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DESIGN OF SOLAR WALL ON APCOER BUILDING USING PVSYST SOFTWARE

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Abstract: The unexpected depletion of conventional energy assets is the cost of urbanization and improvement in today's global world. The value of these power sources reaches its maximum. Due to the lack of land resources, urban areas become concrete jungles with tall buildings pushing up, densely populated large consumers of traditional electricity sources that change the natural environment. This dense population and hastily working conventional sources of electricity are the cause of rising energy prices at alarming charges. Dealing with this problem is an inexhaustible number of pollutants released and easy energy sources like solar electricity as a boon to mankind. This article is an in-depth look at the field of solar electricity technology with the help of photovoltaic cells and the automatic software known as PVsyst and its evaluation after setup. Power, calculations, losses, and various parameters are calculated after installation on the south-east wall of APCOER building, Parvati Pune, Maharashtra, India.

***Index Terms* - PVsyst, energy sources, solar electricity, APCOER, photovoltaic cells and the automatic software**

I. INTRODUCTION

India is blessed with ample sunshine and hence solar energy is gaining the importance it deserves these days. India has very good climatic and geographical conditions for the development of photovoltaic solar systems. This paper describes the design and cost analysis of a solar wall at APCOER Building, Pune, Maharashtra that minimizes the use of conventional energy sources and the primary objective of the paper is to effectively demonstrate the use of renewable solar energy to meet the growing energy demand and aims to assess potential financial savings and reduce the academy's electricity bills. A photovoltaic (PV) system consists of a PV array, a battery, an inverter, and other elements for the installation of a solar device. A PV system converts solar radiation from the sun into direct current. If AC loads are to be used, the system requires an inverter to convert the DC coming from the solar panels to AC. This project will help us evaluate the financial savings and thereby reduce greenhouse gas emissions using solar PV facades.

II. OBJECTIVES

1. Reduce environmental degradation.
2. Maximum use of already existing structures to produce clean energy.
3. Calculate the amount of energy generated by using photovoltaic cells.

III. METHODS

1. Determine how much energy is needed for the APCOER building.
2. Calculate the infrastructure area required for installation.
3. Calculate the amount of net energy produced by the solar panel.
4. Replace conventional energy with clean energy.

IV. WHEN DESIGNING A PV SYSTEM, POWER PLANTS CONSIDER:

1. Average sunlight at the location.
2. Proportion of rainy / cloudy days at the installation site.
3. Local weather department database, peak sun time, wind speed, cloudy/rainy days, natural disasters, etc.
4. The installation location should be such that there are no tall buildings or other objects that can cover the solar panels in front of the solar panels, thereby reducing the efficiency.
5. When designing the system, a thorough analysis of the following issues should be carried out:
   - Check local weather conditions.
   - Current user needs and potential future requirements.
   - Focus on efficiency and consider energy consumption.
   - Construction costs, transportation, construction conditions.

V. SITE LOCATION

Latitude: 18.49067 Longitude: 73.843521, Altitude: 555m above MSL.

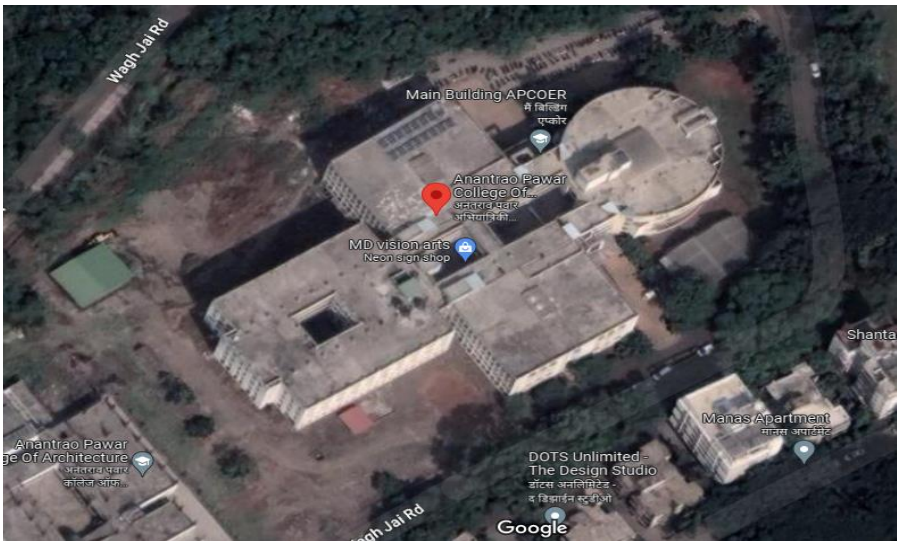

Figure 1: Site location

• PVsyst 7.2 is a PC software package designed by the University of Geneva for the study, sizing, and data analysis of complete photovoltaic systems.

• The software works with on-grid (grid-connected), off-grid (stand-alone), pumped and DC-grid (public transport) PV systems and includes meteorological data and PV system components, databases as well as commonly used solar Includes energy devices. .

• This software is designed to meet the needs of architects, engineers, and researchers.

VI. Solar PV system connected to the grid:

The 93.2 kWp plant is installed on an area of 492 square meters. Giant. Figure 2 shows the layout of a grid-connected solar PV system. All tables below are for APCOER sites only.

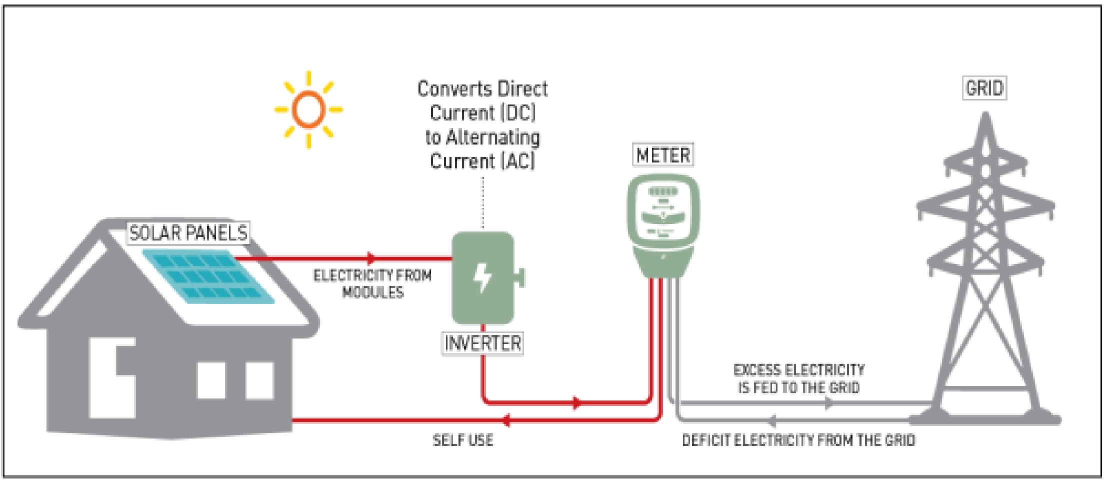

Figure 2 grid connected solar PV system

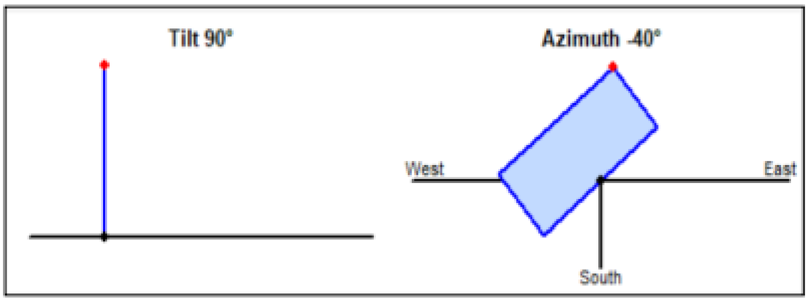

Figure 3: Tilt Angle and Azimuth Given to the Solar Panel

VII. System Specification

Below are the details of the components used in the construction of the solar wall.

Table 1 System Specifications

Module Type	Standards
Technology	Mono-crystaline
Brand Name	Vikram solar
Nominal Power	93.2 kWp
Load profile	Grid connected
PV Module	3370 Wp. 32V
Efficiency of Panel	19.1%
Inverter	80 kW, 570-950 V, 50/60Hz
Brand Name	Sungrow

VIII. Performance Analysis:

This project work is totally based on the PVsyst software. We have used PVsyst software for modelling purpose. As this paper represents the computational modelling so we just present the simulation results only rather than the description.

Table 2 Monthly energy Requirement and Generation

	E_Avail kWh	E_User kWh	E_Grid kWh	SolFrac ratio	PR ratio
January	9282	25000	2438	0.274	0.809
February	8131	25000	1372	0.270	0.800
March	8533	25000	1322	0.288	0.795
April	6692	25000	322	0.255	0.774
May	5631	25000	7	0.225	0.759
June	4385	25000	0	0.175	0.777
July	3944	25000	0	0.158	0.786
August	4553	25000	90	0.179	0.798
September	5876	25000	411	0.219	0.808
October	7815	25000	1121	0.268	0.805
November	9198	25000	2105	0.284	0.809
December	8996	25000	2184	0.273	0.809
Year	83037	299998	11371	0.239	0.796

Table number 2 shows the monthly energy requirement and energy production from SolarWall.

The first column shows the energy available for self-consumption, the second column contains the energy required by the building, and the last column shows the energy entered the network. 83,037 kWh is available for self-consumption and about 11,371 kWh of energy is injected into the grid, while the energy requirement of the building is 25,000 kWh (average assumption)

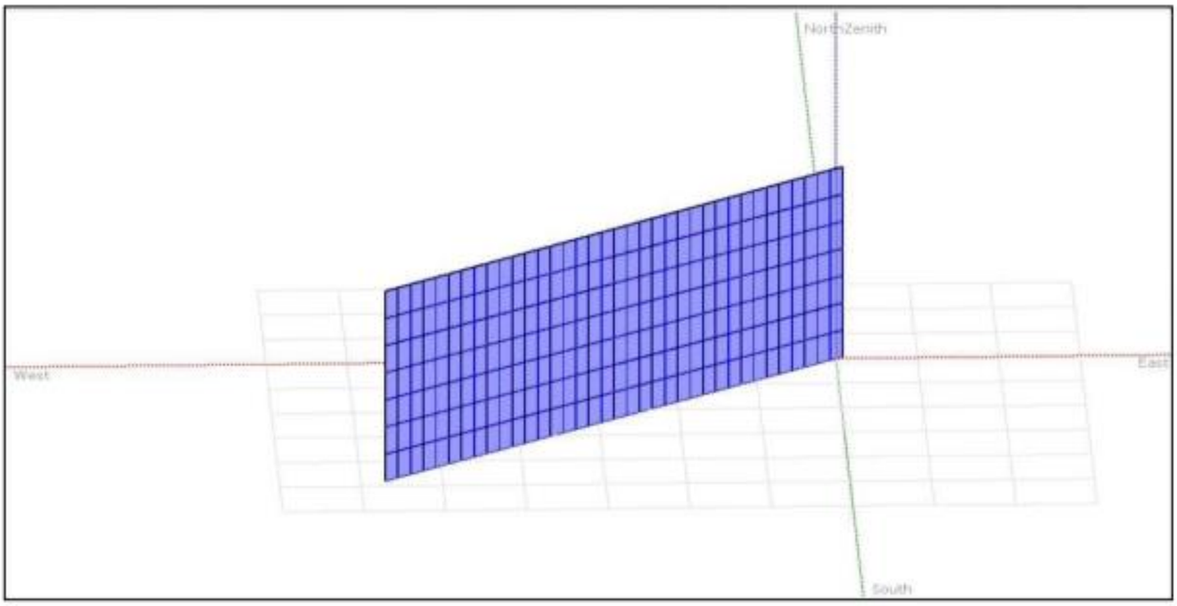

Figure 4 Proposed Layout of Solar PV Array

Figure 4 shows the proposed plan for installing the solar panel on the wall. All panels are facing southeast. 252 370Wp, 32V solar panels are connected in 14 strings with 18 solar panels per string.

Table 2 Monthly energy Requirement and Generation

Table 3 Detailed System Losses

	ModQual kWh	MisLoss kWh	OhmLoss kWh	EArrMPP kWh	InvLoss kWh
January	-73.603	203.5	87.96	9398	115.8
February	-64.444	178.2	70.49	8235	104.6
March	-67.539	186.7	63.67	8641	108.2
April	-52.994	146.5	38.75	6791	98.8
May	-44.650	123.4	23.49	5731	100.2
June	-34.800	96.2	13.72	4471	86.4
July	-31.358	86.7	11.66	4030	85.5
August	-36.111	99.8	17.40	4637	83.8
September	-46.519	128.6	32.72	5963	86.5
October	-61.875	171.1	56.72	7918	102.4
November	-72.953	201.7	83.61	9319	120.8
December	-71.378	197.3	81.95	9117	121.0
Year	-658.225	1819.7	562.16	84251	1214.1

Table No. 3 shows the details of system losses in kilowatt hours by month. The loss of module quality (ModQual) is -658.225 kWh per year, the negative sign indicates the benefit of the system. The module mismatch loss (MisLoss) is 1819.7 kWh per year. Ohm wire loss (OhmLoss) is 562.16 kWh per year. EARrMPP is 84,251 kWh per year. The inverter loss (InvLoss) is 1214.1 kWh per year.

Table 4 Balance & Main Results

	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray kWh	E_User kWh	E_Solar kWh	E_Grid kWh	EFrGrid kWh
January	145.6	49.07	20.06	123.0	113.8	9398	25000	6844	2438	18156
February	154.3	52.46	22.76	108.9	100.2	8235	25000	6759	1372	18241
March	195.9	63.45	26.53	115.1	105.2	8641	25000	7211	1322	17789
April	204.0	70.78	29.36	92.7	83.0	6791	25000	6370	322	18630
May	216.8	78.62	29.89	79.5	69.7	5731	25000	5624	7	19375
June	156.4	89.30	26.41	60.5	53.5	4471	25000	4385	0	20615
July	130.6	80.70	25.04	53.8	47.9	4030	25000	3944	0	21056
August	131.0	85.00	24.16	61.2	55.0	4637	25000	4463	90	20537
September	145.7	72.54	24.45	78.0	71.1	5963	25000	5465	411	19535
October	157.5	72.54	25.02	104.2	95.7	7918	25000	6694	1121	18306
November	143.6	50.55	22.36	121.9	112.9	9319	25000	7093	2105	17907
December	139.0	47.63	20.28	119.2	110.0	9117	25000	6812	2184	18187
Year	1920.3	812.64	24.70	1118.2	1018.0	84251	299998	71665	11371	228333

Table No. 4 shows the balance and main results of PV system connected to the grid. Global horizontal (GlobHor) is 1920.3 kilowatt hours per square meter. The horizontal diffusivity (DiffHor) is 812.64 kWh/m2.

Annual global incident energy is 1118.2 kWh/m2. The energy available at the output of the array (EArray) is 84251 kWh. The energy demand of the user i.e. University (E_User) is 299998 kWh. The energy supplied to the user from the sun (E_Solar) is 71665 kWh. The energy injected into the grid (E_Grid) is 11371 kWh.

Reference incident energy (year) 3.06 kWh/m2/day. The normalized array loss (Lc) is the difference between Yr and Ya, which is 0.588.

The normalized array production (Ya) is 2.48 kWh/kWp/day. The normalized system loss (Ls) is the difference between Ya and Yf, 0.036. Normalized system production (Yf) is 2.44 kWh/kWp/day. The performance ratio (PR) is the ratio of Yf to Yr and is 0.796 for the whole year

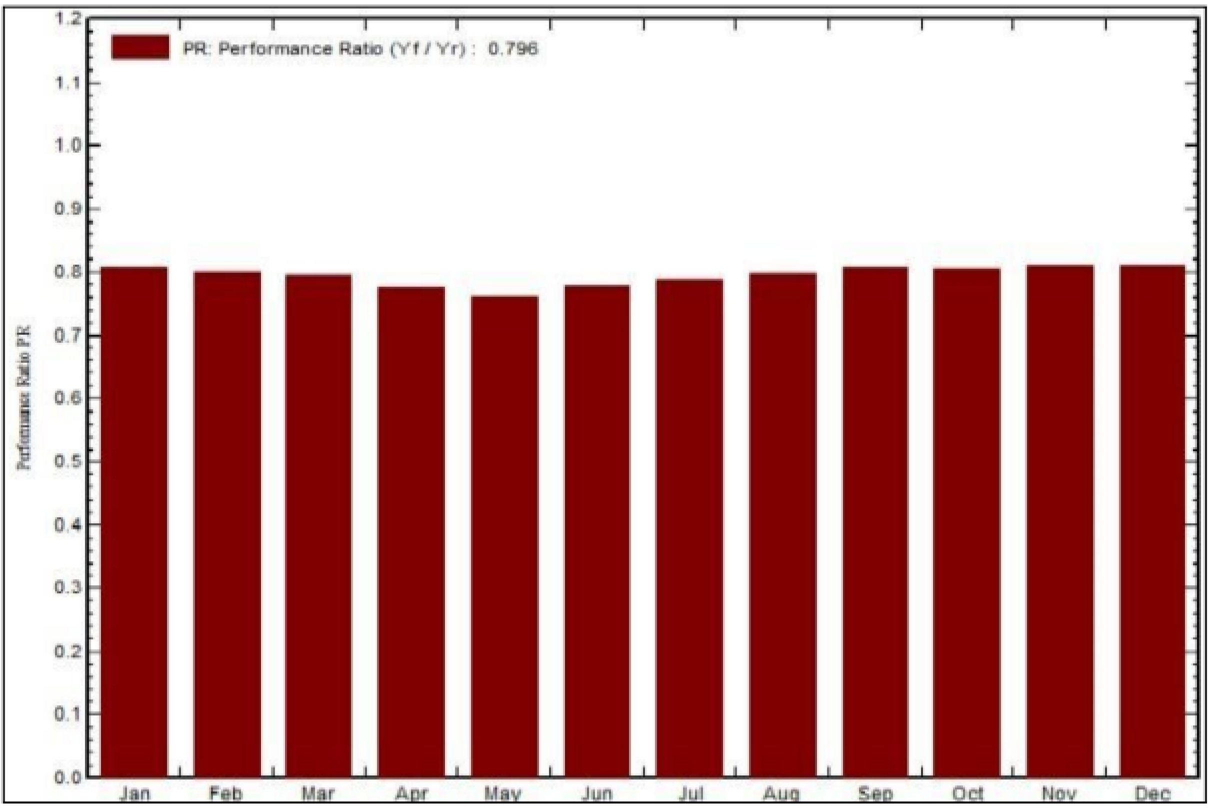

Figure 5 Performance Ratio PR

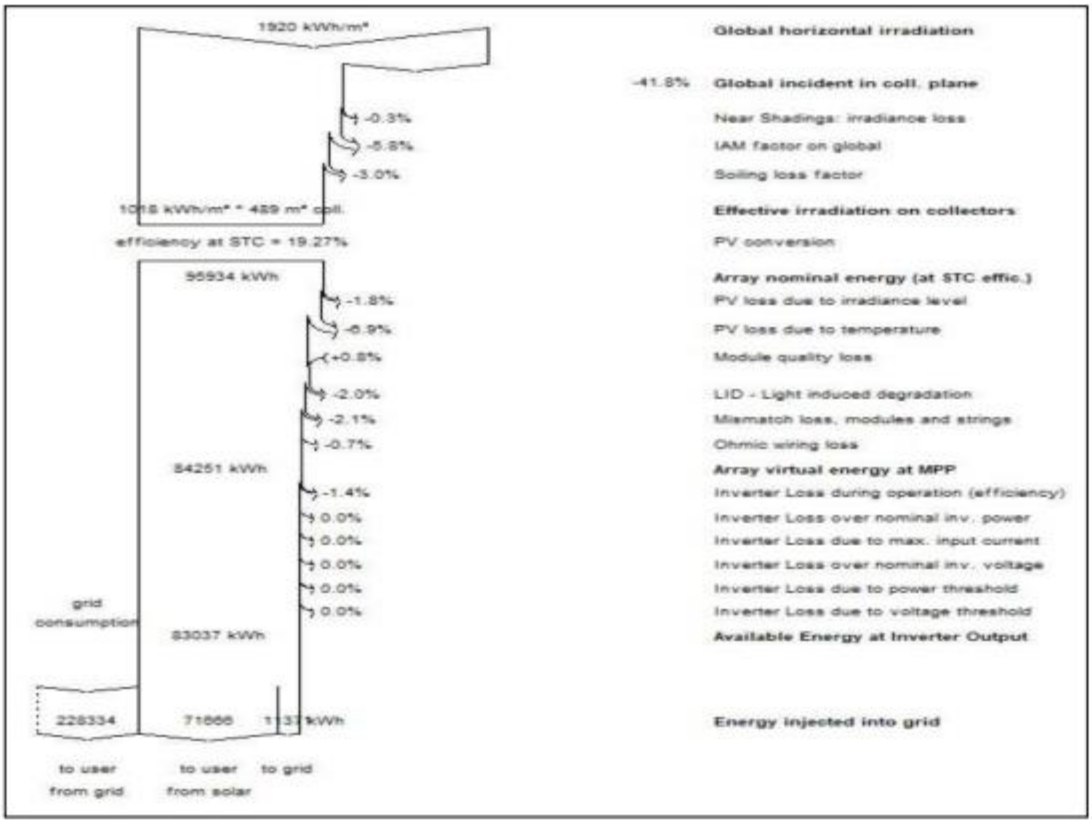

Figure 6 System Loss Diagram

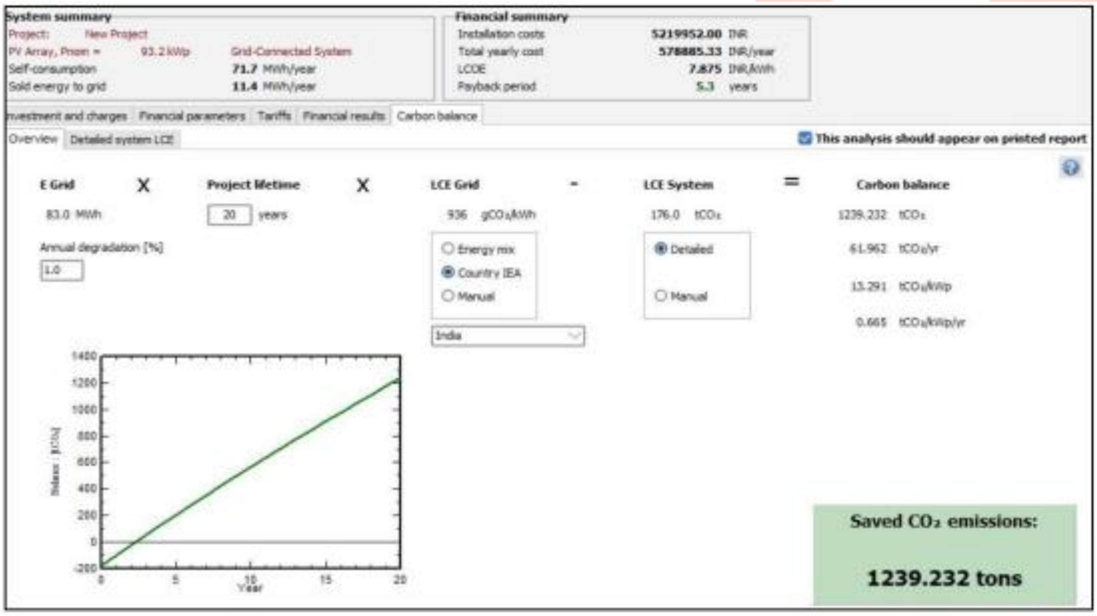

Figure 7 Carbon Balance

IX. Conclusion

In this work, an efficient grid-connected solar PV wall was designed using PVsyst software on the southeast wall of APCOER building in Pune, Maharashtra, India. The solar panels have been installed on a land with an area of 492 square meters and a power plant size of 93.2 kW/s. After installing the solar wall, the total installation provides 169 kWh/m2 and 83,037 kWh per year. This accounts for approximately 30% of the building's total annual energy consumption. By providing this cleanliness By reducing energy consumption, we reduce our carbon footprint by 1,239,232 tons per year and ultimately reduce environmental degradation.

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