International Journal of Applied Energy Systems, Vol. 2, No. 1, Jan 2020
ISSN: 2636 - 3712 (Printed Version) ISSN: 2636 - 3720 (Online Version)
Special Issue: ICEE-2019

Analysis of Photovoltaics in Egypt using SWOT and PESTLE

Azza A. A. MOSTAFA
Energy effeiciency and renewables dept.
Egyptian Electric Utility and Customer Protection Regulatory Agency
Egypt
Eng.azza.aly@gmail.com

Kamelia YOUSSEF
Energy effeiciency and renewables dept.
Egyptian Electric Utility and Customer Protection Regulatory Agency
Egypt
k_energystorm@yahoo.com

M. ABDELRAHMAN
Exective Chairman
Egyptian Electric Utility and Customer Protection Regulatory Agency
Egypt
m.director@egyptera.org

***Abstract*— Over the last few years, the Energy Sector in Egypt has had to embrace a number of steep challenges. The immediate challenge was electricity shortages caused, in part, by a lower amount of domestic gas production. This is now being addressed through a number of supply and demand related initiatives such as new production units, and the increased development of renewable energy technologies in particular, Solar photovoltaic and Wind power resources capitalizing upon Egypt's natural advantage in this area as well as the possible. For the importance of promoting photovoltaic most of studies focused on the technical and economic factors influence to PV penetration. Other authors have emphasized importance of decreasing the passive impact of using conventional electricity production by using renewable resources such as PV. This paper describes the formation and application of the SWOT and PESTLE methods for analyzing photovoltaic state of the art, potential and future prospects for development of photovoltaic systems in Egypt. These include small and large scale photovoltaic electricity generation, photovoltaic systems production, and installation. Strengths, weaknesses, opportunities and threats for SWOT method are discussed. Also political, economic, social, technological, legal and environmental for PESTLE method are discussed. Installed capacities and types of energy sources in Egypt are presented, including the progress and use of photovoltaic systems. Finally, general recommendations for the development of photovoltaic systems in Egypt are reported.**

Keywords—PV analysis, SWOT, PESTLE

I. INTRODUCTION

Egyptian Energy Strategy to 2035 influences the direction and development of specific energy policies in Egypt. The first goal for the energy strategy is "Ensuring Energy Security of Supply". The Egyptian Government takes the view that a more diverse energy mix is a more secure energy mix as it is less vulnerable to fluctuations in the availability of any one fuel. For this reason, The Government needs to ensure that a planned and future investment in the Energy Sector provides greater security of energy supply through a range of fossil fuels (eg. Coal), renewable energy (eg Solar, Wind and Biomass) and Nuclear technologies. The renewable energy is planned to be 42% and the PV will be 22% by 2035[1]. A lot of measures were done to promote PV like the Government Initiative to install photovoltaic systems on 1000 governmental buildings.

Then the Cabinet issued the Feed-In Tariff (FIT) low first round in 2014 [2] and the second round of the FIT law in 2016 [3] to encourage the public and private sector to invest in PV projects.

SWOT and PESTEL are analytical tools that help identify the key external and internal factors that should be taken into account in order to achieve success in a project or initiative. They are usually used together, and are applied in a group setting to support effective strategic planning, decision-making and action planning. SWOT and PESTEL are cost and time efficient means for highlighting key issues relating to the context of a project or initiative which, if not identified and addressed, could critically affect the chances of success. They also offer the benefit of framing these issues in a way that is easy for participants to understand and discuss. The examinations how PESTLE factors or changes effect on the power generation projects of Bangladesh was introduced in [4]. PASTLE analysis of barriers to community energy development for four European countries Finland, Ireland, Sweden, and Germany was presented in [5]. A Lithuanian climate change mitigation policy in household's evaluation was analyzed and summarized using SWOT and PEST analysis in [6]. In [7] the opportunity for a Latvian company of alternative energy sources to enter business in Russian market from the point of view of legislation is provided. And the SWOT analysis method was applied for analyzing the company's current situation with the focus on the strengths. To become international, The PESTEL analysis was used to analyze the possible challenges and opportunities of the Russian market area. Different methods of strategic analysis were considered in [8] and highlighted the advantages and disadvantages of these methods. SWOT and PESTLE analysis is concluded in these methods. Advantages and disadvantages of DR aggregators were discussed in [9] from political, economic, social and technological (PEST) point of views. Based on this analysis, a strengths, weaknesses, opportunities, and threats (SWOT) analysis for a typical DR aggregator was presented. PESTLE and SWOT analyses were applied for implementation drain heat water units in Poland to organize accurately information and present them in a clear way to the recipient in [10].

This paper describes the formation and application of the SWOT and PESTLE tools for analyzing photovoltaic state of the art, potential and future prospects for development of photovoltaic systems in Egypt.

II. POWER SECTOR IN EGYPT

It is well known that no single energy source can sustainably meet the energy demands of any country over the world. Using different energy sources is a viable way of achieving security in energy supply. In Egypt, the total installed capacity in 30/6/2018 reached 55213 MW compared to 45111 MW in 30/6/2017 at a growth rate of about 22.4%, distributed as follows [1]:

- Gas 5745 MW
- Steam 15449 MW
- Combined Cycle 30030 MW
- Hydro 2832 MW
- Renewables 1157 MW

The percentage of the total installed capacity is shown in Fig. 1.

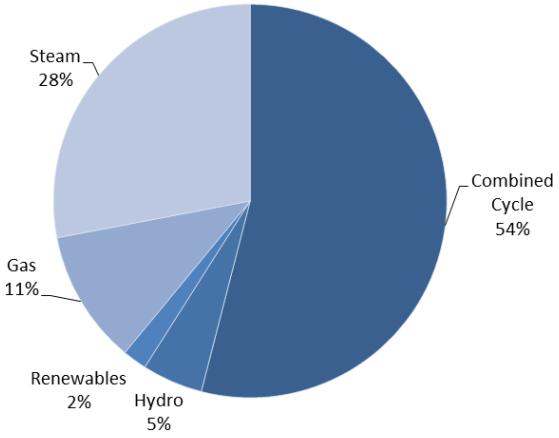

Fig.1: Installed capacity percentage by type.

Egypt possesses an abundance of land, sunny weather and high wind speeds, making it a prime location for renewable energy sources. The Egyptian Electricity Utility and Consumer Protection Agency (EGYPTERA) is responsible for developing regulation, electricity codes, and tariff structure. EGYPTERA published regulation for PV net-metering scheme to encourage investment in PV.

The fourth goal for the Egyptian energy strategy is "Strengthening Competitive Markets and Regulation". Promoting competition to reduce energy costs should be a major energy market policy driver. The electricity law number 87 is published in 2015 is ensured the strategy goal by allowing private sector to invest in electricity sector. The new Electricity Law will allow a new market to operate.

The market will comprise two different elements working in parallel:

• A competitive market where eligible customers can choose supplier;

• A regulated market where there are non-eligible customers. These are generally small / domestic customers.

Competitive suppliers may use PV system to supply their customers as it is safe, easy to install, low maintenance cost, guaranteed return of investment, and independent to fuel cost.

III. TOOLS METHODOLGY

A SWOT analysis measures a business unit; a PESTLE analysis measures trends and changes in market. A SWOT analysis is a structured planning method to evaluate the strengths, weaknesses, opportunities and threats involved in a project or business venture. PESTLS is another analysis method for political, economic, s**ocial**, t**echnological**, legal and environmental involved in the market. It is recommended to use PESTEL and SWOT together. PESTEL complements SWOT by identifying specific relevant factors (such as economic trends, social attitudes, technological developments, etc.) that are significant for the project being considered.

SWOT and PASTLE can be applied for the following purposes:

- Creating, or helping create, a strategic plan or an action plan when launching a project.
- Weighing the pros and cons of major decisions.
- Reviewing positioning on an ongoing project.

From 2013 till the present date all notes are followed up and recorded. From these notes the following SWOT and PESTLE analyses are derived.

A. SWOT tool

SWOT analysis is a general analysis technique suitable for the application of both the initial decision-making, and to develop strategic plans. SWOT analysis involves two steps. First, the most important facts and data are collected. Second, the data collected and information is evaluated and it is decided whether the factors identified are the advantages and disadvantages. [6] The scheme of SWOT analysis is shown in fig. 2. The degree to which the internal environment of the entity matches the external environment is expressed by the concept of strategic [11, 12]:

- Strengths: characteristics of the business/project that give it an advantage over others.
- Weaknesses: characteristics that place the business project at a relative disadvantage.
- Opportunities: elements the project could use to its advantage.
- Threats: elements in the environment that could jeopardize the business/project.

Fig.2 Scheme of SWOT analysis

B. PESTLE tool

PESTEL, a complementary tool to SWOT, expands on the analysis of external context by looking in detail at specific types of issues that frequently have an impact on implementation of project. It facilitates identification and classification of external impacting the study subject into political, economic, social, technological, legal, and environmental issues. [8]

- Political factors determine the extent to which a government may influence the economy or a certain projects. These include e.g. tariffs, legal frameworks, competition regulation, regulation and deregulation, tax policy (tax rates and incentives).
- Economic factors are determinants of an economy's performance that directly impact a project and have resonating long term effects. They may include: inflation rate, interest rates, foreign exchange rates, economic growth patterns etc. From an energy perspective.
- Social factors analyze the social environment of the project, and assess determinants such as cultural trends, demographics, and population analytics.
- Technological factors refer to innovations in technology that may affect the operations of the project.
- Legislative factors include the laws that affect that project within a certain country and may include consumer law and safety standards.
- Environmental factors include all those that influence or are determined by the surrounding environment and may include climate, weather, climate change, and environmental offsets. [5]

IV. SWOT AND PESTLE ANALYSIS OF PHOTOVOLTAIC SYSTEMS

A. SWOT analysis

SWOT analysis tool systemizes information on the subject of research in four specific groups, and identifies the relationships between the elements assigned to each group. Strengths and weaknesses of the project assessed are classified as internal factors, while opportunities and threats as external ones. Table-1 presents the four groups.

Table-1 SWOT analysis

Strengths	**Weakness**
S1: The geographical location of the whole Egypt is almost appropriate place for getting solar energy in abundant and there are also vast areas in rural Egypt can be utilized for installing photovoltaic panels. S2: A photovoltaic energy system can be installed anywhere, photovoltaic panels can be easily placed on houses and public building roof tops. S3: Photovoltaic energy is environment friendly; it does not release CO2 and other gases that pollute the air. S4: Comparable price of kWh for 25 years with conventional energy resources. S5: Low operating cost. S6: Low maintenance.	W1: The initial investment cost is high. W2: No local photovoltaic industry, yet. W3: Production does not occur at a stable level. W4: Feed-In Tariff law ended since October 2017, leading to decrease in investment. W5: Maintenance of photovoltaic panels at frequent intervals. W6: Lack of technical support for the remote locations. W7: Few researches credit. W8: Public lack of awareness and education. W9: No available data base yet for on-grid and off-grid photovoltaic systems.
Opportunities	**Threats**
O1: Egyptian Energy Strategy to 2035 planned renewable energy to be 42% and the PV will be 22%. O2: Government strategy is entering into the production of photovoltaic panels; this may lead to reduction in cost. O3: Starting to introduce the ideas of renewables in educational curricula. O4: Lower subsidy for energy. O5: Government undertakes to reinvest part of its revenues in renewable energy especially PV (the project of 1000 governmental building by 1000 photovoltaic system since 2013). O6: Open new markets by electrifying rural dwellings. O7: Tradable certificate for green energy.	T1: Dust and low raining may affect the performance of photovoltaic panels. T2: Temperature in Egypt can be more than 25°C in summer days, which may affect the performance of photovoltaic panels. T3: The peak load in Egypt occurs after sunset so there is no direct use of photovoltaic energy at peak load. Needs of water in frequent maintenance of photovoltaic panels. T4: Does not take advantage of current expertise.

B. PESTLE analysis

First, Identifying factors that impact the development of PV projects. That was based on a brainstorming approach following the analysis and synthesis of knowledge within authors. Then, applying PESTLE analysis tool as in table-2.

Table-2 PESTLE analysis

Political	**Economic**
P1: Egyptian Energy Strategy to 2035 planned renewable energy to be 42% and the PV will be 22%. P2: Government strategy to enter into the production of photovoltaic panels. P3: Open competitive electricity market. P4: Decrease subsidy in energy.	Ec1: PV system cost independent to fuel cost. Ec2: guaranteed return of investment. Ec3: Profitable to sell surplus electricity. Ec3: Banks are less able to provide credits for PV projects with low rate. Ec4: capital expenditure levels are relatively high.
Social	**Technological**
S1: Society's inclination to use PV. S2: Geographical location of the Egypt is almost appropriate place for solar radiation. S3: PV projects are safe and undisturbed. S4: Small free spaces in buildings roof. S5: Most building near each other which case shaded areas. S6: Ageing of buildings. S7: Society's lack of knowledge in PV maintenance.	T1: Technology changes in fast rate. T2: Experience in operating PV systems. T3: A lot of suppliers company for PV installation. T4: Lack of energy storage solutions. T5: Lack of grid study and upgrades to absorb all PV energy efficiently. T6: Lack of research fund. T7: Difficult to replace technology.
Legal	**Environmental**
L2: The renewable energy law number 203 is published in 2014 to organize electricity production from renewables. L1: The electricity law number 87 is published in 2015 and allowed private sector to invest in electricity sector.	E1: Fossil energy resource reserves. E2: Atmospheric air quality. E3: Ability to reduce fossil fuel consumption and greenhouse gas emissions. E4: Abundance of land. E5: Dust and low raining. E6: High temperature more over the year.

L3: PV net-metering regulation with capacity up to 20 MW. L4: The New & Renewable Energy Authority (NREA) plays a strategic role in the government's renewable energy plans as it owns huge renewable projects and evaluates other renewable projects.	E7: No tradable certificate for green energy.

The position of PV projects in the power market is analyzed using SWOT and PESTLE tools to introduce the benefits and barriers of PV projects. That will be helpful to take steps to encourage PV projects to meet the Egyptian strategy.

V. RECOMMENDATIONS

- Higher subsidies for photovoltaic system components.
- Incentives for using photovoltaic systems.
- Decrease taxes in PV components.
- Mandatory to export high efficiency PV panels and inverters.
- Encourage investment in photovoltaic system by efficient price for kWh as feed-in tariff laws 2014 and 2016.
- Increase public awareness.
- Every building which has photovoltaic system, should record the production of photovoltaic energy with a dedicated device to review this record frequently.
- Create database for on-grid and off-grid photovoltaic system to be under responsibility of a single entity.
- Set national community energy strategy like PV over every school.
- Tradable certificate for green energy.
- Build up grid studies and upgrades to absorb all PV energy efficiently.

REFERENCES

[1] Egyptian Electricity Holding Company. "Annual Report 2017/2018" (http://www.eehc.gov.eg/eehcportal/YearlyReports.aspx, 2018)

[2] Egyptian Electric Utility for Consumer Protection and Regulatory Agency."Cabinet Decree No. 1947 / 2014 the First Round of Feed-In Tariff Mechanism" (http://egyptera.org/Downloads/taka%20gdida/firststage.pdf October 2014)

[3] Egyptian Electric Utility for Consumer Protection and Regulatory Agency. "Cabinet Decree No. 2532 / 2016 the Second Round of Feed-In Tariff Mechanism" (http://egyptera.org/Downloads/taka%20gdida/Secondstage.pdf October 2016)

[4] Farhan Hussain, " Impact of PESTLE Factors on Power Generation Projects of Bangladesh" Mater thesis. April,2013. (http://dspace.bracu.ac.bd/xmlui/bitstream/handle/10361/3737/13182003.pdf?sequence=1&isAllowed=y)

[5] Local Energy Communities, European Union (http://leco.interreg-npa.eu/subsites/leco/PESTLE_Analysis_LECO_A4_180830.pdf)

[6] Z. Simanaviciene, A. Volochovic, A. Simanavicius, " Analysis of energy efficiency improvement and climate change mitigation policy in Lithuania" (http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.735.4572&rep=rep1&type=pdf)

[7] Tatyana V. SHTAL, Mykhailo M. BURIAK, Yerzhan AMIRBEKULY, Galiya S. UKUBASSOVA, Tlegen T. KASKIN, Zukhra G. TOIBOLDINOVA," Methods of analysis of the external environment of business activities" (https://www.revistaespacios.com/a18v39n12/a18v39n12p22.pdf)

[8] Kody T. Ponds1, Ali Arefi1, Ali Sayigh2, Gerard Ledwich, " Aggregator of Demand Response for Renewable Integration and Customer Engagement: Strengths, Weaknesses, Opportunities and Threats" (https://www.preprints.org/manuscript/201808.0424/v1/download)

[9] Sabina Kordana , Kamil Pochwat , Daniel Sły´s and Mariusz Starzec "Opportunities and Threats of Implementing Drain Water Heat Recovery Units in Poland" (https://res.mdpi.com/d_attachment/resources/resources-08-00088/article_deploy/re)

[10] T. J. Chermack and B. K. Kasshanna. "The use and misuse of SWOT analysis and implications for HRD professionals" (Human Resource Development International Journal, Vol. 10, Issue 4, https://doi.org/10.1080/13678860701718760, Dec. 2007, pages 383–399)

[11] J. Terrados, G. Almonacid, L. Hontoria. "Regional energy planning through SWOT analysis and strategic planning tools: Impact on renewables development" (Renewable and Sustainable Energy Reviews June 2007, pages 1275–1287)