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### A STUDY ON COST-BENEFIT ANALYSIS OF INSTALLING SOLAR PANELS IN FAVOUR TO SOCIETY IN VIJAYAWADA: ANDHRA PRADESH

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#### ABSTRACT

This study was undertaken to determine if it would be cost-beneficial over a 30-year Period to install solar panels to power the homes. A cost-benefit analysis was performed to determine if the investment would be financially worthwhile. The analysis included calculating the net present values of the annual cash flows along with the calculation of the internal rate of return. If the net present value proves greater than zero and the internal rate of return proves greater than the discount rate, the investment will be cost-beneficial. This study based on the primary data received from the respondents of which are using presently the solar and enjoying the benefits of incentives. The program is formulated as an integer linear program where the objective function is to show the relation between demographic factors and users of solar and also to show the solar will be beneficial to the society and to be minimizing the initial capital investment. Hence, to give a finding and the recommendations of the research from the analysis made and finally to conclude that the research given the project is beneficial to the society of investing on solar.

**Key words:** Cost-Benefit, Solar Panels, Investments, NPV etc.

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#### INTRODUCTION

SOLAR: "It related to or determined by sun" (Energy from the sun).

Solar the word derives from the "Latin" word for "sun". It is one of the most powerful energy sources in the world. It is one of the most freely available renewable energy sources to the world; without of sun the mankind will not be surviving. It is available on the earth from past so many decades. The solar energy is the energy which produces energy through radiation from the sun. The main solar energy is of two types. They are-

- i) **Thermal energy-** it is everywhere in the earth. It light's up our days and heats our bodies, homes and also dries our clothes. It is purely for free.
- ii) **Electric energy-** it uses the power of sun to produce electricity through solar cells for energy supply to the homes, industries etc.,

It is the process or conversion of sunlight into electricity, through using of solar panels with the connected cells on the solar plate. It is of using through directly photovoltaic system (PV) or indirectly using of concentrated solar power.

### HISTORY

In 1838- Edmund Becquerel observed materials which turn light into energy, wherein 1876 - 78 - William Adams, wrote the first book about Solar Energy called- A Substitute for Fuel in Tropical Countries and was able to power a 2.5 horsepower steam engine and at 1860- Auguste Mouchout used direct conversion of solar radiation into mechanical power and 1895 - Aubrey Eneas formed the first Solar Energy company. In 1904 - Henry Willis built 2 huge plants in California to store generated power. He was the first to successfully use power at night after generating it during the day and 1954 -Calvin Fuller, Gerald Pearson and Daryl Chaplin of Bell Laboratories discovered the use of silicon as a semi-conductor, which led to the construction of a solar panel with an efficiency rate of 6%. 1956 -The first commercial solar cell was made available to the public at a very expensive \$300 per watt and at 1958- Vanguard I the first satellite was launched that used solar energy to generate electricity.1970- The Energy Crisis (OPEC oil embargo) Solar energy history was made as the price of solar cells dropped dramatically to about \$20 per watt.

### IMPORTANCE OF SOLAR

The importances of using solar energy are as follows

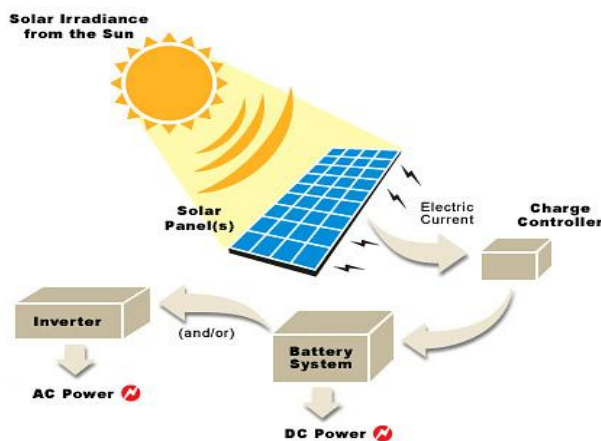
- Role of fossil energy are getting reduced, while the renewable resources are increasing
- Solar energy is a very accessible and reliable in nature.
- Solar cost and technology has been increasing vastly.
- Solar energy is very clean and eco-friendly to the environment and it doesn't make any global warming impact.
- Solar energy is of resilient and independent in energy
- Solar energy fits not only to the home but also electricity energy can be sold to the economic platform where it's time to get change into the eco-friendly products.

### Concept of Cost-Benefit Analysis (CBA)

Jules Dupuit, a French engineer, first introduced the concept of Cost-Benefit Analysis in the 1930s. It became popular in the 1950s as a simple way of weighing up project costs and benefits, to determine whether to go ahead with a project. CBA applies to policies, programs, projects, regulations, demonstrations and other government interventions. A cost benefit analysis finds, quantifies, and adds all the positive factors. So that all flows of benefits and flows of project costs over time (which tend to occur at different points in time) are expressed on a common basis in terms of their "net present value.

As its name suggests, Cost-Benefit Analysis involves adding up the benefits of a course of action, and then comparing these with the costs associated with it. These are the benefits. Then it identifies, quantifies, and subtracts all the negatives, the costs. The difference between the two indicates whether the planned action is advisable. The real trick to doing a cost benefit analysis well is making sure you include all the costs and all the benefits and properly quantify them.

### How solar works in generating electricity? (Figure)



**Cost-Benefit Analysis of Cash Flows - 30 years @ 6% Discount Rate**

YEAR	YEAR	SYSTEM COST	Federal Tax Credit	Avoided Electricity Cost	Annual Cash Flow	NPV of Annual Cash Flow	Cumulative NPV
0	2011	(\$615,825.00)	\$0.00	\$0.00	(\$615,825.00)	(\$615,825.00)	(\$615,825.00)
1	2012	\$0.00	\$184,747.50	\$49,555.84	\$234,303.34	\$221,040.89	(\$394,784.11)
2	2013	\$0.00	\$0.00	\$50,299.18	\$50,299.18	\$44,766.09	(\$350,018.02)
3	2014	\$0.00	\$0.00	\$51,053.67	\$51,053.67	\$42,865.64	(\$307,152.38)
4	2015	\$0.00	\$0.00	\$51,819.47	\$51,819.47	\$41,045.88	(\$266,106.50)
5	2016	\$0.00	\$0.00	\$52,596.76	\$52,596.76	\$39,303.36	(\$226,803.14)
6	2017	\$0.00	\$0.00	\$53,385.72	\$53,385.72	\$37,634.82	(\$189,168.31)
7	2018	\$0.00	\$0.00	\$54,186.50	\$54,186.50	\$36,037.12	(\$153,131.20)
8	2019	\$0.00	\$0.00	\$54,999.30	\$54,999.30	\$34,507.24	(\$118,623.95)
9	2020	\$0.00	\$0.00	\$55,824.29	\$55,824.29	\$33,042.31	(\$85,581.64)
10	2021	\$0.00	\$0.00	\$56,661.65	\$56,661.65	\$31,639.57	(\$53,942.07)
11	2022	\$0.00	\$0.00	\$57,511.58	\$57,511.58	\$30,296.38	(\$23,645.69)
12	2023	\$0.00	\$0.00	\$58,374.25	\$58,374.25	\$29,010.21	\$5,364.52
13	2024	\$0.00	\$0.00	\$59,249.87	\$59,249.87	\$27,778.65	\$33,143.17
14	2025	\$0.00	\$0.00	\$60,138.61	\$60,138.61	\$26,599.37	\$26,599.37
15	2026	\$0.00	\$0.00	\$61,040.69	\$61,040.69	\$25,470.15	\$85,212.69
16	2027	\$0.00	\$0.00	\$61,956.30	\$61,956.30	\$24,388.87	\$109,601.6
17	2028	\$0.00	\$0.00	\$62,885.65	\$62,885.65	\$23,353.49	\$132,955.5
18	2029	\$0.00	\$0.00	\$63,828.93	\$63,828.93	\$63,828.93	\$155,317.12
19	2030	\$0.00	\$0.00	\$64,786.37	\$64,786.37	\$64,786.37	\$176,729.86
20	2031	\$0.00	\$0.00	\$65,758.16	\$65,758.16	\$20,503.71	\$197,233.56
21	2032	\$0.00	\$0.00	\$66,744.53	\$66,744.53	\$19,633.27	\$216,866.83
22	2033	\$0.00	\$0.00	\$67,745.70	\$67,745.70	\$18,799.78	\$235,666.60
23	2034	\$0.00	\$0.00	\$68,761.89	\$68,761.89	\$18,001.67	\$253,668.28
24	2035	\$0.00	\$0.00	\$69,793.32	\$69,793.32	\$17,237.45	\$270,905.73
25	2036	\$0.00	\$0.00	\$70,840.22	\$70,840.22	\$16,505.67	\$287,411.40
26	2037	\$0.00	\$0.00	\$71,902.82	\$71,902.82	\$15,804.96	\$303,216.36
27	2038	\$0.00	\$0.00	\$72,981.36	\$72,981.36	\$15,134.00	\$318,350.36
28	2039	\$0.00	\$0.00	\$74,076.08	\$74,076.08	\$14,491.51	\$332,841.87
29	2040	\$0.00	\$0.00	\$75,187.22	\$75,187.22	\$13,876.31	\$346,718.18
30	2041	\$0.00	\$0.00	\$76,315.03	\$76,315.03	\$13,287.22	\$360,005.40

Table notes:

Annual Inflation	1.50%
Base Annual Electricity Bill	\$48,823.49
Discount Rate	6%

Analysis Calculations:

NPV	\$360,005.40
IRR	11.91%
Payback	Year 12

It shows the information on the net present value and the internal rate of return were determined at the discount rate of 6%, the NPV for 30 years is \$360,005.40 and the IRR is 11.91%. The NPV and IRR turned out to be favorable. The NPV is a great deal above zero, which is good and the IRR is not only positive but also above the 6% discount rate, which is great. Overall this means that the financial benefits outweigh the costs. The cumulative NPVs also look favorable. After eleven years, the system will begin operating as a positive cash flow and no longer be a burden to the ranch's financials.

**REVIEW OF LITERATURE**

**Sophia and Satya** (2015) entitled "cost benefit analysis on renewable energies" stated that to switch over to meet energy demand in integrating to use of renewable resources. In order to this they presented this in a mathematical model. It is taken renewable energy for meeting electricity demand as alternative energy to

reduce cost of expenditure on the electricity and consider it as a better availability from the environment. **Brandon Walter Ness** (2010) entitled the "Cost benefit analysis of utilizing solar panels on bates nut farm" in alteration of electricity for energy supply to the farm. He stated that to reduce cost (expenses), they want to invest on solar as a onetime investment. He considers different factors in the use of solar in present days, of global warming, new source of fuels, and technological updating etc and also mainly focused on the incentives from the government on installing of solar. **Morgan Anne Wampler** (2011) entitled the "cost benefit analysis of installing solar panels on the schnoor almond ranch". He stated that they want to install solar for supply of energy to water pumps in their farm for supply of water to the ranch. He describes the cost beneficial analysis was performed to determine the investment would be financially worthwhile. **Dr. A.K.ENAMUL HAQUE** (2016) entitled the "Benefits of lighting- A cost benefit analysis on distributed solar home systems" stated that to promote a strategy of 'light' off-grid rural houses. As of seen now the government has giving number of incentives to get light up the homes in rural and the incentives the government is offering in Bangladesh is compared to India is very low.

#### PROBLEM OF THE STUDY

The problem is to identify that solar installation will be cost beneficial to the society and eco-friendly to the environment.

#### OBJECTIVES OF THE STUDY

The following objectives of the study are as

- To analyse the relationship between income levels of investor and installation of solar panel on cost efficient.
- To examine the satisfaction levels of current user on solar PV system in association with different factors.
- To know the relationship between replacing of solar PV system in order to get long term benefit.
- To give appropriate suggestions for improving the awareness in the minds of public on solar installation.

#### HYPOTHESIS

1. H0: There is no significance relation between income of investor and the cost efficiency for solar installation

H1: There is significance relation between income of the investor and the cost efficiency for solar installation

2. H0: There is no significance on satisfaction levels in between each variables

H1: There is significance on satisfaction levels in between each variable

3. H0: There is no significance relation between replacing solar energy with long term investment benefit

H1: There is significance relation between replacing solar energy with long term investment benefit

#### RESEARCH METHODOLOGY

**Area of the study:** The study has been made in the Vijayawada region, Krishna district. It is a developing city and the people in the region are going towards the eco-friendly city. So, the people are showing much interest in shifting from present energy source to the solar energy. The area usually has the hot weather where it is beneficial in changing their energy source and it is also benefit to the investors and traders. The government even supporting the eco friendly solar energy source and offering the number of incentives. As it has been taken shift because of taking consideration on decreasing of fossil fuels and availability for the future generations. People in the area are from different sectors like farmers, shopkeepers, business people, public servants, private jobbers etc., they are all even shown basis of much interest in change of their energy source for the benefit of the eco-friendly environment and to save their money in investing one time long term investment.

**Research design:** The study adopted under quantitative research design. Under the quantitative design, survey research method was used. It is totally based on the perception of the public and values on the eco-friendly products. The study was sampled of 50 respondents who were using of the solar by installing in their homes and to be support to the values of eco-friendly products towards the environment. The respondents are taken by interviewing directly, and taking their opinions on the installation of solar. This method ensures that all

cases have direct and quality response from the respondents. The study adopted the questionnaire in the collection of data. In the process of administering the questions have taken relating to the concept of my research program. After completing of preparing questions, it has been taken out for the survey. The forms were distributed among the Vijayawada region where the people are installed of solar products and given a grace period of one day to fill those forms and submit back. After the grace period over, the forms are been collected and started the next step of being analyzing the data on the responses. The analysis of data for the study was done using simple percentages and analytical tables for the survey while test of hypotheses involved the application of chi-square and Regression analysis using computer software programmers known as statistical package for social sciences (SPSS version 21).

#### Data analysis and Data interpretation on Hypothesis

##### HYPOTHESIS-1:

##### CASE-1:Crosstabs

##### Case Processing Summary

Particulars	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
What is the annual income of the family? * Indicate your level of satisfaction for using solar photovoltaic system in The solar installation is cost efficient	50	98.0%	1	2.0%	51	100.0%

##### What is the annual income of the family? \* Indicate your level of satisfaction for using solar photovoltaic system in the solar installation is cost efficient Cross tabulation

##### Count

Particulars	Indicate your level of satisfaction for using solar photovoltaic system in The solar installation is cost efficient				Total
	DA	N	A	SA	
What is the annual income of the family?					
<100000	0	3	3	3	9
100000-200000	1	1	14	2	18
200000-300000	0	3	6	2	11
>300000	0	0	2	10	12
Total	1	7	25	17	50

##### Chi-Square Tests

Particulars	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	26.326 <sup>a</sup>	9	.002
Likelihood Ratio	26.823	9	.001
Linear-by-Linear Association	7.413	1	.006
N of Valid Cases	50		

a. 12 cells (75.0%) have expected count less than 5. The minimum expected

b. Count is .18.

**Case-2:Crosstabs****Case Processing Summary**

Particulars	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
What is your age? * Indicate your level of satisfaction for using solar photovoltaic system in The solar installation is cost efficient	50	98.0%	1	2.0%	51	100.0%

**What is your age? \* Indicate your level of satisfaction for using solar photovoltaic system in The solar installation is cost efficient Crosstabulation**

Particulars	Indicate your level of satisfaction for using solar photovoltaic system in The solar installation is cost efficient				Total
	DA	N	A	SA	
20-30	0	1	8	6	15
30-40	1	3	13	6	23
40-50	0	3	3	4	10
>50	0	0	1	1	2
Total	1	7	25	17	50

**Chi-Square Tests**

Particulars	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.742 <sup>a</sup>	9	.765
Likelihood Ratio	6.215	9	.718
Linear-by-Linear Association	.188	1	.664
N of Valid Cases	50		

a. 11 cells (68.8%) have expected count less than 5. The minimum expected count is .04.

**INTERPRETATION****Case-1: Income variable**

It is to interpret the data that there is a significance relation between income level of an investor and the cost efficiency in installation. Where, the significance level is less than 0.05(0.02<0.05). Hence to conclude we accept H1 (alternative hypothesis).

**Case-2: Age variable**

It is to interpret the data that there is no significance relation between age variable and the cost efficiency in installation. Where, the significance level is greater than 0.05(0.765>0.05). Hence to conclude we accept H0 (null hypothesis).

**HYPOTHESIS-2:****Correlations**

<b>Correlations</b>							
Particulars		Indicate your level of satisfaction for using solar photovoltaic system in The solar installation is cost efficient	Indicate your level of satisfaction for using solar photovoltaic system - it requires low maintenance	Indicate your level of satisfaction for using solar photovoltaic system - it is suitable for all the isolated areas to install	Indicate your level of satisfaction for using solar photovoltaic system - solar power is nor existent to limited	Indicate your level of satisfaction for using solar photovoltaic system - solar installation gives no power issues	Indicate your level of satisfaction for using solar photovoltaic system - solar increases the status indication to home
1) Indicate your level of satisfaction for using solar photovoltaic system in The solar installation is cost efficient	Pearson Correlation	1	.492**	.462**	.273	.074	.226
	Sig. (2-tailed)		.000	.001	.055	.612	.115
	N	50	50	50	50	50	50
2) Indicate your level of satisfaction for using solar photovoltaic system - it requires low maintenance	Pearson Correlation	.492**	1	.338*	.592**	-.034	.305*
	Sig. (2-tailed)	.000		.017	.000	.815	.031
	N	50	50	50	50	50	50
3) Indicate your level of satisfaction for using solar photovoltaic system - it is suitable for all the isolated areas to install	Pearson Correlation	.462**	.338*	1	.161	.139	-.029
	Sig. (2-tailed)	.001	.017		.265	.337	.843
	N	50	50	50	50	50	50
4) Indicate your level of satisfaction for using solar photovoltaic system - solar power is nor existent to limited	Pearson Correlation	.273	.592**	.161	1	-.007	-.086
	Sig. (2-tailed)	.055	.000	.265		.960	.552
	N	50	50	50	50	50	50

5) Indicate your level of satisfaction for using solar photovoltaic system - solar installation gives no power issues	Pearson Correlation	.074	-.034	.139	-.007	1	-.188
	Sig. (2-tailed)	.612	.815	.337	.960		.190
	N	50	50	50	50	50	50
6) Indicate your level of satisfaction for using solar photovoltaic system - solar increases the status indication to home	Pearson Correlation	.226	.305*	-.029	-.086	-.188	1
	Sig. (2-tailed)	.115	.031	.843	.552	.190	
	N	50	50	50	50	50	50

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

\* . Correlation is significant at the 0.05 level (2-tailed).

From the above analysis indicates that first two variables are associated with other variables and there is a positive correlation between the variables. The significant value is less than 0.05 whereas last four variables are not associated with other variables and significant value is higher than 0.05. Hence, it is therefore installation of solar system is cost efficient and it requires low maintenance.

### HYPOTHESIS-3:

#### Crosstabs

#### Case Processing Summary

Particulars	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Do you support the solar photovoltaic system in replacing of present energy source? * What do you think on long term investment for installing solar, rather using present energy with paying of periodical bills? Will it be cost beneficial to the society?	50	98.0%	1	2.0%	51	100.0%

Do you support the solar photovoltaic system in replacing of present energy source? \* What do you think on long term investment for installing solar, rather using present energy with paying of periodical bills? Will it be cost beneficial to the society?

Cross tabulation

Count

Particulars	What do you think on long term investment for installing solar, rather using present energy with paying of periodical bills? Will it be cost beneficial to the society?		Total
	YES	NO	
Do you support the solar photovoltaic system in replacing of present energy source?	40	4	44
YES	1	5	6
NO	41	9	50



**Chi-Square Tests**

Particulars	Value	Df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	19.718 <sup>a</sup>	1	.000	.000	.000
Continuity Correction <sup>b</sup>	15.008	1	.000		
Likelihood Ratio	14.925	1	.000		
Fisher's Exact Test					
Linear-by-Linear Association	19.323	1	.000		
N of Valid Cases	50				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 1.08.

b. Computed only for a 2x2 table

**INTERPRETATION:**

It is to interpret the data that the significance level is less than 0.05 (.000<0.05). It means there is a relation between the replacing of solar energy with the long term investment benefit. Hence to conclude, we accept H1 (alternative hypothesis).

**4.2 DATA ANALYSIS AND INTERPRETATION OF QUESTIONNAIRE****DATA ANALYSIS**

S.NO	CHARACTERISTICS	NO.OF RESPONDENTS	%
Q1	<b>GENDER:</b>		
	MALE	34	66.7
	FEMALE	16	31.4
	<b>TOTAL</b>	50	100
Q2	<b>AGE:</b>		
	20-30	15	29.4
	30-40	23	45.1
	40-50	10	19.6
	>50	2	3.9
	<b>TOTAL</b>	50	98.0
Q3	<b>WHAT TYPE OF HOUSE YOU ARE LIVING IN?</b>		
	OWN	28	54.9
	RENT	22	43.1
	<b>TOTAL</b>	50	98
Q4	<b>HOW MANY MEMBERS ARE LIVING IN YOUR FAMILY?</b>		
	3	13	25.5
	4	7	52.9
	5	9	17.6
	>5	1	2
	<b>TOTAL</b>	50	98
Q5	<b>WHAT IS THE ANNUAL INCOME OF THE FAMILY?</b>		
	<100000	9	17.6
	100000-200000	18	35.3
	200000-300000	11	21.6
	>300000	12	23.5
	<b>TOTAL</b>	50	98
Q6	<b>ARE YOU A CURRENT USER OF SOLAR SYSTEM AS ENERGY SOURCE?</b>		
	YES	46	90.2
	NO	4	7.8

	<b>TOTAL</b>	50	98
Q7	<b>WHAT TYPE OF SOLAR INSTALLATION YOU ARE USING?</b>		
	OFF-GRID	24	47.1
	ON-GRID	26	51
	<b>TOTAL</b>	50	98
Q8	<b>ON WHAT SOURCE YOU GET INFORMATION REGARDING SOLAR ENERGY PRODUCTS?</b>		
	TELEVISION	9	17.6
	NEWSPAPER	16	31.4
	RELATIVES	22	43.1
	OTHERS	3	5.9
	<b>TOTAL</b>	50	98
Q9	<b>DO YOU HAVE AN IDEA ON WHICH SUITABLE ALTERNATIVE ENERGY SOURCE FOR VIJAYAWADA WILL BE BENEFICIAL?</b>		
	SOLAR ENERGY	45	88.2
	NUCLEAR ENERGY	1	2
	WIND ENERGY	4	7.8
	BIO ENERGY	0	0
	<b>TOTAL</b>	50	98
Q10	<b>DO YOU THINK THE INSTALLATION OF SOLAR ENERGY WILL BE THE ECO FRIENDLY TO ENVIRONMENT?</b>		
	YES	44	86.3
	NO	6	11.8
	<b>TOTAL</b>	50	98
Q11	<b>IS IT TO INSTALL SOLAR BY ONLY FINANCIALLY SOUND PEOPLE?</b>		
	YES	14	27.5
	NO	36	70.6
	<b>TOTAL</b>	50	98
Q12	<b>DO YOU SUPPORT THE SOLAR PHOTOVOLTAIC SYSTEM IS REPLACING OF PRESENT ENERGY SOURCE?</b>		
	YES	44	86.3
	NO	6	11.8
	<b>TOTAL</b>	50	98
Q13	<b>What do you think on long term investment for installing solar, rather using present energy with paying of periodical bills? Will it be cost beneficial to the society?</b>		
	YES	41	80.4
	NO	9	17.6
	<b>TOTAL</b>	50	98
Q14	<b>Have you compared your electricity bill before and after installing photovoltaic system?</b>		
	YES	43	84.3
	NO	7	13.7
	<b>TOTAL</b>	50	98
Q15	<b>If "yes" please specify whether it is costly or cheaper?</b>		
	COSTLY	5	9.8
	CHEAPER	43	84.3
	<b>TOTAL</b>	48	94.1
Q16	<b>Are you aware on offering of incentives by government on solar installation and bank credit facilities?</b>		
	YES	35	68.6
	NO	15	29.4
	<b>TOTAL</b>	50	98

Q17	<b>Have you taken any incentives or benefits from government or through banks for installing solar?</b>		
	YES	33	64.7
	NO	17	33.3
	<b>TOTAL</b>	50	98
Q18	<b>What type of financial arrangement would you prefer in investing on solar installation?</b>		
	CASH	22	43.1
	BANK LOAN	26	51
	DON'T KNOW	2	3.9
	<b>TOTAL</b>	50	98
Q19	<b>Main reason in investing to solar power?</b>		
	SAVE MONEY	14	27.5
	ECO FRIENDLY	17	33.3
	NO OTHER POWER SOURCE	16	31.4
	OTHERS	3	5.9
	<b>TOTAL</b>	50	98
Q20a	<b>Indicate your level of satisfaction for using solar photovoltaic system - The solar installation is cost efficient</b>		
	STRONGLY AGREE	18	35.3
	AGREE	24	49.0
	NEUTRAL	7	13.7
	DISAGREE	1	2.0
	STRONGLY DISAGREE	0	0
Q20b	<b>Indicate your level of satisfaction for using solar photovoltaic system - it requires low maintenance</b>		
	STRONGLY AGREE	5	9.8
	AGREE	23	45.1
	NEUTRAL	22	43.1
	DISAGREE	0	0
	STRONGLY DISAGREE	0	0
Q20c	<b>Indicate your level of satisfaction for using solar photovoltaic system - it is suitable for all the isolated areas to install</b>		
	STRONGLY AGREE	15	29.4
	AGREE	20	39.2
	NEUTRAL	13	25.5
	DISAGREE	2	3.9
	STRONGLY DISAGREE	0	0
Q20d	<b>Indicate your level of satisfaction for using solar photovoltaic system - solar power is nor existent to limited</b>		
	STRONGLY AGREE	6	11.8
	AGREE	18	35.3
	NEUTRAL	24	47.1
	DISAGREE	2	3.9
	STRONGLY DISAGREE	0	0
Q20e	<b>Indicate your level of satisfaction for using solar photovoltaic system - solar installation gives no power issues</b>		
	STRONGLY AGREE	10	19.6
	AGREE	23	45.1

	NEUTRAL	16	31.4
	DISAGREE	1	2
	STRONGLY DISAGREE	0	0
	<b>TOTAL</b>	50	98
Q20f	<b>Indicate your level of satisfaction for using solar photovoltaic system - solar increases the status indication to home</b>		
	STRONGLY AGREE	35	68.6
	AGREE	12	23.5
	NEUTRAL	3	5.9
	DISAGREE	0	0
	STRONGLY DISAGREE	0	0
	<b>TOTAL</b>	50	98

**DATA INTERPRETATION:**

From the above table it is to be interpret the data with respect to of different areas-

Based on the survey, 50 respondents have taken from the Vijayawada region. From the survey the male respondents are 34(66.7%) and female respondents are 16 (31.4%) the male respondents are more than compared to the females. Based on age classification, 15 respondents are from 20-30 (29.4%) 23 respondents are from 30-40 (45.1%) 10 respondents are from 40-50(19.6%) and 2 respondents are from >50(3.9%). Hence the 30-40 age respondents are more than the other age group respondents. Based on area consideration of respondents living, 28(54.9%) are from own and 22(43.1%) are from rent based living areas. Hence the areas of living of respondents are mostly both equal at percentages with a 10% change. Regarding members living in a family of solar installed homes are of 13 respondents from 3 members home (25.5%), 27 respondents are from 4 members home (52.9%) and 9 respondents are from 5 members home (17.6%) and 1 respondent from more than 5 members living home (2.0%). Most of the respondents are more from the 4 members living in a family.

Based on the annual income of the family, 9 respondents are from <1 LAKH (17.6%), 18 respondents are from 1LAKH to 2 LAKHS (35.3%), 11 respondents are from 2 lakhs to 3 lakhs (21.6%) and 12 respondents are from >3 lakhs (23.5%). The annual incomes of 1lakhs to 2lakhs are more than all other income level groups. Based on the respondents are using solar, 46 respondents are using solar system (90.2%) and 4 respondents are not using solar system (7.8%). The data surveyed are mainly from the solar using respondents. Based on the type of solar using by the respondent, 24 respondents are using off-grid solar (47.1%) and 26 respondents are using on- grid solar system (51%) and the major respondents are using of on-grid solar which it works both on electricity and solar. Based on the respondent knowing about solar from, 9 respondents are from television (17.6%), 16 respondents are from newspaper (31.4%), 22 respondents are from relatives (43.1%) and 3 respondents get through other sources (5.9%) the major respondents are known about solar from the newspaper. Based on the suitable alternative energy source for Vijayawada, 45 respondents choose solar energy (88.2%), 1 respondent choose nuclear energy (2%) and 4 respondents choose wind energy (7.8%) the major people choose solar energy.

Based on solar eco-friendly to the environment 44 respondents have agreed (86.3%) and 6 respondents have not agreed (11.8%). Hence, major respondents have agreed solar eco-friendly the majority of the responded said that solar is eco-friendly. The status on installing solar 14 respondents have agreed (27.5%) and 36 respondents have opposed to the statement (70.6%). Hence, the solar installation is not based on status. Based on survey solar replacing present energy source 44respondents have supported for replacement (86.3%) and 6 respondents have opposed to the replacement (11.8%). Majority of the respondents have supported the replacement of energy source for solar. The efficiency of long term investments on solar 41 respondents have agreed for the long term investment (80.4%) and 9respondents have not supported for the long term investment (17.6%). It is long term investment will be beneficiary. Theimpact of solar on electricity bill before and after installation 43 respondents have compared (84.3%) and 7 respondents have not compared (13.7%). Majority of respondents have compared after the installation. Based on comparison 43 respondents given the statement that it is cheaper (84.3%) and 5 respondents have stated that it is costly (9.8%) and 2 respondents have not compared. The incentives provided by govt. and bank, 35

respondents have awareness (68.6%) and 15 respondents are not aware on the incentives (29.4%). Regarding to receive incentives, 33 respondents are installed solar with receiving benefits (64.7%) and 17 respondents are not availed the incentives on solar installing (33.3%). The financial arrangement preferred, 22 respondents are preferred for cash payments on solar (43.1%), 26 respondents are preferred for bank loan (51%) and 2 respondents are not chosen the any of the option.

On the survey reason in investing of solar, 14 respondents are invested for saving money (27.5%), 17 respondents are invested for eco-friendly (33.3%), 16 respondents are invested due to no other power source (31.4%) and 3 respondents are for other reasons (5.9%). Major respondents preferred for the environment friendly. Based on the satisfaction level of cost efficiency, 18 respondents are strongly agreed (35.3%), 25 respondents are agreed (49%), and 7 respondents are in neutral stage (13.7%). The satisfaction level of low maintenance, 5 respondents are strongly agreed (9.8%), 23 respondents are agreed (45.1%) and 22 respondents are for neutral (43.1%). Majority of the respondents level of satisfaction on low maintenance for solar is given majorly the option of "agreed". The satisfaction level on suitable for all isolated areas, 15 respondents are strongly agreed (29.4%), 20 respondents are agreed (39.2%), 13 respondents are neutral (25.5%) and 2 respondents are disagreed (3.9%). The major level of satisfaction is majorly given the option of "agreed". The satisfaction level on solar power is not existent to limited, 6 respondents are strongly agreed (11.8%), 18 respondents are agreed (35.3%), 24 respondents are neutral (47.1%) and 2 respondents are disagreed (3.9%). Major level of satisfaction is majorly given the option of "neutral". Based on the satisfaction level of no power issues, 10 respondents are strongly agreed (19.6%), 23 respondents are agreed (45.1%), 16 respondents are neutral (31.4%) and 1 respondent is for disagreed (2%) majority of respondents level of satisfaction is "agreed". The satisfaction level of status indication to homes, 35 respondents are strongly agreed (68.6%), 12 respondents are agreed (23.5%) and 3 respondents are neutral (5.9%). Hence the major level of satisfaction is majorly given the "strongly agreed".

**FINDINGS:** It was found from the above analysis the solar installation houses are mainly of their own properties than in rental houses. The solar installed house annual income range between 1 lakh to 2 lakh. Since it is to say the average income people can also have capability to invest on solar.

- It is observed that the advertising the product of solar mainly from the relatives. It seems that the mouth publicity is more than other source of advertising. Hence, it is to say that the product is beneficial. More responses given that the installation of solar will be eco-friendly and the installation of solar will be not by only financially sound people but also can be by middle income people. The major responses are saying investment on solar are cheap. The solar energy can have an ability to replace the present energy.
- The installation of solar with long term investment will be benefit to the society than the paying of periodic bills.
- The installation space is a convenient factor to the installation for the houses.
- The installing solar would be status indication to their homes.

#### RECOMMENDATIONS

Based on the results of the study, through the survey conducted on the cost benefit of solar installations it is recommended that the installing solar would be cost beneficial to the society. The data analysis on hypothesis and the feedback received through current users on solar installation is that the investment on long term is beneficial and also to recommend that it is eco-friendly to the environment. It is also recommended to those considering expanding on this project that more research should be done on power purchase agreements.

#### CONCLUSION

After reviewing the cost of the project and known all of the federal and state incentives that the project will give an option of investing on solar to homes. Power consumption of Vijayawada region, Krishna district has been surveyed and few suggestions have been made. The purpose of this work aims at showing the application of integrated energy sources will be cost benefit as well as fulfil the energy needs without any interruption. It may conclude that the number of incentives and benefits offered by the government and banks to the solar installation, they probably move to the solar energy from the present energy system which is going

to deplete in future. So in advance it is beneficial to the society to install solar power to their homes and enjoy the benefits from the various sources and also can support to the eco-friendly environment.

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