Analysis of Solar and Windmill Using Real Time Simulation Tool

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Abstract. This work is concerned with modelling and modification of a wind power production method into a solar-wind composite mode along with analysis and simulation of the proposed method. The suggested Wind turbine is modelled, and parameters such as rotor diameter, wind speed, pitch angle, etc are taken into count. The PV module is then modeled based on general parameters such as solar irradiation and temperature, etc. A PVsyst simulation is performed for the solar PV grid and stand alone system. Further homer grid software is used to perform simulation on the hybrid system and the results were observed. The hybrid system has an output 1.5kw or 1500w which consists of wind turbines (500kw) and PV solar system of 6 panels of 165w each producing the total peak output of 1kw or 1000w. Autocontollers and converters are used along with a battery of 155w for storage. Conclusions point that the load absorbs power from both solar and wind schemes. However, there is the fluctuation of power supply in some driving conditions, such as modification of solar radiation and wind velocity

Keywords: Wind Energy Generating System, Solar, PV-Wind Hybrid System.

1 Introduction

First and foremost, wind is an unlimited, free and both wind and solar energies are utilised to operate the load. Solar energy is eco friendly.It can be installed in areas where Building heights is prohibited. The solar panels harmlessly generate electricity and iincreases the overall efficiency of the system. Solar can be operated in absence of wind. When both wind and solar energies are unavailable then the energy stored in the battery can be utilised to operate the load. The overall power factor of the system is increased and losses are reduced. Proposed This Control Strategy Used In Pumping And Smart House Applications [1]. Transformer. Reduce Total Cost. Investigates the possible synchronous generator based wind power production mode providing a separate load managing recent innovation [2-3]. To Produce A Stable Energy From Solar –wind Hybrid System By Using A Sliding Mode Controller Which Works With Better Efficiency In Rural Areas[4]. Includes some fuzzy logic controller with MPPT algorithm to improve this effective risk following complex and transient conditions [5]. The Types Converters Like DC-DC, PFAC, HFAC & Hybrid DC-PFAC Which Solves The Typical Issues Of The Hybrid System Management[6].Generation of

maximum power from less energy using microgrid technology[7].Solar/Wind scheme for Power utilization for Rural regions. Production of Energy Using Both Wind And Solar To Achieve Higher Efficiency With Stable Output[8].An innovative Hybrid Methodology To Optimize the wind turbine installation. Increasing Annual Energy Production(AEP) By Generating Huge Amount Of Energy In Wind Forms[9]. A KY(Buck-boost)Converter To Analysing The Hybrid System Generating Higher Output [10-11].This Paper Presents An Advanced Consolation Of Hybrid System So That Demand For More Power Generation Could Be Fulfilled[12]. To Optimize The Energy utilization According the power availability and load profile For this applications the intelligent Controller Determines the utilization of Multisource Energy System[13]-[15].

2   Using Homer PRO Application

HOMER PRO programming is a useful asset for structuring and arranging of HRES so as to decide the ideal size of its segments via doing the techno-monetary examination. HOMER likewise considers Hybrid sunlight based in the network associated and independent modes. The average setup and structure in HOMER have appeared here. Required info information for re-enactment with HOMER and furthermore a complete system to show how ideal sizes of half and half sunlight based gear is controlled by HOMER is depicted in this area.Solar Radiation test has been done by referring to the website "HOMER PRO software" and " PVSYST 6.86 software" by locating our collage. The solar radiation with the input and output has been taken for both one month and each month of a year(I.e from January to December 2020). The below-mentioned simulations show all about the radiation input and output with efficiency and accuracy.

Using HOMER PRO software we have connected all the components directly to the bus and then the output has been converted and directly taken to the consumer side. Initially we have connected the PV to the DC Windmill to the AC bus. Thereafter, we have connected the loads and converter as per the specification with the tariff as power the local electricity cost.
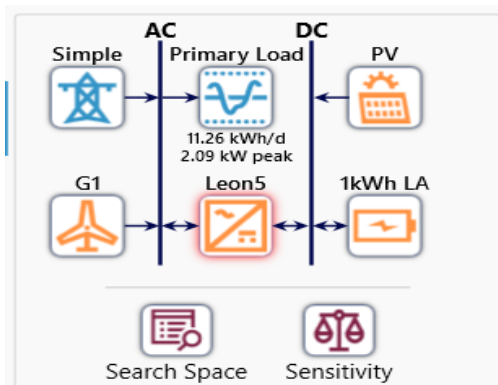

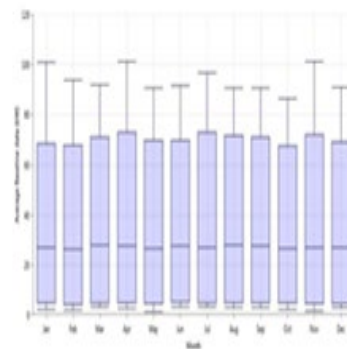**Fig. 1.**Block Diagram of Homer Application.   **Fig. 2.**Load for a complete year

By alluding the heap profile utilizing HOMER programming it has given a tremendous amount of vitality as a normal estimation of the day by day vitality consumption(kWh/day)

taken between these seasons. The vitality load request of this region appears here. It is seen that the pinnacle months are April, July, and November and the occurred top burdens have appeared. The enormous interest happens during the peak season that is between July to November.

The heap profile of every district is the most significant factor in reproduction and advancement. A few areas, for example, colleges, Factories, medical clinics, lodgings, and industrial areas have genuine burden utilization information, which are fitting for reproduction. This genuine information is taken care of into HOMER as time arrangement information or as a boundary. In any case, in certain locales particularly remote zones and rustic zones, the genuine burden utilization information is not accessible, the heap profile ought to be determined with a notification to the detail of that district, relies upon which the force will be created. This information is taken care of into HOMER as everyday profile and HOMER uses them in power balance oblige.
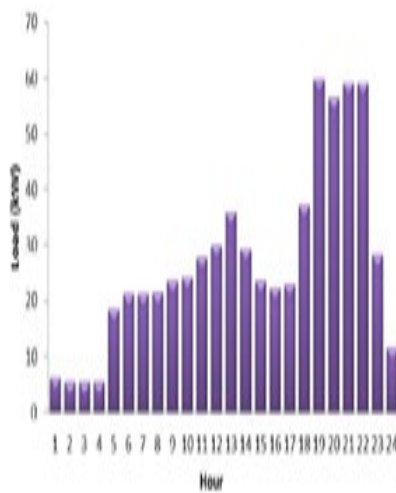
Fig. 3. Load Profile Daily   **Fig. 4.** Wind speed (Monthly)Average
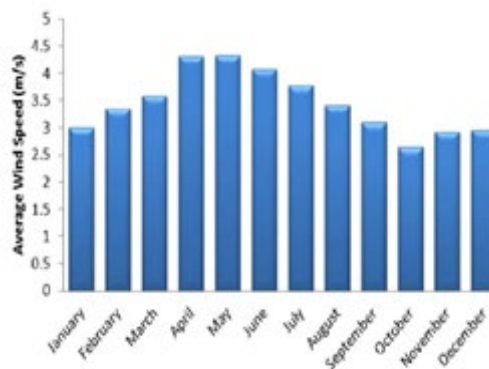
HOMER models a wind turbine as a gadget that changes over the active vitality of the wind into ac or dc power as per a specific force curve.This fig.4 gives a model force bend. HOMER expect that the force bend applies at a standard air, which compares to standard temperature and weight conditions. Every hour, HOMER computes the force yield of the wind turbine in a four-advance procedure.
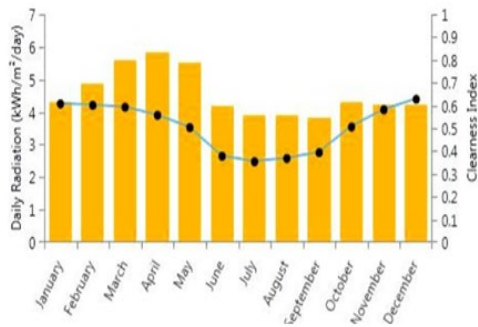
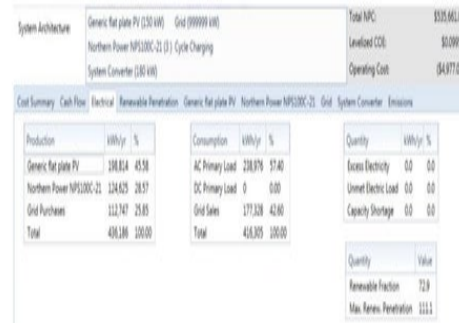**Fig. 5.** Solar irradiation and Clearness Index

Fig.6. Snapshot of the Production (Monthly) and Consumption scenario.

HOMER shows the normal yearly wind speed, fuel cost, and sun-powered radiation for the affectability factors that appeared in cost estimation and streamlining table. It is then utilized in the improvement procedure to get the best design of a half and half sustainable power source framework comprising of wind turbines, PV cluster frameworks, battery stockpiling as well as force converter. For this situation study, the framework comprising of a wind turbine, battery stockpiling, and additionally power converter respects the most conservative expense with the base TNPC and a base Cost of Energy (COE). Be that as it may, the TNPC and COE will become costly when the PV cluster framework is remembered for the framework. The vitality got from various parts of a crossover sustainable power source framework is appeared in Fig. The wind turbine delivered a sum that is 60% of the all-out vitality served. The staying 40% of all-out vitality is served by utilizing EB stockpiling. This framework delivered 11.3% of inordinate vitality and 0.1% of limit lack.

3 Using PV SYST 6.8.6 Application

As we couldn't get the official PVsyst 6.8.6 application, we used the trial version of this application where some of the specifications are not available. Initially, after opening the trial version of the application the design type has been chosen. Then the area of connection has been chosen (for this application stand alone). Before that, we have tried for both the stand alone system and the grid system. But, the stand alone system gives better output and its more efficient, so we have simulated and implemented the stand alone system. Thereafter, the database and parameters need to be chosen and then all the system variant has been perfected as per the simulation needed. This particular simulation gives all the information about maximum radiation angle(tilt angle), latitude, longitude, characteristics of the PV array, efficiency of the panel, etc. Moreover, it also shows the battery management system, loss management factors, gives information about the charging and discharging of the controller. Furthermore, the best and most valuable point of this simulation is, it gives exact and accurate information about the input/output at the panels and load usage and tariff. The result has been shown below.

Stand alone system: Simulation parameters

Project :	**New Project**			
Geographical Site	**Madras**		Country	**India**
Situation	Latitude	13.07° N	Longitude	80.25° E
Time defined as	Legal Time	Time zone UT+5.5	Altitude	10 m
	Albedo	0.20		
Meteo data:	**Madras**	Meteonorm 7.2 (1981-2010) - Synthetic		

Simulation variant :	**New simulation variant**	
	Simulation date	12/03/20 11h47

Simulation parameters	System type	**Stand alone system with batteries**		
Collector Plane Orientation	Tilt	15°	Azimuth	0°
Models used	Transposition	Perez	Diffuse	Perez, Meteonorm
User's needs :	Daily household consumers average	Constant over the year 6.1 kWh/Day		

PV Array Characteristics				
PV module	Si-poly	Model	**TSM-310PD14**	
Original PVsyst database		Manufacturer	Trina Solar	
Number of PV modules	In series	2 modules	In parallel	1 strings
Total number of PV modules	Nb. modules	2	Unit Nom. Power	250 Wp
Array global power	Nominal (STC)	**500 Wp**	At operating cond.	449 Wp (50°C)
Array operating characteristics (50°C)	U mpp	53 V	I mpp	8.4 A
Total area	Module area	**3.3 m²**	Cell area	2.9 m²

System Parameter	System type	**Stand alone system**		
Battery	Model	**MK 8GU1 Gel**		
	Manufacturer	MK Battery		
Battery Pack Characteristics	Nb. of units	8 in parallel		
	Voltage	12 V	Nominal Capacity	208 Ah
	Discharging min. SOC	20.0 %	Stored energy	2.0 kWh
	Temperature	Fixed (20°C)		
Controller	Model	Universal controller with MPPT converter		
	Technology	MPPT converter	Temp coeff.	-5.0 mV/°C/elem.
Converter	Maxi and EURO efficiencies	97.0 / 95.0 %		
Battery Management control	Threshold commands as	SOC calculation		
	Charging	SOC = 0.92 / 0.75	i.e. approx.	13.8 / 12.4 V
	Discharging	SOC = 0.20 / 0.45	i.e. approx.	11.3 / 12.1 V

PV Array loss factors				
Array Soiling Losses			Loss Fraction	5.0 %
Thermal Loss factor	Uc (const)	10.0 W/m²K	Uv (wind)	0.0 W/m²K / m/s
Wiring Ohmic Loss	Global array res.	212 mOhm	Loss Fraction	3.0 % at STC
Serie Diode Loss	Voltage Drop	0.7 V	Loss Fraction	1.2 % at STC
LID - Light Induced Degradation			Loss Fraction	1.0 %
Module Quality Loss			Loss Fraction	4.0 %
Module Mismatch Losses			Loss Fraction	2.0 % at MPP
Strings Mismatch loss			Loss Fraction	1.00 %
Incidence effect, ASHRAE parametrization	IAM =	1 - bo (1/cos i - 1)	bo Param.	0.05

Fig. 8. PV SYST Specifications

If there should be an occurrence of PVsyst, reenacted execution of 1 kW remain solitary Si-poly photovoltaic framework is done in this investigation utilizing the PVsyst 6.8.6 programming, which gives all the data on

• Annual premise vitality creation that is infused into the boards with explicit items on a yearly premise for each introduced kW.

• Maximum vitality infused into the boards on a month to month premise. for the arranged area.

• From the outcomes, it tends to be reasoned that the arranged PV framework will give the operational advantages to the installer or proprietor.

• Further, the examination can be completed utilizing distinctive PV module advances with fitting establishment strategies for improving the exhibition.

So as to produce what is indicated here the "PVSYST Standard Model" for the module type under test, default esteems endorsed by PVsyst are utilized for the boundaries. As referenced before, in this model the deliberate, or, proportionally here, the nameplate temperature co-proficient of the most extreme force is additionally embedded into

PVSYST, In request to decidethe incentive for μγ by setting the force in PVSYST, which thusly decides the temperature reliance of the displayed. The current paper looked into those articles that have utilized HOMER for the ideal arranging of Analysis of Solar and Windmill Using Real-Time Simulation Tool and PVsyst for exact sunlight-based yield.

Stand alone system: Detailed User's needs

Project :	New Project
Simulation variant :	New simulation variant

Main system parameters		Stand alone system with batteries		
PV Field Orientation	tilt	15°	azimuth	0°
PV modules	Model	TSM-310PD14	Pnom	250 Wp
PV Array	Nb. of modules	2	Pnom total	500 Wp
Battery	Model	MK 8GU1 Gel	Technology	Lead-acid, sealed, AGM
Battery Pack	Nb. of units	8	Voltage / Capacity	12 V / 208 Ah
User's needs	Daily household consumers	Constant over the year	Global	2221 kWh/year

Daily household consumers, Constant over the year, average = 6.1 kWh/day

Annual values

	Number	Power	Use	Energy
Lamps (LED or fluo)	10	18 W/lamp	12 h/day	2160 Wh/day
TV / PC / Mobile	2	150 W/app	6 h/day	1800 Wh/day
Domestic appliances	1	150 W/app	14 h/day	2100 Wh/day
Stand-by consumers			24 h/day	24 Wh/day
Total daily energy				6084 Wh/day
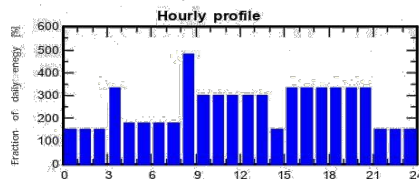
Fig.9. Standalone Parameters

Annual values

	Number	Power	Use	Energy
Lamps (LED or fluo)	10	18 W/lamp	12 h/day	2160 Wh/day
TV / PC / Mobile	2	150 W/app	6 h/day	1800 Wh/day
Domestic appliances	1	150 W/app	14 h/day	2100 Wh/day
Stand-by consumers			24 h/day	24 Wh/day
Total daily energy				6084 Wh/day

Fig.10. Standalone: Detailed User note

Stand alone system: Main results

Project :   **New Project**
Simulation variant :   **New simulation variant**

Main system parameters	System type	**Stand alone system with batteries**		
PV Field Orientation	tilt	15°	azimuth	0°
PV modules	Model	TSM-310PD14	Pnom	250 Wp
PV Array	Nb. of modules	2	Pnom total	**500 Wp**
Battery	Model	MK 8GU1 Gel	Technology	Lead-acid, sealed, AGM
Battery Pack	Nb. of units	8	Voltage / Capacity	**12 V / 208 Ah**
User's needs	Daily household consumers	Constant over the year	Global	2221 kWh/year

Main simulation results				
System Production	**Available Energy**	**562.8 kWh/year**	Specific prod.	1126 kWh/kWp/year
	Used Energy	470.1 kWh/year	Excess (unused)	0.1 kWh/year
	Performance Ratio PR	47.92 %	Solar Fraction SF	21.17 %
Loss of Load	Time Fraction	79.5 %	Missing Energy	1750.5 kWh/year
Battery ageing (State of Wear)	Cycles SOW	87.8%	Static SOW	80.0%
	Battery lifetime	5.0 years		

Normalized productions (per installed kWp): Nominal power 500 Wp

Lu : Unused energy (battery full)   0 kWh/kWp/day
Lc : Collection Loss (PV-array losses)   1.98 kWh/kWp/day
Ls : System losses and battery charging   0.81 kWh/kWp/day
E : Energy supplied to the user   2.58 kWh/kWp/day

Performance Ratio PR and Solar Fraction SF

PR : Performance Ratio (Yf / Yr)   0.479
SF : Solar Fraction (ESol / ELoad)   0.212

New simulation variant
Balances and main results

	GlobHor kWh/m²	GlobEff kWh/m²	E_Avail kWh	EUnused kWh	E_Miss kWh	E_User kWh	E_Load kWh	SolFrac
January	149.2	156.2	50.11	0.000	142.8	45.81	188.6	0.243
February	164.4	167.5	51.60	0.000	128.1	42.24	170.4	0.248
March	196.2	188.4	57.18	0.009	141.7	46.93	188.6	0.249
April	194.2	175.8	53.51	0.000	139.2	43.33	182.5	0.237
May	192.7	166.0	50.61	0.000	147.9	40.71	188.6	0.216
June	169.4	143.2	44.78	0.004	146.7	35.80	182.5	0.196
July	161.3	138.3	43.29	0.006	154.2	34.39	188.6	0.182
August	162.4	144.1	45.15	0.002	152.7	35.91	188.6	0.190
September	160.6	149.7	45.72	0.004	145.1	37.45	182.5	0.205
October	137.2	133.3	41.59	0.011	151.1	37.55	188.6	0.199
November	115.1	114.5	37.44	0.006	150.5	32.03	182.5	0.175
December	123.5	128.3	41.78	0.012	150.6	37.98	188.6	0.201
Year	1926.2	1805.4	562.77	0.053	1750.5	470.13	2220.7	0.212

Legends:	GlobHor	Horizontal global irradiation	E_Miss	Missing energy
	GlobEff	Effective Global, corr. for IAM and shadings	E_User	Energy supplied to the user
	E_Avail	Available Solar Energy	E_Load	Energy need of the user (Load)
	EUnused	Unused energy (battery full)	SolFrac	Solar fraction (EUsed / ELoad)

PVsyst Evaluation mode

Fig. 11. Stand alone: Main results

Loss diagram over the whole year

1926 kWh/m²   **Horizontal global irradiation**
+1.9%   **Global incident in coll. plane**
-0.04%   Global incident below threshold
-3.15%   IAM factor on global
-5.00%   Soiling loss factor
1805 kWh/m² * 3 m² coll.   **Effective irradiation on collectors**
efficiency at STC = 15.22%   PV conversion
904 kWh   **Array nominal energy (at STC effic.)**
-0.04%   PV loss due to irradiance level
-22.70%   PV loss due to temperature
-4.00%   Module quality loss
-1.00%   LID - Light induced degradation
-3.00%   Mismatch loss, modules and strings
-3.88%   Ohmic wiring loss
+0.01%   Unused energy (battery full)
619 kWh   **Effective energy at the output of the array**
-8.64%   Converter Loss during operation (efficiency)
-0.05%   Converter Loss due to power threshold
+0.00%   Converter Loss over nominal conv. voltage
-0.43%   Converter Loss due to voltage threshold
   Converter losses (effic, overload)
   Battery Storage
-0.27%   Battery Stored Energy balance
-16.44%   Battery efficiency loss
-1.86%   Charge/Disch. Current Efficiency Loss
+0.00%   Gassing Current (electrolyte dissociation)
-0.13%   Battery Self-discharge Current
   Energy supplied to the user
   Energy need of the user (Load)

Missing energy
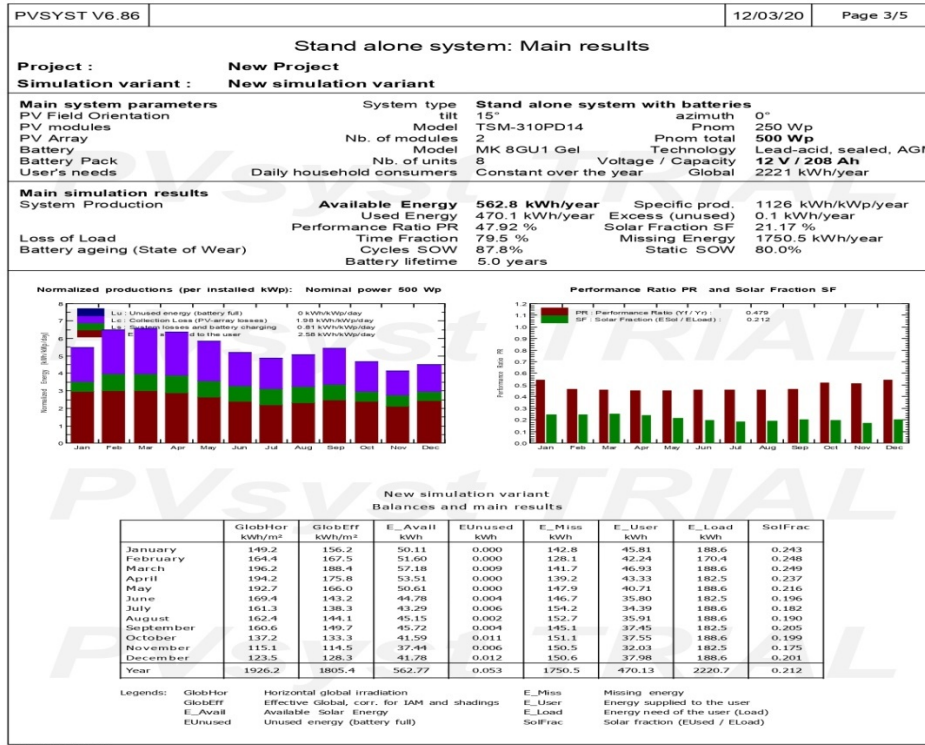78.83%

Direct use 42.9%   Stored 57.1%
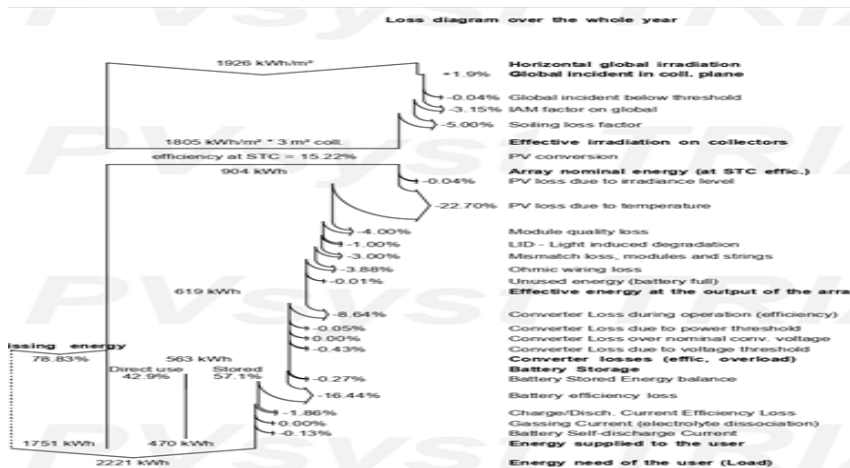563 kWh
1751 kWh   470 kWh
2221 kWh

Fig. 12. Standalone: Loss Diagram

4 Conclusion

HOMER PRO Software is a suitable answer for meet the neighborhood loads in rustic, remote, and the urban regions, similar to colleges and medical clinics and enterprises. Deciding the ideal sizes of gear is the significant worry of specialists. HOMER programming is a useful asset utilized by numerous scientists around the globe for ideal arranging of the hybrid framework. As indicated by the capacity and across the board utilization of this product. The product has been utilized in creating nations more than different locales, particularly in remote and provincial zones. The product has been utilized for a wide scope of burden from 0.626 kW to 2,213,000 kW. PV is a famous asset considered by numerous specialists. The Analysis of PV-Solar And Windmill Using Real-Time Simulation Tool has been demonstrated in an independent mode more than hybrid associated mode. Wind speed, sunlight based radiation, part cost, and essential burden are the most dubious boundaries alluded to in the articles.

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