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A Framework for applying Renewable Energy in Floating Hotels: A case of Egypt

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ABSTRACT

There is now a common trend worldwide that reducing gases that have a great impact on the surrounding environment is extremely important, and to overcome this and reduce negative impacts, hotels must reduce dependence on fossil fuels in electricity generation, and replace that with investment in electricity generation from renewable energy sources. This research aims to set a suggested framework for applying renewable energy in the Egyptian floating hotels. The current research used personal interviews with the managers of floating hotels, managers and experts of the renewable energy companies, and based on the distribution of survey forms to the engineers and technicians of the maintenance and engineering department. The interviews were conducted with Forty-Two managers of floating hotels. The valid questionnaires for analysis were 253. The total number of interviews with the managers and experts of renewable energy companies was twelve. Research findings highlighted that it is possible to use solar panels on the floating hotel to provide electrical energy to the rooms of the hotel sample of the research.

Introduction

Comparing the sources of renewable energy with other traditional sources, it became clear that renewable energy is the best solution, which is found in a few developing and developed countries. The rapid growth and spread of renewable energy and diversification in the use of this technology have resulted in numerous economic benefits (IEA, 2012). It is noticeable that the renewable energy that gets its energy from the sun's radiation directly from the sun or indirect methods such as (hydroelectric energy, wind energy, biomass energy, geothermal energy, etc.) can supply the world with energy for nearly a billion years more (Carrington, 2007; Schröder and Smith, 2008). The problem of the research lies in answering the following questions:

Question 1: What are the current methods in floating hotels depend on electricity generation and quantities and the cost of biofuels used?

Question 2: What are the opportunities and benefits of investing in applying renewable energy applications on floating hotels?

Question 3: What are the challenges of applying renewable energy on the floating hotels?

Question 4: What are the mechanisms proposed by the managers and experts of renewable energy companies towards overcoming the challenges facing renewable energy applications on floating hotels?

This research aims to set a suggested framework for applying renewable energy on Egyptian floating hotels. To achieve this aim, the following objectives are set as follows: Exploring the methods of electricity generation currently used in floating hotels in terms of financial cost, type and quantities of fuels used. Determining the opportunities for investing in applying renewable energy. Studying the challenges of applying renewable energy. Realizing the mechanisms proposed by the managers and experts of renewable energy companies towards overcoming the challenges facing renewable energy applications in floating hotels. Providing a proposed plan for applying renewable energy sources in terms of the required technology.

Literature Review

Renewable energy is the energy that is collected from renewable resources, which are naturally replenished on a human timescale, such as sunlight, wind, tides, waves, and geothermal heat (Ellabban et al., 2014). Solar energy is radiant light and heat from the Sun that is harnessed using a range of ever-evolving technologies such as solar heating, photovoltaic, solar thermal energy, and artificial photosynthesis (IEA, 2011).

(Xydis et al., 2009) mentioned that hotel establishments are among the highest energy needs, as large quantities of electricity are consumed to provide services and facilities for guests. Many guests are aware, knowledgeable, and they have the desire to pay more for the convenience, enjoyment and facilities provided. And energy consumption also differs, from one hotel to another, this difference may be due to the hotel size, type, tourism class, capacity, guest profile, location, as well as according to the facilities, services, and activities that are provided and served to guests.

Due to the absence of enough energy sources, the focus on solar energy was widespread in the early stages of solar energy production sites. However, recently and with technological advancement and technologies in investing in solar power, the current trend is towards shifting focus and attention towards the decentralized generation on a small scale to provide the needs of remote areas with energy sources, and that the utility networks do not cover these places. Moreover, many previous studies have found that a complete shift in investment in the use of solar energy as an alternative for harmful diesel generators as a backup system is expected soon (El-Katiri, 2014).

The Opportunities and Motives of applying the Renewable Energy Applications

Recently, decision-makers in hotels have been exposed to many motives and pressures towards green environmental practices to become sustainable, environmentally friendly hotels. Of course, to do that, it is necessary to provide expertise, technical competencies and technological means to ensure the possibilities of obtaining sustainable energy (Chan, 2005). Renewable energy technology also mentioned the lack of economically feasible data and information available on renewable energy technicians (Li, 2003).

Many researchers also find that from the benefits and advantages that result from the use of renewable energy technologies; reducing negative effects on the environment such as the events of ambient air pollution resulting from the burning of fossil fuels, increasing and improving the level of human health, and reducing numbers and proportions of deaths due to environmental pollution incidents, and reducing the level of spending which may amount to billions of dollars annually on health in the United States (Jacobson, Delucci and Pazuin, 2015).

Challenges of applying Renewable Energy

Because many countries have adopted many wrong practices and policies regarding investment in the field of renewable energy, there are many challenges regarding the possibility of spreading the renewable energy markets significantly, including the follows (Al-Khayat, 2006*).

Social challenges of applying renewable energy can be found in the lack of awareness of renewable energy, as well as means of promoting. Lack of full confidence in the information provided on renewable energy and related technology- perception of costs and aesthetics (Mondal et al., 2010; Kinab and Elkhoury, 2012; Zhang et al., 2012; Karakaya and Sriwannawit, 2015; Kannan and Vakeesan, 2016 and Da Silva and Izael, 2017).

The lack of sufficient space for installation and the inefficiency of the infrastructure and its suitability for the installation process. Lack of qualified technical workers capable of operating with renewable energy technology (Niles and loyd, 2013; Karakaya and Sriwannawit, 2015). The problems that result from the installation process in the existing buildings, which are difficult to deal with compared to the new buildings that are being built and the design of the infrastructure in a manner compatible with the basics of renewable energy (Zhang et al., 2012).Lack technical skills necessary to install renewable technologies in the workforce (Philibert, 2006; Commonwealth Secretariat, 2016; Kinab and Elkhoury, 2012; Ince et al., 2016; and Da Silva and Izael, 2017).

The economic challenges that hinder the investment process in renewable energy technologies are the significant increase in the capital cost of the technology needed to invest in renewable projects, and the lack of financing mechanisms for decision-makers, as well as the wrong dependence of decision-makers that investing in renewable energy projects is a futile financial risk. This is because there is financial support from banks to provide soft loans to decision-makers to encourage investment in such environmentally friendly projects, compared to traditional energy projects. Where the feasibility of investment in such projects becomes evident, as the use of solar heating systems at high prices compared to the prices of the traditional subsidized systems make traditional water heating systems the most used, in addition to the lack of credit facilities provided by banks for these systems to encourage investment in them, the noticeable rise in technologies. Renewable energy, as the availability of natural gas at the present was found to weaken investment options in solar energy and make it uncompetitive in this part (UNEP, 2002).

The length of the payback period, the return investment in renewable energy projects, and related concerns (Zhang et al., 2012 and Gabriel Cle-Anne et al., 2016). High construction and infrastructure costs, initial installation and maintenance costs required

for project installations and turbulent economic growth may hinder the efficient investment process in renewable energy projects (Karakaya and Sriwannawit, 2015; Eleftheriadis and Anagnostopoulou, 2015; Kannan and Vakeesan, 2016). Lack of long-term strategic plans to support governments of different enterprises by shifting to sustainable energy, and reverence for financial support and incentives for that transformation (Commonwealth Secretariat, 2016; Kannan and Vakeesan, 2016).

Floating Hotels

Consumers around the world are today willing to pay more for products and services offered by companies that show a real commitment to making a positive environmental impact according to sales. They are also increasingly feeling the need to escape from their busy and overscheduled lives and want to embrace new forms of mobility that enable more freedom and greater contact with nature. The property offers its guests the luxury and amenities of a typical hotel along with the privacy of a single cabin without invading the natural environment around it (Paola, 2020).

Potential of Renewable Energy in Floating Hotels

Solar power systems for hotels are like any other commercial or industrial application. There is no minimum or maximum solar power size, as the system depends on the available space, the hotel's architecture as well as the available budget. The first steps towards renewable energy can start with solar streetlights, gardening pumps or a small Photovoltaic system in a range of 20-50 kW as a trial unit (e.g. a carport roof installation). A visible photovoltaic system (PV system) as a decentralized smaller unit on a carport is also a great marketing tool to demonstrate the hotel's ambition to protect the environment, the size of the system is irrelevant, as long as another energy source is available. It can support various applications within the hotel, where it is most convenient to connect the solar system to the main power source (Karina et al., 2018).

Several studies indicated that floating hotel establishments enjoy the ease of successful investment in renewable energy technology as there are few challenges in the marine or river areas to invest in such projects compared to other projects on land. It is also possible to invest in stabilizing solar energy and wind energy technology in marine life more than Land. Specifically, hydraulic power beneath floating structures can be utilized to generate energy from a renewable source. A big advantage cannot be obtained from other traditional methods of electricity generation. Because the water temperature is lower than the air temperature in the summer and vice versa in the winter. Therefore, hydrothermal power can be utilized in applications of air conditioning in equatorial areas and heating in cold areas. (BES and IBA, 2013).

According to (Berinstein and Paula, 2001), regarding renewable energy used in marine life, the results indicated that the possibility of using renewable energy sources has many competitive advantages in terms of cost rationalization in terms of obtaining the resources necessary for installation and use, compared to using traditional energy from fuel. Fossil. For example, we find that hydraulic energy is a combination of solar energy in the form of winds that create waves on the surface of a river or sea. It is also possible to obtain electricity through the process of converting mechanical energy into waves by using a wave transducer into electrical energy.

Methodology

The Framework of the Research

The Multi-criteria Decision Making (MCDM) method provides analysts with an appropriate way to handle multiple criteria at the same time. It can deal with multiple evaluation criteria in a set of scenario (Thomas et al., 2009).

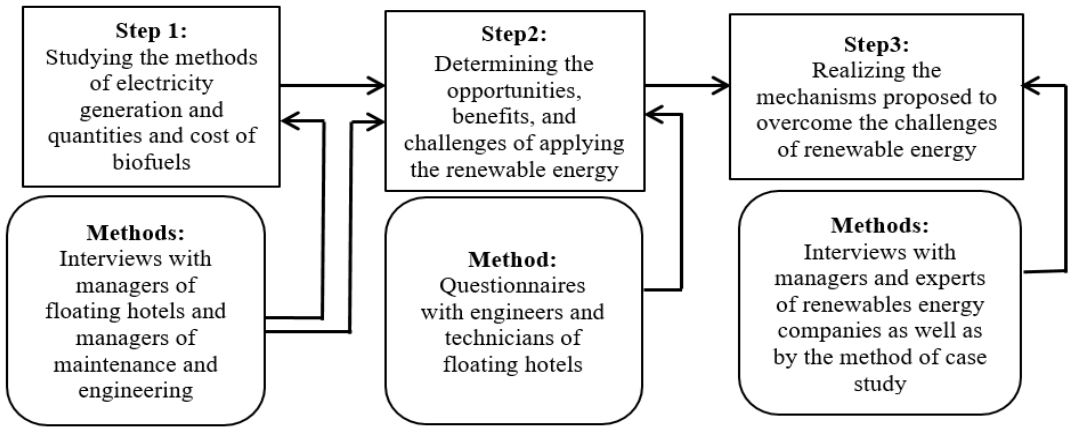

Fig.1. The Framework of the Research

- The data collection for research input was 42 mangers and assistant managers of floating hotels and managers of the maintenance and engineering department**.** Personal interviews were undertaken with managers in Five-Four-star hotels in Luxor and Aswan to get additional in-depth information that will helps to set a suggested framework for applying renewable energy on Egyptian floating hotels, throughout studying the opportunities and challenges of the renewable energy. The mangers were all ages between 30 and 60 years, with more than five-year work experiences in floating hotels.
- 253 questionnaires were distributed to engineers and technicians of the maintenance and engineering department.
- 12 interviews with managers and experts of renewable energy companies. The experts of renewable energy companies were selected on their work experiences and professional knowledge. The managers and experts were all ages between 30 and 55 years old, with more than six-year work experiences in renewable energy projects. The format of the interview was face to face meetings, each of which lasts 30-50 min.
- As well as by the method of case study. The researchers chose M.S Grand Princess Nile Cruise (Five Stars) as a Case study of the research. The researchers used the individual case study method as there are two basic types of case study: individual case study and multi case study. Choosing one of these two types is a matter of choosing a design. Both are included under the case study methodology. The motivation is to use the case study method in conjunction with other methods used in order to reach more accurate results about the possibility of using renewable energy applications in floating hotels.

According to (Yin, 2003), an individual case study can focus on a single unit of analysis. For example, individual, organization, program of study, or class of students. If more modules are involved in the study, it becomes a comprehensive case study. In contrast to individual case study, multiple case studies attempt to understand the differences and explore similarities between cases (Baxter and Jack, 2008).

At the beginning of the interview, the managers and experts were given a brief introduction to the objectives of this research to improve the accuracy and consistency of the interviews. The key points in the meeting were interpreted into word files format for data extraction. There were two stage interviews carried out by the study. The objective of the first interview with mangers of floating hotels was to state of the reality of electricity generation currently in floating hotels in terms of financial cost, type and quantities of fuels used and determining the opportunities and benefits for investing in applying the renewable energy applications on floating hotels. The objective of the second interview with the experts of renewable energy companies was to realize the mechanisms proposed towards overcoming the challenges facing renewable energy applications in floating hotels.

Data analysis

To achieve the objectives, the Statistical Package for the Social Sciences (SPSS) version 22.0 for Windows was used to analyze the valid forms, the statistical techniques used in data analysis include Cronbach alpha to assess the reliability, frequencies, percentages, means, standard deviation. The mean used in determining the response to the research dimensions is illustrated as follow:

Table 1

Five Likert-Scale

Agreement Scale	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
No.	1	2	3	4	5
Range	1- 1.80	1.81-2.60	2.61-3.40	3.41-4.20	4.21-5

Note that: the range of each level of agreement was calculated as follow: 5 – 1 /5 = 0.80

Five-and Four-Star Floating Hotels were chosen Five-and four star floating hotels are characterized by the huge operation, a large number of employees, various functions and outlets. Therefore, it needs to adopt a new strategy to focus on core activities. Furthermore, targeting all floating hotel grades in one study is not practical. According to the chamber of Hotel Establishments (2019), a list of Five- and four-star hotels in Luxor and Aswan was developed. Out of 205 floating hotels 85 floating hotels were available for use. 26 hotels were selected, and the sample of the current study represents 30.5 % out of the available floating hotels in Luxor and Aswan. Eight of the interviews were with managers of renewable energy companies.

Time Limitations

The field part of this research was conducted from March 2019 to April 2020. The personal interviews with general managers in investigated floating hotels were conducted from February 2019 and end in March 2019. The questionnaire forms were distributed to the engineers and technicians of the maintenance and engineering

department from December 2019 to February 2020. And the personal interviews with the managers and experts of renewable energy companies were conducted after the researchers finished the personal interviews with managers of floating hotels and distributed the questionnaire forms to employees in the floating hotels.

Reliability

According to Pallant (2007), the Cronbach Alpha reliability for variables and the tests indicated that the reliability coefficients for variables were above 0.92 which shows that the instrument is reliable for being used.

Results and Discussions

Results of Engineers and Technicians

Demographic Data

Table 2

Demographic data of employees

Demographic Data	Attribute	Statistics	
		Freq.	%
Gender	Male	251	99.2
	Female	2	0.8
Total		253	100
Age	Less than 30 years	58	22.9
	30 – Less than 40 years	124	49.0
	40 years - Less than 50 years	66	26.1
	50 years and over	5	2.0
Total		253	100
Educational level	Vocational or Technical School	154	60.9
	Bachelor's Degree	97	38.3
	Postgraduate (Diploma - Master – Ph.D.)	2	0.8
Total		253	100
Years of Experience	Less than 5 years	82	32.4
	From 5 – Less than 10 years	131	51,8
	10 years and over	40	15.8
Total		253	100
Job	Senior Management	35	13.8
	Technical Engineer	72	28.5
	Technician	146	57.7
	Others (please mention)	-	-
Total		253	100

This section includes five questions. These questions aimed to recognize the demographic data of the employee's sample of the research. The results are shown in Table 2.

The results in Table 2 indicated that from the 253 respondents, only 2 were females 0.8%, while the vast majority of respondents were males 251 (99.2%). According to age group, among the 253 respondents, 49.0% belong to the age group 30 – 40 years; this was followed by age group more than 40 years - Less than 50 years by 26.1%, the age group less than 30 years was the smallest and presented by 22.9%.Concerning the educational level, it could be noticed that only 2 were Postgraduate (Diploma - Master –

Ph.D.)) (0.8%), 97 were Bachelor's Degree (38.3%) and the majority of the respondents were Vocational or Technical School, which were 154 (60.9%), as presented in Table 2.The results also showed that, years of experience in the same position as the majority of the respondents (51.8%) were from 5 – 10 years. While 32.4% was less than 5 years. Respondents with 10 years and over of experience were the smallest group and represented by 15.8%. As it can be noticed from the previous Table 2, among the 253 respondents, 146 respondents (57.7%) were technician, and 72 respondents (28.5%) were a technical engineer. the respondents from senior management were the smallest group and presented by 35(13.8%).

Table 3

The weekly consumption of diesel in floating hotels in one trip

Answers	Freq.	%
Less than 10 tons per week	27	10.7
10 to 20 tons per week	224	88.5
More than 20 tons per week	2	.8
Total	253	100.0

The result of this question showed that 88.5% of respondents see that the investigated hotels consume10 to 20 tons of diesel per week. 10.7% of respondents see that the investigated hotels consume less than 10 tons of diesel per week. The smallest percentages .8% of respondents see that the investigated hotels consume More than 20 tons of diesels per week. The majority of the hotels in the study sample consume large quantities of diesel for the operation process. This result agreed with what was mentioned by the study sample managers, who stated that hotels consume 16,000 liters of diesel per week.

Table 4

The rate of electricity generation from power generators per week

Answers	Freq.	%
Less than 10,000 kW	30	11.9
From 10,000 to 200,000 kW	25	9.9
More than 20,000 kW	198	78.3
Total	253	100.0

The findings indicated that 78.3% of all respondents stated that the rate of electricity generation from power generators per week in floating hotels sample of the study more than 20,000 kW, 11.9% stated that the rate of electricity generation from power generators per week less than 10,000 kW, and 9.9% stateded that the rate of electricity generation from power generators per week from 10,000 to 200,000 kW.

Table 5

The weekly consumption of electricity in floating hotels

Answers	Freq.	%
Less than 10,000 kW	17	6.7
From 10,000 to 200,000 kW	31	12.3
More than 20,000 kW	205	81.0
Total	253	100.0

The vast majority of respondents reported that the weekly consumption of electricity on floating hotels more than 20,000 kW by 81.0%, 12.3% pointed that the weekly consumption of electricity from 10,000 to 200,000 kW, while the smallest percentage of respondents indicated that the weekly consumption of electricity in floating hotels less than 10,000 kW by 6.7%. These results imply that the majority of the investigated floating hotels use large amounts of energy per week. This result in agreement with what was mentioned by the managers of the floating hotels, which stated that room consumption per Kilowatt per week 11648 K.W for the floating hotels which consist of 128 rooms, this consumptions for room only.

The Opportunities and the Incentives to apply the Renewable Energy

Table 6

The opportunities and the incentives to apply the renewable energy

Statements	Statistics		
	Mean	SD	R
1. Many fixed hotels have sought to use renewable energy to generate energy to make them environmentally friendly.	3.06	1.20	9
2. Increased global interest in clean energy technology to secure energy in the future.	3.45	1.05	6
3. Increase in biofuel prices compared to using renewable energy applications.	3.78	1.07	1
4. Low prices for renewable energy technology year after year.	3.38	.88	7
5. Reliance on renewable energy leads to positive impressions among workers.	3.47	.85	5
6. The few problems that result from using renewable energy.	3.51	.994	4
7. The state provides financial support for hotels that use renewable energy applications.	3.32	1.05	8
8. Hotels that implement renewable energy are more profitable by saving operating costs.	3.51	.98	3
9. Providing accredited local maintenance centers for renewable energy systems while providing free maintenance for the project for five years of installation.	3.54	.91	2
Gross Mean and Standard Deviation	3.45	0.60	-

N.B: SD, "Standard Deviation".R=Ranking

The statements in this part aimed to study the opportunities and the incentives to apply renewable energy on floating hotels. From Table 6, it could be noticed that the answers of investigated respondents towards the opportunities and the incentives to apply renewable energy. The respondents agreed on six statements out of nine statements. These statements were as follows:" Increase in biofuel prices compared to using renewable energy applications (Mean= 3.78)"."Providing accredited local maintenance centers for renewable energy systems while providing free maintenance for the project for five years of installation (Mean= 3.54)"."Hotels that implement renewable energy are more profitable by saving operating costs (Mean= 3.51)"."The few problems that result from using renewable energy (Mean= 3.51)"."Reliance on renewable energy leads

to positive impressions among workers (Mean= 3.47)"."Increased global interest in clean energy technology to secure energy in the future (Mean= 3.45)".

Concerning the answers of the investigated respondents towards the opportunities and the incentives to apply renewable energy. The answers of respondents were natural with three statements. According to their means as follows: "Low prices for renewable energy technology year after year (Mean= 3.38)". "The state provides financial support for hotels that use renewable energy applications (Mean= 3.32)". "Many fixed hotels have sought to use renewable energy to generate energy to make them environmentally friendly (Mean= 3.06)". The gross mean of respondents about the opportunities and the incentives to apply renewable energy in floating hotels with average (Mean= 3.45).

The Weaknesses and the Challenges Facing the applying of Renewable Energy
Political Challenges

Table 7
The political challenges facing the applying of Renewable Energy

Statements	Statistics		
	Mean	SD	R
1. Failure to provide tax exemption and grants by government agencies.	3.29	1.45	4
2. The decline in the global market for alternative energy technology compared to conventional energy.	3.53	1.25	3
3. Developing countries lack policies and rules that encourage optimal use of renewable energy	3.58	1.08	2
4. Lack of government policy, financial support, and promotion of the use of renewable energy sources.	3.74	1.11	1
Gross Mean and Standard Deviation	3.53	1.06	-

N.B: SD, "Standard Deviation". R=Ranking

These statements aim to determine the weaknesses and the challenges that facing applying of renewable energy. According to the results shown in table 7, the respondents agreed that there are three statements out of four statements about the political challenges that facing applying of renewable energy which is arranged according to their means as follows:"Lack of government policy, financial support, and promotion of the use of renewable energy sources (Mean= 3.74)". This result agreed with what was mentioned by (Zuboy and Margolis, 2017) who stated that lack of government policy and financial support and incentives from a political barrier. "Developing countries lack policies and rules that encourage optimal use of renewable energy (Mean= 3.58)". "Decline in the global market for alternative energy technology compared to conventional energy (Mean= 3.53)".

Meanwhile the answers of the investigated respondents towards the weaknesses and the challenges that facing applying of renewable energy. The answers of respondents were natural with one statement. According to their means as follows: "Failure to provide tax exemption and grants by government agencies (Mean= 3.29)". The gross mean of respondents about the political challenges that facing applying of renewable energy with average (Mean= 3.53)".

Economic Challenges

Table 8

Economic challenges facing the applying of Renewable Energy

Statements	Statistics		
	Mean	SD	R
1. Lack of funding for renewable energy projects.	3.44	1.41	4
2. Increased primary costs for using renewable energy applications.	3.66	1.16	3
3. The long-term investment returns from renewable energy applications.	3.72	1.14	1
4. Fluctuation in the prices of biofuels restricts investment decisions in renewable energy.	3.69	1.08	2
Gross Mean and Standard Deviation	3.63	0.98	-

N.B: SD, "Standard Deviation". R=Ranking

From the tabulated data in Table 8, it could be noticed that the answers of investigated respondents towards the economic challenges. The respondents agreed on all statements. These statements were as follows according to the mean: "The long-term investment returns from renewable energy applications (Mean= 3.72)". This result agreed with mentioned by (Gabriel Cle-Anne, 2016) who stated that a long payback period and investment risks from economic challenges. "Fluctuation in the prices of biofuels restricts investment decisions in renewable energy (Mean= 3.69)". "Increased primary costs for using renewable energy applications (Mean= 3.66)". This result agreed with (UNEP, 2002) who stated that the constraints are the increase in the capital cost of renewable energy projects and the lack of funding mechanisms. "Lack of funding for renewable energy projects (Mean= 3.44)". The gross mean of respondents about the economic challenges that facing applying of renewable energy with average (Mean= 3.63).

Social Challenges

According to the results shown in Table 9, the respondent agreed on two statements from four statements about the social challenges that facing applying of the renewable energy which is arranged according to their means as follows: "Lack of conviction by the decision-maker about the feasibility of generating energy from renewable energy sources (Mean= 3.54)". "Lack of exchange between societies in transferring experiences in planning such projects (Mean= 3.49)".

Table9

Social challenges facing the applying of Renewable Energy

Statements	Statistics		
	Mean	SD	R
1. Lack of community participation and social acceptance.	3.11	1.25	4
2. Lack of information dissemination and consumer awareness and awareness of renewable energy applications.	3.37	1.12	3
3. Lack of exchange between societies in transferring experiences in planning such projects.	3.49	1.12	2
4. Lack of conviction by the decision-maker about the feasibility of generating energy from renewable energy sources.	3.54	1.22	1
Gross Mean and Standard Deviation	3.37	1.00	

N.B: SD, "Standard Deviation". R=Ranking

Meanwhile the answers of the investigated respondents towards the social challenge that facing applying of renewable energy. The answers of respondents were neutral with two statements. According to their means as follows: "Lack of information dissemination and consumer awareness and awareness of renewable energy applications (Mean= 3.37)". This result was neutral, on the other side (Da Silva and Izael, 2017 and Zuboy and Margolis, 2017) mentioned that lack of information dissemination and consumer knowledge and awareness from the Social Challenges. "Lack of community participation and social acceptance (Mean= 3.11)". This result not agreed with what was mentioned by (New and Renewable Energy Authority, 2006) who stated that Social barriers include a lack of social acceptance, community participation. The gross mean of respondents about the social challenges that facing applying of renewable energy with average (Mean= 3.37).

Technical / Technological Challenges

Table 10
Technological challenges facing the applying of Renewable Energy

Statements	Statistics		
	Mean	SD	R
1. Insufficient space for renewable energy technology from solar panels and others.	3.91	1.23	3
2. Corrosion in solar collectors due to salts in the water in the heating cycles.	3.98	1.07	2
3. Solar storage batteries are not enough to cover energy consumption during the night or cloudy and dusty days.	4.07	1.10	1
4. Lack of local companies specialized in manufacturing and maintaining accessories for renewable energy applications and after-sales services.	3.80	1.14	4
5. Lack of knowledge and scientific and technical skills in the workforce.	3.56	1.09	5
Gross Mean and Standard Deviation	3.86	0.85	-

N.B: SD, "Standard Deviation".R=Ranking

From the tabulated data in Table 10, it could be noticed that the answers of investigated respondents towards the technical technological challenges. The respondents agreed on all statements. These statements were as follows according to the mean: "Solar storage batteries are not enough to cover energy consumption during the night or cloudy and dusty days (Mean= 4.07)". "Corrosion in solar collectors due to salts in the water in the heating cycles (Mean= 3.98)". "Insufficient space for renewable energy technology from solar panels and others (Mean= 3.91)". This result agreed with (Niles and loyd, 2013 and Karakaya and Sriwannawit, 2015) who mentioned that from technical barriers inadequate installation space and service infrastructure. "Lack of local companies specialized in manufacturing and maintaining accessories for renewable energy applications and after-sales services (Mean= 3.80)". "Lack of knowledge and scientific and technical skills in the workforce (Mean= 3.56)". This result agreed with (Vredenburg and Liu, 2016and Da Silva and Izael, 2017) who mentioned that lack of necessary scientific and technical knowledge and skills in the workforce is considered

one of the most technical and technological challenges. The gross mean of respondents about the social challenges that facing applying of the renewable energy with average (Mean= 3.86).

Environmental Challenges

Table11

Challenges facing the applying of Renewable Energy

Statements	Statistics		
	Mean	SD	R
1. The brightness of the sun is not uniform, affecting the overall dependence on solar energy generation.	3.22	1.29	4
2. Lack of social acceptance and community participation by encouraging investment in the use of renewable energy.	3.45	1.22	3
3. Unconscious about the dangers that result from power generation from traditional sources.	3.54	1.17	2
4. Lack of awareness and knowledge of the benefits that result from using renewable energy compared to traditional energy.	3.63	1.13	1
Gross Mean and Standard Deviation	3.46	0.98	-

N.B: SD, "Standard Deviation".R=Ranking

According to the results shown in Table 11. The respondent agreed on three statements from four statements about the environmental challenges that facing applying of renewable energy which is arranged according to their means as follows: "Lack of awareness and knowledge of the benefits that result from using renewable energy compared to traditional energy (Mean= 3.63**)".** "Lack of social acceptance and community participation by encouraging investment in the use of renewable energy (Mean= 3.45)". "Unconscious about the dangers that result from power generation from traditional sources (Mean= 3.54)". Meanwhile the answers of the investigated respondents towards the environmental challenge that facing applying of renewable energy. The answers of respondents were natural with one statement from four statements. According to their means as follows: "The brightness of the sun is not uniform, affecting the overall dependence on solar energy generation (Mean= 3.22)". The gross mean of respondents about the environmental challenge that facing applying of renewable energy with average (Mean= 3.46)".

Legal Challenges

Table12

Challenges facing the applying of Renewable Energy

Statements	Statistics		
	Mean	SD	R
1. There is an obstruction in obtaining licenses and legal approvals towards investing in renewable energy.	3.62	1.16	3
2. High taxes and customs imposed on renewable energy technology.	3.74	1.14	2
3. There are strict laws for any facility that uses unclean energy that causes negative impacts on the environment such as (power generation using diesel generators and harmful carbon emissions.	3.79	1.07	1
Gross Mean and Standard Deviation			

N.B: SD, "Standard Deviation". R=Ranking

From the tabulated data in Table 12, it could be noticed that the answers of investigated respondents towards the legal challenges. The respondents agreed on all statements. These statements were as follows according to the mean: "There are strict laws for any facility that uses unclean energy that causes negative impacts on the environment such as (power generation using diesel generators and harmful carbon emissions (Mean= 3.79)". "High taxes and customs imposed on renewable energy technology (Mean= 3.74)". "There is an obstruction in obtaining licenses and legal approvals towards investing in renewable energy (Mean= 3.62)". "The gross mean of respondents about the legal challenges that facing the implementation of renewable energy with average (Mean= 3.71)".

Analysis of Personal Interviews Questions with Floating Hotels Managers

The managers of the research sample mentioned that floating hotels operate with three engines to operate hotel machines in addition to three power generators. Since the three motors used to generate power in floating hotels, not all of them operate simultaneously, with one generator running and switching with other generators. This result agrees with what was mentioned by Katerina et al. (2018) that many hotels also use backup generators that use diesel fuel. Both diesel and Liquid Petroleum Gas are fossil fuels that emit significant amounts of Greenhouse Gas, although Liquid Petroleum Gas emits less than diesel and is, therefore, considered to be a 'cleaner' fuel. Hotel managers also stated that floating hotels consume between 14,000 to 18,000 liters of biofuels per week for the duration of the trip. The trip takes four days, going to Aswan and three days, from Aswan to Luxor. One of the most energy-consuming departments in floating hotels is the power generation engines, which work 24 hours. The hotel contains three generators for power generation, where each generator works for about 8 hours interchangeably. But all generators operate during the trip from Luxor to Aswan. If the consumption rate is high and the loads are high, then two or three generators will be powered according to the loads. While running a dryer, washing machine, air conditioner, lighting and other uses, not a single generator is not enough to operate all of this, as well as hotel floating machines. As for the wind speed, this affects the availability of energy to go or return, as when going to Aswan, it is the opposite of the direction of water, so we need more energy than going back, as the journey back from Aswan to Luxor is in the same water direction. It becomes clear from the results of the managers that the cost of biofuels used throughout the trip in a week is about 108,000 pounds, which is considered a high cost; whereas, the cost per month at this rate reaches about 432,000 pounds. And by calculating the annual cost, it is 5616000 pounds. This result referring to the cost of biofuels is considered so much, therefore, we need alternative sources to rationalize these costs.

When the managers were asked about the consumption of electricity in floating hotels, their answers were as follows; it is difficult to calculate the energy consumption of the floating hotel in all departments, so if the researchers calculate the energy consumption of the rooms, it will be easy to calculate this through the engineers of the maintenance and engineering department in the floating hotel. The majority of managers agreed that the main energy-consuming activities in a hotel are: hot water use, air-conditioning for rooms and public facilities, energy-intensive facilities (e.g. kitchen, laundry, and spa facilities), swimming pool, water heating, lighting, facilities, and special applications. The Director of Maintenance and Engineering and at M.S Grand Princess Nile Cruise

(Five Stars) (a case study of the research) mentioned that the hotel has a capacity of sixty-two rooms. The average consumption of the sold room from electricity power per night is from 10-15 kW. As 20% of energy consumption in heating water. So, if we assume that the occupancy rate of the hotel is 100%, we find the rate of energy consumption in the rooms as follows:

According to the prices of electricity strips for the commercial sector, the fifth tranche from zero to more than one thousand kilowatts (160 piasters instead of 150 piasters).

Table 13

Energy consumption of rooms daily, weekly, monthly and annually

❖ **Daily**
✓Rooms Consumption per Kilowatt per Night
13 k.w×62(Room) =806 **K.W**
✓Electricity Cost per Rooms per Night
806K.W×160 piasters =1289.60 **Pound**
❖ **Weekly**
✓Rooms Consumption per Kilowatt per Week
13 k.w×62×7=5642 **K.W**
✓Electricity Cost per Rooms per Week
5642K.W×160 piasters =9027.20 **Pound**
❖ **Monthly**
✓Rooms Consumption per Kilowatt per Month
13 k.w×62×30=24180 **K.W**
✓Electricity Cost per Rooms per Month
24180K.W×160 piasters =38688 **Pound**
❖ **Annually**
✓Rooms Consumption per Kilowatt per Year
13 k.w×62×365=294190 **K.W**
✓Electricity Cost per Rooms per Year
294190K.W×160 piasters =4707040 **Pound**

The results of personal interviews show that; it is not permissible to place solar panels on the surface of the sun deck, because it has the majority of the facilities and entertainment provided by the hotel such as swimming pool and Jacuzzi and because the vast majority of guests spend most of the time on the sundeck, and the use of solar energy application hinder the benefit from this. Also, if its pillars are designed on the surface of the floating hotels as a wall to install solar panels on it, thus the success is met with a handicap of technical obstacles such as Edfu Bridge. And one of the managers mentioned that on the surface of the floating hotels there are tandems that are lowered when passing down the Edfu Bridge to prevent friction when installing solar cells, these obstacles must be addressed where the passage of the bridge Edfu between Luxor and Aswan height hinder it. Decision-makers in the management of floating hotels worry about financial risk because they are new projects. Solar storage batteries are not enough to cover energy consumption during the night or cloudy and dusty days.

The Investment in Renewable Energy Technology in Floating Hotels

To support the investment in renewable energy technology on floating hotels, such as solar energy. And to install the solar cells, the following must be followed:

Firstly: Calculating the Amount of Energy Consumed Per Day: By Applying the Following Equations

by applying to the research (hotel case study), the researchers find that the consumption of one room is approximately 13 kilowatts per day with all that it includes, and by applying to the total rooms in the hotel Nile Cruise Grand Princess the case study, which has a capacity of 62 rooms, we find that the total daily consumption of rooms in the hotel is the case study is approximately 806 kW:

- ✓ 13 K.w x 62 **Rooms** = 806 K.W

By calculating the loss during installation 30%: of course, there is a loss during the installation of any electrical system, and the loss may reach 30% due to the conduction and quality of the wires and the resistance of the batteries used as well as the efficiency of the solar panels, and therefore this loss must be added to the total energy consumed per day by applying the following formula:

- ✓ Total Desired Energy = Total Energy Consumed per Day x 1.3

By applying to the case study, we find the following:

- ✓ 806 kW x 1.3 = 1047.8 kWh per day

With the end of the first step, it is clear to the researchers that the total energy consumption of the rooms and by adding the percentage of losses during installation, it was found that the total energy consumed for the number of 62 rooms is approximately 1048 kW per day.

Second: Calculating the number of solar panels

To know the energy of solar panels, the energy to be generated must be divided by the rate of solar radiation per day for the area where the panels will be installed, between 4 to 6.3, which is one of the highest in the world.

So, the necessary plate power = 1048 ÷ 5 = 209.6 kW

- ✓ Number of panels = Energy of panels needed ÷ The capacity of the plate we want to buy

For Example: if we want to buy 1000 watt panels:

The panels are 1000 watt and size is 99 * 196 cm

- ✓ The number of solar panels = 210 ÷ 1 = 210. Approximately 210 plates equal 1000 watts.

Third: Calculating the number of batteries

- Battery Capacity (Am per H) = {(Power to generate x Number of cloudy days (in which panels will be discharged) x 1.3 x (30% of battery capacity required to maintain)} ÷ Volts
- For example, the capacity of the batteries in our example on the assumption that the system voltage will be 24 volts and the reason for choosing the system 24 volts, due to the use of large systems (1000 watts).

- ✓ 113.53 = (1048 x 2 x 1.3 ÷ 24)

To find out the number of batteries, we apply the following relationship:

- ✓ Number of batteries = battery capacity ÷ the size of the battery to be purchased

So, the number of batteries in our example is 113.53 ÷ 100 amps = 1.13 and roughly equal to 100 amperes battery.

Fourth: The size of the Solar regulator

It is calculated as follows:

- ✓ Number of panels planned to be installed in the system x Isc (highest plate charging amp)

In our example:

- ✓ Solar regulator size = 210 x 4 = 52.5 = 50 amps approximately. The voltage is 24V.

It is preferable to double the size to take the reserve in the future if we want to expand the system to work for a longer time or to add other devices.

Fifth: Calculating the transformer size (from the battery to 220 volts)

The size of the inverter depends on the total peak power of the devices

- In our case study:

The total loads of all the devices that were calculated in the hotel room per hour = approximately 4007 watts

And 30% should be taken as an efficiency factor to perform the transformer precaution and vary according to the manufacturer and its efficiency:

- ✓ So, the size of the infrared = 4007 x 1.3 = 5209.1 watts approx.

Note: Take into account the ability of the inverter to be able to give a high startup if it is used to power a refrigerator, heater, etc.

Conclusion and Recommendations

This paper focused on the set suggested framework for applying renewable energy on Egyptian floating hotels after interviews with managers of floating hotels and Interviews with managers and experts of renewable energy companies. The results indicated that it is possible to use solar panels on the floating hotel research sample to provide electrical energy that is sufficient for the needs of the rooms in the hotel. The research sample emphasized the need for panels and all the requirements as follows:

- ❖ 210 solar panel of 1000 watts.
- ❖ One battery 100 AMP.
- ❖ Solar Regulator 50 AMP.
- ❖ Connected wires
- ❖ Inverters with a power of 5209 watts or more.

- ▪ Cell guarantees 10 years to 20 years.
- ▪ Inverter Guarantee 2 years.
- ▪ Battery Guarantee 1 year.
- ▪ After 5 years the battery will be changed.

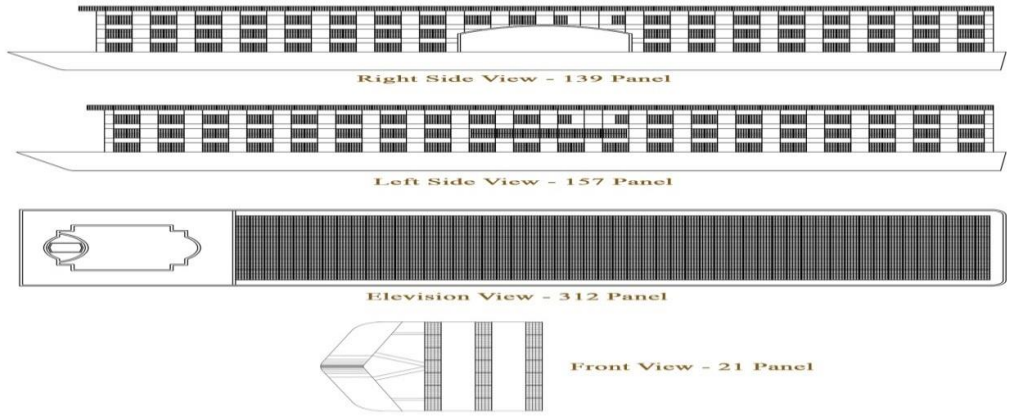

Fig.2. The engineering design for solar panel installations
Source: The researchers and director of engineering and maintenance department

According to the engineering drawing and the sizes that were submitted to the hotel, the study sample and the size of the solar panels It became clear that it is possible to place the panels as follows 312 panels on the surface of the hotel, the number of 21 panels on the boat side of the boat that contains the entrance 139 panels, to the other side of the hotel 157 panels. In the end, it becomes clear that the number of panels that can be installed on the hotel is 629 panels. We only need 210 panels to power 62 rooms of electricity consumption. Generating electricity using solar energy is economically feasible compared to traditional energy, as the system generates electricity with a power of 1000 watts or the equivalent of 50 AMP, which is rewarding compared to an electric generator powered by traditional fuel to generate the amps. The research recommends the following:

Table 14
Research recommendations and implementation mechanisms

Recommendations	Entrusted with Implementation	Implementation Mechanisms
❖ Using solar energy in floating hotels to reduce consumption and costs and reduce negative impacts on the surrounding environment.	- Senior management. - Directors of engineering and maintenance. Department. - Purchasing department. - Renewable energy companies.	- Providing financial support to purchase implementation requirements. - Contracting with renewable energy companies. - Perform future maintenance. - Establishing an approval system for suppliers' installers and solar cell models.
❖ Providing an innovative financial support mechanism that provides financial support to decision makers in floating hotels.	- Financial institutions in the country such as banks. - Decision- makers in floating hotels.	- By providing grants exempt from VAT. - Reducing customs duties. - Providing bank loans at low interest rates on repayments. - Collecting the value of loans at the lowest interest rate in the long term.

Continued

Recommendations	Entrusted with Implementation	Implementation Mechanisms
❖ Encouraging cooperation with developed countries in this field and benefiting from their expertise.	- Ministry of Electricity and Renewable Energy. - Ministry of Tourism - Ministry of Environment. - Egyptian hotel associations.	- Launching initiatives to support institutions in simulating successful programs in developed countries.
❖ Launching an effective awareness campaign focused on stakeholders.	- Egyptian hotel associations. - Ministry of Electricity and Renewable Energy. - Senior management in floating hotels.	- Holding scientific seminars and conferences about using solar energy in each sector involved. - Through seminars, releases and press releases in the hotel sector. - Facilitate contact with installers and trusted suppliers of solar energy systems.

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إطار عمل لتطبيق الطاقة المتجددة في الفنادق العائمة: مصر حالة

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الملخص

هناك الآن اتجاه مشترك في جميع أنحاء العالم بأن الحد من الغازات التي لها تأثير كبير على البيئة المحيطة أمر بالغ الأهمية، وللتغلب على هذا والحد من الآثار السلبية، يجب على الفنادق تقليل الاعتماد على الوقود الأحفوري في توليد الكهرباء، واستبدال ذلك بالاستثمار في توليد الطاقة الكهربائية عن طريق مصادر الطاقة المتجددة. يهدف هذا البحث الى وضع إطار مقترح نحو تطبيق الطاقة المتجددة فى الفنادق العائمة المصرية، اعتمدت منهجية البحث على المقابلات الشخصية مع مدراء الفنادق العائمة عينة الدراسة، مدراء وخبراء شركات الطاقة المتجددة وكذلك اعتمد على توزيع استمارات استقصاء على المهندسين والفنيين بقسم الهندسة والصيانة فى الفنادق العائمة عينة البحث والدراسة.تمت المقابلات الشخصية مع عدد 45 من المدراء المساعدين للمديرين ومدراء قسم الهندسة والصيانة للفنادق العائمة. كما أن عدد الاستبانات الصالحة للتحليل كانت 253. وكان عدد المقابلات الشخصية مع مدراء شركات الطاقة المتجددة 12 مقابلة. كما أوضحت النتائج أنه من الممكن استخدام الألواح الشمسية على الفنادق العائمة لتوليد الكهرباء لغرف الفنادق العائمة.