13.2.1 Measure the amount of low carbon energy used across the university

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 climate models, simulation, and data analysis, the institution evaluates electrical loads, current, and 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 campus infrastructure modernization through improved structure, process optimization, and enhanced renewable energy integration.

Alexandria University implements an integrated carbon management approach focused on reducing carbon dioxide emissions through energy efficiency operations, renewable energy expansion, and sustainable resource use. The University applies advanced monitoring, analysis, and performance evaluation systems to track CO2 emissions and improve environmental stability across campus. Through optimized process dynamics, innovative technology, and compliance with national and international environmental standards, Alexandria University continually enhances its climate action efforts. This comprehensive framework supports long-term sustainable development, aligns with national vision targets, and strengthens the University's leadership in low-carbon transition shift.

- The consistent downward trajectory aligns with the emission reduction pathways recommended by the Intergovernmental Panel on Climate Change for limiting global warming to 1.5 °C. It supports Egypt's updated Nationally Determined Contributions under the Paris Agreement. By embedding these measures into core operational planning, the university demonstrates a replicable model of science-based climate governance within the higher education sector.
- Alexandria University has consistently published its sustainability report on its official website for four consecutive years, covering the 2022, 2023, 2024, and 2025 reporting periods. Each report provides a comprehensive overview of the university's sustainability achievements, including environmental performance, green campus infrastructure, academic and research initiatives aligned with sustainable development goals, and community engagement activities that support Egypt Vision 2030. The reports also highlight formal institutional policies and governance frameworks for integrating sustainability across education, research, operations, and outreach. These policies remain publicly accessible and systematically embedded within strategic planning and operational practices. Continuous annual publication reflects strong commitment to transparency, accountability, and sustainable development.
- The university also monitors greenhouse gases and solid particles to prevent environmental pollution and mitigate climate change. Monitoring is conducted by faculty members holding consultant certificates for self-monitoring of facilities, alongside environmental measurements performed in accredited laboratories.

- The university has introduced several renewable-energy projects, including:
  - Solar photovoltaic panels installed on university buildings.
  - Solar-energy research and training facilities at the Faculty of Agriculture.
  - Wind-energy installations and hybrid solar-wind systems.
  - Solar installations at the Faculties of Engineering, Education, and Medicine.
  - Renewable-energy monitoring and energy-efficiency initiatives.

  Measurement of Low-Carbon Energy

  According to Alexandria University's 2024–2025 Sustainability Report:

Indicator	Reported amount
Total electricity consumption	4,228,995.91 kWh
Renewable energy production	1,213,291.2 kWh/year
Renewable electricity share	28.69%
Reduction in natural gas usage	70%

  The university reports that renewable energy accounts for 28.69% of its total electricity use.

  Calculation

  The percentage of low-carbon electricity is calculated using:

  Renewable electricity share (%) = (Renewable electricity generated ÷ Total electricity consumed) × 100

  Using the reported figures:

  (1,213,291.2 ÷ 4,228,995.91) × 100 = approximately 28.69%.

  This indicates that approximately 28.69% of the university's reported electricity consumption was supplied by renewable energy.

- To ensure accurate measurement across all faculties, the university should:
  - Record electricity generated by every solar installation using generation meters.
  - Measure electricity supplied by wind turbines.
  - Collect monthly electricity-consumption bills from every faculty.
  - Separate renewable electricity consumed on campus from electricity exported to the grid.
  - Record renewable electricity purchased from external suppliers separately.
  - Calculate the renewable-energy percentage for each faculty and for the entire university.
  - Prepare annual energy-monitoring reports to compare performance over time.

- **Energy Conservation Advisory Group in Center for Graduate Studies and Research – Institute of Graduate Studies and Research – Alexandria University**

  This group is concerned with reviewing energy in all its forms at all levels, such as measuring and analyzing exhaust gases in furnaces and boilers with the aim of improving combustion efficiency and reducing emissions, measuring and analyzing boiler water, in addition to tests of thermal insulation

efficiency, lighting efficiency, electrical energy analysis, and compatibility with electrical loads. It also determines the power factor to increase efficiency. Rationalizing the energy used, reviewing energy use, radiation measurements and safety tests for radioactive sources. The group has a mobile laboratory that can visit sites and make environmental measurements related to energy as well as emissions and study energy consumption and the extent of thermal insulation in industrial sites.

- S**olar Energy Center at the Faculty of Agriculture (Alexandria University)**
  Hybrid Renewable Energy Systems to Supply Services in Rural Settlements of Mediterranean Partner Countries.
  The services provided by the center:
  1) **Research and development**: Encouraging applied research on renewable energy at AU and through collaborations with other national and international universities. Development of hybrid systems in renewable energy and its uses in water pumping and water desalination and development of remote and desert areas. Development of research in energy from biomass and waste. Development of thermal uses of solar energy.
  2) **Consultations:** Various consultations in renewable energy systems, especially hybrid systems, drying and solar heating.
  3) **Education and Training:** Supporting the renewable energy education at AU. Developing and delivering courses, e-learning, workshops, training courses, and conferences on various renewable energy systems.

  Serving the Egyptian community by providing all renewable energy information to the public.



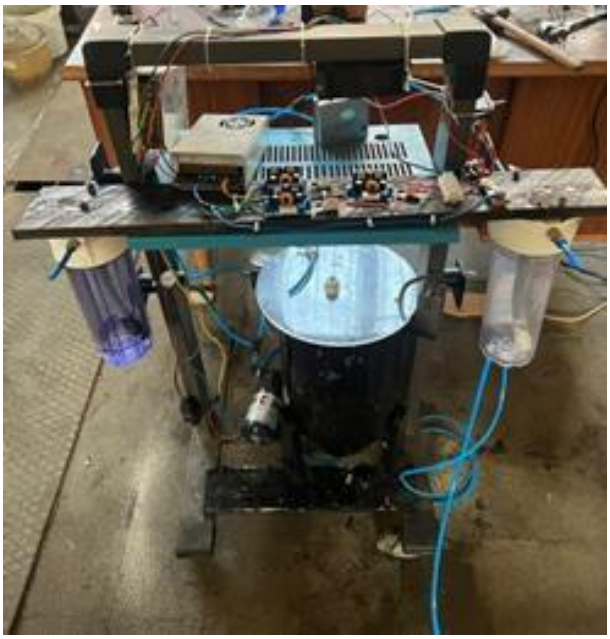
Innovative Renewable Energy (RE) Driven - Multi Stage Flash (MSF) System with Salts Precipitator and Nano Filtration (NF) Feed Water pre Treatment (RE-NF-MSF) - Faculty of Agriculture

- **Renewable energy sources:**
  Renewable Energy Sources in Campus: 1,228,291.2 kWh/year
  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, reducing greenhouse gas emissions, and supporting sustainable campus development and smart building implementation.

	
Automatically Controlled Biodiesel Production Unit. (Faculty of Engineering, Alexandria University)	Activated carbon cloth from biomass fibrous resources (Faculty of Engineering, Alexandria University)

	
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)



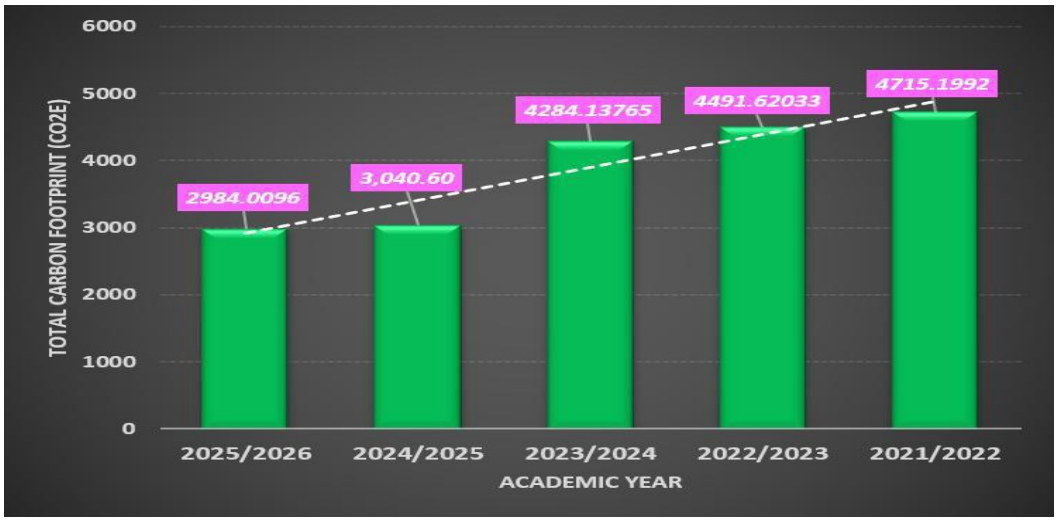
Solar Energy Center at the Faculty of Agriculture (Alexandria University)



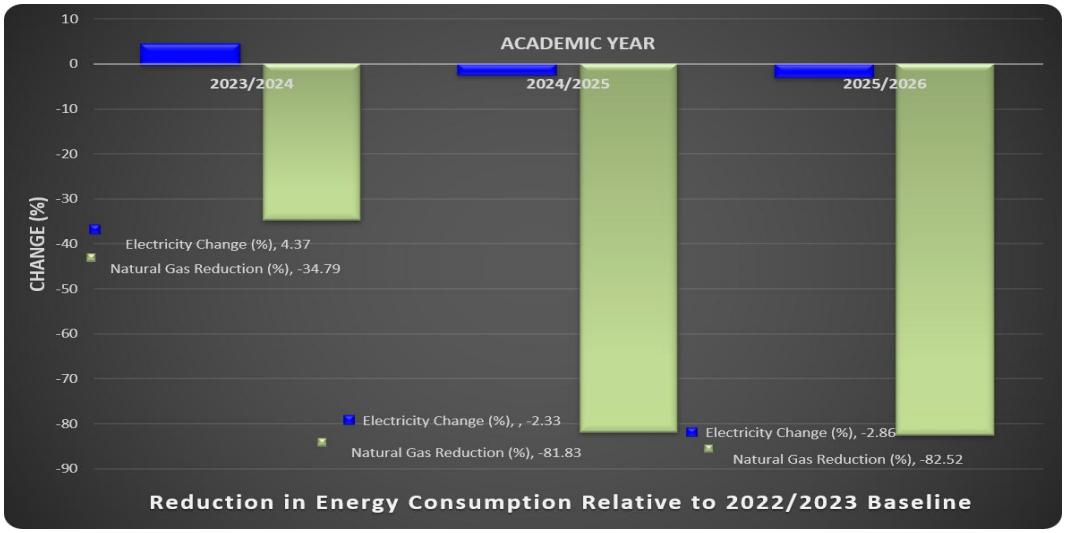
Windmill and Solar Panels (Solar Energy Center at the Faculty of Agriculture - Alexandria University)

- **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 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 action, energy conservation, and the transition toward a low-carbon and sustainable campus.



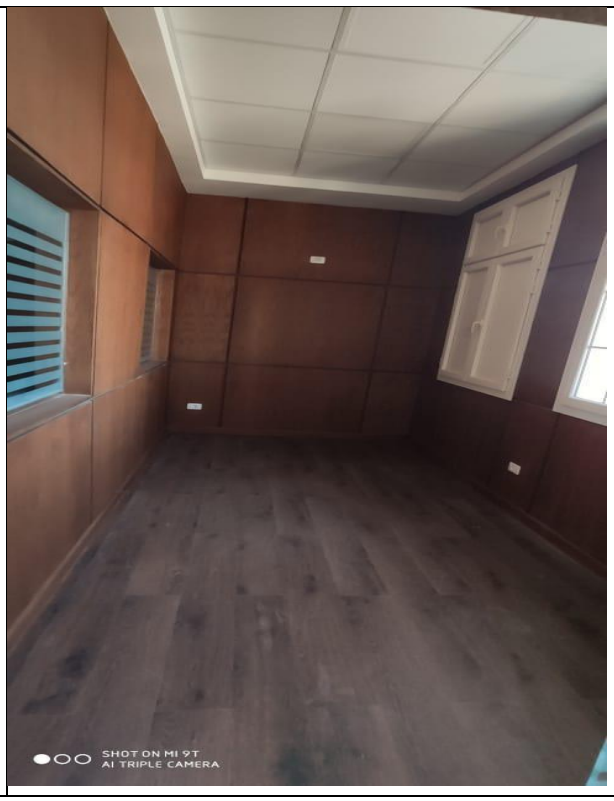
- **Improvement in Energy Efficiency:**
  Alexandria University continuously enhances its energy efficiency through targeted energy management initiatives and infrastructure upgrades. Compared with the 2022/2023 baseline, natural gas consumption decreased significantly by 34.79% in 2023/2024, 81.83% 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.



- 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**

- **Sustainable Waste Management:**
  Alexandria University continues to strengthen its sustainable waste management system through integrated initiatives in waste reduction, recycling, and digital transformation. During the 2025/2026 academic year, the University generated 183.19 tons of paper and plastic waste, a 2.76-ton reduction from the previous academic year. Plastic waste decreased from 77.00 tons to 74.94 tons (a reduction of 2.06 tons), while paper waste declined from 108.95 tons to 108.25 tons (a reduction of 0.70 tons). These improvements were achieved through a comprehensive strategy that includes electronic books, paperless administrative services, online examinations, learning management systems, digital communication, QR-code forms, and electronic student services, significantly reducing paper consumption across the University.



Institutional side-by-side comparison of plastic waste and paper waste alongside the cumulative Total Waste tonnage between last year and this year. Over a two-year tracking period, 2024/2025 and 2025/2026.

Projects:

University administration building

The project of "supplying, installing and operating the photovoltaic solar plant with a capacity of 20.1 kW above the administration building of Alexandria University in Shatby was launched by the Arab Renewable Energy Company, on 2/14/2020. The capacity of the station per month is 20.1 kW, while the capacity consumed from the building is 255 kW /month, meaning that the station provides within 8% of the total monthly consumption. Total Solar energy per year = **241.2 KWh**.

Higher Institute of Public Profession

The Institute has two initiatives to exploit solar energy at the Institute through two units of photovoltaic cells (50 watts each) that are currently installed and are exploited to provide the electrical energy necessary to operate the Ultra- Filtration unit located in one of the laboratories of the Department of Materials Science for educational purpose.
Moreover, five units of photovoltaic cells (260 watts each) were installed to operate the discussion room at the Institute and to provide it with sufficient energy for lighting purposes and to operate its display device. Total Solar energy per year = **360 KWh**.

The Faculty of Engineering

The implantation of the new Solar Station is completed. The implementation of the solar photovoltaic panels was performed in December 2022 with a capacity of **220** kilowatts on the 2000 m^2 roof top of the building of the Mechanical Engineering Department at the Faculty of Engineering.

Alexandria University have generalized this initiative in some of the faculties of Alexandria University in gradual stages.



Solar photovoltaic with a capacity of 220 kilowatts on the 2000 m^2 roof top of the building of the Mechanical Engineering Department at the Faculty of Engineering