

SOLAR POWER HEATERS IN RUBAN SOCIETY OF ANDHRAHALLI - A STUDY OF THE CONSUMER ADOPTION PROCESS

Pala Suriya Kala

Associate Professor, ABBS, Andhrahalli, Bangalore.

We have proved ... that after our stores of oil and coal are exhausted the human race can receive unlimited power from the rays of the sun.
—Frank Shuman, New York Times, July 2, 1916^[106]

Abstract

The rural-urban divide is a glaring one in India and one of the major trends in the world. There is an exodus of resources from the rural area to the urban area. In this scenario all initiatives to reverse this trend and look into areas of improvement for sustaining the rural society is the order of the day. One such area is green technology for ruban development. Solar power is a green initiative which has received immense importance in the recent years by all the governments in the world. A sustained increase in the green energy can bring down the energy crisis especially in solar rich countries. In this context, a study has been undertaken to understand the adoption of this green technology by many inhabitants of Andhrahalli. Andhrahalli is a ruban area and comes under the category Bangalore-rural. This laid back area has seen a rapid growth with the urban influence of Bangalore city. The locality has well out colonies and there is a spurt of residential and commercial growth in this area. The adoption of sustainable green solar energy in this area is studied.

Key Words: Ruban Society, Sustainable Energy, Green Power, Green City, Solar City, Solar Energy.

Solar energy is one of the thrust areas for tapping sustainable energy all over the world. New and unconventional sources of energy are looked into with the serious energy depletion of non-renewable energy sources in the world. A lot of developments in technology have therefore lead to some applications in the domestic sector where consumers can use solar energy for cooking, lighting and hot water. Solar energy has been defined in various ways. According to International energy agency, Solar energy is a radiant light and heat from the sun harnessed using a range of ever-evolving technologies such as solar heating, solar photovoltaic, solar thermal energy, solar architecture and artificial photosynthesis.¹

There are many renewable energy resources in the world. They are wind, tidal, wave, hydro, biomass, geo-thermal as well as solar energy. Among these the amount of energy received by the earth is the highest in for solar energy. An hour of solar energy received by the earth is equivalent to a year's consumption of energy by humans globally.

The following table sums up the various energy sources and the amount of energy that can be harnessed as compared to early energy consumption all over the world.

Early Solar Fluxes & Human Energy Consumption		
Solar	3,850,000 EJ	[8]
Wind	2,250 EJ	[9]
Biomass potential	~200 EJ	[10]
Primary energy use (2010)	539 EJ	[11]
Electricity (2010)	~67 EJ	[12]
1 Exajoule (EJ) is 10 ¹⁸ Joules or 278 billion kilowatt-hours (kW)		

Table – 1, Early solar fluxes & human energy consumption ²

¹ "Solar Energy Perspectives: Executive Summary" (PDF). International Energy Agency. 2011. Archived from the original on 2011-12-03.

² http://en.wikipedia.org/wiki/Solar_energy.

Pioneer: The early use of solar energy was pioneered by an American named Frank Shuman. Shuman built the first solar powered thermal station in Egypt in 1912-1913 which was successful in pumping water to the nearby cotton field. After the lull following the use of cheap oil, the plant was resurrected once again in the 1970's.

To recall Shuman's vision, he said

"We have proved the commercial profit of sun power in the tropics and have more particularly proved that after our stores of oil and coal are exhausted the human race can receive unlimited power from the rays of the sun."³

From the days of Shuman till now, solar energy has come to be more commercially viable and has been used in various applications. Some of the areas of application are as follows

1. Electricity Production
2. Fuel Production
3. Transport
4. Water Heating
5. Lighting
6. Cooking
7. Agriculture And Horticulture
8. Fuel Production
9. Process Heat
10. Photovoltaics
11. Heating, cooling and ventilation systems
12. Water treatment

Thus the uses that solar energy can be put to are immense. One of the dreams for solar energy that I envisage is the making of an energy sustainable home, village, etc., where all the energy resources needed for the individual unit is self-produced and is not dependant on the external sources for supply of energy.

One of the areas of application of solar energy under the study is the solar water heating systems. Solar water heating systems as it implies used the solar energy to heat water through a thermal collector. There are various technologies that have been developed to produce hot water from solar energy.

Some of the various systems are as follows

- Direct and indirect systems
- Passive and active systems
- Passive and direct systems
- Active direct systems: drain back and antifreeze

As with technology each system has its various capacities, which can be summed up in the following table. Though not much significant difference has not been seen in the various types of SWHS.

Energy production (kW_{th}.h) of five solar thermal systems. The evac tube systems used below both have 20 tubes					
Technology	Flat plate	Flat plate	Flat plate	Evac tube	Evac tube
Configuration	Direct active	Thermosiphon	Indirect active	Indirect active	Direct active
Overall size (m ²)	2.49	1.98	1.87	2.85	2.97
Absorber size (m ²)	2.21	1.98	1.72	2.85	2.96
Maximum efficiency	0.68	0.74	0.61	0.57	0.46

³ "American Inventor Uses Egypt's Sun for Power - Appliance Concentrates the Heat Rays and Produces Steam, Which Can Be Used to Drive Irrigation Pumps in Hot Climates - View Article - NYTimes.com". nytimes.com. 2 July 1916.

Energy production (kW.h/day): – Insolation 3.2 kW.h/m ² /day (<i>temperate</i>) – e.g. Zurich, Switzerland	5.3	3.9	3.3	4.8	4.0
– Insolation 6.5 kW.h/m ² /day (<i>tropical</i>) – e.g. Phoenix, USA	11.2	8.8	7.1	9.9	8.4

Table - 2: Energy production of five solar power systems⁴

Domestic Water Heating Systems: Mounting a metal tank in the sunlight to heat the water is the simplest way to heat the water. This was also how it also worked centuries ago. To increase the efficiency various types of collectors are used such as, ICS or batch collectors, Plate collectors, Evacuated Tube collectors, unglazed or formed collectors are types of collectors used to enhance the water heating capacity. The flat plates are more efficient in sunny conditions and the ETC are efficient in managing heat in cloudy conditions.

Some of the major concerns for domestic customers about solar water heating systems area as follows

- Upfront state or government subsidy for installation of a solar water heater
- Recurrent or annual tax rebates or subsidy for operating renewable energy
- SWHs system's Annual maintenance cost (e.g. antifreeze or pump replacements)
- Savings in annual maintenance of conventional (electric/gas/oil) water heating system
- Cost of purchasing solar water heater (more complex systems are more expensive)
- SWHS system purchased and its efficiency
- Installation cost of the SWHS
- Price of electricity use for mains pumping (if this is used)
- Price of water heating fuel (e.g. gas or electricity) saved per kwh
- Amount of water heating fuel used per month by a household

The Ministry of New and Renewable Energy, is the pivotal body under the Government of India, to monitor and encourage the growth of renewable resources of power in India. In its open document, the Ministry(MNRE) believes that “Though the initial investment for a solar water heater is high compared to available conventional alternatives, the return on investment has become increasingly attractive with the increase in prices of conventional energy. The payback period depends on the site of installation, utilization pattern and fuel replaced.”⁵

In this context the study concentrated on the domestic water heating systems used in the ruban society of Andhrahalli. It has been observed that the adoption of solar water heating systems have been on an increase due to the utility it has served primarily in the city of Bangalore due to its climatic conditions. The city has seen a rapid increase of adoption, coupled with the increased number of players in the market.

The major players in the market, marketing the solar marketing power systems in India and especially in Bangalore are as follows

- Tata power
- Nu tech
- Anu solar
- Kamal
- Rayyon
- Supreme Solar
- Sunsol max

Till recently the Ministry of New and Renewable Energy has offered subsidy to the various customers to encourage the use of solar power. Recently the government after years of subsidizing has called off the subsidy. The concept of solar Cities or green cities has been encouraged by the GOI, in order to encourage the states in implementing the solar power usage. The selected cities have been sanctioned 50 lakhs to implement the same.

⁴ http://en.wikipedia.org/wiki/Solar_water_heating.

⁵ <http://mnre.gov.in/schemes/decentralized-systems/solar-systems/solar-water-heatres-air-heating-systems/>

In Karnataka, Mysore and Hubli/Darwad has been selected as the solar cities by the ministry. The area of study has been Andhra halli , which comes under Bangalore rural in Karnataka.

Bengaluru Rural District is one of the 30 districts in Karnataka. It was formed in 1986, when Bangalore district was divided into Bangalore Rural and Bangalore (Urban). Presently in Bangalore Rural district, there are 2 divisions, 4 Talukas, 35 Hoblis (cluster of villages), 1,713 inhabited and 177 uninhabited villages, 9 towns, and 229 Gram Panchayats. Proximity to the city of Bangalore has its own impact on the district, with a considerable daily commuting population.⁶

Andhralli ruban area: Andhrahalli is under the Bengaluru rural area is gaining immense importance with the development of SEZ, establishment of IIT and the various academic institutions. Further various software companies have established themselves in this area. The area is pre dominantly agriculturalist with sericulture and weaving too forming one of the major occupation of the inhabitants. A lot of wineries have also been established in this area, which the increase in the output of wine increasing tremendously.

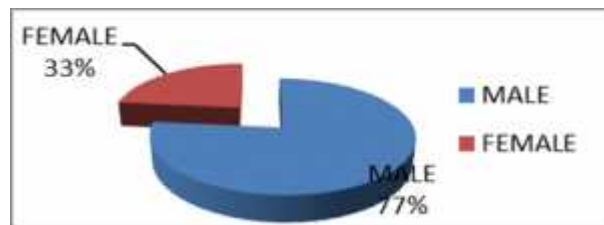
The proximity of the region to the Bangalore city has seen a lot of commuting of the inhabitants between the city and the region. In this the ever changing scenario, the study becomes more relevant as it is typical ruban area, facing all the challenges of being so.

The Objective of the study was to understand the adoption process and the usage of the solar water heating systems in the Andhra halli. As time has been a constraint a sample size of 30 households has been taken for the study to understand the adoption process. The collected information has been collated and analysed as follows

Research Methodology

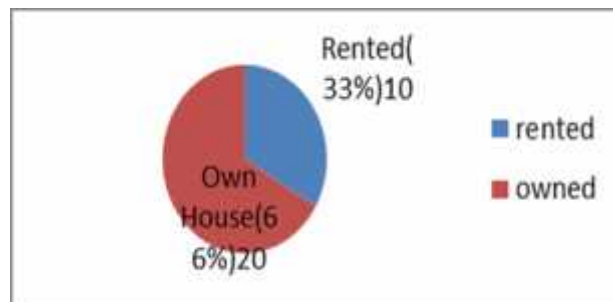
A sample size of 30 was taken for the purpose of the study. A convenience sampling was used to pick up the thirty households for study. A structured questionnaire was used as a research instrument , which concentrated on the demographics of the consumer and then concentrated on the adoption of solar heaters.

Table - 1, Gender of Respondents



Among the respondents 33% were women respondents and 77% were male respondents

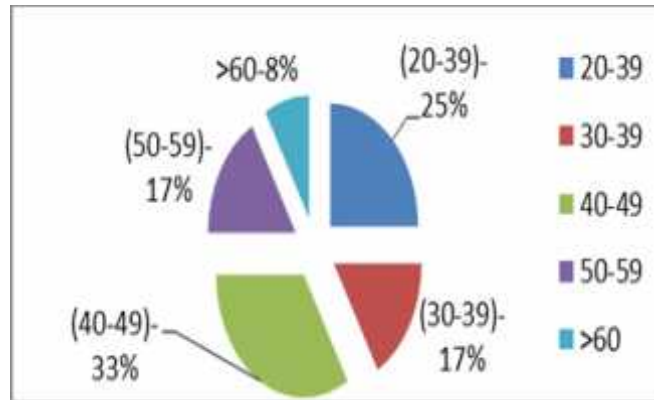
Table – 2, Type of Residence



Among the household with SWHS 66% were the owners and the remaining 33% were tenants who spoke for their owners

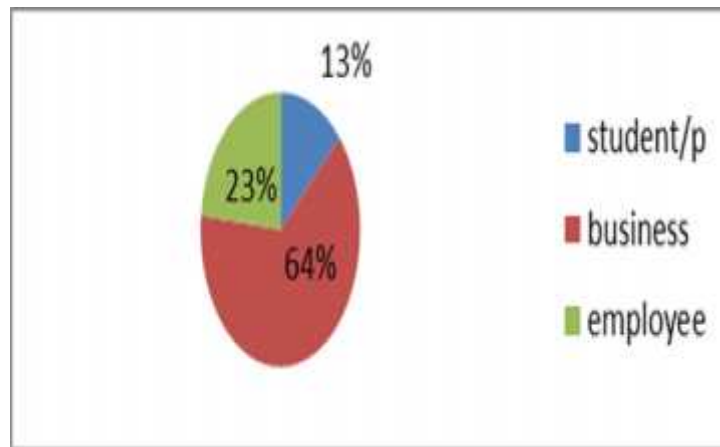
⁶ http://en.wikipedia.org/wiki/Bangalore_Rural_district.

Table 3: Age of the Respondents



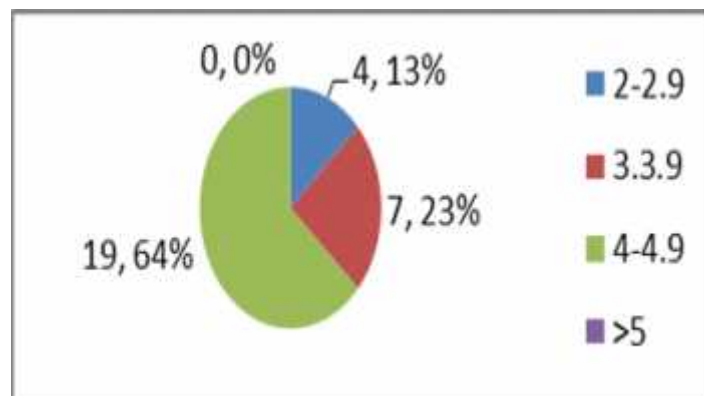
Among the respondents 8% were above 60 yrs, 17% were in the age group of 50-59yrs,33% were in the age group of 40-49yrs,another 17% were in the age group of 30-39yrs and 25% were in the age group of 20-39 years

Table – 4, Occupation of the respondents



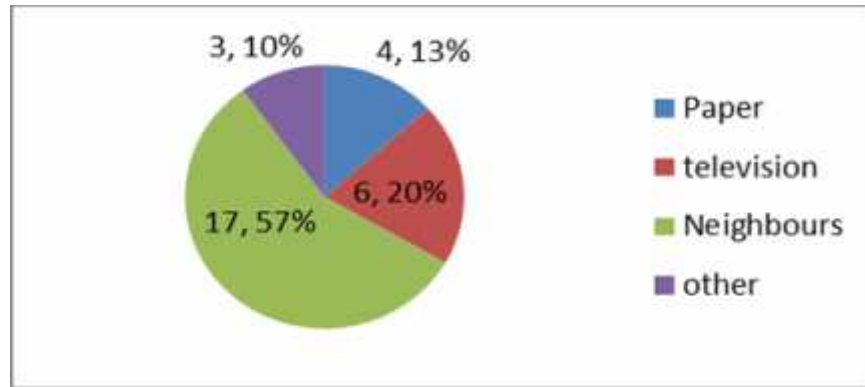
Among the respondents 64% were doing business, 23% were employees and 13% were students.

Table - 5: Income of the respondents



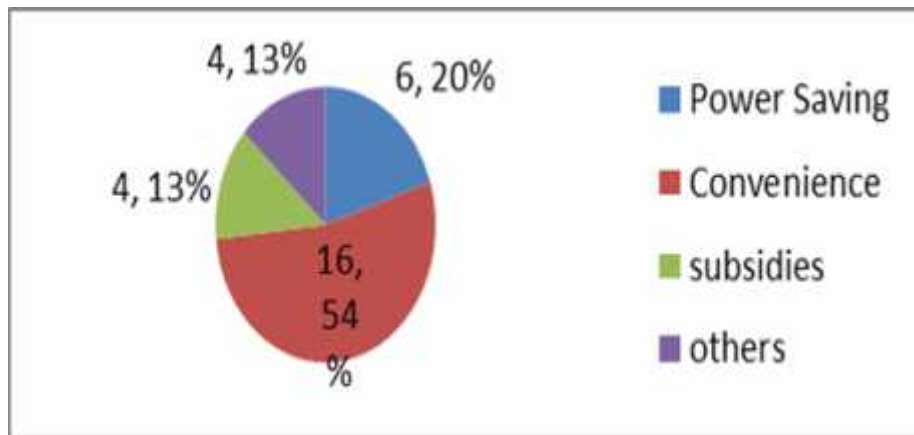
The income of respondents with more than >5 Lakhs p.a. were nil, the respondents at 4-4.9L. p.a were 64%, the respondents at 3-3.9 pa were 23% and those with 2-2.9 were 13%.

Table - 6, Medium of Awareness



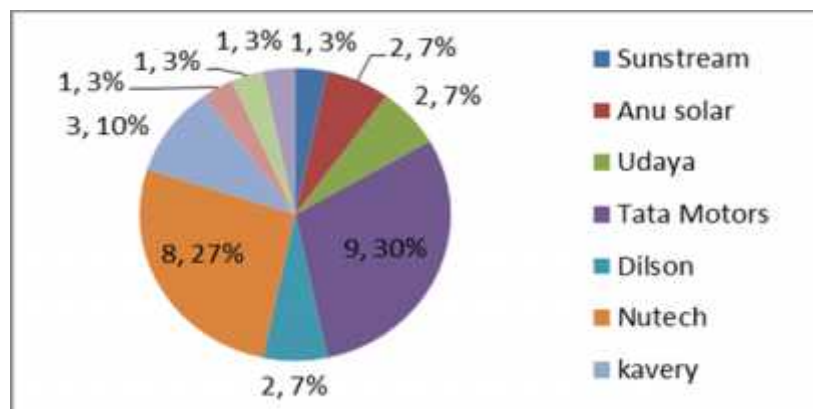
Among the respondents 57% were aware of SWHS because of their neighbours, 20% knew about it through television, 13% knew about the heating systems through newspapers, 10% knew about them through various other sources.

Table – 7, Reason for Adoption



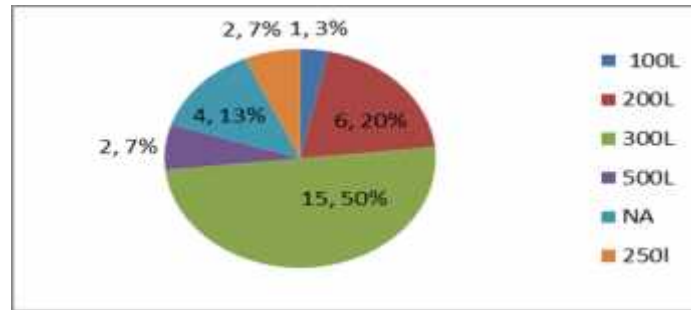
Among the reasons for adoption 54% adopted the same for the convenience and the utility, 20% for the reasons for power saving, 13% because subsidy was given and 13% for other reasons.

Table - 8, Brands Adopted



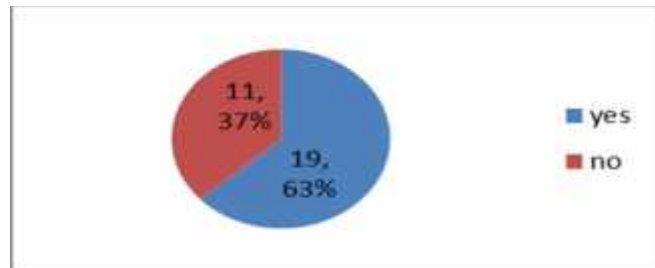
Among the brands adopted, 30% used Tata Power, 27% used Nutech, 10% used Kavery, 7% used Dilon, 7% used Udaya, 7% used Anu solar, another 1% each used Nutech, Sunstream, Kamal, etc..

Table – 9, Capacity of Power System



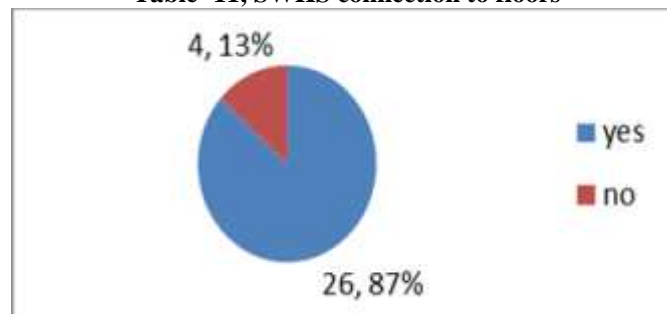
Capacity of the power system used 50% used 300L, 20% used 200L, 7% used 250L, 3% used 100L, 7% was not aware of the capacity

Table – 10, Presence of additional Floors.



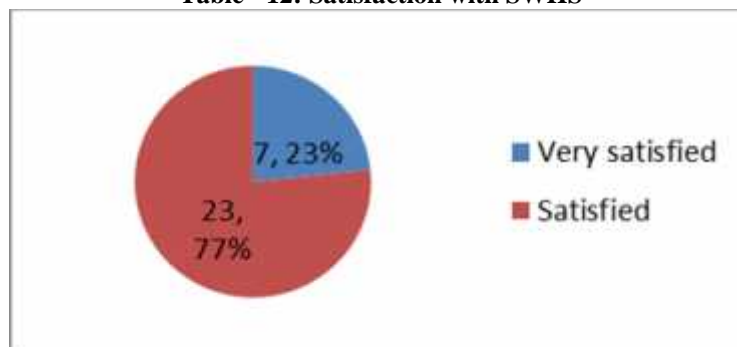
Among the households 63 % had additional floors and 37% were not having floors.

Table -11, SWHS connection to floors



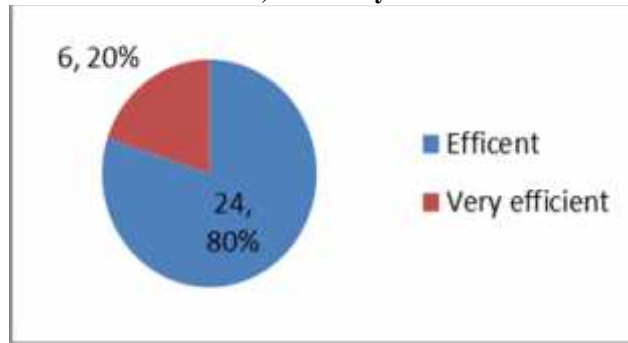
Among those with additional floors, 87% had solar power heating systems attached to the same and 13 % had not attached

Table - 12: Satisfaction with SWHS



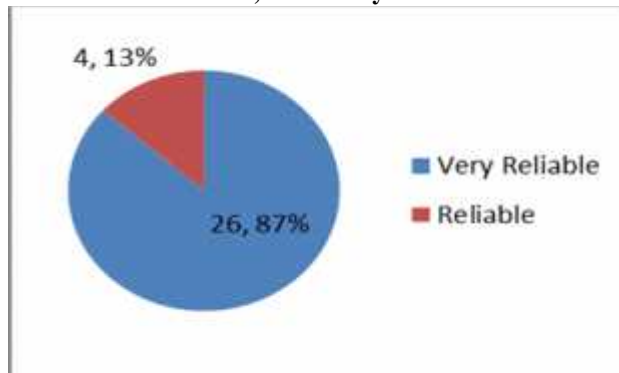
Among the respondents the satisfaction levels were high for the SWHS, 77% were satisfied and 23% were very satisfied.

Table - 13, Efficiency of SWHS



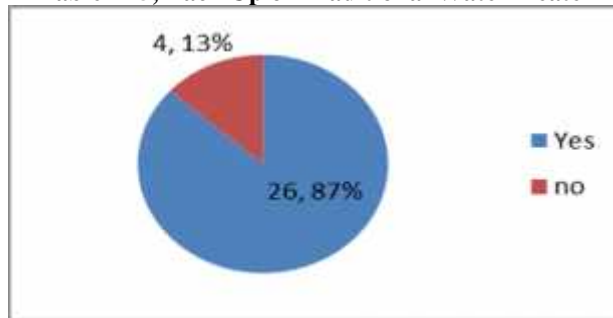
When asked about the efficiency 80% felt the heating system was efficient and 20% felt they were very efficient.

Table - 14, Reliability of SWHS



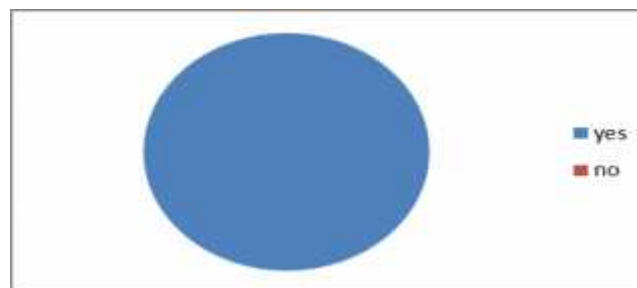
87% of the respondents felt that SWHS were very reliable and 13% felt they were reliable.

Table - 15, Back Up of Traditional Water Heater



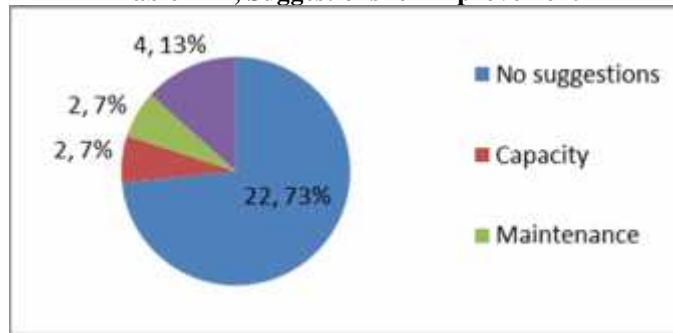
87% had the back up of traditional water heater and 13% didn't have the same.

Table - 16, Continuation of Subsidies by GOI



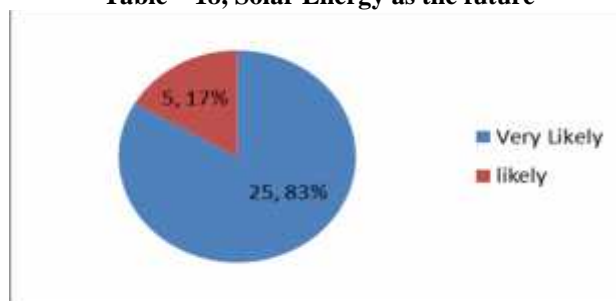
All the respondents that is 100% felt that GOI should continue subsidies for SWHS

Table – 17, Suggestions for improvement



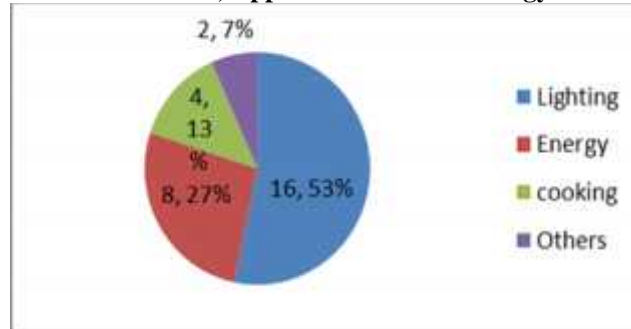
Majority of the respondents said that they had no idea so could not suggest improvements i.e.,73%, maintenance and capacity were suggested by two that is 7% of respondents.

Table – 18, Solar Energy as the future



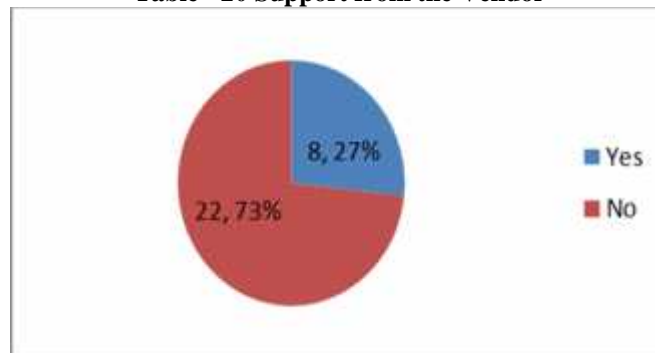
Majority 83% believe that it is very likely that solar energy is the energy of the future and 17% also believed it is likely to be so.

Table - 19, Applications of solar energy



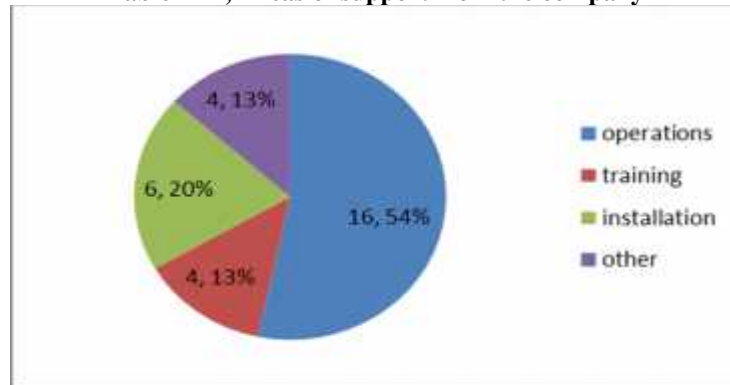
The other applications of solar energy as known to the respondents, 53% knew about lighting, 27% knew about energy, 13% knew cooking and 7% said other uses.

Table - 20 Support from the Vendor



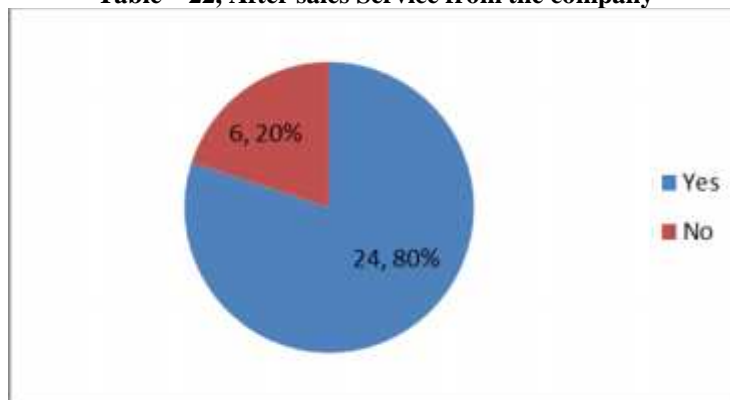
73% of the respondents said that there was no support from vendors and 27% said that was support from the vendors.

Table – 21, Areas of support from the company



Areas of support from the company were operations 54%, Installation 20%, Training 13% and other 13 %.

Table – 22, After sales Service from the company



80% of the respondents said that there is after sales service support and 20% said there was't support from the company.

OBSERVATIONS

One can by surveying the locality of the ruban area of Andhrahalli see that there is a wide spread adoption of solar water heating systems. Though a small representative sample was taken, the survey was very insightful and was helpful in understanding the customers of solar water heaters.

Many of the respondents were the locals of Andhrahalli and they had adopted the same for their own homes. The survey could get across to 64% of the owners. The owners of these homes were in their 40's or 50's. A small percentage of younger generation of respondents were those who stayed for rent and spoke on behalf of their owners. The majority of the owners had 300L as capacity and many of them have had more than one floor and had the solar water heating systems attached to the various floors. Most of them were inspired by their neighbours to have the solar water heating systems. They also felt that the water heating systems were efficient and reliable. Among the brands Tata solar led the brands in adoption followed by Nu tech and Kavery. At this point one must note that the scenario for water heaters is one of perfect competition and there are many players in the market and the customer has a lot of choice of brands to choose from. The customers said that after sales support was available but then continual support was not available from the vendors. Of the support that was available operations, training and installation was received by the customers. All the customers felt that the government should continue support for the solar power in terms of subsidies.

CONCLUSION

It is really warming to see that the ruban society of andhrahalli has adopted Solar Power Water heating systems. For most of them, the neighbours have been the inspiration to adopt the same. Most of them are middle class as indicated by their income and the reason for using solar heating system is for the utility and convenience it provides. The adoption is predominant in this area and the customers feel that it is efficient and reliable. They are not aware of any new developments but at the same time suggest that the technology can be improved. They are also open to other non-conventional uses of solar power like cooking, energy and lighting. The adoption of solar power water heating systems is a welcome trend which coupled with the



initiatives of the ministry of new and renewable energy resources has seen an increasing trend of adoption by customers. Such a green initiative of using green power is a welcome trend in rural areas. Andhra Pradesh is therefore on a right track of becoming a solar rural area.

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