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Feasibility Analysis of Stand Alone Solar-Wind Hybrid System for Rural Tribal Areas

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ABSTRACT: The India is known as country of villages and Indian economy based on agriculture. The Indian villagers required sufficient power supply because, the electrical energy is the basic requirements in modern era, but some rural tribal areas of India still facing electric power cut or electricity transmission lines not installed. Indian population are increasing day by day and energy demand are also increasing exponentially but the conventional energy sources are limited and exhaustible, not eco-friendly. Solar energy have been deemed clean, inexhaustible, unlimited and environmental friendly, But solar energy source is dependent on unpredictable factors such as weather and climatic conditions therefore for backup wind system used for continuous energy supply whole year.
The main objective of my research work is to analyse the possibilities for installation of solar-wind stand-alone hybrid system in Rural Tribal areas on the basis of location. To supply electric power in these areas first we proposed the small solar-wind stand-alone Hybrid system according to availability of solar radiation and wind speed in these tribal areas.

KEYWORDS: HOMER, Hybrid System, Tribal Areas,Stand Alone, Eco-Friendly

I.INTRODUCTION

The non-conventional sources are available free of cost, are pollution-free and inexhaustible. Man has used these sources for many centuries in propelling ships, driving windmills for grinding corn and pumping water, etc. Because of the poor technology then existing, the cost of harnessing energy from these sources was quite high. Also because of uncertainty of period of availability and the difficulty of transporting this form of energy, to the place of its use are some of the factors which came in the way of its adoption or development.

The use of fossil fuels and nuclear energy replaced totally the non-conventional methods because of inherent advantages of transportation and certainty of availability; however these have polluted the atmosphere to a great extent. In fact, it is feared that nuclear energy may prove to be quite hazardous in case it is not properly controlled.
Now day's applications with photovoltaic (PV) energy and wind energy have been increased significantly due to the rapid growth of power electronics techniques. Generally, PV power and wind power are complementary since sunny days are usually calm and strong winds are often occurred at cloudy days or at night time. Hence, the hybrid PV/wind power system therefore has higher reliability to deliver continuous power than either individual source

II. LITERATURE SURVEY

Literature review has helped to discusses about previous research work of different areas. The research papers give some survey about different views of different authors. This section presents the various approaches to predict solar-wind output with precision. Standalone&Renewable Global Status Report provides a comprehensive and timely overview of renewable energy and energy policy development worldwide. .

Z. Benhachani, B. Azoui, R. Abdessemed, M. Chabanestudy the sizing and economic optimization of a stand-alone photovoltaic-wind hybrid system with storage batteries. Two methods are developed. The first method is based on the average annual monthly values in which the size of photovoltaic (PV) .In the second method, the determination of the size of these two components of the system is based on the worst month.
M. Bashir, J. Sadeh Over last two decades, solar and wind energies have become an alternative to traditional energy sources, In tribal areas can also energized using this renewable sources.

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III.SURVEY OF IDENTIFIED AREAS

In India most of people's lives in villages and they are isolated from main city (specially tribal areas). In which some villages suffer for electricity supply therefore they use the different sources of energy. The survey of lighting fuel and cooking fuel uses in some villages are conducted near to study areas.

On the basis of survey the villagers use the different sources of energy for lighting as shown in table 1& Fig. 1 below.

Table 1

S.No.	Village	Candle	Battery	Lantern	Kero.	Elect.	Gen.	Solar	Biogas
1	MOLIKHEDA	55	25	59	60	60	0	38	6
2	BAIHEDA	31	0	56	56	22	9	0	0
3	NAINAWAD	42	23	77	64	84	13	32	0
4	KANARDI	20	3	29	0	30	1	0	5
5	DUHANI	90	35	99	100	100	0	0	82
6	MAJHANIYA	30	3	33	0	56	1	0	31
7	DUPADA	57	20	65	65	65	4	0	47

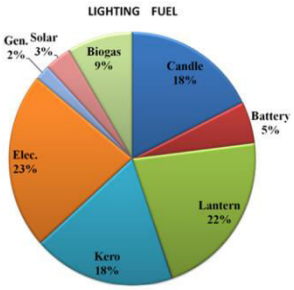


Fig. 1 Pi Graph of different sources used by villagers for lighting

On the basis of survey the villagers use the different sources of energy for cooking as shown in table 2& Fig.2 below

Table 2

S. No.	Village	Cowdung	Wood	Charcoal	LPG	Kero.	Elect.	Biogas	Solar
1	MOLIKHEDA	59	59	2	38	54	0	36	0
2	BAIHEDA	68	68	0	57	32	2	4	0
3	NAINAWAD	63	60	1	80	58	9	12	0
4	KANARDI	30	27	0	30	23	0	1	0
5	DUHANI	100	100	8	79	76	61	67	32
6	MAJHANIYA	56	41	0	52	37	0	3	0
7	DUPADA	65	65	17	49	49	0	51	0

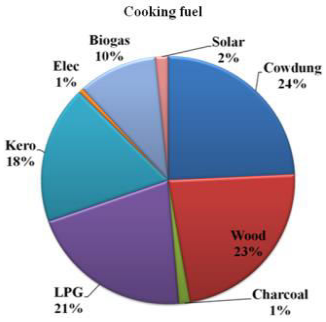


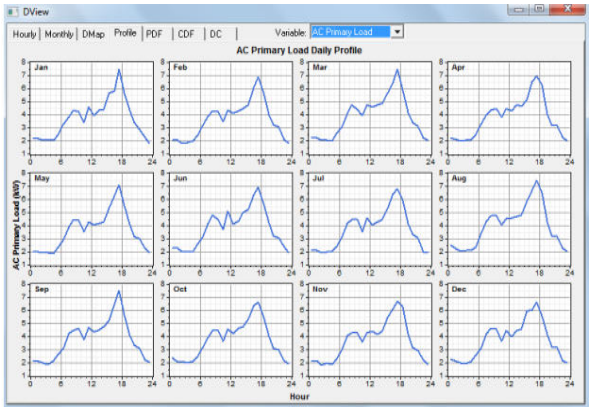
Fig. 2 Pi Graph of different sources used by villagers for cooking

IV. DAILY LOAD PROFILE OF STUDY AREA DUHANI

This proposed area is consisting of 1150 people with 187 houses. Daily load profile is based on basic demands of utility such as lighting, cooling, communication and other household applications. The total load consumption is 90 kwh/day and 12 KW is peak load of this remote area. The daily load profile is shown in below

Table: 3Hourly Electrical Load data

TIME (HOURS)		1	2	3	4	5	6	7	8	9	10	11	12
KW	Jan to Dec	3.70	3.44	3.42	3.29	3.50	3.70	3.90	3.70	4.6	3.92	3.75	3.75
TIME (HOURS)	Jan to Dec	13	14	15	16	13	18	19	20	21	22	23	24
KW		3.95	4.13	3.75	3.77	3.71	4.18	4.14	3.79	4.13	3.82	3.36	3.42



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The data of electric load calculated on basis of 24 hours requirements and average data of solar-wind collected yearly month wise and these data feed in HOMER software for proposed model.

Table 4

Average Wind and Solar Data for Village Duhani (M.P.), INDIA

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed (m/s)	2.57	2.89	2.86	3.38	4.11	4.30	3.06	3.27	2.80	2.17	2.22	2.36
Solar radiation ($kWh/m^2/d$)	4.18	5.65	6.35	6.99	7.20	6.08	4.77	4.12	5.19	5.79	4.70	4.21

V.METHEDOLOGY

The generation, transmission and distribution of electric energy are based on conventional Grid system since generation of Electrical Energy. The conventional Grid system generation point of building block of electricity but energy saving and continues power supply point of view grid not supply power in tribal areas.so stand-alone solar-wind hybrid system is best option in these areas to electrified. We proposed a small solar-wind hybrid on grid model using HOMER software for village Duhani, Sajapur, M.P.

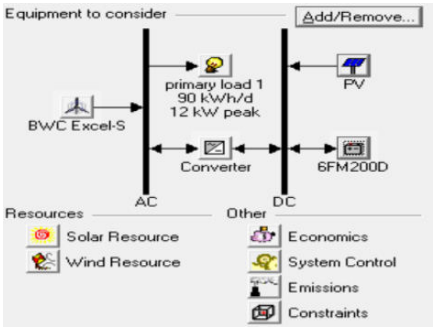

Fig.3 Stand-Alone Solar-Wind Hybrid System

The electric power requirement of village Duhani, Sajapur, M.P. is around 90 kWh/day for this load, we proposed a stand-alonesolar-wind hybrid system using HOMER software, to analyse the feasibility of system according to location use the HOMER software.

VI. SIMULATION RESULTS

The proposed stand alonesolar-wind hybrid model simulates in HOMER software and generates the number of feasible combination of system with optimized result as shown in fig.4.

It is difficult manually to finalize the feasible combination of components, which are actually used in Installation of solar-wind hybrid system. We provide the number of different combinations to HOMER software, on the basis of different combination, HOMER calculate the solar radiation of whole year, wind speed and other devices prices.

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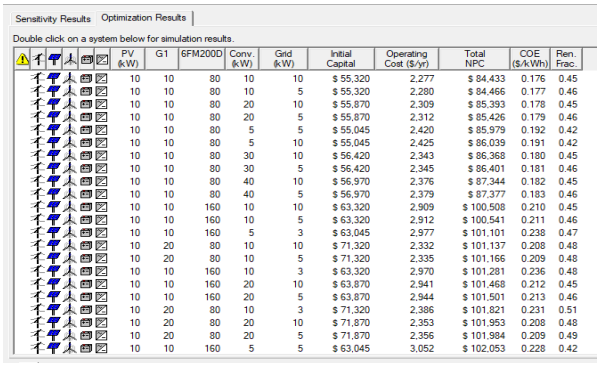

Sensitivity Results | Optimization Results

Double click on a system below for simulation results.

	PV (kW)	G1	6FM200D	Conv. (kW)	Grid (kW)	Initial Capital	Operating Cost ($/yr)	Total NPC	COE ($/kWh)	Ren. Frac.
	10	10	80	10	10	$ 55,320	2,277	$ 84,433	0.176	0.45
	10	10	80	10	5	$ 55,320	2,280	$ 84,466	0.177	0.46
	10	10	80	20	10	$ 55,870	2,309	$ 85,393	0.178	0.45
	10	10	80	20	5	$ 55,870	2,312	$ 85,426	0.179	0.46
	10	10	80	5	5	$ 55,045	2,420	$ 85,979	0.192	0.42
	10	10	80	5	10	$ 55,045	2,425	$ 86,039	0.191	0.42
	10	10	80	30	10	$ 56,420	2,343	$ 86,368	0.180	0.45
	10	10	80	30	5	$ 56,420	2,345	$ 86,401	0.181	0.46
	10	10	80	40	10	$ 56,970	2,376	$ 87,344	0.182	0.45
	10	10	80	40	5	$ 56,970	2,379	$ 87,377	0.183	0.46
	10	10	160	10	10	$ 63,320	2,909	$ 100,508	0.210	0.45
	10	10	160	10	5	$ 63,320	2,912	$ 100,541	0.211	0.46
	10	10	160	5	3	$ 63,045	2,977	$ 101,101	0.238	0.47
	10	20	80	10	10	$ 71,320	2,332	$ 101,137	0.208	0.48
	10	20	80	10	5	$ 71,320	2,335	$ 101,166	0.209	0.48
	10	10	160	10	3	$ 63,320	2,970	$ 101,281	0.236	0.48
	10	10	160	20	10	$ 63,870	2,941	$ 101,468	0.212	0.45
	10	10	160	20	5	$ 63,870	2,944	$ 101,501	0.213	0.46
	10	20	80	10	3	$ 71,320	2,386	$ 101,821	0.231	0.51
	10	20	80	20	10	$ 71,870	2,353	$ 101,953	0.208	0.48
	10	20	80	20	5	$ 71,870	2,356	$ 101,984	0.209	0.49
	10	10	160	5	5	$ 63,045	3,052	$ 102,053	0.228	0.42

Fig.:4 Simulations results of solar-wind hybrid system

The HOMER software use the data feed by us and after simulation, display the number of feasible combination of solar-wind hybrid system and also suggest the optimized combination of system. The load demand data vary day to day but these are the traditional based hybrid system so we use month wise data

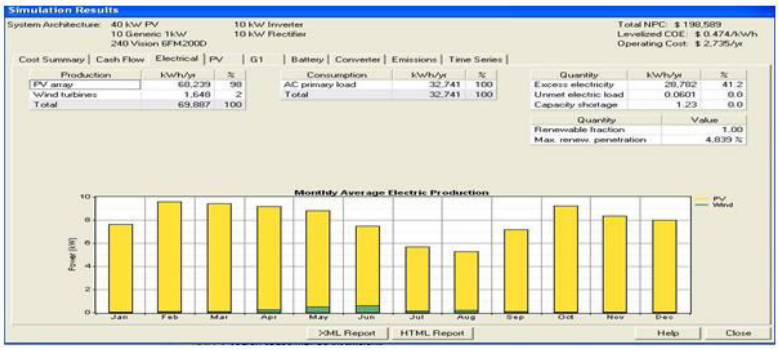

Fig.5 Renewable output power

The simulation result of standalone solar-wind hybrid system is shown in above fig. 5 renewable output power. In stand-alone hybrid system the number of PV array is used 40, 240 battery bank and 10 kW wind turbine to fulfil the electric load requirement 90 kWh/d. The total production of power is 69887 kWh/yr., in which power 68239 kWh/yr (98%) is by PV array, 1648 kWh/yr. (2%) by wind turbine. primary AC load required around 32741 kwh/yr. The electricity generation more than requirement so power excess because the proposed system is standalone, to use this excess electricity, we can modified the proposed system standalone solar-wind hybrid into on-grid hybrid system.

VII. CONCLUSION

There are many options for renewable energy generation, solar, wind, Tidal, Geo Thermal, Biomass etc. In whichthe stand-alone solar-wind hybrid system is best option to electrify the isolated areas from main city due to hilly areas or cost reason installation of power towers too costly. The electrical power generation by solar power plant only not continues due to weather so, we use in combine wind power plant .The solar-wind hybrid system is the best system for power generation.

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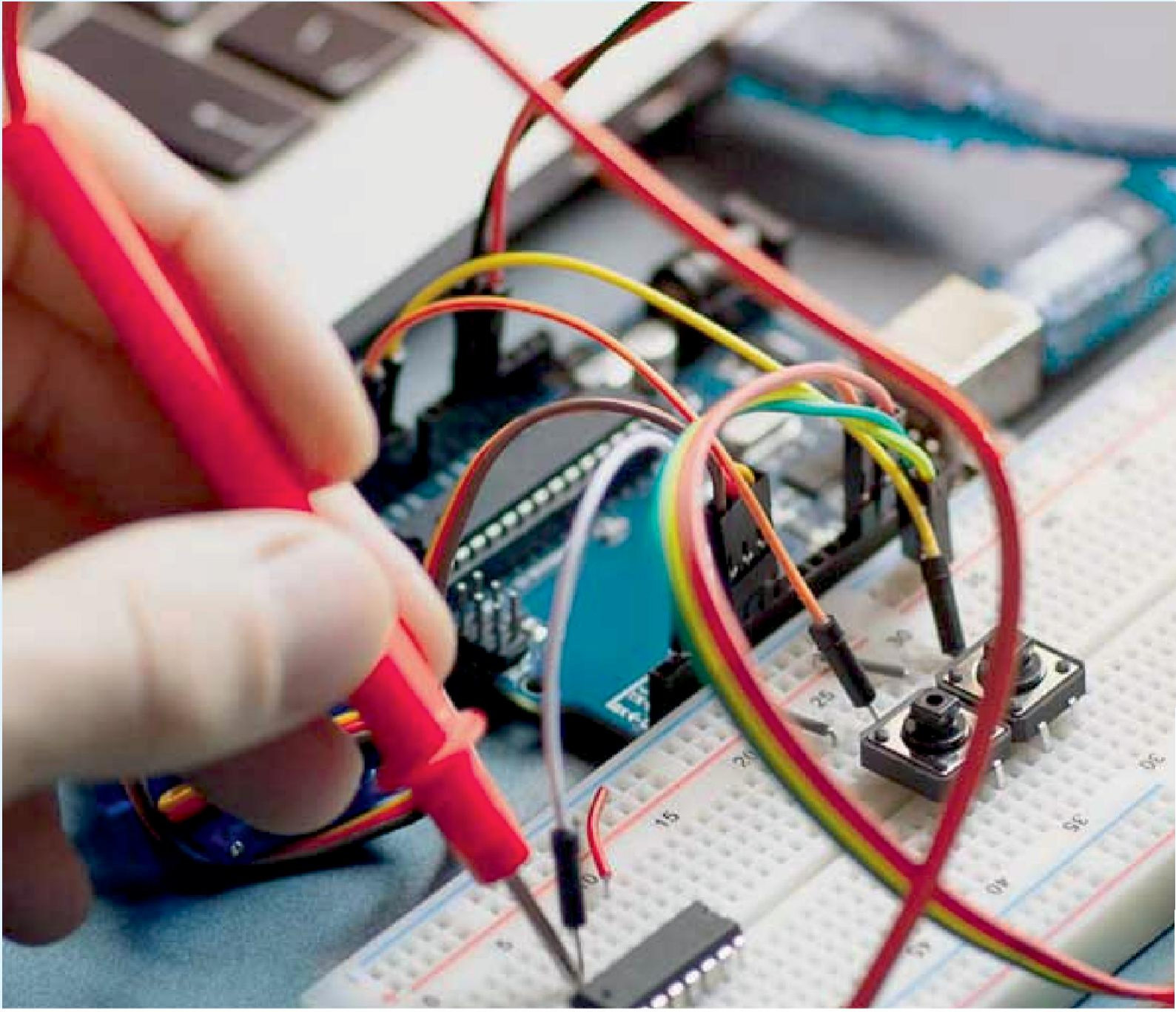

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