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Realization of Green Engineering at ETUT

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Abstract. Despite being one of the young universities in the country, Oguz han Engineering and technology university of Turkmenistan (ETUT) aims to integrate all sustainable development goals in all aspects of its education and research programs within the scope of "Green Engineering." To increase the awareness and recognition of green engineering in our university, community, country, and world, we are developing sustainable projects such as the production of green hydrogen through solar panels, conversion of plastic waste into liquid fuel, bioethanol production from cotton stalks, sorting of solid wastes with a novel waste separator, production of synthetic fibers, clonal propagation of local plants, and obtaining of degradable bioplastics. This paper will explain these projects in detail accordingly. Realization and implementation of these projects into our society will contribute to applying sustainable development goals in the energy, climate change, and waste management areas of campus sustainability.

Keywords:
Green Engineering, Sustainable Development Goals

1. Introduction

The 2030 Agenda for Sustainable Development received unanimous adoption by the global community on 25 September 2015 during the United Nations Summit. The 2030 Agenda, comprising 17 Sustainable Development Goals interlaced with 169 targets, embodied the laudable aspirations of the international community towards the attainment of a harmonious, affluent, secure, and sustainable planet [1].

The implementation of SDGs greatly depends on the presence and influence of Higher Educational Institutions (HEIs). Their mission is to cultivate exceptional scientists and influential executives for tomorrow, all while promoting sustainability goals and instilling green living habits in the upcoming generation [2].

ETUT played an active role in the process by enacting the Green Engineering Policy (GEP)

in 2021. The objective of GEP is to create a campus atmosphere that is eco-friendly and enduring for educational and professional pursuits.

The aim of this paper is to highlight significant initiatives carried out at ETUT campus with regard to enhancing environmental sustainability through focusing on themes such as energy, climate change, and waste management.

2. ETUT's eco-policy

2.1. A concise overview of ETUT

ETUT was founded on July 15th, 2016, has gained rapid prominence as a burgeoning university within the nation. The ETUT establishment is home to five distinct faculties, namely the faculties of chemical and nanotechnologies, biotechnology and ecology, computer sciences and information technologies, cyber physical systems, and economics of innovations [3]. The aforementioned faculties provide 32 undergraduate programs exuding a target audience of 3807 students. Moreover, a one Master's degree course is available for a group of 100 students. At present, ETUT's faculty and staff complement constitutes approximately of 500 personnel.

The ETUT's three campuses are situated in the elevated southwest region of Ashgabat city and span across 52.2 hectares, as stipulated by the development plan. The primary location boasts a stunning and eco-friendly atmosphere that facilitates educational, scholarly, and investigative pursuits. Two additional campuses located in the Bekrewe and Garadamak areas comprise a forested expanse of 40 hectares, commonly referred to as the "Green belt". They contribute to decreasing the environmental impact of the university through carbon reduction measures.

2.2. Green Engineering Policy

Environmental issues had transformed into an immediate concern for ETUT, much like any other university. To address these issues, GEP (Green Engineering Policy) was created in the year 2021. The objective of GEP is to guarantee a campus devoid of pollution while adhering to Green Engineering principles for all initiatives.

ETUT has accomplished remarkable achievements both nationally and globally by introducing this comprehensive policy. The year 2022 saw the recognition of ETUT's efforts in advancing the Sustainable Development Goals as it secured a spot on the prestigious "Times Higher Education" list of global universities [4]. In the UI GreenMetric ranking of 2022, ETUT made its debut and ranked as the second university in Turkmenistan and the 637th worldwide [5].

3. Energy and climate change

The construction of campus buildings is strategically planned to optimize the utilization of natural heating and ventilation. Furthermore, the electrical system was developed with the objective of saving energy. An intelligent mechanism has been developed to control the lighting in classrooms, offices, and dormitories so that they are switched off when not in use.

ETUT's research centers conducted numerous investigations into various sustainable energy options as a means of reducing the impact of climate change.

The Green Chemistry research center has patented a new method of producing eco-friendly bioethanol from cotton stalks. This fuel is ideal for small engines found in lawn

mowers on campuses.

The Nanoelectronics research center intends to construct a small-scale facility that utilizes solar energy to generate green hydrogen in the near future. By adopting this measure, the university can significantly decrease its usage of non-renewable energy sources.

At the Biotech and Genetics Research Center, instructors and students are investigating clonal propagation of important crops, such as tomatoes, peppers, and eggplants, by obtaining callus biomass. This method has the potential to help solve global issues, such as climate change, desertification, and water crises, which contribute to food shortages.

4. Waste management

ETUT implements effective waste management by categorizing its waste into five fundamental groups. Five different types of trash cans have been provided to sort the waste based on their chemical composition and properties (Figure 1). These materials include plastic (red), metal (yellow), glass (green), paper (blue), and organic matter (grey). The small recycling plant on campus receives these items for further processing. The facility is equipped with an automated waste sorting machine capable of handling unseparated waste.

Figure 1. Bins designed for the categorization of various types of waste for recycling.

Based on calculations, the campus produces an annual amount of 70 tons of waste. A majority of the identified waste consisted of plastics, organic matter and paper. The local company which manufactures paper products from recycled materials receives the paper waste. Bioreactors are utilized to convert organic waste into compost.

The treatment of plastic waste varies. Plastic waste is first directed to the synthetic fiber manufacturing apparatus (Figure 2). Synthetic fibers are used to produce furniture, toys, and filters.

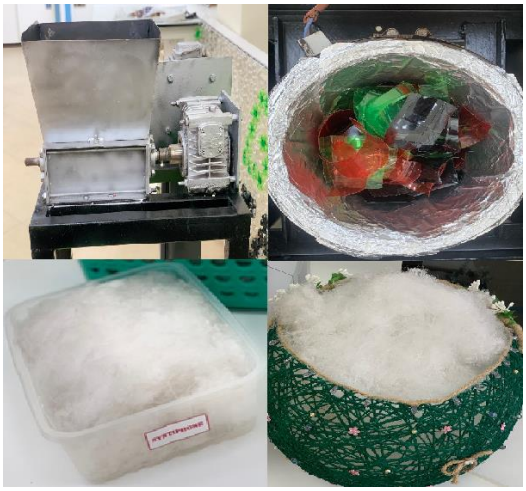

Figure 2. Synthon production device

The latest initiative of the Ecological Biotechnology Research Center is focused on devising a method to transform plastic refuse into liquid fuel. The fuel in its liquid form bears a resemblance to the gasoline utilized for transportation and machinery purposes. Additionally, it can function as a solvent for paints and varnishes.

ETUT produces bioplastics to replace hazardous plastic, furthermore students use bioplastic for food consumption in the university canteen. They also use bioplastic cutlery and garbage bags in the dormitory.

5. Conclusions

This paper outlines ETUT's sustainable development and green campus accomplishments. The university is crucial not just for providing education to students, but also for influencing the mindset of upcoming generations who will take charge of the entire nation. ETUT emphasizes environmental protection and pledges a sustainable campus for all. Consequently, the university's first measures towards promoting a green environment serve as the basis for the substantial transformations we strive to achieve in the future

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