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A Study of Power Generation Model Using PV-Biomass Hybrid Energy Systems

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ABSTRACT
Population growth and technological advancements are driving a fast increase in global energy demand and traditional sources of energy, such as diesel or coal-fired power plants and nuclear-powered heat-power stations, dominate the world's energy output. Renewables contributed 19% to human energy consumption and 22% to the generation of electricity in 2012 and 2013, according to REN21's 2014 report. Traditional biomass accounts for 9% of this energy consumption, 4.2% for non-biomass heat energy, 3.8% for hydroelectricity, and 2% for wind, solar, and geothermal electricity. In some long-term scenarios, a considerable increase in the percentage of renewable technologies is expected. If appropriate laws and technical advancements are enacted, renewable energy sources might satisfy up to 50% of the world's energy demands by the middle of the twenty-first century. It has become more vital for the advancement of civilization in recent years that we use biomass energy to generate electricity. Sustainable development has become a reality due to global warming, resource depletion, and other worldwide issues. Biomass can be a key source of renewable energy for electrical power plants. PV (solar)-biomass hybrid technology is studied in this article as an alternative to relying on the grid. This hybrid plant might be a viable alternative for places with modest solar availability but plentiful biomass. Using sun insolation to limit the usage of biomass can enhance the output of a power plant. The biomass system will be employed when solar thermal energy is insufficient.

Keywords
Conventional sources, Photovoltaic, Biomass, Renewable resources.

1. INTRODUCTION
A common energy source due to its ease of transportation is electrical energy. It is not necessary to produce (convert) and consume energy at the same spot, unlike other types of energy. The product might be created a long way from the place of consumption. On top of all of that, it's also incredibly quiet and quick to use. Carbon-based fuels and nuclear power are two of the three types of renewable energy systems that exist globally. When they're in their natural state, all of these materials are fossil fuels. Because the majority of the world's population lacks access to atomic energy, wealthy nations have been the exclusive users [1]. A significant rise in the usage.
of renewable technology is predicted in some long-term scenarios (made up of solar, wind, geothermal, modern biomass, as well as the more traditional source i.e., hydro). [2]. According to these scenarios, suitable policies and technological advancements will allow renewable energy sources to supply up to 50% of total world energy consumption by mid-century. The use of renewable resources, on the other hand, comes with a slew of issues, including production variability and environmental reliance. When production exceeds demand, for example, we may store extra energy and then disperse it when output falls below need. In this example, we're utilizing the grid-integrated functionality. Photosynthesis converts water and CO2 into organic matter using the sun's energy. That is to say, that biomass is produced directly or indirectly by plant growth. [3] The current scenario has led to the choice of sustainable development due to climate change and resource depletion.

1.1. Solar Photo Voltaic Energy
By far the most important renewable energy source in the world is solar energy. In temperate or tropical climes, urban or rural environments, and with either dispersed or grid-feeding modes, solar power may be produced everywhere there is enough insolation. In a solar cell, the process of producing current is known as 'light-generated current'. The absorption of incoming photons creates electron-hole pairs as the initial stage of the reaction. An electron-hole pair will develop in the solar cell if the incident photon's energy is larger than the bandgap. Instead of using a p-n circuit, the electron and hole are separated spatially. At the p-n junction, the electric field separates the carriers. An electric field carries minority over a p-n junction and makes their majorities. As soon as the solar cell's emitter and base are short-circuited [4], light carriers flow via the external circuit. Photovoltaic (PV) panels are a clean, sustainable energy source. Solar PV is therefore ecologically friendly. PV panels' operation and maintenance costs are regarded to be negligible, if not non-existent when compared to other renewable energy sources. There is no sound from them since PV panels are silent. Solar PV systems, on the other hand, tend to be sporadic, unreliable, and weather-dependent. As a result, it is impossible to establish a reliable and uninterrupted power supply without energy storage technologies. Electricity generated more than the amount needed can be stored in an energy storage system (ESS) and released when the net load is present, allowing intermittent renewable energy to be reliably backed up. To increase the system's dependability, this study makes use of several battery systems. This hybrid technique employs the most common storage method in order to provide a unique solution to the difficult problem of energy storage.

1.2. Biomass Energy System
Water-based vegetation or waste of organic matters, agricultural production products, and agro and food industry waste all fall under the category of biomass. In India, there are several types of biomasses available. Plants come in a wide variety of shapes and sizes. Grass, woody plants, fruits,

vegetables, manures, and aquatic plants are among the most often encountered. As of today, algae and Jatropha are both being used in the manufacture of biodiesel as well. Plantations, municipal and industrial waste streams, and agricultural crop leftovers provide the majority of biomass energy. The composition of animal manure is made up mostly of moisture, organic stuff, and ash. If the animal is anaerobic, the breakdown of its faeces will take place under anaerobic conditions. During anaerobic circumstances, CO2 and stable organic molecules are produced, whereas, during aerobic ones, CH4 is produced. We're talking about large amounts of CH4. Biomass comes from a variety of sources: Indirect harvesting and agricultural wastes; rice mills, sugar refineries, and sawmills; direct harvesting and agricultural wastes; A lack of adequate infrastructure and seasonal fluctuations in biomass availability make it hard for Indian consumers to ensure a reliable fuel supply. Since the early 2000s [6,7], the cost of biomass has increased dramatically [6,8].

1.3. PV- Biomass Hybrid Energy System

Hybrid plants might be a viable option for places with a modest solar resource, but a large amount of biomass to burn. Solar insolation allows the use of hybridization to optimize a power plant's performance by limiting the usage of biomass resources; it will be utilized if solar thermal energy is inadequate [8]. Solar thermal and biomass combustion are coupled because of their seasonal and diurnal complementarity [9]. Biomass can be used as an alternative fuel source, as well as a primary fuel supply for a constant base load. [10]. It has an energy thickness that is 10–40% of that of most oil-based commodities [11].

2. OBJECTIVES

- The current scheme is integrated, with the SPV generating power during the daytime and the generator supplying power at night.
- This extra energy is also utilized for battery charging and supply power as needed, as well as to charge the system.
- Batteries will be utilized as a backup in the event of a power outage. The battery will help minimize the sporadic nature of the SPV system.
- Solar PV-biomass hybrid system is introduced in this work, and its potential for supplying reliable, cost-competitive power to the planned community load is examined.

3. LITERATURE REVIEW

Bulm et al. contrasted solar photovoltaic (PV) and micro hydro-powered village grids against the traditional diesel option (LCOE). Alternatives to solar PV systems are being investigated, such as decreasing supply contingency and hybridization methods. Finally, it contains a table showing the costs and potentials of CO2 emission reduction. When the village grid is located in a remote location and the supply contingency is minimized, PV-powered solar solutions become more competitive. Micro hydro-powered village grid systems have been demonstrated to have negative abatement costs and significant potential to cut emissions. [13]

They look at India's biomass energy resources and potential, as well as its strategies for encouraging biomass energy usage (2015). India's installed capacity for power generating was 2666.64 GW at the end of March 2013. Biomass generates 12.83 percent of all power produced. The Indian government has implemented several policies and initiatives for biomass energy generation in recent years. Biogas, biodiesel, and other biomass-based energy sources are examples [14].

Bai et al (2017) designed it to maximize the use of renewable energy. The system includes a solar-thermal energy collection subsystem, a biomass steam boiler, and a steam turbine power generation system. This is higher than the yearly net sunlight-to-electricity efficiency of 15.79 percent for a typical parabolic trough solar energy system, which is the industry norm. Energy's levelized cost falls from 0.192 $/ (kW h) to 0.077 $/ (kW h) (kW h). The annual biomass consumption rate is lowered by 22.53 percent when compared to traditional biomass power system installations. Studies suggest that we should make efficient use of renewable energy resources and minimize carbon dioxide emissions [15].

4. METHODOLOGY

4.1. PV Performance Assessment

The assessment and monitoring of the performance metrics of big photosystems over long periods are hampered by several variables, including weather variations and inadequate data gathering. This method is currently not governed by any standard [16].

4.2.Standard IEC-61724

This International Standard not only tracks energy PV parameters example in-plane irradiance, array output, storage, etc, but it also provides data exchange and analysis tools. There are several different methods for evaluating the overall performance of PV systems, whether they're standalone or linked to a utility grid.

4.3.Energy Balance Equation [17]

Energy E_{in} is the system energy, also energy E_{use} energy utilized by the system in this equation (see below).

$$E_{in} = E_{BU} + E_{FSN} + E_{FUN} + E_A$$
$$E_{use} = E_L + E_{TSN+E_{TUN}}$$

On the other hand, E_{FU} and E_{TFU} are used to represent energy going and coming out of the utility, respectively, E_{TSN} and E_{FSN} are used to represent Net Energy going and coming out of the Storage Unit respectively.

Assumptions that have been made in this work:

As there is no utility connection, E_{in} and E_{use} have been simplified. Use the IEC Standard when there is a utility connection. We also skipped over the global effects of energy to or from this device on the system's long-term performance since we assumed the analysis period would be long enough (usually one year) to ignore these effects.

Two assumptions have been taken into consideration when constructing the following energy balance equations

$$E_{in} = E_{BU} + E_A$$
$$E_{use} = E_L$$

4.4.System Performance Indices

To compare PV systems of various designs and locations, you may utilize normalized system parameters including output, losses, and efficiency. The amount of energy created by the array, normalised to the rated array power, is referred to as array yields. The array area determines the system's efficiency. The difference in yields is described as a loss.

4.5.Biomass Energy Assessment

Globally, biomass is ranked number four in terms of energy production. It accounts for around one-third (35%) of primary energy consumption in developing nations and 3% in affluent countries. Because of its high volatile matter concentration (80% in biomass vs. 20% in fossil fuels), biomass is a fuel with great flexibility and igniting stability [19]. Biochemical, chemical, and thermochemical processes can transform this fuel into other higher-value fuels (solid, gaseous, or liquid). As a result, biomass has a lower energy density than most fossil fuels. Regardless, waste and stores of biomass are at this point thought to be huge and to some degree humble wellsprings of energy [12]. The bioenergy sector may utilize

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these wastes to dispose of them in an ecologically acceptable manner.

5. SIMULATION MODEL

HOMER (Hybrid Optimization Model for Electric Renewables), a tool developed by the National Renewable Energy Laboratory (NREL), USA, was used to simulate it. When it comes to optimizing hybrid energy systems, this software makes extensive use of micropower optimization. This program is preferred when modelling a feasible hybrid system. Using this flexible tool, we configure any hybrid system we use, simulating a mixture of traditional and renewable sources. It is our responsibility to notify HOMER about electric load, renewable energy sources, and component technical data as well as dispatch strategy types, etc.

5.1. Modelling Solar Geometry

Though not perpendicular to the Earth's daily rotation around its axis, it is perpendicular to the plane of Earth's orbit (North and South). This means Earth's obliquity (or tilt) is now about 23.5°. Essentially, a sun's equator is a plane that runs parallel to Earth's celestial equator and passes through its center. We're in an elliptical orbit that sees the Earth pass over and below this plane once per year.

5.2. The Clearness Index

A daily, weekly, or monthly period can be established Using the Solar Resource Inputs box in the program, the clearness index monthly average values are presented. An indicator of average clearness for a certain month is indicated by the letter K.

For example, the Kt of a dismal month may beam 0.25, whereas the Kt of a sunny month would be 0.75. We use the equation to calculate.

:$\eta_{mp,STC} = \frac{Y_{PV}}{A_{PV} G_{T,STC}}$

5.3. Solar Declination

Declination is the latitude at which the sun's rays are parallel to the earth's surface during solar noon, and it varies depending on the season. Use the following equation to find the solar declination:

$$\delta = 23.45° \sin\left(\frac{360°\ 284 + n}{365}\right)$$

YPV is for the PV module's rated output under standard test circumstances [kW], APV represents the PV module surface area [m2], and $G_{T,\ STC}$ stands for the radiation under standard test conditions [1 kW/m2]. The day of the year is [a number from 1 to 360] ‘n’.

5.4. Modelling of PV Power Generation

This is determined by the PV array's load consumption and output (current and voltage), which are calculated under optimum operating circumstances. [16, 17] is used to estimate the PV array's power generation. The output current I of a PV array is proportional to the voltage V.

$$I = N_p I_{ph} - N_p I_0 \left(e^{\frac{1}{V_t}\left(\frac{V}{N_s}+\frac{I_{RS}}{N_p}\right)} - 1\right) - \frac{N_p}{R_p}\left(\frac{V}{N_s} + \frac{I_{RS}}{N_p}\right)$$

Amount of light (A) I_{ph}; Series resistance (Ω); Resistance in shunt/parallel circuits (Ω); Thermal voltage (Vt); Boltzmann's constant (K); electron charge (q); and number of PV cells in series (Ns). (Np) is the number of parallel PV modules. As a result, the PV array's power output is

$$P = VI = N_p I_{ph} V - N_p I_0 V \left(e^{\frac{1}{V_t}\left(\frac{V}{N_s}+\frac{I_{RS}}{N_p}\right)} - 1\right) - \frac{N_p}{R_p} V\left(\frac{V}{N_s} + \frac{I_{RS}}{N_p}\right)$$

Where, $I_{ph} = I_{ph,STC}[1 + \alpha I_{sc}(T - T_{STC})]\frac{G}{G_{STC}}$, $I_0 = I_{0,STC}\left(\frac{T}{T_{STC}}\right)^3 \exp\left(\frac{E_{g,STC}}{kT_{STC}} - \frac{E_g}{kT}\right)$, $P_{PV} = Y_{PV} f_{PV}\left(\frac{\bar{G}_T}{\bar{G}_{T,STC}}\right)[1 + \alpha_P(T_c - T_{c,STC})]$, $V_t = V_{t,STC}\frac{T}{T_{STC}}$, $R_p = \frac{R_{p,STC}}{G/G_{STC}}$, $R_{sh} = R_{sh,STC} + 3 \times R_{sh,STC} e^{-5.5/G_{STC}}$, $T = T_m + \frac{G}{G_{STC}}\Delta T$

Also, The PV generator's energy balance model at time t is written as:

$$P_{PV}(t).f_{PV}.\eta_{inv} = P_{PV_L}(t) + P_{PV_P}(t) + P_{PV_D}(t)$$

PV power provided directly to the load is measured by $P_{PVL}(t)$; PV energy given to the solar pumps is measured by $P_{PVP}(t)$, and PV power wasted to the dump load is recorded by $P_{PV\ D}$ (t).

5.5. Modeling Biomass Energy

It is possible to determine the power generating potential of biogas using the equation below.

$$P_e = \frac{f_{CH4} \times H_{vCH4} \times B_{igas} \times \eta_e}{3.6 \times 10^6 \frac{MJ}{GW\,h}}$$

After combustion, gasification, and pyrolysis, the following equation is used to calculate the electricity-generating potential of biomass materials.

$$P_e = \frac{\eta_c \eta_e m_i H_{vi}}{3.6 \times 10^6 \frac{MJ}{GW\,h}}$$

For example, P_e is the electricity generation potential in gigawatt-hours per year, m_i is the mass of residue in kg/year, H_{vi} is the heating value of biomass (MJ/kg), η_c is the conversion process efficiency (0.7 for gasification), and η_E is the thermal energy to electricity conversion efficiency (for gasification 0.3).

5.6. Modeling Load Consumption

This assumption is made throughout the system modelling process:

$$P_L(t) = P_{PV_L}(t) + P_T(t)$$

for example, $P_{PVL}(t)$ represents the PV array's direct output, while P_T (t) represents the wind turbine's output. As a result, $P_{PVL}(t)$ is zero on zero net loads.

5.7. Economic Parameters

5.7.1. Net Present Cost

By subtracting total lifetime earnings from total lifetime costs, the net present value may be determined. This covers all expenses involved with obtaining electricity from the grid, such as capital expenditures, replacement costs, operations and maintenance costs, fuel costs, environmental fines, and gasoline prices. Salvage value and grid sales are the two methods to generate money.

The equation may be used to calculate the system cost.

$$C_{NPC} = \frac{C_{ann,tot}}{CRF_{(i,R_{proj})}}$$

Where $C_{ann,tot}$ is the yearly rate of discount; R_{proj} represents lifespan; and CRF is the capital recovery factor.

5.7.2. Capital Recovery Factor

To determine an annuity, this ratio is utilized (a series of equal annual cash flows). The following equation can be used to determine the capital recovery factor.

.$CRF(i, N) = \frac{i(1+i)^N}{(1+i)^N - 1}$

the interest rate I and years N.

5.7.3. Levelized Cost of Energy

The average cost per kilowatt-hour of useable electrical energy generated by the system, as defined by software. COE is calculated as the annual cost of delivering power divided by the annual cost of supplying electricity (total annualized costs minus cost of feeding the thermal load). The following is our COE equation:

$$COE = \frac{C_{ann,tot}}{E_{prim,AC} + E_{def}}$$

Where $C_{ann,tot}$ = the total optimization cost of energy [$/kWh], $E_{prim,AC}$ = AC load in kWh/year and E_{def}= deferrable load served in kWh/year.

6. SYSTEM ANALYSIS

As depicted in Figure 1, system components comprise a power producer (PV array, biomass generator, and battery), a load (the end-user of the system), and a control station. This system's primary mode of operation is considered to be stand-alone mode. One little island in Kendrapara district is the topic of this research.

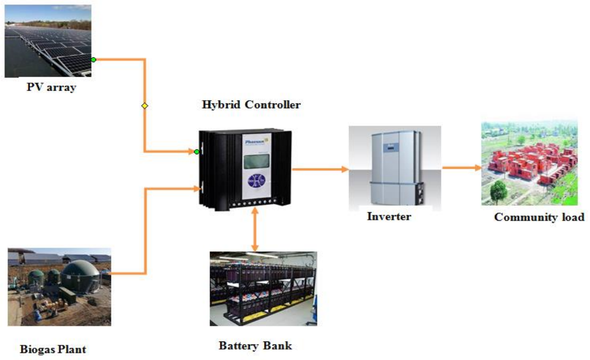

Figure 1: PV Biomass hybrid system

As many renewable sources as possible are integrated to fulfil the maximum load demand. Solar panels use the sun's beams to produce power. Batteries are used to store extra power that has been used to fulfil load requirements. They can be used when there is a power outage. An evening biomass generator will come on at a predetermined time. When a battery-powered power supply is available in the evenings, biomass does not operate as well as it does during the day. In addition, an inverter device converts the PV array's DC power output into AC electricity. As soon as the load and battery charge controls are fulfilled, a "dumping load" can be used to transfer excess power back into the grid. For a 24-hour energy supply, charge and discharge rates, as well as battery capacity, would be enough. There is a solar array with batteries, a biomass generator with batteries and a charge controller.

6.1. Load Profile

Design dictates it can manage daily loads up to 487 kWh/day and peak demand of 64kW. On the other hand, the average load demand is indicated in Figure 2. More and more equipment will be added over time, causing the power requirements to rise. Designed to fulfil the demands of a single-family house. Inevitably, nights are when power demand rises. With the help of HOMER software, an appropriate load profile may be produced by randomising the daily base load. This means that seasonal fluctuations in load are ignored. Suggestion: Assume steady load for the whole simulation year.

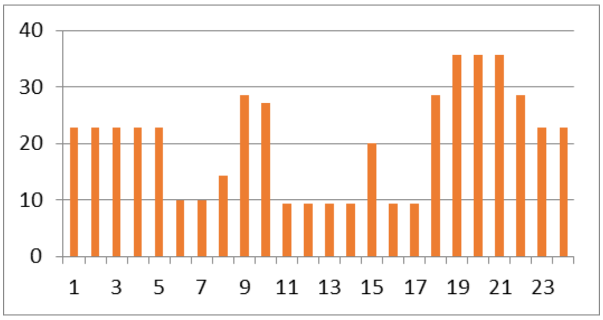

Figure 2: Hourly load.

6.2. Solar Energy Resource

As part of the planned architecture, solar energy plays a key role. Power generation from photovoltaic panels rises as technology improves. These resources are depicted in Figure 3. There is a wide range of solar radiation in India, from 3 to 8 kWh/metre 2/day. 20.59 degrees north, and 86.59 degrees longitude are the study's coordinates. Installed PV array capacity based on average daily solar radiation of 5.42 kWh/metre2/day and an index of 0.578% is 65kWP.

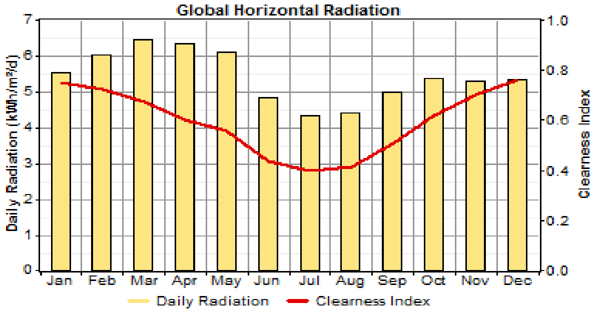

Figure 3: Solar Energy resources

6.3. Battery

As a result of this, a higher-quality battery has been added to the system to improve power quality. 75 units of the system are represented by the Surrette 4KS25P battery. To build this system costs INR 4,53,750 and to operate it costs INR 37,500 a year.

6.4. Converter

Assumptions for this study include AC loads and DC solar PV output. Rather than using a converter, this approach utilizes an inverter There were twenty-kilowatt inverters with a 15-year lifetime and a 90% efficiency. It is anticipated that the capital cost would be INR 1,26,000, while the yearly O&M cost is set at INR 6,300.

6.5. Biomass Resources

There is just one part of the system that is weather-independent: the biogas generator. There is a significant amount of biomass at the suggested location since most people keep cattle as pets. Biodegradable wastes include food leftovers, leftover food, and agricultural wastes. Garbage disposal is a breeze with this strategy, which also generates power for the neighbourhood, which is now without it. Aside from that, the region around the site has adequate forest cover to provide the biomass generator's bio stock reserve. An estimated INR 1,84,0000 is required to purchase the 20-kW biomass generator, while the O&M cost is projected at INR 2/hr. Figure 4 shows the monthly biomass resources. It's not included in the software's fuel transportation cost calculation; therefore, it's added to the system cost.

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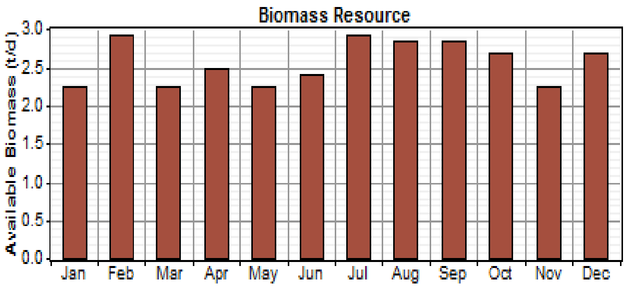

Figure 4: Biomass resource

7. RESULTS AND OBSERVATIONS

7.1. Solar and Biomass Output Power

Photovoltaic power generation fluctuates with worldwide sun radiation, as seen in Figure 5. Fuel availability affects the amount of biomass power generated, with a maximum of 45,67 kWh at an average radiation of 0.333 kW/m2 throughout the day (Figure 6). According to the manufacturer's data, the highest production capacity is 20kW and the yearly energy output is 87.511 kilowatt-hours.

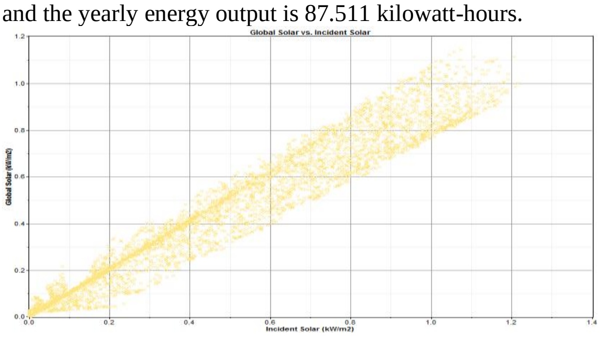

Figure 5: Solar radiation and PV Output Power

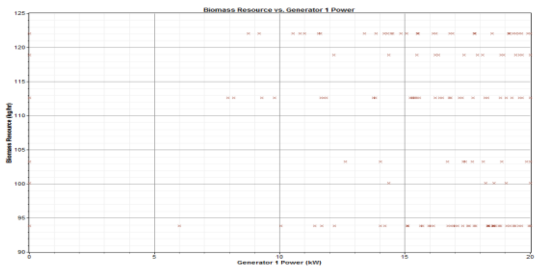

Figure 6: Biomass resource and output power

7.2. Battery Output

Due to the fact that a battery is an additional power source, this is the case. Energy generated by solar photovoltaics will be utilised to recharge the batteries. When the combined power generation is insufficient, solar PV arrays and/or biogas producers will release stored energy to meet load demand. It was regulated by a charge controller, which was attached to the battery. Total annual production and consumption for the battery is 47,746, with losses of 8,966 kWh per year and an expected depletion rate of 309.

As seen in Figure 7, the average battery output is shown.

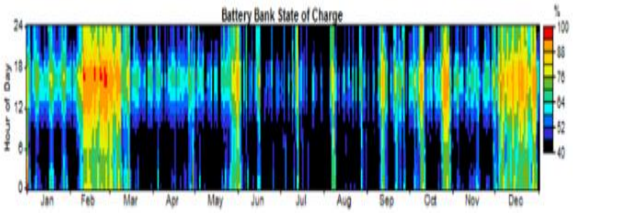

Figure 4: Battery output

7.3. Hourly energy balance of the proposed system

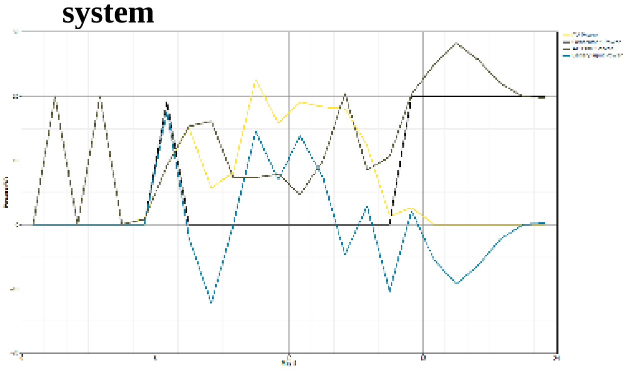

Figure 5: Hourly energy Balance

7.4. Economic Analysis

7.4.1. Yearly Cash Flow

Figure 9 depicts the annual cash flow over the system's lifetime. An annual cash influx or outflow is represented by each bar in the graph. The capital cost in year zero is examined first. A negative number is recorded when equipment is changed or O&M is conducted. Batteries and converters may need to be replaced every 12 to 24 years, depending on how long they've been in use. Positive numbers, such as money from salvaged project equipment, show this.

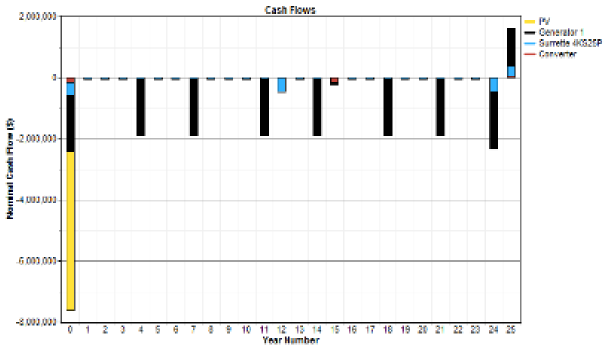

Figure 9: Cash Flow Information of the scheme

7.4.2. Optimization Results

As shown in Figure 10, a hybrid system's overall optimization may be determined by using HOMER software. According to the table below, each row represents a potential configuration for a computer's hardware. There are eight key modelling findings after the first four columns, which include initial capital cost, operational cost, and net current cost, renewable fraction, capacity shortage, and Biomass. In terms of net power consumption, the solar PV system with 65kwp and a 20kw biomass generator, 75kwh of S4KS2P batteries, and a 25kwh converter are optimal (NPC). It costs INR 14,596,594 to run an NPC. The COE is 7.141/kWh with 100 percent renewable energy.

PV (kW)	Label (kW)	S4KS25P	Conv (kW)	Initial Capital	Operating Cost ($/yr)	Total NPC	COE ($/kWh)	Ren. Frac	Capacity Shortage	Biomass (t)	Label (hrs)
65	20	75	25	$ 7,521,250	$45,658	$ 14,595,594	7.141	1.00	0.14	938	4,401
65	20	80	25	$ 7,549,500	$48,033	$ 14,555,264	7.153	1.00	0.13	938	4,381
65	25	75	25	$ 8,001,250	$26,082	$ 14,806,463	7.261	1.00	0.14	938	3,502
65	25	80	25	$ 8,109,500	$28,542	$ 14,865,042	7.271	1.00	0.13	938	3,524
70	20	75	20	$ 7,989,750	$43,506	$ 14,917,578	7.299	1.00	0.14	937	4,403
70	20	70	25	$ 7,993,000	$44,187	$ 14,949,538	7.258	1.00	0.13	938	4,418
70	20	80	20	$ 8,018,000	$46,011	$ 14,987,861	7.290	1.00	0.13	937	4,394
70	20	75	25	$ 8,021,250	$46,436	$ 15,006,513	7.243	1.00	0.12	938	4,437

Figure 6: Optimization result of PV Biomass Hybrid System

Table 1: Performance summary of PV array and Label generator-1

Parameter	**Value**	**Unit**	**Parameter**	**Value**	**Unit**
PV array			Label Generator 1		
Rated Capacity	65	kW	Working Hours	4,401	hr./yr.
Output Average	12.8	kW	Starts	790	starts/year
Output	308	kWh/d	Operational Life	3.41	yr.
Capacity Factor	19.8	%	Capacity Factor	49.9	%
Total Production	1,12,516	kWh/year	Fixed Generation Cost	125	$/hr.
Minimum Output	65	kW	Marginal Generation Cost	0	$/kWh
Maximum Output	12.8	kW	Electrical Production	87,511	kWh/ yr.
PV Penetration	308	%	Mean Electrical Output	19.9	kW
Hours of Operation	19.8	hour/year	Electrical Output (Min)	6	kW
Levelized Cost	1,12,516	$/kWh	Electrical Output (Max)	20	kW
		Consumption of Feedstock.		938	t/yr.
		Consumption of Specific Fuel Stock		7.5	kg/kWh
		Fuel Energy Input		10,02,732	kWh/yr.
		Efficiency (Avg.)		8.7	%

Table 2: Performance summary converter and Battery

Parameter	**Value**	**Unit**	**Parameter**	**Value**	**Unit**
Converter (inverter)			**Battery**		
Capacity	25	kW	**Nominal Value**	570	kWh
Mean Output	9	kW	**Usable Nominal Capacity**	342	kWh
Minimum Output	0	kW	**Autonomy**	16.9	Hr.
Maximum Output	25	kW	**Lifetime Throughput**	7,92,645	kWh
Capacity Factor	36.2	%	**Battery Wear**	0.598	$/kWh
Hours of Operation	6	hours/yr.	**Mean Cost**	0	$/kWh
Energy In	88	kWh/year	**Power In**	47,746	kWh/yr.
Energy Out	79	kWh/year	**Power Out**	38,471	kWh/yr.
Losses	8	kWh/year	**Depletion of Storage**	309	kWh/yr.
			Losses	8,966	kWh/yr.
			Throughput Annual	43,012	kWh/yr.
			Expected Lifetime	12	Yr.

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8. CONCLUSION

The study explores hybrid solar PV-biogas system for Odisha Island formed by the confluence of Kharasrot and Brahmani rivers. Early findings

are nevertheless positive. After the system is fully integrated, its power production will grow,

The capacity shortfall is 14 percent, which increases system dependability, and the reduced cost of energy is 7.141 INR/kWh, which may drop in the near future owing to a trend of falling prices for such systems. A wide area may be electrified with sufficient supply, and renewable energy sources that are already available on the site can be optimally utilized, as shown in the paper.

REFERENCES

[1] IEA, International energy annual 2004. Energy Information Administration; 2006

[2] Akella AK, Saini RP, Sharma MP. Social, economic and environmental impacts of renewable energy systems. Renewable Energy 2009; 34:390–6.

[3] Pachauri S, Jiang L. The household energy transition in India and China. Energy Policy 2008; 36:4022–35

[4] Mohan BK. Rising fuel costs make biomass energy unattractive. Business Standard; 2009.

[5] pveducation.org [accessed April, 2021]

[6] Hussain, C. M. I., Norton, B., & Duffy, A. (2017). Technological assessment of different solar-biomass systems for hybrid power generation in Europe. Renewable and Sustainable Energy Reviews, 68, 1115–1129. Doi: 10.1016/j.rser.2016.08.016

[7] Upadhyay S, Sharma MP. A review on configurations, control and sizing methodologies of hybrid energy systems. Renew Sustain Energy Rev 2014; 38:47e6

[8] Fathima AH, Palanisamy K. Optimization in micro-grids with hybrid energy systems, A review. Renew Sustain Energy Rev 2015; 45:431e46

[9] Tiwary A, Spasova S, Williams I. A community-scale hybrid energy system integrating biomass for localized solid waste and renewable energy solution: evaluations in UK and Bulgaria. Renew Energy 2019; 139:960e7

[10] Kumar, A., Kumar, N., Baredar, P., & Shukla, A. (2015). A review on biomass energy resources, potential, conversion and policy in India. Renewable and Sustainable Energy Reviews, 45, 530–539. Doi: 10.1016/j.rser.2015.02.007

[11] Bai, Z., Liu, Q., Lei, J., Wang, X., Sun, J., & Jin, H. (2017). Thermodynamic evaluation of a novel solar-biomass hybrid power generation system. Energy Conversion and Management, 142, 296–306