7.4.3 Direct services to local industry aimed at improving energy efficiency and clean energy (energy efficiency assessments, workshops, research renewable energy options)

Decarbonization and Sustainable Development through Synergy Between Academia, Industry and the Government

An Initiative by Alexandria University

An initiative is proposed by Alexandria University to adopt a synergetic approach towards achieving decarbonization and sustainable development. The synergy is established between the three key players who are responsible for developing solutions to the climate crisis, namely, academic institutions through research, innovation and consultation; governmental bodies through policies and procedures; and industrial entities through implementation. Within this synergetic framework, Alexandria University and its academic and industrial partners introduce six multidisciplinary projects that would be integrated to efficiently allocate our resources, hence positioning Egypt as an African gate of decarbonization to Europe, while accelerating the path towards net zero for Egypt. The projects include decarbonization of the Egyptian fertilizer industry, technology transfer and localization of electric vehicle manufacturing in Egypt, reduction of global emissions through the Suez Canal expansion and the provision of low carbon bunkering, energy and water efficiency initiatives through the founding of Alexandria water and energy services company, establishment of Egypt as a world hub for electronics design and manufacturing, and finally enhancement of the Egyptian energy mix and establishing Egypt as a regional energy hub.

I. Introduction

In ancient Egypt, Alexandria, through its library, played an important role as a center of knowledge and enlightenment for the whole world. In modern Egypt, through its university, it seeks to continue this role by proposing an effective approach towards the decarbonization and sustainable development of the country.

In recent years, the climate crisis has heavily impacted the lives of millions of people across the globe through the increased frequency and intensity of extreme weather events. Global warming and rising average global temperatures are causing alarming consequences on human life and on the sustainability of our planet. As such, urgent actions are necessary to address the climate crisis through collective efforts of all mankind.

An initiative is thus proposed by Alexandria University to adopt a synergetic approach towards achieving decarbonization and sustainable development. Three key players are responsible for developing solutions to the climate crisis, namely, academic institutions through research, innovation and consultation; governmental bodies through policies and procedures; and industrial entities through implementation. Through synergy between all three players, decarbonization and sustainable development is an attainable target.

Alexandria University is located in the city of Alexandria, the largest Egyptian port located on the Mediterranean Sea, and represents the first industrial center in Egypt which encompasses alternative industries such as the petroleum and petrochemicals industry, the fertilizer industry, the steel industry, the textile industry, and shipyard and marine engineering related industries, among others. As such, Alexandria University and the city of Alexandria are in prime position to take an essential role in positioning Egypt as an African gate of decarbonization to Europe, while accelerating the path towards net zero for Egypt through the following proposed set of six projects, integrated with an economic and anthropological approach to achieve efficient allocation of our resources in Egypt:

1. Decarbonization of the fertilizer industry through the production of green hydrogen and green ammonia.
2. Establishment of the electric vehicle (EV) manufacturing industry in Egypt.
3. Reduction of global emissions through the Suez Canal expansion and the provision of low carbon bunkering.
4. Energy and water efficiency initiatives through the founding of Alexandria water and energy services company (AWESCO).
5. Egypt as a world hub for electronics design and manufacturing.
6. Enhancement of the Egyptian energy mix and establishing Egypt as a regional energy hub.

II. Decarbonization of the Fertilizer Industry

Since the discovery of its synthesis from hydrogen and nitrogen at the beginning of the 20th century by Haber and Bosch in Germany, ammonia has had a profound impact on the global scale. Nowadays, the key role for ammonia is as the basic feedstock for the production of fertilizers that currently support food production for around half of the global population. Ammonia is also an efficient refrigerant that has been used extensively in industrial cold stores and in large-scale air-conditioning. It is also the main ingredient in the textile and pharmaceutical industries. Ammonia could also be used as a hydrogen carrier and future bunker for ships. Current global ammonia production is predominantly achieved through the steam reforming of methane to produce hydrogen to feed into ammonia synthesis. Ammonia production through this procedure is a highly energy intensive process, and along with cement, steel and ethylene production, represent the ‘big four’ industrial processes where a decarbonization plan must be developed and implemented to meet the net-zero carbon emissions.

As such, a consortium is being established between Alexandria University and the leading fertilizer manufacturing companies in Egypt, in which Alexandria University would provide the technical expertise necessary to develop green ammonia production plants for these companies.

III. Electric Vehicle Manufacturing

Transport is one of the major areas that contribute significantly to the amount of global carbon emissions. As more electric vehicles are manufactured and enter the local and global market, this would allow a seemingly smooth shift of energy demand from oil to electricity. Combined with decarbonization of electricity production plants, the infusion of electric vehicles into the market would result in a drastic reduction in carbon emissions.

Historically, reduction of CO2 emissions had been the main motive to move from gasoline/diesel engines into hybrid and electric transportation. The European commission estimates that greenhouse gas emissions from transportation in 2017 accounted for 25% of global greenhouse gas emissions versus 15% only in 1990. This percentage measured by the European Union is also confirmed in Egypt through the United Nations Development Program (UNDP) in Egypt which stated that in 2002/2003, the transport sector was responsible for 28 % of the final energy consumption in Egypt and for about 25 % of the energy related CO2 emissions and is the fastest growing source of CO2 emissions in the country. The total amount of greenhouse gas emissions from the transport sector in Egypt in 2002/2003 was estimated at 29 million tons of CO2. Public transportation represents a major part of transport, the UNDP project estimates the share of public transport (including buses, mini-buses, shared taxis, light rails and metro) to be around 75% of total emissions versus 25% for private cars in 2001.

As such, Alexandria University participated in an initiative with a group of academic and industrial partners, for the technology transfer and localization of electric vehicle manufacturing technology in Egypt. This is carried out through the design and manufacturing of an electric power train for a city bus. The project involves the design and manufacturing of an electric powertrain for city bus transport vehicles. The main objective of the project is to develop production-ready electronic control units (ECUs) that shape the bases of electric vehicle (EV) power train system. Specifically, the target category of electrical vehicles is the city bus transport vehicles. The project addresses the development of four ECUs, namely, the battery management system (BMS), the power train (PT), the inverter and the instrument cluster.

The project is sponsored by ITIDA – Egyptian Ministry of Communications through a 5 million Egyptian pound fund and also co-sponsored by 12 million Egyptian pounds from our industrial partner, Brightskies, a leading Egyptian company in the field of embedded software systems. It involves the design, manufacturing and testing of the battery package which includes modification of the existing brake system to support regenerative braking and involves the design of the best experience of vehicle dynamics, especially stability over curves, while adapting the suspension system to the new vehicle dynamics model. The developed powertrain will be demonstrated by converting a 12m bus (6-7 years old) into a fully electric bus.

IV. Suez Canal Impact

Egypt has a distinctive geographical location, which is highly accessible by three continents; Europe, Africa and Asia. Bordered by the Mediterranean and the Red Sea, Egypt is primed as a central hub for different trade routes. Egypt has historically contributed with many projects that led to a faster and more economical path for connecting the corners of the world, which directly contributed to the boosting of the world economy. Such transport projects include the Suez Canal (SC) and SUMED oil transport pipeline.

Recently, Egypt is contributing through the Suez Canal Economic Zone (SCZ) to support the global supply chains and green ship bunkering. These faster and highly economical routes always had a great impact on the reduction of the fuel consumed and consequently the reduction in emissions which became lately the world's main point of concern.

During 2019, 18,880 vessels passed via SC with a total deadweight of about 1billion tons, which represents about 10% of the world's global trade. The distance saved reached about10,000 nautical miles (18,000 Km) on certain voyages which contributes to immense fuel and emission savings, in addition to the contribution to the global economy.

Currently, Egypt is establishing the Suez Canal Economic Zone (SCZ) with the aim of providing bunkering facilities on this main shipping route which is expected to include different types of low emission and green fuels. In addition to the added reduction in emissions, another contribution involves simplifying world supply chains and creating new hubs directly on the main shipping routes.

SUMED is a crude oil pipeline established in 1974 connecting the Gulf of Suez and the Mediterranean sea. This project has an added contribution in reducing the shipping required for oil and consequently the amount of emissions involved. A detailed analysis is currently being carried out to highlight the role and impact of the SC, SCZ and SUMED to the reduction of CO2 emission globally and discusses how the tolls scheme could be used by SCA to provide incentives for the use of clean bunkering in the shipping industry. The objectives of this analysis is to measure the impact of the Suez Canal in the shift towards carbon clean maritime supply chains, and to provide investment plan to the SC to become carbon neutral by investing in hybrid tugboats and applying ISO 14001 & ISO 50001. Academic partners in this project include the Arab Academy for Science, Technology& Maritime Transport.

V. Alexandria Water and Energy Services Company (AWESCO)

There has been an increased interest in recent years in providing energy services for the purpose of achieving energy and environmental related goals. In particular, specialized companies providing energy services to final energy users, including the supply and installation of energy efficient equipment, and/or building refurbishment, have started to operate on the international market.

Alexandria University is planning to establish a water and energy services company (AWESCO) to operate in the fields of energy and water resources. Potential shareholders shall be Alexandria University and a financing institute. AWESCO vision is to:

- Transform Egypt’s built environment and industry to a leading example of energy efficiency.
- Help Alexandria to be a green and sustainable city.
- Lower the carbon footprint of the region.
- Introduce and implement the concept of energy performance contracting.

AWESCO will provide services for the fields of construction, industry, transportation, agriculture, and entrepreneurship. For the field of construction, the following services will be provided:

- Energy auditing of existing buildings as well as proposed construction.

- Propose sustainable building retrofitting techniques that help optimize building energy consumption.
- Propose appropriate renewable energy systems.
- Propose water efficiency measures.
- Provide complete solutions including procurement and project management.
- Provide energy performance contracts to act as a third party between lending and financing agencies and building owners in order to fund proposed building energy retrofitting with guaranteed payback time.
- Amend national building codes and standards to improve energy efficiency.

Services for the industry would include:

- Provide energy auditing for the building envelope as well as the industrial process.
- Propose solutions for optimization of energy use.
- Perform research and development for common industry energy optimization problems through funding of research in Alexandria University.

Services in the field of transportation would include performing studies and research for enhancement of green transportation, while services provided by AWESCO in the field of agriculture would include water efficiency in irrigation systems and energy efficiency in agricultural machinery. Target funding agencies include international funding agencies and the Egyptian banking sector.

VI. Egypt as a World Hub for the Electronics Design and Manufacturing

Egypt is making significant steps towards transforming its economy into a knowledge economy based on innovation. In this context, Egypt has launched a Presidential Initiative entitled “Egypt Makes Electronics (EME)” to capitalize on the growth of this nascent industry in Egypt during the last two decades and to capture a huge opportunity that is presenting itself on the international scene. The objective of EME is to transform Egypt into a world hub for electronics design and manufacturing and to attract significant foreign direct investment (FDI) in this field.

Egypt has intrinsic advantages that play in the favor of attracting FDI in electronics design and manufacturing such as the abundance of talent and its strategic geographic location. However, several important drivers and dynamics may prove highly valuable in enabling Egypt to position itself as a world hub for this industry. Indeed, the world is moving from a globalization model that has prevailed for decades to a model where manufacturing is more regional and distributed. Many players are starting to establish regional manufacturing facilities in contrast to depending on the Far East and specifically China as the world’s major manufacturer of electronics. This is driven by geopolitical reasons as well as securing supply chain and avoiding its disruption. In addition, one important reason to move manufacturing facilities to regions closer to big markets is to minimize the cost of transportation and its negative impact on the environment. On the design side, many global players are looking for talent around the world to augment their resources and their ability to develop and produce new products in

time. Such global companies will establish Offshore Design Centers (ODCs) wherever they find critical mass of talent that they can tap into.

The objective of this initiative is to establish a technology park for electronics manufacturing and design. The project has two pillars; the first is to establish a hub for Electronics Manufacturing Services (EMS). This can be spearheaded by one mega company through a Joint Venture between one of the local Egyptian players with track record in electronics manufacturing and a global EMS player. The other pillar is to establish a cluster of ODCs serving European and international players in the semiconductor and electronics industries. The objective of the initiative is to have a significant positive impact on the Egyptian economy and to boost exports and creation of high value jobs.

Alexandria University is positioned to be the academic leader of this project due to its expertise and resources and the large number of qualified graduates that can fuel both parts of the projects, manufacturing, and design. Potential industrial partners are currently being assessed who can spearhead the establishment of a major EMS provider in partnership with a global player.

VII. Egyptian Energy Mix and Egypt as a Regional Energy Hub

The present initiative aims at establishing Egypt as an energy hub for gas and other sources of energy. Moreover, and in the meantime, Egypt should also ensure a sustainable balanced portfolio of alternative energy sources (oil, gas, solar, wind, hydro, and nuclear). Although renewable energy sources provide environmental advantages, they cannot fully replace fossil fuel use. They also offer challenges of their own. As such, we can see that short-term replacement of oil and gas is not possible. And with the growing energy needs of rising population, urbanization, and increased standard of living; investment in all sources of energy should be sought. Investment into reducing the harmful emissions from fossil fuels to make them cleaner should be also increased. The two large-scale feasible solutions (at least technically) available to mankind to reduce CO2 and harmful gases emissions are: (1) Forestation or planting trees (which require significant fresh water resources) and (2) Carbon Capture and Storage (CCS) in underground reservoirs. Improving the efficiency of all systems that use energy should also be sought. Efficiency of existing systems that consume high energy (regardless of the source of energy) can be increased by a combination of technological solutions, improvement of building codes and implementation of regulations and effective audits.

Alexandria University offers a group of courses related to the environment and sustainability in various sectors, in line with the state's strategies to achieve sustainable development goals and to achieve the goals of linking science with industry and qualifying the graduate to find job opportunities commensurate with the field of specialization. The university works to qualify the graduate by providing various awareness and training programs during the study period. The university also provides a distinguished group of postgraduate programs that are compatible with their counterparts in international universities, as indicated by the indicator data for this standard.

An academic team (Ph.D.) from the Faculty of Science at Alexandria University teaches a course titled 'Man and Environment' (University Elective Course – 2 Credits). The course addresses environmental problems, types of

natural resources, pollution, environmental footprint, carbon footprint, waste management, recycling, climate change and global warming, biodiversity, and the Sustainable Development Goals (SDGs). It is offered to students from various faculties at Alexandria University, such as:

1) Faculty of Science
2) Faculty of Tourism
3) Faculty of Agriculture
4) Faculty of Sport Education
5) Faculty of Business
6) Faculty of Computers and Data Science
7) Faculty of Dentistry
8) Faculty of Economics and Political Science
9) Faculty of Arts
10) Faculty of Nursing

Also, this course is offered in some programs at Alexandria National University, including:

A. Computer and Data Sciences (CDS) Programs
B. Oral and Dental Surgery Program
C. Software and Multimedia Production Program (SIM)

The Industrial Microbiology and Applied Chemistry Program (IMAC) at Faculty Science of Alexandria University organized a scientific visit to El-Shafei Leather Tannery in the Al-Max area of Alexandria on March 26 and April 30, 2024. This visit was part of the program's applied teaching and learning methods and was included in the practical component of the 'Bioremediation of Pollutants' course (Code: Micb 472). During the visit, the students toured all departments of the company and received a comprehensive scientific explanation of the stages of natural leather production, as well as how to protect the leather from mold during manufacturing and how to manage leather industry waste.

Alexandria University Technology Incubator for Smart Systems (AUTISS)

Alexandria University Technology Incubator for Smart Systems (AUTISS) was accredited by the Ministry of Higher Education in 2020 to be established at Smart Critical Infrastructure (SmartCI) Research Center, Alexandria University (AlexU). AUTISS aims to nurture the culture of innovation at campus among the university community and to create value added services for researchers and entrepreneurs. AUTISS is mainly interested in using Smart systems and modern technology for the development of different infrastructure systems (e.g., education, transportation, healthcare…etc.).AUTISS aims to be a hub that fosters synergy between the academia and the industry to fuel entrepreneurial spirit among students to help them to be self-reliant and contribute to the economic development and nation building.

The Renewable Energy Center at Faculty of Agriculture Alexandria University.

- The center along with partner from Greece, Germany, Spain Morocco and Tunisia awarded a Six Framework project (FP6project) from the European commission to developed Hybrid renewable energy system to supply service for Mediterranean partner countries.
- The center representing AU and Las Palm University in Spain awarded a project from the Spanish cooperation Spanish Agency for International Co-Operation (AECE), in the area of water desalination by Renewable Energy.
- Recently with cooperation with the Faculty of Engineering, the center awarded an STDF project. The project title

is "Development of hybrid renewable energy - RO desalination system and minigrids for remote and desert areas in Egypt(HAREDES)".

The Center Goals are to:

- Remove the knowledge barriers against the installation of RE systems in Egypt.
- Enhance the utilization of renewable energy.
- Develop educational and e-learning program about renewable energy.
- Educate students, graduates, public and key stakeholders in Egypt and the Arab world on the various sources ofrenewable energy and its successful applications.
- Build the infrastructure necessary to develop, install and maintain renewable energy applications.
- Present a show case or a model for the successful utilization of renewable energy in Egypt.
- Continue excellence in all of our educational programs.

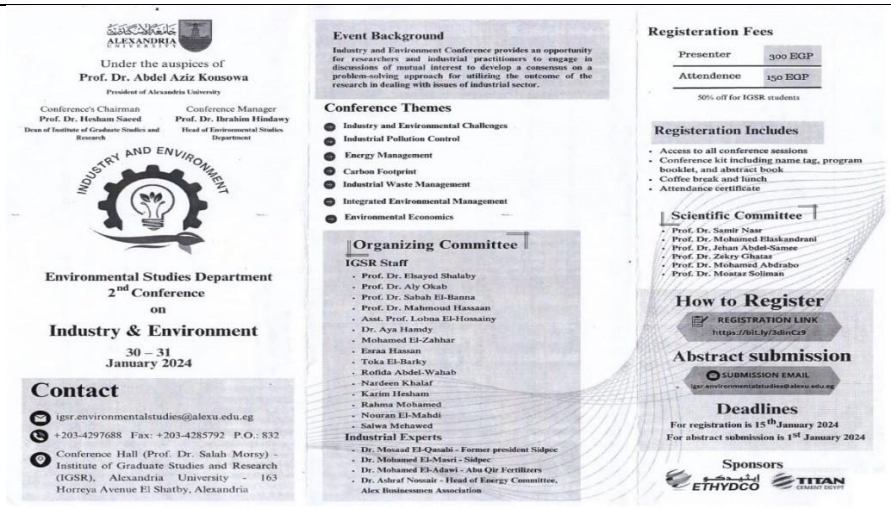
S**olar Energy Center at the Faculty of Agriculture (Alexandria University)**

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

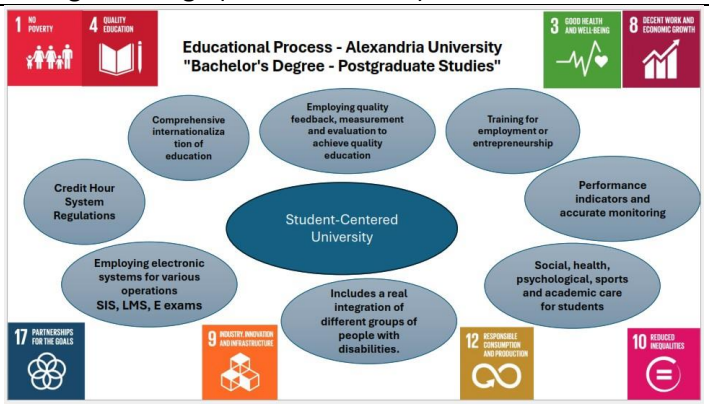
Alexandria University held a symposium on “Climate Change and Green Transformation: The Vision of Alexandria University with several universities and scientific bodies to participate in the COP27 climate conference. These projects include the use of green hydrogen and green ammonia in the fertilizer industry in cooperation with the Egyptian Chemical Industries Company (Kima), the establishment of the Alexandria University Company for Energy and Water Services, the localization of the electric car industry inside Egypt through the design and manufacture of the electric bus and the electric car, the role of the Suez Canal in reducing carbon emissions on the global level, the establishmentof the Alexandria University Centre for the blue-green economy, the role of Egypt as a regional centre for Energy, the production of green and grey hydrogen, the establishment of the Electronic Components Manufacturing Centre, in addition to the establishment of the Alexandria University Centre for Sustainable Development, with the aim of achieving sustainable development goals within the Alexandria University campus in order to turn it into a green university.



Industry and Environment Conference held by Institute of Graduate Studies and Research, Alexandria University (30-31 January 2024)

The students of the Gas and Petrochemical Program visited the Middle East Petroleum Refining Company “Midor” on Thursday, 24/3/2022, where the students learned about the refining operations and the various industrial operations that take place in the company, the treatment andseparation operations, and the expansions that take place in the company, where the company's refining capacity is 60%, and this comes as a continuation of the cooperation between the company and the Faculty of Engineering, Alexandria University, in line with the cooperation between Alexandria University, industry, and society.

The EFFCT team from Alexandria University has won second place in the prestigious Hult Prize International Competition, held in Paris, France. Competing against over 10,000 teams from 110 countries, the team impressed the judges with their innovativestartup, which focuses on recycling waste from the textile industry. Their achievement highlights Alexandria University's dedication to fostering student innovation and entrepreneurship on the global stage (November 2023).



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Discussing ways of cooperation between Alexandria University and the Vice President of the Climate Group at the University of Cambridge in Britain and the official for international cooperation in the COP26 university network on the issue of climate change and ways to enhance academic and research relations and aspects of joint cooperation in preparation for the COP27 conference. The attendees gave a presentation on Alexandria University's projects in the field of environmental sustainability in preparation for the COP27 climate conference, and included projects on the production of green and grey hydrogen, the design and manufacture of electric vehicles, the establishment of the Alexandria University Company for Energy and Water Services, and the establishment of an electronic components manufacturing center, in addition to preparing studies on diversifying energy sources. Egypt's role as a regional energy center and the contributions of the Suez Canal to reducing carbon emissions at the international level.

The first activity of the Greener Blue Economy Center at Alexandria University, a workshop held under the title "Sustainable Blue Economy Issues in the Mediterranean Basin Countries", in the Conference Hall at the Faculty of Commerce, generating electricity from water energy, mining activities in the seas and oceans, marine tourism, fishing activities, extracting raw materials from the sea, and other forms of economic activity mainly related water resources.

The preparatory webinar for the COP28 Climate Conference, which was organized by the International Committee for the Development of Dry Lands, the Regional Action for Climate Change Foundation in Japan, the "Nizami Ganjavi" International Centre, and the African Organization for Young Leaders, at the Conference Centre of the Faculty of Medicine. The webinar discussed many important topics, including climate change and dry lands, food security, biodiversity, energy and sustainable development, political will and human solidarity needed for change, adaptation, African youth's view of climate change, the Egyptian perspective on climate change, and funding requirements.