Geothermal Energy

© 6 March 2015

By Lester Miller

Reprinted 2015

By ***Aquosus Potentia***

www.aquopotent.net

© 2015 by Lester Miller, reprinted 2015 by *Aquosus Potentia*, www.aquopotent.net

Outline

I. Geothermal energy
   A. Constant sustainability
   B. What it is, where it's from, and how it works
   C. While fossil fuels are being depleted daily, geothermal energy remains consistent and reliable.

II. What is geothermal energy?
   A. How is it useful?
      1. How is it obtained?
      2. What are the costs?
   B. Will it be the future?
      1. Readily available
      2. Precautions and production
   C. Is it safe?
      1. Safety
      2. Risks
   D. It can be said that safety regulations are extremely important due to the risks involved in obtaining geothermal energy. However, experimental expansion should take place to see if it is beneficial for everyday use of all people.

III. Conclusion
   A. Review
   B. While fossil fuels are being depleted daily, geothermal energy is consistent and reliable.

© 2015 by Lester Miller, reprinted 2015 by *Aquosus Potentia*, www.aquopotent.net

Geothermal energy is a direct energy source from the earth. It comes from natural decay of organic materials deep in the earth's crust. One can drill down through the outer surface and reach pockets of heat and steam. Once these pockets are located, a pipeline can be run down to that pocket to redirect this natural energy to the surface. Scientists have found several different ways to use this energy, such as direct heat. Because this energy comes directly from the earth, depletion is not a concern, thus making this energy source constantly sustainable. The fossil fuel system, on the other hand, has no way to replenish itself. The simple fact is once it is gone, it is gone. However, while fossil fuels are being depleted daily, geothermal energy is consistent and reliable. What is geothermal energy? How can it be useful? How is it obtained? Generally speaking, how much will it cost? Some truly believe that geothermal energy is the future in the energy industry. Is geothermal energy really readily available? Is it safe? These questions can only be answered by looking into safety regulations, precautions, and production. Maybe the risks involved are too great. However, fossil fuels are in high demand and short supply. So, do we really have an option? At the current rate that this fuel system is being depleted, it would not only be irresponsible to do nothing, but just plain foolish.

What is geothermal energy? "Geothermal energy is the flow of heat from the earth, coming from natural cooling and natural radioactive decay within the core" (Mink, 2006). This radioactive decay produces heat and in turn heats up everything around it. These radioactive materials are made of uranium, potassium, and thorium. The heat generated is so hot that it can liquefy solid rock. The temperature at the earth's core is around 6,600 degrees Celsius or 12,000 degrees Fahrenheit. For over 2,000 years, water has seeped through the layers of the

© 2015 by Lester Miller, reprinted 2015 by *Aquosus Potentia*, www.aquopotent.net

earth and stored in porous rock called aquifers. The heat energy in the earth heats these aquifers up hundreds of degrees and then forces it up towards the surface through channels. From here, it shoots out of the ground in the form of bubbling clouds of steam or as geysers. However, like steam from a shower, the more it diffused the less the concentration ("Geothermal Energy," 1995).

The first challenge in obtaining geothermal energy is locating a reservoir hundreds of yards underground. Once it is found, information is needed, such as temperature, pressure, volume, and chemical characteristics. After successfully locating a useful reservoir, the next challenge is managing it to ensure longevity. As an aid, "researchers from the University of Utah Research Institute are developing tracers to track thermal fronts" (Kenkeremath, 1990). Tracers are chemicals that are introduced into a reservoir and monitored to determine fluid movements, temperature changes, and chemical conditions inside the reservoir. The best way to tap into these reservoirs is also the most expensive, and that's by drilling. Fossil fuel companies drill through sedimentary rock, which is relatively soft. However, in order to drill into these reservoirs, one must drill through hot hard rock and corrosive fluids at great depths. These formations are generally made up of volcanic rock or granite. Drilling through these hard formations wears drill bits out very fast, making it timely and costly (Kenkeremath, 1990).

Most reservoirs do not percolate on their own, so pumps are a necessity. These pumps help to bring the fluids to the surface level and also help in the prevention of gas leaks. The main type of pump used is the line-shaft pump. However, in deeper reservoirs, a submersible pump is required. To date, the line-shaft pump has been the preferable choice over submersible pumps, due to cost and outstanding performance. Piping is a key factor in getting

© 2015 by Lester Miller, reprinted 2015 by *Aquosus Potentia*, www.aquopotent.net

those fluids to the surface. These pipelines, usually made of carbon steel, carry the geothermal fluids from the reservoir to the production site. These pipes must be placed in special arrangements to ovoid corrosion. Examples of these arrangements are on rollers or slip plates. These pipes must also have a protective barrier on them, covered in concrete, or laid in trenches. Due to maintenance issues, trenches allow for much easier access than do wrappings or concrete. This insulation is necessary to protect against loss of heat and waterproofing (Lund, 2010).

Scientists have found many uses for geothermal energy. Examples of these are heat pumps, greenhouse heating, agricultural, and industrial uses. Although there are plenty more uses for geothermal energy, these specific uses make up the majority of the total installed capacity. Heat pumps alone consume about 68% of this capacity. Presently, over 40 different countries have installed heat pumps. These numbers have increased from just under 30 countries in just ten years. Heat pumps have been successfully used from residential to industrial applications. Over 30 countries are now using geothermal energy applications for greenhouse effect. These countries use greenhouses to grow a variety of items, such as vegetables, flowers fruits, and trees. Due to geothermal energy, these operations have been able to lower operating cost in the form of manual labor. Greenhouse heating is now up to just over 3% of installed capacity. Agricultural use is almost at 4.5% installed capacity and is split up into two divisions: drying and pond heating. Crops being raised in geothermal environments have proved to be a major success. This also can cut cost almost in half. It has also allowed for a faster production. The use of geothermal energy has impacted almost every aspect of the agricultural business, from raising crops, to direct use in ponds, to indoor facilities for livestock.

© 2015 by Lester Miller, reprinted 2015 by *Aquosus Potentia*, www.aquopotent.net

The industrial capacity sits just over 1%. This is a very significant impact, considering all the industries world-wide. These industries are able to use geothermal energy and make products such as ethanol and bio diesel. Industrial plants are very large and consume a lot of energy. They can process geothermal heat for the use of curing concrete, bottled drink, and chemical extraction, just to name a few (Lund, 2010).

The initial cost of starting a geothermal energy system is a rather large investment. After everything is installed and in place, the cost annually is much smaller. Operationally and maintenance wise, the cost of a geothermal system is very comparable to a fossil fuel system. However, due to depletion, the cost for fossil fuels will continue to rise while the geothermal system will remain constant. Individually, the biggest problem with geothermal energy is the initial investment. In other words, how much one saves and how quickly one saves it may depend entirely on how great the use will be. On a large-scale, costs are greatly impacted because of consumption; compared to a small-scale, where consumption is drastically reduced, the return may not be suitable (Lund, 2010).

So, the burning question is whether or not geothermal energy is a viable source of energy for the future. According to Leland Roy Mink, Manager of the Office of Geothermal Technology, "the long-term potential for geothermal energy will depend on the success of engineered systems," (2006). There is reason to believe that the amount of energy that can be recovered from the geothermal system can be largely greater annually than the amount of energy consumed in a total year. The Department of Energy (DOE) is currently working hand in hand with the Office of Energy Efficiency in relation with the private sector to develop a way for the future of individuals to efficiently invest in geothermal systems. This operation is known as

© 2015 by Lester Miller, reprinted 2015 by *Aquosus Potentia*, www.aquopotent.net

the Geothermal Technology Program (GTP). The GTP is looking for cost-effective ways to implement this future technology into individual homes. The DOE is working with the United States Geological Survey to update new resource assessments. Exploration tools are also in the process of being updated, along with new and improved drilling techniques. Due to the fact that drilling in geothermal locations is very hot, tests will need to be conducted on the materials for the new drill bits. Also, of equal importance, they are looking for ways to make components cheaper without cutting corners and quality (Mink, 2006).

To consider geothermal energy as a readily available power source is a must. The earth is constantly breaking down radioactive materials at a rate that all the countries combined haven't come close to. Also, the geysers and volcanos are great conductors of geothermal energy with minimal or no drilling required at all. Likewise, because this energy source can be piped and pumped, it makes it easier to deliver geothermal energy to areas where it is considered undesirable to drill. This makes geothermal energy readily available to everyone. Another reason would be simply because the earth is full of renewable resources. Under our feet, deep in the ground, shallow in some places, the earth is made of tectonic plates that shift. When these plates shift, they can open up fissures, pushing this energy closer to the surface. However, whether deep in the ground or closer to the surface, with time and technology improvements, there will soon be no reason why everyone in every country couldn't have a way to access these resources (Lund, 2010).

Geothermal energy production follows four simple guidelines called phases. These phases are known as "phase I resource procurement and identification, phase II resource exploration and confirmation, phase III permitting and initial development, and phase IV

© 2015 by Lester Miller, reprinted 2015 by *Aquosus Potentia*, www.aquopotent.net

resource production and power plant construction," ("Annual U.S. Geothermal Power," 2012). There are currently about 700 projects in one of these developmental phases going on across almost 80 different countries. Due to this fact, geothermal energy is staying at a consistent rate of 4% to 5% internationally. A lot of countries have encountered problems with climate change and are opening the door to a new sustained and reliable energy source. Over the next three to five years, a prediction of large growth is to be expected as many countries are finalizing there current projects. Any geothermal energy plants that were damaged, due to inclement weather, are making speedy recoveries and catching up to speed. Because of the speed at which a few countries are moving in their developments, the U.S. may no longer be the production leader in geothermal energy ("2014 Annual U.S. Global Geothermal," 2014).

Unfortunately, drilling for geothermal energy does have the possibility and capability to trigger earthquakes. This sometimes happens because the earth's surface all the way to the core is very dense. The deeper one drills, the more pressure is released from the ground. Likewise, removing materials that are so deep underground, even from natural pockets, can cause the earth to shift. A major downfall in drilling for this energy source is that the more shallow the pocket, the more at risk for an earthquake. This is because these shallow plates are found around areas that have been proven to be seismically active. Another common downfall while drilling for geothermal energy is hitting pockets of gas. Sensitive ecosystems can also be compromised during the building of power plants and sub-stations, depending on size and location. S ince these plants are usually erected away from everything, this must be taken into consideration before proceeding to drill for future reservoirs. There are always risks involved

© 2015 by Lester Miller, reprinted 2015 by *Aquosus Potentia*, www.aquopotent.net

with every action, and these are just a few to consider that are directly associated with drilling for geothermal energy ("2014 Annual U.S. Global Geothermal," 2014).

Current regulations concerning geothermal energy may hinder its production on a large-scale basis. However, a company named Geoelec has made some propositions to try to limit or alleviate some of the negative aspects, while boosting and maximizing developments. A few of these barriers that need to be overcome is "uncertainties of resource ownership, environmental regulations, secured grid access, and public acceptance issues," ("Report on Geothermal Regulations," 2013). Some of the recommendations that were made are "clear definition of geothermal energy, national guideline licensing in English, non-redundant requirements, information required at appropriate stages, thorough expertise, and coordinates competent administrative bodies," ("Report on Geothermal Regulations," 2013). These regulations are extremely thorough in their entirety. These regulations include licenses, environmental issues, existing systems, and new systems, just to name a few. It is clear to say that the geothermal energy industry is under constant and heavy scrutiny. Unless someone is willing to bend, there is a strong possibility that we may never see the true possibilities of geothermal energy ("Report on Geothermal Regulations," 2013).

Anything worth doing comes with a certain number of risks. When the structure of the earth is changed in any way, for any reason, there are going to be ecological effects. Some of these effects may even be irreversible. Likewise, it is absolutely impossible to have the approval of everyone at any given time. This is an idea that might be called absolute approval. In today's society, we as a nation have become a green monster. The portrayed attitude of most people is that if something has the possibility of being damaged in any way, it is

© 2015 by Lester Miller, reprinted 2015 by *Aquosus Potentia*, www.aquopotent.net

unacceptable. Unfortunately, this attitude has been nursed to the point of being unbearable. At the rate our population is growing, we as a nation are going to have to start making some tough calls. The bottom line is that the way we are doing things is going to have to change. Safety regulations are in place for very important reasons. However, is there really a necessity to force us into a one-world energy source? I don't believe so. There should be boundaries set that are very clear and properly enforced. There should also be a set of guidelines that gives us a little freedom to preserve some of our non-renewable resources. One possibility to be further explored is on small-scale experimental expansion for residential homes. There seems to be no problem clearing hundreds of acres of land for new homes and shopping centers, which is a necessity. Likewise, flexible parameters and logical expansion of a completely renewable and sustainable energy source should also be undetested.

In conclusion, geothermal energy is a natural heat source that comes directly from the earth through the decay of radioactive materials. Some of its uses are direct heating through heat pumps, greenhouse heating for growing crops, and many agricultural and industrial uses. This is a very small list of the possible applications of geothermal energy. The way this energy is obtained is through the process of drilling. Once a reservoir has been opened, a pump is placed inside to assist in redirecting the flow upwards to the surface. From there, it is directed to whatever application is being implemented at its current location. The cost for a geothermal energy system requires a significant capital investment up front, with small annual and maintenance charges afterwards. The efficiency of the return on this investment greatly depends on how much energy will be consumed each year. Large-scale production uses find this type of energy system much more attractive than do small-scale productions. Geothermal

© 2015 by Lester Miller, reprinted 2015 by *Aquosus Potentia*, www.aquopotent.net

energy has been proven to be consistent, reliable, stable, and completely renewable. With this track record, it has the possibility to be the future in the energy industry. However, like all things, it comes with some risks. The possibility of causing earthquakes due to drilling and extraction of underground materials is a very serious concern. However, the earthquakes have been on such a small scale that drilling in remote locations should never be an issue. The biggest concerns seem to be with hitting pockets of trapped gases while drilling. Hopefully, with future technological advancements, these pockets will be well defined before a drill bit ever touches the ground, almost making this issue all but obsolete. Safety regulations are very important for every operation. However, if you remove oxygen from a fire, the fire will die. Between the government and safety personnel, they must find a way to loosen their grips on the reins, or geothermal advancements will be shot down before they ever get off the ground. This will be a major problem in the near future if they cannot or will not find a common ground. Again, while fossil fuels are being depleted daily, geothermal energy is consistent and reliable.

© 2015 by Lester Miller, reprinted 2015 by *Aquosus Potentia*, www.aquopotent.net

References

2014 annual U.S. global geothermal power production report. (2014). *Geothermal Energy Association*. Retrieved from http://www.geo-energy.org/global productions and development

Annual U.S. geothermal power production and development. (2012). *Geothermal Energy Association*. Retrieved from http://www.geo-energy.org/productions and development

Are geothermal power plants safe? (2015). *How Stuff Works*. Retrieved from http://science.howstuffworks.com/environmental/energy/geothermal-power-plants-safe.htm

Benefits of renewable energy use. (n.d). *Union of Concerned Scientists*. Retrieved from http://www.ucsusa.org/clean_energy/our-energy-choices/renewable-energy/public-benefits-of-renewable.html#.VRSdFeGy480

Geothermal energy. (1995). Interactive*. Earth Explorer.*

Kenkeremath, D. C. (1990). Harnessing the earth's heat*. World & I*, 296-303.

Lund, J. (2010). Direct utilization of geothermal energy. *Energies*, *3*(8), 1443-1471.

Mink, L. R. (2006, April). Renewable and alternative energy. Congressional testimony.

Report on geothermal regulations. (2015). *GEOELEC*. Retrieved from http://www.geoelec.eu/regulations

Schott, K. K. (2014). Geothermal energy in 2014: Emerging economies power up. *Business Wire.*

© 2015 by Lester Miller, reprinted 2015 by *Aquosus Potentia*, www.aquopotent.net