Journal of Sustainability Perspectives: Special Issue, 2022, 230-237

Journal of Sustainability Perspectives

journal homepage: https://ejournal2.undip.ac.id/index.php/jsp/

Decarbonizing the Aligarh Muslim University Campus: An Experiential Analysis of Initiatives, their Impact and Lessons Learned

Mohammad Rihan[1], Tariq Mansoor[2]*

[1] Director, Centre for Integrated Green and Renewable Energy, Aligarh Muslim University, UP, India

[2]Vice Chancellor, Aligarh Muslim University, Aligarh, UP, India

[*]corresponding author: m.rihan.ee@amu.ac.in, mohd.rihan.ee@gmail.com

Article Info

Received:
14 March 2022
Accepted:
25 May 2022
Published:
1 August 2022

DOI:
10.14710/jsp.2022.15516

Presented *in the 7th International (Visual) Workshop on UI Greenmetric World University Rankings (IWGM 2021)*

Abstract. The climate crisis is the biggest existential threat to humanity in present times. Realizing this the United Nations have taken several important measures to address this challenge and prevent the rise in temperature of the earth. Increased concentration of carbon Dioxide in the environment is the major contributor to the global warming. Energy produced through the fossil fuels is a great factor behind this increase in CO_2. The use of energy sources which do not produce CO_2 are to be adopted and promoted aggressively.

Universities have to play a crucial role in achieving this shared goal of humanity of saving the environment. The universities have to adopt sustainable development plans in their campuses, implement green energy sources and promote a culture of energy efficiency and conservation. In addition, the universities have to address the research questions in this area and train the manpower also. The Aligarh Muslim University, a leading university of India has been contributing towards these goals. This paper describes the initiatives of the university in adopting green sources of energy, energy efficiency and conservation. The future plans based on the experiential learning are also explained.

Keyword:

Green Energy, Energy Efficiency, Solar Energy, Energy Conservation, AMU

1. Introduction

The issue of climate change and global warming is connected closely with the carbon dioxide (CO_2) emissions. The increased proportion of CO_2 in the environment has been the major cause of increase in the average temperature of the surface of earth. It is causing

harsher summers in various parts of the world including the parts which never saw any substantial summer seasons historically. The sustained increase in average temperature can lead to catastrophic consequences in the near future [1].

The rising level of CO_2 in the environment is already a major global concern. In 2015, the 21st session of the Conference of the Parties (COP21) to the 1992 United Nations Framework Convention on Climate Change (UNFCCC) was held in Paris. The 196 nations that are part of the UNFCCC approved the Paris Agreement, which aims to limit the global temperature rise to 2 degrees Celsius, and to make best efforts to keep it to 1.5 degrees. To that end, countries submitted intended nationally determined contributions (INDCs) detailing the level to which they planned to cut emissions and their plans to reach that goal [2].

India has also committed to contributing towards attaining the sustainable development goals. The Indian contribution is aimed at:

1. Acceptance and promotion of values of conservation and moderation.
2. Adopting a climate-friendly and clean energy policy for economic development.
3. Reducing the emissions intensity of its GDP by 33 to 35 percent by 2030 from 2005 levels.

An important component of the CO_2 emission reduction initiative of the UN is the installation of renewable energy sources at a large scale throughout the world. In line with this vision the most important part of the carbon emission reduction plan in India is to have non-polluting sources of electricity generation 40% of the total installed capacity by 2030.

The 2019 edition of BP's Energy Outlook has predicted that the global energy demand will increase by about 33% by 2040 as compared to the present level, driven by improvements in living standards, particularly in India, China and across Asia. The role of electricity in this projected demand can be gauged from the fact that about 75% of this increased demand will be due to increased requirement of electric energy.

The most common method worldwide for producing electricity is by burning coal in the thermal power plants to generate steam which in turn drives the generators through prime movers. The problem with coal-based generation is that coal is a non-renewable fossil fuel and when it is burned to generate 1 unit of electricity-1000 watts used for one hour-about 850 g of Carbon Dioxide (CO2) is released.

Because of this direct implication of energy like electrical energy on global warming, three of the sustainable development goals (SDGs) are directly related to energy. Goal 7 of the SDGs is dedicated to 'affordable and clean electricity'. This goal aims to promote green energy and energy efficiency in the electric energy sector.

The colleges for higher education and the universities have an important role to play in achieving the sustainable development goals in general and in the adoption and promotion of green sources of electricity in particular. More importantly, these institutes need to work on creating awareness about the need for sustainable development and SDGs, a crucial requirement for their achievement. The institutes should also make sustainable development an integral part of their future plans. Green and renewable sources of energy like solar PV should be adopted for existing buildings and these should be made mandatory for the new buildings. The academic institutes, more importantly, should practice on their campuses what they are preaching in the class.

2. Aligarh Muslim University

Aligarh Muslim University (AMU) occupies a unique position amongst universities and institutions of higher learning in the country. It was established in 1920 and evolved out of

the Mohammedan Anglo-Oriental (MAO) which was set up in 1877 by the great visionary and social reformer, Sir Syed Ahmad khan. Spread over 467.6 hectares in the city of Aligarh, Uttar Pradesh, Aligarh Muslim University offers more than 300 courses in the traditional and modern branches of education. It draws students from all states in India and from different countries, especially Africa, West Asia and Southeast Asia. In some courses, seats are reserved for students from SAARC and Commonwealth Countries. The University is open to all irrespective of caste, creed, religion or gender. It ranks 8th among the top 20 research universities in India.

It has more than 37327, students, 1,686 teachers and some 5,610 non-teaching staff on its rolls. The University now has 13 faculties comprising 117 teaching departments, 3 academies and 21 centers and institutes. A special feature of the University is its residential character with most of the staff and students residing on the campus. There are 19 halls of residence for students with 80 hostels.

The Aligarh Muslim University has a sanctioned load of 8500kVA for the main campus and 650kW for the new campus. The annual electricity consumption of the university crossed 2.6 Cr. units of electricity in the year 2016. The maximum demand had crossed the 8.4MVA mark against a sanctioned load of 8.5MVA.

Realizing its duty towards adoption and promotion of sustainable growth, the Aligarh Muslim University prepared the Master Plan for development of Green Campus in March 2018. The plan was prepared under the scheme 'Development of Green Campus of Ministry of New and Renewable Energy (MNRE), Government of India. The target set for the campus under the scheme is to reduce the consumption of fossil fuel to the extent of 25% in the coming five years. This target would be achieved through a mix of various Renewable Energy and Energy Efficiency Projects.

Walkthrough energy audit of the campus was conducted by the certified energy auditors and an energy consumption baseline was defined for the year 2016-17. The energy consumption forecast was made for the next ten years. The green campus under solar city programme envisages a 25% reduction in conventional energy demand through a combination of various demand side and supply side measures by the end of next 5 years. Accordingly, the target for AMU considering a reduction of 25% of the total energy demand which turns out to be equal to 86.6 Lakh units of electricity. The implementation of the proposed plan shall lead to an equivalent saving of 1099 ton of CO_2 emissions.

The initiative, therefore, marks an important contribution towards India's national climate action plans as nationally determined contributions (NDCs), under the Paris Agreement of the United Nations.

3. Green Energy at AMU

Taking inspiration from National concerns and requirements of promoting Green energy resources two large solar power plants have been integrated in the distribution grid in the campus. One plant of 3.3MWp is installed in the campus on an unutilized barren land; a unique installation of renewable energy in any academic institute.

To augment the solar power capacity, the university undertook the installation of RoofTop Solar Power Plant under the Solar Energy Corporation of India (SECI)/ CPWD scheme in power purchase agreement mode. In the first phase the university had installed about 1.5 MWp of rooftop solar under this scheme. The capacity of rooftop solar PV has been further augmented in October 2018 making the total capacity equal to 6.5MWp. These plants have been successfully operational and they have proved major milestones towards making the

university a Green campus. These plants have also relieved the state power grid from a significant share of load during day time.

Figure 1. 3.3 MWp Grid Integrated Solar Farm at AMU

Figure 2. Rooftop Solar PV plant around the iconic Victoria Gate of AMU

Figure 3. Utilization of Parking area for a Solar PV Plant at AMU

Figure 4. Case study of Green Energy at AMU Shared in the International Training Program

Among all the educational institutions in the country this is the largest such installation at present. The impact of these plants is shown in fig.5 and fig. 6. These plants are generating about 27,000 units of electricity per day. This has resulted in a major reduction in the carbon footprint of the campus.

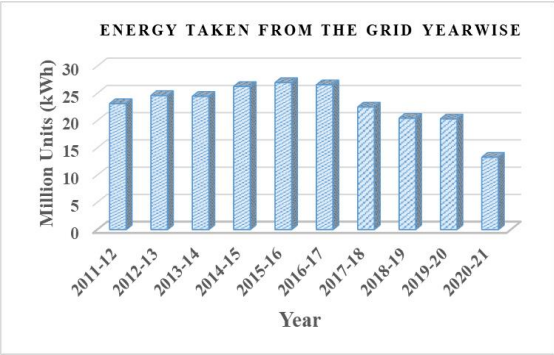

Figure.5 Energy drawn from the grid year wise

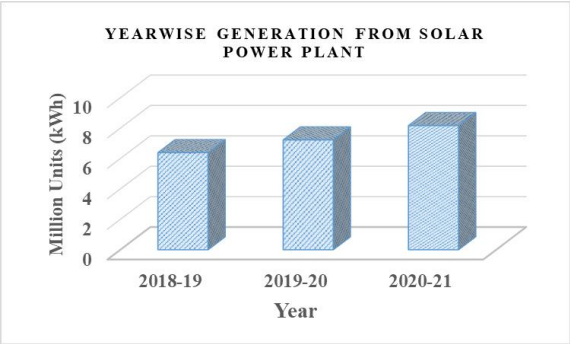

Figure 6. Annual generation from solar power plants

About 60 lac units of electricity have been shifted from the conventional grid to the solar plants. This amounts to equivalent saving of about 50 lac kg CO_2 emissions per year.The maximum demand in the whole year 2018 and 2019 has been limited to about 7.0MW. This has provided scope for expansion with the existing electricity distribution network. The university has been awarded by the state government for its contribution to energy conservation.

Figure 7. Rooftop Solar PV plant around the iconic Victoria Gate of AMU

Figure 8. Utilization of Parking area for a Solar PV Plant at AMU

An important feature of the installation is the innovative utilization of parking areas for installation of solar PV plants. This has proved highly effective and the university intends to replicate this model for other parking areas in future also.

3.1. Outreach and Training of Manpower in Green Energy

Considering the fact that the Grid Integrated Solar PV is a recent phenomenon all over the world, the technique is usually not covered well in the curriculum of engineering programs. Notwithstanding this fact these plants are coming up in a very fast way due to the environmental concerns. It has been observed that the engineers responsible for managing the grid and the distribution networks are also not well versed with the technology and often they are anxious with respect to the effect of these plants on the power grid. This has led to hesitation on part of these field engineers and it is adversely affecting the growth of solar PV plants in the country.

In view of this it is an urgent requirement to fill the gap by providing training to fresh engineering graduates on the grid integrated plants in a short and effective way. The second requirement is to train the Engineers of the distribution companies to remove any unfounded apprehensions and also to enable them to be a better interface with the consumer. The AMU with the experience of successful implementation of solar energy setup has been working on training the fresh as well as working engineers in this area. The following major programs have been conducted by the university:

Training Programs for Engineers of Government Owned Distribution Companies

- Entrepreneurship Development Programmes on Solar PV Rooftop
- Skill Development Programme on Solar PV Rooftop Grid Engineer
- Training Program on Solar Water Pumping
- Seminar for Pre-University Students of Senior Secondary Schools

The case study of the green energy setup of the AMU campus has also been shared at International Training programs organized by the Ministry of New and Renewable Energy and the Ministry of External Affairs for participants of different countries. Through these programs India has been helping the participant countries of International Solar Alliance for implementation of environment friendly solar energy sources.

3.2. Center for Integrated Green and Renewable Energy

Availability of such a large Grid Connected installation in the university is also providing a very good test bed for the researchers; both students and faculty members to address different issues pertaining to integration of renewable energy with the grid. The

university has established a dedicated center for Integrated Green and Renewable Energy. The Center will offer these benefits:

- Better coordination of research work and industrial collaboration in the area.
- The renewable energy integrated electricity network of the university shall serve as a very good test bed for research on impact of these sources on the power grid and other real practical issues in the area.
- Important research questions related to the management of the power grid with high penetration of variable renewable energy may be addressed.
- Innovative technologies like wide area measurement may be tested for their role in the modern distribution networks with high penetration of renewable energy.

Modernization of the National Power Grid in the changed scenario is also a national mission in moving towards the smart grid. In this way the center will serve two important national missions; on solar energy, and on smart grid.

4. Energy Efficiency and Conservation at AMU

In line with Goal 7 of SDGs, in addition to green energy the adoption of energy efficiency and conservation is essential for reducing the carbon footprint. This principle has been applied to the AMU campus. The energy efficiency has been implemented by making it mandatory to use only LED based lighting in the campus. An example of savings achieved by LED based lighting is given in table 1.

Table 1. Example of Energy Savings Achieved by Energy Efficiency

Efficiency Initiative	**Consumption Before Replacement**	**Consumption After Replacement**	**Saving**
Campus Street lights	37840W	1500 W	22840W
Residential colonies street Lights	79620W	48660W	30960W

Only five star rated/inverter technology air conditioners are installed in the campus. Old ACs are also being replaced with new energy efficient ACs. In addition, about 5000 old fans have been replaced with energy efficient fans. Innovative solutions like centralized switch control outside large halls and classrooms have also been effective. Daylight sensors with street lights have been installed and occupancy sensors have also been successfully tested at some locations.

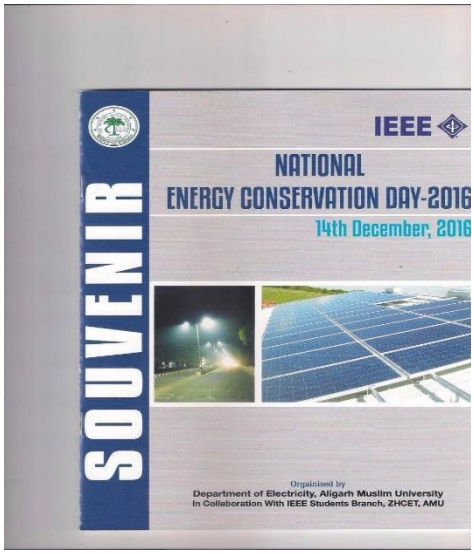

Figure 9. Important days used to create awareness towards energy conservation

Figure 10. Energy monitors of the campus being motivated for energy conservation

Any initiative on sustainable development and conservation can only succeed by active participation of stakeholders. This has been successfully implemented in the AMU campus. Nodal officers and energy monitors have been appointed in each office and department. These officers are regularly motivated by the university administration for contributing to energy conservation and to take this message forward. Many awareness campaigns have been conducted with the help of student bodies in the campus for wider participation.

Official circulars and pamphlets have been effectively used for creating awareness regarding the importance of operating the air conditioners at a set temperature of 24-25 degree and the importance of preventing wastage of electricity by standby and networked appliances. Important days related to energy conservation like National Energy Conservation Day, World Environment Day, Earth overshoot Day etc have been used to organize awareness creating programs in the campus as well as for others outside the campus.

5. Experiential insights

Successful implementation of these initiatives at AMU has led to important learnings also for further strengthening such steps as well as to be used as a template by other institutes. Some of the important insights are:

5.1. Need for Transactive Energy System

Net metering has been a major attraction for consumers adopting the grid connected solar PV plants. But as the percentage of solar energy being injected into the grid has increased; the regulations have restricted net metering benefits to agriculture and residential consumers only. In this scenario implementation of transactive energy systems using technology like Blockchain can radically increase solar energy adoption.

5.2. Need for advanced forecasting and allocation of energy resources

Historically the power grid operators had to rely only on forecasting the load and accordingly the electricity generation sources were scheduled. But with the inclusion of solar

and wind energy sources with the grid there is a high uncertainty on the supply side also. Forecasting of generation, therefore, has become much more important now.

5.3. Role of IoT and Big data Analytics

The green sources of energy especially solar PV are distributed in nature. Hence the monitoring and maintenance requirement has become distributed also. The volume of data generated from these distributed sources is also large. There is a lot of scope for technologies like Internet of Things (IoT) and big data analytics now.

5.4. Importance of Energy Efficiency and Conservation

The experience at AMU has shown that energy efficiency and conservation should be pursued simultaneously with the adoption of green energy. The International Energy Agency (IEA) has rightly identified energy efficiency as a crucial clean energy resource having enormous potential [5].

5.5. Importance of Stakeholders Participation

The goal of energy efficiency and conservation can only succeed with a widespread participation of stakeholders of the organization. The experience at AMU has again substantiated this. The myths have to be broken by regular campaigns, the costs have to be conveyed and apart from financial losses the bigger picture of the climate crisis has to be conveyed to the people to get their full cooperation and support in a conservation movement.

References

1. https://unfccc.int/
2. Abrahm Lustgarten, “The Great Climate Migration”, The New York Times Magazine, 23 July 2020, The Great Climate Migration Has Begun - The New York Times (nytimes.com)
3. https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/energy-outlook/bp-energy-outlook-2019.pdf
4. https://www.amu.ac.in/
5. International Energy Agency (@IEA) / Twitter