THE INTERNATIONAL JOURNAL OF SCIENCE & TECHNOLEDGE

Concept and Case Study of Model Classroom Energy Management System

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Abstract:
Energy Management System is one of the basic energy management paradigm used to intelligently manage, operate and optimize energy need. This papers presents concept and build a case study for a model classroom considering a typical university. This has been done using energy calculation devoid of any electronic system and scheduling need with utilization in line with availability. The focus of study a classroom of Pandit Deendayal Petroleum University and a case study is built to comprehend and implement the concept of energy management. The data pattern is collected for spring and autumn semester utilization for need and consumption. This is used to determine planned load switching and termination. Finally the economic analysis of energy management system is prepared and template is made which can be used for further similar investigation.

1. Introduction

Energy is one of important pillars of all the activities. Without energy, there will be no power statement our world today have, that is why our society always look forward towards one who use had some advancement in form of innovation or even modification in it. Since, this element has its proven importance, its utilization or we can say better utilization is vitally needed. In terms of fact, for India, we can say 1/3rd of our energy requirement goes unsatisfied. Energy Management is a perception through which we can manage and use it more efficiently. Manual Energy Management is most basic yet a useful tool through which we can lower our bills as well as just cut down this energy thirst by decent amount. Flower of EMS has many more Petals like in Figure 1.

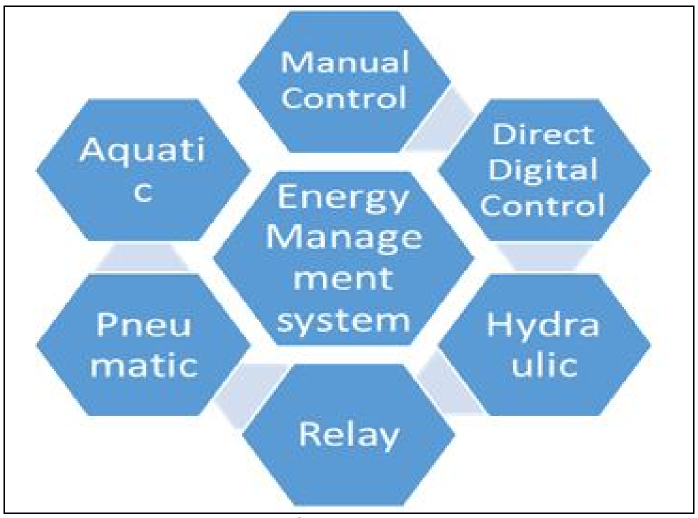

Figure 1: Flower of Energy Management Systems

2. Procedure of Deployment

In process to develop understanding of Manual Energy Management System (MEMS), literatures have cited some powerful and tested step to be taken up under listing:

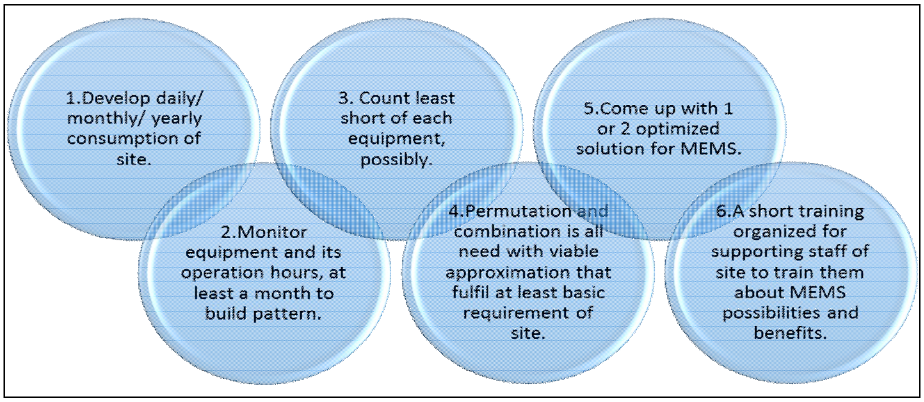

Figure 2: Procedure to Deploy MEMS in an organization

3. Experimental Methodology

3.1. Specification of Site

Since place of implementation is very important perspective, therefore, its specification is listed for concerned. The given specification is only meant for test set-up.

S.No.	Parameter	Quantity
1.	Place (Latitude Longitude)	Pandit Deendayal Petroleum University, E-block, 2nd Floor, Gandhinagar (23.1571^{O}N 72.664^{O}E)
2.	Area	25 feet *20 feet (7.62 m*6.096 m)
3.	Capacity	61 peoples

Table 1: Site Specification

S.No.	Name of Equipment	Quantity (units)	Rating (each unit)
1.	Tube light	45	40W
2.	Fan	8	80W
3.	Desktop computer + Projector + Board	1	300W
4.	Air Conditioning	4	1 TR = 3.52 KW

Table 2: Electrical Load Description

After listing all the specific data about test site, that is, classroom only interaction is to check the energy consumption of it everyday of experiment.

3.2. Procedure of Experiment

After accounting load of site, next step is to check vulnerability of each load appliance for testing method. Like Air- conditioning has compressor in it, which makes it less available for option of regular switch on/off than others like tube-light, fan and Desktop-projector-board. So, we start with pattern-wise development of template to make it future ready. One appliance at a time. Develop energy permutation and cost calculation sheet separately.

4. Result and Discussion

4.1. Consumption Pattern (operational hours):

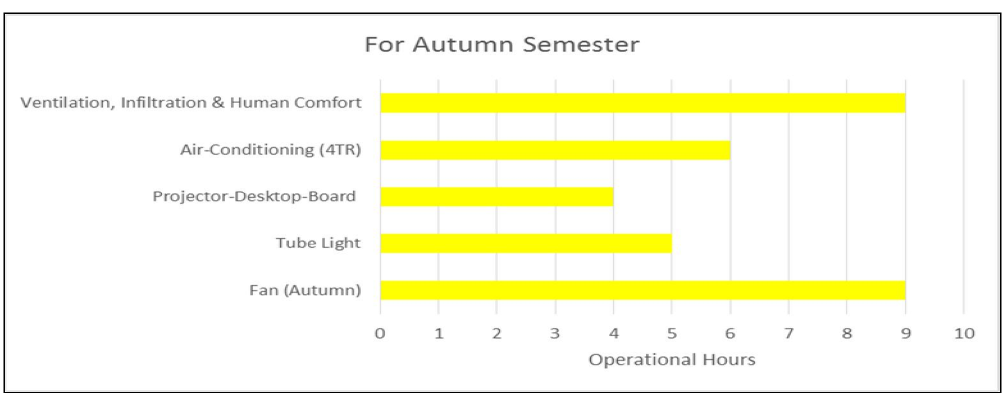

Figure 3 : Operational hours of Different load Parameters (Experimental) for autumn Semester

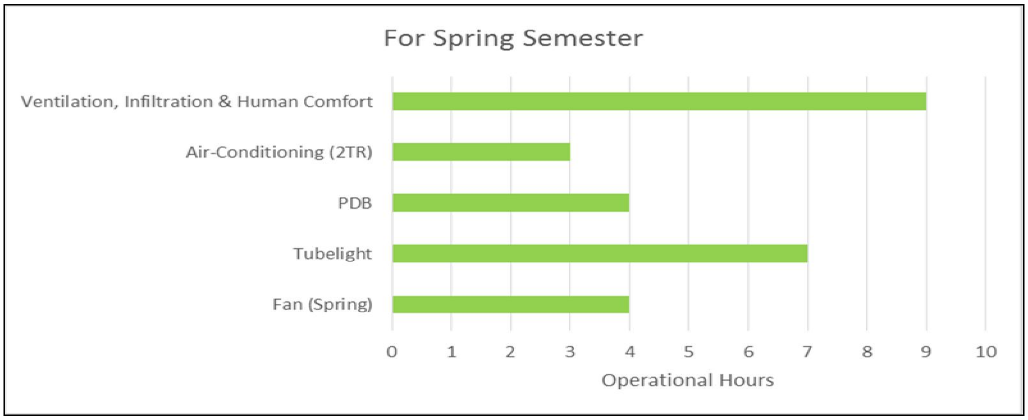

Figure 4: Operational hours of Different load Parameters (Experimental) for spring Semester

4.2. Graphical Representation for Each Control Strategy

Representation is done for combination done for Fan, Tube-light and Projector-Desktop-Board only because for Air-conditioning, as mentioned above, regular switching off and on is not suitable and ventilation, infiltration and Human comfort must be monitored every-time. Therefore, they are excluded straightway but their planned installation can result into huge saving as suggested in last. With these 3 options, we have 8 possible combinations:

Option A (Fan)	**Option B (Tube-light)**	**Option C (Projector-desktop-board)**
0	0	0
X	0	0
0	X	0
0	0	X
X	X	0
X	0	X
0	X	X
X	X	X

Table 3: Possible combination of Available Options

X represents engaged option(s) and 0 disabled option(s).

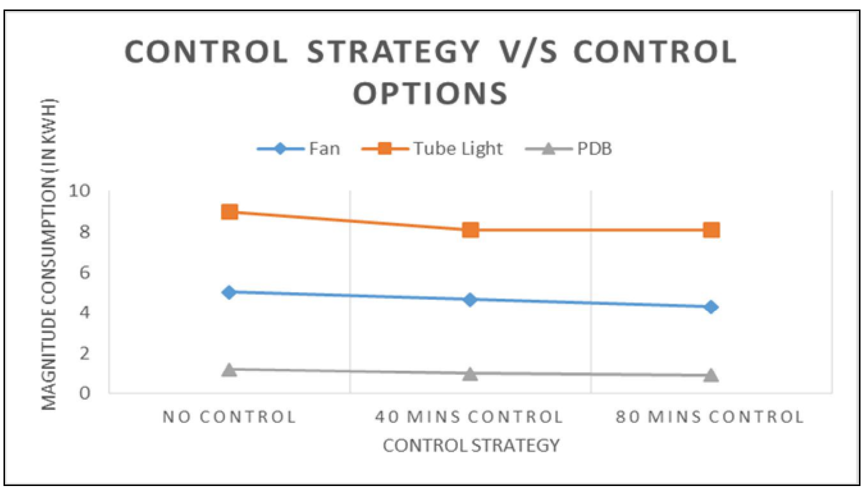

Figure 5: Control Strategy variation with control options

Figure 5 shows that how switching or control strategy variation affecting consumption of electricity. It can be easily seen that variation in tube light control not occur because in 40 minutes control strategy only its minimum requirement is deprived, therefore, it is controlled for 30 minutes only and for that only data is generated. Apart from only 30 minutes control, it generates most saving in electricity and hence in cost, too.

4.3. Graphical Representation of Combination Done with Suitable Requirement

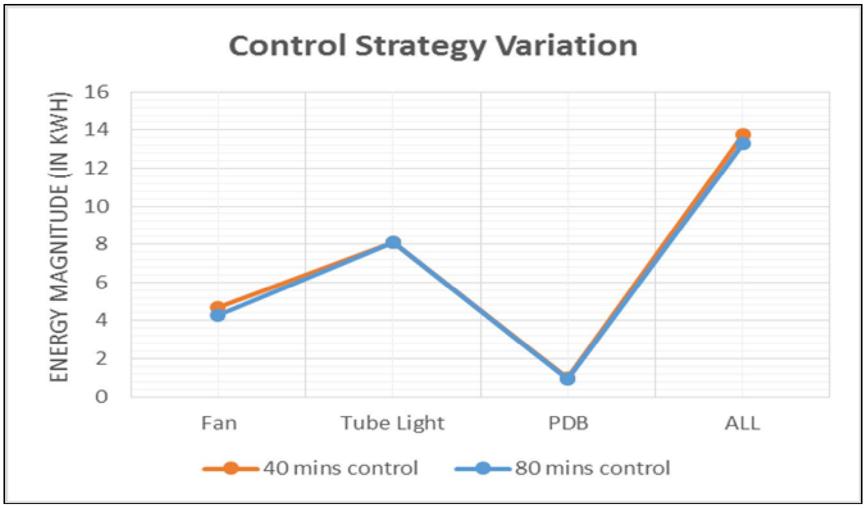

Figure 6: Combination of all Control switching to minimum requirement

Here, all switching type is implemented to check overall consumption which gives obvious pattern of 40 minute control strategy consuming more than 80 minutes consumption pattern. But major point is that in this graph, overall consumption differs to only 0.47 KWh by increasing control from 40 to 80 minutes.

4.4. Cost Variation with Variation of Control Strategy

Cost economics is important, it is also very important parameter as if, we are able to save 10 units per day we can bring huge saving monthly as well as annually. Cost analysis is discussed below:

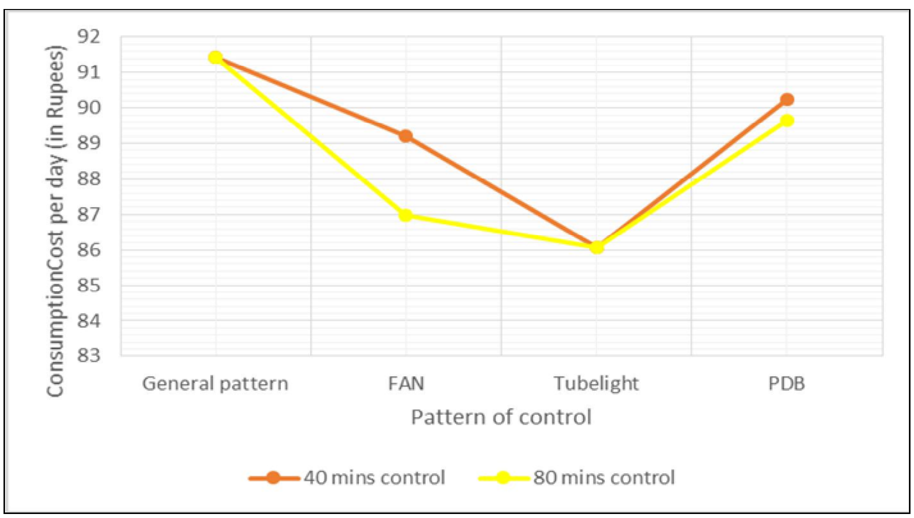

Figure 7: Cost Reduction per day with different control strategy and pattern

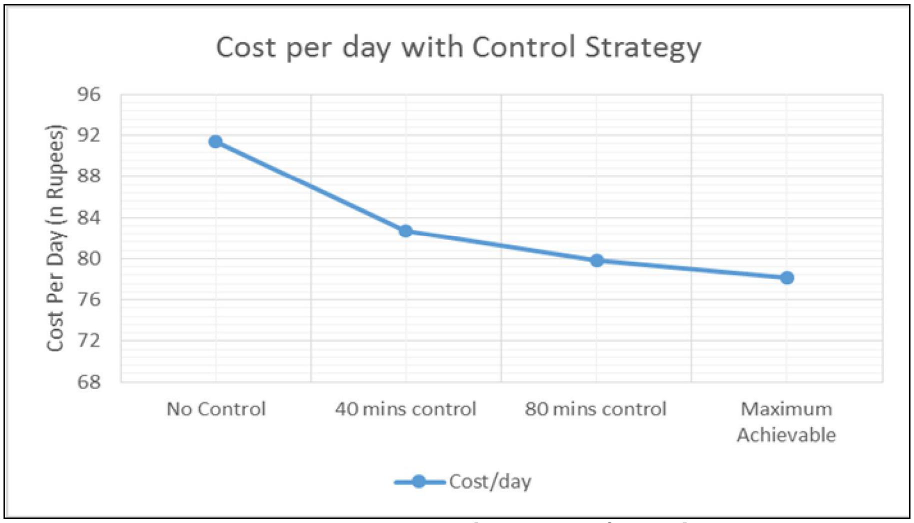

Figure 8: Consumption Cost with variation of control timings

As we can see that Figure 7 clearly shows that Tube light which is constant for 40 minutes and 80 minutes control strategy is generating minimum cost consumed, it can noted that tube light working hours are most concern for cost reduction as compared to others. From Figure 8 shows how percentage of reduction can be achieved with 40 minutes and 80 minutes control.

5. Conclusion

As above exercise is performed for energy management, we have derived certain conclusions:

i. Load with maximum product of rating and operational hour is most concerned load.
ii. Control strategy should be defined in such a way that it doesn't hinders minimum requirement.
iii. As we all know, small amount of attention can save us large sum of money is verified here.
iv. With minimum control strategy only, nearly 40% saving can be done.
v. Certain appliances must be targeted who don't produces life span issue with regulation and there regulation can achieve hefty percent of maximum possible saving (in this case 67% to 88%).

6. References

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