7.2.2 University plans to upgrade existing buildings to higher energy efficiency

Alexandria University is upgrading existing facilities through a comprehensive energy efficiency strategy that enhances solar energy conversion, optimizes battery and energy storage systems, and improves overall performance under varying temperature and operational conditions. Using advanced models, simulation, and analysis, the institution evaluates loads, current, and electric potential to reduce carbon dioxide emissions and increase system stability. The plan applies innovative materials, thin films, solar cells, and wind power technologies, combined with intelligent control systems to ensure efficient energy utilization and long-term sustainable development. This approach supports the modernization of campus infrastructure through improved structure, process optimization, and enhanced renewable energy integration.

- The University has reached 55.6% implementation of smart building technologies via the progressive integration of digital infrastructure and intelligent management systems across campus facilities. Major applications feature QR code-based smart attendance systems, automated monitoring and reporting platforms, fire alarm and smoke detection networks, video surveillance, and digital access and safety controls. Comprehensive training programs are executed to ensure effective system adoption and operation. These strategic initiatives drive improved operational efficiency, enhanced safety and security, reduced manual tasks, and the ongoing advancement of a connected, data-driven campus environment.

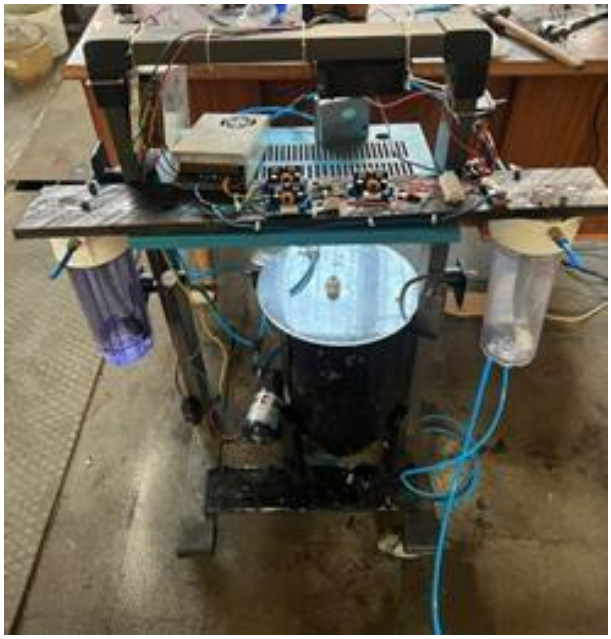
- Alexandria University assigns 137 staff members toward sustainability governance, incorporating university leadership, office personnel, vice deans, and faculty committees. Their ongoing activities span sustainability reporting, policy development, workshops, research collaboration, stakeholder engagement, and applied research projects focused heavily on energy, water, waste, and circular economy themes.

- The university campuses located in Alexandria, Egypt, span a total area of 13,982,352.9 square meters, with 8,090,641.9 square meters dedicated to planted vegetation. Beyond these green sectors, 3,460,144.6 square meters remain open spaces, while building structures account for just 2,431,566.4 square meters of the overall campus zone. This well-planned spatial distribution reflects the institution's dedication to restricting urban growth, safeguarding natural landscapes, and providing expansive outdoor settings that boost biodiversity, ecological health, and student well-being.

- Renewable energy sources and technologies supporting power generation and combined heat applications include:
    1. **Solar Thermal Systems:** Solar collectors generate renewable thermal energy to support heating and hot water demands and complement building energy systems.
    2. **Wind Energy:** Wind turbines convert wind energy into renewable electricity to support campus operations and reduce dependence on conventional energy sources.
    3. **Biodiesel Production:** Biodiesel derived from biological feedstocks such as plant oils, used cooking oil, and other renewable organic materials serves as a cleaner alternative fuel for energy generation and operational activities.

4. **Green Hydrogen:** Hydrogen produced through water electrolysis using renewable electricity (e.g., solar or wind power) serves as a clean energy carrier that can support electricity generation, thermal applications, and future low-carbon energy systems, including CHP applications where implemented.
5. **Biomass Energy:** Biomass utilization includes advanced conversion technologies such as carbonization, torrefaction, gasification, pyrolysis, and biochar production, contributing to renewable energy generation and efficient resource utilization.
6. **Waste-to-Energy Systems:** Organic or biodegradable waste is converted into useful energy, with CHP applications enabling simultaneous production of electricity and recoverable heat.

Together, these renewable energy technologies contribute to increasing renewable energy production, improving energy efficiency, reduce greenhouse gas emissions, and supporting sustainable development and smart building implementation.

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<td>Automatically Controlled Biodiesel Production Unit. (Faculty of Engineering, Alexandria University)</td>
<td>Activated carbon cloth from biomass fibrous resources (Faculty of Engineering, Alexandria University)</td>
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Design and Fabrication of Biodiesel Burner test rig. (Faculty of Engineering, Alexandria University)	Green Hydrogen/Diesel Dual-Fuel Retrofit: A Scalable Pathway to Industrial Decarbonization (Faculty of Engineering, Alexandria University)
	
Design of Integrated Augmented Vertical Axis Wind Turbine (VAWT) With Solar Energy System for High Rise Urban Applications (Faculty of Engineering, Alexandria University)	Experimental and Simulation Study of Natural Gas–Hydrogen/Diesel RCCI for Engine Decarbonization (Faculty of Engineering, Alexandria University)



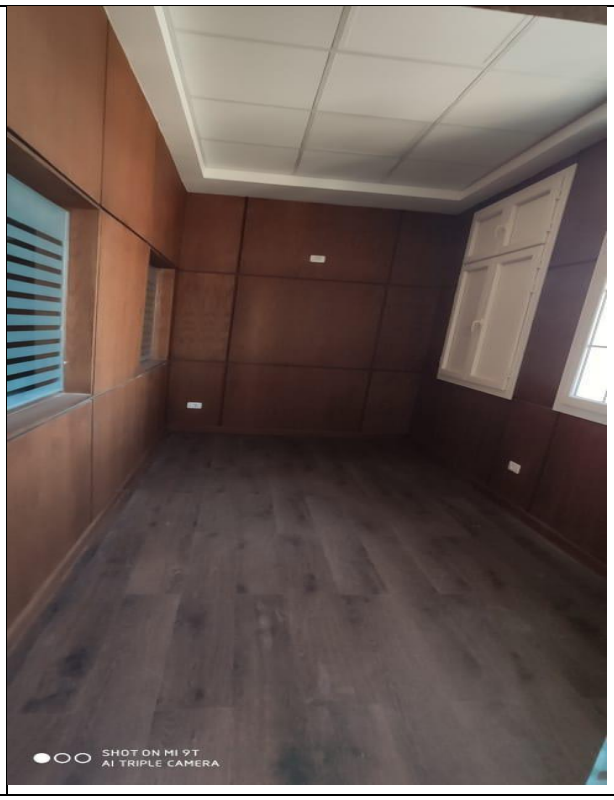
Solar Energy Center at the Faculty of Agriculture (Alexandria University)



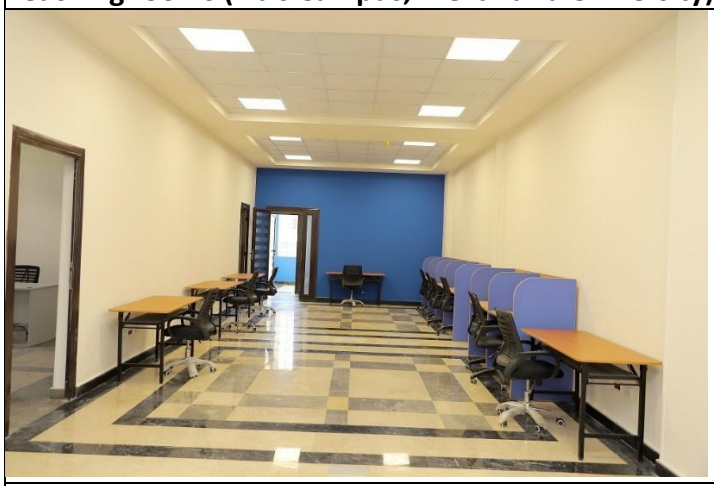
Windmill and Solar Panels (Solar Energy Center at the Faculty of Agriculture - Alexandria University)

- Driven by the University's keen commitment to transforming into an environmentally friendly institution dedicated to enhancing resource management and rationalizing energy consumption, the Department of Community Service Development launched a comprehensive project aimed at the total transformation of all used fluorescent lighting by replacing them with modern LED bulbs. These light-emitting diodes provide significantly higher efficiency, lower energy consumption, and extended operational lifespans compared to conventional fluorescent lamps. Initiated in 2019, the project has been systematically implemented in structured phases, beginning with a complete inventory of the total quantities required across all university faculties and institutes. During the first quarter, 30% of the necessary stock—covering specific 60 cm, 120 cm, and 9-watt bulb categories—was procured and installed. Concurrently, appropriate measures were executed to safely discard the decommissioned fluorescent lamps through specialized environmental disposal contractors. The second stage involved purchasing and transitioning 37% of the total university requirements, while the third stage accounted for another 25%. In the final phase, the complete transformation of all remaining LED units was successfully performed. The table below summarizes the total quantity of LED bulbs required for this total transition to a green energy source, detailing the replacement percentages achieved over the past four years.





Teaching rooms (Abis Campus, Alexandria University)



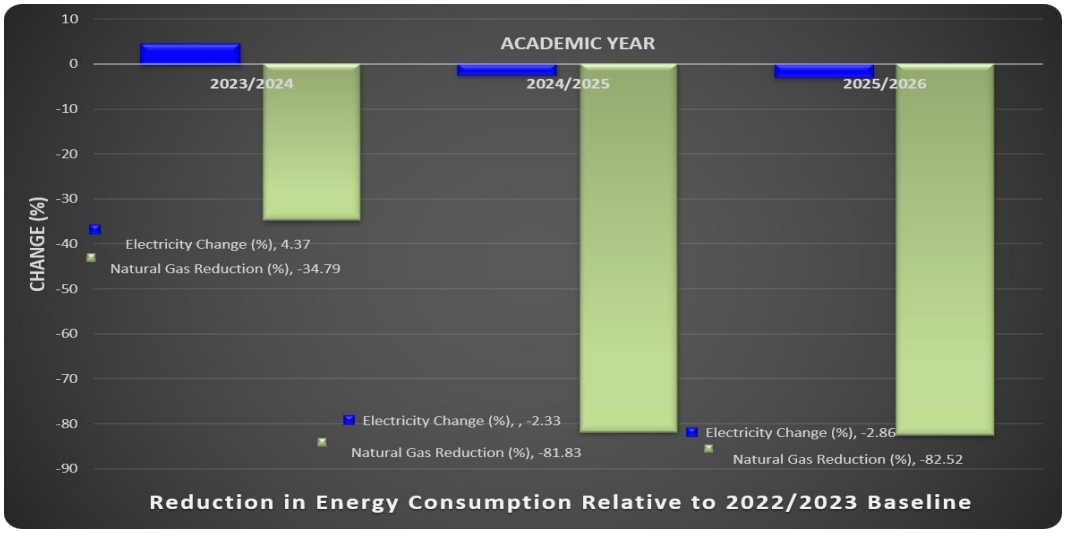
All teaching rooms contain well-equipped technological facilities (screens, data shows, and white boards).



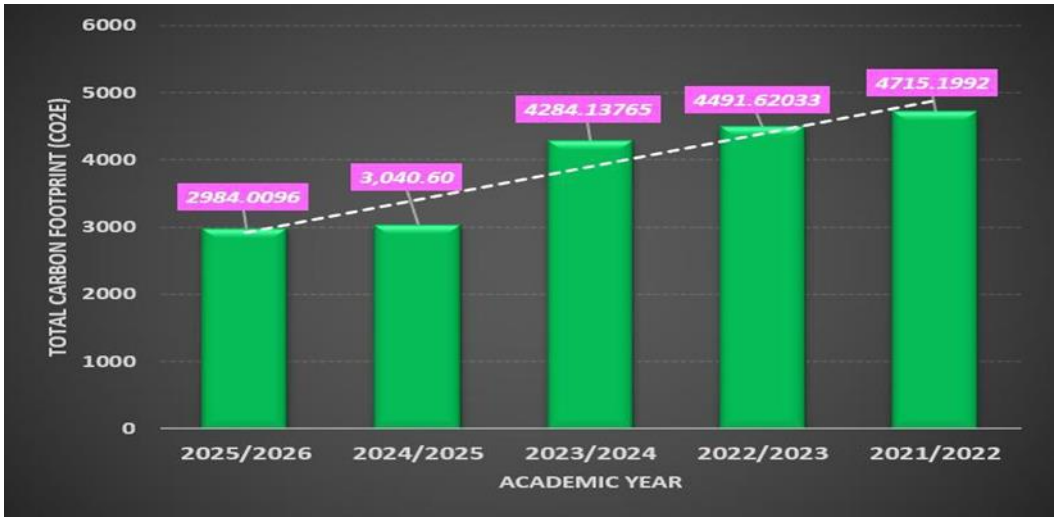
Smart screens are used in all lecture halls

- **Improvement in Energy Efficiency:**
  Alexandria University continuously enhances its energy efficiency through targeted energy management initiatives and infrastructure upgrades. Compared with the 2022/2023 baseline, natural gas consumption decreased significantly by 34.79% in 2023/2024, 81.83% in 2024/2025, and 82.52% in 2025/2026. Electricity consumption also declined by 2.33% in 2024/2025 and 2.86% in 2025/2026, following a temporary increase of 4.37% in 2023/2024. These results demonstrate the University's ongoing commitment to reduce energy

consumption, improve operational efficiency, and lower greenhouse gas emissions in support of sustainable development goals and regional sustainability frameworks.



- **Reduction in Carbon Footprint**
  Alexandria University has achieved a continuous reduction in its carbon footprint through the implementation of energy efficient technologies, renewable energy initiatives, and sustainable campus management practices. As shown in the figure, total carbon dioxide emissions decreased from 4,715.20 tCO_2e in the 2021/2022 academic year to 4,491.62 tCO_2e in 2022/2023 and 4,284.14 tCO_2e in 2023/2024. This downward trend continued with emissions declining to 3,040.60 tCO_2e in 2024/2025 and further to 2,984.01 tCO_2e in 2025/2026. Overall, the University achieved a reduction of approximately 36.7% compared with the 2021/2022 baseline, reflecting its commitment to climate change action, energy conservation, and the transition toward a low-carbon and sustainable development path.



Energy Efficient Appliances Usage

- Alexandria University intends to realize further energy savings by paying close attention to

energy management. All the faculties and institutes of the university realize their own energy-saving potential by means of LED lighting and the deployment of sustainable technology.

- Motion-Activated Lighting with PIR Sensors
  PIR sensors have been installed in select faculties to enable motion-activated lighting by detecting changes in heat signatures. Gradual implementation of PIR sensors across all faculties and institutes of the university, as a future phase.
- Automated Lighting Systems
  Install lighting systems that automatically adjust based on occupancy or time of day to enhance energy efficiency.



Energy Efficient Appliances Usage: Use of LED lighting and lamps (New Abbes Campus, Alexandria University)

Alexandria University Program to reduce Electricity consumption from Air Conditioners and electric devices such as Computers, printers, photocopiers, surveillance cameras.

1. All newly purchased AC are inverter AC to reduce the electricity consumption
2. The new electric devices such as Computers, printers, photocopiers, and surveillance cameras are energy efficient devices.
3. All electronic devises must be shut down at night, when not used.
4. Passive Infrared (PIR) Sensors were implemented in some Faculties for motion-activated lighting to detect changes in heat signatures when someone or something moves within the sensor's range. These sensors will beimplemented in phases in for all faculties and institutes of the university.
5. Regular Maintenance of all devices.
6. The thermostats of the air conditioner are set at 25°C, and direct sunlight is avoided by using sun protection curtains.

Energy Efficiency

- Integrating solar and wind energy sources into building design reduces reliance on non-renewable resources.
- Installing systems that optimize ventilation with minimal energy consumption.
- Automated lighting systems that respond to occupancy or time of day.
- As for energy, all the buildings have solar energy generation cells to provide part of the

building’s needs, which are estimated at about 45%, in addition to using energy-saving lamps (LED).

- The public site lighting poles are powered by solar energy.