Proposal Details

Title	Application of renewable energy technologies for green ports: Egyptian ports as a case study
Short Title or Acronym	Green Ports
Keywords	Green energy; Environmental protection; wind turbines; port emissions; Fuel cell; Electric grid; Egyptian ports
Duration	12 months
Total cost	250,000 EGP pound
Research Theme	Renewable Energy

Proposal Summary: English and Arabic

Sea Ports/harbours are regularly situated close to urban communities/local locations and are contrarily influencing the climate and environment, as far as air and water quality, noise, and emissions. To meet administrative prerequisites for air quality and the foundation of low emissions zones inside urban communities progressively necessitates that emissions for modern portable applications should be tended to. The environmental impressions from ports that are near urban places are high not just due to for the presence of shipping with huge diesel engines, yet additionally because of the huge length of loading and discharging of goods from these ships. Emissions from terminal port tasks related with electric power are assessed to contribute roughly 10% of the all-out port greenhouse gas (GHG) emissions while emissions caused by ships at berth typically accounts for up to 30%, with the excess dominant part of emissions brought about by to ships generators. Most of seaports rely upon the national electric network as a wellspring of power for the domestic and ships' electric demands. Therefore, this project is supporting the organization of sustainable power sources for seaport to diminish fuel consumption, increment the energy efficiency and to improve port activity. This project examines the chance of shifting ports from depending on the national grid electricity to green power-based ports. With expanding focus around both nearby and worldwide emissions, zero emissions arrangements that have a capacity surpassing current sustainable power sources are required. For such applications, the suitability and viability of fuel cell technologies, solar panels and offshore wind turbine should be assessed. Considering this appraisal, the most encouraging arrangements ought to be created and approved in the field. The project targets evaluating prospective decreases of ships' emission of GHG notwithstanding the expected economic impact in case of applying various renewable energy technologies for seaports. As a case study, this project researches the possibility of changing Egyptian Ports over to be an eco- friendly port with the emphasis on technical, logistic, and financial prerequisites.

تقع الموانئ البحرية بانتظام بالقرب من المجتمعات الحضرية / المواقع المحلية وتؤثر بشكل عكسي على المناخ والبيئة ، فيما يتعلق بجودة الهواء والماء والضوضاء والانبعاثات. للوفاء بالمتطلبات الاساسية لجودة الهواء وتأسيس مناطق منخفضة الانبعاثات داخل المجتمعات الحضرية يتطلب بشكل تدريجي الاهتمام بالانبعاثات الخاصة بالتطبيقات المحمولة الحديثة. إن الانطباعات البيئية من الموانئ القريبة من الأماكن الحضرية عالية ليس فقط بسبب وجود الشحن بمحركات الديزل الضخمة ، ولكن أيضًا بسبب طول المدة لتحميل وتفريغ البضائع من هذه السفن. يتم تقييم الانبعاثات من مهام الموانئ المتعلقة بالطاقة الكهربائية حيث تساهم بما يقرب من 10٪ من انبعاثات غازات الاحتباس الحراري في الميناء بالكامل بينما تمثل الانبعاثات التي تسببها السفن في الرصيف عادةً ما يصل إلى 30٪ ، مع الجزء المهيمن الزائد من الانبعاثات التى تأتى عن طريق مولدات السفن. تعتمد معظم الموانئ البحرية على الشبكة الكهربائية الوطنية كمصدر للطاقة لتلبية الاحتياجات الكهربائية المحلية والسفن. ولذلك يدعم هذا المشروع تنظيم مصادر الطاقة المستدامة للموانئ لتقليل استهلاك الوقود وزيادة كفاءة الطاقة وتحسين نشاط الميناء. يدرس هذا المشروع فرصة تحويل الموانئ من الاعتماد على شبكة الكهرباء الوطنية إلى الموانئ القائمة على الطاقة الخضراء. مع توسيع التركيز حول كل من الانبعاثات القريبة والعالمية ، يلزم وجود ترتيبات صفرية للانبعاثات لديها قدرة تفوق مصادر الطاقة المستدامة الحالية. لمثل هذه التطبيقات ، ينبغي تقييم مدى ملاءمة وجدوى تقنيات خلايا الوقود والألواح الشمسية وتوربينات الرياح البحرية. في ضوء هذا التقييم ، يجب إنشاء الترتيبات الأكثر تشجيعًا والموافقة عليها في هذا المجال. يهدف المشروع إلى تقييم الانخفاضات المحتملة لانبعاثات السفن من غازات الدفيئة بغض النظر عن الأثر الاقتصادي المتوقع في حالة تطبيق تقنيات الطاقة المتجددة المختلفة للموانئ البحرية. كدراسة حالة ، يبحث هذا المشروع في إمكانية تغيير الموانئ المصرية لتكون موانئ صديقًا للبيئة مع التركيز على المتطلبات الفنية واللوجستية والمالية.

Introduction/Background

Climate change and air pollution that are enormously impacted by the energy division have become an intriguing issue drawing consideration everywhere on over the world. With the reason to battle against global warming, air contamination and even the energy crisis, the interest for sustainable and renewable energy was expanded essentially. Environmental change has got more consideration in the transportation area. This is mostly because of developing interest for decreased worldwide emissions and the way that transportation is one of the quickest developing areas regarding greenhouse gas (GHG) emissions (Winnes et al. 2015). Maritime transportation contributes with roughly 2.4% of worldwide anthropogenic greenhouse gas (GHG) outflows, and its segment is predictable to rise in the future (Smith et al. 2014). GHGs from shipping incorporate principally carbon dioxide (CO_2), methane (CH4) and nitrogen oxide (NOx), of which CO_2 leads the global warming potential. Furthermore, ships radiate additionally different gases with atmosphere effect, for example, black carbon which has a warming potential and sulfate particles which have a cooling impact. The objective to keep the expansion in worldwide mean temperature under 2 °C is getting increasingly harder to reach since worldwide activity has been moderate and all greenhouse gas radiating areas would require decarbonizing to a serious level inside a couple of many years. Energy proficiency measures are imperative to actualize to diminish fuel use, yet critical decrease in GHG outflows can be accomplished exclusively by the supplanting of petroleum products with renewable sustainable power sources.

Ports are linked sea and land transportation which they are feature of worldwide logistics and supply chains. Numerous contamination sources are caused from port processes, for example, wastewater contamination, solid waste contamination, noise pollution and air pollution. Marine ports are one of the issues influencing the shipping sharing percent with respect to GHG. It was appeared by (Qiu et al. 2018) that there is an advised augmentation in the quantity of ships calling the seaports, which prompted an expansion in port emanations during the most recent decade. Ammar and Seddiek (Ammar and Seddiek 2018) show that the ports burning-through a lot of energy for the various ships operations. This drove the ports to be one of the fundamental wellsprings of the negative effect on the environment (Kwame et al. 2017). Clott and Hartman (Clott and Hartman 2013) uncover that the majority of ports rely upon diesel-powered motors prompting a gigantic measure of fumes outflows including particular matters (PMs), sulphur dioxide (SOx) and nitrogen oxide (NOx) emissions, carbon monoxide (CO) and carbon dioxide (CO_2). Viana (Viana et al. 2014) stress that transport discharges could influence close by urban areas with the scope of 400 around ports, which make ports a wellbeing danger to close by networks. Johansson (Johansson et al. 2017) feature that connected (PM) discharges are liable for roughly 60,000 cardiopulmonary and lung cancer deaths annually, with the vast majority of those deaths happening along the coasts. Merk (Merk 2014) concur that the measure of transportation outflows in ports is in proceeds with increase, speaking to around 18 million tons of CO_2 discharges, 0.4 million tons of NOx, 0.2 million of SOx and 0.03 million tons of PM. Around 85% of these emissions come from containerships and tankers. This is partly explained by their dominant presence in terms of port calls, around three quarters of all calls. Both containerships and tankers have more emissions than could be expected based on the number of port calls (Merk 2014; Badurina et al. 2017).

Just moderately as of late, ports have begun to acquaint explicit projects and strategies with address greenhouse gas emissions (Gibbs et al. 2014). These projects are significant since a huge portion of CO_2 outflows from shipping are gotten from the time the vessels stay in ports. Vessels’ emissions at berth have been assessed to roughly multiple times more prominent than those from the ports' own processes and there is a more noteworthy potential to diminish GHG discharges from vessels in port than from port operations on the landside (Winnes et al. 2015). Villalba and Gemechu (Villalba and Gemechu 2011) determined emanations in the port and found that the discharges of GHG from the port zone started in equivalent sums from the vessels and from land-based exercises.

Many research were completed to put a down to earth estimation to arrive at green ports (Lirn et al. 2013; Chiu et al. 2014; Hiranandani 2014; Lee and Nam 2017). The vast majority of the measures are identified with the presentation of cold ironing, LNG bunkering framework, and the arrangement of shore-side power at berth or by characterizing motivating forces for fuel exchanging or green ships (Smith et al. 2014). Gibbs (Gibbs et al. 2014) represent that ports in North America (Los Angeles Long Beach, Seattle, Vancouver, New York) and Europe (Venice, Barcelona, Gothenburg, Antwerp) have begun to acquaint explicit measures and arrangements with straight forwardly address GHG discharges.

One of the guaranteed sustainable power advances is the solar energy. The port of Hamburg has actualized a funding arrangement, which permits port clients to set up sun based energy facilities, and solar energy is utilized to heat water in the port position's' workplaces (Acciaro et al. 2014a). Solar energy is additionally on the plan in Antwerp (Lam and Notteboom 2014), Rijeka (Boile et al. 2016), Genoa (Acciaro et al. 2014b), Venice and Yantian (Li et al. 2011), Tokyo and San Diego (Acciaro et al. 2014b). These distributions don't examine how sun based energy is utilized, yet Kang and Kim (Kang and Kim 2017) propose that sun based energy can be utilized to control cranes. Another environmentally friendly power innovation is offshore wind turbine (OWT). The market of OWT overall shows a perceptible addition with respect to the quantity of wind turbine farms that are developed during the most recent 10 years, with the chance of giving a major share to the electric grids (Pfeifenberger et al. 2018). A few publications refer to practical experiences with wind energy in ports, which has been actualized in the ports of Rotterdam, Kitayjushu, Zeebruges, Hamburg (Acciaro et al. 2014a) and Venice (Li et al. 2011). The literature with respect to this point tends to the possible utilization of wind power in the ports of Rotterdam and Antwerp (Lam and Notteboom 2014), and at a beginning phase, an arranged wind power plant in Port of Genoa was relied upon to lessen 6000 tons of CO_2 (Acciaro et al. 2014a). Procedures with setting up wind power are expensive; nonetheless, as they may require an entire year of observing wind conditions on the chose site (Acciaro et al. 2014a).

Another methodology of elective power source for sea ports is the utilization of tidal energy and wave energy to control port activities (Acciaro et al. 2014a). At the Mediterranean Sea region, a few investigations were completed to assess the applying of sustainable power supply for green ports. Esteve-Pérez and Gutiérrez-Romero (Esteve-Pérez and Gutiérrez-Romero 2015) in their investigation in regards to the applying of sustainable power for ships at the port of Cartagena, Spain show that the usage would be a critical ecological advantage for both port laborers and the number of inhabitants in Cartagena and abutting zones, even in the quick stage with a decrease of 10% of discharges produced by petroleum products. Therefore, the most immediate challenges ahead for the reduction of GHG from ships in port keep a strong relationship with the adoption of the renewable power technology. Applying any of the previous alternatives as the main source for electricity either separately or in a combined system is the matter of shore facility and financial support.

Questions and Objectives

The project shed the light to the association of the concept of green energy using power concept as a tool for eco-friendly ports. The overall scope will be to investigate an integrated sustainable solution for seaport that will enable regional authorities to meet air quality requirements, IMO pollutant emission prescription and the second step of the IMO Commission strategy for the reduction of maritime CO_2 emissions/greenhouse gas reduction targets for the maritime transport sector. The suggested power source will be solar units, fuel cell units and offshore wind turbines.

Project Questions

1. What are the annual exhaust gas quantity which emitted from ships call Egypt's ports?
2. Do these ports comply with the IMO regulations?
3. What are the available renewable energy sources that could be used to eliminate the adverse effect of ship emissions?

Project Objectives

The project should address the following issues:

1. Estimate the annual quantity of ship emissions due to ship berthing at Egypt ports.
2. Proposed a Port Environmental Management Plan (PEMP) and Green Port Policies for Egypt ports
3. Present the most feasible solution (types of renewable energy sources) in terms of technical and economic aspects, able to prove the most effective reduction of CO_2, and determine the obstacles and guidelines associated with ports use of renewable energy will be studied.

Among Sustainable and Development Goals (SDGs) which put by United Nations for vision 2030 the present project matching with the following goals:

1. Switching to renewable power will help the country to achieve its carbon emission reduction goals and manage fluctuating energy costs.
2. Ports that commit to 100% renewable power will help play a leadership role in delivering a low carbon economy.
3. Affordable and Clean Energy for operating seaports.
4. Partnerships to achieve the Goal.

Project Description

Green port is a one-year interdisciplinary project applied for AASTMT by a team of scientists working in fields concerned with shifting Egyptian ports to eco-friendly ports by using renewable energy sources instead of fossil fuels especially, Alexandria, Damietta, Safaga ports. The project has the timely and ambitious aim to build an alternative power source for seaport to use this resource to project future of Egypt.

Green port project aims to study the potential of converting Egyptian ports to be eco-friendly green ports by using the different renewable techniques. This modeling technique is developed with more required process to increase its simulation results. Green port team will work to develop these modeling techniques to fit Egyptian ports and produce more reliable powering scenarios. The project will start with an overview of port and ship emissions and important marine air pollution regulations which will be addressed. After that, the data will be collected from Egyptian ports to present the most feasible solution (types of renewable energy sources) in terms of technical and economic aspects which able to prove the most effective reduction of emissions. Building a numerical model for the renewable energy sources to discuss the obstacles and guidelines associated with ports use of renewable energy. The next step is the discussion of the procedures for shifting Egyptian ports to eco-friendly ports. Economic and environmental analysis associated with ports' use of renewable energy will be studied in an attempt to overcome the problem of emissions. Description of a group of scenarios by using one solution separately or a combined unit for the optimum green energy. The results of environmental and economic studies will be discussed the ability of the systems to withstand pollutant air coming from CO_2, PM, SOx and NOx from ship emissions. Evaluating the technical and economic potential benefits resulted from the conversion process. **Figure 1** shows the full description for the project steps.

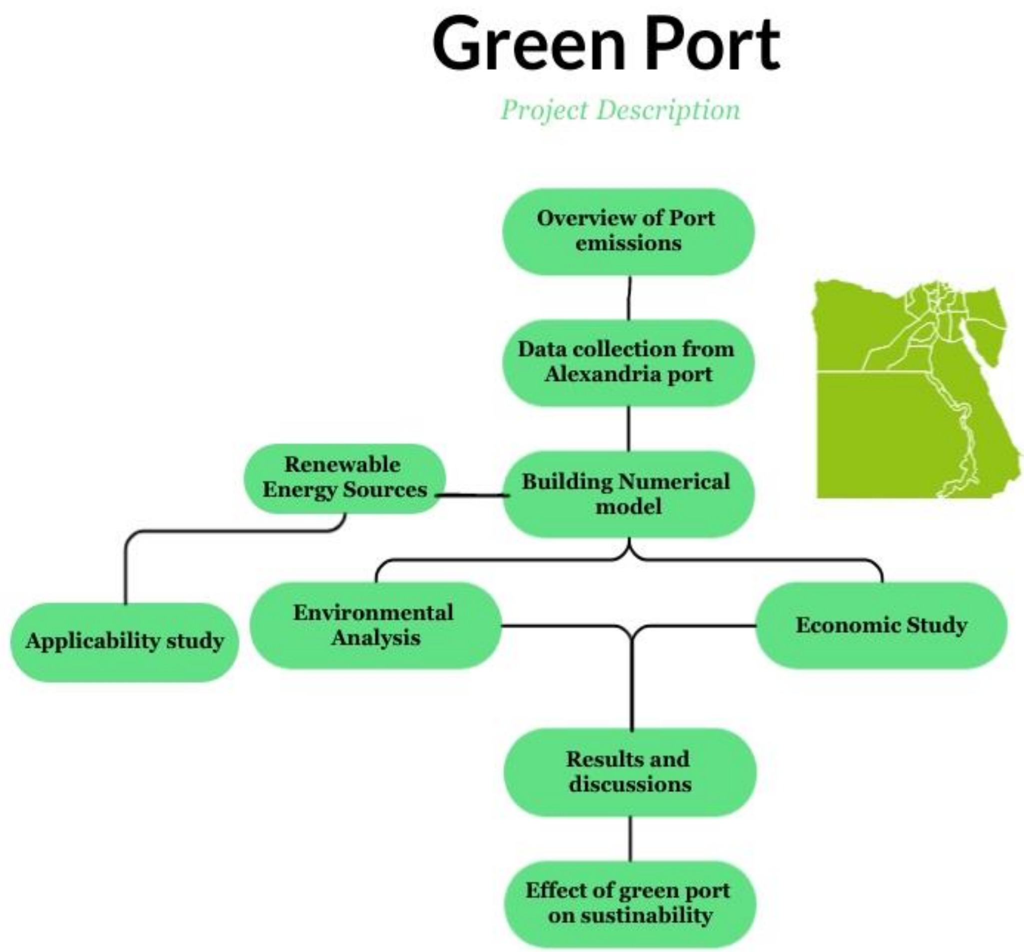

Figure 1. Flowchart for the description of green port project

Research Design and Methods

This part is meant to go about as an asset control for the full examination plan and techniques which will be examined to build up an emission decrease system for port related discharge sources and convert it to be a green port. It diagrams the techniques that will be utilized to create, assess, actualize, and track intentional emission control gauges that go past administrative prerequisites. The evaluation cycle will incorporate a depiction of the principal essentials of the outflows decrease methodology from the view purpose of detail, accessibility, and cost investigation. The investigation of elective port power innovation will be trailed by the examination of environmental parts of this innovation to show the local area benefits.

Alternative energy sources for power supply at ports

Renewable energy sources have become a top priority for countries to reduce reliance on traditional energy sources. Maritime ports as an energy consuming sector are trying to find an alternative energy source. Vessels depend for the most part on their generators for giving the fundamental electric interest during berthing, which present wellspring of emissions. The option for this is shore power supply, which might be acquired from fuel cells, solar panels or wind turbine farms. Applying any of the past choices as the primary source for power either independently or in a joined framework is the matter of shore facility and financial support. Subsequently, it is imperative to examine the essentials, attributes, applicability, and monetary sides of every option as follows.

Fuel cell technology

Fuel Cell technologies are able to challenge the autonomy and charging time problems in the short term with the adoption of automotive stacks technologies on board various applications of port. Fuel cells are getting more popularity because they provide more efficiency and economy as a source of power generation, with minimum emissions quantity (Rajasekhar D. et al. 2015). **Figure** *2* describes the fundamentals of fuel cell cycle operation, which mainly depends on the fuel used, including Hydrogen fuel cells (Rajasekhar D. et al. 2015) and hydrocarbon fuel cells (Inal and Deniz 2018).

There are four main criteria that are essential to the applicability of fuel cells at ports: first, technology criteria, such as power levels, lifetime, tolerance for cycle operation, efficiency, maturity, sensitivity to fuel impurities; second, cost, represented in relative costs among different fuel cell (FC) types; third, safety, represented in special safety aspects relevant to each FC type; and fourth, environment, represented in the emissions. All the four criteria will be discussed in the project with presenting the right framework to apply Fuel cell technology to be a renewable source in green ports.

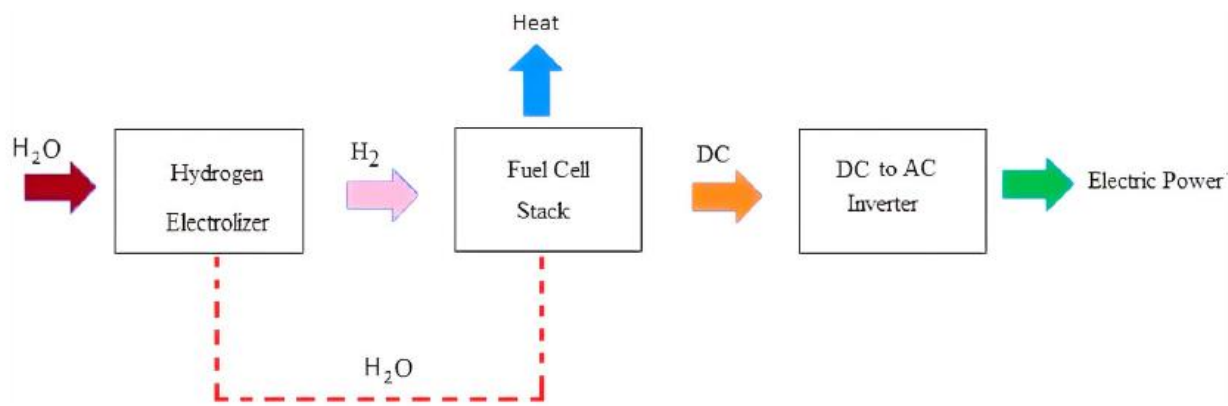

Figure 2. Fundamental of hydrogen fuel cell power generation

Solar energy

There are some factors that may affect the applicability of using the solar system as a power source for maritime applications. These factors include:

1) Availability of high solar radiation.
2) Existence of adequate area exposed to the Sun.
3) Availability of a suitable grid-connected PV solar power system.
4) Techno-economic selection of available solar panels.
5) Scientific preparation of the system layout.

A grid-connected PV solar power system consists mainly of solar panels, inverter, battery bank and other necessary electric devices. **Figure** *3* describes a simple model of a grid-connected PV system, which can be installed at ports. Costs for solar systems differ according to the kind and the use of solar cell and comprise capital cost, operating and maintenance (O & M) costs, as follows in Eq. (1):

$$SU_C = SP_{CC}.N_m[1 + ins_{cp}] + \sum_{a=1}^{a=i} O\&M_C \quad (1)$$

where SP_{CC} is the cost of one solar panel in US$, N_m is the number of solar panel modules, ins_{cp} is the installation cost percentage, $O\&M_C$ is the operating and maintenance cost in US$ and i is the total number of various operating and maintenance cost items (Salem and Seddiek 2016).

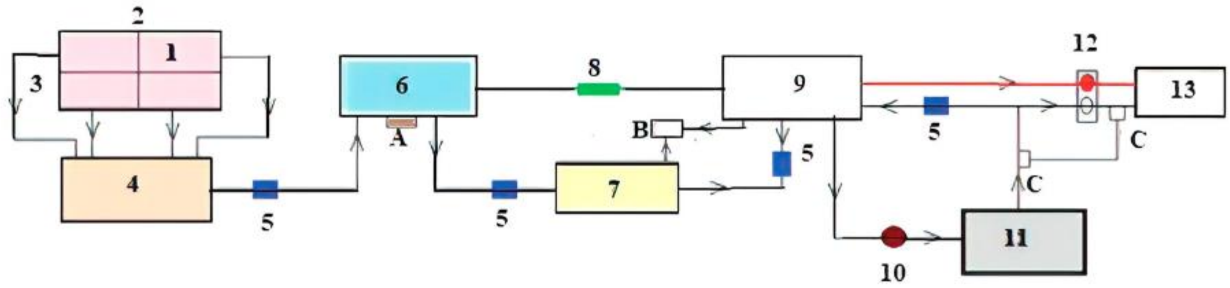

Figure 3. Simple model of a grid-connected PV system

Offshore wind turbine technology

Wind energy is one of the most quickly developing sustainable energy sources with the quality of being perfect and environmentally friendly. At this point, onshore wind energy has been very much evolved while the capability of offshore wind energy is significant, especially in generally seaport water (Arcigni et al. 2021). Wind power is created offshore by wind turbines that comprise of a rotor, a drivetrain, and an electric generator, power cable, upheld on a tower and a base fixed or floating structure introduced with a mooring system (Tran and Kim 2015). Initially, offshore wind turbines were regularly fixed base in the seabed situated close to land, and the business utilization of these is restricted by the water depth of the workplace, which is generally under 50 m. Since base fixed turbines are depth restricted and can't be introduced in specific locations, the capability of creative floating structures for high rated wind turbines and water depths greater than 50 are getting more competitive (Arcigni et al. 2021). Choosing the site location of the offshore wind turbine is considered one of the primary factors that affect the wind turbine performance. Some factors affecting the choice of this site are wind resource density, wind speed, wind direction, turbine height, turbine load, turbine minimum spacing, site capacity, site elevation, site accessibility, spacing, environmental considerations, birds' movement, maritime traffic, and oil & gas wells. The wind power (P) is given by using Eq. (2) (Sarkar and Behera 2012):

$$P = 0.5 * \rho * A * V * C_p * N_g * N_b \tag{2}$$

where ρ is Air density in kg/m^3, A is Rotor swept area (m^2), C_p is maximum power coefficient, varying from 0.25 to 0.45 dimensionless theoretical maximum= 0.59, V is the wind velocity (m/s), N_g is the generator efficiency, N_b is the gear box bearing efficiency. C_p is extracted from C_P/λ curve, where (λ) is tip speed ratio and calculated as shown in Eq. (3) (Yurdusev et al. 2006).

$$\lambda = \frac{\omega * R}{V} \tag{3}$$

where ω is the rotor velocity, R is the rotor radius in meters and V is the wind speed (m/s). For the wind turbine farm cost evaluation, the total cost C_{OWT} will involve the predevelopment and consenting $C_{P\&C}$, manufacture, and purchase $C_{P\&A}$, fixing contracting $C_{I\&C}$, operation and maintenance $C_{O\&M}$ and retiring and removal D&D. The total cost of the offshore wind turbine farm could be estimated as shown in Eq. (4) (Effiom et al. 2016).

$$C_{OWT} = \sum_{I=1}^{m} C_{P\&C} + \sum_{j=1}^{n} C_{P\&A} \sum_{x=1}^{l} C_{I\&C} + \sum_{y=1}^{k} C_{O\&M} + \sum_{z=1}^{s} C_{D\&D} \tag{4}$$

Hence, to determine the annual capital cost, Eq. (5) may be used, which mainly affects the expected offshore wind turbine lifetime.

$$CA = C_{OWT} * \frac{i(1+i)^n}{(1+i)^n - 1} \tag{5}$$

Where CA is the annual cost, n is the predictable OWT lifetime and i is the yearly interest rate (Banawan et al. 2010).

Anticipated Results and Evaluation Criteria

The project expected to provide a significant step towards successful market introduction of renewable energy inside the port sector, with a significant impact in the reduction of CO_2 emissions and air pollution from Egypt seaports. The project will support the establishment of a Supply Chain and foster value creation in maritime industry. Professional dissemination of information on the activities of the project to the broad public is considered as a key part of this project; it should especially be foreseen to communicate the benefits of renewable energy sources for port operations. Regional authorities could support the project with communication activities.

Expected impacts of the project include:

1. Increased users' renewable energy acceptance and knowledge.
2. Put a principle of Port Environmental Management Plan (PEMP) and Green Port Policies for Egypt ports
3. Select the more suitable renewable energy source that could be matching with the Egypt seaport facilities as a step to improve the ports' efficiency.

Expected Project Outcomes and Impact to AASTMT

1. **Technical output and Impact:**

Building renewable energy systems: The present project concerning to provide a design and implementation of modelling of port's renewable energy, compare port's power with digital elevation and land use data, and development of the overall control strategy that control using of power during ship berthing in the Egyptian seaports with analysing the effect of renewable energy on the surrounding environmental at these ports. Moreover, Illustrate the major and minor structural elements that affect the using of renewable energy at ports and their impact on the groundwater occurrence with determine the main abstractions that facing implement green ports technology.

2. **International journal articles**

- Paper about Egyptian port renewable sources and applicability for use at ports with emphasis on the effect of renewable energy on Egyptian port's economy.
- Paper about port emissions at Egypt and the negative impact of such emissions.

3. **MSc theses**

One M.Sc. theses: It planning to allow one student of AASTMT to register a master's degree in the same theme of the project through the project year. This will allow the student to use the available collected data of the proposed project. The thesis planned to complete after one year of project completion.

Resources

Laboratory Space:

1. Green Port team will use the equipment available at CMTT-AASTMT, Engine Room Simulator (ERS), CMMT, ASSTMT. Dr. Seddiek who is in the PI of Green Ports project will facilitate using this simulator as he is working as approved marine instructor at CMTT with the help of laboratory resources which available at Faculty of Engineering, Alexandria University through Eng. Gamal.
2. Green Port team will utilize environmental monitoring and climate change lab facility in, CMTT, AASTMT. Dr. Tonbol who is one Green Port team will facilitate using this lab as he is Assistant Professor in CMTT .

Personnel:

Green Port team contains 4 expertise as follows: environmental and climate change expertise (Dr. Tonbol), marine engineering expertise (Dr. Samir), two renewable energy and modelers developers (Dr. Seddiek and Eng. Gamal). Green Port expertise have vast experience; more than 28 years' experience with Dr. Seddiek, more than 15 years' experience with Dr. Tonbol, about 13 years' experience with Dr. Samir, and more than 4 years' experience with Eng. Gamal. The formation of the team reflects the multidiscipline activities which set up cooperation strategy between different scientific committees with national cooperation such as the Faculty of Engineering, Alexandria University, as well as international cooperation.

Facilities:

1. Green Ports plan to take benefit from the of AASTMT meteorological lab.
2. Green Ports plan to cooperate with WMU in Malmo-Sweden to facilitate any modelling problems through Dr. Ibrahim Seddiek.
3. Green Ports team will cooperate with EAMS to make use of their data regarding ship call ports through Dr. Ibrahim Seddiek.
4. All the required modelling software codes are freely available online through Eng. Ahmed Gamal and Dr. Samir.
5. Website will be designed and lunched free online based on the expertise of Dr. Tonbol in that field.
6. Printing paper will be covered freely from Green Ports team .

Office and Computer Facilities:

1. Green Ports expertise will use their offices in their institutes freely to work with the project managements.
2. Green Ports expertise will use their own laptops and software's to perform the project analyses.

Team Information

Green Port team contains 4 expertise, and the following table shows brief information about Green Ports team's members.

Table 1. Green Ports Team Information Table

Name of Res. Team Member in English	Name of Res. Team Member in Arabic	University / Institute in English	Position / Title	% of time spent on project	No. of months	Contact No	Contact E-mail
Ibrahem Sadek Seddiek	ابراهيم صادق صديق	AASTMT	Vice dean of postgraduate studies at CMTT	80%	9	01001303250	isibrahim@aast.edu
Kareem Mahmoud Tonbol	كريم محمود طنبل	AASTMT	Associate Professor, Head of Meteorology and Hydrographic Survey Program	60%	7	01065544817	ktonbol@aast.edu
Ahmed Samir Shehata	أحمد سمير شحاته	AASTMT	Associate Professor of Marine Engineering	60%	7	01000839938	a_samir@aast.edu
Ahmed Gamal Elkafas	أحمد جمال القفص	Engineering, Alexandria University	Assistant Lecturer, Marine Engineering	90%	10	01156668856	es-ahmed.gamal1217@alexu.edu.eg

Background and recent scientific publications

Dr. Ibrahem Sadek Seddiek

Dr. Seddiek has an extensive research experience in marine engineering, energy efficiency, ship emissions, environmental data analysis and renewable energy in marine field. He serves as an Associate Professor of Marine Engineering and Vice Dean of postgraduate studies at the College of Maritime Transport & Technology (CMTT), Arab Academy for Science, Technology & Maritime Transport (AASTMT). He has many scientific publications such as the following:

1. **Ibrahim S. Seddiek** (2020) Application of renewable energy technologies for eco-friendly seaports, Ships and Offshore Structures. DOI: 10.1080/17445302.2019.1696535.
2. **Sadek, I.**, Elgohary, M. Assessment of renewable energy supply for green ports with a case study. Environment Science and Pollution Research. 27, 5547–5558 (2020). https://doi.org/10.1007/s11356-019-07150-2.
3. Nader Ammar- **Ibrahim S. Sedek**, "Enhancing energy efficiency for new generations of containerized shipping", Ocean Engineering- 215- (2020).
4. Nader Ammar- **Ibrahim Sedek**, "Thermodynamic, environmental and economic analysis of absorption air conditioning unit for emissions reduction onboard passenger ships", Transportation Research Part D- V 62- pp (726-738), 2018.
5. **Ibrahim S. Sedek**, "Eco-environmental analysis of ship emission control methods: Case study RO-RO cargo vessel", Ocean Engineering,137, 166-173, 2017.

Dr. Kareem Mahmoud Tonbol

Dr. Tonbol is a physical oceanographer with extensive research experience in climate change, sea level rise, air temperature trends, meteorological and oceanographic data analysis. He serves as an Associate Professor of Meteorology & Physical Oceanography and Head of the Meteorology & Hydrographic Survey Program at the College of Maritime Transport & Technology (CMTT), Arab Academy for Science, Technology & Maritime Transport (AASTMT). He has many scientific publications such as the following:

1. **Tonbol, K.M.**, El-Geziry, T.M. & Elbessa, M., "Assessment of weather variability over Safaga harbour, Egypt", Arab J Geosci 12 (24), 805. https://doi.org/10.1007/s12517-019-4974-z, 2019.
2. **Tonbol, K.M.**, El-Geziry, T.M. and Elbessa Mohamed, "Evaluation of Changes and Trends of Air Temperature within the Southern Levantine Basin", Weather, 73 (2): 60–66. DOI: 10.1002/wea.3186, 2018.
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Dr. Ahmed Samir Shehata

Dr. Samir has an extensive research experience in marine engineering, wind turbines, numerical analysis, and renewable energy. He serves as an Associate Professor of Marine Engineering at the College of Engineering & Technology, Arab Academy for Science, Technology & Maritime Transport (AASTMT). He has many scientific publications such as the following:

1. A.M. Ragab, **Ahmed S. Shehata**, A.H. Elbatran, M.A. Kotb " Preliminary Design of an Offshore Wind Farm on the Egyptian Coast" 2020 IEEE The 3rd International Conference on Power and Energy Applications (ICPEA) October 9-11, 2020, At: Busan, South Korea, P: 159-163, 978-1-7281-9028.
2. M.Z. Mansour, **Ahmed S. Shehata**, A. I. Shahata, A. F. Elsafty "Techno Selection Approach of Working Fluid for Enhancing the OTEC System Performance" 2020 IEEE The 3rd International Conference on Power and Energy Applications (ICPEA) October 9-11, 2020, At: Busan, South Korea, P: 154-158, 978-1-7281-9028.
3. AM Hamouda, AS Abutaleb, SS Rofail, **Ahmed S. Shehata**, AH Elbatran" Comparative Analysis of Different Current Turbine Designs Based on Conditions Relevant to main canals of the Nile River in Egypt", 2019, 20th Commemorative Annual General Event of AGA20, Proceedings of the International Association of. Maritime Universities (IAMU) Conference Book, P. 365-379, 30 October – 1 November 2019, ISSN: 2706-6762, Tokyo Japan.
4. A.H. Elbatran, OB Yaakob, Yasser M. Ahmed, **Ahmed S. Shehata**, "Numerical and experimental investigations on efficient design and performance of hydrokinetic Banki cross flow turbine for rural areas", 2018, Ocean Engineering, 159 : 437-456 .

Eng. Ahmed Gamal Elkafas

Eng. Gamal is a marine engineer with extensive research experience in marine engineering, energy efficiency, ship emissions, and renewable energy. He has many abilities in data analysis, model development, and simulation programs. He serves as an Assistant Lecturer of Marine Engineering at the Faculty of Engineering, Alexandria University. He has many scientific publications such as the following:

1. **Elkafas, A.G.**, Elgohary, M.M. & Shouman, M.R. Numerical analysis of economic and environmental benefits of marine fuel conversion from diesel oil to natural gas for container ships. Environmental Science and Pollution Research (2020) https://doi.org/10.1007/s11356-020-11639-6

2. **Elkafas, A. G.**, Elgohary, M. M., & Zeid, A. E. Numerical study on the hydrodynamic drag force of a container ship model. Alexandria Engineering Journal, 58(3), 849-859, (2019) https://doi.org/10.1016/j.aej.2019.07.004

3. Ammar, N.R., Elgohary, M.M., Zeid, A.E., & **Elkafas, A.G.** Prediction of Shallow Water Resistance for a New Ship Model using CFD Simulation: Case Study Container Barge. Journal of ship production and design, 35, 198-206, (2019).

Project Management

PI and COPI will be responsible for:

- Chairing the general assembly.
- Chairing the technical committee.
- Scheduling and guiding the project.
- Implementing decisions of the general assembly and the technical committee.
- Ensuring that work packages are carried out according to the timetable and advising partners in terms of what work needs to be performed.
- Coordinating the updating of the implementation plan.
- Setting up systems for and supervising the production of financial reports (cost statements).
- Writing scientific reports for the AASTMT at stipulated intervals (the reports may be drawn up by other groups within the project).
- Informing the project's scientific officer at the AASTMT, within the stipulated timeframes, of scheduled meetings and their agendas (this function may be delegated to the project manager).
- Setting up quality assurance and quality control procedures where necessary (in collaboration with the Steering Committee).
- Distribution of project funds.
- Checking and coordinating all publications, overseeing the dissemination, education and training, and technology transfer work groups.
- Identifying potential new project partners.

Management Office

The management office will handle the management and administrative aspects of the project. This office comprises PI and COPIES of the project at the Arab Academy for Science and Technology and Maritime Transport, Alexandria, together with Project Management Office in Faculty of Engineering – Alexandria University. The management office will be responsible for:

- Organizing and coordinating meetings of the steering committee and technical committee, coordinating, and ensuring administrative information dissemination to members,
- Keeping regular contact with all relevant project bodies,
- Coordinating practical aspects regarding the exchange of personnel,
- Establishing good operating practice for financial management,
- Producing reports on behalf of the general assembly.
- Checking partner financial statements, and,
- Coordinating financial audits of the partners, to comply with necessary AASTMT regulations.

Allowable Project Costs

The budget of the project is expected to be 250,000 Egyptian pounds for one year. The details of the budget are given in **Table 2**.

Table 2. Table of Eligible Cost

Eligible costs	Break downs		AASTMT support (L.E.)
(A) Staff Cost	Dr. IbrahemSadekSeddik		12500
	Dr.Kareem Mahmoud Tonbol		12500
	Dr. Ahmed Samir Shehata		12500
	Eng. Ahmed Gamal Elkafas		12500
	Total		50,000
(B) Equipment & Materials	There is no doubt that the cost of emission measurement devices is very expensive. And the project depends mainly on accurate readings of emissions from ships in ports; devices will be borrowed from accredited centres. A number of port emission measurements (9) (practical visits) to Egyptian ports (Alexandria, Safaga, and Damietta) will be carried out.		
	Cost of one practical measurement (equipment) for each visit		5,000*9=45000
	Fees of entrance port for project team for each visit		1000*9=9000
	Fees for support from ship's crew for each visit		1000*9=9000
	Port Agency fees for each visit		1000*9=9000
	Total		72,000
(C) Travel	Internal Transportation		
	Transportation to Safaga port		3 times*2000=6000
	Transportation to Damietta port		3 times *3000=9000
	Accommodation		
	Hotel at Safaga		2persons*1000*3 times=6000
	Hotel at Damietta		2persons*1000*3 times=6000
	Total travel		27,000
(D) Other Direct Costs	Services	Acquiring access to specialized reference sources databases or computer software	10,000
		Computer services	0,000
	Report preparation		5,000
	Publications & patent Costs		40,000
	Workshops organization or Training		20,000
	Student Master registration fees		10000
	Others (indirect costs)		16,000
	Total other direct costs		101,000
(E) Total Costs			**250,000**

Breakdown of Costs Other Grant(s)

The budget for the one-year project is 250.000 Egyptian pound. The salary includes 20% salary, 28.8% for Equipment and materials costs, 10.8% for travel and accommodation, 6.4% for indirect cost, 26% for organizing final report, workshop and cost of Publications & patent, while the rest 8% for the specialized reference sources and master registration fees. The justification of the budget is given below.

- The salaries including the PI, Co-PI, associated professor (12500 EGP per each). This is incentives for the team as each member will dedicate some of his time to the research activity assigned to him in the project.
- There is no doubt that the cost of emission measurement devices is very expensive, and the project depends mainly on accurate readings of emissions from ships in ports; devices will be borrowed from accredited centers. The expected cost for the practical equipment including port entrance fees, agency fees and support from crew of ships is 72000 EGP.
- The expected Travel cost including transportation to ports (Safaga and Damietta ports and the accommodation at hotels) is 27,000 pound as the team will need to travel around to attend practical measurements for emissions from ships and ports.
- A cost related to organizing final workshop within the project is 20.000 EGP. The outcomes of these workshops along with the overall results of the project will be contextualized to propose through scientific publications, presentations and stakeholder communications, a set specific interventional reform programs and a roadmap towards a sustainable development policy through the mitigation of the likely impacts of renewable energy on the seaports.
- International Publications & patent Costs are 40.000 EGP.
- Acquiring access to specialized reference sources databases or computer software cost 10,000 pounds.
- Indirect Cost which is 6.4% of the modified total Direct Cost is 16,000 Pound.

Plans for Disseminating Research Results and Sustainability of the action

Green port project results will be summarized in:

1. Two progress reports each 4 months together with the final report.
2. Manual about conversion port to a green one and modeling procedures.
3. Developing two workshops with all the stakeholders.
4. Submit at least two papers in international journals or / international conferences.
5. Create a website to make all the project materials allowed for the stakeholders.

Sustainability of the action:

1. Green Ports results will give scientific bases and reliable results in regards with the possibility of using renewable energy along all Egyptian seaports.
2. Green port team plan to provide the results to Seaports Authority to support them in designing Egyptian 2030 vision to support sustainable actions to protect our coastal areas and the whole environment.
3. Green Ports team is planning to continue working on the expected results from the project and will apply for international funds to complete related objectives.
4. The effect of renewable resources on energy in cooperation with international expertise in energy field (to be submitted in future for Erasmus funding).
5. Initiate master's degree about renewable energy application in seaports and planning to be submitted in future for Erasmus funding.

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Declaration of original submission and Other Grant(s)

LPIs declare that their proposal did not and will not be submitted in whole or part for funding; twice within the same cycle, or to other funding programs within AASTMT, or other funding agencies. This is to avoid any possible co-funding.

Acknowledgment Form

By signing below, I acknowledge that I have read, understand and accept to comply with all the terms of the foregoing application, mentioned in AASTMT general conditions and guidelines for submitting a research proposal, including, but not limited to:

- The total number of the application pages should not exceed **30 pages** excluding a cover page, as well as all sections of the proposal (as mentioned in AASTMT General Conditions and Guidelines for Submitting Research Proposal).
- At any time, a contracted AASTMT project team member should only be participating in a maximum of 3 projects (or a maximum of 2 projects as a PI).
- Allowable budget maximum limit should be strictly adhered to in the project proposal. In all cases, requested budget has to be justified in detail.
- AASTMT guidelines, IPR rules, code of ethics, etc. (www.aast.edu), should be read carefully and adhered to. These are integral parts of the contract.
- All proposals – in addition to PI and other data - must be uploaded to the AASTMT website by the designated deadline. Uploaded PI data should conform to the corresponding data in the application form. The PI must be a PhD holder.

Applications will not be considered eligible and will be discarded in the following cases:

- Proposals submitted by e-mail or sent as hard copies or uploaded to the AASTMT website after the deadline.
- Proposals not conforming to the designated format.
- Proposals whose uploaded PI data does not conform to PI data in the proposal file.
- Proposals in which the allowable budget maximum limit has been exceeded.
- Proposals in which maximum allowable contracted AASTMT project participation limit has been exceeded.
- Proposal letter does not include a scanned copy of the signed and stamped PI institution endorsement letter in case of team member work outside AASTMT.
- Submitted applications will be evaluated and the applicant will be informed with the evaluation result of his/her proposal within 3-4 months.
- AASTMT technical decisions made by remote reviewers are final.
- Proposal does not include a scanned copy of the signed acknowledgment form.

Date & Signature: ____________________________________

DETAILED PLAN ON PROJECT'S ACTIVITIES (GANTT CHART):

Table 3. Plan on project's activities

Activity Name	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
Main 1: Overview of emissions and regulations	■											
Main 2: Data Collection		■	■									
Sub 2.1: Egyptian ports facilities		■										
Sub 2.2: Renewable energy sources		■	■									
Sub 2.3: applicability of each option			■									
Main 3: Numerical Modelling				■	■	■	■					
Sub 3.1: Port model				■								
Sub 3.2: Environmental model					■	■						
Sub 3.3: Economical model							■					
Main 4: Building various scenarios								■	■			
Main 5: Results and discussions										■	■	
Main 6: Test and performance analysis											■	■
Main 7: Writing			■				■				■	■