

## SDG 7: CLEAN AND AFFORDABLE ENERGY

Leader: Assam Don Bosco University (ADBU), India

<https://www.dbuniversity.ac.in/>

### Satellites in Subcluster:

- Qatar University, Qatar
- Strathmore University, Kenya



### SDG 7 Activity Report for the academic year 2023-24

Compiled By-



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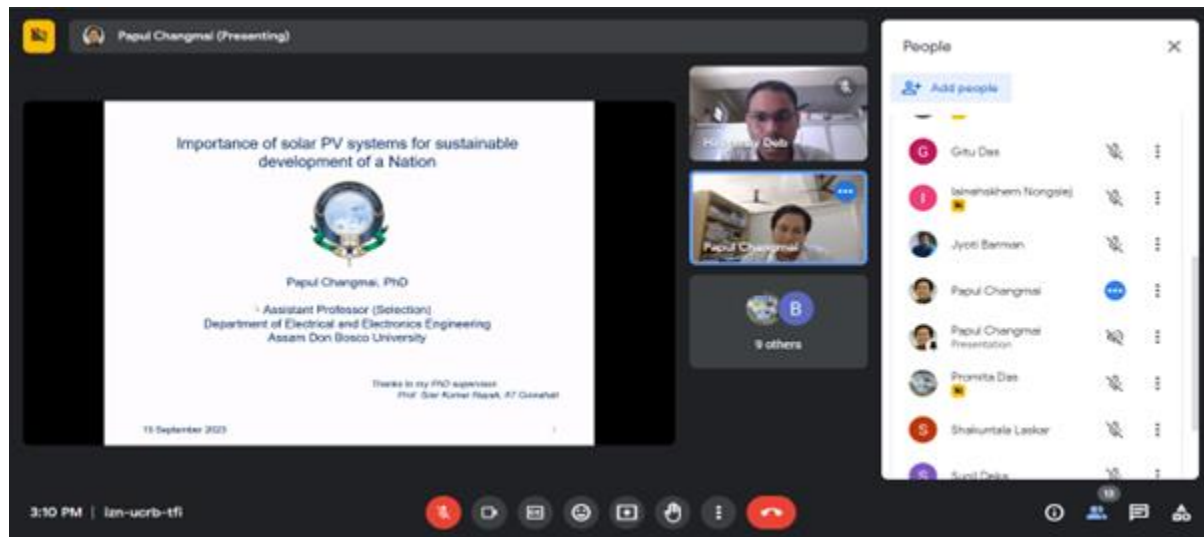
### SDG 7 Cluster Overview

Apart from water and food, energy is one of the key enablers of human life. Energy is central to nearly every major challenge and opportunity the world faces today and access to energy for all is essential. Therefore, energy needs to be available and affordable to all to allow future development, and it needs to be clean to ensure that the development can be sustainable. Assam Don Bosco University promotes and supports clean energy, both through research, campus outreach and in their behaviour and consumption. Taking heed of these conditions, a solar energy-based training programme is conducted every year which provides leading on-the-job education for emerging energy planners and rural youth. Our onboard research programme in a multidisciplinary scheme is based on determining integrated practices to improve energy efficiency, resource recycling, making modern energy production cleaner and more affordable. As a University, we prioritise collaborative work involving a broad range of stakeholders and provide a model to strengthen cooperation in research, innovation and practice. The following activities outline our progress in commitments of SDG7:

**ACTIVITY 1:** Talk on “Potential of renewable energy across the various sources and the trend of greater reliance on renewable energy sources in the future”

On Engineer’s Day, which falls on September 15, 2023, the Department of Electrical and Electronics Engineering, School of Technology Assam Don Bosco University organized an online academic talk on Engineering Applications of Renewable Energy. All the B.Tech (Bachelor of Technology) and M.Tech (Master of Technology) students including the faculty members from the Department of Electrical and Electronics Engineering participated in the event. The speakers discussed the potential of renewable energy across the various sources and the trend of greater reliance on renewable energy sources in the future, which would offer enormous economic,

social, and environmental benefits. There were two talks delivered on the occasion, "Introduction to Renewable Energy Systems" and "Importance of Solar PV Systems for Sustainable Development of a Nation."



## ACTIVITY 2: Webinar on "Global Understanding of Sustainability"

The webinar on "Global Understanding of Sustainability" was held on 4 September 2023 as an online event. The Webinar was organized by the Department of Civil Engineering, School of Technology, Assam Don Bosco University in collaboration with the UNESCO-Chair on Global Understanding for Sustainability, Friedrich-Schiller-Universität Jena Germany on 4 September 2023. The resource person for the webinar was Prof. (Dr.) Benno Werlen, Chair holder of the UNESCO- Chair on Global Understanding for Sustainability, Friedrich-Schiller-Universität Jena Germany.



Prof. (Dr.) Benno Werlen

The webinar was organized as the first jumpstart collaborative activity consequent to the mutual signing of MoU between Assam Don Bosco University and Friedrich-Schiller-Universität Jena Germany. The webinar was attended by 50 faculty members and students of the Department of Civil Engineering and faculty member from the Department of Geodesy and Geomatics Engineering, Geology and Oceanography, Institut Teknologi Bandung (ITB), Indonesia. The webinar ended with a focus on the importance of international cooperation and partnerships in achieving global sustainability goals with collaborative efforts, knowledge sharing, sustainability resource allocation and social corporate responsibility towards a sustainable world.

**ACTIVITY 3: SWABALAMBAN:** “Free Skill Development program focused on designing solar-powered chargeable LED lamps”.

The Department of Electronics and Communication Engineering at the School of Technology, Assam Don Bosco University, organized a free skill development program focused on designing solar-powered chargeable LED lamps. This initiative targeted unemployed youth from surrounding communities, providing them with valuable training in both the design and production of these sustainable lighting solutions.

Participants, comprising educated yet unemployed young men and women, were taught how to harness solar energy to charge LED lamp batteries via solar panels. Additionally, the system featured options for electrical charging and included a USB port for charging mobile phones.

At the program’s conclusion, each participant received a certificate and the solar-powered LED lamp they had developed. This gesture aimed to encourage immediate self-employment and entrepreneurial ventures. Equipped with these skills, participants are now capable of producing solar-powered LED lamps on a small scale, catering to consumers in rural areas where electricity supply is often unreliable. Over time, they can expand their operations and innovate with new, indigenous designs.



**ACTIVITY 4: Project on “GREEN WATER: HARNESSING THE POWER OF FLOATING PLANTS FOR WASTE WATER TREATMENT”**

This project focused on the treatment effects brought about by floating plants which has emerged as a boon as it has been widely adopted for treating various kinds of polluted water including agricultural runoff, stormwater, industrial effluents and other water borne pollutants. Moreover, it has proved beneficial as it can reduce the pollutants in the wastewater leading to a habitat in the aquatic environment as aquatic organisms can survive in the wastewater due to assistance of these plants. Two different plants i.e., Lucky Bamboo and Spider Plant were selected in conducting the project to compare the parameters between them. Parameters used in the study include Alkalinity, Chloride, Hardness and BOD which was conducted over a period of 2-3 months to check the required content of parameters the wastewater possess.

The objective of this study is to improve quality of wastewater by determination of the above parameters and remove nutrients. Moreover, it reduces the eutrophication level of the wastewater and prevents causes of harmful diseases such as cholera, diarrhea, dysentery. The use of these floating plants is one of the most effective ways because they improve the quality of wastewater as it reduces the level of pollution in the water body and makes it suitable for aquatic plants and animals to live in the environment.

**ACTIVITY 5: World Environment Day celebrated on 5<sup>th</sup> June, 2023**

The Environment Club of Assam Don Bosco University organized a program in collaboration with the NSS (National Service Scheme) club to celebrate World Environment Day on Monday, June 5<sup>th</sup>, 2023. A significant component of the celebration was a tree plantation drive. The plants were adopted from the World-Wide Fund for Nature (WWF) in Assam, India. A designated area within the campus was identified for planting saplings of tree species. Students, faculty members and staff actively participated in the tree planting activity, fostering a sense of responsibility towards the environment and understanding the importance of green cover.



Tree Plantation Drive

Cleaning Drive in the locality

Furthermore, a clean-up campaign was organized near the university, targeting a nearby drain to remove the litter and plastic from the drain. The campaign aimed to address the issue of pollution and promote environmental consciousness by actively involving community members in cleaning and restoring the drain's health and ecosystem by removing debris, plastic bottles, wrappers and other wastes.

Following the clean-up, two floating gardens were planted in the cleaned drain to act as natural filters for absorbing pollutants and excess nutrients from the water. They help improve water quality by reducing the level harmful substances and promoting a healthier aquatic ecosystem



Planting Floating Gardens

Banners were placed near the cleaned drains to raise awareness in society which help to educate and remind people about the importance of keeping drains clean and preventing pollution.

### **Activity 6: “Sustainability water management at Assam Don Bosco University”**

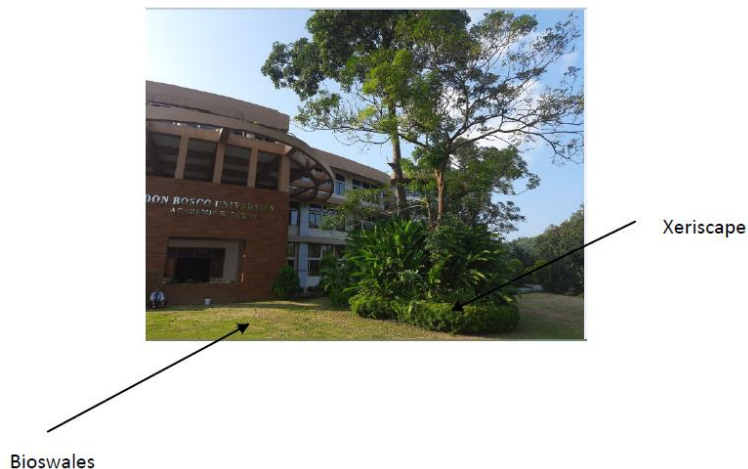
#### **OUTDOOR WATER SAVING STRATEGIES**

##### **(i) Water use zonation**

To optimize irrigation, the landscape of Assam Don Bosco University campus is divided into three water-use zones: High water-use zones in public areas and patio areas where plants are watered regularly, Moderate water-use zones such as lawns in which plants are watered only occasionally during moisture stress and Low water use such as agroforestry plantations which do not require irrigation once they are established.

##### **(ii) Xeriscape and bioswales**

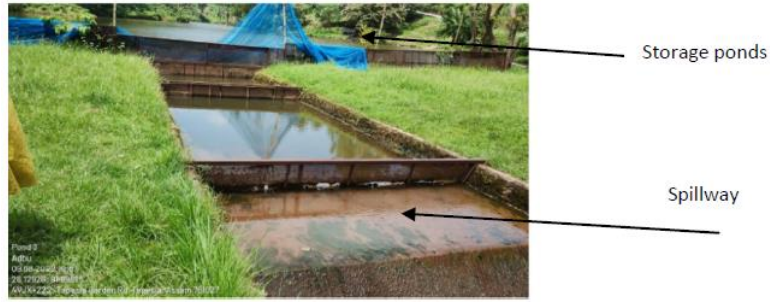
The landscaping architecture in Assam Don Bosco University is compatible with the standard xeriscaping principles in which low water demand plant species such as *Cupressus sempervirens*, *Berberis thunbergii*, *atropurpurea* and *Juniperus sabina* are planted together with conifers such as *Pinus nigra*, *Pinus mugo*, *Robinia pseudoacacia*, *Syringa vulgaris*. The bioswales with kerbs are provided for groundwater recharge.



##### **(iii) Low Impact Development Design (LID) storm water management infrastructures:**

##### **(a) Storage ponds**

The Assam Don Bosco University campus has 6 constructed storage ponds which have the capacity to store stormwater over a long period of time. Extra water is released slowly to the receiving water bodies downstream from spillway




(b) Springshed management


The springs from surrounding hillslopes are tapped with check dams.




**ACTIVITY 7: “Access to Critical Resources” under Viksit Bharat 2047 initiative**



**Seminar**  
**on**  
**Access to Critical Resources**



**28<sup>th</sup> March 2024**



**Energy Independence by 2047**



**Circular Water Economy**

**Organized by**  
**Department of Civil Engineering**  
**&**  
**Department of Electrical and Electronics Engineering**

**Assam Don Bosco University School of Technology**



## Introduction

The seminar on "Access to Critical Resources," held at Assam Don Bosco University (ADBU) on March 28th, 2024, showcased the university's commitment to fostering sustainable development in India. Aligned with the Viksit Bharat 2047 initiative, the event addressed key challenges and opportunities related to India's journey towards energy independence and a circular water economy with complete wastewater treatment.

## Event Details

- **Date:** March 28th, 2024
- **Time:** 1:30 PM - 4:30 PM
- **Venue:** Conference Hall, Assam Don Bosco University
- **Chairpersons:** Dr. Girija T. R., Head of the Department, Civil Engineering Department & Dr. Bikramjit Goswami, Head of the Department, Electrical and Electronics Engineering Department

## Opening Remarks

The seminar commenced with an introduction to its objectives by the anchor, followed by opening remarks by Dr. Bikramjit Goswami. He emphasized the significance of the seminar in addressing critical resource challenges and its potential benefits for the audience.



## Presentations

The seminar comprised two sessions featuring insightful presentations by students from both the Civil Engineering and Electrical and Electronics Engineering departments.

- **Session 1 (1:50 PM - 3:00 PM):**
  - Renewable Energy Revolution in India
  - Wastewater Use in Agriculture
  - Rural Empowerment for Energy Independence
  - Integration of Renewable Energy Sources in Wastewater Treatment Plants
- **Session 2 (3:15 PM - 4:30 PM):**
  - Transitioning to Electric Mobility
  - Challenges and Opportunities in Achieving 100% Wastewater Treatment
  - Integrating Clean Energy Technologies
  - Lessons from Bharat's Circular Water Economy Success Stories
  - Role of Circular Water Economy in Climate Change Mitigation

These presentations explored innovative approaches and policy frameworks driving progress in achieving energy independence and a sustainable water management system.

## Key Ideas

- **Wastewater Treatment:** Generating electricity from wastewater, biological treatment, membrane filtration.
- **Energy Independence for Rural India:** Microfinance schemes for renewable energy implementation, community ownership of renewable energy installations, capacity building, Power Purchase Agreements (PPAs).
- **Integration of Renewable and Wastewater Treatment:** Bio-electrochemical devices, Microbial Fuel Cells (MFCs).
- **Transitioning to Electric Vehicles:** Cleaner power grids, charging stations in public spaces, incentives for manufacturing, battery technology research funding.
- **Achieving 100% Wastewater Treatment:** Mobile water units, rainwater harvesting, gravity-fed filtration systems, advanced oxidation processes, membrane bioreactors.
- **Circular Water Economy:** Community-driven River rejuvenation initiatives, ice stupa construction, greywater systems.

**Closing Remarks.** Prof. Manoranjan Kalita, Director, School of Technology, Assam Don Bosco University emphasized the importance of student engagement in these critical areas and concluded the seminar with the national anthem.

**Conclusion:** The "Access to Critical Resources" seminar served as a valuable platform for robust discussions, knowledge sharing, and collaboration. It paved the way for exploring innovative solutions to ensure access to critical resources for a sustainable future in India.

## ACTIVITY 8: “Ongoing Research Studies on Smart Renewable Energy Systems for Drone Infrastructure”

The Department of Mechanical Engineering, School of Technology, Assam Don University in association with the University’s Research & Development Cell (RDC) initiated a fact-finding requirement to be pursued based on the current drone technology available and its ecosystem. The initial study revealed that the drone ecosystem in India and worldwide needs more basic infrastructure to maintain drone systems in all categories, such as land, sea, and air systems. Recently, the surge has witnessed technology upgrades in drone hardware with high computing features. However, there needs to be more focus on energy generation, utilization, and maintenance of drone equipment. Therefore, our study focuses on creating new concepts for bridging the gaps in energy generation, storage, and charging infrastructure. An array of technology sub-domains, such as artificial intelligence, electric propulsion, and Smart Energy storage using IoT and safety systems are being explored in this study.

### Technology Proposed:

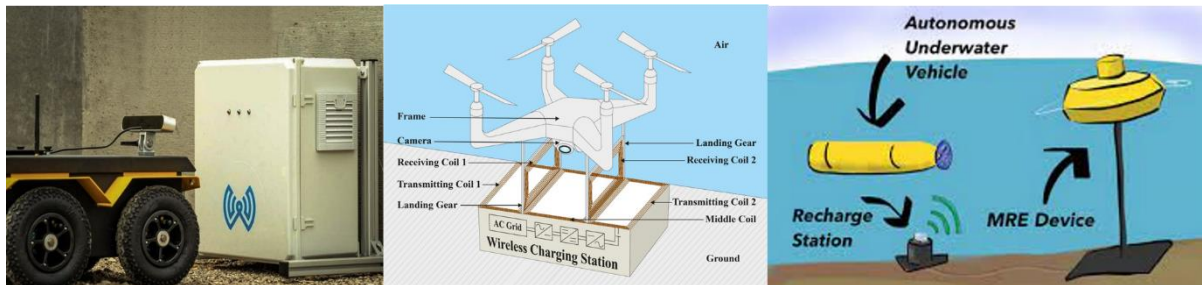


Illustration of proposed renewable energy docking station solution in all 3 domains

- Docking Station with wireless charging station in drone ports, and the charging system will be powered by Methanol/Ethanol Based Fuel cell localised/standalone grid system.
- The charging device will also use an array of sensors to smartly monitor the health and charge maintenance of the battery system which comprises of a Lithium-Ion cell battery bank.
- Air vehicles, it would have the same energy system, however the difference would be in the docking mechanism and its rate of charging.
- The sea and underwater drones would require a complex system of magnetic coupling to ensure mobility across different sea states. The charging will occur through the magnetic coupling.
- The surface vehicles will have access to floating buoys with hybrid solar and wind energy systems for charging in the middle of the sea.
- In case of underwater vehicles, the charging will be carried out through the magnetic coupling system. The energy resource will be a floating piston mechanism which generates electricity based on the movement of the sea waves and stores the energy generated in the lithium-ion battery bank which is an additional part of the submerged structure in connection with the floating hybrid energy buoy.

## **JOURNAL PUBLICATIONS:**

### **1. Influence of Tea Plant Roots for Soil Slope Strengthening: Case Studies and Numerical Investigation**

DOI: <https://doi.org/10.1007/s40515-023-00350-x>

In this study, the influence of vegetation, particularly the mechanical influence of root systems, on the stability of slopes is investigated. The primary objective is to understand how the presence of roots in the soil can affect the overall stability of the slope. The evaluation of the improvement in slope stability resulting from the reinforcement by tea roots was carried out through a numerical analysis based on the finite element method, which is used to reinforce the cohesive properties of the individual slope components associated with the presence of tea roots as reinforcement.

### **2. Natural Air Filtration: Potted Plants for Management of Sick Building Syndrome**

DOI: <https://doi.org/10.21203/rs.3.rs-2680821/v1>

Air pollution is a pressing issue that warrants attention. It is crucial to comprehend the impact of air pollution on human health. With the rapid growth of industry and urbanization, the air we breathe has become hazardous to our well-being. Moreover, because people spend most of their time indoors, the risk of exposure to toxic pollutants indoors is higher. Inorganic gases and biological factors also contribute to indoor pollution, and these contaminants can cause Sick Building Syndrome, which can result in symptoms that vanish once individuals leave the building. Sick Building Syndrome has a significant impact on the health and productivity of occupants.

### **3. Peak Power Extraction from a PV System for Various DC and AC Loads**

DOI: <https://doi.org/10.1109/ICPC2T60072.2024.10475038>

This paper describes the MPP determination of a photovoltaic (PV) panel using the explicit equation of current, which is only a function of voltage. Using an approximation of a straight-line expression, the explicit equation of current is derived from implicit V-I characteristics. The V-I curves obtained from an implicit expression of current for various panel ratings are used to implement the proposed PV system expression of current. Under various environmental conditions (DEC), the proposed explicit V-I expression is used to directly estimate the MPP of a PV system. Using the MATLAB program, the MPP of the panel at DEC obtained by applying the proposed algorithm is contrasted with various existing techniques. The estimated MPP of a panel using the developed method closely matches the actual MPP values, according to the results. Additionally, there is little (%) error between estimated peak power using the developed method and measured peak power. As a result, a panel's estimated MPP calculated using the developed method is more precise.

### **4. Performance analysis of gallium nitride-based DH-HEMT with polarization-graded AlGaN back-barrier layer**

DOI: <https://doi.org/10.1007/s00340-023-08042-7>

In this paper, polarization-graded AlGaN back-barrier nanolayer has been introduced to improve the DC and RF parameters of gallium nitride-based high electron mobility transistors (HEMT). To explore the characteristics, both graded and non-graded double heterojunction high electron mobility transistor (DH-HEMT) structures are optimized using SILVACO-ATLAS physical simulator. Enhanced DC and RF parameters have been observed in the optimized

graded DH-HEMT. In this paper, we have also studied the development of the quantum wells at the AlGa<sub>N</sub>/Ga<sub>N</sub> interfaces due to the conduction band discontinuity in both structures.

## **BOOK CHAPTER**

### **1. Design and Economic Analysis of Grid-Connected PV System in Kamrup Polytechnic**

[DOI: 10.4018/979-8-3693-2260-4.ch007](https://doi.org/10.4018/979-8-3693-2260-4.ch007)

Educational institutes have ample potential and good scope to generate solar energy. As these institutes function during daytime, the generated energy can be used to meet the electricity requirements of the campus. It can both be designed to work as grid-connected and off-grid mode using the unused rooftops of these institutes. In this study, a 90 kW grid connected solar photovoltaic system for Kamrup Polytechnic in Baihata Chariali has been designed at the proposed rooftop. It simulated using PVsyst version 7.0.9 simulation tool. The annual energy generation from simulation for the 90 kWp grid connected 12675 kWh with a performance ratio of 73.1%. Economic analysis of these PV systems has also been performed to determine the annual levelized cost of energy production which is found to range from about Rs 3.170/kWp for 90 kW PV system. This work summarizes the estimation of electrical load in Kamrup polytechnic, the design of PV system, the simulation results, performance analysis, as well as economic analysis for grid connected PV system.

### **2. Optimizing the Benefits of Solar PV-Integrated Infrastructure in Educational Institutes and Organizational Setups in North Eastern India**

[DOI: 10.4018/979-8-3693-2260-4.ch013](https://doi.org/10.4018/979-8-3693-2260-4.ch013)

In typical Indian organizational settings, users usually rely on the traditional electrical grid and costly, environmentally harmful diesel generators to supply electricity for regular, emergency backup, and transient services. In addition to offering a chance to supply electricity to relocated people, integrating solar capacity into the current grid can result in considerable cost and carbon reductions. Utilizing computational energy system modelling and the analysis of monitored demand data, we assess the savings made possible by the integration of solar (160 kW) capacity into the current supply grid of Assam Power Distribution Co. Ltd. (APDCL, India) at the Azara campus of Assam Don Bosco University, India. The authors discover that, over a five-year period, the renewable infrastructure significantly lowers costs and CO<sub>2</sub> emissions. To cut costs and emissions and pave the way for sustainable energy practices, organizations should look into ways to integrate renewable energy sources into their current electrical infrastructure and maximize their performance once installed.