7.2.3 Process for carbon management and reducing carbon dioxide emissions

Alexandria University implements an integrated carbon management approach focused on reducing carbon dioxide emissions through energy efficient operations, renewable energy expansion, and sustainable resource use. The University applies advanced monitoring, analysis, and performance evaluation systems to track emissions and improve environmental stability across campus. Through optimized processes, innovative technology, and compliance with national and international environmental standards, Alexandria University continually enhances its climate action efforts. This comprehensive approach supports long-term sustainable development, aligns with Egypt's Vision 2030, and strengthens the University's leadership in low carbon transformation.

- **Renewable energy sources:**
  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)



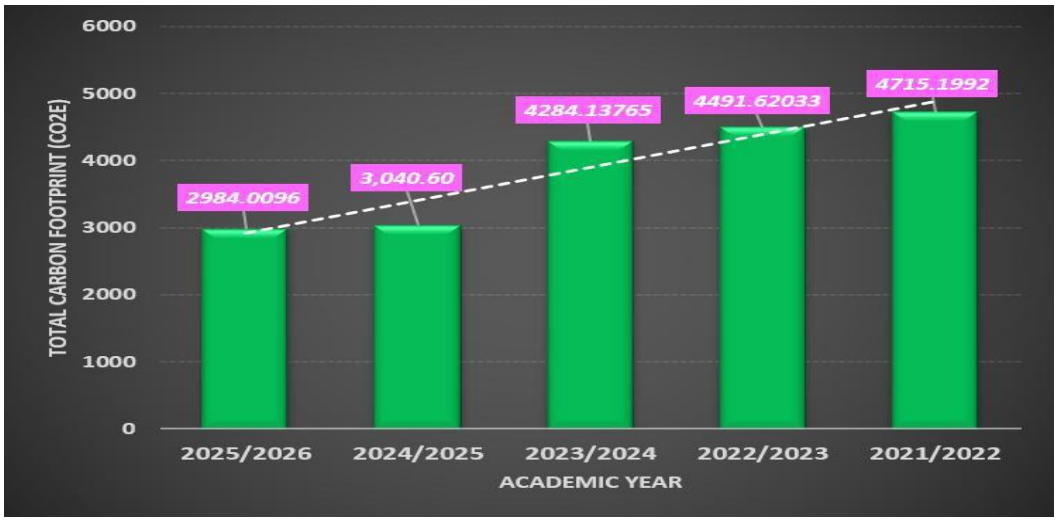
Solar Energy Center at the Faculty of Agriculture (Alexandria University)



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.



- Alexandria University has established a comprehensive portfolio of 26 innovative programs and projects that promote renewable energy, energy efficiency, climate change mitigation, and sustainable resource management. These initiatives integrate education, research, infrastructure, and community engagement through renewable energy centers, solar and wind power systems, green building technologies, biofuel research, circular economy projects, and international academic partnerships. The University operates renewable energy centers at the Faculty of Agriculture, Faculty of Science, and Faculty of Engineering, where hybrid solar–wind systems, photovoltaic installations, and Building-Integrated Photovoltaic (BIPV) technologies support both campus operations and applied research. In addition, Alexandria University offers specialized postgraduate programs in climate change, sustainable fisheries, natural resource sustainability, and the blue economy through Erasmus+ and other international collaborations. Campus sustainability projects, including the Green Cycle initiative, greywater recycling, energy-efficient buildings, solar power stations, and plastic recycling laboratories, further demonstrate the University's commitment to reducing carbon emissions, improving resource efficiency, and preparing graduates to address global environmental challenges.



Carpooling application for smartphones - Green Cycle project in the Faculty of Pharmacy (Alexandria University, Egypt)

- **Sustainable Transportation:**
  Alexandria University is committed to developing a sustainable transportation system that minimizes environmental impacts, improves campus accessibility, and promotes low-carbon mobility. Through an integrated transportation strategy, the University encourages walking, cycling, shared mobility, and public transportation while reducing dependence on private vehicles. These initiatives support climate action, improve air quality, reduce traffic congestion, and contribute to creating a safe, accessible, and environmentally friendly campus.

  To improve mobility across its campuses, Alexandria University provides regular free shuttle bus services connecting faculties, student housing, research institutes, and major transportation hubs. The shuttle system operates on scheduled routes, ensuring convenient, safe, and accessible transportation for students, faculty members, staff, and visitors while reducing the need for private vehicles. The University has also expanded shared transportation options through partnerships with transportation providers and campus-based ride-sharing initiatives.

  The University has implemented 22 sustainable transportation initiatives designed to reduce private vehicle use and greenhouse gas emissions. These include shuttle services, carpooling programs, bicycle parking facilities, pedestrian-friendly campus design, awareness campaigns, sustainable mobility competitions, smart parking management, and incentives encouraging environmentally responsible travel. Together, these initiatives help decrease traffic congestion, improve campus safety, and enhance environmental quality.

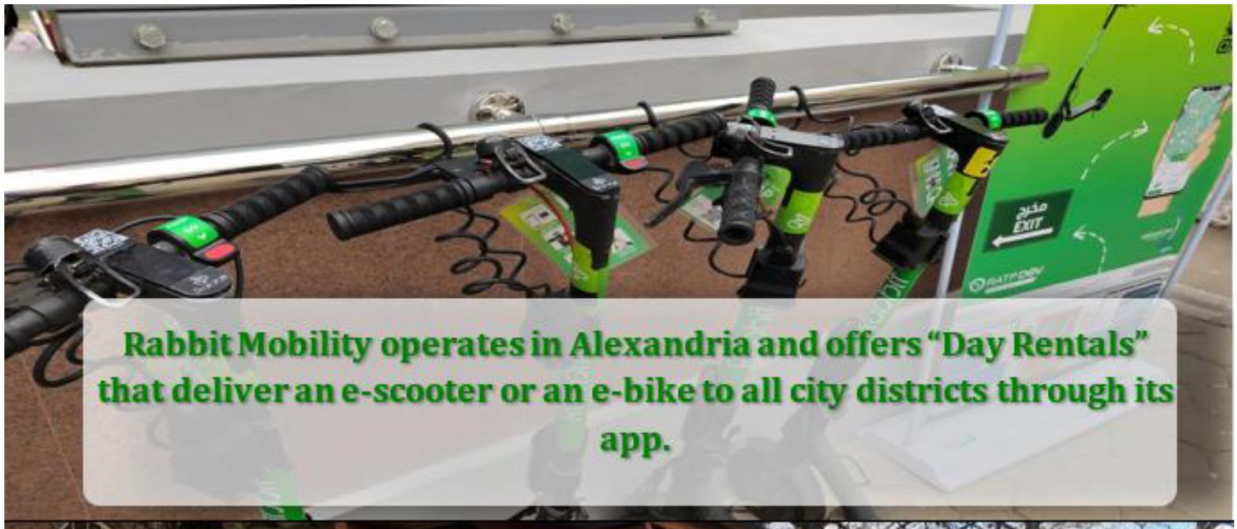
  Alexandria University actively promotes zero-emission transportation by providing approximately 1,960 bicycles, e-bikes, and e-scooters across its campuses. Bicycle parking stations, cycling initiatives, the "Green Cycle" carpooling application, and collaborations with micromobility providers encourage students and staff to adopt clean transportation alternatives. The University is also preparing electric vehicle charging infrastructure and supports the gradual transition toward electric and low-emission campus transportation.

  Walking remains the preferred mode of movement within Alexandria University campuses. An extensive network of pedestrian pathways connects academic buildings, administrative offices, student facilities, and green spaces. These pathways include shaded walkways, accessible ramps, smooth surfaces, clear signage, lighting, and barrier-free access for persons with disabilities, creating a safe, inclusive, and attractive environment that encourages active mobility while reducing vehicle traffic inside campus.

  The University also applies sustainable land-use planning by minimizing parking areas. Parking facilities occupy only approximately 1.13% of the total campus area, with parking primarily reserved for faculty members and administrative staff, while students are encouraged to park outside campus and walk or use sustainable transportation options. Over the past three years, Alexandria University has reduced and optimized parking spaces, converting selected parking areas into green spaces, pedestrian zones,

and sustainable mobility infrastructure. These measures improve biodiversity, reduce land sealing, and strengthen the University's commitment to sustainable campus development.

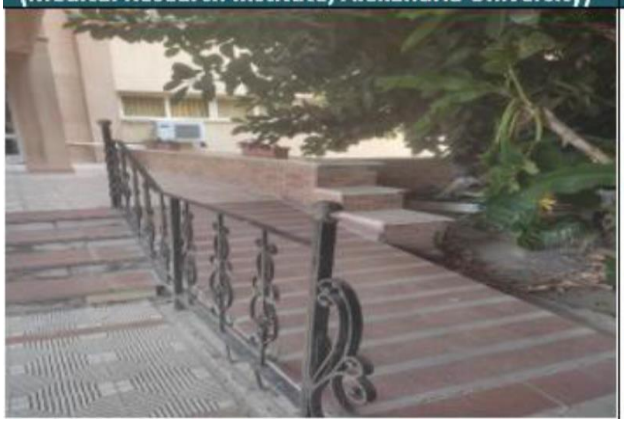




Rabbit Mobility operates in Alexandria and offers "Day Rentals" that deliver an e-scooter or an e-bike to all city districts through its app.



Bicycle Parking Facilities Supporting Sustainable Campus Transportation.

Replacing steps with ramps for disabled people (Medical Research Institute, Alexandria University)	Pedestrian path (Alexandria University, Egypt)
	

- **Sustainable Graduates careers:**

  Alexandria University continues to prepare graduates for careers that contribute to sustainable development and the green economy. The number of graduates employed in green jobs remained consistently high over the three academic years. In 2022/2023, 22,457 out of 37,669 graduates secured green jobs, representing 59.62% of total graduates. This proportion increased significantly to 65.7% in 2023/2024, with 22,534 graduates entering green employment out of 34,300 total graduates, and was maintained at 65.7% in 2024/2025. The sustained increase in the percentage of graduates employed in green sectors reflects the University's commitment to integrating sustainability into education, equipping students with the knowledge and skills required for emerging green careers, and supporting the transition to a sustainable and low-carbon economy.

- **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.

  To promote a circular economy, Alexandria University has implemented source-separation programs for paper, plastic, glass, metal, organic waste, and aluminum cans across its campuses. Recyclable materials are collected through color-coded waste bins and processed in collaboration with recycling companies. The University also introduced the Green Cycle mobile application, which enables students to locate recycling stations, report recyclable waste using artificial intelligence, and earn reward points that encourage active participation in campus recycling programs. In parallel, a pilot partnership with **BekyaPay** has been launched to facilitate the collection and monetization of recyclable materials, strengthening resource recovery and sustainable waste management practices.

  The University's commitment to waste reduction extends beyond campus operations through research, innovation, and community engagement. Alexandria University established the **PECA Fab Lab** for recycling plastic waste into new products using digital manufacturing technologies, while students and researchers have developed innovative projects such as converting used cooking oil into environmentally friendly plasticizers. Community initiatives, including beach-cleaning campaigns, recycling workshops, environmental awareness programs, and partnerships with national and international organizations, further promote responsible consumption, environmental stewardship, and public participation in sustainability.



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.





https://apps.apple.com/us/app/green-cycle/id6587549284
https://play.google.com/store/apps/details?id=net.alexpharmacy.green_cycle

The mobile app includes maps of the faculty that help students reach recycling bins more easily. Students can take pictures of the waste to be disposed of, and points are credited after verification using AI.



Alexandria University is exploring a partnership with BekyaPay, with implementation planned by 2027, to collect and monetize recyclable materials such as paper, plastic, and aluminum cans. A pilot has already been launched at the Faculty of Pharmacy, supporting circular economy practices and improving waste segregation.

- **Sustainability-Related Startups**

  Alexandria University actively promotes sustainability-driven entrepreneurship through a dynamic innovation ecosystem that supported 46 sustainability-related startups during the reporting period. The University provides comprehensive incubation, mentoring, training, and commercialization support through initiatives such as the Artificial Intelligence Minds Incubator (AIM) and the Alexandria University Technology Incubator for Smart Systems (AUTISS), which foster innovative solutions in artificial intelligence, smart infrastructure, healthcare, agriculture, energy, and digital technologies. Student-led startups, including Samdha Company, develop environmentally friendly products by converting organic and agricultural waste into natural fertilizers and biodegradable materials, thereby reducing waste, supporting sustainable agriculture, and conserving water. In addition, entrepreneurship competitions such as the Startup Olympics and international programs, including the Bio-iChallenge and Hult Prize, encourage students and researchers to transform innovative ideas into market-ready businesses with significant environmental and social impact.



Artificial Intelligence Minds Incubator (Faculty of Engineering, Alexandria University)



Artificial Intelligence Minds Incubator (Faculty of Engineering, Alexandria University)



Alexandria University Technology Incubator for Smart Systems {AUIlSS) Incubator (Faculty of Engineering, Alexandria University)



Agro-Food Industries Alliance Products



New partners

Agro-Food Industries Alliance Project

Startup name: "National Committee Sustainable Development"

Startup area in UI Greenmetric questionnaire (SI, EC, WS, WR, TR, ED)

Description: Proposed Mission: Striving to maximize the utilization of the outputs of education and scientific research with the sustainable development goals "Egypt Vision 2030", linking them with the United Nations goals for sustainable development together with developing a framework for the educational system governance aiming at achieving the well-being of society. It includes green, sustainable development and innovative incubators.



Samdha Company, founded by Musaad Darwish, a student in the Department of Civil and Environmental Engineering at the Faculty of Engineering



Samdha Company: The plants in the 2 photos on the left are planted in presence of natural organic fertilizers