: Electric Vehicle Charging Station

Chapter 8

AUTOMATIC LIGHT AND MOBILE CHARGING UNIT

8.1 Introduction

The objectives the proposed works include automatic lighting and mobile charging units. Light in the charging area can be automated and powered by the system. The proposed system automatically controls the Light in the charging station, with its operation after 7 PM. A Mobile Phone Charging circuit is also incorporated for the work. Mobile Phone Charging circuit can be implemented by providing a 230V Plug point and Universal Multi Pin Smart Phone Charger.

8.2 Automatic Light

The figure 8.1 shows the circuit for the lighting system in the charging station area. This system is very essential to our station, so that vehicles can be charged even if light goes down.

Working: The circuit comprises of LDR to light the lamps. During daytime when there is enough of light, the LDR will have low resistance and the circuit will be conducting. In such a case the relay will be inter normally on condition. As it can see from the circuit in such a condition the lamp will not be lighted as if it is an open circuit. As soon as the light goes down, the resistance of LDR will increase and this will lead to the relay of condition and hence the lamp will be lighted, using LDR returns ec2 automatically switch on and off the light as per requirement when the light in the area is low. The need for manually switching on and off does not exist and hence the charging station becomes completely automatic. Figure 8.2 shows the installation of automatic lighting setup in the charging area.

Power charging station is a completely automatic charging station where user can charge their vehicles automatically through the system that is installed. In such a condition it is also necessary that the lighting systems in our charging station are also self-automated. Therefore, designed and implemented the automatic lighting system by using the LDR.

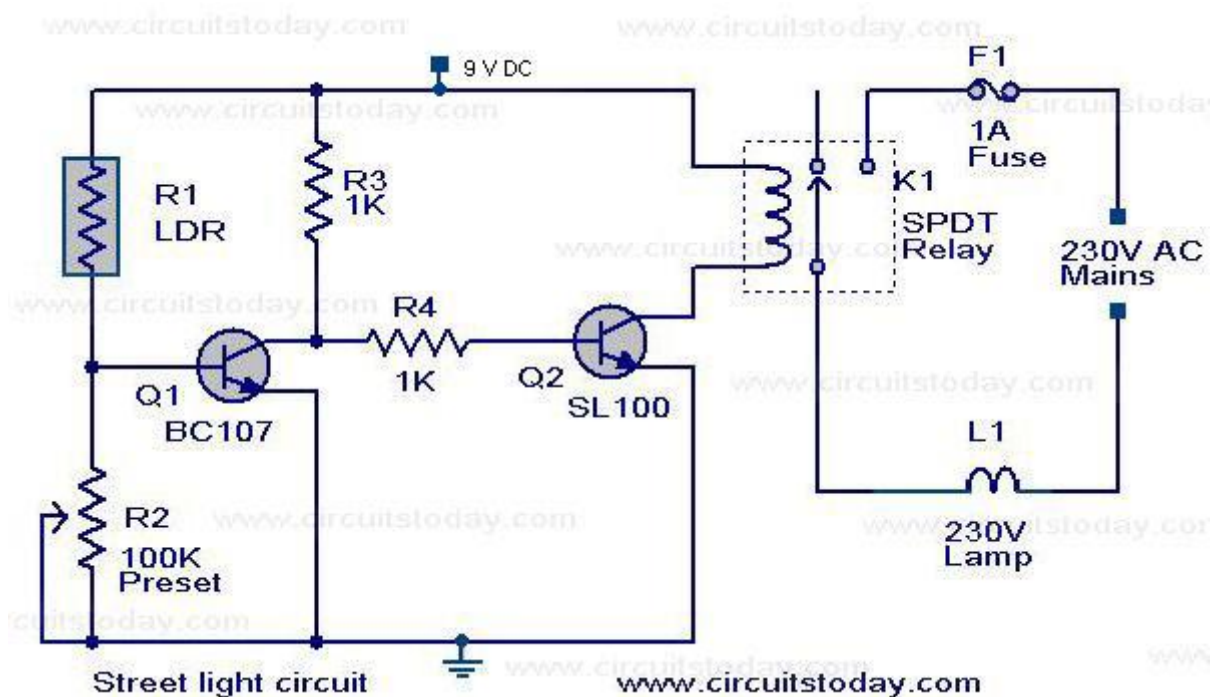


Figure 8.1. Circuit diagram for Automatic Lighting System



Figure 8.2. Automatic Lighting System

8.3. MOBILE CHARGING UNIT

The figure 8.3. shows the circuit diagram of the mobile charging unit. The AC supply taken from the main supply is step down using a transformer. The output is given to an USB wall socket after rectification and filtering (figure 8.4). At the time of charging the vehicle, it can also charge the mobile phones from the charging station.

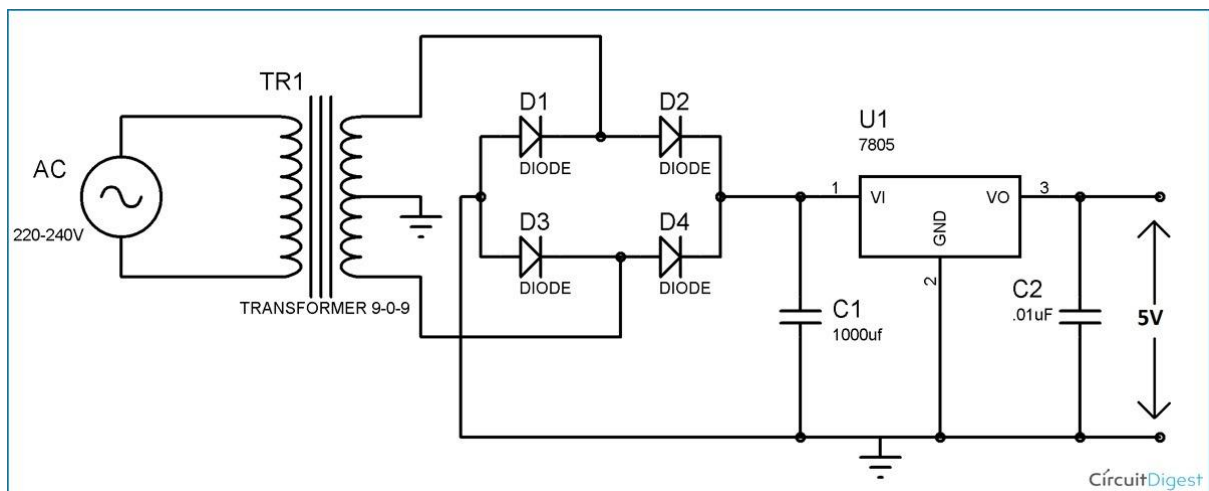


Figure 8.3. Circuit for Mobile Charging Units at Electric Vehicle Charging Station



Figure 8.4. Mobile Charging Units

Chapter 9

CONCLUSION

The movement of automobile sector from conventional fossil fuelled vehicles to Electric vehicles are drastically increased. There is a requirement for more electric vehicles charging station in the roadsides of highways in regular intervals like the petrol pumps now. This electric charging increases the needs of more electricity. If the demand of electricity increases the respective department want to produce more electricity by hydro-power plant, thermal plants, etc. The use of fossil fuels also leads to environmental pollution. So we need a grid connected solar powered electric vehicle charging station. This can reduce the cost of battery for store charge in day time and provide charge for charging in night time, the efficiency of battery is also small. So by eliminating batteries we can improve the performance. After analysing the requirements of the charging unit and solar system using the PvSyst software, we realize that the 6 KW solar panel is essential for supplying power to the charging unit. And our conclusion was presented as a paper in a conference (International Conference on Automation, Signal Processing, Instrumentation and Control (iCASIC 2020)), that will publish in Springer proceedings in their edition “Advance in Automation, Signal Processing, Instrumentation and Control” .Then after proper studies of the charging infrastructure protocol released by the government of India we select a charging unit which has compliance with the protocols. Our main focus are the E-Autos released by Kerala automobiles and the Mahindra Treo. In implementation part, the solar panel is implemented on the building in Chinnakada, Kollam which is owned by Kollam municipal corporation, and the charging unit is erect in ground of that building near the roadside. We also made some prediction of number of electric vehicles in Kerala in coming years by regression methods, based on the data collected from website of ministry of road transport and highways (Parivahan). Also installed the mobile phone charging unit and automatic light near the charging station. At the time of charging their vehicle, they can also charge their mobile phones from our charging station.

Future Scope: In future we can incorporate the charging units for electric cars and bus along with this unit. Also the implementation of wireless charging can be incorporated in the future.

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List of Publications

Sheeba R, Sheik Mohammed, Varun S Prakash and Abhiraj P "Optimal design and implementation of Solar Powered EV Public Charging Station", International Conference on Automation, Signal Processing, Instrumentation and Control (iCASIC 2020), Vellore Institute of Technology on 27-28, February 2020.

APPENDIX 1

PROJECT PROPOSAL- DOECC



Government of Kerala

Directorate of Environment & Climate Change

SCIENCE & TECHNOLOGY INTERVENTION FOR CLIMATE CHANGE MITIGATION/MANAGEMENT/ADAPTATION

Nature of Project: Please tick one or more boxes, as applicable

Technology Development	
Technology Development and Transfer	
Technology Dissemination	
Technology optimization/adaptation, demo and training	
Action oriented Research	
Others (please specify)	

DECLARATION BY THE PRINCIPAL INVESTIGATOR

I have gone through the rules and conditions of the financial support and if selected, I agree to abide by them. The particulars given in the form are correct and I am prepared to present myself for presentation/discussion, if called upon to do so.

Date:

Signature of the
Principal Investigator

[Office Seal]

DETAILS OF THE PROJECT

Project Summary

1.1 Title of the Project :

Grid connected Solar Powered Charging Station for Electric Vehicles

1.2 Name and Address of the PI/PIA :

Principal Investigator : Dr. Sheeba R
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1.3 Abstract :

Climate change is one of the major threat being faced in this era. As it is observed that the lion's share of pollution caused is due to the major fossil fuel usage in the transportation sector.

Kerala has been facing severe environmental pollution with increased use of fossil fuels in the transportation and industrial sectors which result in Climate changes. Kerala now has over 25 lakh licensed vehicles on the road wherein the total length of the carriage way is only 21347 km.

Demand for electric power in the future intensify the uncertainty on depending renewable resources. This project proposes the idea of grid connected solar powered charging station to deliver sufficient energy for the charging of electric vehicle. These stations could be located along a highway, or personalized for an in house installation. This project mainly prefers the installation of PV Panels among the Governmental infrastructures, Houses, Bus stops.

A smart user interface to locate the charging stations will be implemented and the total cost of charging station is reduced by the elimination of batteries. The automobile industry is migrating into electric mobility and it is expected to have a large number of EV's in the near future. EV requires regular charging, this further increases the electricity demand and utilization of fuels for generation. Moreover, the infrastructure is also not available.

1.4 Total Budget Outlay : 6,78,500.00 Rupees per Station

1.5 Duration of the project : 1 year

1.6 Implementing Geographical Area :

Project is planned to implement in the Chinnakkada Bus Station, Kollam (Approval from all concerned departments)

1.7 Expected Output and Outcome :

- Climate change is one of the major threat being faced in this era. As it is observed that the lion's share of pollution caused is due to the major fossil fuel usage in the transportation sector.
- The expected increase in the electric vehicle production in the transportation sector would drastically increase the electric power demand. As Kerala's energy production isn't enough to cover the demand, dependency on renewable energy has to be considered. The proposed project can contribute the renewable energy to feed the power grid.
- The proposed project focus on the charging of Electric Auto's, as the Kerala Automobiles plant with capacity to rollout 7000 e-autos annually is lacking for charging stations in Kerala.

- A Public Mobile Charging System will also be equipped within the charging station for the public use.
- Charging station Implementation will enhance the usage of sustainable electric vehicles in large count.
- Commercializing charging station will help the government to economically implement more sustainable projects.

1.8 Details of Beneficiaries :

- Kerala State Electricity Board would be able to meet the demand in the future with least dependency of thermal power plant which even produce more pollution.
- Every citizen who owns an electric vehicle can depend on these charging station.
- Kerala state road transport sector with their new initiative of electric buses can be encouraged further.
- Kerala Automobiles Limited has initiated bulk production of Electric – Auto and the autos will be launched in the market during this Onam 2019. The proposed charging station will be great aid for the new launch and implementing a solar powered charging station encourages sustainable transportation with low cost.
- Passengers will be provided with Mobile Charging Facilities at the Bus Stations.
- The charging station will create new employability. The operational monitoring and Management of the station can be given to Kudumbashree Units and it provide technician employability also.

Detailed Project Report

Grid connected Solar Powered Charging Station for Electric Vehicles

2.1 Introduction

The use of Electric Vehicles is growing fast as a dependable alternative to gas-powered vehicles. The Electric Vehicle charging has traditionally been grid-based but use of solar powered chargers has materialized as a fascinating opening. These chargers are pollution free and provide clean electricity to electric-powered cars. It results in a sustainable impact to the environment.

With electric vehicles becoming more affordable every year, investors are starting to see the demand for charging stations rise as well. We wanted to use this fact and the idea that electric vehicle consumers are typically environmentally friendly individuals to create an electric vehicle charger using 100% renewable energy. As of now, the electric grid is not nearly as dependent on renewable energy as it is with fossil fuels.

This impact can be reduced by creating an on-the-grid, Solar Powered Electric Vehicle Charging Station. The current scenario in the Kerala's power generation is that, of the total power generation about 73.06 % is produced from hydel.

Hydropower has the ability to generate electricity without emitting greenhouse gasses. However, it can also cause environmental and social threats, such as damaged wildlife habitat, harmed water quality, obstructed fish migration, and diminished recreational benefits of rivers. The other hand of production from thermal power plants, which is a major threat of producing environmental pollutions.

By the effective implementation of proposed a Grid connected solar powered charging station can reduce problems caused due to the future demand crisis. Economically this would enable the public sector to improve the project through protection against environmental pollutions. The project can be implemented through a cost effective, pollution free technique by the elimination of batteries in the operation. Grid connected Solar Powered Charging Systems helps in sharing power to the main supply covering the demand for electricity to some extent.

From recent reports, Kerala Automobiles Limited's (KAL) introduced a three-seater environment- friendly auto rickshaw which is the first public sector undertaking to get approval in the country. The KAL has planned to commercially produce e-autos across Kerala, with limited public charging stations. Demand for the charging stations indicates the importance of our Project in the present situation. The proposed project provides Mobile charging facility at the Bus Station for the public, Automatic control of Street lights around the Bus Station, Solar powered Grid connected Charging for E-Bikes and E-Auto's. The Charging Station Management can be effectively done with the help of **Kudumbashree**.

2.2 Objectives of the Project

- Design a sustainable charging station to reduce the future demand of electricity.

Electric vehicle becoming more affordable every year, investors are starting to see the demand for charging station as well.

The automobile industry is migrating to electric mobility and more EVs are expected in the future, which eventually increases the demand for electricity. The government will be forced to depend more on generation from fossil fuels. This effect can be reduced with the Solar powered charging stations.

- Design a solar powered charging station to eliminate the over usage of fossil fuel which increases the air pollution and leads to Climate Changes.

Raised demand forces the government to depend on the thermal power plants which uses coal as its driving fuel. The main emissions from coal-based power plants that contribute to air pollution include sulphates, nitrates, mercury, and secondary particulate matter (which is largely formed by SOX emissions). Coal, fly ash, and secondary particles from thermal power plants and industries in Delhi contribute 35% of PM2.5 in the winter and 41% of PM2.5 in the summer. Since Delhi has 13 thermal power plants with a capacity of

over 11,000 MW within a 300-km radius, these emissions are often blown into the NCR by the northwesterly winds.

- Design of a Mobile Phone Charging circuit.

Mobile Phone Charging circuit can be implemented by providing a 230V Plug point and Universal Multi Pin Smart Phone Charger.

- Design of Automatic control circuit for Street Lights near the Local Station.

2 - 4 Light can be automated and powered by the system. The proposed system automatically controls the Lights in the charging station, with its operation after 7 PM.

- Design user interface for the electric vehicle charging.

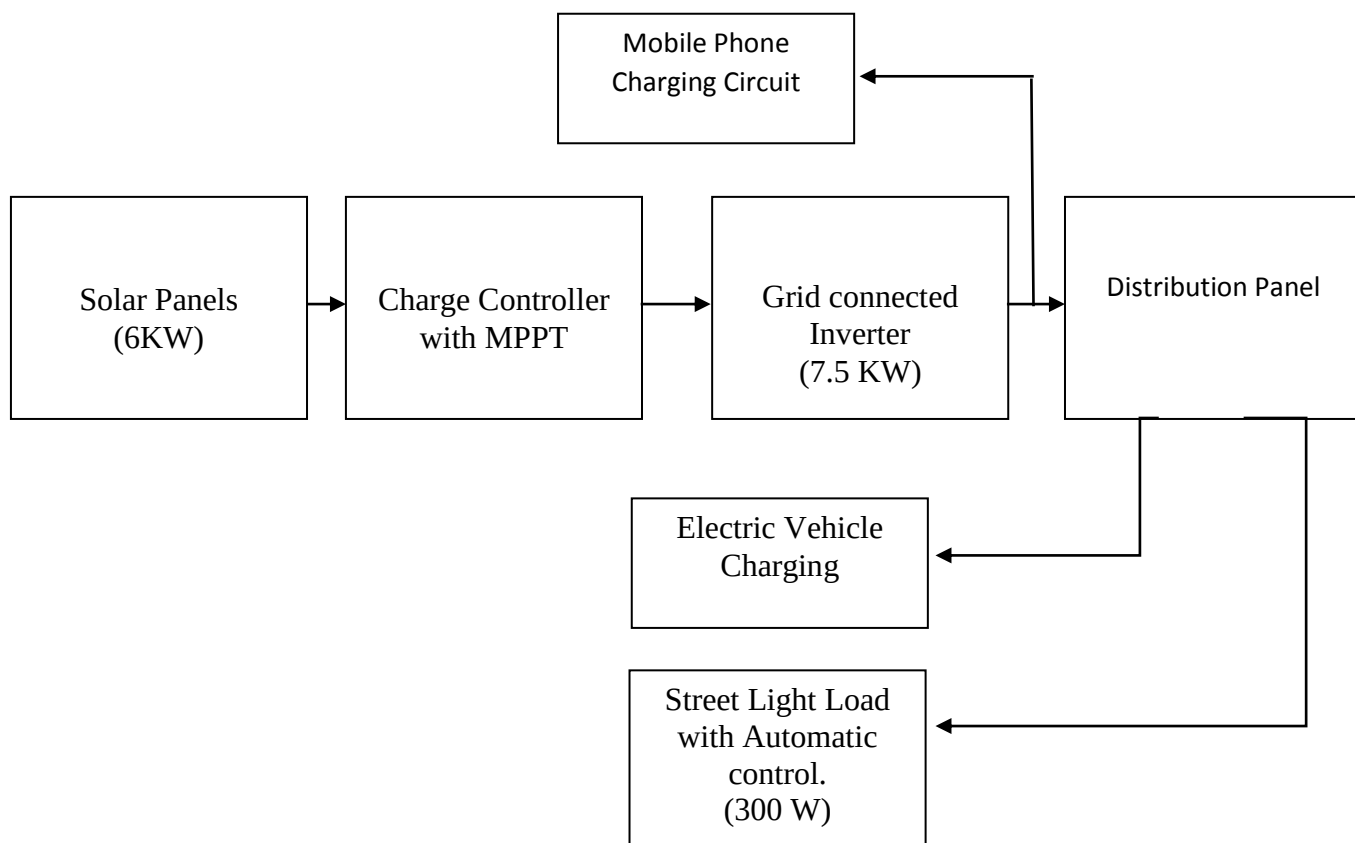
Design of Application which displays the charging stations in Kerala. In Future, payment for the energy consumption, Analysis of energy consumed can be implemented.

2.3 Scope of the Project

Project scope description	Grid connected solar fed Charging station. This is a renewable energy harvesting by the use of PV Panels, which would enable the charging of electric vehicles. Grid connection of such energy will help the sharing of energy with economic benefits. Usage of this smart charging reduces the cause for climate change in certain manner. Mobile Phone Charging Facility can be implemented in the Station for the Public. Automated control of Street Lights around the Local Station with Solar powering can be made possible.
Project Deliverables	- Normally a charging station is powered by conventional grid supply but it has many limitations and disadvantages. Hence a solar powered charging station is proposed. The implementation of switching circuit enables us to switch supply.
Project Acceptance Criteria	- The proposed project has environmental, social, technological and economic relevance. - The system works with solar power source and hence, it has no emission and support the mission “climate change”. - System can be installed in public places and could be used

	by individuals - Cost effective solution for electric vehicle charging (E-Autos, E-Bikes), Mobile Phone Charging for public and also to power Lights in the Bus Station.
Project Constraints	- Maximum Efficiency can only be expected during summer. - A maintenance team with experts has to be formed. - Implementation in a large area is needed for fulfilling the demand.

2.4 Materials and Methodology



Design of the System:

The Proposed project includes a charging point mainly focused for Electric Vehicles (e-auto's, e-bikes), Mobile Phone Charging Circuit, Automatic controlled Lights in the Bus Station.

E-Auto produced by the Kerala Automobiles Ltd is equipped with 5.4 kWh (ranging from 2 kW to 5.4 kW) Battery capacity.

Capacity of PV Panel to be installed = 6kW, Minimum of 3 kW is required to connect to the Grid.

There for assuming 5 hours as the Peak Sun Hours, a capacity in the range of 24-30 kW per day can be produced in a day.

As the PV Panels produce 24-30 kW per day, 2-3 e-autos can completely be charged from the renewable generation. Additional demand can be compensated by utilizing the Grid power.

2-3 Street Lights in the Bus station can be automated to operate in the evening, which includes three 100W Street LED Lights, with a required capacity of 300W. Hence the system is capable of covering a demand of approximately 6-7.5 kW.

2.5 Review of the work done (if any) in the proposed area, National and International level

Smart charging station was inaugurated in national capital for the charging of electric vehicles.

In a bid to push electric mobility in the country, the government has approved a plan to set up 131 public charging stations in the capital. The plan includes setting up some of these stations at such locations so that electric vehicles coming from Noida, Gurugram, and Ghaziabad as well. The plan approved by the Ministry of Power and Delhi government includes setting up 33 EV chargers at Metro stations. The smart public chargers are of 15 kilowatt power and will fully charge a vehicle in one hour. EV charging station is equipped with an analytic platform to help consumers get a seamless online experience. It also said through the ElectreeFi mobile app, an EV consumer can locate the nearest charging station, make advance booking of their charging time and even pay online. Charging initiation and session authentication will be done using RFID, SMS and mobile apps, and an alert will be sent if the vehicle connector is not properly connected to the EV. The smart public chargers are of 15 kilowatt power and will fully charge a vehicle in 60-90 minutes.

Here the charging station is not much dependable to the solar energy, where they failed to implement a completely renewable source of energy.

Metro Station in Ernakulam, has e-auto facility with charging station implemented in the station itself. The cost for transportation is lesser, but limited by the range of travelling. This is due to the absence of charging station other than those installed in the metro stations.



Electric Auto developed by Kerala Automobile Ltd,



Mahindra Treo

2.6 Details of project implementing geographical area

Project is planned to implement in the Chinnakkada Bus Station, Kollam (Approval from all concerned departments.)

2.7 Details of R&D component, if any

Nil

2.8 Beneficiaries of the Project

-This project enhances the lifestyle of people to a way of sustainable living. This is will allow the charging of electric vehicles for the owners.

-KSRTC has initiated their electric buses, it can also be utilized by them.

-More investors looking forward for the production of electric vehicles will be encouraged.

-Reduction of the power per unit can be reduced with the usage of renewable source of energy. Replaces conventional gas engine vehicles with electric vehicles.

-Kerala State Electricity Board would be able to meet the demand in the future without any further dependency toward thermal power plant which even produce more pollution.

-Kerala Automobiles limited is initiating bulk production of Electric – Auto's, there for implementing a solar powered charging station encourages sustainable transportation with low cost.

-Passengers will be provided with Mobile Charging Facilities at the Bus Stations.

2.9 Significant output and outcome of the project

Output of Project

- Climate change is one of the major threat being faced in this era. As it is observed that the lion's share of pollution caused is due to the major fossil fuel usage in the transportation sector.
- The expected increase in the electric vehicle production in the transportation sector would drastically increase the electric power demand. As Kerala's energy production isn't enough to cover the demand, dependency on renewable energy has to be considered. The proposed project can contribute the renewable energy to feed the power grid.
- The proposed project focus on the charging of Electric Auto's, as the Kerala Automobiles plant with capacity to rollout 7000 e-autos annually is lacking for charging stations in Kerala.
- The Project expects to provide Public Mobile Charging System near the bus station for the passengers.
- Charging station Implementation will enhance the usage of sustainable electric vehicles in large count.
- Commercializing charging station will help the government to economically implement more sustainable projects.

Outcome of Project:

- **Aims for sustainable green transportation.**
- **Reduces the overall carbon emission by the elimination of petrol / diesel engines.**
- **Usage of unlimitedly available resources doesn't cause any sort of depletion of power.**
- **Energy production with no limitation is possible.**
- **Employability**

2.10 Detailed budget and year wise work plan with proper justification

Work Plan	
Initial survey of project development	Understanding the suitable places (Bus stops, infrastructures etc.) with desired solar power harvesting specifications for the installation of PV Panels. Analyzing the scope of project in different parts of the state and finding suitable companies for collaboration.
Proper Study on the implementation of project	Components required for the project are listed. Complete study of technical aspects of the project. Seeking Mentorship for the project from experts from the same field. Analysis of related project implemented in the country.
Prototyping	The proposed system will be implemented.
Finalizing the components	Finalizing the components through comparison of cost effective products in the market. Access to high end technologies for efficient manufacturing of hardware.
Month 1-3	Field Survey and Literature Study.
Month 4-6	Design and procurement
Month 7-8	System Development: Installation and Commissioning.
1 Year	Project Completion

Budget (<i>Approximated value, may vary with bulk production</i>)	
Component	Price (<i>in Rupees</i>)
6000 Wp Panels	3,00,000.00
7.5kVA Inverter	1,25,000.00
Control Circuit Hardware for Mobile Charging and Lighting control	10,000.00
Charging Panel Structure and Assembly	40,000.00
Structure, Cabling and Accessories	70,000.00
Installation and Commissioning	20,000.00
Travel	10,000.00
Publication	15,000.00
Contingency	88500.00
Total	6,78,500.00

2.11 Previous experience in similar works / area of specialization

1. Two B-Tech Projects-

- Solar Fed Charging Station
- Electric Vehicle

2. One Paper publication in this field

Title- Optimized Charge Scheduling of Plug-In Electric Vehicles using Modified Placement Algorithm. International Conference on Computer, Communication and Informatics, Jan 2019, Coimbatore, India.

2.12 References

- [1] F. Mwasilu, J. J. Justo and T. D. Do, ‘Electric vehicles and smart grid interaction: A review on vehicle to grid and renewable energy sources integration’, Renewable and Sustainable Energy Reviews 34, 2014, pp. 501-516
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- [4] S. Lee, P. Shenoy, D. Irwin and S. Iyengar, “Shared Solar-powered EV Charging Stations: Feasibility and Benefits”, 7th IEEE International Green and Sustainable Computing Conference, 2016.
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- [8] http://www.kerenvis.nic.in/Database/Energy_831.aspx
- [9] <http://www.kseb.in/index.php?lang=en>
- [10] <https://www.cprindia.org/news/7192>
- [11] <https://www.hindawi.com/journals/jse/2016/8012432/>

Details of Principal Investigators / Project Implementing Agency

3.1 Name, address of the host institution:

TKM College of Engineering,
Karicode,
Kollam – 691005
Kerala, India

3.2 Name and official address of Principal Investigator/s and Co Investigators

Principal Investigator : Dr. Sheeba R
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3.3 Bio-data of the Investigator/s

See attachments.

3.4 Infrastructure and lab facilities available in the host institution which will be made available for the project

Yes

3.5 Details of Government Departments/ Local bodies/Institutions, etc, if there is any collaboration for project implementation

No

Terms and Conditions and Declaration

1. A project will normally be sanctioned for a maximum period of three years. However, in exceptional cases, DoECC holds the right to select projects with higher project duration, if found necessary.
2. The grant will be disbursed to the administrative authorities of the Institutions in accordance with the principles provided below.
3. The authorities receiving the grants will be responsible for their disbursement, administration, and maintenance of accounts. In the case of collaborative work carried out by a network of Institutions, the Coordinating Institution would be responsible for submission of the Utilization Certificate, Expenditure Statement and Progress Reports covering all the partners.
4. After execution of the agreement, the first installment of funds will be released to the institution. For the projects with the project period less than or equal to 2 years, total funds will be released in 3 installments (40%, 40% and 20% of the project cost) of the total amount sanctioned for the project. The last installment (20% of the project cost) will be released on receipt of the draft final report of the project and its appraisal by the Committee based on its recommendations. If the project period is more than 2 years, yearly requirement as approved by the Committee and the Working Group, will be released as first and subsequent installments on yearly basis. While first installment will be released as envisaged above, subsequent ones and 80% of the last year installment will be released based on appraisal of the progress and submission of details of utilization of at least 80% of the funds released. Remaining 20% of the last installment will be released only on receipt of the draft final report of the project and its appraisal by the Committee and submission of the final report based on its recommendations. In exceptional cases, the committee/ working group shall decide on fund allocation, if found necessary.
5. The approved grant should be exclusively spent on the project for which it has been sanctioned within the stipulated time period. In the project wholly sponsored by the Directorate, the grantee organization is not permitted to seek or utilize funds from any other organization (Government, semi-government, autonomous or private) for the same project. Any unspent amount out of the grant sanctioned by the Directorate for a particular project would be required to be surrendered to DoECC. The carry forward of the unutilized amount from one to the next year for utilization for the same project would require the specific approval of the Directorate.
6. An extension of project period up to a maximum of six months may be granted to projects in deserving cases. Any request for extension of the project should be sent by PI / PIA to DoECC at least three months before the closing date. In the case of an extension of tenure of projects, the PI / PIA would provide complete justification for the same. The

PI should not make any expenditure after the closing date without specific approval of the DoECC till the extension is conveyed to him. No additional funds would be sanctioned for the extension period.

7. The implementing institution and the PI have the full responsibility for completion of the project and to achieve the expected outcomes and deliverables of the project.

8. In case any Investigator (including Lead or Principal Investigator) leaves the institute on account of superannuation, unforeseen circumstances, the responsibility for the completion of the project may be entrusted to another equally qualified Investigator by the Head of the Institution with approval of the DoECC at no extra cost.

9. If the investigator leaves the institution where the project is based, he / she should submit 5 copies of complete and detailed report of the work done on the project till the date of his release. Prior to leaving, the Investigator shall inform the Directorate and get an approval to hand over the project to another Investigator who shall be responsible for the completion of the project and submission of the final report.

10. In case the PI is shifting to another institution due to a new appointment/transfer/long-term deputation, the project could be transferred to that institution with mutual consent of both the institutions and with the approval of the Directorate.

11. Those institutions/individual PIs which/who do not render accounts/submit physical progress reports against the released grants within the stipulated period will be blacklisted by the Directorate after ensuring an adequate dialogue, both in speech and writing, by the Directorate with the authorities of the concerned defaulting institution/individual.

12. For permanent and semi-permanent assets acquired solely or mainly out of the grant, including books and furniture, an audited record in the form of a Register shall be maintained by the grantee. All equipment and stores purchased out of the grant would remain with the institution concerned unless otherwise specified in

the sanction. The grantee will submit the list of assets acquired under the project. The term "Assets" here means (a) immovable property and (b) movable property of a capital nature, where the value exceeds Rs 10,000/-. The grantee should make every effort to put all the equipment available in the institution in effective use for the future needs of the Directorate /other Govt. Departments. The Director, DoECC shall hold the right to decide on the future use of the equipments/instruments acquired as part of the project.

13. The grant should not be utilized for construction of any buildings. The implementing institute should provide full infrastructural facilities such as accommodation, water, electricity, library, and communication facilities etc. for smooth implementation of the project.

14. The project becomes operative with effect from the date of receipt of the first installment by the implementing Institution through DD/ NEFT/ RTGS transfer. This date should be intimated by the Institution authorities/ Principal Investigator to the Directorate. It will, in no case be later than one month after the receipt of the Draft/ NEFT/ RTGS transfer of first installment by the Institute.

15. The selection and appointment of JRFs/SRFs/ Staff for the project may be made by the Principal/Lead Investigator in accordance with the procedures of the concerned Institutions for the period not exceeding the sanctioned duration of the project. The qualification and experience should be followed as per the CSIR/UGC guidelines.

16. Staff appointed for the research project will be subject to the administrative control and service rules as applicable at the Institute where they are appointed and DoECC / Govt. of Kerala will not have any commitment in any respect.

17. The grantee organization would furnish to the Directorate yearly progress report of the work done on the project, an audited Statement of Expenditure and Utilization Certificate in prescribed formats (KFC Form 44) within thirty days from the close of each sanction year (sanction year implies one year from the date of release of grant for previous financial year).

18. The Directorate have the right to depute empaneled Expert Peer Reviewers/Scientists/Specialists/Finance persons of the Department to visit the grantee organization periodically for reviewing the progress of the work and for suggesting such measures as to ensure early realization of the objectives of the project. Full facilities are to be provided by the grantee organization to the visiting scientists/specialists.

19. In the event, after due enquiry, of any conclusion that the progress of a project is highly unsatisfactory, cannot be improved and violated the conditions of agreement; DoECC will be at liberty to terminate the Project. Upon such termination, the PI / PIA shall refund the sanctioned amount with 18% interest.

20. On termination of the project, the duly audited accounts shall be submitted and the unspent balance, if any shall be refunded to the DoECC within three calendar months of completion of the project. Full and final payment will be made only on completion of all closure formalities such as the acceptance of all the financial certificates, audit reports and final technical reports of the project.

21. The PI / PIA shall submit files and accounts related to the project whenever the DoECC demands.

22. Calendar of events should be prepared and forwarded to DoECC in pen drive. The PI / PIA shall exhibit the Board of DoECC in the premises of the project.

23. The grantee organization(s) has to furnish 5 copies of the Final Project Report, including Executive Summary, database and any other relevant documents along with a soft copy, to DoECC.

24. If the PI and the institutions who fails to submit the final project report / relevant documents even 3 months after the end of the scheduled time period or if the progress of the project is not satisfactory, procedure for the refund of the amount as per relevant Government norms will be initiated. Further, the Head of the Institution where the PI is located should be intimated regarding the nonsubmission of the project report and the decision of Government to suspend future funding to the institution. A list of such PIs and Institutions would be submitted to government.

25. Investigators who wish to publish papers based on the research work done under the Project or to present such papers at conferences need to duly inform the Directorate and

should acknowledge the financial support received from the Directorate. Three copies of the publications/papers shall be sent to the Directorate.

26. Patents shall be filed only with the concurrence of DoECC. If the research results are to be legally protected, the results should not be published without action being taken to secure legal protection for the research results.

27. The Investigator(s) should not enter into collaboration on the sanctioned project with a foreign party (individual/industry) without prior approval of the DoECC.

28. Sharing of Intellectual Property Rights between the Government and the Institution(s) and research staff participating in the project would be specified in the sanction order based on Guidelines of the CSIR.

29. All correspondence is to be addressed to the Director, Directorate of Environment and Climate Change, IV Floor, KSRTC Terminal, Thampanoor P.O.,
Thiruvananthapuram – 695 001, Ph: 0471-2326264, Email: envt.dir@kerala.gov.in;
environmentdirectorategmail.com

Place:

Date:

Signature, name & address of investigator

Principal Investigator :

Dr. Sheeba R
Professor
Electrical and Electronics Engineering Dept.
TKM College of Engineering, Kollam-5

Co Investigators :

Dr. Sheik Mohammed S
Assistant Professor
Electrical and Electronics Engineering Dept.
TKM College of Engineering, Kollam-5

Varun S Prakash
B Tech Student
TKM College of Engineering, Kollam-5

Abhiraj P
B Tech Student
TKM College of Engineering, Kollam-5

Counter signed by
The Head of the Instituti

(SEAL)

APPENDIX 2

GOVERNMENT ORDER TO SANCTION THE PROJECT

15167
5118119



GOVERNMENT OF KERALA

Abstract

Environment Department – Directorate of Environment & Climate Change-
Annual Plan 2019-20 - Implementation of Plan Schemes - Administrative
Sanction accorded - Orders issued.

ENVIRONMENT (A) DEPARTMENT

G.O.(Rt)No.82/2019/Envr Dated, Thiruvananthapuram, 22/08/2019

Read: 1. Letter No.DoECC/A1/1080/2018 dated 22.07.2019 from the
Director, Directorate of Environment & Climate Change.
2. Minutes of the meeting of Departmental Working Group held
on 25.07.2019.

ORDER

As per the letter read above the Director, Directorate of Environment & Climate Change has submitted various proposals for according Administrative Sanction under Annual Plan 2019-20 for implementation of Plan Schemes by utilizing current year's budget provision.

2) The Departmental Working Group of Environment Department held on 25.07.2019 scrutinized the proposals in detail and recommended the following schemes for Administrative Sanction as detailed in the minutes read above, subject to specific conditions. The details of the scheme and component wise break up are as follows :

D) Environmental Awareness & Incentives

Head of Account : 3435-03-003-98(P)

Sl. No	Item under Scheme and Components	Period	Amount (in Rs)
1	Paristhithikam	On going	15 Lakh
2	Online database management system for the activities of "Environmental awareness and incentives" scheme. Subject to the condition that the database should be bilingual(Eng & Mal) and the possibility for linking the database with the website of the DoECC should also be explored.	On going	15 Lakh
	Total		30 Lakh

II) Environmental Research & Development*Head of Account : 3435-03-103-99*

Sl. No	Item under Scheme and Components	Period	Amount (in Rs)
1	Paristhithi poshini research fellowship	On going	31.04 Lakh
	Total		31.04 Lakh

III) Climate Change*Head of Account : 3435-04-104-98(P)*

Sl. No	Item under Scheme and Components	Period	Amount (in Rs)
1	Climate Change, floods and rural farming communities in Kuttanad : A shift from disaster management towards disaster preparedness. Subject to the condition that 2 nd installment will only be released on receipt of the progress report of the project during the 1 st year and undertaking in this regard should also be obtained from the University and institutional expenses(other Government agencies)are to be excluded.	3 years	17.17 Lakh (1 st year - 10.09 Lakh; 2 nd year- 3.39 Lakh; 3 rd year – 3.69 Lakh)
2	Traditional ecological knowledge and climate resilience : A study based on indigenous communities of two different sanctuaries of Kerala. Subject to the condition that 2 nd installment will only be released on receipt of the progress report of the project during the 1 st year and undertaking in this regard should also be obtained from the University.	2 years	17.45 Lakh (1 st year - 10.35 Lakh; 2 nd year- 7.10 Lakh)
3	Grid connected solar powered charging station for electric vehicles. Subject to the condition that 2 nd installment will only be released on receipt of the progress report of the project during the 1 st year and undertaking in this regard should also be obtained from the University.	1 year	6.785 Lakh
4	Reassessing insect assemblage after three decades to decipher climate change induced	3years	35.21875 Lakh

	impact in southern Western Ghats. Subject to the condition that 2nd installment will only be released on receipt of the progress report of the project during the 1st year and undertaking in this regard should also be obtained from the University and institutional expenses (other Government agencies) are to be excluded.		(1st year - 11.75625 Lakh; 2nd year - 11.85625 Lakh; 3rd year - 11.60625 Lakh)
5	Establishing rainwater harvesting/aquifer recharging structures in public building and selected households in Amboori village, Thiruvananthapuram Subject to the condition that 2nd installment will only be released on receipt of the progress report of the project during the 1st year and undertaking in this regard should also be obtained from the University.	1 year	20.9 Lakh
6	Eco restoration and biodiversity enhancement of Kallada river through People's Participatory Programme. Subject to the condition that 2nd installment will only be released on receipt of the progress report of the project during the 1st year and undertaking in this regard should also be obtained from the University and institutional expenses (other Government agencies) are to be excluded.	3 years	13.19 Lakh (1st year - 6.46 Lakh; 2nd year - 3.78 Lakh; 3rd year - 2.95 Lakh)
	Total		110.71375 Lakh

IV) Climate Resilient Farming

Head of Account : 3435-03-103-97(P)

Sl. No	Item under Scheme and Components	Period	Amount (in Rs)
1	Development of drought tolerant cardamom hybrids through pollen selection and selective fertilization. Subject to the condition that undertaking in this regard should also be obtained from the University & institutional expenses (other Government agencies) are to be excluded.	3 years	24 Lakh (1st year - 12 Lakh; 2nd year - 6.75 Lakh;

V) Strengthening of the Department of Environment

Head of Account : 3435-60-800-99(P)

Sl. No	Item under Scheme and Components	Period	Amount (in Rs)
1	Replacement of official vehicle for the Director	1 year	10 Lakh
2	Capacity Building	1 year	10 Lakh
3	Modernization of Environment Department	1 year	53.25 Lakh
4	Strengthening of Library	1 year	1.00 Lakh
	Total		74.25 Lakh
Grand Total (I+II+III+IV+V)			388.89875 Lakh

3) Having considered the above proposals with reference to the recommendations of the Working Group in detail, Government are pleased to accord Administrative Sanction to the Directorate of Environment & Climate Change for implementation of the above projects as recommended by the Working Group for a total amount of **Rs.388.89875 Lakh (Rupees Three Hundred and Eighty Eight Lakh Eighty Nine Thousand Eight Hundred and Seventy Five only)** by debiting the expenditure from the respective head of accounts during the year 2019-20.

4) The Director of Environment & Climate Change will strictly monitor the implementation of plan schemes at each stage and they will furnish physical and financial progress reports to Government before 10th of every month.

5) The above sanction is subject to the following further conditions :

- (1) Tender/e-tender and other required formalities shall be followed wherever necessary.
- (2) Store Purchase Rules shall be strictly adhered to.
- (3) For civil works PWD schedule of rates shall be followed.
- (4) The funds releasing will be based on actual requirement.

(By order of the Governor)

VALSA .V

ADDITIONAL SECRETARY

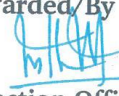
To

The Director, Directorate of Environment & Climate Change,
Thiruvananthapuram.

The Director, Institute of Climate Change Studies, Kanjikuzhy, Kottayam.

The Principal Accountant General (A&E/Audit) Kerala,
Thiruvananthapuram.
The Finance Department.
The Planning and Economic Affairs Department.
The State Planning Board, Thiruvananthapuram.
✓ The Director, Information & Public Relations (Web & New Media)
Department, (for uploading in the Government Website)
Stock file/ Office copy.

Forwarded/By order



Section Officer

✓

APPENDIX 3

SANCTION ORDER FROM CORPORATION SITE

PERMISSION



കൊല്ലം മുനിസിപ്പൽ കോർപ്പറേഷൻ
 കോർപ്പറേഷൻ ഓഫീസ് കൊല്ലം, പിൻ - 691 001
 ഫോൺ : 0474-2742192, 2746193, 2741381, ഫാക്സ് : 0474-2742724
 Email: secretarykollam@gmail.com

PW4 (PW2)-47539/19

08.11.2019

പ്രേഷകൻ

സുപ്രണ്ടിന്റെ എഞ്ചിനീയർ

സികർത്താവിന്:

പ്രിൻസിപ്പൽ ഇൻ ചാർജ്ജ്
 റി.കെ.എം കോളേജ് ഓഫ് എൻജിനീയറിങ്
 കരിക്കോട്
 കൊല്ലം

സർ,

വിഷയം:- കൊല്ലം കോർപ്പറേഷൻ - എഞ്ചിനീയറിംഗ് വിഭാഗം - ഇലക്ട്രിക്
 വെഹിക്കിൾ ചാർജിങ് സ്റ്റേഷൻ സ്ഥാപിക്കുന്നത് സംബന്ധിച്ച്.

സൂചന:- താങ്കളുടെ ഓഫീസിലെ PI/1/292/19 dtd 16.09.19 നമ്പർ കത്ത്.

കൊല്ലം കോർപ്പറേഷൻ പരിധിയിൽ സോളാർ പവറിൽ പ്രവർത്തിക്കുന്ന ഇലക്ട്രിക്
 വെഹിക്കിൾ ചാർജിങ് സ്റ്റേഷൻ സ്ഥാപിക്കുന്നതിലേക്ക് ചിന്നക്കടയിലെ അഞ്ചുനില
 കെട്ടിടത്തിന് സമീപമുള്ള അമിനിറ്റി സെന്ററിന്റെ മേൽക്കൂരയ്ക്ക് മുകളിൽ സോളാർ
 പാനൽ സ്ഥാപിക്കുന്നതിനും ഈ സെന്ററിന്റെ സമീപത്ത് ചാർജിങ് സ്റ്റേഷൻ
 സ്ഥാപിക്കുന്നതിനും 14.10.19 തീയതിയിലെ 35-ാം നമ്പർ കൗൺസിൽ തീരുമാന പ്രകാരം
 അംഗീകാരം നൽകിയിട്ടുള്ളതാണ് എന്ന വിവരം അറിയിക്കുന്നു.

ചാർജിങ് സ്റ്റേഷൻ സ്ഥാപിക്കുന്നതിന് മറ്റ് സാമ്പത്തിക ബാധ്യത കോർപ്പറേഷൻ
 ഏറ്റെടുക്കില്ല എന്ന വ്യവസ്ഥയ്ക്ക് വിധേയമായിട്ടാണ് അംഗീകാരം നൽകുന്നത്.
 ചാർജിങ് സ്റ്റേഷന്റെ തുടർപരിപാലനം നഗരസഭ ഏറ്റെടുക്കുന്നതിനും
 തീരുമാനിച്ചിട്ടുള്ളതാണ്.



ഉള്ളടക്കം : കൗൺസിൽ തീരുമാനം

DB

വിശ്വസ്തതയോടെ,

സുപ്രണ്ടിന്റെ എഞ്ചിനീയർ

APPENDIX 4

EXPENDITURE REPORTS

Thangal Kunju Musaliar College of Engineering

Kollam - 691005, Kerala, India



Accredited by NAAC with 'A' Grade & Programmes Accredited by NBA *

Phone: +91-474-2712022, 2712024, 2713129 Fax: +91-474-2712023

E-mail: principal@tkmce.ac.in, website: www.tkmce.ac.in

*UG Civil Engg., Mechanical Engg., Electrical & Electronics Engg., Electronics & Communication Engg. and Computer Science & Engg. accredited till 2022, UG Production Engg. and Chemical Engg. accredited till 2020, PG Structural Engg. & Construction Management and Industrial Refrigeration & Cryogenic Engg. accredited till 2019.

A3/3152/2019

09/09/2020

To,

Director
Directorate of Environment and Climate Change
4th Floor, KSRTC Bus Terminal
Thiruvananthapuram

Sir,

Sub:-TKMCE – DOECC Project- Forwarding Utilisation Certificate- Request
for Second Installment-Reg

Ref:- G O (Rt) No.82/2019/Envr dated 22/08/2019

As per the order referred above a grant for **Rs.6.875 Lakhs** has been sanctioned to Dr. Sheeba R, Professor, Department of Electrical & Electronics Engineering of this Institution for the Project titled **"Grid connected Solar Powered Charging Station for Electric Vehicles"**. **Rs. 271400/-** has been released as first Installment.

I am forwarding herewith the Utilisation certificate and expenditure statement for the released grant.

Kindly issue necessary orders to release the second Installment at the earliest.

Yours Faithfully



PRINCIPAL

Encl:- Utilisation Certificate and Expenditure Statement in Duplicate

K.E.C FORM 44
FORM OF UTILISATION CERTIFICATE
Certificate showing utilisation of Grants-in-aid
'Grid Connected Solar Powered Charging Station for Electric Vehicles'
Sanctioned by Directorate of Environment and Climate Changes

Name of institution: **TKM College of Engineering, Kollam**

S. No	Order sanctioning grant	Amount sanctioned Rs.	Year of which the grant relates	Period of utilization	Date of payment	Purpose of the grant	Amount spent	Unspent balance	Remarks
1	2	3	4	5	6	7	8	9	10
	G.O (RD) No.82/2019 /First dated 22/08/2019	271400	2019-2020	1/11/2019 to 09/09/2020	27/08/2020 to 09/09/2020	Grid Connected Solar Powered Charging Station for Electric Vehicles	Project Rs. 2,10,900/- Travel Rs. 7034/- Publications Rs. 6000/- Contingency Rs. 46201/- Back Charges Rs. 21864 Total Rs. 270353.64	Rs. 770353.64 Rs. 1046.36	

1. Certified that out of the grant-in-aid of Rs.271400 sanctioned during the year 2019 in favour of the project fund named 'Grid connected Solar Powered Charging Station for Electric Vehicles' by 'Directorate of environment and climate change, Government of Kerala' as per the orders mentioned above, a sum of Rs. 270353.64 has been utilised for the purpose of for which the grant was sanctioned and that the balance of 1046.36 remaining will be adjusted towards the grant-in-aid payable for the next installment.

2. Certified that I have satisfied myself that the conditions on which the grant-in-aid was sanctioned have been fully fulfilled and that I have exercised the following transaction to see that the money was actually utilized for the purpose for which it was sanctioned.

Kinds of transactions

1. Bank Transfer

Signature of the Principal Investigator

Kollam
09/09/2020

Dr. Sheeba R

Signature of the Head of Institution

Dr. Elipinkal HANIF T.A.
Principal,
TKM College of Engineering,
Kollam

SOLAR POWERED GRID CONNECTED ELECTRIC VEHICLE CHARGING

TKM College of Engineering, Kollam

Expenditure Statement

Sl Number	Item	Expenses in Rs	Notes
1	Project	210,900.00	
2	Travel	7,034.00	
3	Publication	6,000.00	
4	Contingency	46,201.00	
5	Bank Charges	218.64	
Total Expenses		270,353.64	

Amount received	271400
Balance	1,046.36


 Dr. Shreeja R
 Principal Investigator


 Dr. Shreeja R
 Principal Investigator
 TKM College of Engineering
 Kollam

Thangal Kunju Musaliar College of Engineering



Kollam - 691005, Kerala, India

Accredited by NAAC with 'A' Grade & Programmes Accredited by NBA *

Phone: +91-474-2712022, 2712024, 2713129 Fax: +91-474-2712023

E-mail: principal@tkmce.ac.in, website: www.tkmce.ac.in

*UG Civil Engg., Mechanical Engg., Electrical & Electronics Engg., Electronics & Communication Engg. and Computer Science & Engg. accredited till 2022, UG Production Engg. accredited till 2023, UG Chemical Engg. accredited till 2020, PG Structural Engg. & Construction Management and Industrial Refrigeration & Cryogenic Engg. accredited till 2020.

A3/3152/2019

18/01/2021

To,

Director
Directorate of Environment and Climate Change
4th Floor, KSRTC Bus Terminal
Thiruvananthapuram

Sir,

Sub:-TKMCE – DOECC Project- Forwarding Utilisation Certificate- Request
for Last Installment-Reg

Ref:- G O (Rt) No.82/2019/Envr dated 22/08/2019

As per the order referred above a grant for **Rs.6.875 Lakhs** has been sanctioned to Dr. Sheeba R, Professor, Department of Electrical & Electronics Engineering of this Institution for the Project titled "**Grid connected Solar Powered Charging Station for Electric Vehicles**". An amount of **Rs.270354/-** has been released as second installment. Total grant for the second term is **Rs.271400.36/-**, including the unspent balance for the first year.

I am forwarding herewith the Utilisation certificate and expenditure statement for the released grant.

Kindly issue necessary orders to release the last Installment at the earliest.

Yours Faithfully

PRINCIPAL

Encl:- Utilisation Certificate and Expenditure Statement in Duplicate

SOLAR POWERED GRID CONNECTED ELECTRIC VEHICLE CHARGING STATION			
TKM College of Engineering, Kollam			
Sl Number	Item	Expenses in Rs	Notes
1	Project	₹ 264,969.00	
2	Travel	₹ 5,400.00	
	Total Expenses	270,369.00	
	Previous Balance	1046.36	
	Amount received	270354.00	
	Total Income	271,400.36	
	Balance Amount	1,031.36	
	Bank Transfer	180000.00	For Solar Installations
	Cash Payment	90,369.00	
	Total	270369.00	

Dr. Sheela R



[Signature]
 D. SHAMULHAMEED T.A.
 PRINCIPAL
 THANSAL KUNJU MUSALIAR
 COLLEGE OF ENGINEERING
 KOLLAM-5

K.F.C FORM 44

FORM OF UTILISATION CERTIFICATE

Certificate showing utilisation of Grants-in-aid

'Grid Connected Solar Powered Charging Station for Electric Vehicles'

Sanctioned by Directorate of Environment and Climate Changes

Name of institution: TKM College of Engineering, Kollam

S o	Order sanctioning grant	Amount sanctioned Rs.	Year of which the grant relates	Period of utilization	Date of payment	Purpose of the grant	Amount spent	Unspent balance	Remarks
1	2	3	4	5	6	7	8	9	10
1	G.O (Rt) No.82/2019 /Env dated 22/08/2019	Previous Balance Rs.1046.36/- & Current Year amount Rs. 270354/- Total Rs. 271400.36	2019- 2020	01/11/2020 to 15/01/2021	01/11/2020 to 15/01/2021	Project fund	Rs. 2,70,369/- Project (2,64,969) Travel(5400)	1031.36/-	

1. Certified that out of the grant-in-aid of Rs.271400 (Previous Balance Rs.1046.36 + Current Year amount Rs. 270354) sanctioned during the year 2020 for the project titled 'Grid connected Solar Powered Charging Station for Electric Vehicles' by Directorate of environment and climate change, Government of Kerala as per the orders mentioned above, a sum of Rs 270369/- has been utilised for the purpose of for which the grant was sanctioned and that the unspent balance for Rs. 1031.36 will be adjusted towards the grant-in-aid payable for the next instalment.

2. Certified that I have satisfied myself that the conditions on which the grant-in-aid was sanctioned have been duly fulfilled and that I have exercised the following transaction to see that the money was actually utilized for the purpose for which it was sanctioned.

Kinds of transactions

1. Bank Transfer
2. Cash Payment

Signature of the Principal investigator

[Signature]
Dr. Sheela R

Kollam
18/01/2021



Signature of the Head of Institution

[Signature]
Dr. SHANIL HAMEED TA
PRINCIPAL
THANGAL KUTTU MUDALIAR
COLLEGE OF ENGINEERING
KOLLAM-5

APPENDIX 5

COST ANALYSIS & BUSINESS MODELS- CASE STUDY

9.1. SWOT Analysis

STRENGTH

- Minimum 25 units of power will be generated by solar panels everyday
- Can charge three vehicles at a time
- Integrated with grid so as to get uninterrupted supply

WEAKNESS

- Is not suitable for large vehicles

OPPORTUNITY

- Great scope in future as it is an emerging technology
- Increasing demand of electric vehicles

THREATS

- Emergence of new charging stations across the city.

9.2. Targets

9.2.1. Three wheelers

The major target audiences are the Electric three wheelers in Kollam

At present there are almost 30 three wheelers in Kollam

The major three wheelers are KAL Neem G & Mahindra Treo



Fig 9.1 Mahindra Treo & KAL Neem G

Vehicle	Description	Specification
Mahindra Treo	Battery Capacity (Installed) – kWh	7.37 kWh
	Charging Time 0-100% @Standard Conditions	3 h 50 min
	Typical Driving Range – km	130 km
KAL Neem G	Battery Capacity (Installed) – kWh	5.4 kWh
	Charging Time 0-100% @Standard Conditions	3h 55 min
	Typical Driving Range – km	100 km

9.2.2. Two wheelers

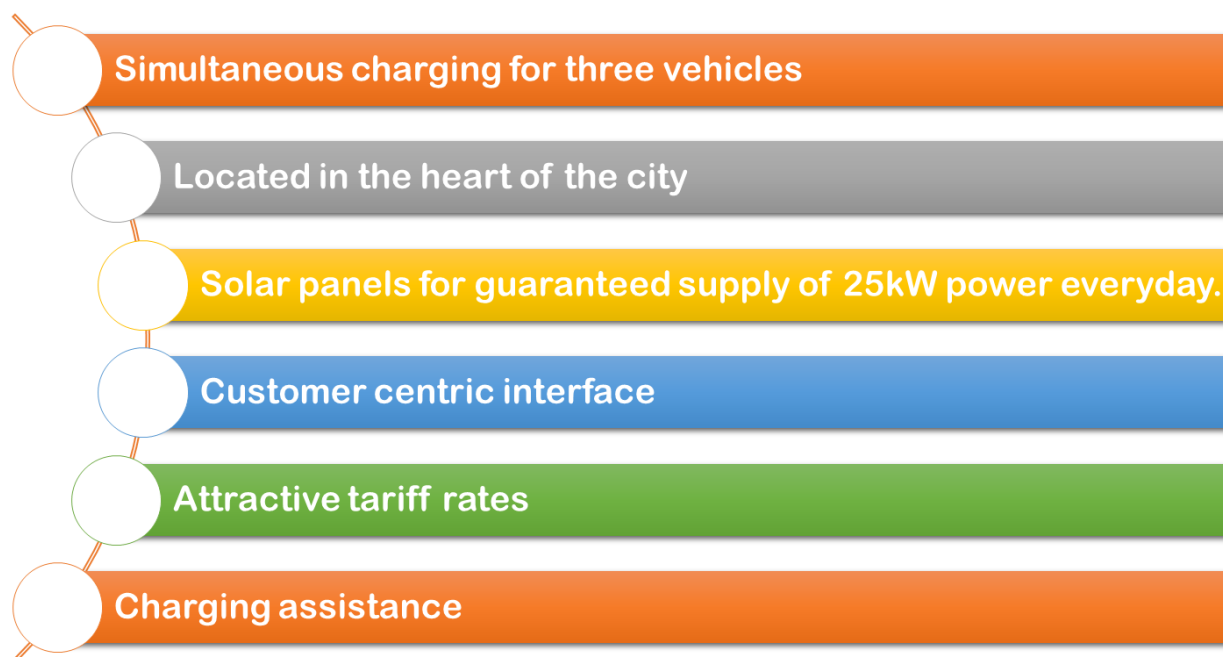
Our station can also be used to charge electric scooters.

The major electric scooters available are Bajaj Chetak, TVS iQube Electric, Revolt RV400, Ather 450.



Model	Battery Capacity (kWh)	Range(km)	Charging Time(hours)	Top speed (kmph)
Bajaj Chetak	3	85 – 95	5	78
TVS iQube Electric	4.5	75	5	78
Revolt RV400	3.24	80 – 150	4.5	80
Ather 450	2.7	55 – 75	5	80

9.3. UNIQUE SELLING PROPOSITIONS (USP)



9.4. Business Models Suggested- Case Studies

Sl. No.	Description
Case 1	Lease out the charging station to Kudumbasree
Case 2	● Charging by Pre-paid mode ● Additional infrastructure (Rs 10,000+)
Case 3	Charging by an appointed Casual Labour staff

9.4.1. Assumptions

1. Number of vehicle to be charged/day would be 5 vehicles in year 1, 10 vehicles in year 2, 15 vehicles in year 3, 20 vehicles in year 4 and 30 vehicles in year 5 (optimistic scenario)
2. Electricity tariff to the KSEB is considered as Rs 5.5/ kWh
3. Purchase cost of Solar power per unit- Rs 4/kWh
4. Total number of days= 300 days
5. Maximum energy from Solar Panel= 30 kWh
6. Annual energy from Solar Panel = 10950 kWh
7. Tariff for EV charging with operator- Rs 15
8. Tariff for EV charging with the Automatic Charging- Rs 12
9. Full capital expenditure is subsidized (Appendix 2)
10. Operation and maintenance expenditure have annual 10% increment

9.4.2. Case 1

In this case the charging station is lease out to kudumbasree and Co-operation receives 25% of the profit annually. (Appendix 2)

Maintenance Expenditure per year= Rs. 27,444

Total Revenue at the end of 5 years= Rs. 16,59,000.00

Total Expenditure at the end of 5 years= Rs. 8,27,548.36

Total Profit for co-operation at the end of 5 years= Rs. 2,07,862.91



Fig 9.2 Graph on Case 1

9.4.3. Case 2

In this case charging is done by the prepaid mode. (Appendix 2)

Maintenance Expenditure per year= Rs. 27,444

Total Revenue at the end of 5 years= Rs. 16,59,000.00

Total Expenditure at the end of 5 years= Rs. 8,27,548.36

Total Profit at the end of 5 years= Rs. 8,31,451.64

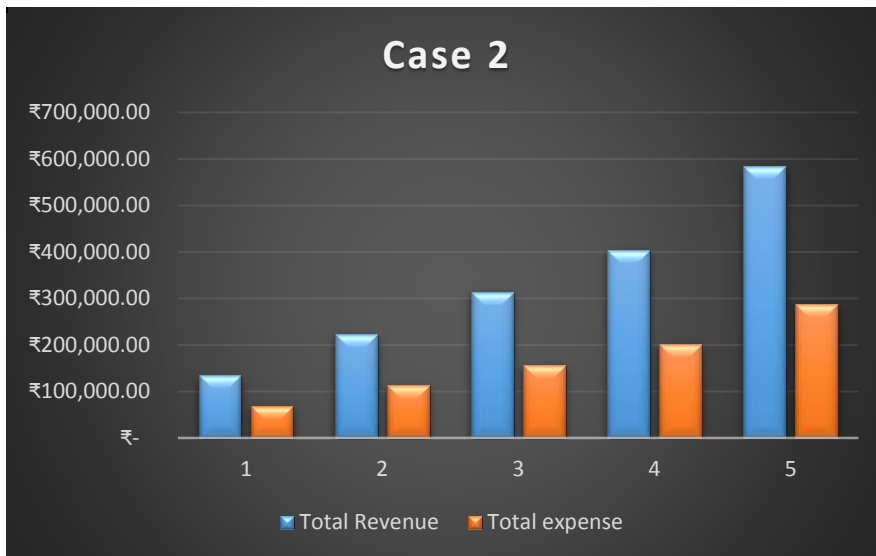


Fig 9.3 Graph on Case 2

9.4.4. Case 3

In this case manual charging is done by the appointed staff. (Appendix 2)

Maintenance Expenditure per year = Rs. 25,444

Operational Expenditure per year = Rs. 1,20,000

Total Revenue at the end of 5 years = Rs. 20,19,000.00

Total Expenditure at the end of 5 years = Rs. 15,47,950.16

Total Profit at the end of 5 years = Rs. 4,71,049.84



Fig 9.4 Graph on Case 3

9.5. Comparison of the suggested business models

The figure 9.5 shows the three cases which are compared on the basis of the profit for the co-operation.

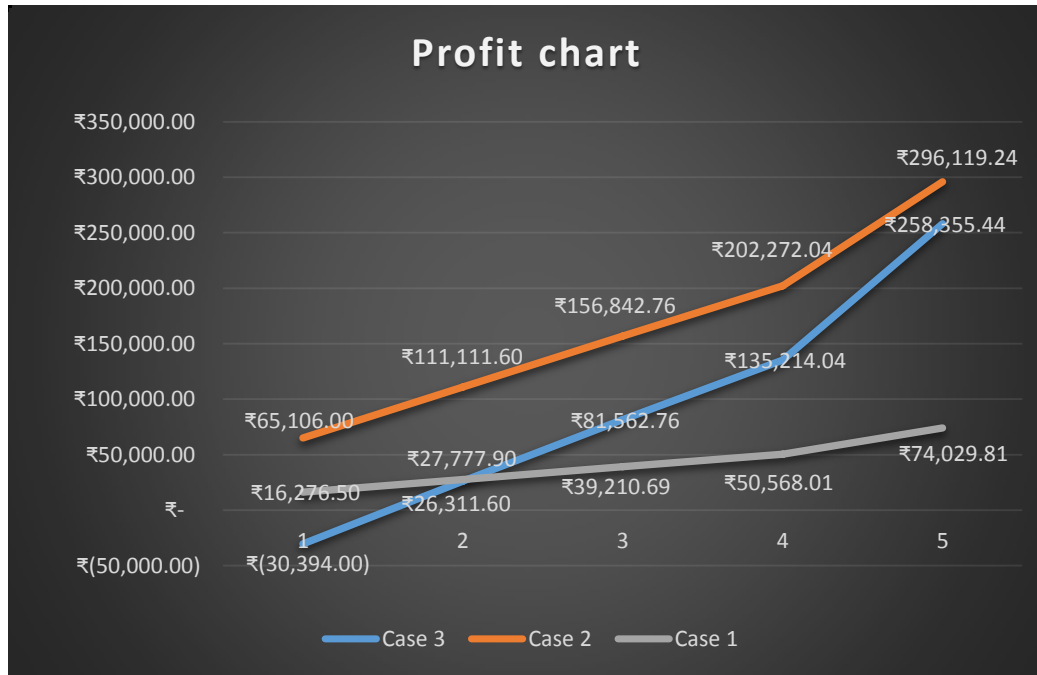


Fig 9.5 Graph on comparison of profit

9.5 Minimum Tariff Calculation

9.5.1 Charging by an appointed Casual Labour Staff (Considering 5-year)

Total No of vehicles expected in 5 years = 80

Vehicle consumption of charging in 5 years = Total No of vehicles x Average kWh consumption x Working days per year = 80 x 5kWh x 300 days = 1,20,000 kWh.

Expense to KSEB = Electricity used for Charging in 5 years x KSEB Rate = 1,20,000 x ₹ 5.5 = ₹ 6,60,000.

Total Maintenance Cost for 5 years= ₹ 1,55,338.16

Considering ₹ 25,444 in the initial year, 10 % increment in cost from previous year.

Total Salary Expenditure in 5 years= ₹ 7,32,612.

Considering ₹ 1,20,000 in the initial year, 10 % increment in cost from previous year.

Total Expenditure in 5 years = Expense to KSEB + Total Maintenance cost + Salary = ₹ 15,47,950.16.

Considering a minimum 2 lakh profit, after 5 years.

Total Revenue should be = Total Expenditure + Profit = ₹ 15,47,950.16 + ₹ 2,00,000 = ₹ 17,47,950.16

Revenue from Installed Solar = Return Rate of KSEB x Total days per year x Average expected generation from Solar per day x No of years = ₹ 4.4 x 365 x 30kWh x 5 = ₹ 2,19,000.

Revenue from Vehicle Charging = Total Revenue – Revenue from Installed Solar = ₹ 17,47,950.16 - ₹ 2,19,000 = ₹ 15,28,950.16

Minimum Tariff = Revenue from Vehicle Charging / Vehicle consumption of charging in 5 years =

₹ 15,28,950.16 / 1,20,000 kWh = Approximately 12.74 Rupees.

Minimum Value of Tariff with a 2 Lakh profit in 5 years is 12.74 Rupees, hence tariff can be set from 12.74. Currently Charging stations across Kerala provides for an average rate of around 15 rupees.

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total	
No of Electric Vehicles (Optimistic Assumption)	5	6	7	9	10	12	15	18	21	26	31	37	45	53	64	360	Yearly Increment in EV
Electricity Sold to EV/Year (kWh)	7500.00	9000.00	10800.00	12960.00	15552.00	18662.40	22394.88	26873.86	32248.63	38698.35	46438.02	55725.63	66870.75	80244.90	96293.88	540263	Tariff
Revenue from KSEB	43800	43800	43800	43800	43800	43800	43800	43800	43800	43800	43800	43800	43800	43800	43800	₹ 657,000.00	KSEB Rate
Total Revenue	141300.00	160800.00	184200.00	212280.00	245976.00	286411.20	334933.44	393160.13	463032.15	546878.58	647494.30	768233.16	913119.79	1086983.75	1295620.50	₹ 7,680,423.02	KSEB return rate
Expense to KSEB	41250.00	49500.00	59400.00	71280.00	85536.00	102643.20	123171.84	147806.21	177367.45	212840.94	255409.13	306490.95	367789.14	441346.97	529616.37	₹ 2,971,448.20	Daily Average usage per vehicle (kWh)
Maintenance cost	25444.00	26970.64	28588.88	30304.21	32122.46	34049.81	36092.80	38258.37	40553.87	42987.10	45566.33	48300.31	51198.33	54270.23	57526.44	₹ 592,233.78	Daily units from solar PV (kWh)
Salary	120000.00	126000.00	132300.00	138915.00	145860.75	153153.79	160811.48	168852.05	177294.65	186159.39	195467.36	205240.72	215502.76	226277.90	237591.79	₹ 2,589,427.63	
Total Expense	186694.00	202470.64	220288.88	240499.21	263519.21	289846.80	320076.12	354916.63	395215.97	441987.43	496442.81	560031.98	634490.23	721895.10	824734.60	₹ 6,153,109.61	Maintenance cost increment
Profit	-45394.00	-41670.64	-36088.88	-28219.21	-17543.21	-3435.60	14857.32	38243.50	67816.18	104891.16	151051.49	208201.18	278629.56	365088.66	470885.90	₹ 1,527,313.41	Salary increment
Net cash flow	-42905.48	-37227.07	-30473.08	-22521.75	-13233.69	-2449.56	10012.46	24359.72	40828.40	59687.34	81242.39	105841.30	133879.33	165805.52	202129.95	₹ 674,975.77	
Invested Capital	₹ 675,000.00																
Total net cash inflow	₹ 674,975.77																
Net Present Value (NPV)	(24.23)																
Internal Rate of Return (IRR)	5.80																

9.6 Internal Rate of Return

9.7 Cost per Kilometre comparison between Electric and fuel based auto rickshaws.

E-Auto –

Average unit required for complete charge	=	7 units.
Cost per unit in average charging station	=	15 Rupees / unit.
Total cost for full charge of e-auto	=	7 x 15 = 105 rupees.
Total km range for a full charge	=	130 km.

Cost per Kilometre = Total cost for full charge of e-auto / Total km range for a full charge
= 105/130 = 0.80 Rupees.

Fuel based auto rickshaws-

Mileage of average petrol auto rickshaw	=	25 km/litre.
Cost per litre of petrol (dated 02/11/21)	=	111.45 rupees/ litre.

Cost per Kilometre = Cost per litre of petrol / Mileage of auto rickshaw = 111.45 / 25
= 4.458 Rupees.

Life Cycle Analysis of the Solar PV Panels

Life Cycle Analysis allows a decision maker to assess the whole product system and environmental impact because it includes the entire lifespan of a solar panel. The analysis includes the inputs including raw materials and energy and the outputs such as atmospheric emissions, waterborne wastes, solid wastes, co-products and other releases.

Most of the solar PV manufacturers offer warranty period of 25 years for the PV panels which is actually the life cycle of the Panels. However, literatures state that the 25-year lifespan of a solar PV panel may be a significant underestimation of the actual performance in the field since, the power capacity decreases only 6 to 8% after 25 years, as compared to the 20% decrease used to estimate the 25 to 30-year lifespan. Hence, the more accurate lifespan of the solar panels are 35-40 years. For our system, also the life span can be considered as 30 years with proper cleaning of the panels and maintenance of the system.

ഏയ് (ഇലക്ട്രിക്) ഓട്ടോ...



■ മൂന്നുചക്ര ഇലക്ട്രിക് വാഹനങ്ങൾക്കു നഗരത്തിൽ റിചാർജിങ് സെന്റർ വരുന്നു

കൊല്ലം • വൈദ്യുതിഉപയോഗിച്ച് ഓടിക്കുന്ന മൂന്നുചക്ര വാഹനങ്ങൾക്കു നഗരത്തിൽ റിചാർജിങ് സെന്റർ വരുന്നു. കോർപറേഷൻ പരിധിയിൽ ഇലക്ട്രിക് വെഹിക്കിൾ ചാർജിങ് സെന്റർ സ്ഥാപിക്കുന്നതിനായി പരിസ്ഥിതി കാലാവസ്ഥാ വ്യതിയാന വകുപ്പാണു നിർദ്ദേശങ്ങൾ ക്ഷണിച്ചത്. സൗരോർജ്ജ ഉപയോഗിച്ചു പ്രവർത്തിക്കുന്ന ഈ സംവിധാനം കോർപറേഷന്റെ അറവുശാലയ്ക്കു സമീപം നിർമ്മിക്കുന്ന അമിനിറ്റി സെന്ററിലാണു പ്രവർത്തിക്കുക. ഇതിന്റെ മേൽക്കൂരയ്ക്കു മുകളിൽ സൗരോർജ്ജ പാനലുകൾ സ്ഥാപിക്കും. അറവുശാല കെട്ടിടത്തിനു സമീപം ചാർജിങ് പോയിന്റ് കൂടി ഘടിപ്പിച്ചാൽ മൂന്നുചക്ര വാഹനങ്ങൾക്കു തടസ്സമില്ലാതെ ചാർജ് ചെയ്യാനാകും.

കൊല്ലം ടി.കെ.എം. എൻജിനീയറിങ് കോളേജ് സമർപ്പിച്ച പ്രോജക്ടാണു പരിസ്ഥിതി വകുപ്പിന്റെ അംഗീകാരം നേടിയത്. തുടർന്ന് ഇതിനാവശ്യമായ സ്ഥലം നൽകാൻ കോർപറേഷനോട് ആവശ്യപ്പെടുകയും ചെയ്തു. മേയർ വി.രാജേന്ദ്രബാബുവിന്റെ നിർദ്ദേശപ്രകാരം കോർപറേഷൻ അധികൃതരും ടി.കെ.എം. കോളേജ് ടീമും ചിന്നക്കടയിലെ വിവിധ പ്രദേശങ്ങൾ പരിശോധിച്ച ശേഷമാണ് അറവുശാല കെട്ടിടത്തിനു സമീപത്തെ സ്ഥലം അനുയോജ്യമാണെന്നു കണ്ടെത്തിയത്. നിർമ്മാണത്തിനു ശേഷം ചാർജിങ് സെന്ററുടെ ധനകാര്യ ബാധ്യതകൾ കൂടാതെ

കോർപറേഷനു കൈമാറും. പിന്നീട് ഇതിന്റെ പരിപാലനം കോർപറേഷന്റെ ചുമതലയിലായിരിക്കും.

വൈദ്യുതി ഉപയോഗിച്ച് ഓടുന്ന വാഹനങ്ങൾ വ്യാപകമാകുന്നതോടെ ഇതു നഗരത്തിലെ സാധാരണക്കാരായ ഓട്ടോറിക്ഷ തൊഴിലാളികൾക്ക് ഉൾപ്പെടെ പ്രയോജനപ്പെടുമെന്നാണു പ്രതീക്ഷിക്കുന്നതെന്നു കോർപറേഷൻ അധികൃതർ പറഞ്ഞു.

സംസ്ഥാനത്ത് ആദ്യ സോളാർ ചാർജിങ് സെന്ററുണ്ട് ചിന്നക്കടയിൽ നിർമ്മിച്ചാൽ 'കറന്റ് ടിച്ചു' പോകാം

■ വൈദ്യുതിയിലോടുന്ന വാഹനങ്ങൾക്ക് കോർപറേഷൻ നേതൃത്വത്തിൽ കൊച്ചുത്ത് ചാർജിങ് സെന്ററുണ്ട്

പ്രൊജക്ട് ഇതും ഇന്ത്യയിലെ മറ്റേതൊരു പ്രദേശത്തെയും സമാനമാക്കുന്ന പദ്ധതി നടപ്പാക്കി വാഹനങ്ങൾക്ക് ചാർജ് ചെയ്യാനാണ് ഉദ്ദേശ്യം. ഇതിന്റെ ഭാഗമായി കോർപറേഷൻ നേതൃത്വത്തിൽ കൊച്ചുത്ത് ചാർജിങ് സെന്ററുണ്ട്.

പ്രകൃതി സൗഹൃദമാണെന്ന നിലയിൽ സർക്കാർ വാർഷിക സബ്സിഡിയും വിനിയോഗിച്ചു തുറന്നിട്ടു. ഇലക്ട്രിക് ഓട്ടോകൾ ഉപയോഗിച്ചു പദ്ധതിയുടെ ഭാഗമായി കോർപറേഷൻ നേതൃത്വത്തിൽ കൊച്ചുത്ത് ചാർജിങ് സെന്ററുണ്ട്.

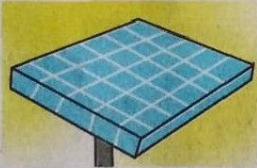
പ്രകൃതി സൗഹൃദമാണെന്ന നിലയിൽ സർക്കാർ വാർഷിക സബ്സിഡിയും വിനിയോഗിച്ചു തുറന്നിട്ടു. ഇലക്ട്രിക് ഓട്ടോകൾ ഉപയോഗിച്ചു പദ്ധതിയുടെ ഭാഗമായി കോർപറേഷൻ നേതൃത്വത്തിൽ കൊച്ചുത്ത് ചാർജിങ് സെന്ററുണ്ട്.

പ്രകൃതി സൗഹൃദമാണെന്ന നിലയിൽ സർക്കാർ വാർഷിക സബ്സിഡിയും വിനിയോഗിച്ചു തുറന്നിട്ടു. ഇലക്ട്രിക് ഓട്ടോകൾ ഉപയോഗിച്ചു പദ്ധതിയുടെ ഭാഗമായി കോർപറേഷൻ നേതൃത്വത്തിൽ കൊച്ചുത്ത് ചാർജിങ് സെന്ററുണ്ട്.

വാഹനങ്ങൾക്കും സൗരോർജ്ജ വൈദ്യുതി

സംസ്ഥാനത്തെ ആദ്യ സോളർ ചാർജിങ്ങ് സ്റ്റേഷൻ കൊല്ലത്ത്

കൊല്ലം: സംസ്ഥാനത്തെ ആദ്യ സോളർ ചാർജിങ്ങ് സ്റ്റേഷന്റെ നിർമ്മാണം ജില്ലയിൽ പൂർത്തിയായി. കൊല്ലം കോർപ്പറേഷന്റെ നേതൃത്വത്തിൽ ചിന്നക്കടയിൽ തങ്കപ്പൻ സ്മാരക കോർപ്പറേഷൻ കെട്ടിടത്തിനു സമീപമുള്ള ചാർജിങ്ങ് സിംഗിളാണ് വൈദ്യുത വാഹനങ്ങൾക്കായുള്ള സൗരോർജ്ജ ചാർജിങ്ങ് സ്റ്റേഷൻ സജ്ജീകരിച്ചിരിക്കുന്നത്. പതിനേഴ് വർഷം മുമ്പ് അനുവദിച്ച 6.74 ലക്ഷം രൂപ ഉപയോഗിച്ച് കൈപ്പറ്റി എൻജിനീയറിംഗ് കോളേജിലെ ഇലക്ട്രിക്കൽ ആൻഡ് ഇലക്ട്രോണിക്സ് വിഭാഗത്തിന്റെ നേതൃത്വത്തിലാണ് സ്റ്റേഷൻ നിർമ്മാണം പൂർത്തിയാക്കിയത്.



10 കിലോവാട്ട് വൈദ്യുത ക്വാസിറ്റിയുള്ള ചാർജിങ്ങ് സ്റ്റേഷനിൽ സോ ചാർജിങ്ങ് സഹിയാനവായാ ഗിപ്പി ഇരുപതുവാഹനങ്ങൾ മുതൽ ചെറിയ കാറുകൾ വരെ ചാർജ് ചെയ്യാനാവും. 6 കിലോവാട്ടിന്റെ

വണ്ടികൾ ഒരു സമയം ചാർജ് ചെയ്യാവുന്ന സൗകര്യമാണ്. പ്രതിദിനം 20 യൂണിറ്റ് വൈദ്യുതിയാണ് ഉൽപ്പാദിപ്പിക്കപ്പെടുക. ഇതിൽ കേവലം 7 യൂണിറ്റ് വൈദ്യുതി മതിയാകും ഒരു ഓട്ടോ

18 സൗരോർജ്ജ പാനലുകളാണ് സ്ഥാപിച്ചിട്ടുള്ളത്. 'ഓൺ ഗ്രിഡ്' സഹിയാനവായാ ഗിപ്പി ഇരുപതുവാഹനങ്ങൾ മുതൽ ചെറിയ കാറുകൾ വരെ ചാർജ് ചെയ്യാനാവും. 6 കിലോവാട്ടിന്റെ

3.3 കിലോവാട്ട് വരെ പവർ ക്വാസിറ്റിയുള്ള 3 വണ്ടികൾ ഒരു സമയം ചാർജ് ചെയ്യാവുന്ന സൗകര്യമാണ്. പ്രതിദിനം 20 യൂണിറ്റ് വൈദ്യുതിയാണ് ഉൽപ്പാദിപ്പിക്കപ്പെടുക. ഇതിൽ കേവലം 7 യൂണിറ്റ് വൈദ്യുതി മതിയാകും ഒരു ഓട്ടോ

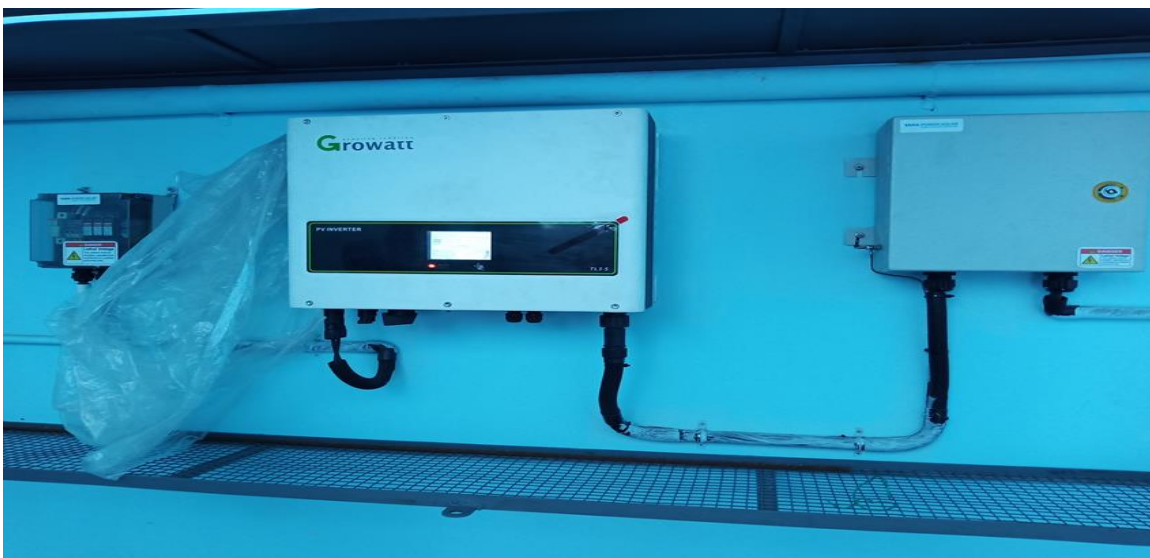
ചാർജ് ചെയ്യാൻ. നേരിട്ട് പണയം തീക്കുന്നതിനു പുറമെ 'ചാർജ് മോഡ്' എന്ന ഓമനെയോടു കൂടി വഴിയരികിലായി ഓൺലൈൻ പേയ്മെന്റ് സംവിധാനവും പ്രവർത്തിച്ചിട്ടുണ്ട്. രാവു സമയം ലഭ്യമായ ഈ ആപ്പിൽ ലൊക്കേഷൻ സഹിയാനവും ഉൾപ്പെടുത്തിയിട്ടുണ്ട്.

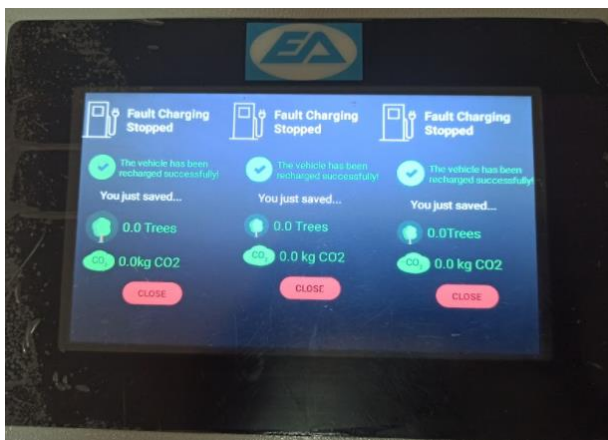
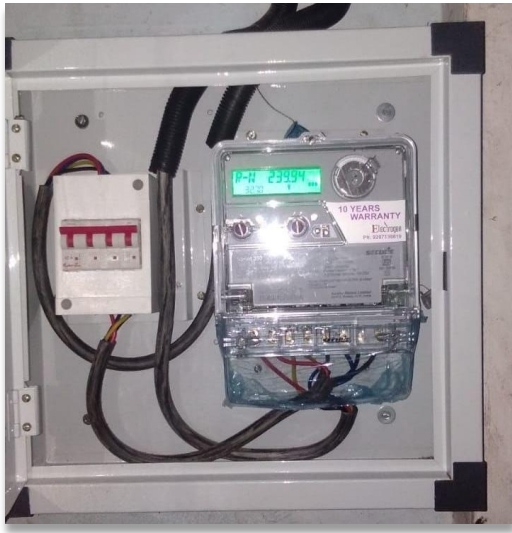
കൈപ്പറ്റി എൻജിനീയറിംഗ് കോളേജിലെ ഇലക്ട്രിക്കൽ ആൻഡ് ഇലക്ട്രോണിക്സ് വിഭാഗത്തിലെ അധ്യാപികയായ ഡോ. ആർ ശ്രീബാബുണ്ണാണ് പദ്ധതിയുടെ പ്രിൻസിപ്പൽ ഇൻവെന്റിഗേറ്റർ. അസിസ്റ്റന്റ് പ്രൊ. ഷൈഖ് മുഹമ്മദ്, വിദ്യാർത്ഥികളായ വാൺ എസ് പ്രകാശ്, പി അഭിരാജ് എന്നിവരടങ്ങിയ സംഘമാണ് പദ്ധതിക്കു പിന്നിൽ.

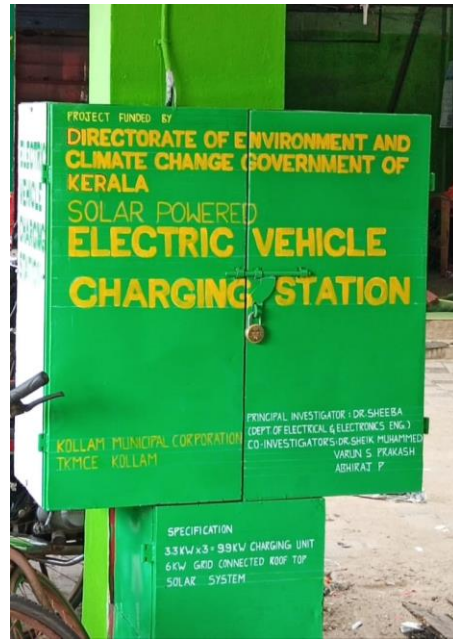


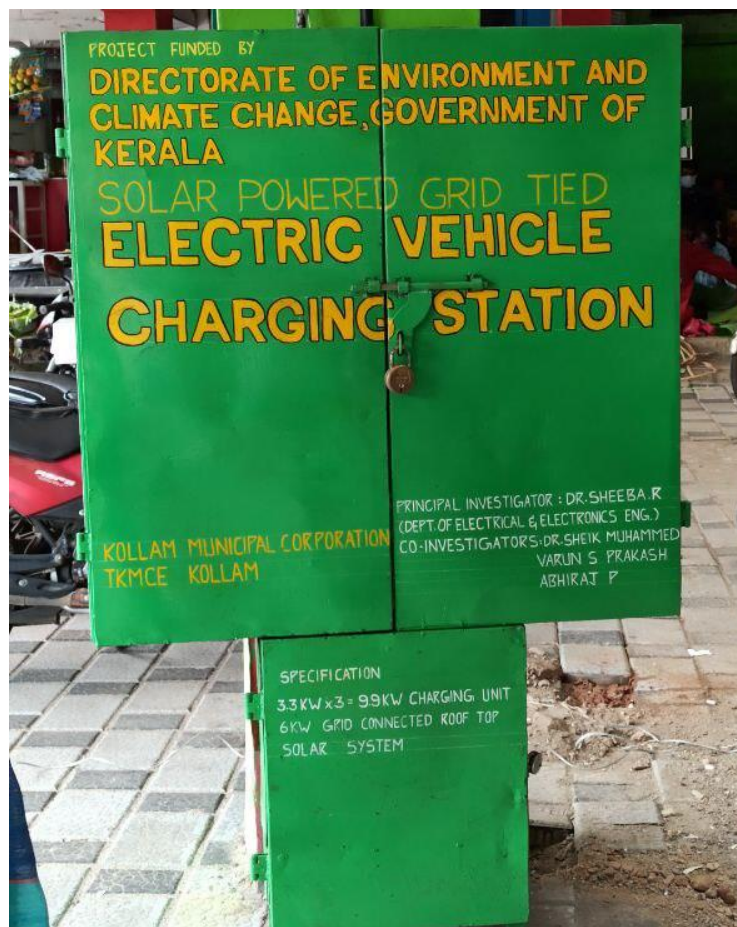
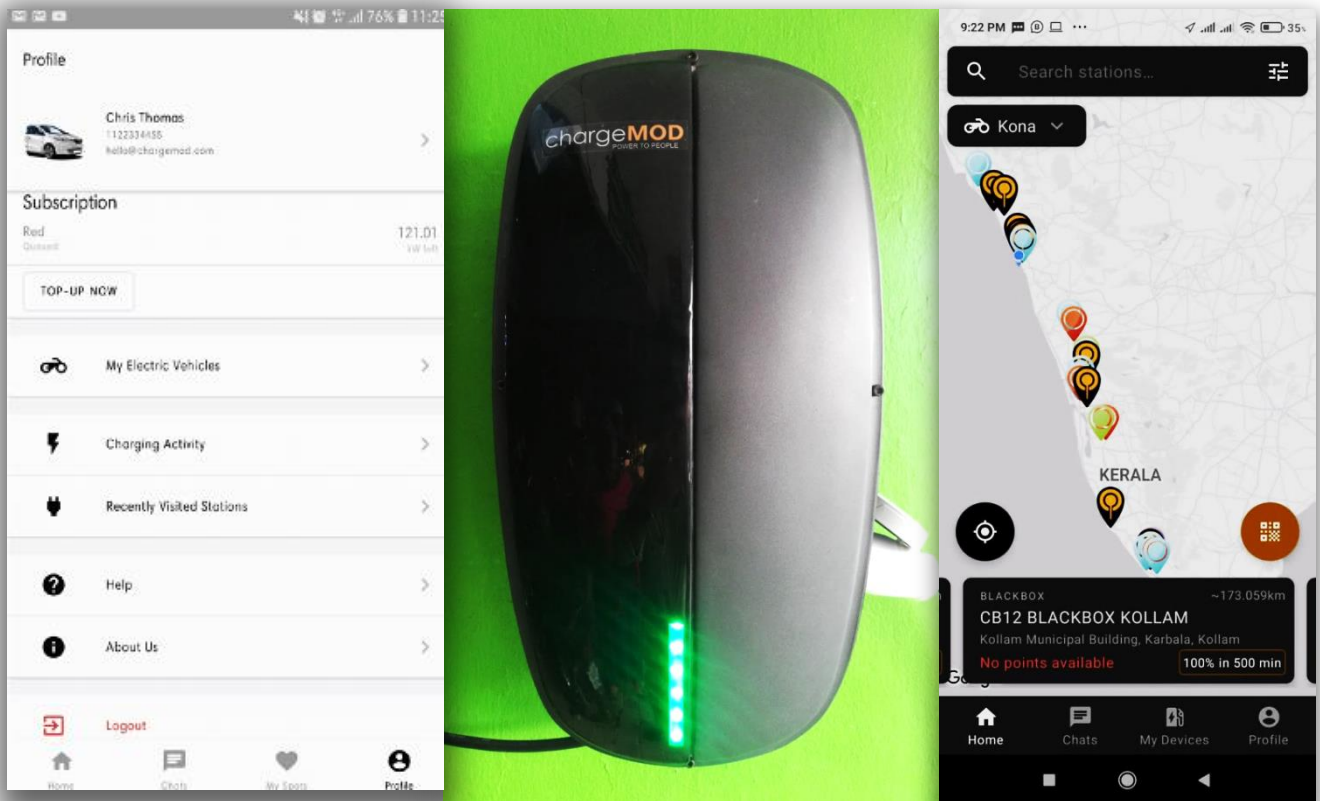
ചിന്നക്കട മുനിസിപ്പൽ കൗൺസിലിനു സമീപം ആരംഭിക്കുന്ന സോളർ വൈദ്യുത ചാർജിങ്ങ് സ്റ്റേഷൻ. ചിത്രം: ഭരണമന്ത്രാലയം

Project Implementation images









Project site visit



