International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Energy Management of a Solar and Wind Energy Hybrid System

[1]Sitanshu Pachori, [2] Varun Brijpuria

[1] M-Tech (Student), [2] HOD (Mechanical Engg. Dept.)
[1,2] Shri Ram Institute of Science and Technology Jabalpur

ABSTRACT:

Renewable energies are considered natural resources of clean energy that the planet offers with no intervention of humans. Those natural resources are essential for life, buw aw we may know the excessive use of them has always caused incalculable damages on our planets and us as humans, for this reason they can be quickly exhausted. On this ground, In this project, a designed hybrid system will be constructed combining solar energy and wind. Ssuccinctly, this hybrid system is a backup mechanism as well as a long term key to preserve energy and provide for other uses.

Introduction

Presently , the request for electricity has been increasing, and this huge demand can't be satisfied by source that are non renewable, for this reason wind and solar sources that are renewable energy became prevalent [10]. Starting to use those renewable energies made a reduction in terms of fossil fuel since they change them with sources of competitive impact and cost. Photovoltaic PV and wind turbines are generators that have been advanced to meet the economical and environmental needs. Those generator can be sometimes costly and uncertain , for this reason integrating them in a storage process would be more efficient. This system is called Hybrid system. This system combines the two generators creating a better use of natural sources [11]. Hybrid system were developed to enhance living standards using further cost effective, and environmentally friendly techniques. Those power system which are Hybrid that are composed of PV and wind can be used to diminish energy storage requirements. Some of the hybrid system can also depend on storage using batteries , but most of them are more into PV and wind energy usage[12]. Standalone technique is a system similar to hybris system , nethertheless they have dissimilar output factors. Taking the hybrid system it can be used as an alternative for gas or wind, and the hybrid PV system works in a way that when the solar source or panels can't provide the required energy , it is automatically switched to provide the required energy. For the ones that count on wind, it works in parallel with season , it provides energy when the season is favorable for such condition , when not the system is diminished [13]. Owing to the change of weather , there is no prediction in the usage of those systems , since they can provide wind when needed and also the solar energy.

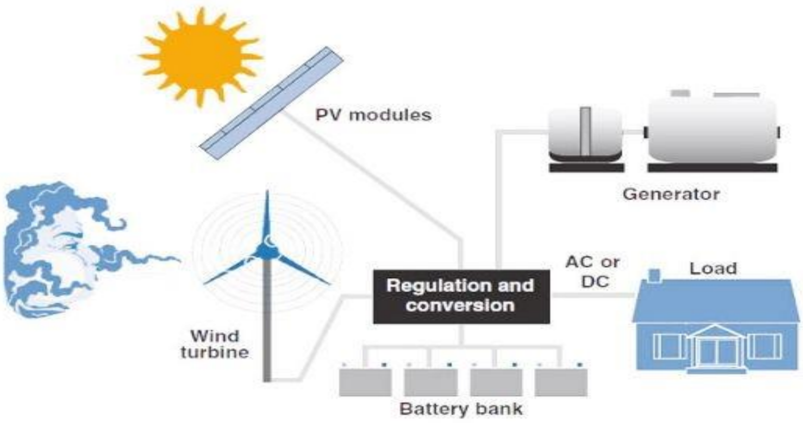


Figure: Hybrid system.

LITELATURE REVIEW

1. Energy Management in Grid Connected Photovoltaic System by Raja Azad Kumar Mishra, Prof. Ashok Kumar Mahapatra , Amit Goshwami…………..2020

In this work A five parameter model of PV modules has been implemented in Simulink/Matlab. The parameters of the model are determined by an approximation method using data sheet values. Inputs to the model include light intensity and ambient temperature. The outputs are any measurements of interests as well as power, current and voltage. A maximum power point tracking algorithm is used to keep the voltage at the maximum power point at all times. utilization of a boost converter for control of photovoltaic power using Maximum Power Point Tracking (MPPT) control mechanism is presented. The Perturb and Observe algorithm utilized for MPPT is a generalized algorithm and is easy to model or use as a code. A battery storage system based on li-ion battery is connected with the photovoltaic plant to store the extra energy generated and/or to fulfil the requirement of the connected load at the time of any discontinuity of the grid supply or any load changes in the grid system. The PV plant with MPPT controller and boost converter is integrated into the AC utility grid by DC/AC inverter to control the active and reactive powers for the desired power factor at the connection point.

This work deals with the management of Energy Storage System connected in a microgrid with a PV array and regulate the battery charge, hold and discharge operations using DC-DC bidirectional converter based on the requirement of the Load. The PV array along with the battery and load is simulated for various conditions such as PV supplying and charging the battery, PV supplying only the load, battery supplying the load and PV-Battery both supplying the load. In this dissertation, different cases are simulated, and the results have verified the validity of models and control schemes.

Scope for Work

1. Improvement to this work can be made by tracking the maximum power point in changing environmental conditions by different algorithms using other techniques. Environmental change can be change in solar irradiation or change in ambient temperature or even both.

2. Further study can be made using optimization methods such as Neural Network, Genetic Algorithms, Particle Swarm Optimization etc. to achieve maximum power at grid

2 On the Reliability Improvement of Distribution Systems Using PV Grid-Connected Systems Prakasit Sritakaew1 , Anawach Sangswang2 , and Krissanapong Kirtikara ,……………………………………..2007

The purpose of this paper is to examine issues related to the distribution system reliability improvement using photovoltaic (PV) grid-connected systems. The output characteristics of a PV system are experimentally measured. The measured data are used to investigate the effects of PV system installation to improve the distribution system's reliability. The system constraints such as, recovered real power, and loading reduction of the tie line/switch after the installation of PV grid-connected systems are concentrated. Simulation results show that with the action of a tie switch, system losses and loading level of the tie switch can be reduced with proper installation location.

3 Grid-based multi-energy systems—modelling, assessment, open source modelling frameworks and challenges by Lukas Kriechbaum* , Gerhild Scheiber and Thomas Kienberger ……………………………………………………….2018

In this paper, we presented an overview of the current research and challenges of modelling grid-based MES. General and specific aspects of modelling grid-based energy carrier systems have been provided. In order to provide a robust and efficient future energy supply, MES models should incorporate the interactions between different energy carriers, and the representation of load flows in grids. They should also enable the cost efficient integration of high shares of RES by using available synergies the different energy grids provide. The aspects which necessitate a power-based perspective in future planning models have been discussed. These aspects include the representation of modelling details, temporal and spatial resolutions, and network representations. Presented are three open source modelling frameworks that have been tested and used by the authors. The challenges discussed show that there are still wide gaps and several opportunities for future research topics. From a technical perspective, the amalgamation of planning and operational models [11] is a major challenge. This is because it demands finer temporal and spatial resolutions and requires the implementation of a lot more technical details into the model. Moreover, the complexity of a model increases when accounting for interdisciplinary aspects such as the interdependency of the food and water sector [29], or human behaviour in an energy system. The most common model families, like simulation and optimisation, might not be sufficient for solving the resulting (usually non-linear) mathematical problem. Model coupling or new modelling approaches like agentbased-modelling might be necessary to obtain robust and relevant results.

Findings

1. The flexibilities offered by one energy carrier that can be used by another energy carrier, e.g. the enormous storage capacity of the natural gas grid is used with power-to-gas plants .

2. For example, World Energy Model (WEM), National Energy Modelling System – Residential Sector Demand Module (NEMS-RSDM)

3. For example, MARKAL/TIMES, MESSAGE

4. For example, Prospective Outlook on Long-term Energy System (POLES), Price-Induced Market Equilibrium System (PRIMES)

4. Energy management in the smart grid: State-of-the-art and future trends Meryem Meliani1, Abdellah El Barkany1, Ikram El Abbassi2, Abdel Moumen Darcherif2, and Morad Mahmoudi The use of Energy Management Systems can effectively increase the balance between supply and demand and decrease peak load throughout unplanned durations. The energy management system is capable of not only sharing or exchanging energy between the different energy resources available, but also of economically supplying loads in a reliable, safe and effective manner under all conditions necessary for the operation of the power grid. This work outlines the structure, goals, benefits and defies of the energy control system via an in-intensity analysis of the distinctive stakeholders and participants engaged on this system. A detailed essential analysis of the functioning of distinct programs which includes Demand Response, Demand Management and Energy Quality Management implemented inside the electricity management gadget is presented in this review. It also summarizes quantifications of the various strategies of uncertainty. It includes as well a comparative and an important assessment of the primary optimization techniques which are used to obtain the extraordinary goals of energy management structures while at the same time meeting a wide range of requirements.

5. Optimal Design and Energy Management of a Hybrid Power Generation System Based on Wind/Tidal/PV Sources: Case Study for the Ouessant French Island

BY O.H. Mohammed, Yassine Amirat, M.E.H. Benbouzid, G. Feld

Hybrid power generation systems have become a focal point to meet requirements of electric power demand. This kind of system combines several technologies and is considered as one of the appropriate options for supplying electricity in remote areas, such islands, where the electric utility is not available. It is one of the promising approaches due to its high flexibility, high reliability, higher efficiency, and lower costs for the same produced energy by traditional resources. Typically, hybrid power generation systems combine two or more conventional and renewable power sources. They will also incorporate a storage system. This chapter will focus on a typical hybrid power generation system using available renewables near the Ouessant French Island: wind energy, marine energy (tidal current), and PV. This hybrid system is intended to satisfy the island load demand. It will therefore explore optimal economical design and optimal power management of such kind of hybrid systems using different approaches: (1) Cascaded computation (linear programming approach); (2) Genetic algorithms-based approach; (3) Particle swarm optimization. In terms of economical optimization, different constraints (objective functions) will be explored for a given 25 years of lifetime; such as minimizing the Total Net Present Cost (TNPC),

Wind and solar energy assessment:

To design the hybrid system, we need to secure an applicable level of authenticity and efficiency of our design. Hence to satisfy the electricity needs, solar and wind potential assessment need to be evaluated for our studied location: Taza, taking into consideration that wind and solar have irregular characteristics. In this first part, the potential as well as the power assessment of both the wind and solar will be illustrated in depth

3.4.1 Wind potential assessment :

It is critical before installing the wind turbine to assess the power output, and to comprehend the amount of wind energy we need to satisfy the refrigerating unit electricity needs.This step of wind resource assessment is necessary for the success of such a development which is the hybrid system. To assess wind distribu tions we will use Weibull distribution as it is relatively simple and easy to implement and uses parameters that we can derive from different other approaches. We applied this method of moments to find the weibull distribution parameters , however in our study we used retscreen which is a software that helps determine those parameters.

To calculate the parameters that describe the weibull distribution , several methods have been developed , the most broadly used one is the method of moments since it is effective and simple to apply .

The first moment is done about the origin and the second one about mean to calculate the parameter ‘k ’ and ‘c’. This method includes the mean wind speed along with the standard deviation:

- ➢ k a parameter that indicates the shape of the Weibull distribution, this parameter takes values within the range of 1 to 3. If the value of K is large it means that the wind is constant , for the case of small K quite variable winds.

It is estimated as K= (0.9874/σ/Vave) 1.0983…………………(1)

- ➢ c is the scale parameter, it is equal to the wind speed’s mean and it is a measure that characterises the wind speed.

It is estimated as : *c* : Vave/Γ(1+1/k) ……………………..(2)

- ➢ *Γ* the gamma function that is calculated following this equation :

$$\Gamma(x) = \int_0^{\infty} t^{x-1} e^{-t} dt$$

Naturally, the speed of the wind varies in a constant way. With the purpose of determining the frequency of every wind speed, some analysis must be done. Ordinarily, wind is measured using anemometer and its mean is noted ever 10 mins.

The primary focus is to approximate the wind speed frequency, hence diverse methods have been applied ending up by applying Weibull distribution [21,22,23].

The following equation describes the energy that the wind contains at specific site:

$$f(v) = \frac{k}{c} \cdot \left(\frac{V}{c}\right)^{k-1} . e^{-\left(\frac{V}{c}\right)^{k}} \quad (3)$$

The value of those parameters are at a height of z_a which means that they will be written as

A_a and K_a , to evaluate those parameters at a higher height (z_z) the following equations will be applied :

- To calculate the scale parameter A_z at a height z_z **:**
-

$$C_z = C_a . \left(\frac{Z}{Z_a}\right)^{n} \quad (4)$$

- n is expressed as :

$$n \text{ is expressed as : } n = \frac{(0.37 - 0.088 \, ln \, c_a)}{(1 - 0.088 \, ln \, (\frac{Z_a}{10}))}$$

- To calculate the shape parameter Kz at a height zz **:**

$$k_z = \frac{k_a . (1 - 0.088 \, ln \, (\frac{Z_a}{10}))}{(1 - 0.088 \, ln \, (\frac{Z}{10}))} \quad (5)$$

When estimating the weibull distribution parameters at different heights , the wind speed should also be taken into account and computed in different heights using the wind vertical profile. In general terms, the evaluation of the wind speed is made in a regular height of 10 m. Considering that this design mainly implicates wind energy conversion system , wind speed at varied elevations need to be conducted applying this equation.

$$V_a = V_z . \left(\frac{Z_z}{Z_a}\right)^{m}$$

- V_{z1} is the wind speed that is usually measured at 10 m.
- V_{z2} is the wind measurement that is required.
- $m$is the wind exponent gradient

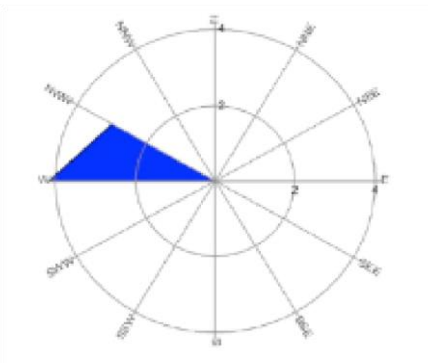


Figure 14 : Mean wind speed direction in the studied location.

3.4.2 Pv potential assessment:

Hybrid system involves dynamic behaviors such as wind and especially solar energy. Solar energy is a parameter that unables to produce energy identical to the energy produced by the wind, hence this parameter is fundamental in the design of hybrid PV-wind system.

When speaking about solar energy , solar irradiation need to be determined which is the power received from the sun and the amount of energy that gets to the surface over a time period. In this study PVGIS has been exploited to determine the solar irradiation over the whole year, In this part we will have to extract the irradiation on optimally inclined plane from PVGIS and then calculate its average to get the irradiation needed for our calculations.

3.4.3 Wind power assessment :

Determining the wind power is a crucial step in the implementation of wind turbines, given that this parameter can calculate the number of wind turbines needed for our system as well as estimating the actual energy production needed to satisfy need . The required electrical power of the wind is needed applying this equation :

$$P_w = \frac{E_{Load}}{C_{ptot} \cdot 24h/day}$$

- ➢ E_{Load} (Kwh/day) the electricity demand on a daily basis.
- ➢ C_{ptot} the total efficiency of the wind energy harvester (conversion system).

$\mathbf{C_{ptot}}$ is the total efficiency that the wind will provide to the system when is wind energy is projected. The efficiency of the wind power is impossible to be 100 % since the generators are not perfect nor the wind blades, and it is also due to the losses under the act of viscosity. Wind turbines are optimally designed to perform at an exact average which gives them an efficiency of approximately 40 to 50%[28].

3.4.4 Pv power assessment :

Pv power need to be assessment to be able to determine and choose the right solar panels for the refrigerating unit. This parameter will allow us to ascertain the type of solar panels we need depending of the value of the solar power , as well as the number of solar panels that we will need to instal to meet the electricity needs.

To determine the required power of PV , this equation is used :

$$: \ P_v = \frac{E_{Load}}{I_{rr} \cdot \eta_{tot}}$$

- ➢ I_{rr} the daily irradiation per year of the studied location.
- ➢ η_{tot} efficiency of the photovoltaic system.

Solar panels can not operate with an efficiency of 100%, since many losses do occur. taking into consideration the efficiency of the cables, also is battery , which makes the efficiency achieve a maximum of 60 %which is enough to generate the energy needed for any use. Which means that η_{tot} =60%

3.4.5 Wind capacity factor :

The capacity factor is known to evaluate the productivity of the wind power , it is defined as the power generated from the wind AEP_w on a period of time over the rated power P_{rated} in the same period of time.

$$C_{fw} = \frac{AEP_w}{8760 * P_{rated}} \quad (9)$$

The wind generation capacity factor is as follow AEP_w is the actual energy production of the wind.

P_{rated} is the power of the wind , and 8760 is the amount of hours during the year. Another method has been generated to compute the capacity factor.

as follow :

$$C_{fw} = \frac{e^{(-(\frac{V_c}{c})^k)} - e^{(-(\frac{V_r}{c})^k)}}{(\frac{V_r}{c})^k - (\frac{V_c}{c})^k} - e^{(-(\frac{V_f}{c})^k)} \quad (10)$$

This equation is composed of the rated wind speed , cut-in wind speed as well as cut-out wind speed. The standard values are defined in the table below[32] :

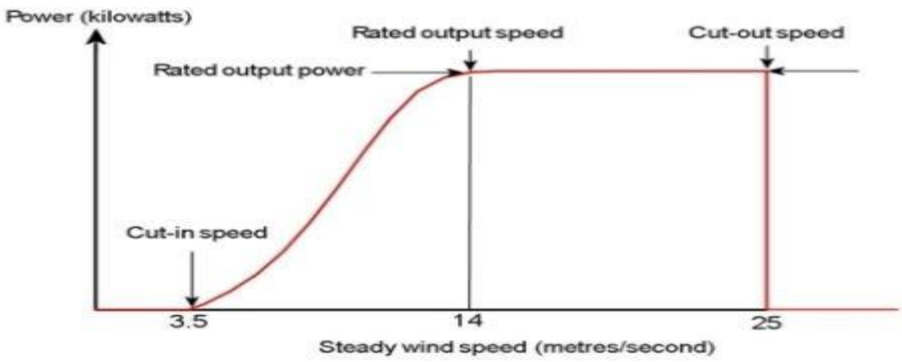


Figure : Graph defining the standard values of wind speeds.

From this table we will take the cut-in wind speed V_c to be 3.5 m/s, the rated wind speed V_r to be 14 m/s, and the cut-out wind speed V_f to be 25 m/s.

3.4.6 PV capacity factor :

Pv power need to be assessment to be able to determine and choose the right solar panels for the refrigerating unit. This parameter will allow us to ascertain the type of solar panels we need depending of the value of the solar power , as well as the number of solar panels that we will need to instal to meet the electricity needs. To determine the required power of PV , this equation is used

$$P_v = \frac{E_{Load}}{I_{rr}.\eta_{tot}} \quad (8)$$

The capacity factor will relate the theoretical output of power with the actual one. For PV generation system , the capacity factor relates power , energy and time accordingly the formula is settled as the actual energy generated over the actual energy if it intervenes and its most energy.

The formula goes as :

$^{C}{}_{f}v = {}_{8}7_{6}{}^{A}{}_{0}{}^{E}{}_{*}{}^{P}{}_{P}{}^{v}rated$ (11)

AEP_v is the actual energy production of the Pv generation system.

P_{rated} is the power of energy generated by the Pv generation system.

To calculate AEP_v we will need to set the previous equation equal to the amount of solar energy received by the PV panels : 876*A*0 *E* PPvrated* = 876*H*0*t o*t*. *PPRated* (12) PR is the efficiency of the Pv generation system which is about approximately 80% since a generating system of photovoltaic can never be 100 % considering the losses

H_{tot} is given by the energy acquired in 365 days : $H_{tot} = 365.(I_{rr}.S_v.\eta_p)$ ○ With S_v the surface of the photovoltaic panels.

η_p is the efficiency of the solar panels

4. Evaluation of the hybrid system design:

4.1 Load requirement E_{load} :

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Units	400	450	500	900	1200	1844	3538	3560	3626	3538	1960	550	22066

Table : Electricity consumption of full hours during the year.

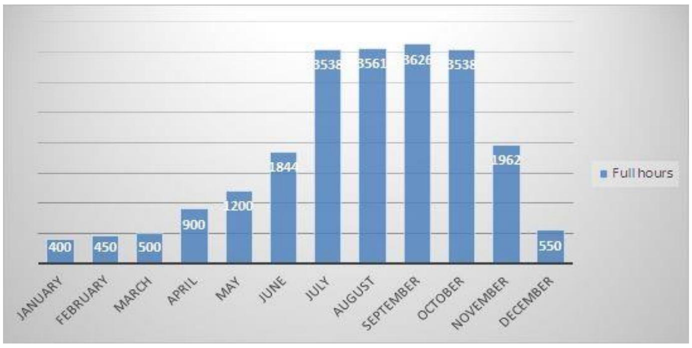


Figure : Graph representing full hours of electricity consumption.

3 Hybrid system power assessment P_w / P_v :

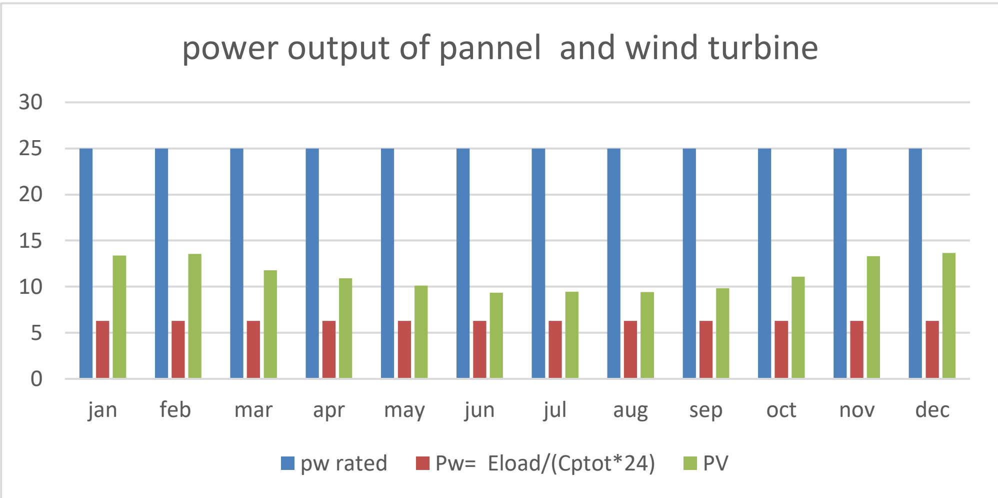
4.3.1 Pv power assessment:

After calculating the electrical daily consumption that has a value of 61.30278 Kwh/day, the required power of PV will be calculated using the equation 8 mentioned in the first part with a total efficiency of the photovoltaic system of 60% and an average irradiation of 5.995 kwh/m².day. :

$$P_v = \frac{E_{load}}{I_{rr} \cdot n_{tot}} \quad \Rightarrow \quad P_v = \frac{61.30278\ Kwh}{5.995\ kwh/m^2.day * 0.6} \Rightarrow P_v = \mathbf{17.0427\ KW}$$

The power calculated stands for the output of the power required that is needed to cover the load requirement when the PV system is used alone.

Month	Ir	Pv=E/I*eff	Eload	Cptot	pw rated	Pw= Eload/(Cptot*24)	PV
Jan	7.624194	13.3784641	60.45	0.4	25	6.296875	13.37846414
Feb	7.530345	13.5451964	60.45	0.4	25	6.296875	13.54519645
Mar	8.666774	11.7690848	60.45	0.4	25	6.296875	11.76908475
Apr	9.341667	10.9188225	60.45	0.4	25	6.296875	10.91882248
May	10.07452	10.1245557	60.45	0.4	25	6.296875	10.12455573
Jun	10.90533	9.35322167	60.45	0.4	25	6.296875	9.353221665
Jul	10.80839	9.43711574	60.45	0.4	25	6.296875	9.43711574
Aug	10.82548	9.42221163	60.45	0.4	25	6.296875	9.422211627
Sep	10.36133	9.84429288	60.45	0.4	25	6.296875	9.844292884
Oct	9.18871	11.1005793	60.45	0.4	25	6.296875	11.10057925
Nov	7.663333	13.3101348	60.45	0.4	25	6.296875	13.31013484
Dec	7.469032	13.6563877	60.45	0.4	25	6.296875	13.65638767



Optimisation methodology:

The electricity consumption takes into account the amount of electricity used and consumed during the year, this consumption is made based on the supply given which is in this case electricity from l'ONE. When analysing the bills as stated before , we could conclude the amount of electricity consumed yearly based on the electricity used during full hours since it is the time where most of electricity is used.

To extract the total electricity consumption , we will use table 3 and sum up all the electricity consumed during full hours .

After summing up all those values will get value for the total electricity consumption of **22069 kWh/year**.

First and foremost , to start with the optimisation methodology we had to know the electricity consumption, and approach it with each actual production energy to see if the value is almost equal to electricity consumption when each system of the wind and solar is used alone . The wind and solar gave us an actual energy production of of AEP_w

=12383.15 KWh/year and AEP_v **=11129.6703kWh/year,** as we can terminate from those values , each system has a capacity that could generate electricity as an alone system. When summing us both system we will get a value of **23512,22 kWh/year** which is the amount of energy we exactly need, with the losses we can for sure get a value of **22069 kWh/year [44]**. Following the calculation of the capacity factor and the investment of the installation , we will now conduct the optimization using GRG in excel. The purpose of the excel solver is to find the right combination of solar and wind as percentages , those percentages will allow us to determine the right percentage of wind we need to satisfy the needs and the right percentage of solar we need to satisfy the need. The combination of the two percentages need to be equal to 100% which means that they satisfy the need completely. Using excel solver the target must be set to be the initial investment of the hybrid it implies that the hybrid installed need to satisfy the price known widely and give the minimum value by setting the excel solver as a target of the minimum , the wind and solar power are taken as variables along with the surface that should be covered by solar panels and the electricity load of 22066 kWh as main constraints,

Month	Jan	Feb	Mar	April	May	June	July	Aug	Sep	August	Nov	Dec
Full hours	**400**	**450**	**500**	**900**	**1200**	**1844**	**3538**	**3561**	**3626**	**3538**	**1962**	**550**

AEPw			**Area**	**No of Pannel**		**Wind Mill**	**Wind Mill**
2265.134	**22066**	**178.7499**	**20**	**10**	**3574.997**	**18491**	**18121.07**
2265.134	**22066**	**178.7499**	**40**	**20**	**7149.995**	**14916.01**	**15855.94**
2265.134	**22066**	**178.7499**	**50**	**25**	**8937.494**	**13128.51**	**13590.8**
2265.134	**22066**	**178.7499**	**60**	**30**	**10724.99**	**11341.01**	**11325.67**
2265.134	**22066**	**178.7499**	**70**	**35**	**12512.49**	**9553.509**	**9060.535**
2265.134	**22066**	**178.7499**	**75**	**37.5**	**13406.24**	**8659.76**	**9060.535**
2265.134	**22066**	**178.7499**	**80**	**40**	**14299.99**	**7766.01**	**6795.401**
2265.134	**22066**	**178.7499**	**90**	**45**	**16087.49**	**5978.512**	**6795.401**
2265.134	**22066**	**178.7499**	**100**	**50**	**17874.99**	**4191.013**	**4530.268**
2265.134	**22066**	**178.7499**	**110**	**55**	**19662.49**	**2403.514**	**2265.134**
2265.134	**22066**	**178.7499**	**120**	**60**	**21449.98**	**616.0154**	**0**
2265.134	**22066**	**178.7499**	**124**	**62**	**22164.98**	**-98.9841**	**0**

The above table shows the optimization of hybrid system in witch power by solar and wind installation can be selected as per area and requirement of the plant/ institute.

Results and discussion:

In this last part , we will start by discussing the placement of solar panels and wind turbine in the location chosen, as it is said by the owner the whole surface of 1391 m² won't be used completely due to security reason as well as esthetique ones.

To know the exact surface that will be covered by the solar panels if the solar power is used completely alone is by calculating first the number of solar panels used and then multiplying it by the surface of each solar panel: The number of solar panels will equal to $n = \frac{P_v}{320}$ which gives a value of 54 solar panels to install when solar power is used alone , then we will calculate the surface covered by the needed solar panels by the equation : $n * S_v$ that gives a value of 104.76 m². Moving on to the number of wind turbines we need to use, we chose wind turbines that generate 6kW which mean that the actual productivity will be equal to 6kW* the number of hours it will be working which is 24 hours all day long * the capacity factor * number of day it will operate which is 365 days those calculation will give a value of **12088.8 Kwh** which is approximately half the electricity consumption we need to generates , it means that two wind turbine will deliver the energy we need for the electricity consumption.

Thereafter using the optimization tool , the main constraint will be the surface used for solar panels , and as stated before the investment cost will be the main target to get the best combination with the least cost possible and the other variables the wind and solar power.In this final step will be demonstrated the management of the hybrid system configuration which means the exact percentages of solar energy and wind energy that will be used in different surfaces. The following table represents the results obtained using the solver in the software excel:

Surface taken (m²)	P_v **(kW)**	P_w **(kW)**	**%** P_v	**%** P_w
20	3.29	22.46	26.07	73.92
40	6.59	14.53	52.15	47.84
50	8.24	10.57	65.19	34.80
60	9.89	6.61	78.23	21.76
70	11.54	2.65	91.26	8.73
74	12.20	1.06	96.48	3.51
> 74	12.65	0	100	0

Table 9 :Results of Optimisation at different surfaces.

After managing the percentages needed to cover the needs of electricity we will be able to calculate the number of solar panels in each surface used by solar energy , wheres the number of wind turbines used will be the same since it doesn't depend on the surfaces stated before. The following table represents the number of solar panels at each surface used by solar energy : to calculate the number of solar panels in each case we will divide the solar power in each surface by 320 which is the peak power of our chosen solar panels :

Surface taken (m²)	**Number of solar panels**
20	10
40	20
50	26
60	31
70	36
74	39

Table 10: number of solar panels at different surfaces.

From this table we judge that every time the surface of solar energy used increases the number of solar panels increases reaching beyond 74 m² 54 solar panels as calculated before when solar energy is used alone since when exceeding a surface of 74 m² the solar energy's percentage attain 100%.

Conclusion:

In this work, an economic pattern has been constructed to develop a hybrid design process which has been based on generalized reduced gradient algorithm known as excel solver . This procedure enabled us to find a right hybrid system configuration in terms of solar and wind energy, this configuration will allow us to meet the exact electricity load with the least investment cost.

The principle aim of this study is to scheme a hybrid system that will allow every owner of a refrigerating unit to first lower the price of electricity consumption as well as be more dependent on the hybrid system then other external energies. This new system of energies has not only been designed to meet the urgent need to electricity , bu also to demonstrate that combining wind and solar power is a solution that generation have to start using. The concept of adopting a hybrid system has been done to make new generations believe that the combination of solar and wind power is much more efficient than using one of them alone , people still think that hybrid systems still are expensive that's why we plugged the initial investment to be the target to prove the opposite.

In the first part of this study , the typical electricity consumption of a refrigerating unit has been analyzed moving to management techniques chosen for the location as well as the solar panels and wind turbines to be used in this project. Following , a hybrid design proposal has been suggested to find the actual energy production of each the wind energy and solar energy, to calculate those two parameters the capacity factor has been studied and analyzed.Afterwards calculations have been made to calculate every parameter to get the actual energy production, then we compared it to the electricity consumption which is approximately the same.In accordance with those calculation , a clear vision of the hybrid system started to be constructed rather than assumptions. Using the excel solver and setting the initial investment as the target and the solar and wind power as variable , adding to it the electricity load as the constraint with the surface used by solar panels, we were able to find combinations for the solar and wind energy based on percentages on each surface area covered by solar panels . Taking everything into account, hybrid systems have been known to be systems that help much more than one system alone , they take into consideration sun and wind because every location is characterised by different weather condition .Those systems have a sparkling future as combined renewable energies , and the world today still know more renewable energies that can help in the extraction of electricity and supply and use it in different domains.

Future scope:

Similar system can be design for the other industries and house hold purpose to make energy sustainable buildings and operations. More combination of renewable energy like fuel cell biogas and other can be design and calculated for maintaining the alternative supply of electrical energy in a grid based system. Cost of system can be reduce by Appling cost optimization.

1. Energy Management in Grid Connected Photovoltaic System by Raja Azad Kumar Mishra, Prof. Ashok Kumar Mahapatra , Amit Goshwami 2020
2. On the Reliability Improvement of Distribution Systems Using PV Grid-Connected Systems Prakasit Sritakaew1 , Anawach Sangswang2 , and Krissanapong Kirtikara .2007
3. Grid-based multi-energy systems—modelling, assessment, open source modelling frameworks and challenges by Lukas Kriechbaum* , Gerhild Scheiber and Thomas Kienberger .2018
4. Energy management in the smart grid: State-of-the-art and future trends Meryem Meliani1 , Abdellah El Barkany1 , Ikram El Abbassi2 , Abdel Moumen Darcherif2 , and Morad Mahmoudi
5. Optimal Design and Energy Management of a Hybrid Power Generation System Based on Wind/Tidal/PV Sources: Case Study for the Ouessant French Island BY O.H. Mohammed, Yassine Amirat, M.E.H. Benbouzid, G. Feld