Abstract — The energy consumption has seen a vast increment because of which the use of non-sustainable sources has increased drastically. Due to this steep increase, the need of energy auditing and conservation has also increased. Growing demand for energy directly increases emission of effluents, causing environmental catastrophe. To tackle this problem a collaboration between energy audit and conservation of energy is required. Energy audit is a procedural approach which is used for a clear description of the energy flow and energy management. This collective data helps in calculating the efficiency and minimizing operational cost. The aim of this project is to carry out the energy audit for the Electrical Sciences Block (ESB) of SRM INSTITUTE OF SCIENCE AND TECHNOLOGY. The main purpose of the following literature is to give a clear picture of the energy details of the ESB block.

Keywords—conservation, pvsyst, standalone PV system, energy auditing.

I. INTRODUCTION
The need of sustainable sources of energy has seen a steep increase in commercial applications. The use of solar energy as an alternative source of conventional systems is one such application. This paper pitches an idea of implementation of energy auditing and the need for conservation of energy. Energy audit helps in reducing the dependency on conventional sources of energy and can be used to switch to alternate source of energy with pre-defined calculations [1].PVSYST is a software package which offers wide range of facilities of designing, sizing, data analyzing of complete PV System to engineers, architects and researchers. It can be used for various PV systems for variety of uses as configured by user settings menu. It offers a user-friendly approach with a guide to develop a project. For making maximum use of the simulation, real time data are to be taken and followed up with subsequent iterations.[2]

PVGIS estimates of solar electricity generation
Solar radiation for the location potheri SRMIST data is collected from PVGIS-CMSAF. For the system considered the following values are tabulated. Electricity production daily average in kWh, Electricity production on a monthly average in kWh, Sum of global irradiation received in kWh/m2 is also recorded. Table 1 depicts the solar radiation data for potheri SRMIST location. Fig. 1 shows the PV estimate and fig. 2 shows the irradiation estimate for the site selected.

Table 1: Solar radiation data for Potheri location

<table>
<thead>
<tr>
<th>Month</th>
<th>Avg_D</th>
<th>Avg_M</th>
<th>S_D</th>
<th>S_M</th>
</tr>
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<tbody>
<tr>
<td>Jan</td>
<td>3.95</td>
<td>123</td>
<td>5.48</td>
<td>170</td>
</tr>
<tr>
<td>Feb</td>
<td>4.54</td>
<td>127</td>
<td>6.36</td>
<td>178</td>
</tr>
<tr>
<td>Mar</td>
<td>4.96</td>
<td>154</td>
<td>7.08</td>
<td>220</td>
</tr>
<tr>
<td>Apr</td>
<td>4.86</td>
<td>146</td>
<td>7.00</td>
<td>210</td>
</tr>
<tr>
<td>May</td>
<td>4.47</td>
<td>138</td>
<td>6.49</td>
<td>201</td>
</tr>
<tr>
<td>Jun</td>
<td>4.07</td>
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<td>176</td>
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<tr>
<td>Jul</td>
<td>3.81</td>
<td>118</td>
<td>5.46</td>
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</tr>
<tr>
<td>Aug</td>
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<tr>
<td>Sep</td>
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<td>121</td>
<td>5.73</td>
<td>172</td>
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<tr>
<td>Oct</td>
<td>3.48</td>
<td>108</td>
<td>4.89</td>
<td>152</td>
</tr>
<tr>
<td>Nov</td>
<td>3.22</td>
<td>96.6</td>
<td>4.48</td>
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<tr>
<td>Dec</td>
<td>3.35</td>
<td>104</td>
<td>4.62</td>
<td>143</td>
</tr>
</tbody>
</table>

Fig. 1 PV estimate

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The features of pvsyst are listed below:

1. “Metronome inside”- Provides the location on earth with the help of google map tool. Provides monthly meteo values for any site with the help of interpolating possibilities of meteonorm 6.1.
2. New Project Management and simulation process- Offers new project management dashboard along with direct access to all parameters, simulation and results in a single dialog.
3. Improved shading calculations
4. Detailed electrical shading losses
5. PV Modules
6. Inverters

Fig. 2 Irradiation estimate

Fig. 3 Input Parameters of PVSYST

SITE SELECTION

Factors affecting site selection:
• Area should be less than 150 metre square.
• It should get direct sunlight for longer duration.
• Should not be situated near tall trees and building to not get shadows.
• It should get direct sunlight from 9 am to 3 pm.

II. FRAMEWORK FOR DESIGNING STANDALONE SYSTEM.

A literature survey of the entire building was tabulated according to the types of the loads present. Most common loads were fluorescent lamps, Ceiling Fans, LED bulbs etc. Also, the standard losses exhibited by the PV systems and the auxiliary system were taken into account. Fig. 3 shows the line graphs of the load distribution in the staff rooms and classrooms. The majority of the loads present in the staffrooms as well as classrooms are fluorescent lamps, ceiling fans, Air conditioners. All the ratings and the outputs should be in compliance with the rules and regulations. It helps in improving the system efficiency[3].The following are the losses taken into account before designing the system.

• HEAT LOSSES-The analysis simulates with a series of gradual stages determining the behaviour of the system under losses due to heat generated at each and every individual stage, this helps in operating of instantaneous temperature operating in PVSYST. The thermal balance includes heat loss factor.
• WIRING LOSSES-the wiring loss includes losses due to ohmic resistance of the wire and helps in determining the instantaneous changes in these losses. As wiring loss behave as square of the current, a default global wiring loss fraction of 1.5% by respect to STC is used.
• MODULE QUALITY LOSS-It is mainly based on the reflection seen in matching the module with real time application that is by respect to the manufacturer’s specifications.
• MISMATCH LOSS-It gives the details about the losses related to the I/V characteristics of the PV array or module. This parameter acts as a constant loss in simulation process. These losses can be nullified when the when the modules are sorted according to their real performance.
• SOILING LOSS-This effect is more prominent in hot and humid climatic locations and also near the railway services.
• IAM LOSS-The incidence effect determines the decrease in the irradiation reaching the surface of a cell to that of the irradiation at a normal incidence. Let us assume that an isotropic diffusion has taken place and now the IAM factor is calculated by integrating the selected spaces and thereby including the low incidence areas.

USES OF PVSYST

PVSYST is the most powerful tool used for designing Photovoltaic system. The following are the advantages in using this software tool:
• It produces various simulation results that helps us in comparing them with the the real time needs.
• The energy auditor can define various specific attributes and can view various outputs like thermal characteristics, PV output quality, mismatch and also statistical attributes of the actual site where the installation of PV has to take place.
• The loss diagram is a pictorial representation of the real time losses occurring in the system which help us in determining the modifications to be done in the design.
• The pvsys consists of a tool specifically designed for a brief financial analysis which gives the approximate investment to be done for the design.
• The results of the pvsys can be graphed or tabulated which helps in maintenance and systematic organisation of the output data.

III. LOAD DISTRIBUTION

The above graphs shown in fig 4 depict the power consumption of lights, fan, air conditioners which are used in the class rooms and laboratories.

Standalone System Parameters

The geographical site chosen for the standalone system is Madras. The chosen place has latitude of 13.07N and Longitude of 80.25E. The system to be used is a standalone system with batteries. The main objective is to provide 147kwh/day. The PV system has the following specifications as shown in fig 5. Successful Energy management requires the establishment of a system to collect analyze and report on the Energy costs and consumption [4].

Fig.4 Class Room and Staff Room Loads

Fig.5 Standalone Grid Parameters

STANDALONE SYSTEM USER NEEDS

Modern and advanced energy efficient appliances are highly needed to substitute the conventional ones.[5] The system needs to provide enough electricity to power 138 fluorescent lamps rated 36W each, 138 tube lights rated 36W each and 138 ceiling fans rated 60W each. The running time for the loads is given as follows: 8 hours for ceiling fans, 5 hours for fluorescent lamps and 6 hours LED lamps. The above running time is defined on the basis of the average daily consumption.

Fig.6 Hourly Load Distribution

The graphs in fig 6 basically show the hourly consumption in a single day and the total power consumed by each of the equipment.
IV. SIMULATION RESULTS

The simulation result in fig 7 shows all the necessary data to be provided for the assembly of the standalone grid. The simulation results along with the power generation graphs for each month is shown below.

The total number of PV modules required is 224. The Standalone grid shall consist of Lead Acid Batteries with 744 units. The total Voltage of the grid will be 96v/7115ah. The Excess Energy that is produced can be exported to the grid.

The data calculated has been considered on the basis of average monthly solar irradiation. The energy audits need to be performed every 4 years for continuous monitoring of consumption [6]. The following table in fig 8 gives the brief data analysis of the energy generation, which can be further classified as unused, used, missing energy as well as the parameters considered with respect to the requirements of the user.
LOSSES in the Standalone system

The losses in the standalone system can be briefly pictured in the loss diagram in fig 9. The loss diagram is a yealy pictorial data describing all kinds of losses which might be due to the PV, Battery, Power Converters Over a span of one whole year. The parameters important for consideration can be classified into two systems, main systems and standalone systems. The main system consists of parameters related to PV cells and their orientation, the orientation is of PV cells is tilted at an angle of 30 degrees while the battery pack used is a lead acid battery consisting a battery pack of 744 units. The voltage capacity being 96 V/7115 Ah. The users' needs has been considered and losses has been calculated by pv syst. Considerable losses has been observed due to high temperature of the pv which is about -13.67%. The converter loss during operation is about -6.1% while the battery storage gives on an average about -5% loss due to efficiency, gassing current, self discharge current and its own loss. Considering the following parameters, Energy Auditing is very successful in improving energy efficiency and cost effectiveness and also reduce the energy gap.[7]

![Fig.9 Loss Diagram](image)

As observed, the following method helps in reducing the electricity bills. A steep decline of 15% is observed[8]. The above table in fig 10 includes cost breakup for the installation of a solar panel. The initial investment for the installation is Rs 3426000 without taxes and by including the taxes and excluding the subsidies the net investment for its installation...
is Rs 3839900. By taking the maintainence of the panel, insurance and the annual taxes into consideration the total yearly cost would be Rs 608124. The solar energy used would be 44.1 MWh/ year and the excess energy consumed is 11.4 MWh/year. The total used energy cost is 13.8 INR/kWh.

V. CONCLUSION

This paper infers an energy auditing study that is performed for the electrical sciences blocks of SRM institute of Science and Technology. This study demonstrates that the present electrical energy usage of the same can be reduced by switching to a standalone grid thereby reducing the dependency on the grid. In addition, the surplus power generated can be exported to the power deficient areas or can be net metered and incentives can be availed.

REFERENCE

5. PVsyst software. CUEPE, University of Geneva. www.pvsyst.com