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The Analysis of geothermal operation cost factors

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ABSTRACT: In this paper, the main independent variables that can impact the running cost of geothermal industries are analyzed, and these analyses are aim at finding the relationship between the impacts and cost. For the first, the development situation of geothermal is deployed and some negative barriers of geothermal are listed. Then, the main barriers are defined and introduced with the lectures researches, the degrees and the reason that these barriers can make extra investment to the geothermal are analyzed. The analysis help finding a new way to solving and utilizing the ground energy and with comparison with current hydrid and steam geothermal features, ground source heat systems is proved that it indeed can help to solve the listed problems of geothermal. And the conclusion of the advantages of the new technology can be used develop geothermal in future.

KEYWORDS: Geothermal development, Geothermal barriers, New solution geothermal technology, New geothermal technology methods.

1 INTRODUCTION

Power plants such as dioxins,whilst needing to be considered in any environmental impact assessment necessary for a resource consent when developing a new plant,were not considered since they have relatively low importance(Ralph,2002).As the fossil energy be stuck in the problem of market prices increasing, the environment pollution limits becoming strict ,the renewable energy filed increase fast by the time of 30S of 20centrury(Ralph,2003). Geothermal energy like any others new energy technologies also get a out stand develop as it have captured 8000MW ,18% percents in sustainable energy contribution all over the world(Ingvar,2001). Any type of new technology energy equipment can have impacts on the environment, the differences just in the impacts degrees, but geothermal is the type that make emission most than any other type of renewable energy(Ladislaus,2003).Although it have help word cut more than 8000M tonnes waste ejections. Besides these, geothermal also face the financial and environments policies problem from the governments and market challenges from others new type of technology(Subir,2004). What is worse, the sharpest completive still from the low price and high pollution conventional fossil facilities.And these problems has come up with some negative barriers and made bad impacts to geothermal industry from 80s 20centrury(Hugh,1999). So these problems of geothermal energy make a gap that let the operates cost difficultly drop to the fossil power levels(Hugh,1999). The main five points that contribute to the extra high cost of geothermal should be pay attention and can be conclude from lecture researches as five highlight asides as below: position of land captured problem, problems of work conditions risk, poisonous pollution, problem of system investment and policy of economic and legal; For as short ,this five asides can be said as Position, Protection, Pollution, Profits and Policy, can be called as 'Five Peas'.

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Positons of land captured: Human beings have a long history for using geothermal, though the way we utilize the energy is very different form heat in ancient to electricity now. Though many towns and city locate besides the place that can get nature heated water in history, such as Etruscans, Romans, Greeks, Mexicans, Chinese, Japanese, and Maoris and other earth quake boundaries, but today many city locate the position far from geothermal source because of economic reason. So the location of geothermal always in remotes place in many countries(Ingvar, 1994). So this situation will make the energy transport cost increase more no matter transport the heat or electricity.Such as for American , the main geothermal energy distribute around and in the LOS ALAMOS mountains , so from 1970S to now time, the technics and cost to use energy situation still very complex.

Problems of work conditions risk: For the people and safe. The technology of geothermal alway have to draw hot water steam or gas from underground or lake bottom for generate the electricity(Ralph). But always electricity always come with all products embracing indigenous steam, hot water, and hot brine, gases results from water, acid gas, or other fluids artificially introduced into geothermal formation(Thomas, 1976). So the geothermal have to set the wash and filter process and pay money for wastes and promote the worker equipments for safe. All the methods fro prevent viperous hurt people, so like many factory, geothermal industry must invest much money to use and check the complete facilities and educate the advanced worker and engineer.

Poisonous pollution:For the surroundings, the protect attitude is very different from the problems of work conditions risks which focus on keep life safe. poisonous pollution always increase the cost from business and tax pay for governments. Because the waste should not emission to atmosphere and surrounding directly.And what is more these waste ingredient steam and water always can not go to the second terms for recycling refining and using(Ladislaus, 2003). So these consideration must be taken into consideration well or the industries may sulfur a series problems before start a process(Thomas, 1976).

Problem of system investment: Before a factory of geothermal start work, project investments in management must have a good estimate, because unlike traditional fossil and Hydro-Electric, the geothermal always low productivity, high investments so the profits always lower though as a sustainable project ,geothermal always have priority to use public and social support funds(THEODORE,1982). Further more, the investments also are compared with other type of new energy projects and the social requirements.Though both capital cost and operations and maintenance costs of geothermal power have declined substantially over the last decade, in light of this development, it is worthwhile assessing the overall cost of geothermal power today(Sayal, 2004).

Policy of economic and legal: government policy is the most complex part for cost. Because geothermal always use some trade estate from governments, what the governments are interesting in not the company benefit, but the location or nation benefit. For one acres which can use in geothermal always go into comparison that whether it can give more social benefit if use for refine minerals, Nature Preserve zone or business quarter in suburb, or it make residence life annoy(Robert D,1982).What is worse, like religiously in spired civil war, bad policy can lead industry's innovations or adverse trend for geothermal(Donald, 1982).So the policy can influent the geothermal cost in very deep level.

From the introduction above , the definition of 5P has been given, and all of them is just the main factors that can make the cost increase. So it is necessary to find the new models to solve them better, and make the society citizens and environments benefit from energy from under ground , also achieve the goals that government and business investors get double-win results.

2 RESEARCH METHOD

A new ameliorate skills use a contacting the contaminated steam with a nonaqueous sorbent to finish the acid wash process to protect the waste leak out from geothermal facilities.(Darrell L,1999).Also a scientist use experimental way to test a well-head technics to increase the economic advantages of geothermal and it also can prevent the systems from anti-corrosion and anti-fouling precautions (Kubiak,1988). Another groups have a test to detect the number of energy storage under the 100meters ground and try to design a series methods to increase the power of geothermal(Burkhard,2001). While a converter technology for ground source can practice a functions than transform the low temperature ground heat to high temperature, as a results this experiments can widen the land can be used for geothermal(Larry,1980).For more , a new production process which manufacture joint productions industry have been tried to increase the profits of geothermal(Tolga, 2009).

The methods illustrated above mainly are based on the experimental process to optimize the results, from this detections have been practiced. And all of this detection also focus on the five problems.Such as Darrell solve the waste gas process and promote the filter efficiency, so does Kubiak; And Burkhard and Larry try the new ground heat skills to generates

electricity;And Tolga introduce a different business way to manage the geothermal production.So from the research method analysis ,All coming up models should focus on the experimental and experiential way to solve the five problems.

3 FACTORS OF COST EXPLORATORY RESEARCH

3.1 ANALYSIS THE FIVE POINTS THAT CAN IMPACT COST

Though geothermal make a function that cut the emissions, but it has still many problem to solve in many sides, and also face big market challenge by far, so the negative difficulties should be paid attention. (Hugh, 1998).There are some asides need attentions.Because geothermal need special geology positions, so the construction and transport process need special extra cost(INGVAR, 1993). It is possible to make accident for people by the emission of geothermal and the unstable geological environments(Ralph,2002). And also for the environments, if it can get efficiency methods to deal the wastes, pollution also can be harmful with surroundings(Ladislaus, 2003).What is more, geothermal still stay in the disadvantage sides compare with conventional energy, so it is necessary to cut extra the cost(Grant, 2009).Last, government always is the factors that can impact the profit and market trends(DONALD, 2014).

It is really that we should not just agree the achievements that the geothermal have gotten, because there are still many problems make obstacles to it, or make it doubtable in future.There are enough data can prove that land limits can make most geothermal have to increase the survey cost and shrink the survey range(INGVAR, 1993).And also the accident in geothermal factory higher than other type energy,the threaten brought to workers is nearly in nuclear power plant.so company must use very accuracy way to operates. For the environment , the geothermal indeed can eject out the waste to the out surrounding so the waste must exhaust cost(Grant, 2009).Market judge always for any business so does geothermal, and geothermal also face the market challenge(Grant, 2009) And, policy always can lead the business situation of geothermal, so geothermal development need more government support to protect the environment (DONALD,2014).

3.2 POSITION OF LAND LIMITS

Geothermal are indeed very depend on the land position as the power of geothermal is far lower that fossil equipment, it still face the transmit power with long distance(INGVAR,1993).So it will increase the power waste.Besides, it may captured the commercial land or mineral land of business(Richo, 1997).So all this prove that before set a geothermal explorations are the most importance part of strategy plan, and it also need technology test for some years and pay the cost though some place can not be adopted at last (Bloomster,1975,Hui-Ming,2012), and also if the energy can be have a good way to convert into hydrogen and transport to far place ,but the process still in higher cost(Tolga, 2000).

Though land limit is the problem, but many professor give the advise to solve the problem, some agree the choice of land is important, geothermal can be chosen near the heat source also very near city ,or geothermal can be use for can make its production just for hydrogen and others pure elements come outs.what is more Richo also give warn that the place fit for geothermal also have more passibilities occur geologic hazard, so it need a numerous cost for construction and maintain safe.

3.3 POISONOUS STEAM RISK

As geothermal features, there are always toxic threaten which caused by the steam containing many elements for people and life who live or work around(Enrico,1997). So the safe filter and absorption facilities must always work in high status, so the cost will come high and but it is still a tough problems(Darell,1999).Not only operates a geothermal have risk, but also plan or construct a place for geothermal still need high risk works in special place(PETER,1982).All above is not guess, but it is fact that geothermal accident have happened many times around the world.

Geothermal is a sustainable energy that can cut emissions, but it still have risk about the wastes, for people and lives around the geothermal, it will be in dangers if the waste can not deal with the toxic steam well. So geothermal factory always keep high level for safe than any other type of energy factories.And also the risk not only in operates period but also in construct and design period. There have been some accident cause by toxic recent years, and also just in Italy there are 4,500 men work in geothermal dead with accident or chronic disease disease cause by geothermal toxic steam from 1950 until now.

3.4 ENVIRONMENT POLLUTION

At the renewable fields, geothermal is the one kind which can make the more pollutions when compare with others, because the heat transport process always have to make the gas containing the water discrete from medium then go to the air(Ingvar,1994).Geothermal indeed can cut the emission but it still have to emission gas though the value is lower than fossil(Ingvar,2001).The steam and water come out of geothermal always can make pollution if eject to the surroundings.So

geothermal need many technologies and procedure to deal with the wastes and pay the tax(PETER,1982). What is more except the air and water pollution, geothermal also can bring noise and land waste(Enrico,1997).

It is like some professors say that any type of energy can impact environment, what different just the degrees.(Ladislaus,2003). So geothermal also can make influence to surroundings though it is better than fossil and coals, what is more ,when it make wastes far less than conventional fossil equipment, it also can make wastes more than solar, turbine and etc(Ingvar,1994;PETER,1982).Besides this it also can make pollution can not be seen, such as land solid waste and noise(Enrico,1997).So this academic results which from experiences and test tell people geothermal is a kind of energy not so friendly with environments.

3.5 PROFITS OF INVESTMENT

Geothermal not only a public careers but also combined with business motivation especially under the market challenge from other types of new energy. So the disadvantages is the lowe emissions but high prices(Grant,2009).Though some one have methods that use geothermal generate hydrogen to increase the profits, but the series of facilities still need amazing investments(Tolga,2000). And also if take policies,sources and technologies conditions, the profits is tough problem to drop(Kubiak,1988).

Though the geothermal is achievements of technology, but the develop will be impacted by the market and government support. As the high price of geothermal electricity, the fossil still attract the stake stocks eyes and the investments of technologies need to be cut(Grant,2009;Tolga,2000). For the first ,just the stable requirements and policies that can make geothermal develop well(Enrico,1997).For the second, the decrease the new efficiency of new technology is the only way to cut the price and increase the benefit(Kubiak,1988).

3.6 POLICY OF GOVERNMENT

The policy for the geothermal not always good for it, but al the problem need to solve by the support policies from governante.During the factors beyond technics, the influence from local and nation policy and support even higher than market(John stone, 2010), because as environment career, government must give many boon policy that geothermal can cut some tax(Ingvar , 2001).But in fact, government should not always consider one industries develop rather than consider the whole society benefits. For government, geothermal just an alternative type energy that can benefit the environments.And also, sometimes, geothermal set in a land will incur doubt of residence. (DONALD,1982).Such for one lands, if it can create more employments, tax,it may be used for minerals(Robert.1982).

Government aims is not just benefits the geothermal, but aims to benefits all nations, so tax, federal laws, residence support will take into consideration though any one know geothermal is a stuff can be good with environments (Ingvar , 2001). But the problems it can bring to community also can make the plan stop(Robert,1982). What is more, government may choose other type of energy to take place geothermal if the facts permits.And also, the price challenge from the fossil and fuels still give new energy pressure include the geothermal energy though the government has give many policy to encourage them(Ingvar B,1994). So geothermal energy should take more advantages to get more support from society.

4 THE COST FACTORS DISCUSSION

From all explanations and evaluations we know that the Position of land , Protection of safe, Pollution of waste, Profits of investment , Policy of governments are reasons that main impact the geothermal operates cost. Position of land will increase the price of construct and electricity transport; Protection of safe will spend cost in safe facilities maintain and stuff education; Pollution of waste will let company pay extra cost and tax for environment; Profits of investments will determine whether the stake stocks profits and governments will support policy; Policy will increase the pressure from society.But from figure, we can see position, protection ,pollution can be solved by technologies , and even if the technologies can make geothermal environment friendly enough and the system cheap enough,these “five peas” problems will all be solved. So it is will be good that if we can use a kind of technics to utilize the ground energy with the way that no limits of land, no risk of safe, high profits for customers, not so independent with policies. It is will make geothermal develop better in future.

5 CONTRIBUTION AND NEW MODES OF GSHP

In recent years there is a new kind of cheap but powerful energy systems can use the geothermal energy within shallow surface of ground and also nearly zero emissions, it is ground source heat pump(GSHP). This kind of systems have many advantages than conventional geothermal.

"The underground in the first approx. 100 m is well suited for supply and storage of thermal energy.The climatic temperature change over the seasons is reduced to a steady temperature at 10-20 m depth, and with further depth temperatures are increasing according to the geothermal gradient(average 3 °C for each 100 m of depth)(Sanner,2001)."So the construct cost of the GSHP is very cheap, the construct requirement just dig bores within 10m of ground surface.The cost can be afforded by a common family.

"GSHP are one of the fastest growing applications of renewable energy in the world, with annual increases of 10% in about 30 countries over the past 10 years. Its main advantage is that it uses normal ground or groundwater temperatures (between about 5 and 30C), which are available in all countries of the world(Curtis,2005)." There is unlikely to be a potentially larger mitigating effect on greenhouse gas emissions and the resulting global warming impact of buildings from any other current, market available single technology, than from ground source heat pumps (Caneta Research 1999)."

The GSHP based work principle is very different the geothermal because there are two forms of heat transfer occur within the Earth:conduction and convection.Conduction transfer the energy between molecules internal verberation without the of mass. While the Convection is the common heat transfer process in liquids or gases from one place to another(Enricho,1997).So the work process of GSHP is totally different with geothermal.

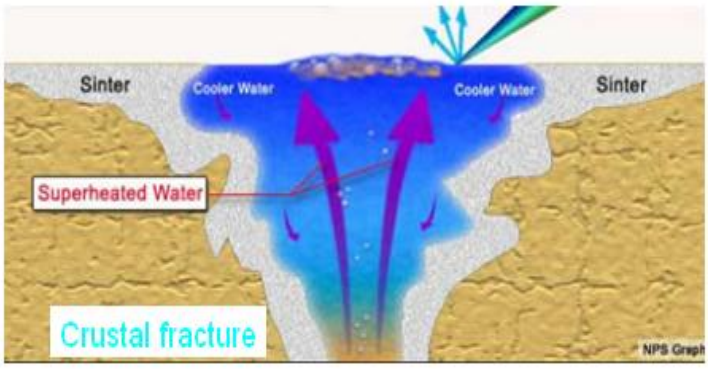

Fig. 1. The Mode of Heat Convection

Fig. 2. The Mode of Heat Conduction

So as ground is a kind of energy storage, and the energy contained by the ground can maintain normal ground surroundings' or groundwater's temperatures varying between 5 □ and 30 □ with the depths and latitudes(Trillat,2006). Due to the heat balance between the solar radiation and the mantle thermal conduction through the atmospheric transmission, the underground earth become a heat source at constant temperature. This feature can be utilized to construct a type of systems that can exchange heat from the earth to the evaporators with a heat pump and a couple of bores.

So far, GSHP (ground source heat pump) systems have increased to 8624MW(56% of global) in the U.S. Because it can operate at higher efficiency and no CO2 ejection compared with the conventional fossil power heat equipment; Moreover, compared with solar panels, wind turbines and tides hydroelectricity, GSHP can work without the limits of seasons and weathers(Sanner,2003).

GSHP system conducts heat with a couple of bores under ground which use water or air as medium. It can operates in

two modes. In the cooling mode, the pump rejects the hotter water to the ground earth from the evaporator in the room with one of the bores, and draws up the cooler water from under ground with the other bore, so it can make a cooling process(figure5 left). On the contrary, in the heating mode, the pump draws the hotter water from the ground earth to the evaporator in the room, and rejects the cold water to the under ground, so it can make a heating process. (figure6 right).

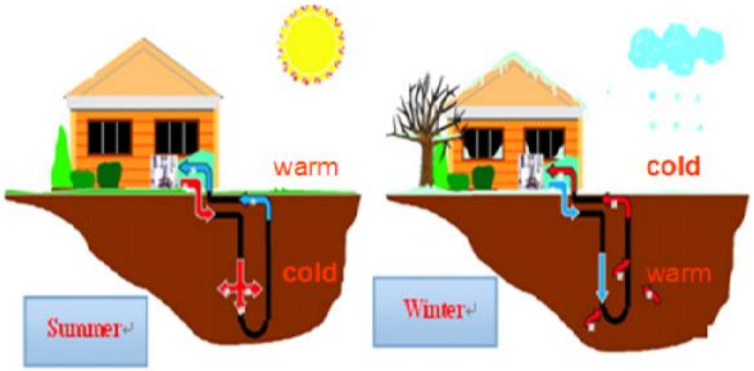

Fig. 3. GSHP Operating Modes

Though GHSP system still works with power pump, but the heat energy it can transfer are always higher than it exhaust. By the far, the highest efficiencies of this kind of systems can achieve 300% to 600%, it means that spend 1Kw•h powers can save 3Kw•h power exhaust at least.

So from the work theory and principle of the GSHP , it is not difficult to find that these new technology system can solve many problems of traditional geothermal. First, these systems can fit most kinds of geological environments, the bores can be digged anywhere ,no matter under school yard or a individual house, the depth always within 20m.Second, it no any emission, it work just with water as medium of heat transfer but the water volume no any exhausted when it work. Third,it no emission, so it is no any toxic things risk the thing need move away just the several kilograms of soil. Fourth, the investment scales always too much lower than geothermal, the most expensive GSHP for factory or greenhouse lower than 20thousands dollars, for residences family house always lower than 2000dollars ,but it have save 8624MW fossil energy by far.

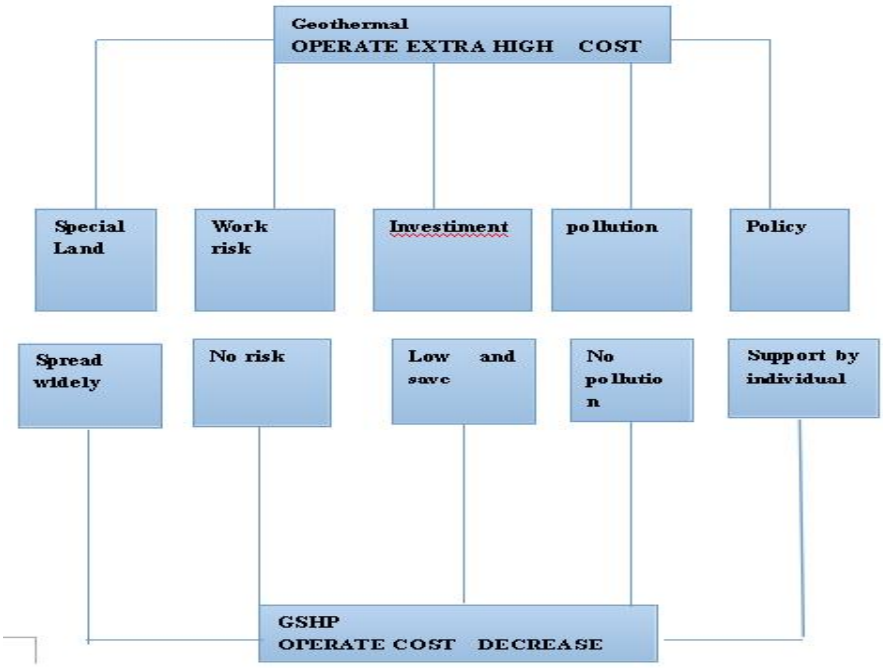

Fig. 4. GSHP Advantages Compare to Geothermal Disadvantages

Table 1. GSHP Advantages Factors

References	Variable and	Quotes
Sanner(2003)	Most of this market development took place, are such that by far the greatest demand is for space heating; air conditioning is rarely requested	1Market percents 2Market demands 3Space of heating 4Air conditions
Trillat(2006)	it can be seen that accounting for environmental factors is frequently a proactive act, motivation levels remain low in the general public	1Frequently proactive 2 motivation remain in public
Lund(2004)	The design type chosen depends upon the soil and rock type at the installation, the land available and/or if a water well can be drilled economically or is already on site	1Soil and rock type 2 The square of land available 3Water well
Hughes(2008)	The most important trade allies of the GSHP industry, electric utilities, today are better able to focus on peak load reduction and improved load factor, two key GHP system benefits, than they were in the past when restructuring was looming.	1 Electric utilizes 2 Peak Load reduction
Onder(2005)	Many variables must be controlled in order to provide the good environmental conditions. The most important parameters to be controlled inside a greenhouse are temperature, humidity and light. Especially, the temperature at night appears as an important critical variable to be controlled.	1 environment conditions 2 The temperature 3 Humidity

6 CONCLUSION

As lectures review and compare, five main reason and their relation to the geothermal extra cost cost have been found as bellows:

A : Position of land will increase the price of construct and electricity transport;
B : Protection of safe will increase cost in safe facilities maintain and stuff education;
C : Pollution of waste will let company pay extra cost and tax for environment;
D : Profits of investments will determine whether the stake stocks can get profits and governments will give support policy;
E: Policy will increase the pressure from society.

With the technology that have found are GSHP systems that use heat conduction to get energy from ground And also it can solve the problems that conventional geothermal with getting a glorious development after 2000year. And GSHP still have great potential power to cut the emission and benefit the society, environments, energy enterprise.

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