

# Geothermal Energy: Definition and Its Applications

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## Abstract

The following study has served the definition of geothermal energy and its application in any sort of field in an extended manner. In the study, some objectives have been developed depending on the subject matter. Also, secondary data has been collected by following the qualitative method which are directly related with subject matter. Later on, all the data has been collected depending on the subject matter. Primarily in this study, geothermal energy has been depicted as the renewable energy source of the earth. Also, there are several types of energy sources that have been showcased as the core part of the study. The usages of geothermal energy have been represented and the benefits have been showcased in an appropriate manner. Renewable and clean energy is produced with help of these geothermal energy sources. Gravitation and friction pull is also managed by this particular thermal energy. Thermal energy plants always try to maintain sustainability and environmental factors. Radioactive isotopes are also used by thermal energy planets to generate electricity. Geothermal energy pumps are used to collect energy. Pollution is also mitigated to produce electricity with help of thermal energy plants. These plants allow the demand of electricity to be fulfilled globally.

## Keywords

Earth, Energy Sources, Geothermal Energy.

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## INTRODUCTION

In the discussion of renewable energy sources, geothermal energy is one of the greatest examples which need to be used in every workplace. Geothermal energy is a kind of heat that has been produced in the core layer of earth. Additionally, geothermal energy is clean and it is a renewable source that can be implemented for the use of heat and electricity in daily lives [1]. As a sustainable energy source, geothermal energy is an immensely used energy source which is expanding its demand day by day. The word geothermal belongs to the Greek word that is the mixture of two separate words, the first one is Geo (earth) and the second one is Therme (heat). As it is a type of geothermal energy, it produces heat in an unerupted way inside the earth. Generally, people implement the geothermal energy in regular deeds like, bathing, providing heats in the building construction and in the process of electricity generation.

As the nature friendly energy source, geothermal energy consists of the effectiveness of meeting the heat, cooling down and the energy source has been designed to keep the future demands in mind. Additionally geothermal energy belongs to the process of heat generation in the authentic formation of the earth and the decay of subsequent radioactive materials [2]. This thermal energy has been preserved within rocks and liquids in the centre of earth. The variation among the temperature of Earth's core and the drive of the surface is an unerupted consumption of thermal energy from the core of Earth to the exterior surface of the planet. For high temperatures in the core of Earth, some of the rocks get melted which is known as magma. Further, the geothermal energy preserved the rocks and fluids which can be seen from the narrow depths of the Earth's surface. It can

be stated that the geothermal energy is the preliminary energy source which has been used in all sorts of work in human lives.

## Objectives

The objective of the following study has been developed below-

- To investigate the concept of geothermal energy.
- To evaluate the source of geothermal energy.
- To identify the use of geothermal energy in daily life.
- To understand the application of geothermal energy in workplaces.

## MATERIALS AND METHODS

The following study has been surrounded over the topic of the definition of geothermal energy and its application and before evaluating the study; some important and reliable materials and methods have been selected and implemented for the study. In the following study, the data which has been collected are related to the subject matter directly. Also, data has been collected and executed by making focus over the subject matter. Further, there are some crucial speculations which have been maintained for selecting and executing the proper type of methodology for the study. There are several types of valid materials and methods that have been selected and evaluated for the study in a proper manner.

For the following study, the cross-sectional research design has been selected and implemented to provide betterment in the evaluation process of the given study. The reason behind selecting the cross sectional research design is to give a valid research process to the study. Furthermore, the data which has been collected for the study is secondary by nature. In the process of collecting the data, the qualitative

method has been maintained and followed in a proper manner. For the following study, the primary data has been excluded and secondary data has been included for the sake of the subject matter. All the data have been collected from authentic peer reviewed journals and the articles have been taken from recent time after the year of 2019. In other words, the study is filled with valid insights of the recent times which are directly related to the subject matter.

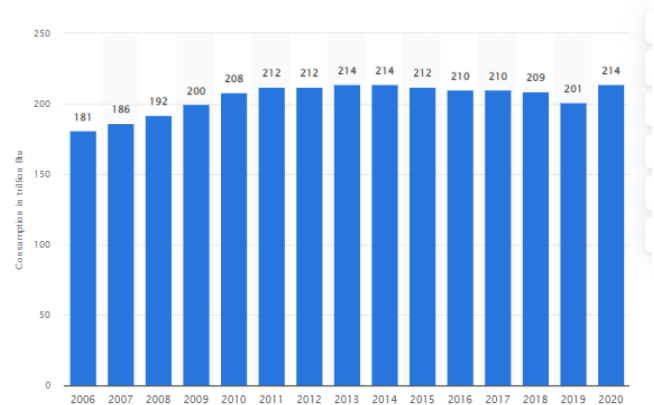
**RESULTS**

The geothermal energy has been implemented in a few countries for several years in daily life routine works like, cooking and heating the system in a certain way. Also, the geothermal reservoirs which consist of streams and highly heated water can be implemented generating electricity and other sorts of cooling and heating applications. Additionally, in these countries, the geothermal energy is the hierarchical energy source to survive everyday life in a proper manner. An instance of heating as a cooling process is always done by the geothermal heat pump which has been located 10 feet under the centre of earth [3]. For safety and to maintain the flow of water, the pipes of the pump have been filled with water or with a solution which is antifreeze. The inner water has been pumped around the closed pipe loops and thus, the heat of the ground sources pump system helps to retain the coolness of the buildings in the time of summer and regulates the temperature of warmth. Generally the process has happened by gripping the heat of earth as the water goes upwards in the building.

In addition, geothermal water has been implemented globally to make and grow plants in the greenhouses and for district heating in homes and manufacturing firms as well and it can also be piped under the paths for melting snow. In order to produce the geothermal sources in a massive amount, the underground reservoirs have been drilled to tap within the source of geothermal energy. However, the resources can be harmed by environmental causes like heat, collision of rocks, water permeability or with the help of an increased geothermal system. The geothermal system can create or increase the rate of geothermal resources with the help of a process which is called hydraulic stimulation. Hydraulic stimulation activates and regulates performance of a hydraulic system for large scale loading and ambient situations before construction of machinery [4]. In the underground water pressure, the hydraulic stimulation has been regulated by following Pascal's Law.

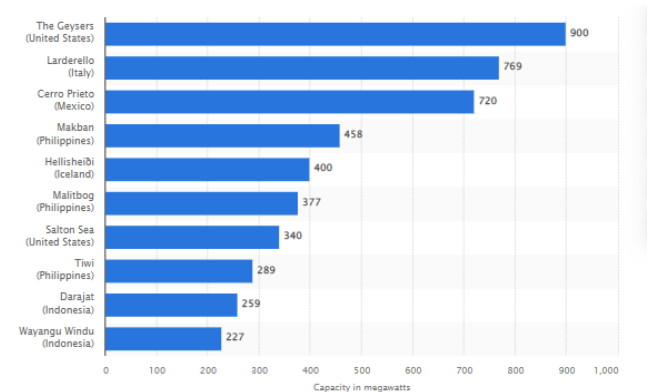
The regulation of heat energy has been found in the crust of earth which has a previous story about the making of Earth. When the ancestors implemented the geothermal resources to bath and cook and descendants implemented the energy by involving electricity generation and various types of industrial applications and districts as well. Rate of geothermal energy sources is continuously enhancing in every decade and in the year of 2021, the surpassed rate of geothermal energy is 15.6 Gigawatts [5]. Further, in the year of 2020, 214 trillion thermal units of reusable energy sources

derived from geothermal sources had been consumed in the United States and capacity of geothermal energy was 32 megawatts.



**Figure 1:** the initiation consumption of geothermal energy in the United States[5]

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**Figure 2:** Largest geothermal plants ranking around the world[6]

Geysers Geothermal Complex has been known as the largest geothermal plant around the world and it has been situated in the United States by holding 900 megawatts capacity. It also consists of plenty of power plants which have been ranged over thousands of kilometres and have been located in San Francisco [6]. The geothermal plants of the United States are also known to be the largest and highest installed geothermal power over the globe. For the low temperature of geothermal fluids, the effectiveness of

geothermal plants becomes low but, however, the capability tends to be high as it depends on a stable resource of energy unlike solar and wind. The geothermal resources have been driven to the turbine links to the electricity generators with both of its natural and natural and enhanced traits.

From the Palaeolithic age, the geothermal energy has been used for bathing. There are several ways of working of the geothermal energy within the daily life of a human being or in any sort of workplaces the geothermal energy has been implemented to get sheer amount of sustainability in the working process of a particular organization. First and initial way to use the geothermal energy sources is the dry steam which takes the stems from the breakage in the ground to remove the turbine in a direct way [7]. Also, flash plants intend to pull up the high pressure hot underground water and mix it with the low pressure cool water. As a result, it makes steam that has been implemented to drive out the turbine. Also, with the help of the binary plants, the hot water can be passed through a secondary fluid that consists of lower boiling point than water and that secondary fluid turns into vapour which drives a turbine. Additionally, there are most of the geothermal power plants which are commonly binary energy plants as they consist of secondary fluid.

Additionally, the united states are the biggest producers of geothermal energy and the United States consists of the largest development of the geothermal energy in the world and the geothermal plant's name is The Geysers. Despite the name, the water that has been used is steam in the plant but water [8]. Another crucial application of this energy is that as it creates heat from the core of the earth, it can be used in different kinds of fields. Construction of roads, agricultural development and the energy sources have been widely used in the industrial plants. Still others use the heat directly from the ground to provide heating and cooling in homes and other buildings.

Later on the heat of earth has been implemented to create Geothermal energy which is an impressive natural phenomena turning into technology. There are several natural sources of geothermal energy and the sources are as follows - volcanoes, fumaroles, boric-acid fumaroles ( $H_3BO_3$ ) and geysers as well. Several geothermal plants have been located in the United States, western states and Hawaii. The reason behind locating the geothermal energy sources in such zones is because the earth's surface is immensely close to these zones [9]. However California activates massive amounts of electricity from geothermal energy. There are several pros of using geothermal energy in the environment and as the benefits of using this energy, it creates one sixth of  $CO_2$  that has been emitted by neat and clean environment friendly natural gasses.

This energy is immensely cost effective and conventional which can be easily consumed by any sort of manufacturing firm. Certainly, geothermal energy is extremely sustainable and eco-friendly which promotes effective norms of sustainability. Unlike other energy sources which are renewable, the geothermal energy is available and budget

friendly from all aspects. Apart from all sorts of benefits, there are several types of drawbacks which are related to the application of geothermal energy. Firstly, the rate of production of the energy because, the availability of this energy is near the earth's surface. The areas which are located in the tectonic plate boundaries would not be able to produce geothermal energy. Also, the imbalance of temperature might be the reason for less production of geothermal energy. It can be concluded that, the area and the temperature both these are the greatest concern of the production of geothermal energy in an effective manner.

Heat produced in core of the Earth is known as geothermal energy. Renewable and clean energy is produced with help of these geothermal energy resources. Geothermal energy sources are effectively beneficial for producing heat and electricity globally. The core is about 2,900 kilometres (1800 miles) below the earth surface [10]. This surface is the hottest part of a planet. A small portion of heat comes from gravitation and frictional pull. Radioactive isotropic is also responsible for producing several types of geothermal energy globally. Vast majority of geothermal energy is produced with help of this radioactive isotropic. Several types of radioactive isotopes are available such as: thorium-232, potassium-40. Continual process in the core is also known as radioactive decay [11]. Heat from the core is radiating outward with help of geological materials, warming rocks, water and gas. Temperature of earth is also enhanced with help of this surface of care segments of the earth.

Geothermal gradient refers to gradual change in temperature. This geothermal energy is captured and used to generate electricity in global market. In recent days, everyone uses several types of electrical gadgets on a daily basis. For this reason, an ample amount of electricity is needed every day. This geothermal energy is effectively beneficial to fulfil demand of electricity globally. Any environmental substances are not disturbed to produce several types of geothermal energy. Sustainability and environmental factors are also maintained properly with help of these geothermal energy sources [12] several types of structures like: buildings, sidewalks and parking lots are heated by this geothermal energy. In order to create a stream, water is accessed by injecting and drilling this geothermal heat. Several countries try to maintain different types of processes for making geothermal energy and heat. Dependable and inexpensive source of energy is geothermal energy in global market [13]. Several types of geothermal energy are available in international market to generate electricity. This heat and energy are an easily accessible and safest option for everybody.

Heating and cooling process is maintained properly with help of this harvesting geothermal energy. Low temperature geothermal energy is a common source of heat in global market. This low temperature geothermal heat is available in a few metres below ground. Process of collecting this heat is effectively easier and also safe for using. Several types of homes, fisheries and industrial processes are heated with help

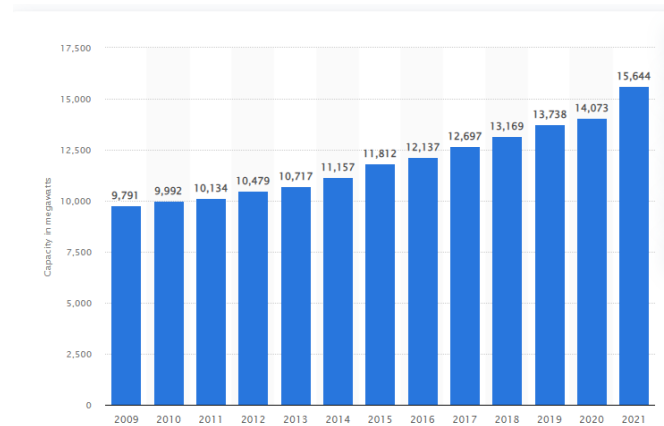
of these low thermal energy resources [14]. This low thermal energy heat is effectively beneficial to generate electricity in a significant way. Engineering, heating, cooking and comfort processes are also maintained with help of this low thermal energy procedure. Co-produced geothermal energy technology creates a positive impact to generate electricity. Water is heated as a by-product in oil and gas for using this co-produced geothermal energy. This is also a potential source of geothermal energy in global market. Modern technology is also helpful for portable energy sources and several types experimental stages are also engaged to improve isolated communities.

Advantage of this geothermal energy is that it can be used anywhere in the world. Geothermal energy pumps (GHPs) are drilled about 3 to 90 metres in earth surface to collect energy for using on a daily basis. A pipe is connected with GHPs to maintain continuous loop in underground and also ground. This continuous loop helps to circulate heat everywhere. In this framework, water and liquids move from here and there by this pipeline. During the winter season, these liquids totally absorb geothermal heat. This system helps to carry heat in upward direction and duct system can easily be heated with help of this geothermal energy. During winter season, this process works in a different way. Duct system collects heat from outside and transforms this heat to cooled underground. Electricity is also produced by this geothermal energy globally. As a result, dry steam power plants, flash steam power plants and binary cycle power plants are controlled by this energy system.

Geothermal energy plays an essential role to maintain sustainability and social responsibility in global market. Geothermal energy is effectively beneficial to generate electricity and also maintain financial growth of a nation. This energy is immensely eco-friendly to maintain environmental factors in an organised manner. Coal and other fossil fuels are creating more pollution globally. Hence geothermal power plant creates effectively low pollution globally. Usage of carbon footprint is totally mitigated by this particular power plant [15]. Emissions of greenhouse gases and other harmful gases are totally mitigated with the help of these plants. Environmental factors are not disturbed with help of this geothermal energy plant. Renewable energy sources are also useful to generate electricity in a significant way. Wind, solar, tidal and hydro energy is also used as renewable energy sources in this particular power plant. Turbines are used to generate electricity from wind and water. Dams and reservoirs are also used to change flow of water. These streams are immensely effective to generate geothermal plants.

Huge potential energy sources are also used by geothermal energy plants globally. Sustainable energy sources are advantageous for producing energy. Geothermal energy capacity helps to maintain financial and organisational performance and culture for a business activity. Installation capacity increases gradually on a daily basis, for this reason, several types of modern geothermal technologies are used for

global geothermal energy capacity. This capacity increases 15,644 Gigawatts in the year of 2021 [16]. This should be beneficial for each and every business activity to use geothermal energy in a successive manner.



**Figure 3:** geothermal energy capacity throughout the World

### DISCUSSION

Geothermal energy sources are stable and sustainable environmentally friendly plants in global market. Several types of renewable sources are used by these plants globally, solar and wind sources are mainly used by geothermal energy plants. Sunlight heat is a natural source of heat, for this reason everyone always tries to capture those heats and uses them. For this reason, sustainability and environmental factors are maintained properly. Geothermal energy capacity is also measured to produce electricity. Huge potential sources are used by these thermal plants globally to maintain their performance. Social responsibilities globally are managed with help of using sustainable products in a significant way. Tidal and hydro energy are used by these thermal plants in the international market to produce renewable resources. These thermal plants allow to maintain solar and wind energy for making geothermal sources. Emission of greenhouse gases and other harmful gases is also reduced from the workplace. In recent days, everyone uses electrical gadgets on a daily basis to maintain a healthy lifestyle.

Electricity is needed more for using electronic gadgets. Geothermal energy sources allow the production of sustainable and potential energy globally. This process is effectively cost effective and everyone can easily afford these thermal energy sources. Coal and other fossil fuels create a negative impact on the environment, by which the ecosystem is disturbed. Biodiversity cannot be able to manage properly by these thermal energy plants. Heating and cooling capacity is also enhanced with help of this thermal energy plants in the international market. Turbines are mainly used by these plants to generate electricity. In order to drive turbines, temperature of water needs to be near about 150 degrees centigrade [17]. Difference between ground and surface source is also used by this thermal plant in global market to produce electricity. During summer season, ground surface is more heated than air, for this reason, geothermal heat pumps



are implemented just two metres below surface. Reliable energy resources are also used by these thermal energy plants globally. These thermal plants allow to use renewable energy sources in an organised manner.

Fuel is not required for geothermal energy sources. Natural resources are effectively beneficial for these plants. These plants must take care to maintain waste management in the workplace. For this reason, this thermal plant can easily get their necessary materials in proper time. Speed and efficiency of work is controlled properly in market. Recycled and reusable products are also used by these thermal plants. Carbon footprint is not used by thermal plants globally. Modern and upgraded machines and technologies are also used by these thermal plants. Sometimes employees of these plants may not be able to use those new machines. For this reason, these individuals cannot be able to provide their better performance. In case geothermal plants enhance engagement of experienced employees in the workplace, proper strategy of work process can easily be managed by these experienced employees. Geothermal plants have a responsibility to identify the proper place for collecting energy sources. These sources are effectively beneficial for those plants to generate electricity. Several risk factors are also engaged in workplace to identify proper place.

Sometimes location is restricted in global market to find energy sources. Geothermal energy is always available everywhere. Geothermal energy plants will produce energy 8600 hours of energy within a year, solar plants will produce 2000 hours of energy in a year [18]. Rate of production of geothermal energy is more in the international market. The rate of production for these plants is constant in global market. Geothermal energy plants allow to make more predictable and plannable. Large space is not required for this particular plant. Wind turbines and photovoltaic panels are mainly used by thermal plants in an organised way. Silent working process is done by this plant everywhere. Several types of opportunities are given by these plants. Job opportunities are enhanced globally, by which everyone can easily maintain their lifestyle. Local and domestic employees are engaged in workplace to understand local energy consumption. Demand off market and customers are easily fulfilled with help of thermal energy plants.

### CONCLUSION

In this study, definition and applications of geothermal energy are critically evaluated. Sustainability and environmental factors are also managed by these plants in global market. Solar and wind energy are used as renewable energy sources. Turbines and photovoltaic panels are used by these thermal plants globally to generate electricity. Emissions of harmful gases are also mitigated by this plant to maintain sustainability and environmental factors. This energy is effectively cost efficient and the safest option to produce electricity. Demand of electricity is immensely high in global market; this thermal plant has a responsibility to fulfil those demands in a successive manner. Geothermal

energy plants allow the use of several types of natural resources globally.

Waste management of this plant is also managed with help of using natural resources. Experienced employees are needed to work in the geothermal plants. Relevant and proper work strategy is managed by this thermal plant. Heating of water, fisheries and building process is also controlled by this thermal plant. This thermal energy is easily available to produce electricity in a significant way. Several types of gases are released for digging the earth to collect energy sources. Earthquake related issues are also faced by geothermal plants by which environmental factors are also disturbed globally. Geothermal energy is immensely expensive, for this reason everyone cannot be able to afford these energy sources. Geothermal energy is the safest option to generate electricity.

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