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Research Paper:
**(Energy Reality, Problem, and Future
in Gaza Strip)**

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Chapter One:

The General framework

(1-1) Introduction

The energy sector, and specifically energy security is one of the most important challenges that facing building and developing infrastructure the economic situation of Palestine. It is considered as an obstacle towards achieving sustainable political and economic independence because of fully rely on the import of energy in all its forms, specifically electricity. During the last two decades, the energy sector has acquired a great deal of global and local interest. It aims to meet the energy sector the growing demand as an economic and environmental entitlement by re-prioritization and restructuring. Also, it achieves the concept of energy security (including supply at reasonable prices, durability, real cost savings, achieving international standards in terms of preserving environment and reduce harmful gas emissions during the energy production and consumption phases). The urgent need to provide stability in the energy sector prompted the official authorities to participate in all the international and regional activities to keep pace with the great development and available alternatives.

In 2010, The Energy Authority has started a comprehensive program to restructure and develop the energy sector.it Included the legal, legislative, regulatory and institutional aspects within a strategic vision to bring the sector to the level that responds to the requirements of economic development and industrial facilities. Also, to provides the current and future needs of the local market by building institutionalization of the sector that guarantees continuity legislative and regulatory frameworks that define the responsibilities of the institutions operating in the sector and ensuring efficient service provision and appropriate quality in a way that does not contradict with international environmental standards. In addition to its inclusion exploiting locally possible natural resources in energy production in order to reduce dependence on importing from abroad and providing energy services in an economically appropriate manner, the latest of which was sectoral strategy for energy and natural resources (2021-2023).

As a result of modernizing and developing strategies related to the energy sector and the scarcity of natural resources and wealth mineral resources locally and the lack of traditional energy sources (such as oil and gas) also the absolute control of the Israeli authorities (the amount of fuel and its prices, and when it is allowed and when it is denied entry) which made these measures a tool of pressure and political blackmail. The renewable energy and energy efficiency law was adopted in 2015 in order to encourage the exploitation and development of renewable energy sources, and increase the proportion of its contribution to the rate total energy.

The impact of the energy crisis affected all operating sectors in the Gaza Strip, whether industrial, commercial or agricultural, or at the human level. This research will focus on the agricultural sector, where it is considered a vital and important sector to secure the food basket for the population of the sector . The other industrial sectors or commercial companies faced the same obstacles related to the shortage of electricity, with a structural and financial difference in the ability of the industrial and commercial sector to adapt and deal with what is available with medium limits of through alternatives to commercial generators with high operational capacity which is not available to the agricultural sector.

(1-2) Study problem / Hypotheses / Objectives:

(1-2-1) Study problem:

a state of energy insecurity was generated as a result of the increasing practices of the Israeli occupation which aimed to control the Palestinian energy sector and as a result of high electricity bills at the domestic and sectoral levels. All vital working sectors were affected, of course, including the agricultural sector, which secures the basket nutritional.

The research problem will be about an overview of the trends and opportunities for the use of alternative energy applications locally and its impact on the agricultural sector. The government policies in general and in private the local adopted the approach of individual and institutional attempts and models for the use of alternative energy to start-up providing

electricity in the medium and long term at all levels and sectors at a low cost in order to reach the stage of security in the sources and quantities of energy.

(1-2-2) study hypotheses:

The research is based on a basic hypothesis, which is that renewable energy has a major role in achieving sustainable development (energy security) due to the close relationship between renewable energy and gross domestic product . Availability of renewable energy sources in Palestine, which qualifies it to go through a stage transition from conventional energy to renewable energy.

(1-2-3) Study objectives:

This paper is a diagnostic study that can lead to an understanding of the problems and opportunities in the sector renewable energy (latent and encouraging opportunities for the development of investment in the renewable energy sector). Besides, it would achieve part of the energy security of the Palestinian.

Chapter two

Energy and its types

(2-1) Energy concept (Cognitive framework):

(Physically)Energy is the ability to do and complete a task or job, and energy has many forms. It listed under two main categories: kinetic energy and potential energy.

(Technology and Economics) Energy refers to sources of natural resources that can be obtaining, converting and using energy. These resources are used in different industrial, economic and agricultural fields to meet the production and consumption of goods and services.

(2-2) Types of energy and available alternatives:

There is a classification of energy and its sources based on the possibility of renewable energy and its continuity; first, the conventional or depleted energy: including coal, petroleum, minerals, natural gas. Second, the renewable energy, clean or alternative energy: including wind, solar energy, water energy or waves, underground energy and biomass energy, which are inexhaustible energies.

To clarify their physical forms, they are classified into two categories:

1. Potential Energy

It is the energy stored in particles and atoms. The forms of energy that fall under it:

- Mechanical energy which is energy that exists in an unstable environment, such as compressed springs.
- Chemical energy which exists in several forms, such as natural gas, petroleum, and coal.
- Nuclear energy which is the energy inherent in the nucleus of the atom, which works to hold the nucleus together, and enormous energy is produced if the nuclei are separated or merged.

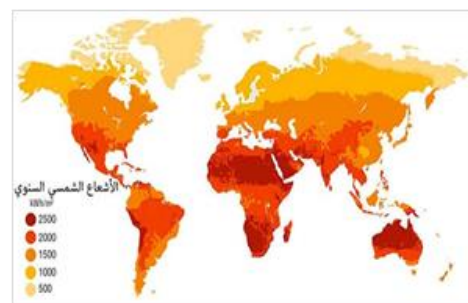
2. Kinetic energy

It represented in the movement of atoms, molecules, and materials, its forms are:

- electric energy, which is about tiny charged electrons moving through a wire. Lightning is an example of electrical energy in a wire nature.
- Thermal energy, which is the energy that results from the movement of atoms and molecules in matter. The amount of energy increases and its strength with the increase in the movement and speed of the particles.

Officially, it was directed to exploit the available alternatives energy in 2010 as part of a production strategy electricity via solar energy. The Palestinian National Authority allowed citizens in West Bank using solar energy to obtain electricity to light homes. At the same time any increase in the production of electrical energy resulting from solar energy can the Palestinian National Authority to buy it from the citizen at prices somewhat lower than the traditional price of electric energy.

Some facts must be mentioned in order to clarify the extent of exploiting renewable energy sources locally (Palestine) which related to the geographical location and the percentage of annual solar radiation. Palestine is 30 degrees north of the equator. This means that the solar energy that falls on every square meter is estimated with three thousand kilowatt-hours, which is a very high percentage in a positive sense, as shown in Figure 1. Palestine also enjoys more than 300 sunny days a year. Which makes it one of the best areas in the exploitation of solar energy, and makes investment in this aspect possible and even useful economic.



Annual solar radiation map

(2-3) National energy strategies

Since energy constitutes the backbone of the economic process, the work organized for it was mostly on a level the country. Programs and policies have been applied to ensure a gradual diversification of its sources that would protect from global fluctuations in prices. Thus, perpetuating the sovereignty and stability of economic and development decisions. At the national and governmental level, a sectoral strategy has been adopted in Palestine for the years 2020-2022, which was issued by the Energy and Natural Resources Authority. Through it, it reflected the directions of the national policy agenda of the Palestinian government and took into account the latest the developments witnessed by the energy sector in Palestine over the past years. It aims to reduce dependence on one source of energy and work to diversify the sources of energy and increasing domestic production of consumed energy, especially renewable energy sources. The new strategy took into account the political, social, economic and legal developments in Palestine. By preparation and development of appropriate policies and legislation to achieve security of supply energy in a sustainable manner according to best international practices. Also, by building a Palestinian national energy system capable of meeting the energy needs of the Palestinian citizen and securing them from its diversified sources, with high efficiency, are able to meet the needs of development comprehensive and sustainable. This strategy included the implementation plan, including projects strategy for the advancement of the energy sector in Palestine in all its sectors, including generation, transmission, and distribution.

The challenges facing the energy sector in Palestine constituted a motive for intensifying efforts and supporting energy projects in Palestine through local partners and a group of donor countries.

historically, it must be mentioned that the Palestinians succeeded in exploiting solar energy at small levels in the beginning. Solar water heaters have been used for hot water since the mid-1970's. The solar heater has become an essential component of every Palestinian house. While the experience of generation electricity with solar energy, on the individual or collective level, remained limited until mid-2000s.

chapter three:

The crisis as a reality and a view to future

(3-1) The root causes of food crises and the sustainable solutions

The theoretical rooting of sustainable development was described in the report of a committee in Portland 1987 as follows: “Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” Hence, sustainable development has become a prerequisite for achieving justice and fairness in the distribution of development gains and wealth among different generations. Sustainable development has a set of goals, centered on preserving the environment and making good use of the resources in it, and providing opportunities for future generations to benefit from them, and they are represented by:

- ❖ Achieving a better life for the population by preserving the environment and dealing with nature.
- ❖ Enhancing the population’s awareness of the existing environmental problems. Sustainable development strives to enhance the population’s awareness of the existing environmental problems, develop their sense of responsibility towards them, and urge them to actively participate in finding appropriate solutions to them through their participation in the proposal, preparation, implementation and follow-up of sustainable development projects.
- ❖ Achieving optimal utilization of resources, sustainable development faces the problem of limited resources through optimal and efficient utilization of available resources, which provides a great opportunity for future generations to benefit from available resources, which achieves a great degree of justice between current and future generations.
- ❖ Activating modern technology and linking it to the goals of society. Sustainable development relies heavily on modern technology, and always seeks to develop its

use in achieving the goals of society, by educating the population about the importance of various technologies in the development field, and how to use the available and new ones in improving the quality of life of society and achieving its desired objectives, without leading to negative environmental risks and effects.

The relationship between renewable energy and sustainable development / economic development is mutual, as the energy sector is considered the key to economic development because there is a strong relationship between economic growth and the expansion of energy consumption, as indicators such as (GDP) gross domestic product and (GDP per capita) average income were used as indicators economic development for several decades. Economic development depends mainly on the availability of the necessary energy services, whether to raise and improve productivity or to help increase local income through improving industrial, commercial and agricultural development and providing job opportunities outside the traditional sector. It is known that without access to energy services and modern fuel sources, job opportunities become available. Increasing productivity and thus the available economic opportunities are greatly limited. The primary role of renewable energy is evident in ensuring that the current development system is provided with a reliable and sustainable source of energy by relying on a diversified economic base that allows prolonging investments based on resources such as oil and gas, increasing the contributions of renewable sectors to the gross domestic product, preserving the position of countries in global energy markets, and promoting growth National economy.

According to a mathematical model for the experts of the German Institute for Economic Research “DIF”, the year 2030 will witness an increase in Germany’s economic output by 3% due to the expansion of renewable energies compared to the growth rate without the expansion of renewable energies and an increase of 3.5% in the volume of consumption, and the study relies on Assuming that the share of renewable energies in consumption will rise in the aforementioned period to 32%, which would cause positive changes in sustainable economic growth rates across the world, especially developing countries, and this takes into account the negative and environmental impacts in terms of high environmental costs and low investments in power plants. traditional.

Global interest has increased in recent years to understand and study the interrelationships between the water, energy and food sectors, and this has resulted in what is known as the “water, energy and food interdependence”, which has now become a concept included in the center of global public policies, development and research agenda, which is considered Witnessing the vital and important role of the nexus approach in meeting the growing demand for water, energy and food in a world suffering from limited resources. This relationship can be understood as a basic starting point for achieving the goals of sustainable development, just like the "cradle-to-cradle" or "circular economy" methods.

Poverty, depletion and deterioration of resources are clear issues in the Arab region, despite the fact that the region contains 43% of the world's oil reserves and the presence of huge potentials for renewable energy, as we find that more than 50 million people in the region are deprived of access to modern energy services, especially electricity. Moreover, the region suffers from very scarce freshwater resources and has only 0.3% of the world's freshwater resources, making it the most water-scarce region in the world. In addition, the per capita share of water per year in more than 50% of Arab countries is less than the level of water poverty (500 m³ / person / year), and this share is expected to decrease by half by the year 2050 AD, while the demand for water continues to rise.

In the Arab region, agriculture represents the largest consumer of water, as it consumes about 85% of the total fresh water withdrawn, driven by many countries in the region with policies of self-sufficiency in food. However, in conditions of limited fertile land, scarce and declining water resources, and the poverty of natural resources for agriculture, any endeavor to increase food production represents a very difficult challenge. The region already suffers from water scarcity and is witnessing fierce competition between various sectors over it, including industry, electricity production, domestic use and the environment. In the face of all these competing sectors, it will be difficult to provide more water for the irrigation sector.

In order to meet the growing demand for water and food, careful attention must be given to managing the risks and opportunities associated with each other and the complex overlap between the characteristics of food security and water security. Providing water of good quality, for example, affects many aspects of food security. The availability of water, in

the required quality and quantity, is a necessity for food production, and even in the stages of food production, preparation and consumption. Similarly, the expansion and intensification of some production practices, for example, leads to an overuse of soil fertilizers, which has significant impacts on water security. And since water is the main input in all stages of agricultural production, the threats of the water sector to food security are large and serious.

It has become a goal and a drive to move towards the use of clean energy and to raise the energy efficiency that is necessary during the stages of processing, distribution, storage, retail sale and preparation of agricultural food products. Adopting an "integrative" or "associative" approach in managing these three sectors. Within the term integrated management of resources is not a new concept, and it has always been the most important in the well-known development methods, where the integration of strategic management and governance across sectors and the shift from traditional sectoral planning aims to exploit the opportunities resulting from the linkage between these three sectors. Resource efficiency, sustainability and productivity by addressing external influences across sectors, and shifting to clean energy to meet each of the requirements of sustainable development.

(3-2) The current available energy crisis (electricity sector):

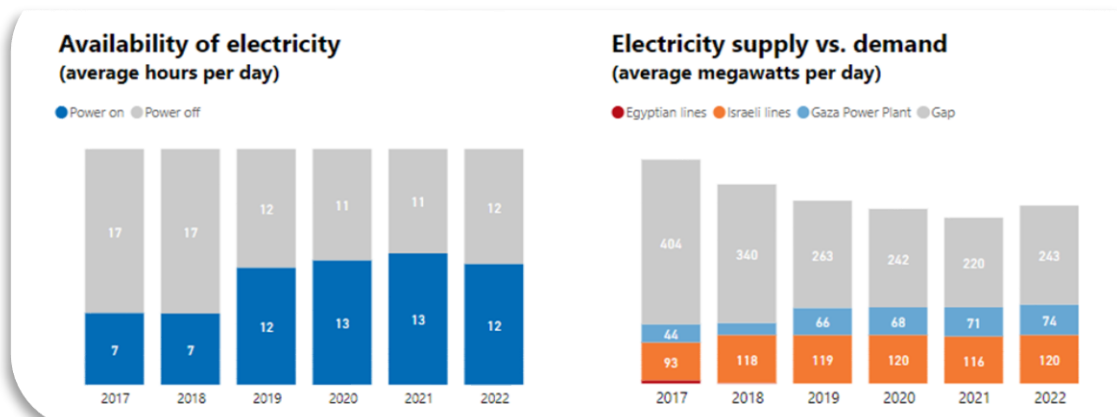
Over the past decade, Gaza Strip has suffered from chronic electricity shortages, undermining fragile living conditions. This growing power shortage has severely affected the availability of basic services, particularly health, water, sanitation, manufacturing and agricultural sectors. The International Committee of the Red Cross, through the production of information materials, clarified the impact of the electricity problem on the lives of people in the Gaza Strip, through questions addressed to a group of beneficiaries to identify the challenges and humanitarian needs imposed by the electricity crisis, especially the daily challenges, and they were summarized as follows:

- 86.2% of the sample reported that they received electricity for (6-8) hours per day on average during the year.

- 80.1% of the sample said that the least amount of electricity they got in one day of the last year was less than 4 hours.
- 26.8% of the sample said that they do not have access to any alternative energy source, whether with high or low capacity, as 91.4% of them stated that they are unable to pay for the additional energy, while 8.6% said that they cannot access any alternative energy source because they refused to home pay extra energy costs.
- 57.1% of those who depend on alternative energy sources do not have access to alternative energy sources of high capacity sufficient to meet their needs and work.
- 22% of those who depend on alternative energy sources have access to commercial generators available in residential neighborhoods as an alternative high-energy energy source, compared to only 8.7% who depend on solar energy systems as an alternative source of energy.
- Village residents can access an alternative energy source less than other residents of cities and camps.
- The residents of Gaza Governorate have greater access to alternative energy sources, followed by North Gaza Governorate, Central Governorate, Rafah Governorate, and finally Khan Yunis Governorate which has less access to alternative energy sources.
- About 77.0% of the respondents believe that the most important problems due to lack of electricity are "their inability to complete household chores that depend on electricity" and "the inability to store food and vegetables in the refrigerator for fear of spoilage."
- 57.0% of the sample believes that the most important problems due to the lack of electricity are "interruption of electrical appliances in the event of frequent and sudden power outages" and "suffering from heat during the summer because of the inability to cool the environment."
- Other energy sources that citizens can access to a limited extent have contributed to reducing or limiting some of the problems resulting from the lack of electricity provided by the public network.
- 94.0% of citizens believe that the lack of electricity affects their mental health.

- 82.0% of citizens are unable to cool food items due to the lack of electricity provided by the public network.
- The more hours of electricity citizens get from the public grid, the more they can cool and store food.
- The more powerful alternative energy sources available, the more people will use refrigerators and coolers to cool food.
- One of the control mechanisms used in the event that food is not able to be refrigerated is to go to the market every day to buy the daily needs of food and drink, as indicated by 51.2% of the sample, while people do not buy foods that need to be refrigerated for fear of spoilage, indicated by a percentage 40.3%. Furthermore, 8.5% use someone else's refrigerator to cool their food as an adaptive mechanism.
- When electricity is available (connection hours), citizens take several measures as their first action; About 53.0% reported that they operate the necessary home appliances such as (fan - air conditioning - refrigerator - washing machine - iron - electric oven - TV...etc.). But 24.2% said they operate the water pump to fill tanks as a first action when electricity is restored, while 15.3% charge home batteries to recharge.

The following graphs show the quantities of electricity available and the annual demand as well as the daily availability of electricity:



Source: United Nations Office for the Coordination of Humanitarian Affairs in the Occupied Palestinian Territories

The available energy sources (energy feeding the Gaza Strip) that do not actually cover the basic needs of citizens, as well as the productive sectors, can be summarized as follows:

The governorates of Gaza are fed by ten Israeli lines, each line with a value of 12 megawatts. They are distributed among the governorates (the total number of Israeli lines is 120 megawatts), as follows:

- Gaza Governorate: Al Qubbah Line, Baghdad Line, Al Sha`af Line, Al Bahr Line (shared between the Gaza and North Governorates).
- North Governorate: Jabalia line, Beit Lahiya line.
- Al-Wusta Governorate: Line K7, Line 11 (shared between Al-Wusta and Khan Yunis governorates).

Khan Yunis Governorate: Line 8.

- Rafah Governorate: Line 9 (shared between Khan Yunis and Rafah governorates).
- Two lines from Egypt with a value of 5 megawatts and 17 megawatts, feeding part of the city of Rafah (total 22 megawatts).
- The power plant operates partially according to the quantities of diesel that are supplied to the Gaza Strip.

It should be noted that the generating station was established to operate with a nominal capacity of 140 megawatts. The western transformer station was bombed by the occupation on 6/28/2006, which led to the destruction of the 4 upstream transformers with a voltage of 220/11KV and the 2 downstream transformers of 220/22KV, as the generating station stopped working completely and became The Gaza Strip suffers from a clear deficit in electric power.

After the station was partially repaired after the bombing, the European Union funded the fuel to operate the station, and it paid about 50 million shekels per month, equivalent to the price of 8,800 cubic meters, sufficient only to produce about (60-65) megawatts, and to compare the available energy needs, it must be noted that the peak it occurs in the winter

and summer seasons (the peak demand for loads is around 600 megawatts). As for the spring and autumn seasons, the loads drop to 270 megawatts.

The energy currently available from the previous sources is approximately 217 megawatts, which is the maximum energy available. From here, we see that the deficit in the summer and winter seasons rises to half, and the deficit increases when one of the lines breaks down or work stops at the power station.

The proposed solutions and alternatives are in line with the strategic plans and statements issued by the official authorities, which indicate that the large shortage in the available quantities of electricity lies in its solution by turning to renewable energy alternatives, which can be worked on and implemented within a wide field due to its great importance, as the world is facing Today is an unprecedented turning point where climate change poses a real threat to the prosperity that many enjoy today and what millions aspire to and work towards tomorrow. But the matter goes beyond this situation, of course, because it relates to simply solving an energy crisis somewhere for a society, but rather goes beyond protecting the ecosystems and biodiversity that we have to secure, in addition to the fact that climate change continues to a large extent as a result of emissions from combustion Fossil fuels and in order to reduce these risks, work must be adopted to reduce consumption of these carbon-intensive fuels, and that renewable energies be a pivotal part of the possible safe alternative line.

Orienting and working on renewable and solar energy technologies will protect the economy from external shocks with regard to energy security and provide a solution that can be applied to treat the electricity crisis with local resources, in addition to creating job opportunities and reducing air pollution at the local levels. Where this type of renewable energy represents one of the fastest ways to provide electricity, as the great standard that characterizes many of these technologies, especially solar photovoltaic patterns, is the ease and speed of installation, and for the first time in the history of the electricity sector, there has become an effective role Individuals and communities have done it on a limited scale by providing what they need from the electricity.

The following table (No. 1) shows the quantities of energy consumption (renewable energy) by sector, energy form, and year. It is clear that the exploitation of alternative energy was concentrated in the domestic consumption sector, while the agricultural sector did not have a significant share in benefiting from renewable energy, but rather it was just initiatives individual and civil did not reach strategic goals.

Table No. (1): Energy consumption (renewable energy) by sector, energy form, and year (2011-2020)										
Renewable energy 2020 (thousand tons of oil equivalent)	Renewable energy 2019 (thousand tons of oil equivalent)	Renewable energy 2018 (thousand tons of oil equivalent)	Renewable energy 2017 (thousand tons of oil equivalent)	Renewable energy 2016 (thousand tons of oil equivalent)	Renewable energy 2015 (thousand tons of oil equivalent)	Renewable energy 2014 (thousand tons of oil equivalent)	Renewable energy 2013 (thousand tons of oil equivalent)	Renewable energy 2012 (thousand tons of oil equivalent)	Renewable energy 2011 (thousand tons of oil equivalent)	expenses
188	197	169	164	222	218	219	193	194	204	final energy consumption
10	13	7	6	5	6	6	5	-	-	by industry
-	-	-	-	-	-	-	-	-	-	by transportation
171	178	158	156	216	211	211	185	194	204	home
-	-	-	-	-	-	-	-	-	-	Farming
7	6	4	2	1	1	2	3	-	-	Trade and public services

(3-3) The impact of energy crisis on sovereignty and economic growth:

The results of the Food, Social and Economic Security Survey for the year 2020 (the Central Statistical Organization) showed that less than half of Palestinian households were food secure during the year 2020, which resulted from the deterioration of the food security situation between (2018-2020) in the Palestinian territories, especially in Gaza Strip.

The Palestinian Economic Policy Research Institute (MAS) released the results of the 2020 Social and Economic Conditions and Food Security Survey, which it prepared in partnership with the World Food Program and the Food and Agriculture Organization of the United Nations (FAO) in Palestine during the year 2020. It provided an analysis of the latest developments related to food security during the period between (2018- 2020) .As the results of the report indicated that during the year 2020 the number of Palestinian families who were food secure was less than half of the number of Palestinian families,

with wide regional differences between the West Bank and Gaza Strip: while 60% of West Bank families were food secure, 60% of them were Families in the Gaza Strip suffer from moderate or severe food insecurity. The report also shows that the food security situation between (2018-2020) has deteriorated more than before, whether at the national or regional level.

In order to link the matter professionally, it is necessary to clarify the repercussions of the electric current crisis on the agricultural sector - the vegetable and animal sector - as it was evident that the rate of irrigation quantities decreased by (50-60%). The eastern regions of Khan Yunis governorate (Al-Fokhari and Abasan) are considered the most affected where the damage rate is estimated at (60%). On the other hand, the damage rate in the northern governorates is estimated at (40%).

As an example of storage and production operations, the productivity of the area cultivated with the potato crop is estimated annually at about 30,000-35,000 tons. About 25,000 tons are stored in 60 refrigerators in Gaza Strip, with the need for these refrigerators to have continuous electric current, which led to the faltering of the storage process and the exposure of a large part of the stock to damage.

(3-4) The most sensitive sectors to energy shortages:

The agricultural sector is considered the most sensitive sector to the lack of energy. Although, the current trend at the governmental, institutional, and private levels is based on adopting reliance on the use of solar energy as a renewable energy source in groundwater pumping, food processing units, sorting and packaging, and within the animal and poultry production sector in Gaza Strip. This source as a new and environmentally friendly technology, and training the local community and specialists to use it.

The results of the sensitivity analysis for power outages by field of work were:

"Based on recent 2022 studies related to solar electrification of the agricultural system prepared by FAO and based on surveys, focus group discussions and interviews with knowledgeable experts"

Next figure No. 2 shows the sensitivity of the value chain to power outages.

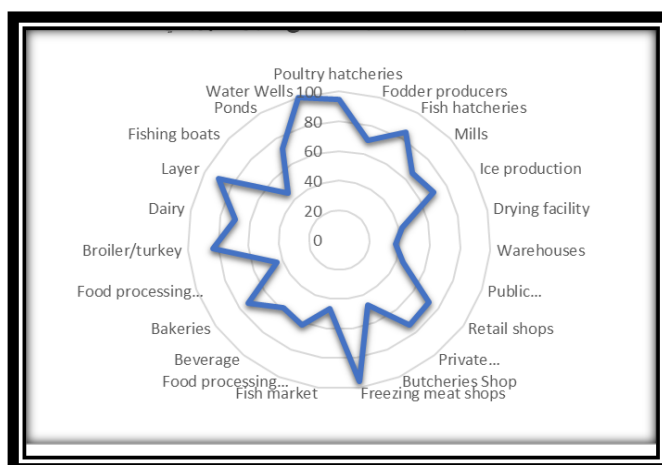


Figure 2: Value chain sensitivity to power outages

Source: United Nations Office for the Coordination of Humanitarian Affairs in the Occupied Palestinian Territories

- ✓ High sensitivity: (>90%) include poultry hatcheries, frozen meat stores, water wells and cold storage.
- ✓ Highly sensitive (70%-89%) includes feed producers, fish hatcheries, ice production, retail shops, and private slaughterhouses, bakeries, broilers/turkeys, dairy products, and ponds
- ✓ Medium sensitivity (50-69%), including mills, food and beverage processing plants, and laboratories.
- ✓ Low sensitivity (<49%) includes drying facilities, warehouses, general slaughterhouses, butcher shop, fish market, food processing cooperatives and fishing boats.

(3-5) Needs and adaptation mechanisms (agricultural sector):

First, the following indicators of the agricultural sector must be taken into account:

- The agricultural sector contributes (5.7%-6%) to the gross national product, while the value of agricultural production amounts to 430 million dollars.
- The agricultural sector consumes about 100 million ^m3 annually, which represents nearly 50% of the annual water consumption.

- Approximately 160,000 m³ of treated water is produced per day from 5 treatment plants, and work began to exploit it in the agricultural sector at the end of last year.
- The actual agricultural area is about 180,000 dunums distributed over the five governorates. The agricultural crop area is about 220,000 dunums. The vegetable production sector ranks first and contributes to that with 54% of the value of agricultural production. The animal production sector contributes 5% and the remaining percentage of the contribution of the fisheries sector.
- The total number of workers in the agricultural sector reached 55,000 workers, 32,000 farmers, and the remaining workers as support services. While the number of agricultural holdings amounts to 23,600 agricultural. “Holdings is defined as a piece of land registered in the name of a specific person or leased and activities of an agricultural nature are practiced on it”
- The number of breeders for the livestock sector reached 5586 breeders for 5919 barns, represented in the barns of “cows, sheep, goats, broiler chickens, turkeys, and laying hens.”

It is clear from what was mentioned that agricultural production processes in all its branches, which are supposed to be in production quantities and high quality, cannot be reached in the absence of an energy source. In other words, the unavailability of the energy operator will lead to a reduction in agricultural land and, consequently, a shortage of agricultural products in all its forms. This will directly affect societies and citizens of all age groups. In short, energy insecurity is a major factor in food insecurity.

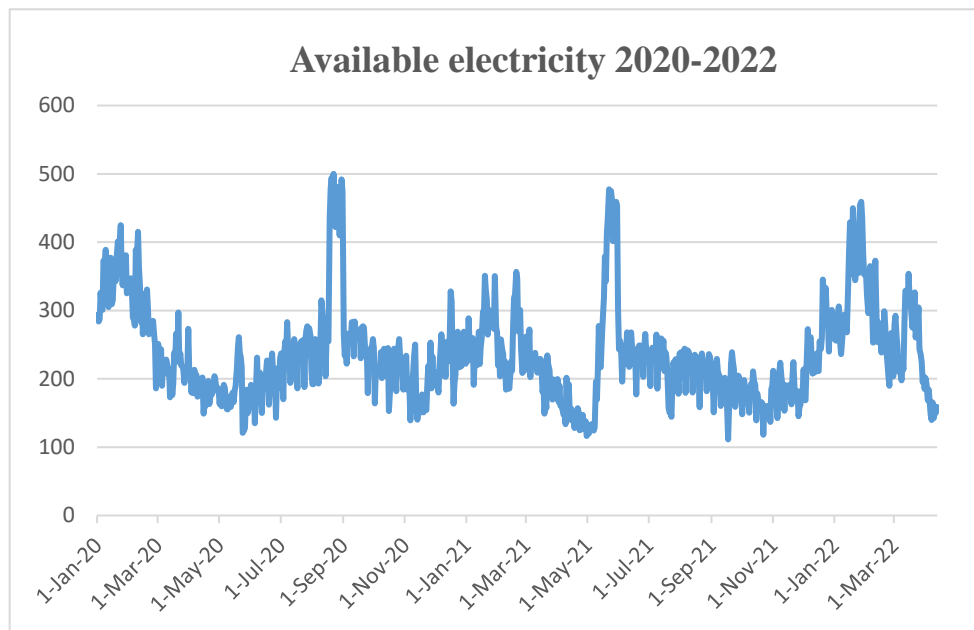
Adaptation mechanisms in the agricultural sector (exploitation of available solar energy):

Solar energy technology has become more widely adopted in the agricultural sector. Supporting investment plans in electrifying the agricultural food system in Gaza with solar energy has become the focus of action for all civil and governmental sectors. It must be mentioned that the energy situation (electricity crisis) during 2022 is bad. The daily deficit

has reached 454 megawatts. This deficit, which has lasted for more than ten years, has undermined the already fragile living and economic conditions in disproportionate proportions.

The agricultural sector is the heart of the affected sectors. Because of the high demand for energy supplies for irrigation wells, ponds, cold storage operations, food production, industrial transformations, and poultry and cow hatcheries. While other sectors tended to overcome the acute shortage of electricity through the trade of backup generators based on diesel. About 47% of these generators are owned by companies or groups of individuals. Also, 30% of households own generators that cover about 40-45% of the electricity supply (most families opted for private, high-cost investment generators, while others opted for using the inverter system with a storage system. Both solutions are very expensive and cover lighting only).

The following chart shows the actual crisis of electricity shortage, as the availability does not cover half of the need.



The following table (No. 2) explains the gaps in energy, cost and investment savings for the agricultural sectors: -a study related to the electrification of the agricultural system by solar energy prepared by the Food and Agriculture Organization for the year 2022-

- An energy gap for all branches of the agricultural sector amounting to 165,586 Kwp.
- The average cost of one kilowatt is 1290 US dollars.
- The total proposed investment is about 213 million US dollars.
- The total annual savings are about 96 million dollars.

It is clearly indicating that investment in electrification of the agricultural sector has close returns and saves the sector from the current crisis if it is carried out according to a central plan with governmental reference.

The conclusion from the data analysis shows that the most important branch of investment and savings in the agricultural sector is water wells and retail stores, with the control of work and development mechanisms. While ice production, feed, cooperatives, fish market and fish hatcheries are the lowest.

The services	Energy Gaps	Cost Per Kwp	Savings	Initial investment
Input Stage	4,115	\$930	\$2,016,326	\$3,825,446
1st processing Stage	796	\$908	\$312,727	\$722,828
Retailer stage	56,319	\$1,400	\$19,983,852	\$78,825,621
Second processing stage	11,229	\$982	\$10,661,393	\$11,022,605
Production Stage	83,336	\$1,199	\$59,919,844	\$99,905,685
Service provision stage	9,791	\$1,976	\$2,736,419	\$19,347,587
Total	165,586	1,290	\$95,630,562	\$213,649,772

table (No. 2) explains the gaps in energy, cost and investment savings for the agricultural sectors

Chapter (4)

Solutions in horizon

(4-1) The crisis and the political dimension:

During the past decades, the agricultural sector in Palestine represented the basic agricultural production base of the Palestinian economy, as it played a major role in the formation of the domestic product and the effective contribution to providing food, in addition to employing and absorbing a large number of workers. However, the direction of investment and attention from agriculture to other economic sectors such as industry, trade and services led to an increase in the challenges facing Palestinian agriculture and caused a decrease in its contribution to the GDP.

This movement as a result of the low agricultural yield, the crises related to closures, the shortage of electricity, and the continuation of the Israeli occupation policies to undermine this sector. This remarkable decline is confirmed by data from the Palestinian Central Bureau of Statistics. In the mid-seventies of the last century, this contribution amounted to about 37% of the GDP. It decreased in 1994 to 13.4%, in 2003 reach to 11%, continuing its sharp decline to reach 5.6% in 2018, and 6.5% in 2021. The challenges facing the Palestinian agricultural sector, and the impact of systematic Israeli practices such as (destruction of water sources "underground wells", bulldozing agricultural lands, and strengthening the electricity crisis) have become negative social and economic impacts and limit the prospects for confrontation. The effects of these measures were represented in the weak tendency to invest in agriculture, an increase in the prices of agricultural products available in the local market, a decrease in the volume of production per unit area, the cost of using new irrigation patterns, and the loss of revenue from water sold from private wells to non-farmers.

The most important social effects of such measures, they were represented in: First, the worsening of the psychological condition of the farmer. Second, the occupation of a large area of the citizen's thinking by the water crisis. Third, the weak ability of the family to improve the financial and social situation of their children . Also, changing the family's priorities.

Local and international civil work and development institutions have submitted proposals to confront these repercussions. These proposals were represented in: financing the rehabilitation of agricultural wells, encouraging water harvesting projects “water collection ponds”, using modern irrigation methods to rationalize consumption with effective and energy-saving alternatives. The solar energy option is the available and effective alternative despite the high initial construction cost.

It should also be mentioned the marketing problems suffered by the agricultural sector in Gaza Strip, such as the freedom of crossings and the ability to maintain the quality of agricultural products, including harvesting and post-harvest operations (including sorting, packaging and packaging operations, and the ability to store and refrigerate), which is its operator and Its backbone is electricity.

Based on what has been mentioned, a number of key points must be emphasized:

- The agricultural sector represents a basic base in the economy of any country. It is the most stable and generous. In Palestine, it takes another sensitivity because it is linked to the land that is the subject of conflict with the occupation, and the ability of the two parties to use the land. The settlement employs the land for the benefit of the occupation. We must use the land for independence.
- In the battle of energy and water, the available potentials must be used efficiently and have the ability to invest them.

In addition to the availability of solar energy geographically in the Gaza Strip and the optimal exploitation strategies for it, a new and old conflict has emerged over natural resources with the occupying state. As the discovery of natural gas fields in the waters of the eastern Mediterranean is a new dimension to this conflict. Where in contravention of the agreements within the economic cooperation chapter of the Oslo Accords. It grants the

Palestinians the right to extract wealth from the area where the gas was discovered, but it gives Israel the right to prevent its navigation for security reasons. The importance of the gas discovered in the Marin field, which contains one trillion cubic feet, with a production volume estimated at about 1.6 billion m³ annually. This gas was described as pure, which makes it easy to sell. It is also close to the shore, which facilitates the process of extracting it at the lowest costs. Therefore, the process of extracting it is commercially feasible. Therefore, its importance for the Palestinians lies in the following considerations: First, contributing to solve the energy problem. Second: supplementing the general budget. The importance of these two items stems from their direct impact in supporting the efforts aimed at secession and then economic independence from the occupation.

(4-2) Solar energy / available solutions and opportunities:

Many developing countries, whose lands are characterized by abundant solar radiation, are investing in concentrated solar energy. However, the challenges that most of them face in making solar energy technology or concentrated solar energy feasible from an economic point of view. These challenges include -just to name a few- financing, risk mitigation, cost reduction, and local capacity building.

In this context, energy policies and strategies have been adopted. Workers in this field have been active in exchanging experiences related to how to manage solar energy programs with medium and high generating capacities.

Supporting the solar energy option and developing and managing solar energy with medium and high generating capacities must be within the following common axes:

- Determining the correct policy and regulatory framework for the development of solar energy with medium and high generating capacity.
- Balance between local industries and the use of various solar energy technologies.
- Mechanisms for integrating solar energy into public electricity networks.
- Requirements for the development of solar energy projects on a large scale.

Solar energy is suitable to address our challenges related to energy security and climate change. However, this energy needs management to become competitive. The development of large-scale solar energy projects in a well-thought-out manner at the strategic level ensures achieving the necessary scale to reduce costs.

(4-3) Findings and Recommendations:

(4-3-1) Findings:

- 1) The electricity crisis in Gaza Strip affected economic and social rights. The Palestinian economy incurred heavy losses, which led to a deterioration in the economic situation. It also worked to increase the poverty rate as a result of the loss of job opportunities .In addition, increasing the daily living costs of the Palestinian family.
- 2) The electricity crisis seriously affected the right to food for the residents of Gaza Strip. The power outages for hours on a daily basis affected agricultural and animal production. Also, on the ability of farmers to market, preserve, and store agricultural and animal products.
- 3) The available electrical energy sources do not meet the minimum needs of Gaza Strip population.
- 4) The electricity crisis in Gaza Strip negatively affected the human right to life. The electric current service has become one of the basic necessities of life. It interferes with the right to work and the right to health, in which living standards have declined and the most basic principles of human rights have been violated.
- 5) The repercussions of the electricity crisis directly affected the farmers and affected all segments of society, especially the poor, due to the high production costs and, consequently, the high prices of agricultural products for the consumer.

(4-3-2) Recommendations:

1. Urging the international community and international institutions to work to overcome all the challenges that hinder the provision of electric power to Gaza Strip. In addition , pressing for lifting the blockade that leads to depriving the Palestinians of a number of their economic, social ,and human rights.
2. Pressuring towards the process of reconstruction of Gaza Strip. Providing a safe base for investment in the alternative energy sectors.
3. Urging the decision-making parties to keep the energy sector away from political conflicts. Adopting and activating all proposals and projects that adopt quick solutions to the electricity crisis that exceeded a decade.
4. Developing strategic plans to ensure the improvement of the quantity of electricity and work effectively in order to exploit natural resources.
5. Providing the necessary support to the residents of Gaza Strip- especially poor families- and the unemployed in a way that contributes to improving their ability to cover the basic requirements of life.
6. Forming professional national committees to study the priorities of support for farmers affected by the energy crisis. These committees include many areas such as land reclamation, developing water harvesting operations, using solar energy sources as an alternative to electricity shortages in agricultural operations, and encouraging agricultural industrialization to benefit from surplus production.
7. Bridging the knowledge gap in the field of interdependence between water, energy and food at the national and regional levels through understanding and quantitative assessment of this interdependence.
8. Identifying and analyzing the water, energy and food interrelationships between the various sectors, in terms of interactions, trade-offs or risks.
9. Adopting a method or approach of the water-energy-food nexus in policy-making to increase the consistency of the policies of these sectors and climate change policies. Thus, providing integrated solutions and mitigating risks related to this interdependence.

