7.2.4 An energy efficiency plan to reduce overall energy consumption

Alexandria University implements an integrated energy efficiency plan focused on reducing overall energy consumption through optimized systems, renewable solar and wind integration, and smart control and monitoring technologies. The University applies advanced analysis, performance evaluation, and energy conservation methods to enhance building efficiency, improve energy utilization, and lower carbon emissions. By expanding photovoltaic systems, deploying efficient equipment, and upgrading infrastructure through data-driven optimization, Alexandria University strengthens its transition toward renewable energy, sustainable development, and long-term environmental stability.

Alexandria University significantly advanced its sustainability and climate action agenda, building on prior initiatives but achieving measurable progress in energy efficiency, renewable energy deployment, green infrastructure, and carbon reduction. The university reported a total electricity consumption of 4,228,995.91 kWh, representing a 6.42% decrease from 2023 to 2024 reflecting the successful implementation of energy-saving retrofits and transitions to cleaner energy systems. Renewable energy production reached 1,213,291.2 kWh/year, accounting for 28.69% of total electricity use, driven by the expansion of solar installations and hybrid systems across faculties.

Alexandria University is advancing a dual-track sustainability initiative comprising a rooftop photovoltaic installation and a Fab Lab for circular economy innovation. The solar component, targeting approximately 200 m^2 of suitable roof space (net usable area: 196 m^2 after accounting for 3% service access), will deploy a 1.5-ton system generating an estimated 37,700 kWh annually under Alexandria's mean global horizontal irradiance of 5.2 $kWh/m^2/day$, factoring in 20% panel efficiency and a 0.75 performance ratio to account for system losses.

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.

- Within the framework of the University's keenness to transform into a green, environmentally friendly university that works to enhance its resources and rationalize energy consumption, the Department of Community Service Development has launched a project for the total transformation of the used LED bulbs instead of the fluorescent ones.
- The light-emitting diode (LED) bulbs are more efficient, and energy-saving compared to fluorescent bulbs, with a relatively longer life span.

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 be implemented 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.

Advanced Solar Complex Design Project

The implementation of an advanced solar complex design project has been completed. The project aims to synthesize biofuel from agricultural and food industry waste and is located at the research and production farm of the Faculty of Agriculture, Saba Basha, Alexandria University. It is funded by the Science, Technology & Innovation Funding Authority (STDF) and executed through a collaboration between the Faculty of Engineering at Alexandria University and the Desert Research Institute at the City of Scientific Research and Technological Applications (SRTA-City), situated at the tenth village in Abis.

The solar complex area is 300 square meters and comprises a system of reflective mirrors that concentrate solar radiation onto a solar collector. Ambient air is introduced at a controlled velocity and heated from 25°C to approximately 500°C using the concentrated solar energy. The heated air is then directed to a heat exchanger to produce biochar from various types of agricultural waste. Additionally, the hot air is utilized in a solar dryer for dehydrating a wide range of agricultural products, including vegetables, fruits, and fodder.

This solar complex serves as a green hub at the Saba Basha agricultural farm, harnessing clean solar energy

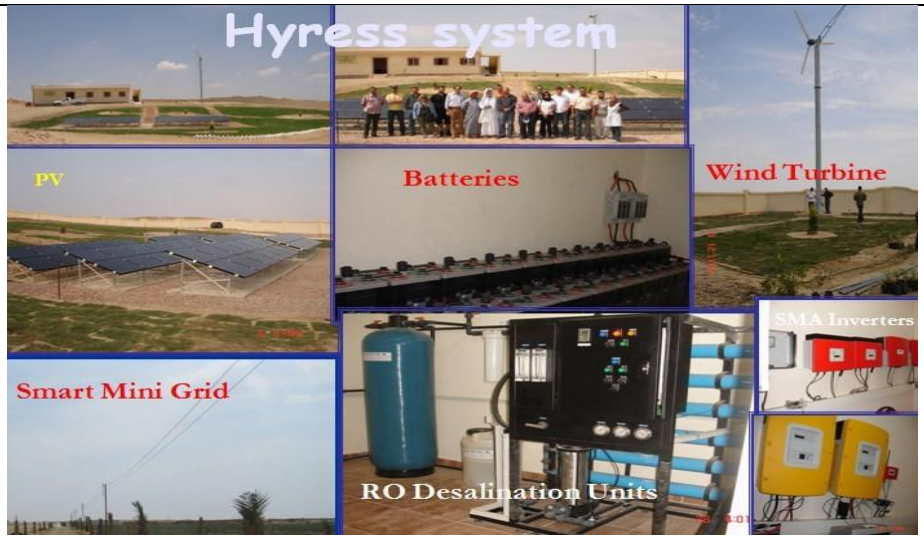
for biofuel production and drying processes without reliance on electrical power. Consequently, it contributes to environmental preservation and the reduction of carbon dioxide emissions. The solar dryer also holds future potential for seawater desalination and clean electricity generation, representing a developmental pathway for optimal utilization of the system.

Renewable Energy Sources in Campus

The Faculty of Agriculture has 2 renewable energy centers and on center at the main building of the University.

1) The renewable Energy Center in Wadi El-Natroon. There are two units from the network:
   - 7 kw hybrid unit for photovoltaic cells and 5 kw for air turbine.
   - 50 kw hybrid unit for photovoltaic cells and 50 kw for air turbines (under maintenance). They are all used in student training and research for graduate students and faculty members.
2) The renewable Energy Center at the Agriculture Research and Experiments Station in Abis Campus.
   - The capacity of the center is 130 kw/h connected to the electricity grid.
3) The renewable Energy Center at the main building of the University.
   - The capacity of the center is 20 kw/h connected to the electricity grid.

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



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

The Faculty of Science:

Research Project: Development and implementation of decentralized solar-energy-related innovative technologies for public buildings, in the Mediterranean Basin.

Environmental Benefits

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

BIPV façade brise-soleil	120	17.28	26350
BIPV garden pergola	90	8.1	23270
BIPV roof pergola	30	4.1	
	Total Power (kWh)		49,620

BIPV Façade Brise-Soleil System

Solar Energy Project at the Faculty of Science (Alexandria University)

System Application	Number of modules	kWp	(kWh)

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

Green building implementation through the use of sun breakers in the SSP building at the Faculty of Engineering

Renewable energy production per year

No	Renewable Energy	Production (in kWh)
1	Solar panel	57,150 + 49,620 + 241.2 + 360 + 220 = 107,591.2
2	Windmill	55,000
	Total	162,591.2

The European Union project to convert several buildings of Alexandria University into green buildings by reducing energy consumption in addition to establishing solar-powered powerstations in 2023-2024

- In light of the keenness to rationalize energy consumption in university buildings and the general trend to increase the percentage of reliance on new and renewable sources in electricity production, and in cooperation with the European Union, the European Union funding was accepted for a project to transform some buildings of Alexandria University into green buildings by reducing energy consumption in addition to constructing Electrical power stations powered by solar energy on the roofs of some qualified faculty and institute buildings suitable for this purpose.
- Accordingly, three buildings belonging to the university's faculties were chosen as a first stage to study the

feasibility of applying the project to them in terms of the building's ability to bear the weight of solar stations to produce electricity, as well as studying the spaces available for building these stations and the extent of those spaces' exposure to solar radiation throughout the day. The opportunities available to reduce reliance on usual energy sources were also studied in terms of using more efficient lighting, increasing reliance on natural lighting during the day, and reducing the building's air conditioning loads.

- After research and review, the specialized scientific programs will be developed in the Faculty of Engineering, the Faculty of Education building within the Literary faculties Complex, and the Manchester Building in the Faculty of Medicine, which were chosen due to the recent construction of these buildings and their ability to accommodate the proposed development in terms of the electrical load network and the development of air conditioning systems and water heating systems used in laboratories and bathrooms.
- These buildings were visited and their suitability for the project was evaluated. The current electricity consumption and the possibility of covering these loads with electricity generated from solar energy were studied. The roof areas facing south and suitable for establishing solar stations were inspected and raised. The available roof area in the Specialized Scientific Programs Building at the Faculty of Engineering, Alexandria University, was 2,400 square meters. It can be used to create a solar station with an area of 1,000 square meters with a capacity of **120 kilowatts**, so that the station will be able to generate **360 megawatt hours** of electricity annually. As for the Faculty of Education building, the total area of the building was 4,000 square meters, and the appropriate spaces for building the station accommodate 1,000 square meters of solar cells with a capacity of **120 kilowatts**, so that the station is capable of generating **360 megawatt hours** of electricity annually, and for the Manchester building at the Faculty of Medicine, 1,200 square meters is capable of accommodating a solar power station with an area of 800 square meters. With a capacity of **96 kilowatts**, the station is capable of generating **288 megawatt hours** of electricity annually. These stations also contribute to reducing carbon dioxide emissions by a total of approximately 214 tons annually. The total expected cost of the project is about 300,000 euros.
- The time to recover the capital was estimated through providing the electricity consumed in the three buildings for approximately seven years from the date the stations entered service at full capacity, considering the periodic maintenance necessary to continue the station's operation with the greatest possible efficiency. Detailed reports were also prepared for each building and submitted to the general coordinator of the project, for review and to take the necessary steps to start this vital project, which is an important step in strengthening the efforts of the Egyptian state towards switching to renewable energy and reducing dependence on fossil fuels that have a negative impact on the environment

New European Union Project for Renewable energy production (Solar panels)

No	Location	Production (in kWh)
1	Faculty of Engineering	360,000
2	Faculty of Education	360,000
3	Faculty of Medicine	288,000
	Total	1,008,000

The total Renewable energy production per year in Alexandria University after the implementation of the European Union project to convert several buildings of AlexandriaUniversity into green buildings

No	Renewable Energy	Production (in kWh)

The European Union project to convert several buildings of Alexandria University into green buildings by reducing energy consumption in addition to establishing solar-powered power stations: the Specialized Scientific Programs Building at the Faculty of Engineering, the Faculty of Education Building within the Literary Colleges Complex, and the Manchester Building at the Faculty of Medicine.

1	**Solar panel**	**57,150 + 49,620 + 241.2 + 360 + 220 = 107,591.2**
2	**Windmill**	**55,000**
3	**New Solar panels in 2023-2024**	**360,000 + 360,000 + 288,000**
	Total	**1,170,591.2**