DESIGN PROJECT REPORT

Design of Self Sustainable Township

Submitted to

B.Tech in Mechanical Engineering
With Specialization in Energy Engineering

by

Kota Srinivasa Aravind
14BEM0002

Konapareddy Bhanu Vikash
14BEM0015

Under the Guidance of
Prof. Vignesh.G

School of Mechanical Engineering

NOVEMBER 2017

Table of Contents

1. Abstract

- Solar is great. But, what happens when monsoon sets in? This is not a problem for most of Tamil Nadu but what about places where it does. And then there are other places where wind offers great potential but not so in summer. Is there a way to offset these seasonal changes? Yes, the answer is – Wind Solar Hybrid System.
- With Wind Solar hybrid system, you can benefit from both forms of energy sources which happens to give way to each other in different seasons of the year

2. Introduction

2.1 Purpose of the Project

- We are in a time in which the resources for producing energy are decreasing dame by day and the harmful effects of using these resources is increasing day by day.
- If we continue to use these resources at the same rate, there won't be much left for our further generations.
- So sustainable development is of the utmost importance now more than ever.

2.2 Scope for the Project

- Further additions can be made to this project by installing rain water harvesting and also electricity can be generated by using this rain water and the water used by the whole township.
- This project can also be applied in universities, schools, industries and wherever possible.

2.3 Realistic Constraints to be addressed

☒Economic

The initial capital investment is high but now subsidies are being given by the govt. and the return in investments is very high. Once the solar panels and wind turbines are bought and installed there won't be any further expenses as the maintenance cost is near to zero and they have a very long life span.

☒Environmental

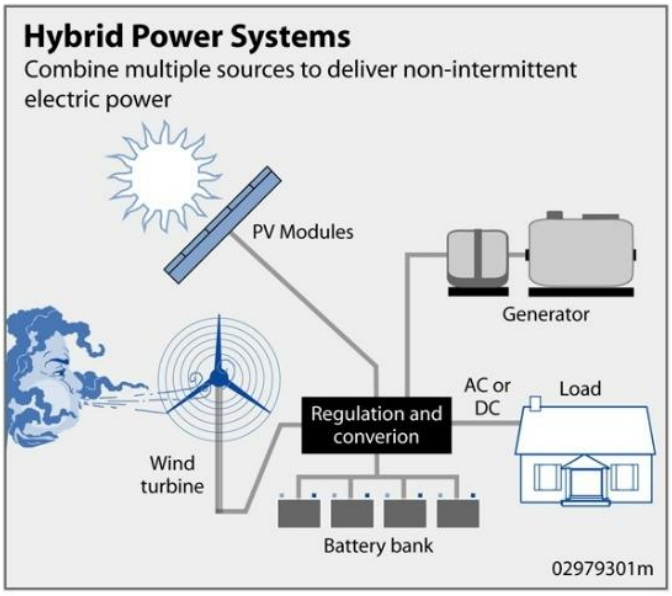
Reduces a great deal of load from the environment since it doesn't produce any greenhouse gases during its working and there is no dependence on fossil fuels. So what we are producing is clean and green energy.

☒Sustainability

The township is a good example of self sufficiency that is this township works with solar energy and wind energy which are renewable in nature and the main advantage of this project is its sustainability.

3. Project Plan

- In this project the objective is to design a township which is self-sufficient in energy by using renewable resources like solar and wind energy.
- This township consists of 100 no of houses which don't depend upon external energy resources but manufacture their own energy to meet their energy demands.
- This is done by installing the required quantity of solar panels and wind turbines.
- The no of solar panels and wind turbines required are calculated by calculating the power consumed by an average house and thus by calculating the energy required by the township.
- The ideal sites for establishing this township are listed by taking the data of the average wind velocity in the particular sites.
- The total cost for installing the solar panels and wind turbines is calculated.
- The time taken for the return of investment is also calculated.



3. Progress of work

1. Township

DEVICE	POWER RATING (W)	NO OF HOURS	QUANTITY	TOTAL ENERGY (WHr)
FAN	60	8	7	3360
TUBE LIGHT	50	8	10	4000
REFRIGERATOR	200	12	1	2400
TV	150	6	1	900
AC	1200	3	2	7200
WASHING MACHINE	500	2	1	1000
OTHERS	1000	-	-	1000
			TOTAL	19860

TABLE: ENERGY CONSUMPTION FOR A HOUSE PER DAY

Energy calculations

- Total energy required for a house per day=20000 WHr= 20 kwh
- Therefore, the energy required for a house per month = 30*20 = 600 kwh
- Therefore, the energy needed for the whole township per month = 600*100=60,000 kWh

2. Solar

2.1 Solar Panels

- As of 2017, a typical solar panel produces around 250 watts of power**.**
- So for an average solar time of 6 hours a solar panel produces 1500 WHr= 1.5 kwh
- No of solar panels required to satisfy the half of the energy demand of the township= 45,000/(1.5*30) = 1000 panels

2.2 Solar Water Heating

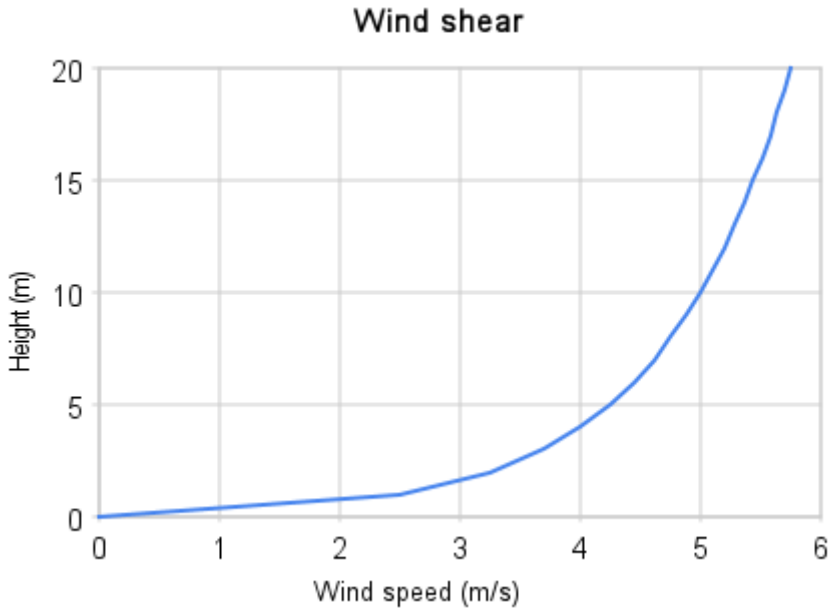
- A domestic solar water heater, with a capacity of 100 lpd (liters per day), is sufficient for a family of four or five members. It can easily replace a 2-kW electric geyser and can save up to 1500 units of electricity a year. It pays back the cost in three to five years depending on the electricity tariff and hot water use in a year. After this, hot water is available almost free of cost during remaining lifespan of the system, which is about 15-20 years.

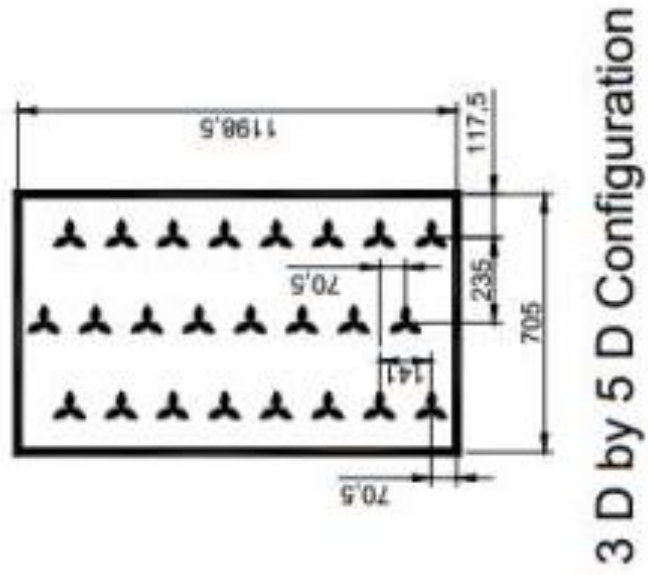
2.3 Incentive for solar rooftop

- For individual applicants only 1 KWp plants for residential purpose will be considered for a TamilNadu Government subsidy of **Rs. 20,000/-** per kWp
- Solar power that is not consumed in the residential building can be exported to the TANGEDCO grid and will be eligible for solar net-metering. In solar net-metering the consumer pays for the net energy imported from the TANGEDCO grid (= energy imported from the grid minus energy exported to the grid).
- The applicant shall make payment of the solar PV system cost to the Installer excluding 30% Ministry of New and Renewable Energy (MNRE) subsidy, Rs. 20,000 per kWp State Incentive.

3. Wind Turbines

- A 10-kW wind turbine can generate about 16,000 kWh annually, more than enough to power a typical household
- Monthly energy generation of turbine= 1333.33 kwh
- No of wind turbines required = 30000/1333.33 = 22.5=23
- Wind turbines produce no pollution and by using wind power you will be offsetting pollution that would have been generated by your utility company. Over its nominal 30 year life a wind turbine will offset approximately 1.2 tons of air pollutants and 200 tons of greenhouse gases.





3.1 Ideal wind sites in Tamil Nadu

STATION	LATITUDE (*N)	LOGITUDE (*E)	AVG. ANNUAL WIND SPEED(kmph)
Edayarpalayam	10.55	77.07	23.80
Muppandal	08.16	77.33	27.6
Poolavadi	10.44	77.16	24.00
Kathadimalai	08.14	77.33	25.30
Ramaswaram	09.17	79.20	26.40
Shankaneri	08.12	77.40	23.40
Ayakudi	09.0	77.21	23.50
Mangalapuram	09.03	77.22	23.40
Panakudi	08.19	77.33	23.90

3.2 Wind Turbine Specifications

Wind turbine selected model – Bergey Excel 10

- Reference Rated Power: 10 kW
- Rated Power: 8.9 kW at 25 mph
- Rated Annual Energy: 13,800 kWh at 11 mph average
- Rated Sound Level: 42.9 dB
- Cut-in Wind Speed: 5 mph
- Cut-out Wind Speed: none
- Peak Power: 12.6 kW at 28 mph
- Max. Design Wind Speed: 134 mph
- Design Operating Life: 30-50 years.
- Turbine Rotor Diameter: 23 ft.
- Height of tower=15m

4. Cost

Electricity cost for the township if power is taken from the grid-

- Cost of 1kwh power=5Rs
- Cost for 1 house per day=100Rs
- Cost for 100 houses per day=10,000Rs
- Cost for the township per year=36,50,000Rs

Cost for setting up solar panels

- Cost of 1 solar panel=Rs.14,000
- Cost of 1000 solar panels=Rs.1,40,00,000

Cost for setting up wind turbines

- Cost for setting up 1 wind turbine=20,00,000
- Cost for setting up 23 wind turbines =4,60,00,000

Total cost for setting up solar panels and wind turbines=6,00,00,000

Therefore the money return period = 6,00,00,000/36,50,000
= 16 years

Lifespan of wind turbines is a minimum of 60 years and that of solar panels is 20 years.

5. Conclusions

- The no of solar panels and wind turbines required to provide electricity for the entire township is calculated
- The wind farm layout is designed
- The wind turbine with the required specifications is designed.
- The perfect site is selected based on the obtained data of the average solar radiation and the average wind speed available.
- The time required for getting back the investments and the economic profit on top of that is also calculated.
- Therefore 1000 (250w) solar panels and 23 (10kw) wind turbines will be sufficient to meet the energy of the designed township.

6. References

- Average annual wind speed is taken from https://www.google.co.in/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&cad=rja&uact=8&ved=0ahUKEwirnbrlzKnXAhXHK48KHYVuCI8QFggqMAE&url=http%3A%2F%2Fwww.teda.in%2Fteda%2Fuploads%2Feditor%2Ffiles%2FLIST%2520OF%2520WMS%2520INSTALLED%2520IN%2520TAMIL%2520NADU_new.pdf&usg=AOvVaw2HD91kz8fPq7yLhNTaPMyE

- Wind turbine specifications are taken form http://bergey.com/documents/2013/10/excel-10-brochure_2013.pdf