

# DEVELOPMENT IMPACT ANALYSIS OF JAILOLO GEOTHERMAL FIELD, WEST HALMAHERA, INDONESIA.

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## ABSTRACT

Star Energy was granted a license to develop Jailolo geothermal field in 2009. The Jailolo concession area is located in West Halmahera, in the North Maluku province of Indonesia. Based on the interpretation of a preliminary survey conducted in the Jailolo geothermal field it is estimated that it could have a power potential of up to 50 MW. A development impact analysis has been prepared as part of a Jailolo feasibility study, aimed at forecasting the impacts and benefits that would result if the project is implemented.

In order to supply electric power to a local area, the Jailolo geothermal field requires new infrastructure which would inevitably change the existing environment as well as affecting social and economic aspects of the local community. As a consequence of any geothermal project Star Energy will bring geothermal technology to Halmahera which has yet experience the use of this technology, for example to explore existing local resources available in the Project area. Thus, the Jailolo geothermal field development will also provide human capacity building in the use of these technologies. Because of the energy efficiency gains and the competitive commercial price compared to other energy resources, the Jailolo geothermal development will potentially raise public awareness of the benefits of the geothermal industry and assist with the reform of the utilization of energy resources. Furthermore, the Jailolo project will obviously generate revenue that will be subject to company income tax in addition to royalties to the government and thus will provide benefits to the general community. The development impact analysis concludes that the project generally will bring social and economic benefits to the local community. However, potentially negative impacts, which could lead to dissatisfaction in the local community, could come from the land acquisition, waste treatment and local labor recruitment activities.

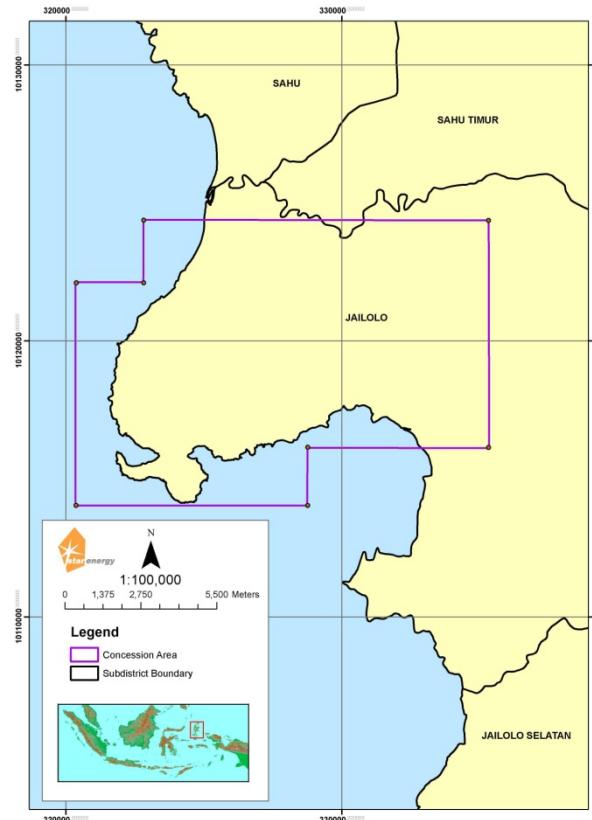
## 1. BACKGROUND

Jailolo is a remote rural settlement which has seen little commercial development. The Indonesia government's efforts to stimulate growth have generally been focused in higher population such as Java and Sumatra. However, the local government of the West Halmahera district, North Maluku Provinces of Indonesia wishes to exploit the available geothermal resource located in Jailolo for the benefit of the local population and country as a whole. One key aspect of this development is recognized to be the establishment of a quality electric power supply.

In 2007, the Ministry of Energy and Mineral Resources (MEMR) established the Jailolo Geothermal Resource as open for tender. After the tender process, a license to develop the Jailolo Geothermal field was granted to Star Energy in 2009. Based on the interpretation of the preliminary survey, the potential resources of the Jailolo

geothermal field that could be developed was assessed to be up to 50 MW.

A development impact analysis has been conducted as part of the feasibility study of the Jailolo Geothermal field development following the concession award and the preliminary survey. The purpose of the development impact analysis is to forecast all the potential impacts that may result if the project is implemented. Furthermore, the result of this development impact analysis will be considered in confirming whether or not the development of the Jailolo Geothermal Plant Project is viable.



**Figure 1: Jailolo Concession Area.**

## 2. INITIAL CONDITIONS

An Environmental Baseline Study (EBS) was conducted by an independent professional firm to determine the initial conditions of the project area. Information obtained cover the topics discussed below.

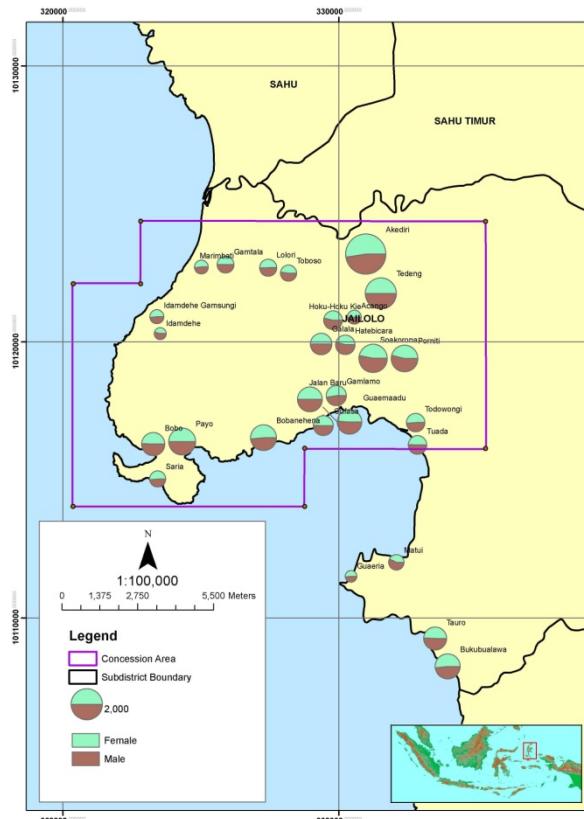
### 2.1 Population Overview

Jailolo is located in the district of West Halmahera which is in eastern Indonesia. This part of Indonesia is less developed and less populated than much of Indonesia. The findings of the 2010 census indicate that Jailolo is the most

populated sub-district in West Halmahera, with an average of 82.6 people per  $\text{km}^2$ . While this number is relatively high compared with its neighboring sub-districts, it is still considered in the low range for Indonesia.

The Jailolo population in 2010 was 28,812 persons. The population density ranges from 7 persons/ $\text{km}^2$  to 2,893 persons/ $\text{km}^2$  (Jailolo EBS Report).

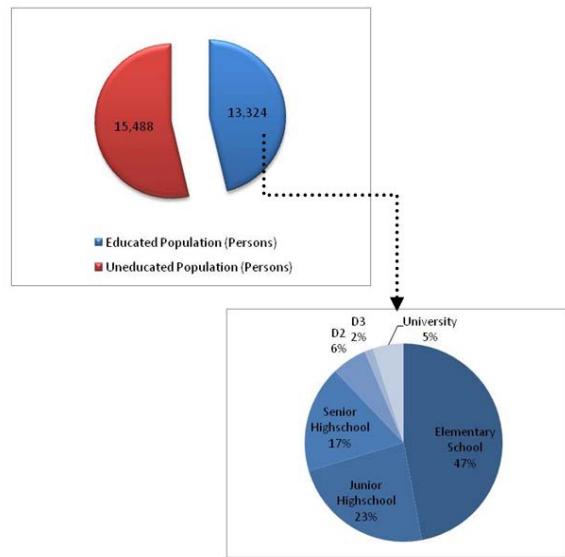
The population in Jailolo is not evenly distributed as shown in Figure 2. There are a total of twenty nine villages in Jailolo, circling Mount Jailolo. Villages with the high population density ( $>1000$  persons/ $\text{km}^2$ ) include Guaemaadu, Gufasa, and Jalan Baru, located in close proximity to one another on the southeastern side of Mount Jailolo. A large jetty constructed near these villages may explain the high density population of the area.



**Figure 2: Jailolo Population Distribution Map in 2010.**

## 2.2 Education

From the most recent data available, in 2010, approximately 13,324 people or 46 % of the Jailolo population have formal education (Jailolo EBS Report). Most have only reached a senior high school level of education. A relatively small proportion of the Jailolo population have a higher education at the level of a Diploma Program or at University level. The Diploma Program is a basic educational program following on after Senior High School that prepares the students for entry into the workforce. usually a 2 or 3 year program. Since data containing the percentage or actual number of educated and uneducated in each village is unavailable, further useful analysis was difficult to carry out.



**Figure 3: Percentages of the Formally-Educated Population by Level of Education in 2010.**

## 2.3 Economy

Jailolo's population comprises farmers, fishermen, civil servants, and entrepreneurs (self employed). The majority of Jailolo's population work as farmers since there is little alternative work opportunity. The main commodities are cloves, coconuts and nutmeg. Farming itself is largely subsistence, informally organized. There are employment patterns that can be noted which are logical for such an under-developed area. Civil servants and entrepreneurs are most prominent in villages southeast of Mount Jailolo, while fishermen are located in villages along the coast.

The existing natural resources in West Halmahera provide significant potential for tourism development. Aesthetically pleasing scenery of Jailolo Mountain, hot springs, mangrove areas for outdoor recreation and the unique local culture are all potential tourism attractions. Scenic dive sites located in Jailolo Bay may also be included as an attraction for Jailolo tourism. The local government has commenced promotion of tourism in Jailolo by holding an annual event, the Jailolo Bay Festival (Festival Teluk Jailolo), a three-day event involving various activities such as dance, music and art performances, traditional ceremony, and local food tasting.

Several factors which may deter tourism development in West Halmahera include lack of adequate accommodation, availability of tourism infrastructure, poor roads, and lack of public transportation.

## 2.4 Culture

The Jailolo population consists of various tribes. The Sahu ethnic group dominates rural areas, while coastal villages are dominated by the Ternate ethnic group. In general, people in the village use Bahasa Indonesia as the language of instruction (EBS Report).

In 1999-2002, there was an ethnicity and religious-based conflict, causing major population displacement in Jailolo. There was significant damage to material, lives and relationships. As of the mid 2000's, there has been no significant reports of conflict and it is widely perceived the

different cultures are no longer in conflict. Further evidence of the current relative conflict-free state has been the acceptance of new tribes arriving to the Jailolo area by the native tribes. Relationships have improved, however, much of the population which left during the conflict has not returned.

## 2.5 Public Health

The state of public health can be observed through the occurrence of various diseases spread within a community. From 2008 through 2012 data has shown that the three diseases that most often affect the Jailolo population are Acute Respiratory Infections (ARI), malaria and diarrhea.

Approximately one half of the Jailolo population suffers from Acute Respiratory Infections. Based on an interview with the Health Officer in West Halmahera carried out by the EBS team, it can be concluded that the high number of people suffering from this sickness is primarily due to poor sanitation, poor ventilation in local housing, bad habit of spitting and therefore the spreading of disease in public places, inhaling carbon monoxide (CO) and hydrogen sulfide ( $H_2S$ ) (caused by poor ventilation).

## 3. DEVELOPMENT IMPACT

The development of a geothermal power plant in Jailolo will potentially change the existing structure and landscape of the environment having an impact on the areas discussed below.

### 3.1 Infrastructure

The development of the Jailolo geothermal field is aimed at supplying electric power to the local area. Therefore new infrastructure will be required during the development process, including civil works (access roads and jetty construction), utility interconnect, steamfield development, power plant, transmission and distribution system, monitoring and control systems, as well as temporary facilities for construction. The plant infrastructure might be located near Idamdehe village depending on the results of exploration. The project site will be developed in stages to accommodate the increasing power demand. The power plant is expected to use a single flash condensing type steam plant. During the exploration phase, some well pads will be constructed to accommodate exploration wells drilled to confirm the resource. It is expected that the initial wells can produce sufficient steam for generating the current power demand. The total land requirement for the whole Jailolo geothermal plant development was estimated to be about 48 ha for the power plant and transmission line and 25.5 ha for the SAGS.

The land procurement for the Jailolo geothermal plant development could potentially make some local residents lose all or a portion of their livelihood. It also will possibly evoke public protest if the land compensation is inappropriate. Therefore, the local government has formed a specialised workforce consisting of representatives of local government, villagers, NGO and heads of the tribes to smoothly communicate and execute the land acquisition process

The mobilization of construction heavy equipment may result in traffic disruption and thus coordination with the local community will be essential. Experience has shown

that construction traffic can be an issue with local villagers, and so initial planning and special care will be devoted to this matter.

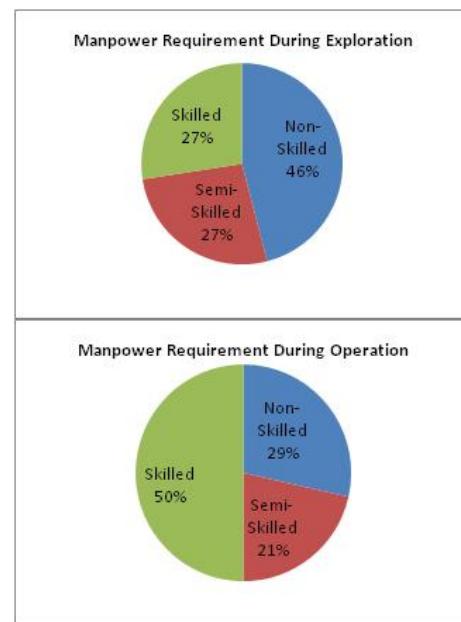
Primarily there is a risk of negative environmental impacts due to the noise, dust, changes on land cover, use of water in large quantities, waste treatment and sewage discharge during construction and drilling activities. Standard procedures have been established, as formalized in the environmental impact assessment, to avoid, reduce or mitigate such impacts, but some disturbance of the local environment will be inevitable. Any physical impact which is caused will be remediated, repaired or compensated for, but it will be critical to ensure that the local community is aware of what can and will happen.

It will be essential to ensure that strict implementation of environmental guidelines is achieved. Adequate training and implementation of safety procedures will be essential to meet this objective.

In spite of this, the local community will benefit from the infrastructure improvement related to the development of the Jailolo geothermal plant. The significant increase in the capacity for electricity production resulting from the construction of the geothermal power plant will allow many sectors, such as tourism, small or medium industry, medical health, education and socioeconomic to improve.

### 3.2 Human Capacity Building

The Jailolo Geothermal Power project will create new job opportunities, both temporary and permanent in the local area. Star Energy plans to promote the hiring of local labor during each stage of development in order to introduce the geothermal industry to the local community. This is an integral element of Star Energy's Corporate Social Responsibility Program. An estimated total of over a hundred employees will be required in the exploration stage and over thirty employees will be required for power station operation. The percentage of the manpower requirement based on skill is shown in Figure 4.



**Figure 4: Percentage of Manpower Requirement Based On Skill.**

By referring to the present condition of local education, it can be inferred that Jailolo lacks skilled labor since only a relatively few people have higher education (university or diploma level). Due to the unavailability of skilled labor, initially the actual number of local people hired will be limited. Star Energy will reserve non-skilled positions for local labor and will use available, suitably-skilled, local labor for semi-skilled positions.

While Jailolo is lacking in skilled labor in the geothermal industry, training programs will be set up to provide the local community with the opportunity for structured learning in a practical work situation. To develop the technical aspects of the Jailolo Power Plant operation and maintenance activity, an Engineer Apprentice Training Program shall be implemented as well as a Operation and Maintenance Training scheme. Star Energy also will support further education at the university level for selected key staff. Safety Training will be an on-going activity and will be conducted for each employee, especially thoroughly for those who work in the field. This training is aimed to provide a safe and healthy workplace for all employees as one of the ways to achieve a "ZERO HARM" outcome.

In addition to increasing job opportunities in the geothermal industry, the development of the tourism sector and plantation sector, as the non-power applications of geothermal heat (direct use), can bring business opportunities which in turn will create jobs for the local community as well. The increasing number of career opportunities within the Project area will decrease the number of unemployed people as well as increasing the average income of the local residents.

### **3.3 Technology Transfer**

Star Energy will bring geothermal technology to Halmahera, which has yet to be exposed to this technology. The development in Jailolo will use groundbreaking technologies in each phase, from the geoscience study, exploration and development drilling, and engineering and construction of the Jailolo geothermal power plant and supporting facilities. Based on experience in other areas in Indonesia and around the world where geothermal development has taken place, significant direct and indirect opportunities will arise to benefit the local community.

The Jailolo geothermal power plant will significantly increase the local capacity for electricity generation which will lead to the development of small and medium industries within the local area. In addition, industries that use the power generated from the geothermal plant will take advantage of a reliable source of energy that can be crucial for operational sustainability. At present most industries in West Halmahera rely on their own diesel generators or the electricity distributed from PLN's small diesel generators that run in the area.

Geothermal energy generated from the power plant will replace the existing electricity plant which is diesel-fired and which provides an intermittent and inadequate supply. The existing diesel-fired power plant is also more expensive to operate and more polluting than a geothermal power plant. Thus replacing the existing diesel-fired power plant with a geothermal power plant will reduce the greenhouse gas emissions and increase the energy efficiency.

The geothermal power plant will expose the domestic market to different technologies and grow capacity for

dealing with these technologies. The technology transfer will not be limited to the geothermal industry. The skills taught for building and operating a geothermal project are required for many businesses. A significant benefit will be the improvement in education of the local people, with the resulting potential improvement in lifestyle.

### **3.4 Potential Market-Oriented Reform**

Geothermal development in Indonesia has been intermittent over the years due to lack of incentives and poor or non-existent government laws and regulations. This has changed in recent years, commencing with the creation of a Directorate General under the Energy Ministry responsible for the implementation of "new and renewable" energy, which includes geothermal, wind and solar. In this regard the development of geothermal energy is being given the highest priority to be implemented quickly. To reinforce this, more acceptable electricity tariffs have been introduced to incentivize investment, with the consequence that many geothermal concessions have now been tendered for and awarded. To support geothermal developments, the government is also drafting legislation to introduce a "feed-in" tariff, which in other countries has greatly increased investment. The development of the Jailolo project, which was one of the first geothermal projects to be offered for competitive tender by the Government, is helping to demonstrate a path for effective geothermal development. This experience will assist the Government to improve the current geothermal regulations to better support geothermal development in Indonesia.

PLN's official costs of US¢ 25.7 per kWh to supply local electric power should be compared to the tariff of Rp 1727.54 (equal to US¢ 18.77/kWh at the current currency exchange rate) proposed by SEGH. This illustrates the potential for reducing PLN's costs. The lower cost in term of energy generation than from other power plants, adds more value to a geothermal power plant because of the competitive commercial pricing for electric power it offers.

The implementation of the Jailolo Geothermal field development plan will be an example of the effectiveness of pushing the development of renewable energy, incentivized by a transparent and competitive measure to encourage geothermal and electricity development in Indonesia, based on Geothermal Law No. 27 of 2003 and Government Regulation No. 59 of 2007.

The implementation of the Jailolo geothermal power plant development may raise public awareness of the beneficial impacts of the geothermal industry and boost private sector investments in geothermal projects. Also, the availability of good electrical power supply will encourage investment in many other business areas, in particular tourism.

### **3.5 Potential National and Local Tax Revenues**

The Jailolo project will generate revenue that will be subject to tax which, with royalties paid on the production of geothermal energy, will contribute income to the government, both at local and national level thus providing benefits to the general community.

#### 4. CONCLUSIONS AND RECOMMENDATIONS

The impact study of the Jailolo geothermal development has shown that the majority of the impacts are positive, with several potential benefits accruing to the local communities. They will be wide-ranging, from a simple increase in taxable income, to new skills development for local workers, and commercial opportunities for many. These benefits are likely to be long lasting, continuing through all the years that the geothermal power plant is operational.

Recommendations from the study follow the assessment of impacts. Impacts may not all be positive, and careful management will be required to avoid some negative impacts. The project must be implemented in accordance with industry best-practice and in full compliance with the laws and specific permits issued for the development. Star Energy has a culture of implementing formal management systems which are independently audited and certified, and adherence to this principle is recommended to ensure that there will be an independent overview of the key aspects of the management of the development.

#### ACKNOWLEDGEMENTS

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