Kochi Municipal Corporation

KOCHI SOLAR CITY PROJECT

- CHULLICKAL WARD ENERGY SURVEY -
Towards making Kochi city into a renewably self-sufficient city

A project by

Centre for Heritage, Environment and Development
(An institution under the Kochi Municipal Corporation)

(KOCHI SOLAR CITY CELL)

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ABBREVIATIONS

CFL	Compact Fluorescent Lamp
LED	Light Emitting Diode
HVAC	Heating, ventilation, and air conditioning
BEE	Bureau of Energy Efficiency
LPG	Liquefied petroleum gas
GHG	Greenhouse Gas
MNRE	The Ministry of New and Renewable Energy
ANERT	Agency for Non Conventional Energy and Rural Technology

1. INTRODUCTION

1.1 GENERAL

India is one of the fastest growing economies in the world. There is a huge demand in the energy market and is a major contributor to the rapidly increasing global energy demand. Given India's growing energy demands coupled with the global energy crisis and sustainable developmental goals, tapping into the renewable energy potential of the country has always been ambitious and has been a rapidly progressing initiative through various government schemes and projects.

The rapid urbanization and economic development in our country are leading to an ever rising energy demands. This is a global scenario especially seen in urban areas in the world and is leading to enhanced greenhouse gas (GHG) emissions. The cities play a major role in tackling the greenhouse gas emissions. Local and national policies are now formulated to incorporate sustainable development in all the sectors of the urban cities.

The Ministry of New and Renewable Energy (MNRE) is the nodal Ministry of the Government of India for all matters relating to new and renewable energy with an aim to develop and deploy new and renewable energy for supplementing the energy requirements of the country. It is the apex body in the field of renewable energy and administers all the programmes and initiatives of Government of India in renewable energy sector. The development of solar cities is such a scheme initiated by the ministry.

During the 11th Five-year plan period, 60 Indian cities were identified to be developed as Solar Cities under the development of solar cities scheme. The cities were selected on the basis of city population, potential and commitment for adoption of renewable energy and energy conservation in the city activities. The Goal of the program is to promote the use of renewable energy in urban areas. The Solar City aims at minimum 10% reduction in projected demand of conventional energy through a combination of enhancing supply from renewable energy sources in the city and energy efficiency measures.

The following study has been done in the 25th division (Chullickal) of Kochi Municipal Corporation. Kochi known as the queen of the Arabian Sea is a major port city on the south-west coast of India bordering the Laccadive Sea. It is part of the district of Ernakulam in the state of

Kerala and is often referred to as Ernakulam town. The city has a corporation limit population of 601,574 and a metropolitan population of 2.1 million for an area of 632 sq.km (India, 2011 census), making it the largest urban agglomeration in Kerala.

Kochi City is the largest agglomeration in Kerala and over the years has experienced an increasing trend in energy demand across different sectors. In addition, the city is home to number of small-scale industries. The city administration's commitment on implementation of renewable energy sources to meet the energy demands in addition to Kochi's solar, wind and biomass energy potential influenced the city's recognition as a potential solar/smart city.

1.2 KOCHI SOLAR CITY PROJECT

Kochi was one among the cities selected by MNRE to be developed as solar city under the solar cities development scheme. The Kochi solar city cell was subsequently set up to take ahead the Kochi solar city project. The energy survey is an initiative under the project and it kick started at the Chullickal division (division 25) which was chosen as the ward were this study would be initiated.

An energy survey can help assess the energy consumption of the ward, provide strategies on how to improve the existing energy utilization in an efficient manner. The report will help to do a feasibility analysis on solar panel installation in the ward in near future.

2. SURVEY AREA-CHULLICKAL

The 25th division, i.e., the Chullikkal division of the Kochi Municipal Corporation was selected to be the area of study. The total area of the division is around 2 Km^2. Chullickal is a residential area with around 2000 residential homes mainly in the middle-income category. The houses are closely knit together and the area does not have a major presence of high rise building or commercial buildings like the main city area of the Kochi Municipal Corporation. The Kochi Municipal Corporation ward map and Chullickal ward map has been shown below.

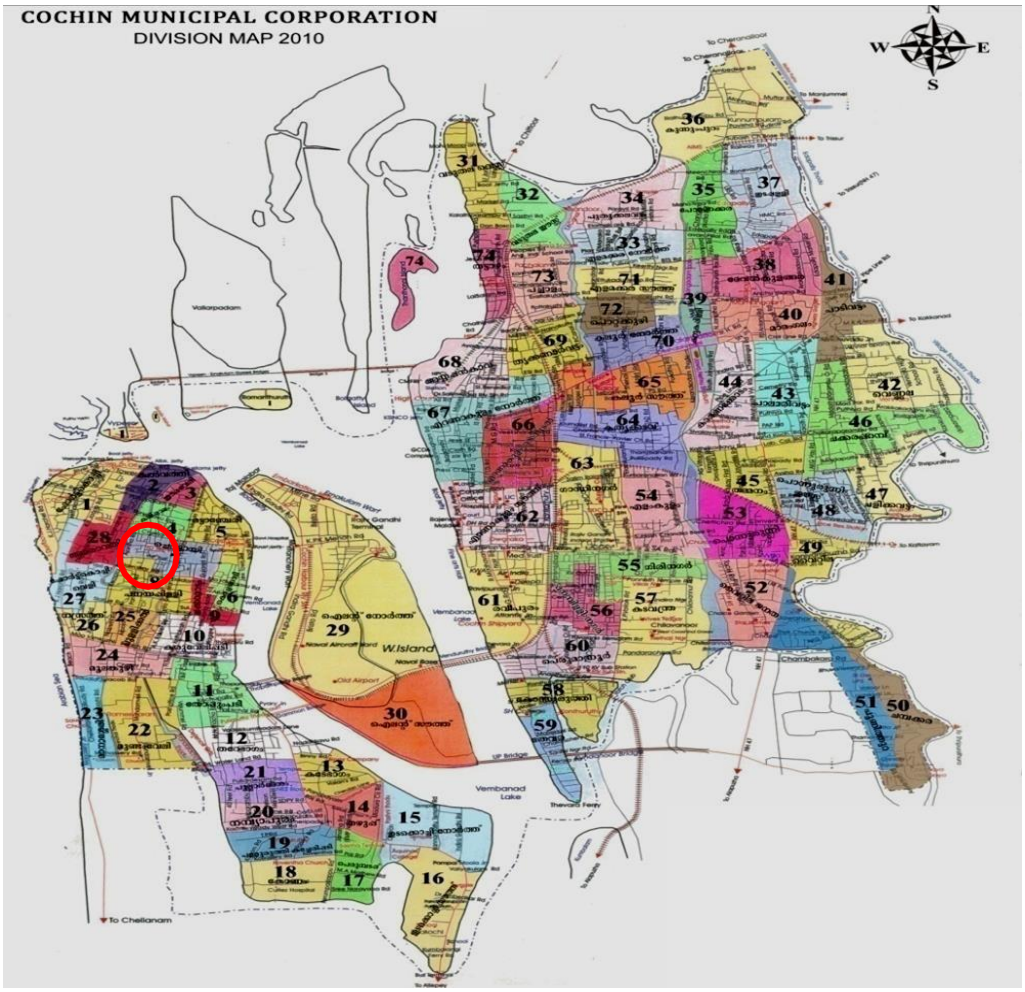

Fig 1: Kochi Municipal Corporation - Division Map 2010

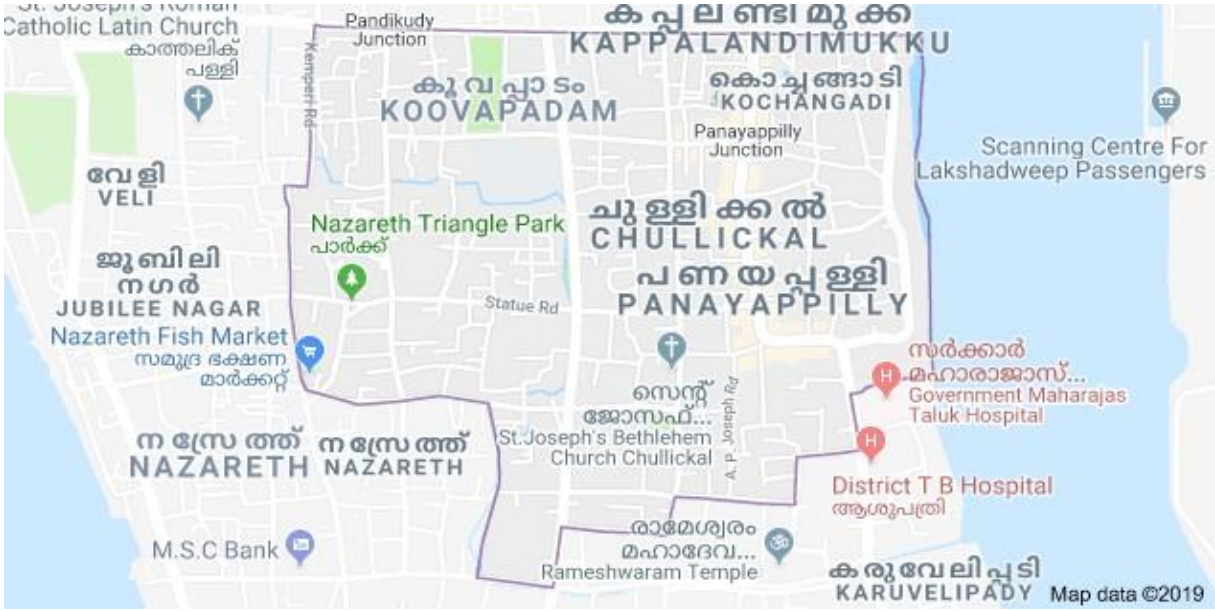

Fig 2: Chullickal Ward

The division has been divided into 10 residents associations which are a major character of the division since such an initiative makes it easier to look into the problems and their welfare at local level. Each of the 10 residential associations has around 150 to 200 building unit in each thus summing up to around 2000 occupancy buildings. The ward includes around 61 commercial centers and 12 institutions. There are no major profit/nonprofit companies in the ward and is predominantly a residential area. The building typology in the ward has been shown below.

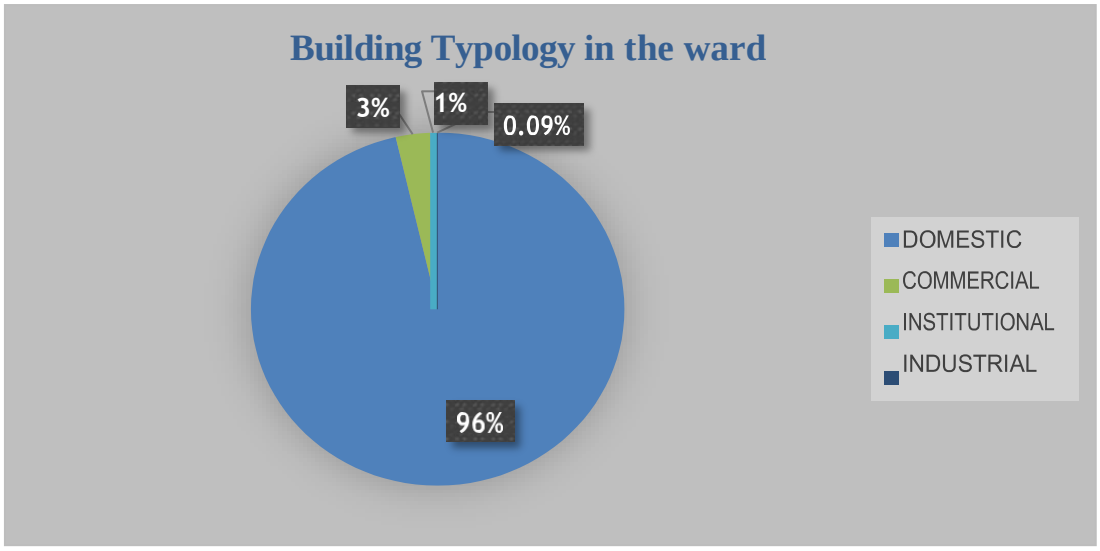

Fig 3: Building typology in the ward

3. METHODOLOGY

The survey was done in the residential area in the ward. A door to door questionnaire survey was formulated in the native language Malayalam. There are five types of sampling methods for surveying and they are Random, Systematic, Convenience, Cluster, and Stratified sampling.

1) Random sampling: It is analogous to putting everyone's name into a hat and drawing out several names. Each element in the population has an equal chance of occurring. While this is the preferred way of sampling, it is often difficult to do. It requires that a complete list of every element in the population be obtained. Computer generated lists are often used with random sampling. Random numbers are generated using the TI82 calculator.
2) Systematic sampling: It is easier to do than random sampling. In systematic sampling, the list of elements is "counted off". That is, every k^{th} element is taken. This is similar to lining everyone up and numbering off"1,2,3,4; 1,2,3,4; etc.". When done numbering, all people numbered 4 would be used.
3) Convenience sampling: It is very easy to do, but it's probably the worst technique to use. In convenience sampling, readily available data is used. That is, the first people the surveyor run into.
4) Cluster sampling: It is accomplished by dividing the population into groups -- usually geographically. These groups are called clusters or blocks. The clusters are randomly selected, and each element in the selected clusters is used.
5) Stratified sampling: It also divides the population into groups called strata. However, this time it is by some characteristic, not geographically. For instance, the population might be separated into males and females. A sample is taken from each of these strata using either random, systematic, or convenience sampling.

The sampling method adopted was the Random sampling method. The survey was conducted taking a random sample of around 350 residential buildings in the area. The division was divided into 10 sections as per the resident association’s area and sampling was done from each area ensuring that there was a uniform coverage across the division under random sampling.

Fig 4: Energy Survey

The main objective of the survey was to promote the solar city project and its initiatives in the city and formulates measures to save electricity and promote the use of renewable energy mainly solar energy in the ward. The survey also aimed to find out the general public opinion and feedback on the same and also find the rooftop solar energy utilization potential within the division. The long-term objective of the survey is to save a substantial amount of electricity and therefore also save fossil fuels and reduce GHG emissions apart from having peak load savings in the city through a combination of promotional incentives and other support measures.

The stepwise process formulated for the study

- Preliminary data collection
- General details about the ward
- General survey covering the residential buildings of the area
- Data tabulation and analysis
- Recommendations for energy saving measures

4. FINDINGS OF THE SURVEY

a) CLASSIFICATION OF RESIDENTIAL HOMES BASED ON TOTAL AREA AND NUMBER OF FLOORS

The division consists of mainly single and double storied buildings. From the obtained data around 57% of the households are single storied and 43% are double storied. The average floor area of the households in the division is 1008 sq.ft with 69% of the households having area below the average.

b) ROOF TYPE CLASSIFICATION

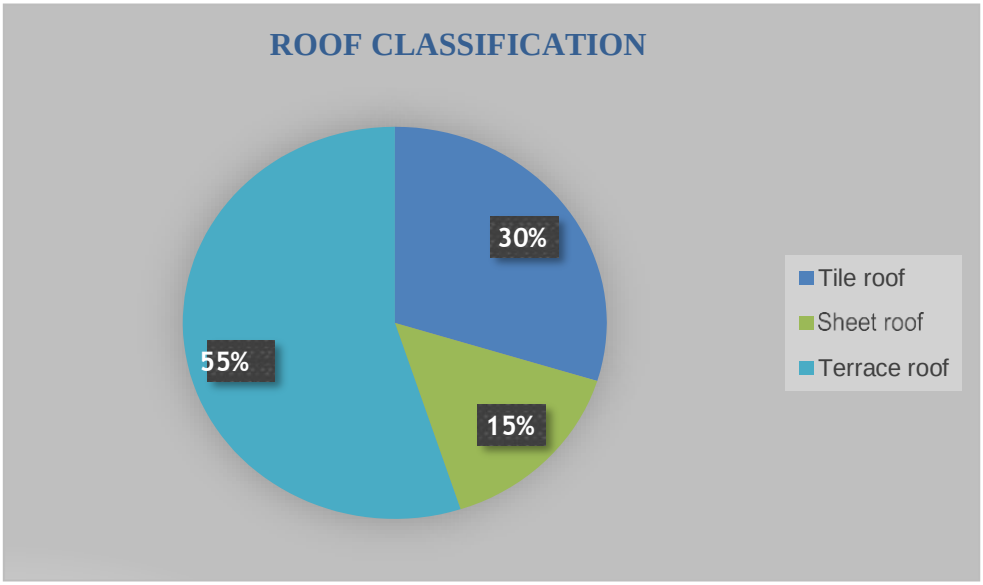

Fig 5: Roof classification

A major portion of the division have flat roof. The type of roof is an important factor while considering the installation of solar panels as it must have enough strength to support the structure. Solar panels can be installed in flat or sloping roof with the help of supporting structures. The installation of solar panels is not limited to flat roof or terraces; it can be installed in roof with sheet or tiled without ruining the structure provided the structure or any truss work of the roof is capable enough to support the addition of the panels.

The survey noted that around 55% of the houses had terrace roofs. From the survey it is clear that

the type of roof is not a limiting factor for the installation of solar panels as most of the houses are suitable for solar panel installation.

c) AVERAGE NUMBER OF CFL, LED AND ORDINARY LIGHT USAGE

From the available data that was gathered during the survey, it was found that the use of ordinary filament bulb is limited to 1%. A major portion of the lighting requirement was met using LED bulbs. This is because of the general awareness among the people that LED bulbs and tubes utilize less energy and the people are more conscious on saving electricity.

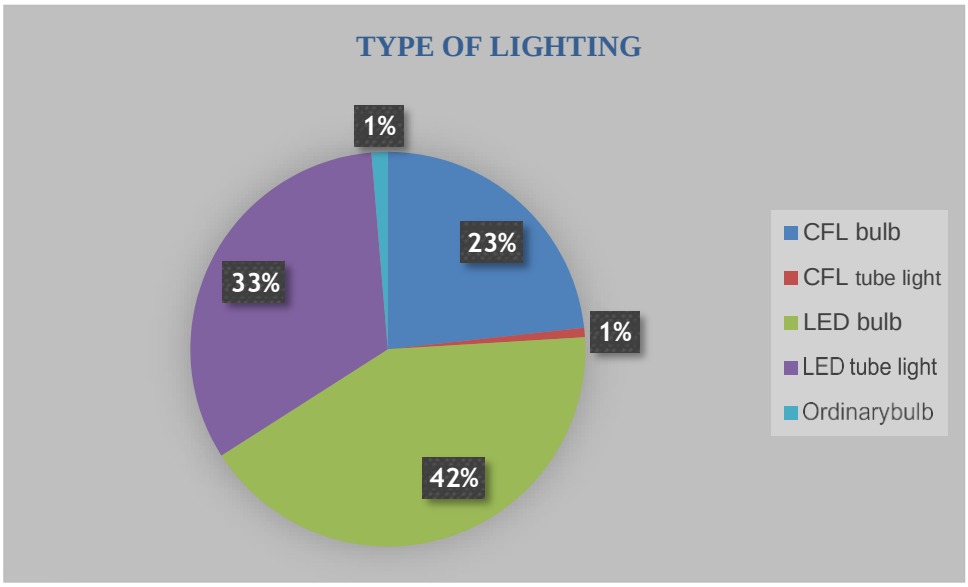

Fig 6: Type of lighting

When the ordinary bulb usage is analyzed, about 94 % of ordinary bulbs in the ward are used by the houses with floor area less than 1008 sq.ft. From the data collected, the ordinary bulbs are mostly used by the houses with floor area less than 1008sq.ft, indicating that the ordinary bulbs are mostly used by the lower and middle income people.

When the LED light usage is analyzed, about 64 % of LED light in the ward are used by the houses with floor area greater than 1008 sq.ft. From the data collected, the LED lights are mostly used by the houses with floor area less than 1008 sq.ft, indicating that the LED light are mostly used by the high income people. This means that the high-income people can afford the cost of LED lights

and they are more aware of energy saving and conservation when compared to other income categories.

d) GENERAL AWARENESS ON SUBSIDIES

From the survey, it was seen that 41% are aware of the subsidies available for solar installation and 24% are not aware that solar panels have subsidies and 23% showed no interest towards the idea of having solar panels. The general awareness and interest among people have to be created for an increased utilization of any non-conventional energy source, solar in this case. The people have to be made more aware on the benefits of utilizing solar energy and about the subsidies that are being made available. Around 12 % stated as they do not know whom to approach or they have either not obtained any information despite trying or whatever information obtained was not useful. Such a scenario can only be avoided if the local bodies/any organizations or groups take an effort to have campaigns regarding this matter and let the common people have an updated knowledge regarding this matter.

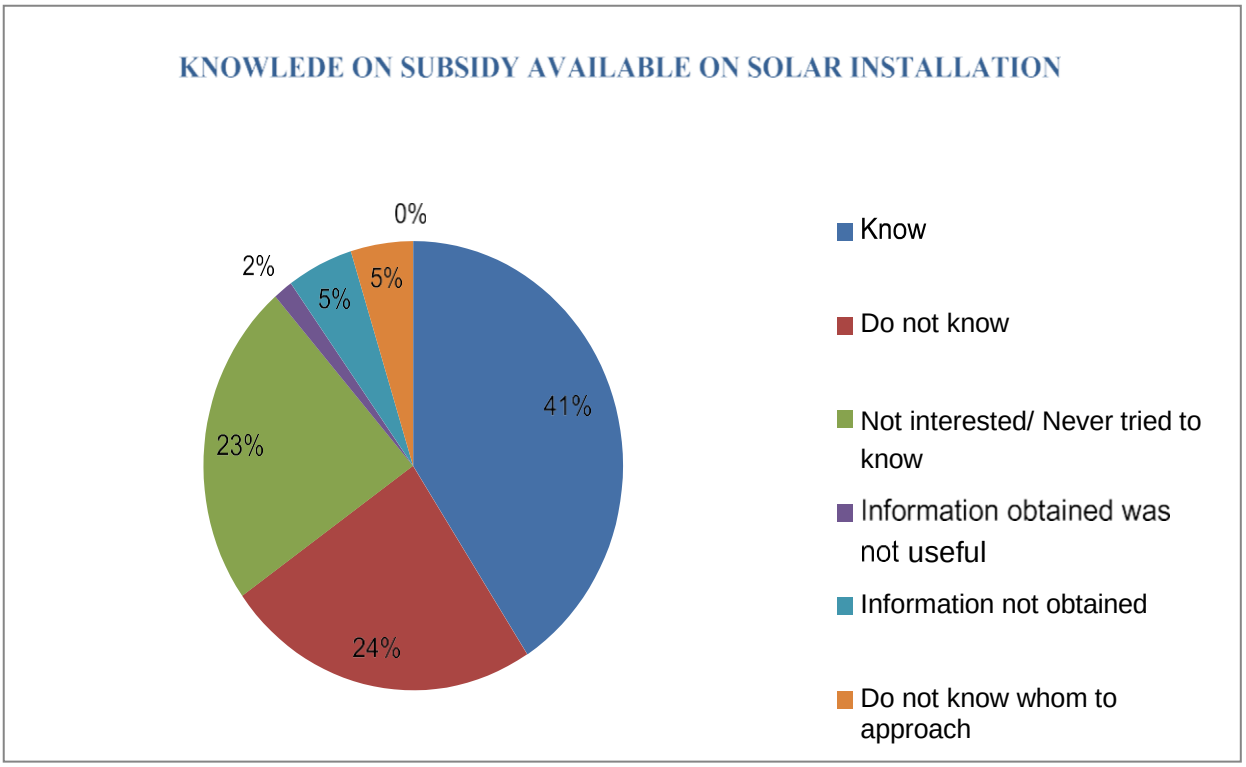

Fig 7: Knowledge on subsidy available

e) INTEREST ON SOLAR INSTALLATION

Knowledge on the willingness and interest of the public with respect to solar installation is an important factor while moving ahead with the Kochi Solar City project. The survey recorded that there was a 50-50 division of interest among the people with regard to installation of solar panel. While asking for the reason behind the disinterest it was seen that people were not keen on installing panels as they did not see the reason as to why there must be change for which a huge investment is required apart from the fact the return period will be long and there is no instant gratification. A change in this impassive attitude can only be brought about by conducting campaigns to make sure that the importance of renewable energy usage like solar and the long term benefits not just for a person but on the global level is made aware and it should pick the peoples conscious enough to act on it.

f) REASON FOR BEING DISINTERESTED IN SOLAR INSTALLATION

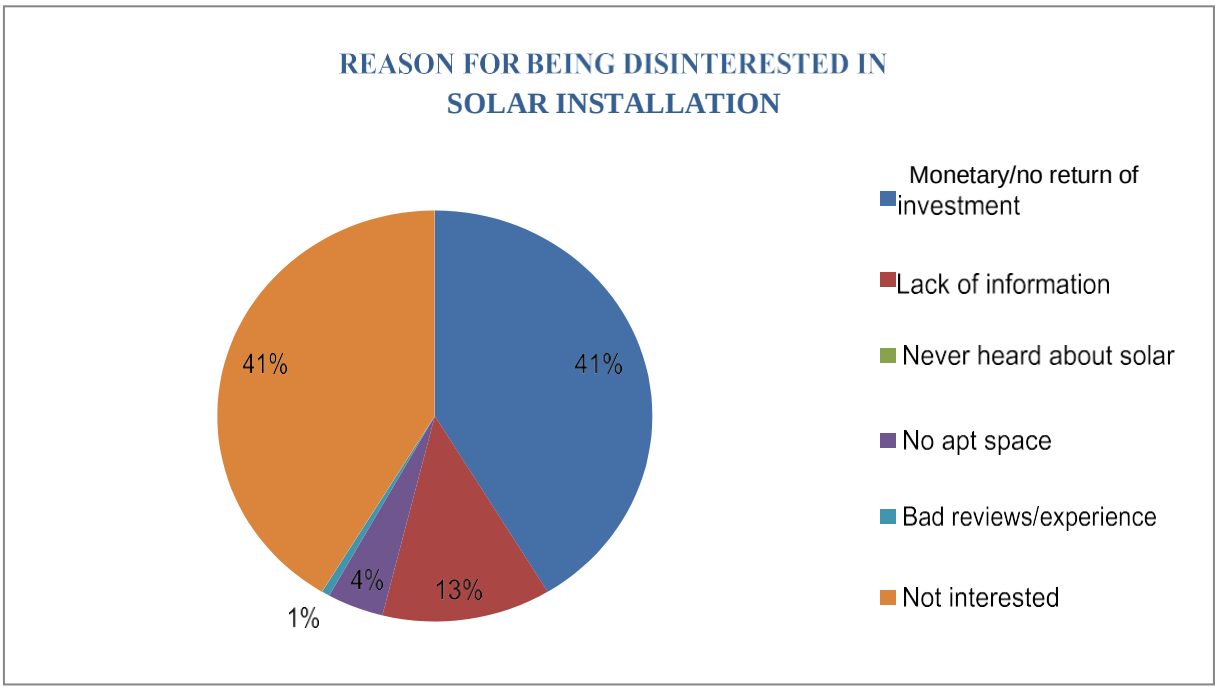

Fig 8: Reason for being disinterested in solar installation

The lack of interest on solar panel installation are mainly due to the fear of having return of investment and lack of enough capital that is required for installation process. 41% people stated monetary reason as being their main reason for the disinterest and also and equal percentage was not at all interest and had never given a thought about it. The monetary reasons can be overcome by providing incentives, subsidies, or attractive benefits or schemes through which people have less financial burden while considering solar installation.

g) MEASURES TAKEN FOR ENERGY EFFICIENCY

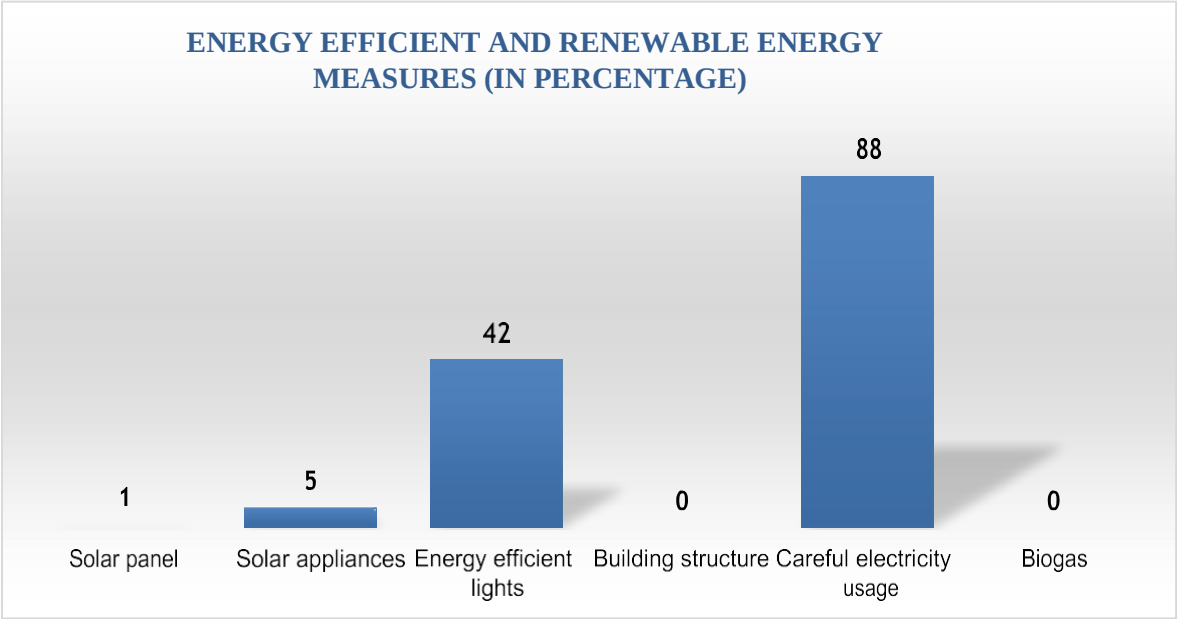

Fig 9: Measures taken for energy efficiency

Through the survey, it was noted that the people were keen on reducing their energy utilization/electricity utilization because of their interest in reducing the consumption charges. Around 88% households stated that they use electricity carefully by making sure to turn off appliances when not in use, avoiding unnecessary usage etc. 42% households stated they have started using LED lights as it is saving more energy. The usage of solar appliances is only 5% with the main being solar water heater apart from solar ornamental lights. Only 1% of the households have solar panels.

h) GENERAL FEEDBACK FROM SURVEY ON THE DIVISION

The scattered sampling survey covered 350 houses. From the interaction the general public it was noted that most people were keen on energy savings. The disinterest towards usage of new source of energy like solar is because they are not aware of the greater benefit it is on a global scale. If this disinterest is changed through more awareness then the next major hurdle will be the investment. The monetary factor concerning the installation may be solved through provision of incentives, subsidies, grants etc.

5. MAJOR OUTCOMES OF THE SURVEY

- Around 57% of the households are single storied and 43% are double storied.
- The average floor area of the households in the division is 1008 sq.ft with 69% of the households having area below the average.
- A major portion of the division have flat roof which is beneficial in case of solar panel installation.
- The use of ordinary filament bulb is limited to 1% and a major portion of the lighting requirement was met using LED bulbs, around 88% households stated that they use electricity carefully by making sure to turn off appliances when not in use, avoiding unnecessary usage etc., 42% households stated they have started using LED lights as it is saving more energy. The usage of solar appliances is only 5% with the main being solar water heater apart from solar ornamental lights. Only 1% of the households have solar panels. This means people in ward are aware of the need of energy saving and are taking efforts to save energy.
- From the data collected, the ordinary bulbs are mostly used by the houses with floor area less than 1008 sq.ft, which means the ordinary bulbs are mostly used by the lower and middle income people.
- LED light are mostly used by the houses with floor area less than 1008 sq.ft, which means the LED light are mostly used by the high income people. This means that the high-income people can afford the cost of LED lights and they are more aware of energy saving and conservation when compared to other income categories.
- Only 41% of people are aware of the subsidies available for solar installation. This means a proper awareness needs to be created among the people about the subsidies available.
- The survey recorded that there was a 50-50 division of interest among the people with regard to installation of solar panel. The reason behind the disinterest it was seen that people were not keen on installing panels as they did not see the reason as to why there must be change for which a huge investment is required apart from the fact the return period will be long and there is no instant gratification. This means a proper awareness need to be created among the people about the long-term and short-term benefits of installing solar system.

6. BACKGROUND STUDY

6.1 WORKING OF A SOLAR PANEL

A solar panel works by allowing particles of light (photons) to facilitate the free flow of electrons, thereby generating the flow of electricity. It consists of many photovoltaic cells which are basically a kind of sandwich-like structure made up of slices of semiconducting material, usually silicon. Silicon is mounted beneath non-reflective glass to produce PV panels that collect photons from the sun and convert them into DC (direct current) electric power. This DC power then flows into an inverter which transforms it into AC (alternating current) electric power.

6.2 TYPES OF SOLAR SYSTEMS

a) Grid Connected Solar Systems

Grid Connected Systems are solar PV systems that only generate power when the utility power grid is available. They must connect to the grid to function. They can send excess power generated back to the grid when you are overproducing so you credit it for later use. They are simple enough that you can install it yourself in a weekend with a friend. They are cost effective enough to pay for themselves and put money in your pocket long term. These systems will pay for themselves by offsetting utility bills in 3-8 years. The major drawback is that they do not provide power during a grid outage.

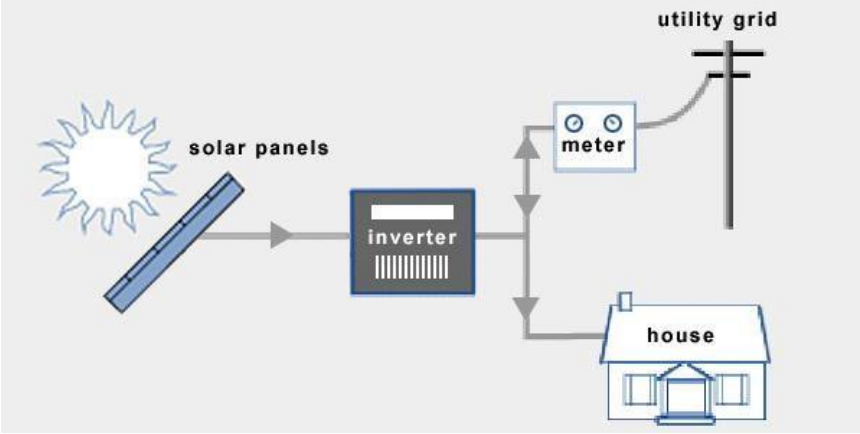

Fig 10: Grid connected solar system

b) Off Grid Solar Systems

These systems allow you to store your solar power in batteries for use when the power grid goes down or if you are not on the grid. Hybrid systems provide power to offset the grid power whenever the sun is shining and will even send excess power to the grid for credit for later use. It provides power for your critical loads when the power grid is down. The major drawback is that it cannot be expected to provide power for all your loads since the cost and volume of batteries would be prohibitive. Off-Grid systems require a lot more specialized equipment to function that is more costly and more complex to install. Sizing the solar array and the batteries required is complex. This is definitely more complex to install as well. There are dangerous components, mostly dealing with high ampere batteries whereby leading to a situation of caution to be exercised. Also, batteries are expensive, require ongoing maintenance and periodic replacement.

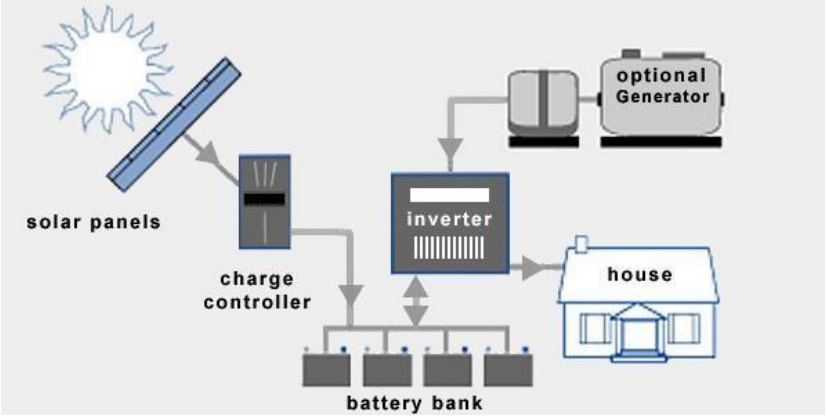

Fig 11: Off grid solar system

6.3 COST OF SOLAR PANELS AND GOVERNMENT SUBSIDIES AVAILABLE FOR INSTALLATION

- The cost of solar panels in a grid connected system is Rs. 50000/Kw
- The cost of solar panels in an off-grid system range from Rs. 70000 – Rs. 100000/Kw
- The subsidy availed by Agency for Non-Conventional Energy and Rural Technology (ANERT) is up to 30%.
- The final subsidy and rates for this year are under revision.

6.4 TOTAL ROOF AREA AVAILABLE FOR SOLAR INSTALLATION AND THE RESPECTIVE SOLAR ENERGY POTENTIAL

From the survey an area roof area of approximately 298362 square feet was noted. Considering an approximate of 2000 houses and average area of 1008 square feet a total roof area of around 2000000 square feet or 0.2 Km^2 may be available in the ward. Considering the thumb rule that 1 Kw capacity solar system requires 10 m^2 area, and the available area of 200000 m^2 a 20000 Kw capacity solar system installation potential is available at the ward. If 1600 – 1700 Kwh of electricity can be generated from a 1 Kw system in 1 year, then the ward has a potential of generating 32 – 34GwH of electricity in a year. A 5,000-watt solar system can eliminate 5,760 lbs of CO_2 per year that correlates to the carbon absorption capability of more than 100 trees. Considering this the 20000 Kw solar potential of the ward can eliminate nearly 23040000 lbs of CO_2 per year which is equivalent to the capacity of 4 lakh trees in an optimum condition. The total initial cost of implementing the solar panels by utilizing the entire roof area available in the ward will be 70 Crore for grid connected solar system and 140 Crore for off-grid solar system. This requires high initial cost and is not an economically and technically feasible option.

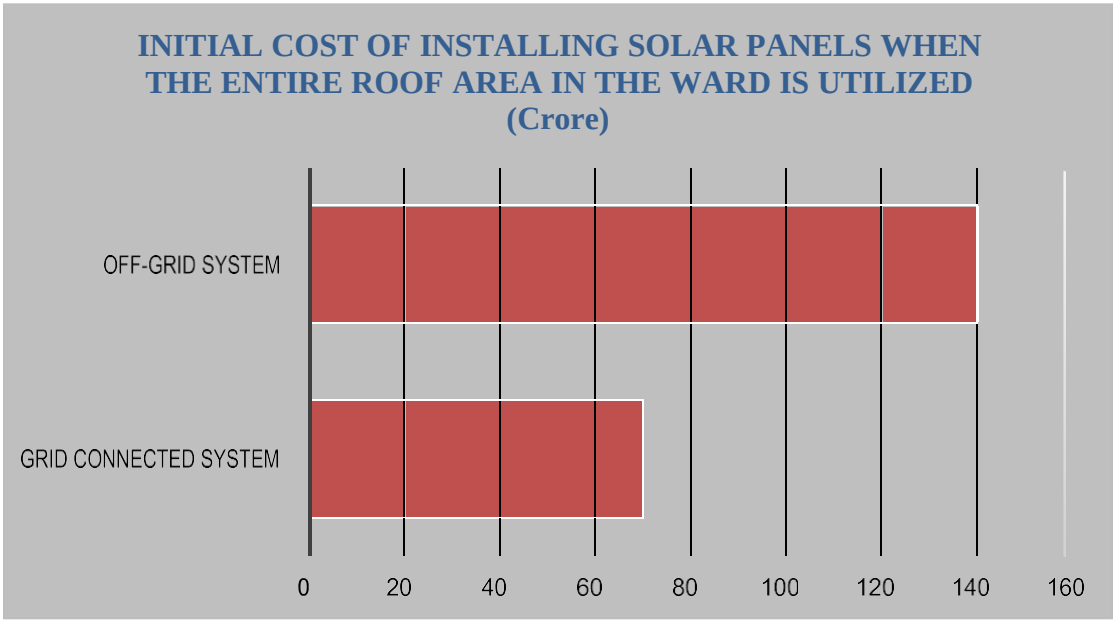

Fig 12: Cost and benefit of solar system

So, the feasible option of implementing this project is by installing the solar panels as per the energy requirement of the domestic area in the ward. From the data collected from the survey, it was found that the total energy requirement (approx.) of houses in the ward is about 520000 Kwh.

6.5 COST BENEFIT ANALYSIS OF THE PROJECT

The Cost-Benefit analysis is done by considering the roof area as per the energy requirement in the ward. Cost-Benefit analysis of off grid system and grid connected system is done by considering a return period of 5 years. The cost after subsidy is considered of the analysis and only the direct benefit is considered for the analysis. If Cost – Benefit ratio is less than 1 then the project is feasible and if it is greater than 1 then the project is not feasible. The project is to install the solar panels as per the energy requirement of the domestic area in the ward. The average initial cost and benefit (in 5 years) of such a solar system (both off-grid and grid connected is as shown below:

Table 1: Cost and benefit of off grid solar system

TERMS	GRID CONNECTED SYSTEM	OFF-GRID SYSTEM
INITIAL COST	14.56 Crore	29.12 Crore
BENEFIT (In 5 years)	27.61 Crore	27.61 Crore
COST BENEFIT RATIO	0.52	1.05

Cost Benefit ratio of the grid connected system was found to be 0.52 (which is less than 1), hence the project is feasible for the residence if done as a grid connected system. Cost Benefit ratio of the off - grid connected system was found to be 1.05 (which is greater than 1), Hence the project is not feasible for the residence if done as a grid connected system. If the panels are installed as a grid connected system, then the total project cost will be paid back in less than 5 years.

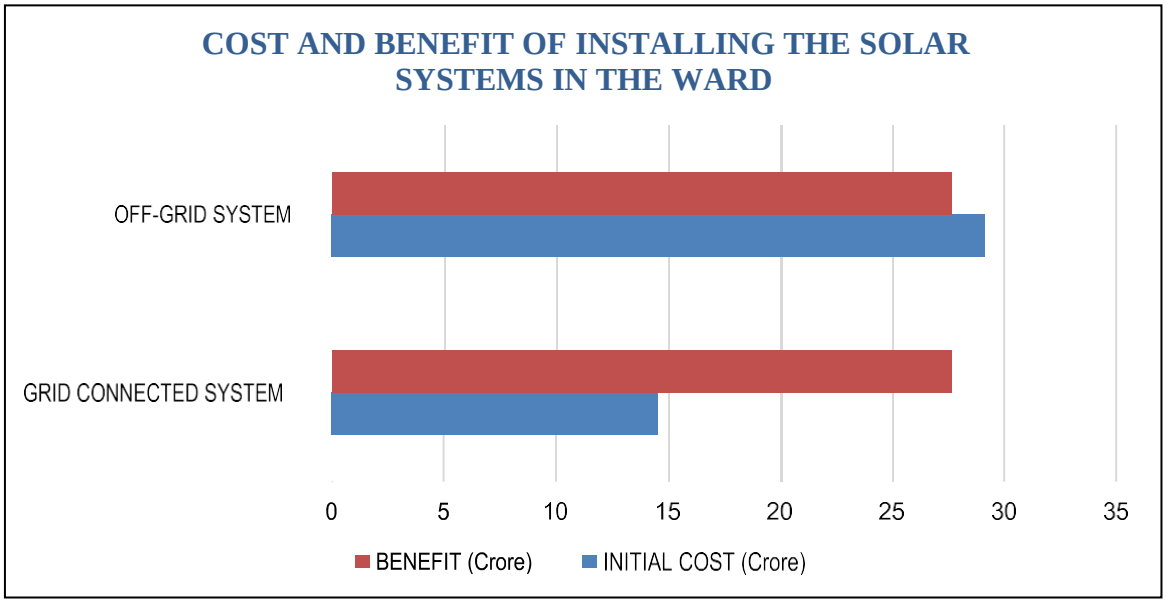

Fig 13: Cost and benefit of solar system

6.5.1 Cost-Benefit analysis for installing solar system in a single residence (1 KW)

The average initial cost and benefit (in 5 years) of such a 1 KW solar system (both off-grid and grid connected is as shown below:

Table 2: Cost and benefit of 1 KW solar system

TERMS	GRID CONNECTED SYSTEM	OFF-GRID SYSTEM
INITIAL COST	Rs. 35000	Rs. 70000
BENEFIT (In 5 years)	Rs. 48596	Rs. 48596
COST BENEFIT RATIO	0.72	1.44

Cost Benefit ratio of the grid connected system was found to be 0.72 (which is less than 1), hence the project is feasible for the residence if done as a grid connected system. Cost Benefit ratio of the off - grid connected system was found to be 1.44 (which is greater than 1), Hence the project is not

feasible for the residence if done as an off-grid system. If the panels are installed as a grid connected system, then the user will get back the initial cost spend within 5 years.

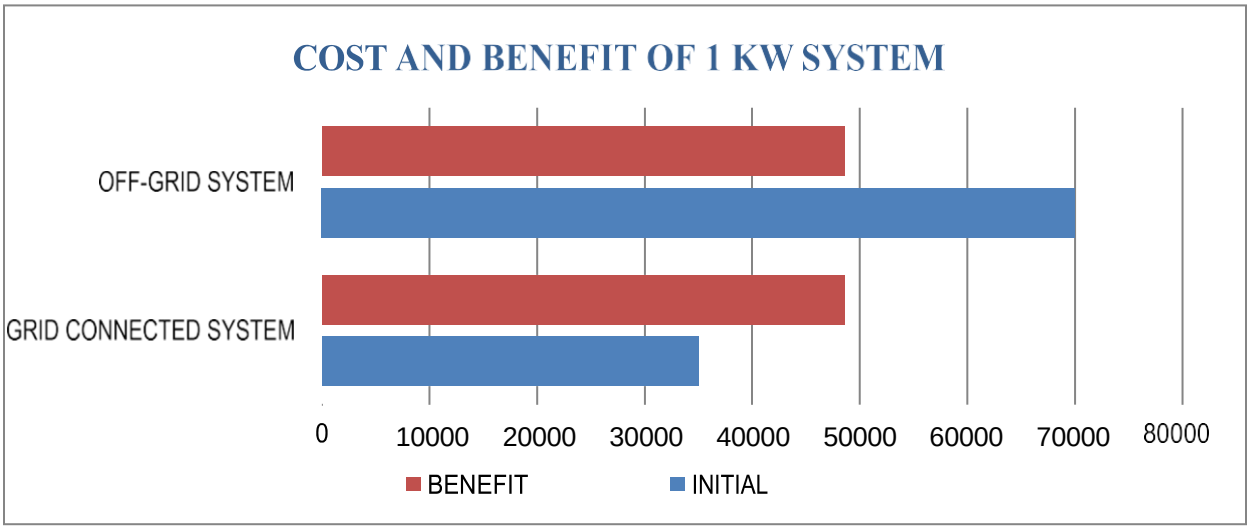

Fig 14: Cost and benefit of 1 KW solar system

6.5.2 Cost-Benefit analysis for installing solar system in a single residence (2 KW)

The average initial cost and benefit (in 5 years) of such a 2 KW solar system (both off-grid and grid connected is as shown below:

Table 3: Cost and benefit of 2 KW solar system

TERMS	GRID CONNECTED SYSTEM	OFF-GRID SYSTEM
INITIAL COST	Rs. 70000	Rs. 140000
BENEFIT (In 5 years)	Rs. 127432	Rs. 127432
COST BENEFIT RATIO	0.54	1.09

Cost Benefit ratio of the grid connected system was found to be 0.54 (which is less than 1), hence the project is feasible for the residence if done as a grid connected system. Cost Benefit ratio of the

off - grid connected system was found to be 1.09 (which is greater than 1), Hence the project is not feasible for the residence if done as an off-grid system. If the panels are installed as a grid connected system, then the user will get back the initial cost spend within 5 years.

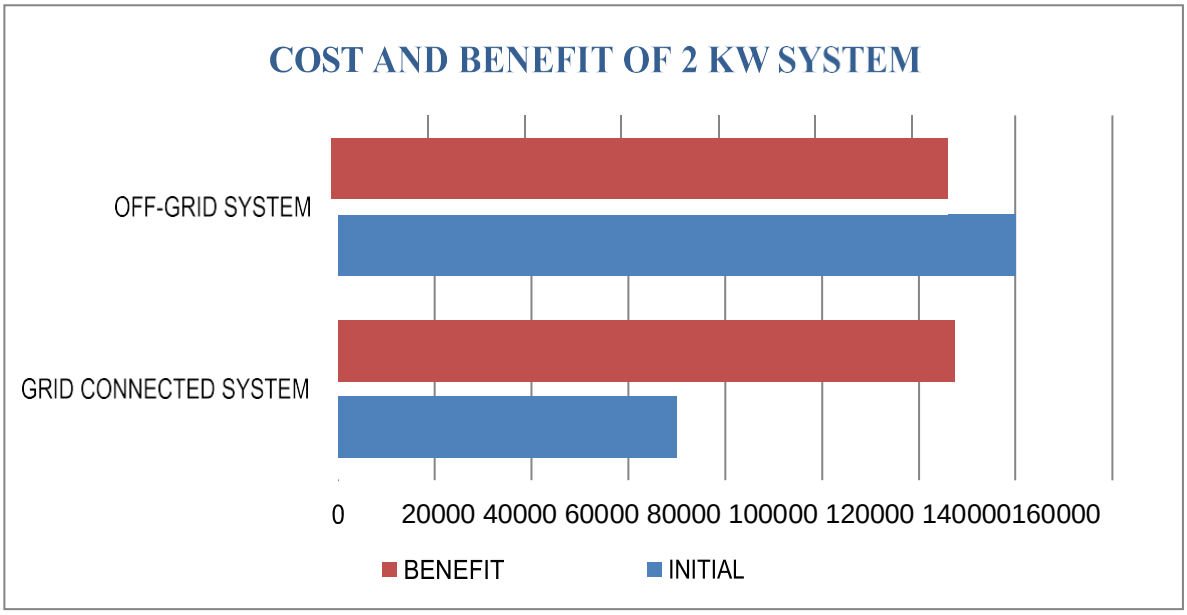

Fig 15: Cost and benefit of 2 KW solar system

6.5.3 Cost-Benefit analysis for installing solar system in a single residence (3 KW)

The average initial cost and benefit (in 5 years) of such a solar system (both off-grid and grid connected is as shown below:

Table 4: Cost and benefit of 3 KW solar system

TERMS	GRID CONNECTED SYSTEM	OFF-GRID SYSTEM
INITIAL COST	Rs. 105000	Rs. 210000
BENEFIT (In 5 years)	Rs. 178189	Rs. 178189
COST BENEFIT RATIO	0.58	1.17

Cost Benefit ratio of the grid connected system was found to be 0.58 (which is less than 1), hence the project is feasible for the residence if done as a grid connected system. Cost Benefit ratio of the off - grid connected system was found to be 1.17 (which is greater than 1), Hence the project is not feasible for the residence if done as an off-grid system. If the panels are installed as a grid connected system, then the user will get back the initial cost spend within 5 years.

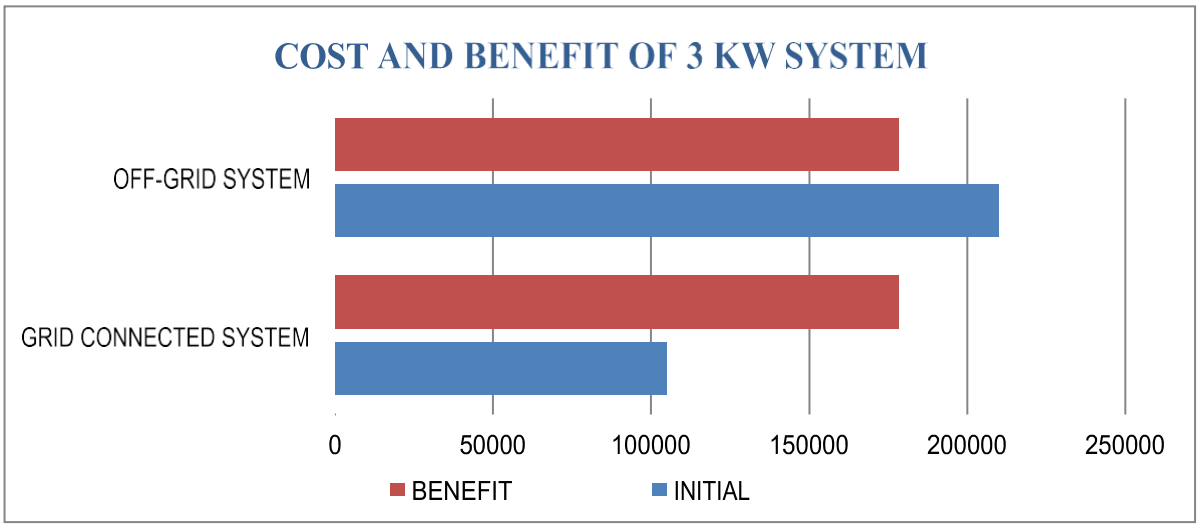

Fig 16: Cost and benefit of 3 KW solar system

6.5.4 Cost-Benefit analysis for installing solar system in a single residence (4 KW)

The average initial cost and benefit (in 5 years) of such a solar system (both off-grid and grid connected is as shown below:

Table 5: Cost and benefit of 4 KW solar system

TERMS	GRID CONNECTED SYSTEM	OFF-GRID SYSTEM
INITIAL COST	Rs. 140000	Rs. 280000
BENEFIT (In 5 years)	Rs. 241905	Rs. 241905
COST BENEFIT RATIO	0.57	1.15

Cost Benefit ratio of the grid connected system was found to be 0.57 (which is less than 1), hence the project is feasible for the residence if done as a grid connected system. Cost Benefit ratio of the off - grid connected system was found to be 1.15 (which is greater than 1), Hence the project is not feasible for the residence if done as an off-grid system. If the panels are installed as a grid connected system, then the user will get back the initial cost spend within 5 years.

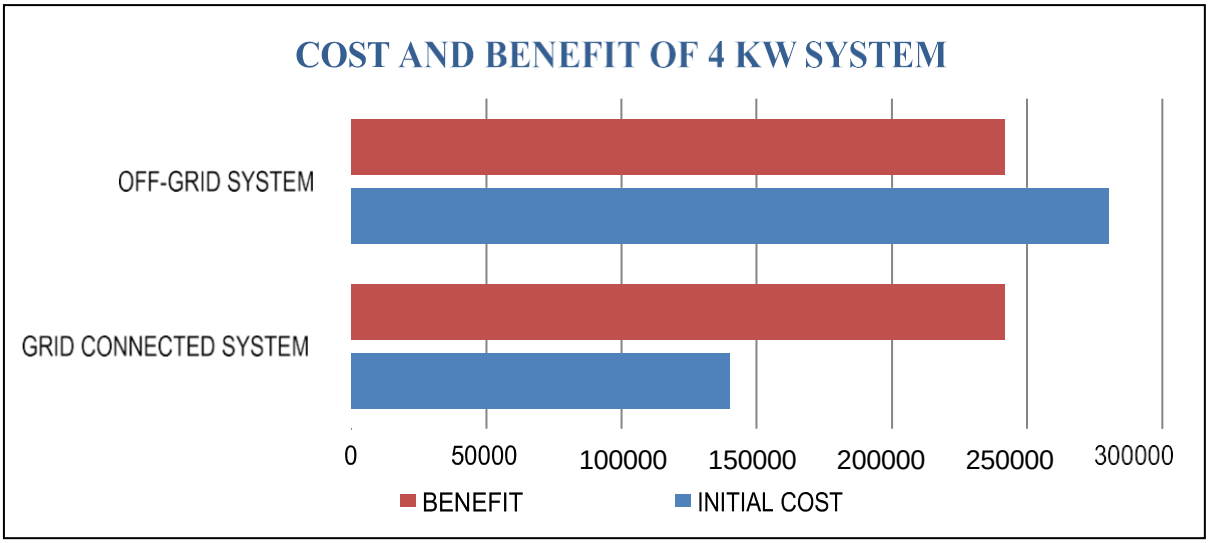

Fig 17: Cost and benefit of 4 KW solar system

6.5.5 Cost-Benefit analysis for installing solar system in a single residence (5 KW)

The average initial cost and benefit (in 5 years) of such a solar system (both off-grid and grid connected is as shown below:

Table 6: Cost and benefit of 5 KW solar system

TERMS	GRID CONNECTED SYSTEM	OFF-GRID SYSTEM
INITIAL COST	Rs. 175000	Rs. 350000
BENEFIT (In 5 years)	Rs. 323981	Rs. 323981
COST BENEFIT RATIO	0.54	1.08

Cost Benefit ratio of the grid connected system was found to be 0.54 (which is less than 1), hence the project is feasible for the residence if done as a grid connected system. Cost Benefit ratio of the off - grid connected system was found to be 1.08 (which is greater than 1), Hence the project is not feasible for the residence if done as an off-grid system. If the panels are installed as a grid connected system, then the user will get back the initial cost spend within 5 years.

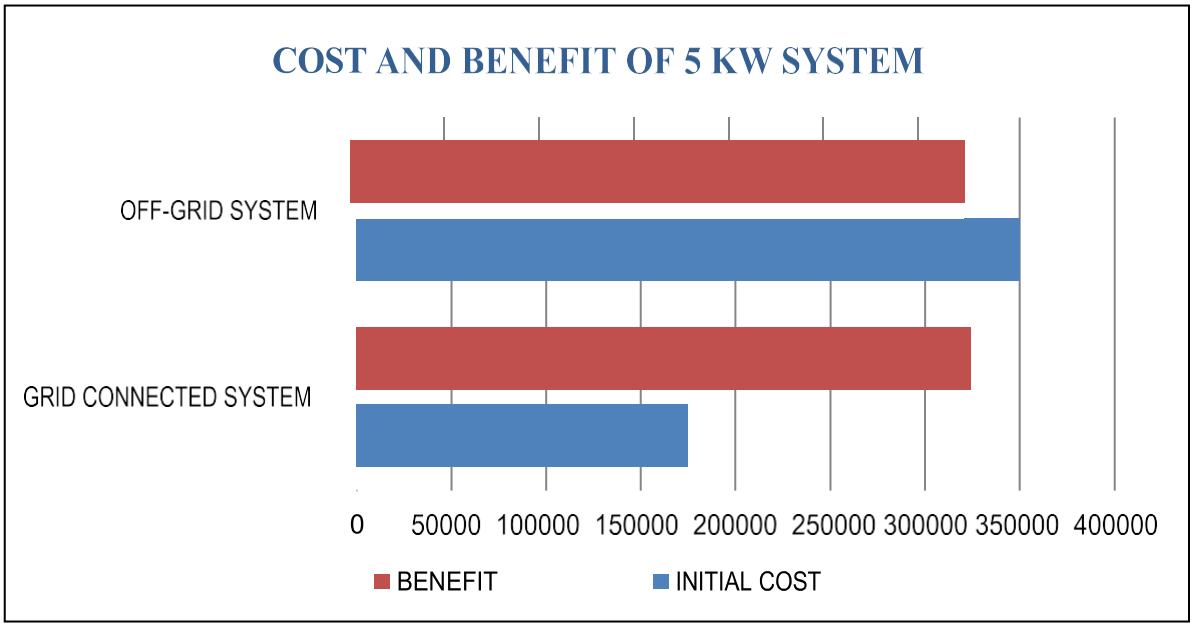

Fig 18: Cost and benefit of 5 KW solar system

7. IMPLEMENTATION PLAN FOR THE AREA

7.1 GENERAL

The solar city project is going to be implemented in 2000 houses in the ward. As per the survey conducted it was identified that only 50 % of people are interested in installing a solar system. This means half of the people are unaware of the benefits of switching to solar panels.

So, as a first step towards switching to solar power, Awareness programs and campaigns need to be conducted in the ward to make the residents aware of the importance of using renewable energy and to build knowledge among the public about various subsidies available if they are switching to solar panels.

The total energy requirement of the domestic sector in the ward is around 520000 Kwh/month. The average energy consumption per house (as per survey details) is 228 Kwh. So, on an average each residence will require a 2 KW solar system. Based on the energy requirement of the house, the required capacity of solar system can vary from 1-5 KW. As per the feasibility analysis, installing a grid connected system will be a much feasible option for this area. The total project cost will be 14.56 Crores.

7.2 DETAILED IMPLEMENTATION PLAN

a) An awareness workshop will be conducted in the ward. The importance of switching to solar power, its long-term and short-term benefits (economical and environmental), solar subsidy details and procedure of application will be covered in the workshop. A technical person from ANERT/ Any other related organization will handle the sessions. The workshop will be a 1-2 day program.
b) Submission of the project proposal to ANERT for approval.
c) Submission of the project proposal for the approval for CSR fund.
d) Online submission of the application through ANERT website.
e) Installation of solar system in each residence.

8. ENERGY SAVINGS POLICY

a) AWARENESS AND MOTIVATION CAMPAIGNS

In any initiative the first step is creating awareness. The common people should be made aware of the value of each unit of electricity they are using beyond the monetary value. The importance of renewable energy and energy conservation should be strongly spoken about. The realization of the importance of same for the sustainable development is a point that should be taken ahead to replace the instant gratification thoughts. Holding interactive workshops and classes, competitions, programmes or any informative campaigns regarding this can be of great use.

Being aware is not enough, taking the step forward is just as important. Motivating them to follow steps to achieve the energy efficiency and the measures they could adopt at homes is an important step. For these easily understandable measures and working methods should be made available and aware to the general people.

b) CONTINUOUS MONITORING

Continuously monitoring the energy utilization by self and finding ways to save energy by replacing old wiring, electrical equipments and careful utilization of electricity. Always remember that a change starts with you. The first initiative has to be taken from each individual's side whereby a successful collective effort can be made for the cause of reduction and efficient utilization of energy.

c) LIGHTING

Promote efficient lighting, enhance awareness on using efficient equipment which reduce electricity bills and help preserve environment. Reduce lighting as per requirement. Convert to LED lighting system. If the entire conversion cannot be done at one go, primary importance will be to convert the bulbs that is used for longer periods like those in living rooms, verandah, kitchen etc. The 20W LED tube lights are 50% more energy efficient than conventional 40W tube lights.

Comparing an average electricity consumption of commonly used lighting systems, LED lights will be the most apt in terms of electricity savings. A 60 watt filament bulb working for 16.67 hours consumes 1 unit electricity while 14 watt CFL bulb consumes 1 unit while working for 71.43

hours, as for LED bulb a 7 watt LED bulb consumes 1 unit in 142.86 hours. An18 watt LED tube working for 3 hours consumes 19.71 units whereas the old 50 W tube working for 3 hours consumes around 54.75 watts. These numbers show that the replacement of old filament bulbs and tube lights with LED lights save a lot of energy and subsequently help in climate resilience plans.

Use natural lighting system. Natural lighting is the best option to reduce lighting during daytimes. Ample lighting is always advised. There is no requirement for having too many lights at your home. During festivities and other occasions of grandeur due care should be given to ensure that the people do not go overboard with the light decoration.

d) LIQUEFIED PETROLEUM GAS (LPG)

Energy efficiency does not refer just to electricity usage; LPG is also a major energy contributing factor. Using pressure cookers, cooking with lid on, cooking on low-medium flame can help to reduce the LPG use. Use of biogas is another method to reduce the use of LPG.

f) HEATING, VENTILATION, AND AIR CONDITIONING (HVAC)

Energy efficient lighting and energy efficient windows can reduce the cooling loads enough to downsize the HVAC equipment. Proper supervision of Night purge cycle can also help reduce the HVAC energy requirements. In simple terms this can be followed through an act of opening your windows to let in the cool air and to reduce the internal humidity during summers and closing them at nights to keep warm during winters. Generally, a 1 ton AC working for 12 hours can consume up to 6 units. It is always advisable to buy 5 star BEE rated devices to reduce the consumption of electricity. With every 1°C increase in temperature after 22°C temperature setting, there is a decrease of 5 % electricity usage. A thermostat setting at 25°C is an apt temperature for efficient use.

g) TRANSPORT

Despite being outside the main survey objective, transport is also a major player in the field of fuel consumption. A way to attain efficiency in the transport scenario will be to opt for bicycles and walking short distances. Efficient driving and being a vigilant and proficient driver is also a way to ensure efficiency of fuel usage in transportation sector. The use of electric vehicles is another option to reduce fuel consumption and eventually reducing transport emissions.

h) RENEWABLE ENERGY

Energy derived from solar, biomass can be the best alternative energy options in the ward. Solar panels, solar lights, solar lanterns, solar water heaters can be used as alternatives to the conventional energy utilities and biogas and replace LPG and can also be a method to dispose the biodegradable waste.

i) PLUG AND PROCESS LOADS

It represents a significant portion of the buildings total energy and is mainly dependent on the occupant behavior. Optimizing the daily usage, avoiding unnecessary electricity usage can help reduce the plug and process loads. It is always important to turn off the appliances with switch rather than just on remote, also to unplug the electronics. Gadgets like laptops and mobile phones consume power even when fully charged so it is important to unplug them when it reaches a 100 percent. Considering an iron box, an automatic temperature cut-off iron box uses only half of the electricity compared to an ordinary one. Also, when considering poor savings as part of our habit of ironing, keep in mind to avoid ironing wet clothes, avoid ironing during low voltage time and evenings as it consumes more power to heat up during these times and also it is more efficient to iron together once a week rather than daily.

Apart from the mentioned gadgets many other electronic appliances that are generally used in residential buildings are mixer grinders, fan, induction stoves, water pumps and motors, washing machine, refrigerators etc. the efficient usage of each of these gadgets and appliances collectively can lead to huge savings in electricity.

Checking for BEE star rating of the appliances and buying 5 star rated appliances are more worthwhile as they are more efficient and consumes less electricity

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ANNEXURE

Fig 1 : Solar City Project - Student Training at Cochin College

Fig 2 : Solar City Project - Field Survey

Fig 3 : Solar City Project Poster Designing Competition - Prize Distribution

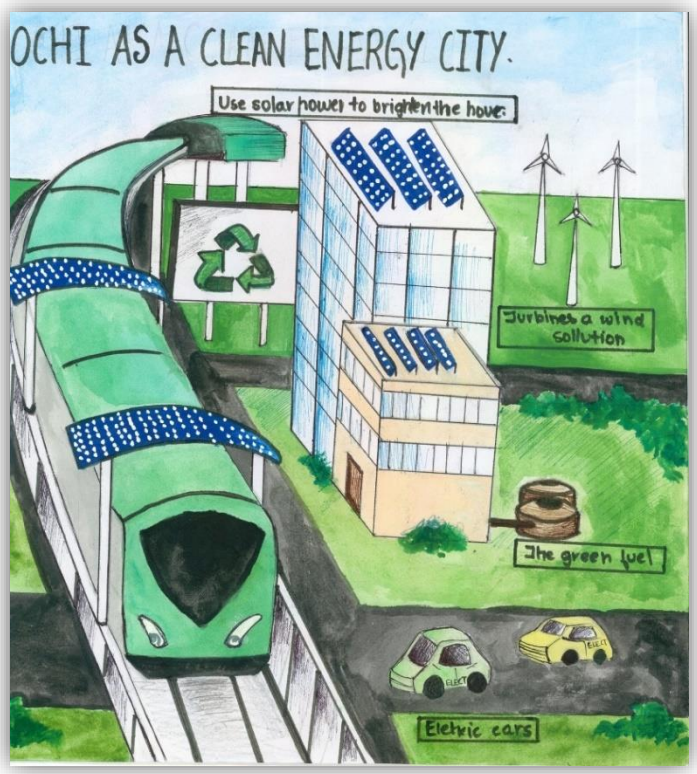

Fig 4 : First Prize – Nived Prem

Fig 5 : Second Prize – Savvy Thomas

Fig 6 : Third Prize – Angel Lizbeth

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