

A Study on Infusing and Expanding Clean and Green Learning Spaces on Campus

Santosh Madeva Naik ¹, Surendra Bandi ², Hema Mahajan ³, Dr. Deepak Waiker ⁴, Deepak Gadhia ⁵

¹Assistant Professor, Mechanical, Hyderabad Institute of Technology and Management, Hyderabad, Telangana, India.

²Associate Professor, CSE, Hyderabad Institute of Technology and Management, Hyderabad, Telangana, India.

³Assistant Professor, CSE, Hyderabad Institute of Technology and Management, Hyderabad, Telangana, India.

⁴Professor, Voice chair, IEEE Education society chapter, Singapore.

⁵Chairman, Sunrise CSP India Pvt. Ltd.

santoshn.mech@hitam.org, surendra.mca@hitam.org, hemamahajan.cse@hitam.org, dlwaikar@gmail.com, deepak.gadhia@sunrisecsp.com

Abstract:

Engineering education is not merely studying different subjects but also acquiring practical knowledge to implement in real-life circumstances. Mechanical engineering is a stream of engineering where students can focus on practical implementation of different concepts to make human life better. This study is inspired from clean & green campus program organized by IUCEE, where experiments on different types of renewable energy demonstrated and also emphasized on its usages in real life to make our environment clean and green. This study implemented different styles and experiments in mechanical engineering to enhance students' learning on renewable energy related concepts. This study has conducted some of the activities in the campus to make campus green and clean so that students can understand the importance of it and can explore themselves to further execute their ideas. In this paper, an attempt is made to provide details about the student's involvement in clean and green campus activity where students will be involved in energy audit, wastage management, water management team activity. This paper briefly summarizes the learning achieved through a faculty development program on clean and green energy campuses. This work comes with limitations and scope for future work in multiple aspects which are described in the complete paper.

Keywords: Solar Cooking, Solar air conditioning, Biogas lab, Green campus.

1. Introduction

In the recent past several researchers have documented their work related to problem solving which is an important aspect in engineering. Examples of different dimensions of such papers include; approach to impart analysis skills required in problem solving [1], solving open-ended problems [2], relationship between problem solving in engineering and professional engineering work [3], requirement of cognitive abilities in problem solving [4], engineering problem solving assessment [5], perceptions of students on engineering problem solving [6], incorporation of technology in solving open-ended problems [7], integrating differentiated instruction and project-based learning [8], etc. These studies essentially highlight the

importance of problem solving, assessment and how this approach enhances students' learning.

Another approach in solving engineering problems can be focused on topics related to clean and green energy without losing the essence of the aspects described in the previous paragraph. For example, [9] explained the importance of green initiative on campus by highlighting the use of solar and wind energy to promote a healthy green campus.

In another study by [10], it is reported how capstone projects can be implemented using the renewable energy sources. The clean & green campus projects are Smart DC power grid, Solar Cell Array for Biofuels and Photovoltaic Electricity, Indoor Solar Harvesting for Sensor Nodes etc. [10]

The idea of 'Clean & Green Campus' is generally by adopting renewable energy sources in the campus for example, windmill, usage of solar panel etc. We have to keep clean campus and surroundings by adopting waste management technology, and waste segregation technique. HITAM believes that nurturing nature is the best way to promote creativity. We are the first Green campus in India to be awarded a Silver Rating. Natural cooling towers, abundance of greenery and natural lighting, use of local materials etc. are a few examples of our environment consciousness. Designed with free flowing geometric structures, the campus is equipped with best-in-class labs, impressive libraries, and spacious classrooms. The free flowing breeze through the corridors and the canopy of green that greets our eyes are bound to boost the creativity of students. The greenery incorporated in our building design offers a calm and inspiring environment that encourages learning, curiosity and alertness. We believe that an inspiring ambience will foster the spirit of discovery and fuel our students' quest for knowledge. We are equally confident that this concept of promoting green and clean would in still in our students the intent to contribute to mother earth whatever we can, rather than deplete her of the resources she has been endowed with. We are convinced that our students' stay in this green campus, though brief, will be purposeful enough to have a lasting impact on them, making them ecologically conscious citizens [16].

IUCEE (Indo Universal Collaboration for Engineering Education) conducted a pre-conference workshop at ICTIEE 2020 (International Conference on Transformations in Engineering Education) on Clean and Green campus and I had the privilege of attending it. This workshop inspired me to learn more about Green campus and in continuation I have visited Muni Seva Ashram [18] at Vadodara to understand more about it. In a three-days faculty development program, I have learned about how solar cooking, solar air conditioning, Live Biogas lab, and the green campus and the associated benefits to the society.

Engineering students in the capstone project can take up topics related to sustainable and green energy. Non-renewable energy sources like fossil fuels providing daily needs of energy but are generating carbon dioxide to the environment which increases global warming. While doing a capstone project following the step procedure can be a small step in fighting towards the global warming problem. First, the requirement is to identify the energy resources problem and accordingly start working to provide solutions to the problems [17].

Over 9,500 students participated in go green across five universities. Go green project shown the good result of using renewable energy sources and reducing of a global warming effect. The Turkey government funded the go green campus project for further implementation [11].

There is a huge demand for non-traditional green energy to overcome this well-trained academia, the process required in this area. Explained the utilization of solar tracking systems and wind energy. Global economy daily rising because of alternative energy utilization. Explained the impact of solar energy, wind energy and biogas on reducing a global warming effect. The faculty should motivate the students to take solar energy and wind energy projects. Students are the future of our nation, so they should know about the different and efficient aspects of how to tackle global warming problems [12].

(Deepak Gadhia & Shirin Gadhia 2006), explained the solar parabolic concentrator for cooking purposes. This renewable energy source project has become a very important in developing nations to improve the economy. [13] The authors also provide explanation about the application of Scheffler cooker and other solar applications.

(Peter Salvatore 2010) stated that the establishment of green team into types one for recycling and another for sustainability. The goal of the green team is to make carbon-neutral and motivating students towards the recycling and sustainability approach in solving problems. [19] Eventually, the team comes with an action plan for reducing carbon dioxide emissions in the environment.

(Santosh Madeva Naik et.al 2020), explained project-based learning and the importance of renewable energy sources.

In this study the authors have conducted projects following the PBL approach under renewable energy. Students have identified real-time problems by following the design thinking process. After exploring about the solar energy students have made a PBL project on solar-powered grass cutter. [14] It works by using solar energy to cut the grass. No electricity is used, instead two rechargeable batteries are used to charge from solar energy and this unit will run for 3 hours without charging. Students have learned about renewable resources, reducing carbon emission and global warming through this project.

(Tiyarattanachai et.al 2016), explained about the comparison between green campuses and non-green campuses universities in Thailand. The authors measured the sustainability practices and quality of life on both campuses. [15] The results show that quality of life is better in green campuses compared to non-green campuses.

2. Methodology

In the workshop related to the clean and green energy, the participants were made aware about the importance of green campuses and using of renewable energy source. The Clean & Green campus of Muni Seva Ashram shown in figure.1

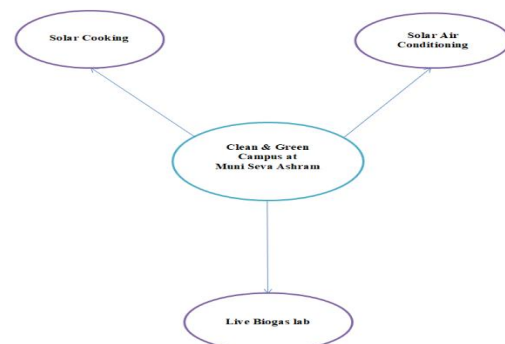


Fig.1 Clean and Green campus

Solar cooking

The first day we learned about solar cookers, about the material used collector and the solar tracking device. Faculties are divided into three teams all are worked on assembling the solar cooker part shown in figure.2.



Fig.2 Dr. Deepak Waiker guiding



Fig.3 Assembled part Solar Cooker

The Solar cooker shown in figure.3 & figure.4 contains a parabolic mirror, mirror holder, stand and maximum temperature will be 250 °C. This solar cooker having a cost of 9,000 Rs.

Advantages

- Less cost compared to other solar-based cookers
- All materials will be manufactured in India.

Disadvantages

- Transferring from one place to another place difficult
- Assembling of parts will take time
- Cooking is a little bit difficult because solar radiation will fall on a person's hand or body.

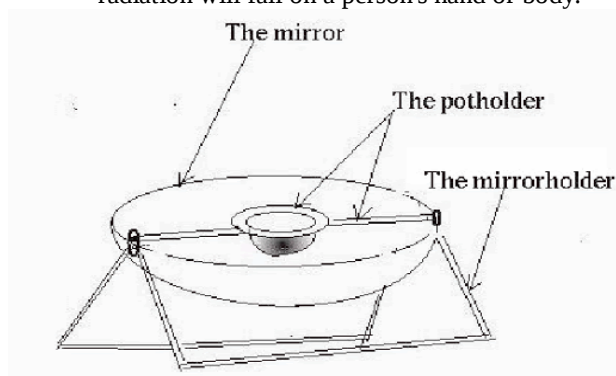


Fig.4 Sketch of Solar Cooker

Advantages

- Assembling takes less time
- Transferring from one place to another place is easy
- Maximum temperature can be obtained
- Cooking is easy

Disadvantages

- Costly
- Material is manufactured in Australia



Fig.5 Parabolic solar cooker

The resource persons in the workshop explained all the aspects related to the working of a solar cooking unit. All faculty from different institutions participated in this FDP program we only assembled the solar cooker equipment's in the group activity shown in figure.5.

Scheffler concentrating cooker which cooks for 50% in the comforts of the kitchen. This technology uses a large parabolic concentrator placed on the south side of the kitchen. The concentrator reflects and concentrates solar rays on to the back end cooking vessel. Once adjusted the system automatically tracks the sun throughout the day. This cooker is ideal for community and institution.

Scheffler collector which concentrates the sun rays on to the receiver is strategically placed to achieve focussed input energy. Water from the steam header enters the receiver gets converted to steam and accumulates in the header. An insulated pipe carries steam to the kitchen where it is used for cooking. Solar stem system is integrated with the existing boiler which reduces fuel consumption by above 50%. Tirupathi temples save about 1.5 Million Rupees every year [21].

Solar Air Conditioning



Fig.6 Solar air conditioning

Solar air conditioning system works on the principle of vapour absorption Lithium chromite base double effective evaporator when steam passes into it will get concentrated and cool water will get [18].

Live Biogas lab



Fig.7 Biogas lab

Biogas is a mixture of methane and carbon dioxide. The team explained the biogas plant and working procedure.

Clean & Green campus

The Muni Seva Ashram school surroundings covered with greenery, agriculture land, and solar cooking, etc. It is a very beautiful campus where school benches are made from bamboo and study rooms are made from natural resources affordable housing with less cost [18].

3. Results

Faculty development program conducted by Prof. Deepak Gadhia and Prof. Deepak Waiker on the clean and green energy was an effective and successful one. We have learned about solar energy utilization, air conditioning, green campus, and biogas energy. After completion of FDP IUCEE started Clean and Green Campus course for Engineering college students. From HITAM 05 Interdisciplinary students taken this course, students' progress grade is shown in figure.8.

Student Name	Notes	Design Thinking Out of 5	Design Thinking Out of 10	Group Assignment Out of 10	Energy Basics Out of 10	Energy Basics Out of 10	Assignment on Energy Out of 10	Group Assignment Out of 10
Aashish Sharma		5	4	10	10	10	10	10
Chhaya Kumar		5	4	10	10	10	10	10
Hemant Dutt		5	4	10	10	10	10	10
GANGANAPU, M.		5	4	10	10	10	10	10
Nikhil Shukla		0	4	10	10	10	10	10
Test student		0	0	0	-	-	0	0

Fig.8 Grades of IUCEE Clean & Green Campus course

Total energy consumption in the world shown in Figure.9. As per 2017 reports non-renewable energy sources Fossil fuels producing 79.7% of energy and renewable energy resources producing 20.3% [10]. By 2040 the demand for renewable energy sources will increase up to 45%. Global warming [20] is a day by day is increasing in Hyderabad previous year temperature raised up to 45°C. The institutions should start practicing the implementation of solar, wind and biogas applications on the campus. Faculty should teach the importance of renewable sources to students and recommend students to incorporate it in

projects because today's students will be the future of our country.

Government initiatives to promote Clean & Green Campus

- AICTE Clean & Smart Campus Award
- Swachh Bharat Abhiyan
- Department of Science & Technology – Waste Management
- Ministry of New & Renewable Energy
- Ministry of Commerce and Industry
- Startupindia

Students feedback

Technology is developing at an incredible speed; however we must make sure that we are balancing our devices with our environment. I learnt about plethora of new things in detail such as energy basics, energy conservation etc. in this course. I enhanced my research skills which were supposed to be followed as a part of assignment for this course. We learnt about existing and emerging technologies in various fields like waste management, renewable energy, etc. We also learnt team work, team management, etc.

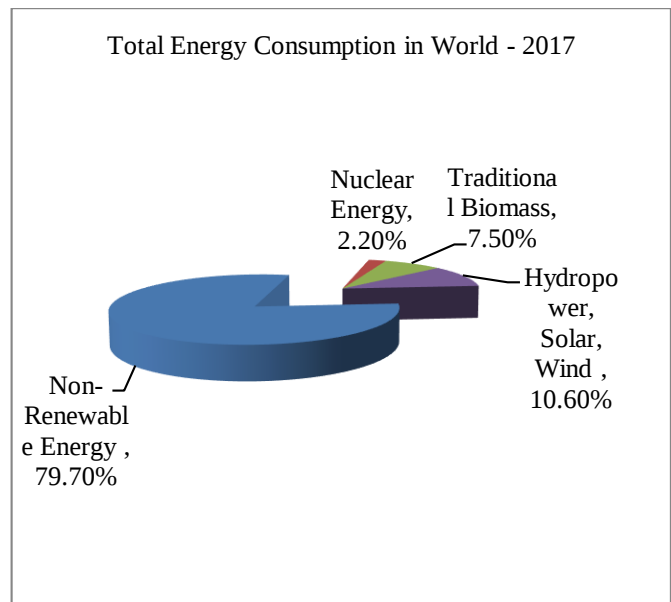


Fig.9 Energy consumption in World

4. Discussion

Hyderabad Institute of Technology and Management (HITAM) located at Gowdavelli village Medchal-Malakajgiri District, Hyderabad, Telangana, India. HITAM is the first green campus in India to be awarded a Silver rated green building [12]. The campus temperature 7 °C to 8°C less when compared to the outside temperature. The campus building having natural cooling towers, the abundance of greenery and natural lighting. The campus having solar lighting, windmill, rainwater harvesting, Reverse Osmosis (RO) plant, etc. The wastewater

recirculated through the RO plant and it will be used for gardening [16].

5. Conclusions

In three days of the faculty development program, we learned solar energy, biogas utilization the campus. To maintain the clean and green campus renewable energy utilization must and should. After seeing the Muni Seva Ashram we came to know that by using solar energy only we produce energy with less cost, for example, solar cooking, and solar air conditioning. On campus for making food in the canteen, we can use solar cooking applications. Implementing solar based application in capstone project renewable sources energy can be improved in institutions.

Challenges: The initial costs of renewable energy sources are costly. By writing a proposal for funding to MHRD we can overcome this problem.

Future work

This paper briefly summarizes the learning achieved through a faculty development program on clean and green energy campuses. This work comes with limitations and scope for future work in multiple aspects. For example, a quantitative study [22-23] can be conducted to understand what some of the factors are that influence/hinder the institutions in moving forward in the direction of clean and green campus. Digging deeper to understand how a certain institution function and work to retain the status of clean and green campuses successfully leaves an area to explore using a qualitative research method [24-25]. Another potential direction for future work is to investigate the impact of clean and green campuses on students learning.

Acknowledgement

I thanks Prof Deepak Waiker and Prof Deepak Gadhia for conducting FDP on a clean and green campus and thanks to Muni Seva Ashram Director for organizing this event. I thank Prof Krishna Vedula sir for organizing a workshop on a green campus in ICTIEE 2020. I extend my sincere thanks to the chairman of our college (HITAM) Mr. Prashanth Arutla. I thanks Mr. Surendra for motivating me to participate in the Clean and Green campus faculty development program. Finally, I thank the Head of the Department of Mechanical Engineering and Principal of HITAM.

References

1. Kavale, S. M., Kittur, J., & Adi, R. (2016). Imparting Analysis Skill in Freshman Engineers - An Experience. *Journal of Engineering Education Transformations*.
2. Muntasher, K. H., & Kittur, J. (2016). Improving Students' Learning Outcomes by Solving Open-Ended Problem in Highway Laboratory: Work in Progress. *Journal of Engineering Education Transformations*.
3. Vinson, A., Davis, P., & Stevens, R. (2017). Problem solving in engineering education and professional engineering work.
4. Reid, C., Dunbar, R., & Buckley, J. (2018). A preliminary model of problem categorization to explore the cognitive abilities required for problem solving in engineering education. In 36th International Pupils' Attitudes Towards Technology Conference (p. 295).
5. Kittur, J. (2018). Applying the General Analysis Procedure in Solving an Engineering Problem-An Assessment. *Journal of Engineering Education Transformations*.
6. Kirn, A., & Benson, L. (2018). Engineering students' perceptions of problem solving and their future. *Journal of engineering education*, 107(1), 87-112.
7. Muntasher, K., & Kittur, J. (2018). Outcomes of Integrating Total Station and Surfer8 Software in Survey Practice Laboratory. *Journal of Engineering Education Transformations*.
8. Sohoni, S. A., Jordan, S. S., Kittur, J., & Pereira, N. L. (2019, June). Work in progress: Integrating differentiated instruction and project-based learning to teach embedded systems. In ASEE Annual Conference and Exposition, Conference Proceedings.
9. RafiquIslam [2011], Continuation of Green Initiative in Campus and the Curriculum Development of a Second Course Concentrating on Selected Choices of Alternative Energy Sources in EET Program Through Global Economic and Environmental Aspects, American Society for Engineering Education.
10. Dr. Irina Nicoleta Ciobanescu Husanu, Dr. Yalcin Ertekin, Dr. Richard Chiou, Dr. Michael G. Mauk [2017], The Contribution of Capstone Projects in Green / Renewable Energy Areas to Growth of the Engineering Curriculum in Global Sustainable Development, American Society for Engineering Education Paper ID #19894.
11. Prof. Patricia Fox, Mrs. Ergem Senyuva Mr. Joe Spaulding [2015], Go green on campus project: a collaborative international student project, 122nd ASEE Annual conference & exposition, June 14-17, 2015, Paper ID #11783.
12. Prof. Hamid Arastoopour, Mr. Mohamed Shahidehpour, Mr. Joseph Clair P.E [2012], IIT Campus as a Sustainability Living Laboratory for Student Education and Research, American Society for Engineering Education.
13. Gadhia, Deepak, and Shirin Gadhia. "Parabolic solar concentrators for cooking, food processing and other applications." *Gadhia Solar Energy Systems Pvt. Ltd* (2006).
14. Santosh Madeva Naik, S., Mahajan, H., Yakub, B., & Sreeramulu, M. (2019). Implementing PBL to Enhance Technical Knowledge through Design Thinking Process. *Journal Of Engineering Education Transformations*, 33(1), 36-42.

15. Tiyarattanachai, Ronnachai, and Nicholas M. Hollmann. "Green Campus initiative and its impacts on quality of life of stakeholders in Green and Non-Green Campus universities." SpringerPlus 5.1 (2016): 84.
16. <http://www.hitam.org/history-infrastructure.html>
17. <https://solarenergymystified.wordpress.com/>
18. <http://www.greenashram.org/>
19. <https://www.asee.org/documents/zones/zone1/2010/student/Greenhouse-Gas-Inventory-Compilation-for-Wentworth-Institute-of-Technologys-Presidents-Climate-Commitment.pdf>
20. <https://www.c2es.org/content/renewable-energy/>
21. <https://www.hinduismtoday.com/blogs-news/hindu-press-international/tirupati-temple-installs-world-s-largest-solar-cooking-system-/2323.html>