

## Geothermal Multiplier Benefits for Triggering Local Economic Growth

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### ABSTRACT

Indonesia has vast geothermal energy resources since the nation lies between the Pacific Ring of Fire and most of the resources, however, are located in the remote areas. Raise in public awareness and understanding of geothermal energy and its environmental benefits in Indonesia, have led to increase in electricity generated as well as direct heating uses from geothermal energy which have numerous socio-economic impacts on local economic growth. In Economically Distressed Areas (EDAs), for example, developments of geothermal resources have beneficial impacts by providing jobs to area inhabitants who might be unemployed, and by furnishing tax revenues as well as bonus productions from geothermal projects and small enterprises for improvements in area infrastructures, such as site accesses and schools. These multiplier benefits can help to stimulate economic growth and creates jobs, frequently in rural areas with few employment opportunities.

There are many success stories of the development of geothermal resource where it has triggered the local economic growth. In the United State of America, for instance, geothermal has major contribution to the economy, social, and environmental wellbeing through a broad range of values.

The impact of geothermal activities to local economic growth may be different from one area to another; yet, it may give huge local economic benefits by increasing electrification ratio, tourism, aquaculture, agriculture, horticulture, drying processes and district heating. This paper will discuss the economic impacts before and after of geothermal activities especially for local areas where the benefits multiply and should trigger local economic growth. In addition, benchmarking from different countries also discussed to give strong support to this study.

### INTRODUCTION

Indonesia has the largest geothermal energy resources in the world since the nation lies between the Pacific Ring of Fire. Based on MEMR's data, Indonesia's geothermal potential resources are approximately around 29 Giga Watt (GW) and spread over 324 locations. A huge amount of geothermal resources might be used to meet the "energy tri-lemma" – as reliable of energy supply, accessible and affordable of energy supply, and environmental sustainability (Bennett, 2014). The energy tri-lemma is crucial to the economic and social development of a country. Therefore, the Government of Indonesia (GoI) has attempted to increase generating electricity as well as direct heating uses from geothermal energy. As of today, total installed capacity hit 1,513.5 Mega Watt (MW) or 1.2 per cent of total energy mix. The generating capacity comes from nine (9) out of sixty-seven (67) geothermal working (concession) areas for

development (MEMR, 2016). In 2025, the contribution of geothermal energy is planned to rise from 1.2 to 4.8 per cent or 7,095 MW. This vision is mentioned by President of Indonesia, Joko Widodo, while attending the 21<sup>st</sup> Conference of the Parties (COP 21) in Paris, France.

Geothermal potential resources have a tendency to be found in remote areas with high unemployment rate. Developments of geothermal resources have numerous socio-economic impacts on local economic growth because it must be developed where the resource is situated (Kagel, 2006). In Economically Distressed Areas (EDAs), geothermal power generations have beneficial impacts by providing jobs to area inhabitants who might be unemployed, and by furnishing tax revenues as well as bonus productions for infrastructure improvements, such as site accesses and schools.

In geothermal industry, Power Purchase Agreement (PPA) is set for long term period; typically negotiate for 30 - 50 year agreements with State Own Enterprise (SOE). Consequently, geothermal activities provide multiplier benefits for indigenous people for decades and help to stimulate local economic growth and creates jobs, frequently in rural areas few employment opportunities. It is noted that, the impact of geothermal activities to local economic growth may be different from one area to another; yet, it may provide enormous local economic benefits by increasing electrification ratio, tourism, aquaculture, agriculture, horticulture, drying processes and district heating.

This paper will discuss the economic impacts before and after of geothermal activities especially for local areas where the benefits multiply and should trigger local economic growth. In addition,

benchmarking from different countries also discussed to give strong support to this study. Hopefully, this study would give an insight analysis where the development of geothermal resources would trigger many potential benefits for indigenous people and hence, local economic development.

## **1. GEOTHERMAL POTENTIAL BENEFITS**

A geothermal power plant promotes local and regional economic growth like any other types of power plants. However, one of the exclusive benefits of geothermal power generations is that, it facilitates sustainable development. Geothermal power plant provides long-term, stable, well-paid jobs (usually in remote areas), produces nearly zero air emissions and associated health impacts, and support local and regional economic developments through decades of reliable, consistent and renewable energy production (Kagel, 2006). Moreover, geothermal power generations support GoI meet the renewable energy target to increase share of production of energy from renewable energies for 23 per cent in 2025.

There are many applications of geothermal energy; some of them utilize the heat from earth just near the surface, while others applications require drilling miles into the earth. Geothermal energy uses at different temperatures is shown in Figure 1. The high temperature resources can be used for electricity generation; however, binary geothermal power generations may be applicable at moderate temperature resources. Lower temperature resource can also be used for heating the buildings, industrial processes, greenhouses, horticulture, aquaculture, public baths, pools etc. These wide range of geothermal energy uses can be classified into two (2) main classifications, namely indirect (electricity generation) and direct uses. Indirect and

direct of geothermal energy uses for triggering local economic growth are

explained in details in the following points.

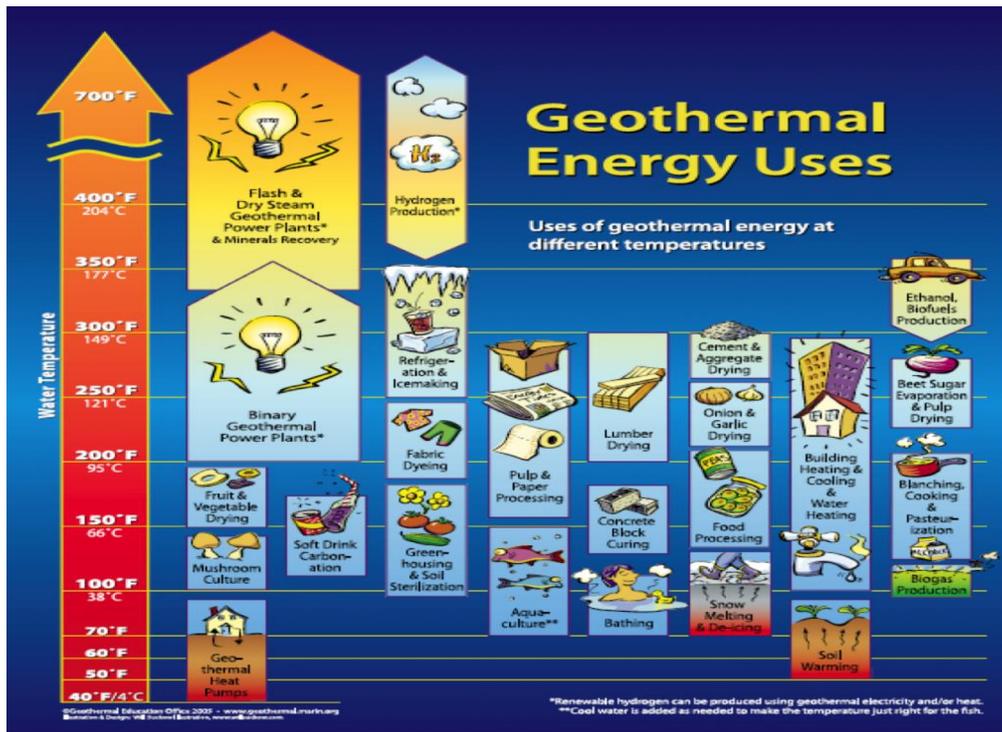


Figure 1 Geothermal Energy Uses at Different Temperatures (Geothermal Education Office and the Geo-Heat Center, 2004)

### 1.1 INDIRECT-USE APPLICATIONS

Geothermal electricity generation requires converting the energy contained within geothermal resources into electrical energy by allowing high steam's temperature into steam turbine then attached to the generator, or by transporting heat from geothermal fluid to a lower boiling points liquids, and then passed through a turbine. Electricity production from geothermal energy is normally used as base-load source of electrical due to a very high capacity factor (approximately 95 per cent) compared with other power sources (Luketina & Barns, 2011).

Development of geothermal power generations triggered local economic developments by increasing electrification ratio, creating jobs and providing tax revenues, giving bonus production and

improving infrastructures. Geothermal provides more, well-paid and long-term jobs due to the location of the project in the remote areas and long-run power agreement with the purchaser (Peterson, Widner, & Nelson, 2005). Therefore, electrification supply, jobs opportunity can be guaranteed for decades especially for indigenous people that living in the neighborhood closest to the geothermal activity.

In addition, various forms of taxes in geothermal industry and bonus production from geothermal for local government spur local economic growth. Recently, the Government has released Presidential Regulation No. 28 of 2016 on Allocating a Certain Portion of Bonus Production from Geothermal Projects to the Relevant Local Government based on Article 53 and Article 83 of Geothermal Law No. 21 of 2014

(Nah'R Murdono, 2016). The local government can use these funds to improve public facilities and infrastructures. Other than that, the resource developers often built a better site accessed (roads) to the power plants as well as offer Corporate Social Responsibility (CSR) programs that would be added-value for local economic growth. Therefore, geothermal power and electricity production can have real impacts that would be one of triggered factors for the development of local community. All geothermal potential benefits mentioned above are categorized as direct and indirect impacts from geothermal activities.

## **2.2 DIRECT HEAT- USE APPLICATIONS**

Direct-use applications of geothermal energy vary according to temperature of the resource, as shown in Figure 1. Normally, lower geothermal temperature resources (less than 150<sup>0</sup> C) are suitable for direct-use applications, even though some applications need a higher temperature. There are environmental, social and economic benefits from the use of geothermal heat directly from the earth that can trigger the development of local economic. These benefits are explained in details in the following parts.

### **2.2.1 Environmental Benefits**

Development and production of energies affects the environment to some degree, however, geothermal energy have less environmental impacts than any other type of energy sources. It is the fact that, development and production of geothermal energy have low Greenhouse Gas (GHG) emissions and air pollutants, low footprint, low visual impact, low noise impact, low ecological impact, and low surface impact (Bennett, 2014).

In direct-use applications, the environmental impacts lesser degree than large-scale, geothermal power generations. This can benefit local communities, agribusinesses, and small enterprises that need these resources, and thus promote local economic growth. According to Roy Mink (2004), the use of geothermal direct-use system for horticulture and aquaculture business, and other industries generally don't generate any more solid waste than any other energy resources. Therefore, all benefits mentioned above can be added-value to encourage local economic development.

### **2.2.2 Social Benefits**

Geothermal activity has an influence on economic growth in various ways, such as increase power supply, increase government revenue, reduce unemployment rate, extension of CSR programs, improve infrastructures and increase in tourism sector (Elizabeth, 2011). All these benefits are intended for public well-being that living in the surrounding of geothermal resources.

Social benefits are not easy to quantify qualitatively. Nevertheless, improved quality of life through refreshment and holiday are indicators to evaluate this matter. Geothermal sector gives various unique recreational opportunities for many people every year, attracting local and international tourists to the area. Therefore, developments of geothermal energy have multiplier benefits that will improve quality of life in the remote areas, and thus local economic growth can be achieved.

### **2.2.3 Economic Benefits**

Developing and producing power from geothermal energy benefits the governments in many ways. For instance, generating electricity by using indigenous renewable resources reduces dependence on imported energy, thereby tempering trade deficits

(Lesser, 1993). As a result, it keeps wealth and promotes healthier system economics. Moreover, taxes and royalties from geothermal activities paid by developers may be used to support and grow rural development.

Geothermal activities give revenue for small and rural communities. In direct-use applications, geothermal energy is applicable for a wide range of businesses. For example, residential – heating home; agriculture – glasshouse for horticulture and fish farming, industrial – timber dries kilns and commercial hot pool (Peterson, Widner, & Nelson, 2005). These businesses provide countless jobs for long-term period especially in rural areas with high employment rate.

## **2.3 EXAMPLES AND BENCHMARKING**

### **2.3.1 Hawaii, USA**

Water and heat from geothermal have been used in Hawaii for centuries. And at the present time, natural geothermal manifestations are being used for recreational and agriculture needs in Hawaii. Geothermal energy is one of the economy key factors in Hawaii, it can be understood because the power generation has been giving a stable energy supply and will continue giving prosperity in Hawaii (Battocletti, 2006). Predictable long-term electricity rates, and ensures that fewer dollars leave the state to purchase field and are instead available for other purposes within the island's economy. A strong local economy includes a vibrant visitor industry. The power generation has impacted the tourism industry that has increased significantly and contributed over \$10 billion in 2006 alone (Battocletti, 2006). Finally, and most essential to local economic growth is the use of low to medium temperature geothermal resources

that could be developed into thriving small local business including industrial processes, cold storages, aquaculture, greenhouses, to resorts and many others.

The power generation Puna Geothermal Venture (PGV) has significant impact to the economy by creating job employments with annual income, long duration full-time jobs with good salaries. In addition, PGV also has contributed to Hawaii through tax and royalties. In thirteen (13) years of operation, PGV has paid \$32.5 million for both tax and royalties. The existence of the geothermal power generation has decreased the imported oil and have estimated cut cost \$144.6 million since 1993 to 2006 (Battocletti, 2006). Every dollar saved from the oil cost translates to more money that can be used for the development of Hawaii. On the other hand, the environmental impact of using sustainable clean geothermal energy is decreasing the usage of fossil fuel as well as GHG emission. While it was estimated to have cut 2.5 million ton of CO<sup>2</sup> that is equivalent to 5.4 million barrels of oil. In comparison with the whole Hawaii's electric industry emitted GHG that is equivalent to burning 19 million barrels of oil. Moreover, the PGV also eliminate the risk of oil spills from ship fuel oil from the refineries

### **2.3.2 Waikato Region, New Zealand**

Geothermal resource is proven to play a significant role to the people in Waikato Region, New Zealand. In 2009/2010, geothermal resource in Waikato Region whether it is used directly or indirectly have contributed to the economy of the region especially to the Gross Regional Product (GRP) and employment. The direct impact from geothermal power generation has contributed \$56.9 million, and if combined with indirect and induced impact the

contribution is lifted up to be estimated \$155.4 million (Luketina & Barns, 2011).

Moreover, geothermal power generation and tourism are two elements that are compatible with each other. Geothermal power generation has the capacity to shape the value of tourism and a spatial increase in tourism may also impact the development of power development in the area. The direct impact to tourism has contributed in a range of \$38.5 – 70.5 million (Luketina & Barns, 2011).

Geothermal has major contribution to the economy, social, and environmental wellbeing through a broad range of values. The impact to the economy is it has created a Marginal Employment Count (MEC) just 80, and tourism has created an astonishing MEC of 1,298 – 2,501 jobs, although the part-time jobs may explain the significant number.

The impact to social is the direct usage of geothermal, which has been used for small industries such as drying processes, greenhouse, agriculture and domestic locals for commercial heating. Geothermal direct use and water have played an important role in the economy factor of Waikato Region especially the impact that created more job and the use of energy that produce low carbon emission. The survey showed that direct use has created 544 employments.

### **2.3.3 Kamojang, Indonesia**

If we take a quick look in geothermal development in Indonesia, Kamojang is one of few places that has successfully developed geothermal power generation as well as multiply its benefits thus impacted in an increase in the local economic growth. The benefits impacted because of the stable supply of electricity to 470,000 families as well as the use of clean energy that produce

low carbon emission (Zainuddin, 2016). In addition, the power generation has created many jobs and has contributed to local government through taxes, royalties, and bonus productions where the local government may be used for the prosperity of the local area. In the development of Kamojang power generation, massive infrastructure improvements have been made as well as CSR programs that Pertamina Geothermal Energy (PGE) has continuously implemented, both have created facilities that can be used by the locals and stimulate local economy growth.

The impact to social is the tourism and industrial processes. The impact of power generation in Kamojang has contributed in creating many facilities for example water (lake) attraction, cultural tourism, forest tourism, and indigenous village tourism (Zainuddin, 2016). Local tourism has slowly increased since geothermal development started. The facilities have been used for festivals that represent local customs such as ornamental sheep (domba-hias) and many others.

Furthermore, geothermal resource direct use has been used by industrial processes, for example, the use of steam for mushroom cultivation. Since the use of steam, mushroom production per day has multiplied, the business is also benefited because it has eliminated the use of Liquid Natural Gas (LNG). There are many direct use activities growing in the area such as roasting coffee beans and cultivating orchid flower. The potential for local economic growth in Kamojang is great and has many rooms for growth, with the encouragement of innovations there is no doubt that it can only make the local economy grow.

## 2. CONCLUSION

Indonesia has the largest geothermal energy resources in the world since the nation lies between the Pacific Ring of Fire and most of the resources, however, are located in the remote areas. Raise in public awareness and understanding of geothermal energy and its environmental benefits in Indonesia, have led to increase in electricity generated as well as direct heating uses from geothermal energy which have numerous socio-economic impacts on local economic growth. Developments of geothermal resources in Economically Distressed Areas (EDAs) have beneficial impacts by providing jobs to area inhabitants who might be unemployed, and by furnishing tax revenues as well as bonus productions from geothermal projects and small enterprises for improvements in area public facilities and infrastructures, such as site accesses and schools. All these benefits are intended for public well-being that living in the surrounding of geothermal resources.

There are many success stories of the development of geothermal resource where it has triggered the local economic growth, for instance Hawaii - United State of America, Waikato Region – New Zealand, and Kamojang – Indonesia. Development of geothermal energy in these areas have been giving huge local economic benefits by increasing electrification ratio, tourism, aquaculture, agriculture, horticulture, drying processes, district heating etc. Therefore, the use of geothermal heat directly as well as indirectly from the earth are able to trigger the development of sustainable local economic developments.

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