BAKU ENGINEERING UNIVERSITY

NECESSARY ACTIONS AND PROJECTS TO REDUCE CARBON EMISSIONS

KEY ENVIRONMENTAL INITIATIVES AT BEU

1. Energy Efficiency and Renewable Energy Adoption
   - Promotion of renewable energy sources, such as solar panel projects, to reduce dependence on fossil fuels.
2. Waste Management and Recycling Programs
   - Implementation of waste segregation and recycling bins across campus.
   - Awareness campaigns to promote responsible waste disposal and reduction of single-use plastics.
   - Collaboration with local recycling facilities to process campus-generated waste effectively.
3. Sustainable Transportation Initiatives
   - Encouragement of cycling and walking by providing bike racks and pedestrian-friendly pathways.
4. Green Campus Development
   - Expansion of green spaces through tree-planting projects and urban gardening initiatives.
   - Water conservation measures, such as rainwater harvesting and efficient irrigation systems.
5. Environmental Education and Research
   - Integration of sustainability and climate change topics into academic curriculum.
   - Support for student-led environmental projects and research on green technologies.
   - Hosting seminars, workshops, and awareness events on environmental issues and sustainable development.
6. Carbon Footprint Monitoring and Reporting
   - Regular assessment of campus carbon emissions to track progress toward carbon neutrality.
   - Development of sustainability reports with measurable targets and improvement strategies.
7. Baku Engineering University (BEU) has carried out a new phase of greening activities.

As part of efforts aimed at improving the environment, promoting ecological awareness, and contributing to the fight against climate change, nearly 1,000 additional trees of various species have been planted on the university campus. In addition, due to the seasonal conditions, a number of landscaping works have been undertaken, agro-technical care has been provided to existing green areas, and new green zones have been established.

Through these initiatives, BEU not only minimizes its environmental impact but also serves as a model for sustainability in Azerbaijan's academic sector. By continuously expanding and refining these efforts, the university aims to create a long-lasting positive environmental legacy.

PROBLEMS OF UNIVERSITY CARBON FOOTPRINT

Main Sources of CO_2 Emissions:

Direct emissions (Scope 1):University-owned vehicles, heating systems, generators.

Indirect emissions (Scope 2): Electricity consumption within the university.

Other indirect emissions (Scope 3):Resource consumption, waste management, student and staff transportation.

Methods for Calculating Emissions

1. Data Collection:

- Monitoring electricity and fuel consumption, waste volumes, and transportation patterns.

- Recording heating system emissions and the use of fossil fuels.

2. Emission Factors Application:

- Using standard conversion rates, e.g., 1 kWh of electricity = ≈0.4 kg CO_2 (for a standard energy mix).

- Applying coefficients based on fuel type and energy source.

3. Carbon Footprint Calculators:

- Utilizing online tools such as GHG Protocol, Carbon Footprint Calculator, or ISO 14064-based methods.

4. Annual Emission Trend Analysis:

- Comparing emissions data across multiple years to identify patterns and opportunities for reduction.

Carbon Emission Standards in Azerbaijan

Azerbaijan follows international climate agreements such as the Paris Agreement and implements local regulations for monitoring greenhouse gas (GHG) emissions. Some relevant national and international standards include:

ISO 14064-1: Standard for measuring and reporting GHG emissions.

Azerbaijan's Nationally Determined Contributions (NDCs): A commitment to reducing GHG emissions by 35% by 2030 compared to 1990 levels.

Law on Environmental Protection of Azerbaijan: Establishes emission control policies and sustainability measures for industries and institutions.

State Program on Renewable Energy: Encourages universities to transition to green energy sources, impacting their carbon footprint calculations.

By aligning carbon footprint calculations with these standards, universities in Azerbaijan, including Baku Engineering University (BEU), can improve their sustainability efforts and contribute to national climate goals.

BAKU ENGINEERING UNIVERSITY'S GLOBAL PARTNERSHIPS FOR CLIMATE ACTION

Baku Engineering University (BEU) and United Arab Emirates University (UAEU) Collaborative Research Program

Baku Engineering University (BEU) is actively engaged in a wide range of international collaborations aimed at addressing climate change, environmental challenges, and advancing sustainable development. One such collaboration is with United Arab Emirates University (UAEU), where both institutions will contribute to four significant research projects:

- **Project 1:** *Development and Characterization of Eco-Friendly IL-Type Surfactants for Enhanced Petroleum Spill Remediation*

This project focuses on the development of environmentally friendly ionic liquid-based surfactants to enhance the remediation of petroleum spills.

- **Project 2:** *Development of Innovative Methods for Disinfecting Water Resources Using Strong Electric Fields and Discharges*

This project aims to explore novel methods for disinfecting water resources by utilizing strong electric fields and discharges to ensure safer water for communities.

- **Project 3:** *Climate Action and Economic Growth: Creating a Sustainable Balance*
  The research will focus on achieving a balance between climate action and

economic growth, promoting sustainability while addressing environmental and economic challenges.

- **Project 4:** *The Role of Energy Efficiency in Reducing Greenhouse Gas Emissions* This project will evaluate the role of energy efficiency measures in reducing greenhouse gas emissions, highlighting practical applications in various industries.

As part of these efforts, BEU is involved in multiple other initiatives that emphasize climate change research and sustainable development. In October 2024, BEU signed a partnership agreement with the Climate Change Response Program, led by Professor Junho Kim from Inha University (South Korea). This agreement is centered on joint educational initiatives and training programs aimed at enhancing climate crisis mitigation efforts.

Furthermore, BEU participates in the ITACA project, funded by the European Union, which brings together European and Azerbaijani universities, including Sapienza University of Rome (Italy), Aalborg University (Denmark), the University of Granada (Spain), and the University of Patras (Greece). This collaborative initiative focuses on establishing a research and training center to address environmental issues arising from oil and gas extraction in Azerbaijan.

In January 2025, a BEU delegation visited Beijing University of Chemical Technology (BUCT), where a memorandum of cooperation was signed, discussing potential joint undergraduate programs in chemical engineering and research collaboration in chemistry.

Additionally, BEU is involved in the "CAMPAIGNers" project, funded under the European Union's Horizon 2020 program, aimed at advancing climate change mitigation strategies.

These collaborations reflect BEU's ongoing commitment to international research and education in environmental sustainability, reinforcing its role in tackling global climate challenges and fostering sustainable development.

PROJECT: COLLECTION AND RECYCLING OF PLASTIC WASTE AT BAKU ENGINEERING UNIVERSITY

Introduction

The Food and Biotechnology Department of Baku Engineering University presents an innovative project aimed at the collection and recycling of plastic waste on the university campus. This initiative is supported by the scientific youth movement and is intended as the foundation for future scientific research projects. The main goal of

the project is to reduce the polluting impact of plastic waste, one of the global ecological issues, and to create biodegradable alternatives for recycling.

Project Objectives

- To establish a system for the collection of plastic waste in the university's cafeterias and designated bins.
- To develop and implement efficient recycling methods for converting plastic waste into alternative materials.
- To ensure the ecological sustainability of reusable materials.
- To research biodegradable plastic alternatives to reduce the long-term impact of plastic waste on the environment.
- To engage students and young scientists in ecological sustainability through scientific activities.

Implementation Plan

Stage 1: Establishing the Infrastructure for Waste Collection

- Placing special bins for plastic waste in cafeterias and key areas of the university.
- Organizing awareness campaigns for students and faculty.

Stage 2: Research and Development

- Analyzing the collected plastic waste and identifying the most efficient recycling methods.
- Producing reusable products such as bioplastics or composite materials from plastic waste.
- Collaborating with laboratories and industry experts to develop innovative recycling technologies.

Stage 3: Pilot Testing and Expansion

- Conducting small-scale pilot tests for waste recycling within the university.
- Evaluating the effectiveness and ecological impact of the produced materials.
- Expanding the project based on the obtained results.

Stage 4: Integration into Scientific Research

- Publishing scientific research and presenting it at international conferences.
- Collaborating with environmental organizations and governmental bodies to scale up the project and secure funding.

- Exploring the commercialization opportunities for the eco-friendly materials obtained from recycling plastic waste.

Expected Results

- A reduction in plastic waste on the university campus and the creation of a cleaner ecological environment.
- Development of innovative recycling technologies that can be applied on a larger scale.
- Increased student interest in ecological scientific research and sustainable development projects.
- Contributing to solving global ecological issues through the application of scientific innovations in the fight against plastic pollution.

This project represents a significant step in integrating the principles of sustainable development into scientific research at Baku Engineering University. This initiative, actively involving students and young scientists, not only addresses the problem of plastic waste management but also contributes to the development of innovative approaches for recycling and reuse. With the necessary support and collaboration, the project can be expanded into a large-scale model that could serve as an example for other universities and scientific institutions.

Our scientists and postgraduate students are developing cutting-edge technologies in the fields of ecology and engineering, which include environmental assessment and strategic environmental assessment.

Application of Ionic Liquids in the Synthesis of Heterocyclic Compounds: Environmental Aspects and Contribution to Climate Initiatives

Modern trends in chemistry are increasingly focused on sustainable development and reducing the negative impact on the environment. The use of ionic liquids as catalysts in the synthesis of heterocyclic compounds represents one of the key solutions for reducing the toxicity of chemical processes and improving their energy efficiency. This approach also aligns with global climate initiatives and the principles of green chemistry, making it relevant for educational institutions.

1. Reduction of Environmental Impact:

Ionic liquids (ILs) have garnered attention due to their potential to reduce environmental impacts compared to conventional solvents. Unlike traditional organic solvents, which can be volatile and toxic, ionic liquids exhibit negligible volatility, thus reducing the risk of air pollution and the emission of hazardous vapors. Additionally, ILs can be synthesized from renewable resources, offering a more sustainable alter-

native for various chemical processes. The use of ionic liquids can decrease reliance on harmful chemicals, thereby contributing to a less detrimental environmental footprint.

2. Alignment with Green Chemistry Principles:

Ionic liquids are often considered to be in compliance with several key principles of green chemistry, such as:

- **Utilization of non-toxic, non-volatile substances:** Ionic liquids are generally non-toxic and have a low tendency to vaporize, which minimizes their potential risks to human health and the environment.
- **Reduction in the use of hazardous chemicals:** Many processes in industries such as pharmaceuticals and biochemistry can replace traditional solvents with ILs, thus reducing the reliance on toxic reagents and chemicals.
- **Recyclability of solvents:** Ionic liquids possess high stability, enabling them to be recycled and reused effectively, which reduces the need for disposal and minimizes chemical waste generation.

3. Minimization of Waste and By-products:

One of the primary advantages of using ionic liquids is the reduction of waste and by-products. Traditional chemical processes often result in waste that is difficult to treat or recycle. In contrast, ionic liquids, with their tunable properties, can be optimized to minimize the formation of unwanted by-products. Their non-volatile nature also helps in reducing waste emissions into the atmosphere. Furthermore, the ability to reuse ionic liquids multiple times helps in minimizing the consumption of raw materials and reduces the overall generation of waste.

4. Development of Biodegradable Ionic Liquids:

The development of biodegradable ionic liquids is a significant area of research in the field of green chemistry. While many ionic liquids are chemically stable and persistent in the environment, raising concerns about their ecological impact, researchers are focusing on designing ILs that can degrade more readily after use. These biodegradable ionic liquids can be synthesized with specific functional groups that promote their breakdown through natural processes, thereby mitigating their environmental persistence and ensuring a lower ecological footprint after application.

5. Increased Energy Efficiency:

Ionic liquids contribute to enhanced energy efficiency in various industrial processes. Their ability to dissolve a wide range of substances and facilitate chemical reactions without the need for elevated temperatures or pressures leads to reduced energy consumption. For example, in extraction and separation processes, ionic

liquids may operate effectively at lower temperatures compared to conventional solvents, which results in lower energy demands. This not only reduces overall energy usage but also lowers operational costs, making industrial processes more sustainable and cost-effective.

Thanks to their ability to lower reaction temperatures and reduce the need for additional energy consumption, the use of ionic liquids helps to reduce CO_2 emissions. This is particularly important in the context of combating climate change and implementing low-carbon technologies.

The application of ionic liquids in the synthesis of heterocyclic compounds represents a promising direction for the sustainable development of the chemical industry and science. It not only contributes to reducing environmental impact but also integrates into global climate initiatives, providing educational institutions with an opportunity to improve their positions in global rankings. Supporting such research and incorporating it into the educational process is an important step toward fostering an environmentally responsible approach in scientific activity and education.