Social Cost-Benefit Analysis of Domestic Solar Power – A Case of Mangaluru City (Karnataka)

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ABSTRACT

Indian power sector is undergoing a significant change that has redefined the industry outlook. Sustained economic growth continues to drive electricity demand in India. The Government of India's focus on attaining 'Power for all' has accelerated capacity addition in the country. At the same time, the competitive intensity is increasing at both the market and supply sides (fuel, logistics, finances, and manpower). Solar power in India is a fast developing industry, with a solar power capacity of (8 GW) as of 31 July 2016. In January 2015 the Indian government significantly expanded its solar plans, benefiting both the industries as well as for household purposes. India currently has around 1.2 million solar home lighting systems and 3.2 million solar lanterns sold or distributed. Solar power usage in residences has witnessed stupendous growth in the past few years owing to dropping prices of solar, growing income level, ample job opportunities in service sectors, environmental benefits and smart policies. India is facing an acute power crunch which is hampering its industrial growth and socio-economic development. Thus, it is necessary to deal with the energy crisis through utilization of abundantly available renewable energy resources. This study is an attempt to evaluate the costs and the benefits of investment and savings in solar power equipment by individuals and the enormous contribution they make towards social benefits accruing from environment protection and renewable power generation.

Keywords: *Power, Environment, Solar Power, Infrastructure, Cost-benefit analysis*

INTRODUCTION

Power is one of the most critical components of infrastructure crucial for the economic growth and welfare of nations. The existence and development of adequate infrastructure is essential for sustained growth of the Indian economy. India's power sector is one of the most diversified in the world. Sources of power generation range from conventional sources such as coal, lignite, natural gas, oil, hydro and nuclear power to viable non-conventional sources such as wind, solar, and agricultural and domestic waste. Electricity demand in the country has increased rapidly and is expected to rise further in the years to come. In order to meet the increasing demand for electricity in the country, massive addition to the installed generating capacity is required. India ranks third among 40 countries in EY's Renewable Energy Country Attractiveness Index, on back of strong focus by the government on promoting renewable energy and implementation of projects in a time bound manner.

Total installed capacity of power stations in India stood at 315,426.32 Megawatt (MW) as of February 28, 2017. The Ministry of Power has set a target of 1,229.4 billion units (BU) of electricity to be generated in the financial year 2017-18, which is 50 BU's higher than the target for 2016-17. The annual growth rate in renewable energy generation has been estimated to be 27 percent and 18 percent for conventional energy.

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Investment Scenario and Government Initiatives
Around 293 global and domestic companies have committed to generating 266 GW of solar, wind, mini-hydel and biomass-based power in India over the next 5–10 years. The initiative would entail an investment of about US$ 310–350 billion. Between April 2000 and December 2016, the industry attracted US$ 11.4 billion in Foreign Direct Investment (FDI).

The Government of India has identified the power sector as a key sector of focus so as to promote sustained industrial growth. There have been many initiatives by the Government of India to boost the Indian power sector, which includes the announcement of a massive renewable power production target of 175,000 MW by 2022; this comprises generation of 100,000 MW from solar power.

India has a tremendous scope of generating solar energy. The geographical location of the country stands to its benefit for generating solar energy. The reason being India is a tropical country and it receives solar radiation almost throughout the year, which amounts to 3,000 hours of sunshine. India's government has begun to acknowledge the importance of solar energy to the country's economic growth. From less than 12 MW in 2009, solar-power generation in the country grew to 190 MW in 2011. By March 2013, it grew fivefold, but the country has a long way to go to reach its goal of increasing solar-power generation to 20GW by 2020. Solar Energy, a clean renewable resource with zero emission has got a tremendous potential of energy which can be harnessed using a variety of devices. With recent developments, solar energy systems are easily available for industrial and domestic use with the added advantage of minimum maintenance. Solar energy could be made financially viable with government tax incentives and rebates

Solar power in India is a fast developing industry, with a solar power capacity of (8 GW) as of 31 July 2016. In January 2015, the Indian government significantly expanded its solar plans, benefiting both the industries as well as for household purposes. India currently has around 1.2 million solar home lighting systems and 3.2 million solar lanterns sold or distributed. Solar power usage in residents has witnessed stupendous growth in the past few years owing to dropping prices of solar, growing income level, ample job opportunities in service sectors, environmental benefits and smart policies.

The change in global climate is one of the significant environmental concerns of our time. Due to industrialization and mounting population, the access to power has led to increased demand in the country. India is facing an acute power crunch which is hampering its industrial growth and socio-economic development. Thus it is necessary to deal with the energy crisis through utilization of abundantly available renewable energy resources. This study is an attempt to evaluate the costs and the benefits of investment and savings in solar power equipment by individuals and the enormous contribution they make towards social benefits accruing from environment protection and renewable power generation.

REVIEW OF LITERATURE

Business standard dated January 28 (2017), found that the real potential in a sunny country to replace fossil fuels is solar: India has a renewable-energy potential of about 895 GW, of which 750 GW is solar, as India Spend reported.

Sujoy Gosh (2017), states that India's solar power sector is becoming commoditized and margins are getting squeezed across the sector's value chain. He also stated that unless solar module firms are able to differentiate themselves and manage ultra-low costs, they will find it difficult to make money in India.

Bridge to India (2016), released in a report that a rapid reduction in cost and increased demand for solar installation has fanned tremendous growth in India and will become the fourth largest solar market globally this year, overtaking the UK, Germany and France

P.Natarajan and G.S Nalini (2015) study unveils that the social benefit is greater than the social cost in case of solar power. However, high start-up capital keeps the customers away from solar power.
According to the report by the Solar Foundation(2014), the study reveals that as with the

solar industry at large, more houses are going solar as installation cost decreases.

According to the latest research report, "Indian Solar Energy Market Analysis" November (2012), it is founded that various state governments are focusing on solar power plants installation to increase the solar power-installed capacity in the country. Some states, like Uttar Pradesh in home lights and street lights installation is witnessing solar photovoltaic systems installations.

National Renewable Energy Laboratory(2012) states that the amount of solar energy that falls on the earth's surface per day is more than what the planet's 6.1 billion people could use in 27 years.

NEED FOR THE STUDY

There is a growing need for new sources of energy and at the same time, there is a power shortage. It is a high time to concentrate more on energy efficiency, conservation and renewable energy. To meet this surging demand, solar energy is the best form of energy to fulfil the energy needs of India and bridge the energy demand-supply gap. This study is conducted in order to know whether solar energy would be a major source of energy in the coming future, to know the payback period of customers investing in solar and to know the awareness level among the residents shifting to solar power in Mangaluru city.

STATEMENT OF PROBLEM

As India is a growing economy, therefore, due to industrialization and mounting population the non-renewable resources are depleting day by day. Health conditions of people are deteriorating and environmental issues are increasing at an alarming rate. Burning of coal for electricity production and extensive use of candles and kerosene lamps to light up the homes can lead to poisoning which is very harmful. Apart from this, the high start-up capital keeps the customers away from solar power. So it is of utmost importance to know whether solar power emerges as one the best solution for sustainable and environment-friendly growth of energy supply and whether adding solar panels to power the electricity prove to be cost beneficial.

OBJECTIVES OF THE STUDY

a) To analyse the amount of investment and the payback period for investment of residents using solar power
b) To evaluate the awareness level among the general public about the benefits of shifting to solar power
c) To calculate the present usage level of solar power among users of Solar heaters and generators and assess up to what extent they are able to meet their power needs.

SCOPE OF THE STUDY

This study was done in order to analyse the payback period of residents investing in solar power for electrifying their homes in Mangalore city and it will help us to know the investment level and savings from solar. This study throws light on the extent to which power needs of households that have shifted to solar power in Mangaluru City are met through renewable resources of solar energy. This study will be helpful to draw up a further policy in increasing the awareness and usage level of solar power among residents and increase the performance of solar dealers and will act as a secondary data for further research.

LIMITATIONS OF THE STUDY

- This study was restricted to Mangaluru city and data was collected from selected areas in Mangaluru
- Time and resource are the major constraints during the execution of the project
- Respondents hesitated to answer the questionnaire due to their lack of knowledge regarding the technical aspects of solar power generation and use.

METHODOLOGY

Designing a research plan calls for a decision on the data sources, research approaches, research instruments, sampling plan, and contact methods. This project is based on certain ideas information, data collection from different sources. This information was to carry out the project, followed by two sources, Primary data and Secondary data

- Primary data: Data for this study was collected through questionnaire method and interview method, with a minimum sample of 50 people using solar power.
- Secondary data: Information was collected from internet, research journals and website.

Selection of sample:
Mangalore city has been chosen as a sample for this study. The sample for the study was chosen on a deliberate basis. A deliberate sampling technique was used to collect information from the respondents through questionnaire methods. The data collected was statistically analysed through SPSS and the conclusions were drawn.

Hypothesis:
There is a shift in the consumers' preference for solar energy from electricity consumption with regard to domestic household purposes

Statistical Techniques
The data collected was subject to statistical analysis which was done through Descriptive analysis, Percentage analysis, Fisher's Exact Test, Kruskal Wallis Test, Wilcoxon sign Test, Correlation Analysis and Friedman's Test

DATA ANALYSIS AND FINDINGS OF THE STUDY

The following is the analysis of the data collected from the primary data survey

Given below is the Sample profile as per percentage analysis of the data collected from the residents using solar panels.

Table 1: Table showing the occupation of the respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Govt employee	18	36.0	36.0	36.0
	Private employee	14	28.0	28.0	64.0
	Business	18	36.0	36.0	100.0
	Total	50	100.0	100.0	

Source: Primary data survey

Interpretation:
From the Table 1, it is evident that 36% of the respondents are Government employees, 28% of the respondents are private employees and 36% of the respondents are businessmen.

Table 2: Table showing approximate Annual household income

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	200000-400000	2	4.0	4.0	4.0
	400000-600000	10	20.0	20.0	24.0
	600000-800000	9	18.0	18.0	42.0
	800000-1000000	24	48.0	48.0	90.0
	Above 1000000	5	10.0	10.0	100.0
	Total	50	100.0	100.0	

Interpretation:
From the Table 2, it can be said that 4% of them have annual income around
200000-400000, 20% of them around 400000-600000, 18% of the respondents between 600000-800000, 48% of them around 800000-1000000, and 10% of the respondents have above 1000000.

Table 3: Table showing the residential status of respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Independent house	50	100.0	100.0	100.0

Interpretation:
From the Table 3, it is observed that 100% of the respondents reside in independent house.

Table 4: Table showing the respondents concern about climate change

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	39	78.0	78.0	78.0
	No	11	22.0	22.0	100.0
	Total	50	100.0	100.0	

Interpretation:
From the Table 4, it is observed that 78% of the respondents are concerned about the climate change and the rest 22% are not concerned about the climate change.

Table 5: Table showing how important it is for respondents to act on climate change

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very important	23	46.0	46.0	46.0
	Important	14	28.0	28.0	74.0
	Not important	6	12.0	12.0	86.0
	Don't care	7	14.0	14.0	100.0
	Total	50	100.0	100.0	

Interpretation:
From the Table 5, it is observed that 46% of the respondents say it is very important to act on climate change, 28% of the respondents say it's important, 12% of the respondents say it is not important and 14% respondents say they don't care.

Table 6: Table showing respondents awareness of solar energy technology

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly aware	13	26.0	26.0	26.0
	Aware	19	38.0	38.0	64.0
	Very much aware	18	36.0	36.0	100.0
	Total	50	100.0	100.0	

Interpretation:
From the Table 6, it is observed that 26% of the respondents are slightly aware of solar energy technology, 38% of the respondents are aware and 36% of the respondents are very much aware.

Table 7: Table showing how long respondents have been using solar energy

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-2 year	31	62.0	62.0	62.0
	2-3 years	11	22.0	22.0	84.0
	3-4 years	8	16.0	16.0	100.0
	Total	50	100.0	100.0	

Interpretation:
From the Table 7, it is observed that 62% of the respondents have been using solar energy for 1-2 years, 22% of the respondents for 2-3 years and16% of the respondents for 3-4 years.

Table 8: Table showing the type of solar system used by respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	On the grid	46	92.0	92.0	92.0
	Off the grid	4	8.0	8.0	100.0
	Total	50	100.0	100.0	

Interpretation:
From the Table 8, it is observed that 92% of the respondents use on the grid system and 8% of the respondents use off-the-grid system.

Table 9 Table showing the capacity of respondent's solar plant

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2Kw	2	4.0	4.0	4.0
	3Kw	13	26.0	26.0	30.0
	5Kw	27	54.0	54.0	84.0
	6Kw	1	2.0	2.0	86.0
	10Kw	6	12.0	12.0	98.0
	12Kw	1	2.0	2.0	100.0
	Total	50	100.0	100.0	

Interpretation:
From the Table 9, it is observed that 4% of the respondents use solar capacity having 2kw, 26% of the respondents with 3kw, 54% of the respondents with 5kw, 2% of the respondents with 6kw, 12% of the respondents with 10kw and 2% of them with 12kw.

Table 10: Table showing the dealers who supplied solar panels to respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Solar trade links	20	40.0	40.0	40.0
	Ampacity solar energy	12	24.0	24.0	64.0
	Cad solar system	8	16.0	16.0	80.0
	Dyuti solar energy	10	20.0	20.0	100.0
	Total	50	100.0	100.0	

Interpretation:
From the Table 10, it is observed that majority, 40% of the respondents have bought solar panel from solar trade links as it was the first Dealership to be established in Mangalore in the year 1983, 24% of the respondents from Ampacity solar energy, 16% respondents from cad solar system and 20% from Dyuti solar.

Table 11: Table showing perception of respondents on whether solar energy is more beneficial than traditional electrical energy

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	21	42.0	42.0	42.0
	Agree	29	58.0	58.0	100.0
	Total	50	100.0	100.0	

Interpretation:
From the Table 11, it is observed that 42% of the respondents strongly agree that solar energy is more beneficial than traditional electrical energy and 58% respondents agree solar energy is more beneficial than traditional electrical energy.

Table 12: Table showing whether solar energy is adequate for consumption of respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	More than adequate	40	80.0	80.0	80.0
	Adequate	10	20.0	20.0	100.0
	Total	50	100.0	100.0	

Interpretation:
From the Table 12, it is observed that 80% of the respondents strongly agree that solar energy is adequate for consumption and 20% of the respondents just agree that solar energy is adequate for consumption. This indicates that a normal household can meet all its energy needs through solar energy.

Table 13: Table showing initial investment made by respondents to set up solar energy

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	200000-400000	14	28.0	28.0	28.0
	400000-600000	26	52.0	52.0	80.0
	600000-800000	3	6.0	6.0	86.0
	800000-1000000	3	6.0	6.0	92.0
	Above 1000000	4	8.0	8.0	100.0
	Total	50	100.0	100.0	

Interpretation:
From the Table 13, and chart it can be observed that 28% of the respondents have invested between 200000-400000, 52% of the respondents between 400000-600000, 6% of the respondents between 600000-800000, another 6% of the respondents between 800000-1000000, and 8% of the respondents above 1000000. Initially, the cost of 1 KW was Rs.

1, 00,000, thus indicating that a majority of the respondents use 4 to 6 KW. This is sufficient to cater to the energy needs of a household with 6 rooms with more than 4 members in the family.

Table 14: Table showing what respondents think the investment for solar energy technology is

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less	13	26.0	26.0	26.0
	Moderate	22	44.0	44.0	70.0
	High	15	30.0	30.0	100.0
	Total	50	100.0	100.0	

Interpretation:
From the Table 14, it is observed that 26% of the respondents think the investment for solar is less, 44% of the respondents think it is moderate and 30% of the respondents think the investment is high.

Table 15: Table showing whether if investment is high, whether respondents think it could be profitable after some years

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	30	60.0	60.0	60.0
	Agree	20	40.0	40.0	100.0
	Total	50	100.0	100.0	

Interpretation:
From the Table 15, it is observed that 60% of the respondents strongly agree that solar could be profitable in the long run even if the investment is high initially and the rest 40% too agree to this. This indicates that all those who have purchased solar panels for their household energy needs vouch for the utility of the panels in terms of being cost effective and profitable.

Table 16 Table showing whether solar power is cheaper than electricity

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	24	48.0	48.0	48.0
	Agree Neutral	26	52.0	52.0	100.0
	Total	50	100.0	100.0	

Interpretation:
From the Table 16, it is evident that 48% of the respondents strongly agree and 52% agree that solar power is cheaper than electricity. None of the respondents disagree for the statement. It can be inferred from the above that solar energy is definitely cheaper than electricity and the main reason why respondents have shifted from electricity is to benefit in terms of their electricity bills.

Table 17: Table showing amount of respondents' electricity bill before converting to solar power

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1000-2000	15	30.0	30.0	30.0
	2000-3000	16	32.0	32.0	62.0
	3000-4000	11	22.0	22.0	84.0
	4000-5000	5	10.0	10.0	94.0
	Above 5000	3	6.0	6.0	100.0
	Total	50	100.0	100.0	

Interpretation:
From the Table 17, and chart it is observed that 30% of the respondents' electricity bill was in the range 1000-2000 before, 32% of the respondents' bill was in the range of 2000-3000, 22% of the respondents' in the range 3000-4000, and the other 5% and 3% in the range 4000-5000 and above 5000 respectively.

Table18: Table showing respondents present electricity bill after conversion to solar power

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 1000	50	100.0	100.0	100.0

Interpretation:
From the Table 18 and chart, it is evident that 100% of the respondents' electricity bill is less than 1000 after converting to solar power

Table 19: Table showing whether respondents installed solar energy technology only to save electricity charges

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	13	26.0	26.0	26.0
	Agree	4	8.0	8.0	34.0
	Neutral	13	26.0	26.0	60.0
	Disagree	12	24.0	24.0	84.0
	Strongly disagree	8	16.0	16.0	100.0
	Total	50	100.0	100.0	

Interpretation:
From the table 19 and chart, it is observed that 26% of the respondents strongly agree and 16% strongly disagreed that solar energy was installed only to save electricity. 26% of the respondents responded neutrally to this statement. 8% of the respondents agree and 24% disagree. The respondents who were indifferent to the benefit of cost saving were of the opinion that the major benefit of solar energy would be derived in the long run due to its definite positive impact on the environment.

Table 20: Table showing respondents savings on utility bills per annum

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	8000-10000	1	2.0	2.0	2.0
	10000-20000	12	24.0	24.0	26.0
	20000-30000	9	18.0	18.0	44.0
	30000-40000	17	34.0	34.0	78.0
	40000-50000	9	18.0	18.0	96.0
	Above 50000	2	4.0	4.0	100.0
	Total	50	100.0	100.0	

Table 21: Table showing respondents annual maintenance cost on solar power

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 20000	14	28.0	28.0	28.0
	20000-40000	9	18.0	18.0	46.0
	40000-60000	6	12.0	12.0	58.0
	60000-80000	14	28.0	28.0	86.0
	80000-100000	5	10.0	10.0	96.0
	Above 100000	2	4.0	4.0	100.0
	Total	50	100.0	100.0	

Interpretation:
From the Table 21, it is observed that 28% of the respondents have to spend annual maintenance cost less than 20000, 18% of them between 20000-40000, 12% of the respondents between 40000-60000, 10% of the respondents between 80000-100000, and 4% of the respondents above 100000. The dealers not only supply the product but also provide regular maintenance facility to the consumers. The maintenance and service charges are calculated at 5% per annum of the initial cost of the panel and is payable on quarterly basis. However, those who do not prefer to have the service on quarterly basis opt for annual maintenance at pro-rata cost.

Table 22: Table showing whether respondents think maintenance cost/Difficulties is high in solar technology

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	1	2.0	2.0	2.0
	Agree	13	26.0	26.0	28.0
	Neutral	6	12.0	12.0	40.0
	Disagree	22	44.0	44.0	84.0
	Strongly disagree	8	16.0	16.0	100.0
	Total	50	100.0	100.0	

Interpretation:
From the Table 22, it is observed that only 2% strongly agree that maintenance cost is high, 44% of the respondents disagree and 26% of the respondents agree that maintenance cost is high in solar, 12% responded neutrally. The respondents have shown highly favourable reaction towards the maintenance cost of solar panels as they are able to offset the maintenance cost through incentives and subsidies.

Table 23: Table showing rebates and incentives availed by respondents for solar power

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Capital subsidies	10	20.0	20.0	20.0
	Net metering incentives	8	16.0	16.0	36.0
	Capital subsidies and Net metering incentives	32	64.0	64.0	100.0
	Total	50	100.0	100.0	

Interpretation:
From the Table 23, it is observed that 64% of the respondents avail capital subsidies and net metering incentives, 20% of the respondents avail capital subsidy alone and 16% avail net metering incentives alone for solar power. Capital subsidy is provided by the Karnataka government at 15% of the initial cost of the panel. Consumers have the option to choose between capital subsidies or Net metering incentives in which they are given the facility to supply power to MESCOM and receive payment at the rate of Rs. 9 per unit. Those who choose both the incentives to get capital subsidy at the rate of 15% and net metering subsidy at Rs. 7 per unit. The subsidies provided by the government have by far been the major reason for the respondents opting for this new concept of solar energy.

Table 24: Table showing the payback period of respondents solar power consumption

		Frequency	Percent	Valid Per cent	Cumulative Per cent
Valid	5-10 years	22	44.0	44.0	44.0
	10-12 years	15	30.0	30.0	74.0
	12-14 years	13	26.0	26.0	100.0
	Total	50	100.0	100.0	

Interpretation:
From the Table 24 and chart, it is evident that 44% of the respondents' payback period is between 5-10 years, 30% of the respondents' between 10-12 years and 26% of the respondents' between 12-14 years. This reflects the fact that as a capital asset, the entire amount spent on the equipment is got back by the investor in a maximum time period of 14 years.

Table 25: Table showing benefits of solar energy which respondents think is more beneficial

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Saves the environment	5	10.0	10.0	10.0
	Less maintenance	20	40.0	40.0	50.0
	Saves electricity bill	25	50.0	50.0	100.0
	Total	50	100.0	100.0	

Table 26: Table showing whether respondents feel solar energy would be the source of energy in the coming future

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	17	34.0	34.0	34.0
	Agree	16	32.0	32.0	66.0
	Neutral	16	32.0	32.0	98.0
	Strongly disagree	1	2.0	2.0	100.0
	Total	50	100.0	100.0	

Interpretation:
From the Table 26, it is observed that 34% respondents strongly agree that solar energy would be the source of energy in the coming future, 32% agree and another 32% respondents are neutral and 2% strongly disagree to the statement solar energy would be the source of energy in the coming future.

Hypothesis 1: Payback period for solar power system is independent of period of usage of solar energy

Crosstab

Count

		How long have you been using solar energy?			
		1-2 year	2-3 years	3-4 years	Total
What is your payback period for your Solar power consumption	5-10 years	15	6	1	22
	10-12 years	10	3	2	15
	12-14 years	6	2	5	13
Total		31	11	8	50

				Monte Carlo Sig. (2-sided)		
					99% Confidence Interval	
	Value	df	Asymp. Sig. (2-sided)	Sig.	Lower Bound	Upper Bound
Pearson Chi-Square	7.249[a]	4	.123	.125[b]	.116	.133
Likelihood Ratio	6.861	4	.143	.201[b]	.191	.212
Fisher's Exact Test	6.361			.161[b]	.151	.170
Linear-by-Linear Association	4.055[c]	1	.044	.050[b]	.044	.055
N of Valid Cases	50					

a. 6 cells (66.7%) have expected count less than 5. The minimum expected count is 2.08.

b. Based on 10000 sampled tables with starting seed 605580418.

c. The standardized statistic is 2.014.

From Fishers Exact test payback period for solar power system is independent of period of usage of solar energy as the p-value is greater than 0.05.

Hypothesis 2: Payback period for solar power system is independent of type of solar energy used

Crosstab

Count

		Which type of solar system is used in your house?		
		On the grid	Off the grid	Total
What is your payback period for your Solar power consumption	5-10 years	22	0	22
	10-12 years	15	0	15
	12-14 years	9	4	13
Total		46	4	50

				Monte Carlo Sig. (2-sided)		
					99% Confidence Interval	
	Value	df	Asymp. Sig. (2-sided)	Sig.	Lower Bound	Upper Bound
Pearson Chi-Square	12.375[a]	2	.002	.003[b]	.001	.004
Likelihood Ratio	11.829	2	.003	.003[b]	.001	.004
Fisher's Exact Test	8.640			.003[b]	.001	.004
Linear-by-Linear Association	8.887[c]	1	.003	.003[b]	.001	.004
N of Valid Cases	50					

a. 3 cells (50.0%) have expected count less than 5. The minimum expected count is 1.04.

b. Based on 10000 sampled tables with starting seed 605580418.

c. The standardized statistic is 2.981.

From Fishers Exact test pay-back period for solar power system is dependent of Type of solar energy used at 1% level of significance as the p-value is less than 0.01

Correlations

			Initial investment made to set up solar energy at your house was	You installed solar energy technology only to save electricity charges	How much do you save on utility bills per annum?	what would be your annum maintenance cost of solar power?
Spearman's rho	Initial investment made to set up solar energy at your house was	Correlation Coefficient	1.000	-.129	.673**	.656**
		Sig. (2-tailed)	.	.372	.000	.000
		N	50	50	50	50
	You installed solar energy technology only to save electricity charges	Correlation Coefficient		1.000	-.034	-.102
		Sig. (2-tailed)		.	.812	.482
		N		50	50	50
	How much do you save on utility bills per annum?	Correlation Coefficient			1.000	**.549****
		Sig. (2-tailed)			.	**.000**
		N			50	50

**. Correlation is significant at the 0.01 level (2-tailed).

From Correlation Analysis we can observe the following:

- Initial investment made to set up solar energy at your house is positively correlated with saving on utility bills per annum and annum maintenance cost of solar power at 1% level of significance
- Saving on utility bills per annum is positively correlated with annum maintenance cost of solar power at a 1% level of significance.

MAJOR FINDINGS

- As per the study, it reveals that 100% of the respondents are residing in Independent houses. Thus solar energy is used to a greater extent by owners of villas and not flat owners. Many residential flat buildings have solar panels for water heating only and is thus used to a very limited extent by residents.

- Out of the total respondents, 48% of them have an annual income between 800000-1000000. Since the initial investment is relatively high, only upper-middle-class house owners opt for solar energy.

- It is revealed in the study that 78% of the respondents are concerned about the climatic changes. This indicates a healthy trend among the general public for the conservation of scarce resources.

- From the study, it is revealed that out of the total respondents 36% of them are very much aware and 38% are aware of the solar power technologies. The initiatives by the government and district administration in this regard has increased awareness among house owners and has effectively promoted its use in the city of Mangalore.

- Out of the total respondents, 62% of them are using solar for 1-2years, 22% of the respondents for 2-3 years which shows that present usage level is more and the increased growth rate of solar power among the residents

- Out of the total respondents, 52% of the respondents have invested between 400000-600000 for solar power.

- 44% of the respondents think the investment for solar power is moderate and 60% of them strongly agree that solar could be profitable even if the investment is high.

- From the study, it is evident that 100% of the respondents' electricity bill is less than 1000 after converting to solar power

- From the study, it is found that 64% of them avail both capital subsidy and net metering incentives for solar power

- Out of the total respondents, 44% of the residents' payback period is between 5-10 years

- 66% of the respondents positively agree that solar energy would be the source of energy in the coming future.
- There is a difference in the electricity bill before converting into solar power and after converting into solar power and it is found that the electricity bill has reduced after converting into solar power

SUGGESTIONS

- Solar policy is new and people should come forward to implement it. The government should also educate people on this project.

- It is suggested that every household should install solar panel as the energy is freely available throughout the day.

- The study reveals that the solar initial costs and maintenance cost is too high and it should be reduced in order to attract more residents to install solar panels.

- More number of dealers should extend the number of offices and should emphasise superior customer service both before and after sales.

- It suggests that solar companies should come with low-cost solar panels so that the middle class can also afford to buy solar.

- The solar companies should take care of their customers' needs and must provide customisation to make more residents to install solar.

- It is suggested that the government should come forward with more incentives to reduce the burden of initial investment on solar panels.

CONCLUSION

Country like India has very much imbalanced electricity production. Production is less and consumption is very much. Solar power is a very good option in India to increase power production. This is also very good for our environment protection and economic development. Solar power is unlimited source of energy and our country also provide a suitable climate for this energy, but we need some better idea to increase efficiency and decrease production cost. Our government launches some schemes for production of solar power and achieves some successes, but we need education and publicity in society for these schemes so that people take some initiative for using renewable energy as much as at a place of conventional energy sources.

As in the study, it is evident that more number of residents are shifting to solar energy as the entire amount spent on the equipment is got back by the investor in a maximum time period of 14 years there can be a phenomenal change in the city of Mangalore. Government is also taking great efforts to implement various incentives to reduce the burden of heavy initial instalment which can have a great positive impact towards saving the environment.

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