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HARNESSING SOLAR ENERGY FOR DOMESTIC USE – FINANCIAL VIABILITY

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Abstract

Amongst new Renewable energy sources, Solar energy is gaining importance. The United Nations Development Programme in its 2000 World Energy Assessment found that the annual potential of solar energy was 1,575–49,837 exajoules (EJ). This is several times larger than the total world energy consumption, which was 559.8 EJ in 2012. In India, Solar Power Industry is fast-growing . India offers a big opportunity for solar energy. Its 750GW potential is driven by roughly 300 sunny days a year, with an average solar radiation range of 4-7 kilowatt-hours per square metre. Despite this, and attractive fiscal incentives, households haven't exactly taken to solar power. Hence there is a need to analyse Financial Viability of Solar Project for the Domestic Use.

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Objective of the Study: The main Objective of the Study is to analyse the Financial Viability of the Solar Electricity for the Domestic purposes. The Sub Objectives are:

Scope of the Study: This study is limited to the comparison of the cost of traditional power consumption of the households with the cost of generation and using Solar Electricity for the Domestic purposes.

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Methodology: Secondary Sources are used for collecting the Data that include the publications of Renewable sources of energy and MNRE website and the records of Bavi Solar Solutions, Nalgonda.

Hypothesis: H0: There is no significant difference in the Cost of Electricity Supplied by the State Government Organisation and the Cost of Solar Electricty.

Data Analysis: The Cost of Electricity Supplied by the State Government Organisation and Cost of Solar Electricity is compared with the help of Non-discounted and Discounted Cash Flow Techniques, Capital Budgeting Techniques.

Conclusion: The Study reveals that the Solar (Domestic) Power Project is highly beneficial and gives big savings to the households.

Introduction

Energy, broadly means the capacity of something, a person, an animal or a physical system to do work and produce change. There are two Sources of Energy – Conventional and Non Conventional Sources. Non Conventional Energy sources are those which are renewable and ecologically safe. Examples are solar energy, wind energy, biomass energy, ocean energy (tidal energy, wave energy, ocean thermal energy), geothermal energy, etc.

About 16% of global final energy consumption comes from renewable, with 10% coming from traditional biomass, which is mainly used for heating, and 3.4% from hydroelectricity. New renewable (small hydro, modern biomass, wind, solar, geothermal, and biofuels) accounted for another 3% and are growing very rapidly. The share of renewable sources in electricity generation is around 19%, with 16% of global electricity coming from hydroelectricity and 3% from new renewable sources.

Amongst new Renewable energy sources, Solar energy is gaining importance. Solar energy can be defined as radiant light and heat from the Sun that is harnessed using a range of ever-evolving technologies such as solar heating, photovoltaics, solar thermal energy, solar architecture, molten salt power plants and artificial photosynthesis.[1][2] The large magnitude of solar energy available makes it a highly appealing source of electricity. The United Nations Development Programme in its 2000 World Energy Assessment found that the annual potential of solar energy was 1,575–49,837 exajoules (EJ). This is several times larger than the total world energy consumption, which was 559.8 EJ in 2012.[3][4]

In 2011, the International Energy Agency said that "the development of affordable, inexhaustible and clean solar energy technologies will have huge longer-term benefits. It will increase countries' energy security through reliance on an indigenous, inexhaustible and mostly import-independent resource, enhance sustainability, reduce pollution, lower the costs of mitigating global warming, and keep fossil fuel prices lower than otherwise. These advantages are global. Hence the additional costs of the incentives for early deployment should be considered learning investments; they must be wisely spent and need to be widely shared".[1]

SOLAR POWER IN INDIA

In India, Solar Power Industry is fast-growing. As of 6 April 2017, the country's solar grid had a cumulative capacity of 12.28 gig watts (GW) compared to 6.76 GW at the end of March 2016. India quadrupled its solar power generation capacity from 2,650 MW on 26 May 2014 to 12,288.83 MW on 10 March 2017. The country added 3.01 GW of solar power capacity in 2015-2016, and 5.525 GW in 2016-2017, the highest of any year.

In January 2015, the Indian government expanded its solar plans, targeting US$100 billion of investment and 100 GW of solar capacity including 40 GW from rooftop solar, by 2022. Commenting on the key importance India attaches to solar power; India's Prime Minister Narendra Modi said at the historic COP21 climate conference in Paris in 2015, "The world must turn to (the) sun to power our future. As the developing world lifts billions of people into prosperity, our hope for a sustainable planet rests on a bold, global initiative." India's initiative of 100 GW of solar energy by 2022 is an ambitious target given the world's installed solar power capacity in 2014 was 181 GW. India is one of the countries with the highest solar electricity production per watt installed, with an installation of 1700 to 1900 kilowatt hours per kilowatt peak (kWh/KWp). With about 300 clear, sunny days in a year, the theoretically calculated solar

energy incidence on India's land area is about 5000 trillion kilowatt-hours (kWh) per year (or 5 EWh/yr). Of India's ambitious target of 175GW of clean energy capacity by 2022, 100GW is to come from solar projects. Of these, while 60GW is targeted from ground-mounted, grid-connected projects, 40GW is to come from solar rooftop projects. Wind power projects are to contribute 60GW). If the policy takes off, householders will not have to bother themselves any more with the time-consuming, bureaucratic nitty-gritty that precedes the installation of panels.
India offers a big opportunity for solar energy. Its 750GW potential is driven by roughly 300 sunny days a year, with an average solar radiation range of 4-7 kilowatt-hours per square metre. Despite this, and attractive fiscal incentives, households haven't exactly taken to solar power. As a result, financial incentives are not being utilised and consumers are not availing significant potential savings on their electricity bills, even as the burden on electricity distribution companies to meet power demand from the grid is growing. A Greenpeace analysis shows that all the major metros are far from meeting rooftop solar targets as laid down by State Governments and the ministry of new and renewable energy. This is despite a significant national incentive in the form of a 30% capital subsidy, and a range of State Incentives and Schemes.

Review of Literature

A brief history of yesteryear's reports, surveys and research articles in the similar area helps as a 'backbone' for any Research/Study.

- Naveen & Prashanth[1] say that Renewable energy sources and technologies have potential to provide solutions to the longstanding energy problems being faced by the developing countries like India.
- Kumar & Kishore[2] , in their paper review the status in some key areas of solar energy utilization and Some of the major barriers to its greater penetration in to the conventional energy markets.
- The Author[3] provides an overview on solar energy in India, also focuses on the technical and economical barriers and challenges for development and utilization of solar energy technology, existing government act and regulatory policies to support solar energy development in India.

- Ashok & Arnab[4] provide an overview of technical, economic and policy aspects of solar energy development and review the status of solar energy in terms of resource potential, existing capacity, along with historical trends and future growth prospects of solar energy.
- The authors[5] review the technical progress made in the past several years in the area of mono- and polycrystalline thin-film photovoltaic (PV) technologies based on Si, III–V, II–VI, and I–III–VI_2 semiconductors, as well as nano-PV and say that PV electricity is one of the best options for sustainable future energy requirements of the world.
- Santamouri[6] opine that the temperature of cities continues to increase because of the heat island phenomenon and the undeniable climatic change. To counterbalance the phenomenon, important mitigation technologies have been developed and proposed.
- The authors[7] observe that while the solar resource in Saudi Arabia and the Arabian Peninsula was believed to be significant based on limited past data, understanding the spatial and temporal variability requires significantly more data and analysis in order to optimize planning and siting solar energy power plants. This paper summarizes the analysis of the first year of broadband solar resource measurements from a new monitoring network in Saudi Arabia developed by the King Abdullah City for Atomic and Renewable Energy (K.A.CARE).
- The authors [8] say that Solar building envelopes are attracting increasing interest. Building-integrated solar thermal (BIST) systems are one of the subgroups of solar building envelopes.
- The Authors[9] opine that Prime Minister Narendra Modi has set an ambitious target of 100,000 MW of solar power capacity to be achieved by 2022, when India celebrates 75 years of her independence. This is a grand vision for ushering in a sort of revolution in clean energy in India in the next six years and conclude that a significant progress can be made towards achievement of this goal.
- Utpal Bhaskar Jyotika Sood[10] says under the 'rent a roof' policy, the developer will take rooftops on rent and will offer lease to each household, and then feed the solar power to the grid, says renewable energy secretary Anand Kumar.
- Anindya Upadhyay[11] opines that Rooftop solar is the fastest growing segment in renewable energy in India, driven by large customers, says research.

➢ Bidya Sapam[12] explains that the total installed capacity of rooftop solar power plants stands at around 525MW. With newer tech coming into play, the adoption rate is expected to go through the roof

The Review of Literature reveals that various studies have been made on different aspects of the generation of Solar Electricity, the policy and regulation towards Solar Energy but very few studies are done on the aspect of the Financial Viability of applying Solar technology for the Domestic use, hence the present study is undertaken to address the research gap.

Need for the Study

A major chunk of the Demand for the Electricity comes from the Domestic front. The demand for the power supply emerges from Households – Urban / Rural, Agricultural / Primary Sector, Small Businesses, Service Organisations – Schools, Colleges, Hospitals and other such consumers. However, due to various constraints, the demand of the Domestic front is met partially. The Cost of Supply of the Electricity is also on the increase as the production cost of Conventional Energy Sources (Thermal / Hydro Electricity) is continuously on the rise. Hence there is a need for applying Non Conventional Energy Resources, particularly, the Solar Energy, for the Domestic purposes. Hence there is a need to analyse its Financial Viability.

Research Methodology

a. Objective of the Study

The main Objective of the Study is to analyse the Financial Viability of the Solar Electricity for the Domestic purposes. The Sub Objectives are:

1. To understand the concept of solar power;
2. To examine the financial feasibility of installing 3kwp off –grid solar power system in the households.

b. Scope of the Study:

This study is limited to the comparison of the cost of traditional power consumption of the households with the cost of generation and using Solar Electricity for the Domestic purposes.

c. Methodology

Secondary Sources are used for collecting the Data that include the publications of Renewable sources of energy and MNRE website and the records of Bavi Solar Solutions, Nalgonda.

d. Hypothesis

H0: There is no significant difference in the Cost of Electricity Supplied by the State Government Organisation and the Cost of Solar Electricty.

H1: There is significant difference in the Cost of Electricity Supplied by the State Government Organisation and the Cost of Solar Electricty.

e. Limitations of Study

The following are the limitations of Study:

1. The Data with regard to the Life and the cost of the installation of Solar Electricity (Domestic) is taken from Bavi Solar Solutions, Nalgonda, a private organization dealing in the installation of the PV Panels and Batteries for the Domestic Use.
2. The cost of traditional power consumption is calculated based upon the horse power / watt consumption of the electrical appliances that might be used by the middle class / higher middle class are identified on a hypothetical base.

f. Data Analysis: The Cost of Electricity Supplied by the State Government Organisation and Cost of Solar Electricity will be compared with the help of Non-discounted and Discounted Cash Flow Techniques, Capital Budgeting Techniques.

The annual requirement of the electricity for the Domestic use by a middle / higher middle class family is estimated and is converted into money terms by multiplying it with rates charged by Electricity Boards (TRANSCO – Telangana State). The same is compared with the cost of Installation & Commissioning of **3KWp Capacity** Solar Photovoltaic Power Generating System. Capital Budgeting evaluation techniques are applied for evaluating the Solar Electricity project.

TABLE 1: Statement Showing Household Appliances and their Electricity Consumption Per Day						
S.No	**Type of Appliance**	**Capacity in Watts**	**Quantity used**	**Usage per day in Hours**	**Watt Hours (Watts X Qty X Hours)**	**Units per day (Watt Hours / 1,000)**
1.	CFL Bulbs	15	8	4.00	480	0.48
2.	Ceiling Fans	100	4	10.00	4000	4.00
3.	Micro Wave Oven	700	1	0.50	350	0.35
4.	Induction Cooker	1200	1	1.00	1200	1.20
5.	Hair Dryer	1500	1	0.50	750	0.75
6.	Vacuum Cleaner	500	1	0.50	250	0.25
7.	Water Heater	1000	1	1.00	1000	1.00
8.	Mixer Grinder	400	1	0.50	200	0.20
9.	Air Cooler	250	1	15.00	3750	3.75
10.	Dish Washer	1200	1	1.00	1200	1.20
11.	Electric Iron	750	1	0.50	375	0.37
12.	Water Pump 0.5 HP	375	1	1.00	375	0.37
13.	Washing Machine	500	1	2.00	1000	1.00
14.	Smart Phone Charger	7	1	4.00	28	0.02
15.	Trimmer	500	1	1.00	500	0.50
16.	Computer	100	1	2.20	220	0.22

17.	Refrigerator 250 Litres	400	1	24.00	9600	1.373
18.	TV 32 Inch LED	40	1	15.00	600	0.60
19.	Electrical Toaster	800	1	0.15	120	0.12
20.	Cloth Dryer	2000	1	0.50	1000	1.00
21.	Room A/C 1 Ton	1400	1	8.00	11800	11.80
	Total (29.55 units Rounded off to 30 Units)					**29.55**

Source: Government of India's Bureau of Energy Efficiency & various Websites

Table 1 shows the identified list of electrical appliances that are normally used by a middle class family in India. It also shows their normal per day usage. It can be understood from the above table that on an average if all the electrical appliances are used a total of 29.55 units of electricity is consumed.

Calculation of the Unit Consumption per day

Based on the above estimates, the daily average consumption of the electricity by a middle / higher middle class family is 30 units approximately i.e., 900 units (30 units X 30 days) per month. The per unit charge that is levied by TRANSCO, Telangana State Electricity Board is Rs.9.50 per unit under the given slab. Hence, the average expenditure towards electricity will be Rs 8550 (Rs.9.50 per unit X 900 units) or Rs.1,02,600- Per annum (Rs.8,550 X 12 months)

The Units consumed per day calculation that is shown in Table 1 is explained through example.

- Ceiling fan is 100 watts capacity. It is assumed that a middle class family on an average has four fans and uses them for 10 hours per day. So the consumption is 100 watts x 10 hours X 4fans = 4000 watt-hours which is equal to 4.0 Kilo-watt hours, since 1000 watts makes 1 Kilowatt and it is equal to One Unit. So every day consumption for Fans is assumed as 4 Units of electricity.
- Similarly, it is assumed that atleast 8 CFL bulbs of 15 watts each are used for 4 hours per day. The total Power consumption of the CFL lamps will be 8 no.s X 15 Watts X 4 Hours is

equal to 480 watts and for a day the Electricity consumption of the 8 CFL lamps will be 480/1000=0.48 KWH or units of electricity.

- For the Refrigerator, a 4★ (4 star) rated , 250 Liter capacity equipment is considered. The Refrigerator will be used continuously for 24 hours and hence will consume 501 units in a year. This information is obtained from the Government of India's Bureau of Energy Efficiency. Dividing 501units by 365 days gives us the daily power consumption as 1.37 units a day.
- Likewise the Units consumption for all other identified appliances are estimated.
- **Installation of Solar Power System**

From table 2 it can be observed that for installing 1KWP off- grid solar power pack costs Rs. 1,58,000 (app). The Government gives a subsidy of Rs.90,000 per one KV capacity. After deducting the subsidy the net cost of the One KV Solar Power pack installation for the household is Rs 68000/-. For a consumption of 900 units of electricity per monththe household needs to install 3 KV capacity Solar Power Pack i.e., household requires 3 KWP off-grid solar power packs and the cost is:

Rs. 68000 X 3 no's = Rs.2,04,000/- (Rupees two lakhs and four thousand only)

This is considered as **Initial Cash outflow or Investment** for the purposes of evaluation the project.

TABLE 2: Statement Showing the Installation & Commissioning of 1kwp Capacity Solar Photovoltaic Power Generating System

Sl. No.	**Description**	**Project Cost (as per bench mark cost of MNRE) (Rs.)**	**MNRE +STATE Subsidy (Rs.)**	**Balance amount (Rs.)**
01	Supply, Installation & Commissioning of **1KWp Capacity** Solar Photovoltaic Power Generating System consisting of **1000 Watt** Solar PV Modules (**250 Wp X 4Nos.**) **1.2KVA** Solar Power Conditioning Unit with built in MPPT Charge Controller. **Tubular**	1,58,000/-	90000/-	**68,000/-**

	Gel Battery bank with **2V cells of Capacity 24V 300 AH (or) 48V 150 AH** and MS Galvanized Structure, Cables as per MNRE specifications.			
02	Supply, Installation & Commissioning of **1KWp Capacity** Solar Photovoltaic Power Generating System consisting of **1000 Watt** Solar PV Modules (**250 Wp X 4Nos**.) **1.2KVA** Solar Power Conditioning Unit with built in MPPT Charge Controller. **Tubular LMLA Battery** bank with **Capacity of 24V 300 AH (or) 48V 150 AH** and MS Galvanized Structure, Cables as per MNRE specifications.	1,57,815/-	90,000/-	**67,815/-**
Note: - The above cost is inclusive of transportation, installation, commissioning, five (5) Years AMC cost, and all applicable taxes.				

Source: Records of Bavi Solar Solutions; Email ID : bavisolar@gmail.com

- **Cost of Electricity from Traditional Sources (Recurring)**

The cost of electricity is calculated based on the rates or tariff charged by the Electricity Board, Telangana State. Electricity purchase from conventional sources is calculated as Rs.1, 02,600/- per annum (Rupees one lakh, two thousand and six hundred only). The calculation is as follows:

30 units per day X 30 days per month X 12 months per year X Rs.9.50 per unit = Rs.1,02,600 (900 units per month or 10,800 units per annum multiplied @Rs.9.50); (See Annexure II for details of the rates or tariff charged by Electricity Board)

R.1,02,600/- is considered as **Cash inflow per annum** as this amount will be saved by household every year if Solar installation is done.

1. Average Rate of return

Average rate of return (ARR) Method of evaluating proposed capital expenditure is also known as the accounting rate of return method. It is based upon accounting information rather than cash flows. There is no unanimity regarding the definition of rate of return. There are a number of alternative methods for calculating the ARR. The most common usage of the average rate of return (ARR) expresses it as follows

ARR= (Average annual profits after taxes / Average Investment) X 100

The average profits after taxes are determined by adding up the after-tax profits expected for each year of the projects life and dividing the result by number of years. In case of annuity, the averages after taxes profits are equal to any year's profits. Rs.1,02,600/- is considered as annual profit.

The average investment is determined by dividing the net investment by two. These averaging processes assumes that the firm is using straight line deprecation, in which case the book value of assets declines at a constant rate from its purchase price to zero at the end of its depreciable life. The total Investment is considered as Rs.2,04,000/-, the purchase cost of Solar Installation.

Average investment = networking capital +salvage value +1/2(initial cost of machine – salvage value)

$$\textbf{ARR} = \frac{\textbf{average annual profits after taxes}}{\textbf{Average investment over the life of the project}} \times \textbf{100}$$

$$\textbf{ARR} = \frac{\text{Rs. 1, 02,600}}{\text{Rs.2, 04,000}} \times 100 = 50.29\%$$

Accept-Reject rule

With the help of the ARR, the financial decision maker can decide whether to accept or reject the investment proposal. As an accept-reject criterion, the actual ARR would be compared with a predetermined or minimum required rate of return or cut-off rate. A project would qualify to be accepted if the actual ARR is higher than the minimum desired ARR. Otherwise; it is liable to be rejected.

Decision:- As the ARR percentage is very high for the Solar project, the installation of the Solar Project is accepted.

2. PAY BACK PERIOD

The pay back method (PB) is the second traditional method of capital budgeting. It is the simplest and, perhaps, the most widely employed, quantitative method for appraising capital expenditure decisions. This method answers the question: How many years will it take for the cash benefits to pay the original cost of an investment. Cash benefits here represent Cash Flows After Taxes (CFAT) ignoring interest payment. Thus, the pay back method (PB) measures the number of years required for the CFAT to pay back the original outlay required in an investment proposal. The Pay Back Period of the Solar Project is:

$$PB = \frac{\text{Investment}}{\text{Constant annual cash flow}}$$

$$PB = \frac{\text{Rs.2, 04, 000}}{\text{Rs.1, 02, 600}} = 1.988 \text{ Years}$$

Accept-Reject Criterion:-The payback period can be used as a decision criterion to accept 'or' reject investment proposals. One application of this technique is to compare the actual pay back with a pre determined pay back, that is, the pay back set up by the management in terms of the maximum period during which the initial investment must be recovered. If the actual period is less than the predetermined pay back, the project would be accepted; if not, it would be rejected. As a thumb of rule if the Pay Back Period is less than half the life of the project, the project can be accepted.

Decision:-The payback period of 1.988 years is less than half the life of the project i.e., 7.5 years (15 years / 2), hence the Solar project is accepted. The life of the Solar (Domestic) project is 15 years. Hence

1.988 Years < (15 / 2) 7.5 Years

3. NET PRESENT VALUE (NPV) METHOD

The first Discounted Cash Flow/Present Value technique is the Net Present Value. NPV may be described as the summation of the present values of cash proceeds (CFAT) in each year minus the summation of present values of the net cash out flows in each year. The NPV for projects having conventional cash flows would be:

Statement Showing Calculation of Net Present Value			
Years	**CFAT Rs.**	**PV factor @ 10%**	**PVCFAT Rs.**
1-15	1, 02,600	7.606	7, 80, 376
		Less : PVCO	2,04,000
		NPV	5, 76,376

Source: Estimates made by the Researcher

The Net Present Value of the Project is Rs. 5, 76,376 (Rupees Five Lakhs, Seventy six thousand, three hundred and seventy six only)

Accept – Reject Criterion

The decision rule for a project under NPV is to accept the project if the NPV is positive and reject if it is negative. Symbolically,

NPV> zero, accept

NPV < zero, reject

Decision:- The three KWP off-grid solar power pack's NPV is positive, so it will be accepted.

4. Profitability Index (PI) 'or' Benefit-Cost Ratio (B/C Ratio)

Yet another time –adjusted capital budgeting technique is profitability index (PI) 'or' benefit – cost ratio (B/C). It is similar to the NPV approach. The profitability index approach measures the present value of returns for rupee invested, while the NPV is based on the difference between the present value of future cash inflows and the present value of cash outlays. A major shortcoming of the NPV method is that, being an absolute measure, it is not a reliable method to evaluate projects requiring different initial investments. The PI method provides a solution to this kind of problem. It is, in other words, a relative measure. It may be defined as the ratio which is obtained dividing the present value of future cash inflows by the present value of cash outlays. Symbolically,

$$PI = \frac{\text{Present value cash inflows}}{\text{Present value of cash out flows}}$$

$$PI = \frac{\text{Rs. 7, 80,376}}{\text{Rs. 2, 04,000}} = 3.82$$

Accept- Reject Rule

Using the B/C ratio or the PI a project will qualify for acceptance if PI exceeds one. When PI equals 1, the firm is indifferent to the project. In other words, the NPV will be positive when the PI is greater than 1: will be negative when the PI is less than 1. Thus, the NPV and PI approaches give the same results regarding the investment proposals.

Decision:- The project's PI is 3.825, so it is greater than the one and hence it is accepted.

5. Internal rate of return (IRR) Method

Another discounted cash flow (DCF) or time adjusted method for appraising capital investment decisions is the Internal Rate of Return (IRR) method. This technique is also known as yield on investment, marginal efficiency of capital, marginal productivity of capital, rate of return, and time-adjusted rate of return and so on. Like the present value method, the IRR method also considers the time value of money by discounting the cash streams. The basis of the discount factor, however, is different in both cases. In the case of the net present value method, the discount rate is the required rate of return and being a predetermined rate, usually the cost of capital, its determines are external to the proposal under consideration. The IRR, on the other hand, is based on facts which are internal to the proposal. In other words, while arriving at the required rate of return for finding out present value the cash flows-inflows-as well as out flows-are not considered. But the IRR depends entirely on the initial outlay and cash proceeds of the project which being evaluated for acceptance or rejection. It is therefore, appropriately referred to as internal rate of return.

The internal rate of return is usually the rate of return that project earns. It is defined as discount rate (r) which equates the aggregate present value of the net cash inflows (CFAT) with the aggregate present value of cash outflows of the project. In other words, it is the rate which gives the project NPV of zero.

Accept-Reject decision

The use of IRR, as a criterion to accept capital investment decisions, involves a comparison of the actual IRR with the required rate of return also known as cut-off rate or hurdle rate. The project would qualify to be accepted if the IRR (r) exceeds the cut-off rate (k). If the IRR and the required rate of return are equal, the firm is indifferent as to whether to accept or reject the project.

Statement Showing Caluculation of IRR					
Years	**CFAT Rs.**	**PV factor@ 50 %**	**PVCFAT**	**PV factor @ 52%**	**PVCFAT Rs.**
1-15	1, 02,600	1.995	2, 04,687	1.919	1, 96,889
		Cash out flows	2, 04,000		2, 04,000
			+687		-(7,111)

Source: Estimates made by the Researcher

$$IRR = r + \left[\frac{PV\,CO - PV\,CFAT}{\Delta PV} \right] \times \Delta r$$

Where, PVCO = Present value of cash out lay

PVCFAT= present value of cash inflows

R = either of the two interest rates used in formula

ΔR= difference in interest rates

ΔPV = difference in calculated present values of inflows

$$IRR = 50 + \left[\frac{204687 - 204000}{204687 - 196889} \right] \times (52-50)$$

$$= 50 + \left[\frac{687}{7111}\right] \times 2$$

$$= 50 + (0.0966) \times 2$$

$$= 50 + 0.1992 = 50.2\%$$

Decision: If IRR is greater than K i.e., the discount rate, the project will be accepted; If the IRR is less than K the project will be rejected.

IRR > K – Accept

IRR < K – Reject

As the Project's IRR is greater than K i.e., 50.19% > 10%, the solar project is accepted.

Conclusion

- Solar power brings in both tangible and intangible benefits when compared to electricity generated by usage of fossil fuels - Solar Power is Good for the Environment – no pollution; Solar Electricity makes the households Independent of Electricity Prices; Solar Power causes use for underutilized land; Continuous power supply; Solar Power is Domestic; Solar Power Creates Jobs and Economic Growth. With the Government giving the subsidy the installation of the Solar Electricity by the households has become affordable. Hence the Government and other concerned authorities have to market the solar power installation rigorously.
- The application of Capital Budgeting Evaluation Techniques, both Non Discounted Cash Flow Techniques and Discounted Cash Flow Techniques, reveal that the Solar (Domestic) Power Project is highly beneficial and gives big savings to the households. Apart from the economic savings the project also has many intangible benefits like continuous power supply, release of power for productive activities, no pollution etc.

SUGGESTIONS:

Based on the study the following suggestions are made:

- The Government of India and the State Governments are implementing Solar power pro policies. However there is very poor awareness amongst the public about the Solar power. Hence rigorous awareness programmes have to be organized by the authorities for marketing this new product.

- Any incentives given to the Agriculture, Industry or any profession should be linked to the installation of the Solar power project by the beneficiaries;
- The House Construction permissions should be based on the installation of the Solar power project by the applicant;
- For already constructed houses or commercial spaces, the installation of the solar power project should be linked to the property tax. If solar power projects are not installed an additional cess has to be collected;
- The power consumption requirements of the Government organizations including the Indian Railways have to be met through Solar power installations;
- The High way / street lighting / traffic signals etc also should be converted to solar power;
- Bank Loans have to be given for the installation of the Solar power projects;

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Quotation

Sir/Madam,

Sub: - Solar Energy 2014-15- implementation of 1 Kwp off-Grid Solar Power Packs in Domestic Sector for Individual Households in Telangana State - Information – Regarding.

With reference to the above cited, we would like to inform that the Ministry of New & Renewable Energy (MNRE), Govt. of India has accorded sanction for installation of 1KWp SPV Standalone Roof Top Power Packs in domestic sector for individual Households of Telangana State with 30% Subsidy facility. The unit cost particulars of 1KWp Off-Grid Solar Power Packs and eligible Central Financial Assistance are hereunder furnished for kind information.

Sl. No.	**Description**	**Project Cost (as per bench mark cost of MNRE) (Rs.)**	**MNRE +STATE Subsidy (Rs.)**	**Balance amount (Rs.)**
01	Supply, Installation & Commissioning of **1KWp Capacity** Solar Photovoltaic Power Generating System consisting of **1000 Watt** Solar PV Modules (**250 Wp X 4Nos**.) **1.2KVA** Solar Power Conditioning Unit with built in MPPT Charge Controller. **Tubular Gel Battery** bank with **2V cells of Capacity 24V 300 AH (or) 48V 150 AH** and MS Galvanized Structure, Cables as per MNRE specifications.	1,58,000/-	90000/-	**68,000/-**
02	Supply, Installation & Commissioning of **1KWp Capacity** Solar Photovoltaic Power Generating System consisting of **1000 Watt** Solar PV Modules (**250 Wp X 4Nos**.) **1.2KVA** Solar Power Conditioning Unit with built in MPPT Charge Controller. **Tubular LMLA Battery** bank with **Capacity of 24V 300 AH (or) 48V 150 AH** and MS Galvanized Structure, Cables as per MNRE specifications.	1,57,815/-	90,000/-	**67,815/-**
Note: - The above cost is inclusive of transportation, installation, commissioning, five (5) Years AMC cost, and all applicable taxes.				

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ANNEXURE -II

SLAB RATES FOR ELECTRICITY BILL CALUCULATION

Category	Fixed/ Demand Charges (INR/ month)		Energy Charge (INR/kWh/kVAh
Low Tension	**Unit**	**Rate**	
LT I: Domestic			
LT I (A): Up to 100 Units/Month			
0-50			1.45
51-100			2.60
LT I (B)(i): Above 100 Units/Month & up to 200 Units/Month			
0-100			3.30
101-200			4.30
LT I (B)(ii): Above 200 Units/Month			
0-200			5.00
201-300			7.20
301-400			8.50
401-800			9.00
Above 800 units			9.50
SOURCE :WWW.TSSPDCL .IN			