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Geothermal Energy in Palestine: Practical Applications

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ABSTRACT

Energy is a main factor in developing nations. Energy is almost a must for surviving with dignity. Palestine situation is different from other countries which can import their energy needs from outside. Palestinians are facing a critical shortage in energy due to Israeli Occupation. They must depend on the naturally available energy to survive in dignity and develop their lives. In this paper, the scope of using geothermal energy in Palestine is taken into consideration, its availability and practical applications, as a source of renewable energy, which is identified by the reliability and sustainability. It has been found that the Palestinians should depend on their own free energy; geothermal energy has a notable role in reducing the residential energy consumption especially for the heating and cooling purposes. Geothermal energy could also be used to reduce the electrical bill that overloading the Palestinians shoulders by using low temperature geothermal water in generating electricity.

1. Introduction

Life in Palestine can be tough and unbearable for most of the people around the world. In addition to one of the world's fastest-growing populations—UNDP estimates that by 2050, population per square kilometer will exceed that of Bangladesh—Palestine is a home to some of the highest energy prices in the region, with a supply reliant on the Israeli occupation. Growing population, without any sources of energy is to be impossible. Sustainable development fueled by renewable energy should be the solution. Geothermal energy is present everywhere in Earth because temperature increases with depth. Existing technologies can extract heat from deep layers and utilize it to produce electricity. Geothermal energy is one of the few renewable energy resources that can provide continuous power with minimal visual and other environmental impacts. Geothermal systems have a small footprint and no carbon dioxide emissions. Although geothermal energy has provided commercial load electricity for more than a century, it has often been ignored in developing energy supply. MENA Geothermal in 2008 lunched the first geothermal system in Palestinian residential complex. Warm geothermal waters at low temperatures (38–70°C) are available in some regions in Palestine [1]. The sources ready for utilization at present could supply heat for about 50 ha of greenhouses (i.e. an equivalent of 5000 tons of petroleum fuel per year).

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Most of the geothermal water is in deep wells (1000–1500m). Water is at low salinity and in most cases can be used for irrigation. Further drilling can increase the geothermal potential to supply heat for about 250 ha of heated greenhouses, which means doubling the heated greenhouse area in Palestine.

Development and research activities aimed at utilization of geothermal water started in the early seventies with an emphasize on soil warming in open fields and low tunnels. These activities were increased following development of a 60°C well at the south valley in Palestine. MENA Geothermal Company is the First Palestinian Company Succeeds in Using Renewable Energy in the West Bank and Jordan.

2. Locations of Geothermal Sources

As it has been previously mentioned geothermal energy is available everywhere except it is located at different depths from the ground surface. Fig 1 shows the temperature of the earth at depth of 6 km from ground surface. Fig 1 indicates that the geothermal energy can be used extensively in Palestine specially in Gazza strip and north of Palestine. Those areas are the densest areas in Palestine, and they consume most of the electrical energy produced and need to be heated in winter with simple cooling in summer. By depending on Fig 1 a temperature of 250 C can be achieved in Gazza strip, which may be used as free energy for generating electricity and heating the camps of refugees.

When temperatures are high (>150 C) but the permeability is low or there is no groundwater, the permeability could be artificially enhanced by rocks in the basement because fractures that are artificially produced in granite are likely to remain open for long periods [2].

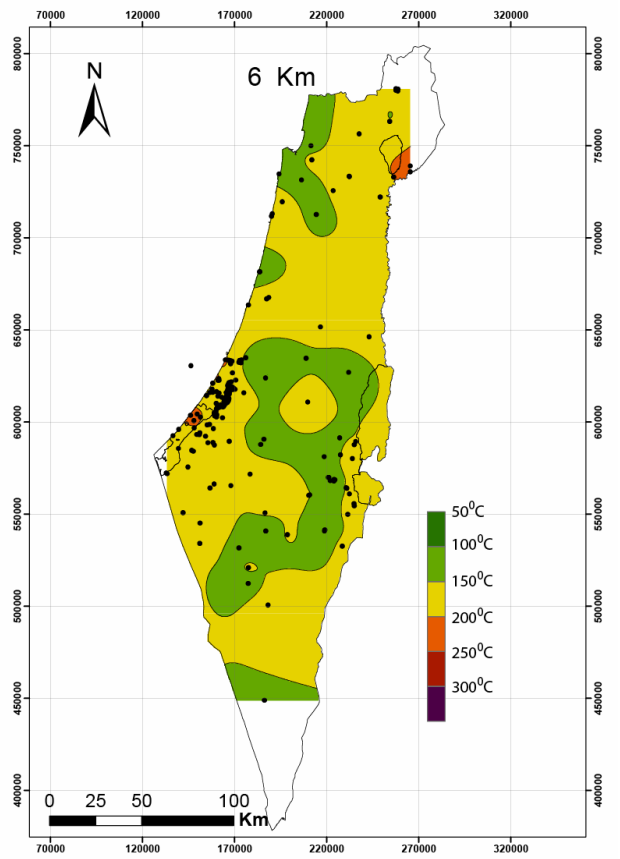

Fig 1. Temperature distribution at depth of 6 km in Palestine [3].

Jordan River fault zone is considered the lowest point on the earth surface; it is full of the warm streams that are not used except for picnics. This area is ideal for digging the geothermal holes to extract the earth geothermal energy and generate electricity, also warm temperature water that results from the electricity generation may be used for heating the crops in the Jordan valley, achieving much more crops all around the year, which helps the development of the country's economy and give more employment opportunities.

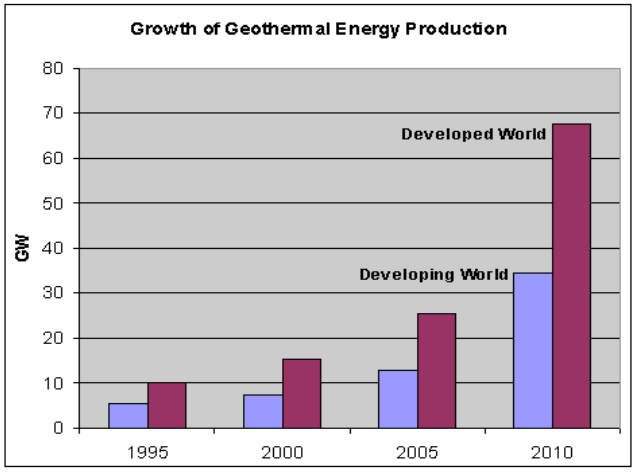

Fig 2. The fast growth in geothermal energy.

Fig 2 shows the growth in the geothermal energy worldwide. It is clear that the world is going toward better use of the GE. Our people must also concentrate on their available GE. More developments in the GE technologies that will allow the use of low temperature fluids, and the reduction in drilling cost of geothermal holes.

3. How Geothermal is Converted

The earth absorb energy from the sun, and then it emit this energy nighttime. The variation in earth surface temperature is just in the first 10m from the external earth surface. Below this distance the earth temperature start increasing with depth as a result of the molten rocks in the core of the earth.

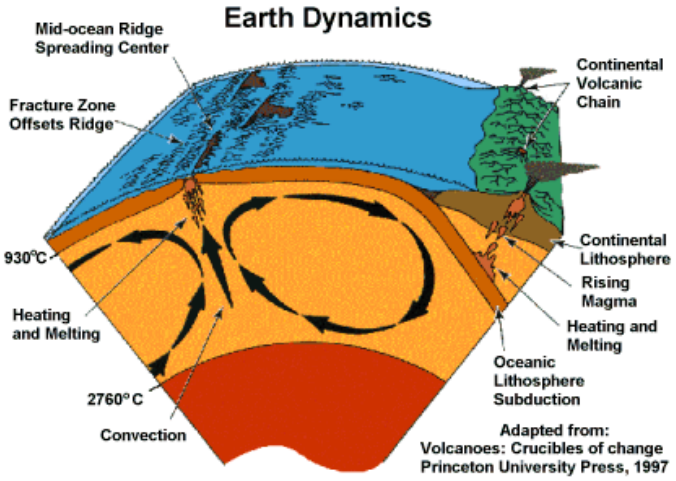

Fig 3. The earth temperatures layers below the earth's surface.

If it is possible to reach the high temperature rocks, a huge energy can be extracted from the earth that could be used for electricity production, heating and cooling purposes. The electricity generation from geothermal energy is done by three ways that is presented next.

3.1. Dry Steam Power Plants

These were the first type of plants created. They use underground steam to directly turn the turbines. The turbine rotates the generator, which produces electricity by its turn. The used steam may be directed to a lower pressure turbine that may generate extra electricity and the condensed water is pumped again to the earth hot layers to be used once again. If the water source is renewable this hot water may be taken and used for residential buildings heating purposes, which can provide a large area of the required heat.

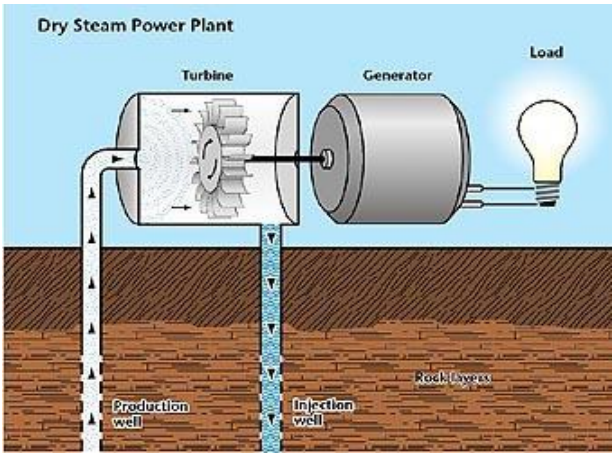

Fig 4. Shows the principle of dry steam power plant [5].

3.2. Flash Steam Plants

These are the most common plants. These systems pull deep, high-pressured hot water that reaches temperatures of 3600F or more to the surface. This water is transported to low pressure chambers, and the resulting steam drives the turbines. The remaining water and steam are then injected back into the source from which they were taken.

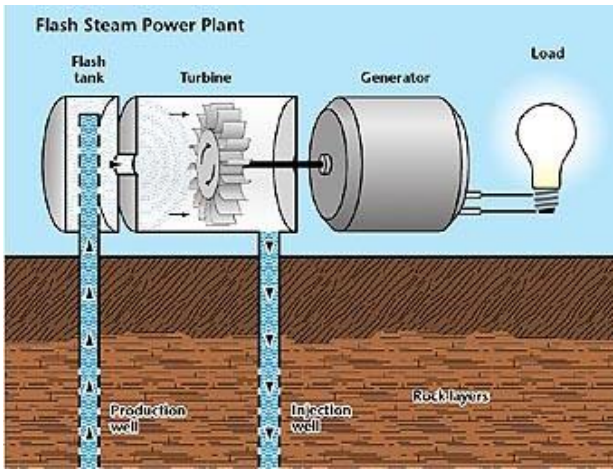

Fig 5. A schematic of the Flash Steam Power Plant [5].

3.3. Binary Cycle Steam Power Plants

This system passes moderately hot geothermal water past a liquid, usually an organic fluid that has a lower boiling point. The resulting steam from the organic liquid drives the turbines. This process does not produce any emissions and the water temperature needed for the water is lower than that needed in the Flash Steam Plants (250^0F – 360^0F). Fig 6 shows the working principle of the binary cycle of a steam power plant, and how heat is transferred between the two fluids.

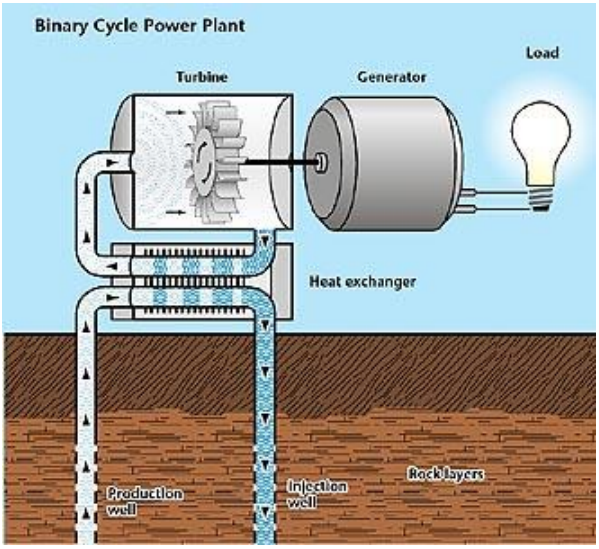

Fig 6. A schematic of the binary system used for low temperature hot fluid [5].

4. Geothermal Energy Applications

Geothermal heat pumps Geothermal (ground-source) heat pumps have the largest energy use and installing capacity worldwide. The energy use reported for the heat pumps was deduced from the installed capacity, based on a coefficient of performance (COP) of around 3.5, which allows for one unit of energy input (usually electricity) to three units of energy output, for a geothermal component of 71% of the rated capacity [i.e. (COP − 1)/COP = 0.71]. The cooling load was not considered as geothermal energy use. In this case, heat is discharged into the ground or groundwater. The cooling has a role in the substitution for fossil fuels and reduction of greenhouse gas emissions. Space heating the hot water can be used for heating the residential building in the near areas. Reducing the fossil fuel consumed in heating houses.

Greenhouse and covered ground heating Worldwide use of geothermal energy in greenhouse heating increased by only 15.7% (or 3.0% annually), which is slightly higher than during the 1995–2000 period. The installed capacity is 1404 MWt and the annual energy use is 20,661 TJ/year. A total of 30 countries report geothermal greenhouse heating, the leading countries being Georgia, Russia, Turkey, Hungary, China and Italy. Aquaculture pond and raceway heating Aquaculture use of geothermal energy has decreased again, as was reported for the 1995–2000 period. The drop in 2000–2005 was 6.4% or 1.3% compounded annually.

Agricultural crop drying fifteen countries report the use of geothermal energy for drying various grains, vegetables and fruit crops; only 10 countries were reported in 2000, e.g. seaweed (Iceland), onions (United States), wheat and other cereals (Serbia), fruit (Guatemala and Mexico), lucerne or

alfalfa (New Zealand), coconut meat (Philippines), and timber (Mexico, New Zealand, and Romania). There is a large potential and great interest in using geothermal heat for drying crops in tropical regions, where field spoilage occurs rapidly. A total of 2013 TJ/year of energy use and 157 MWt of installed capacity is reported.

Industrial process heat is a category that has applications in 15 countries, down from 19 in 2000, where the installations tend to be large and of high-energy consumption. For examples concrete curing (Guatemala and Slovenia), bottling of water and carbonated drinks (Bulgaria, Serbia and the United States), milk pasteurization (Romania), leather industry (Serbia and Slovenia), chemical extraction (Bulgaria, Poland and Russia), CO2 extraction (Iceland and Turkey), mushroom growing and laundry use (Mexico and the United States), salt extraction and diatomaceous earth drying (Iceland), pulp and paper processing (New Zealand), iodine and salt extraction (Vietnam), and borate and boric acid production (Italy). Zinc extraction plant in the Imperial Valley of southern California in the United States [4].

5. Geothermal Energy Advantages and Disadvantages

The geothermal energy has many advantages it is a renewable source of energy, it is non-polluting and environment friendly, there is no wastage, can be used directly, maintenance cost of geothermal power plants is low and geothermal power plants do not occupy too much space and thus help in protecting natural environment. On the other side, few sites have the potential of GE, there is always a danger of eruption of volcano and there is no guarantee that the amount of energy which is produced will justify the capital expenditure and operations costs.

6. Discussion and Conclusions

The Palestinians are under many constrains from Israeli Occupier. They can not control their natural resources of energy. As the energy is a main commodity in human life and development, there should be another way to survive. In this text, the availability of GE as a source of energy and electricity generation source is discussed. It has been found that the Palestinian land is attractive for geothermal energy utilization. Two of the very high sources are in Gazza strip and north Palestine southern of Tabariya Lake. The geothermal energy can be used for different applications as discussed in the text in addition being an independent source of power.

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