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An Opportunity to Develop Industrial Cluster Based Geothermal Energy to Improve Local Competitiveness of North Maluku Province – Indonesia

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ABSTRACT

The Government of Indonesia has announced the Master Plan for the Acceleration and Expansion of Indonesia's Economic Development (MP3EI) in May 2011. The Papua-Maluku Islands Economic Corridor in the 2011-2025 MP3EI raises a central theme of development, i.e. the development of the national food security, fisheries, energy, and mining. North Maluku Province has the potentials of abundant resources, including geothermal energy, nickel, copper, coffee, coconut, cloves, and fish. The processing and utilization of that resources could be made with the development of an industrial cluster based geothermal energy which is geothermal energy as the source of electricity for the needs of the industry (e.g. smelter industry) and as a raw material in other industrial processing (e.g. dry fish industry). This paper will discuss the formation of the cluster strategy, starting from analyzing the local advantage, technology development, human resources, government policy, long-term commitment and prominent leadership.

1. INTRODUCTION

Indonesia has a geothermal potential of about 29 GW scattered along the volcanic line and is supposedly said to be a country with the largest geothermal potential in the world. However, there is only about 1,343.5 MW or 4.6% of this potential utilized for the supply of electricity (Tisnaldi, 2013). So far, there have been no geothermal resources utilized in North Maluku Province, while on the other hand, electricity is supplied by fossil energy with higher base price than electricity tariff.

In the 2011-2025 MP3EI, the Papua-Maluku Islands Economic Corridor raises a central theme of development, i.e. the development of the national food security, fisheries, energy, and mining. In general, North Maluku Province has the potential of abundant natural resources including nickel and geothermal energy. Nickel can be found in Weda, Central Halmahera Regency. The biggest challenge in the acceleration and expansion of nickel mining activities is to create downstream industries of this nickel mining, especially in refining the result of nickel production. Indonesia has not been equipped with the nickel refining facilities. In fact, refining activities provide significant added-value. Meanwhile, the local geothermal energy can be managed as a source of electrical energy for the development of the mineral refining industries.

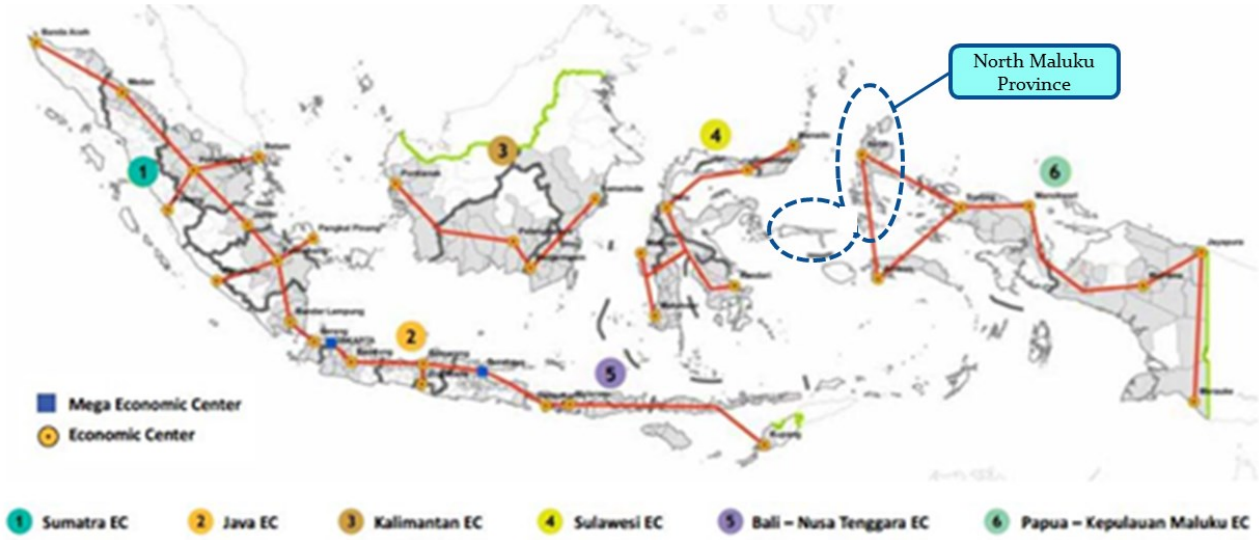

Figure 1: Economic corridors (MP3EI, 2010)

The development of industrial clusters is considered as an effective alternative approach to building a competitive advantage for the industries in particular and the region in general. The current increased regional competitiveness requires a totally time-consuming effort that would hamper economic development. In order to solve this weakness, optimize the utilization of the local potentials and establish local industries with a competitive advantage, production and distribution bases are necessary to be reorganized and developed in synergy with increasing reliance on the best potential and local characteristics of respective regions. The concept of

industrial clusters is an alternative considered appropriate the context of the evolving dynamics of change and diversity in the characteristics of regions in Indonesia, especially to mutually support the MP3EI program.

2. THE INDUSTRIAL CLUSTER APPROACH

2.1 Porter's diamond model

A cluster can be defined as a group of interconnected firms and institutions in a particular field present in a particular location (Porter, 1998). Over the last decade, different models have been developed to study clusters. Porter's diamond model is the result of a four year study based on observations from a multitude of sectors in ten countries.

The diamond model (Figure 2) proposes four interrelated facets, each of which representing a determinant of regional advantage: (1) firm strategy, structure and rivalry; (2) demand conditions; (3) factor conditions; and (4) related and supporting industries. "Chance" and the "government" are two factors that influence these four determinants, but are not determinants themselves. Together these six factors form a system that differs from location to location, thus explaining why some firms (or industries) succeed in a particular location. Not all six factors need to be optimal for firms or industries to be successful.

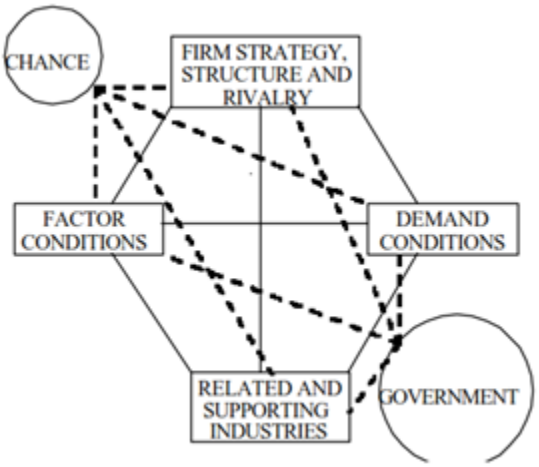

Figure 2: Porter's diamond model (Porter, 1998)

The bi-directional influences between all factors create the dynamics of the system and also point to ten relationships that could be investigated. The dynamics of the system are not spread evenly over an economy but concentrate in clusters in industries which have reached the highest level of competitiveness and productivity.

Factor conditions

Whereas the traditional trade theories define factor conditions as land, labor and capital (including human capital), Porter (1998) distinguishes between the following categories: human resources, physical resources, knowledge resources, capital resources and infrastructure. Factor conditions are further subdivided into basic and advanced factors that can be either general or specialized. Basic factors such as unskilled labor, raw materials, climatic conditions and water resources are inherited and require little or no new investment to be utilized in the production process. Advanced factors are created and upgraded through reinvestment and innovation to specialized factors, which according to Porter form the basis for the sustainable competitive advantage of a country.

The standard trade theories also recognize that there are many different resource explanations of comparative advantage. As explained, even the new trade theories of monopolistic and oligopolistic competition that challenge the orthodoxy of comparative advantage and free trade do not invalidate the theory of comparative advantage. In trade theory, the underlying resource differences between countries still determine the direction of trade flows and thus a country's relative location advantages that lead to gains from trade. The fact that Porter uses a colloquial style based on logical reasoning (which is easier to understand) rather than mathematical models to explain factor conditions thus does not invalidate the standard theory of comparative advantage.

Demand conditions

Demand conditions in a country are also perceived by Porter (1998) as a source of competitive advantage for a country. Demand as a factor explaining trade is not new. Porter, however, focuses more on demand differences than on similarities to explain the international competitiveness of countries. According to him, it is not only the size of the home demand that matters, but also the sophistication of home country buyers. It is the composition of home demand that shapes how firms perceive, interpret and respond to buyers' needs. This forces home country firms to continually innovate and upgrade their competitive positions to meet the high standards in terms of product quality, features and service demands. More specifically, Porter (1990a, 1998a) regards the essential conditions of demand as: a home demand that anticipates and leads international demand, industry segments with a significant share of home demand, and sophisticated and demanding buyers. However, different demand conditions in countries, leading to different demand structures, can determine location economies of increasing returns, as explained by the new trade theories. Location economies of increasing returns that keep an industry in a specific location, due to a specific set of demand conditions,

will be difficult to be competed away by industries in another country. In such cases, comparative advantage is determined by demand conditions rather than differences in factor conditions.

These demand conditions, as explained by Porter, do influence the underlying resource differences between countries and a country's relative location advantages as explained by the new trade theories. The nature of the differences in sources, driven by demand conditions, could be productivity differences, differences in factor endowments or differences in the scale of production (Siggel, 2006). The differences in sources, irrespective of the causes, thus ultimately lead to gains from trade. In this respect, Porter's demand conditions enhance our general understanding of location differences rather than invalidate the trade theories as discussed.

Firm strategy, structure and rivalry

A third determinant of national competitive advantage, according to Porter (1998), is firm strategy, structure and rivalry. The main emphasis here is that the strategies and structures of firms depend heavily on the national environment and that there are systematic differences in the business sectors in different countries that determine the way in which firms compete in each country and ultimately their competitive advantage. Porter (1998) identifies rivalry as the most critical driver of competitive advantage of a country's firms. He believes that domestic rivalry forces firms to be cost competitive, to improve quality and to be innovative. According to Porter (1998), it is firms that ultimately compete internationally, but it is the international competitiveness of a country that shapes the international competitive advantage of firms. It is this assumption that a country's competitiveness ultimately determines a firm's international competitive advantage that led to the belief that countries, like firms, compete internationally and thus that the international trade engagement of countries is a negative sum game, as it is in the case of firms. This is in sharp contrast to the general understanding in trade theory that trade is a positive sum game irrespective of the nature of the sources from which such gains from trade are derived.

Related and support industries

Much of the debate around location as a source of competitive advantage has to do with the way in which the modern global economy is viewed. In the former case, it is believed that almost anything could be moved or sourced around the globe. In the latter case, it is believed to result in an intense specialization and clustering of competitive advantages in different locations as the world becomes increasingly integrated. Porter (1998) claims that specialization leads to the sticky (not easily moveable) location advantages that are the true sources of sustainable competitive advantage of countries. There are basically three reasons why specialization takes place and thus why location matters. Two have already been discussed under comparative advantage, namely, resource-driven specialization and economies of scale at the firm level. A further explanation is the existence of external economies as a result of local clustering, which is the fourth determinant of competitive advantage in Porter's (1998) Diamond Framework.

Like organisms, clusters are born, evolve and ultimately disappear. The diamond theory explains clearly how each determinant is influenced by the other three determinants. For example, intense rivalry, the existence of world class research institutes and suppliers, and sophisticated home demand all contribute to creating those advanced and specialized factors that contribute the most to increased productivity. Reliance on only one factor (e.g., cheap labor) is over time unsustainable (other nations will provide even cheaper labor).

The diamond model is superior in explaining the dynamics of clusters and their role in increasing productivity through the process of industrialization. Increasing productivity is even more important to increasing welfare in developing countries than it is in developed countries. Cluster dynamics are recognized in the dynamic nature of the determinants themselves and in their interactions. Of these dynamics, Porter states that: "clusters not only reduce transaction costs and boost efficiency but improve incentives and create collective assets in the form of information, specialized institutions, and reputation among others. More important, clusters enable innovation and speed productivity growth" (Porter, 1998). Furthermore, Best (1999) develops Porter's argument and proposes a model of dynamic clusters as illustrated in Figure 3.

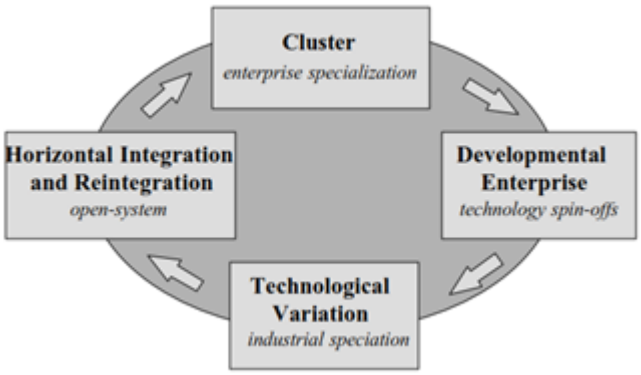

Figure 3: Dynamic cluster model (Best, 1999)

That Best's model describes the evolution process of a cluster that is initially inactive transforms into a dynamic one through the following process:

1. Various companies producing similar commodities within the cluster;

2. The presence of dynamic companies those results in innovation and technology diffusion;

3. When different companies compete with one another to develop a production capacity, technical variations emerge within the cluster while the companies are seeking to increase the production capacities through specializations. They need a partner who can support their activity so that a new business opportunity can be found; and

4. Each company specializes in a particular production process while continuing to enhance technological capabilities.

Furthermore, Best states that key characteristics of a dynamic cluster can be summarized into three points: (1) the clusters produces high-quality goods; (2) each company specializes in a particular product or a certain production process; and (3)the cluster has an open atmosphere, inviting new businesses to join with the cluster.

Cluster dynamics affect competitiveness of the actors involved in the cluster. Cluster dynamics also increase economic performance at the regional level. Thus, the impacts of cluster development occur in two different levels. Nevertheless, the relationship between business development and this area does not occur directly, it remains necessary to examine in which conditions this business cluster development provides benefits to territorial development.

The development of industrial clusters is considered as an effective alternative approach to building a competitive advantage for the industries in particular and the region in general. For economic actors, the industrial cluster approach helps focus efforts for the establishment of a mutually beneficial partnership and the development of an extensive business network. The current increased regional competitiveness requires a totally time-consuming effort that would hamper economic development. In order to solve this weakness, optimize the utilization of the local potentials and establish local industries with a competitive advantage, production and distribution bases are necessary to be reorganized and developed in synergy with increasing reliance on the potentials.

The development of industrial clusters can be used to develop broad industries that focus on the types of products with high international competitiveness in both domestic and global markets. The geographical scope of industrial clusters can be varied widely, stretching from one village or one of the roads in urban areas to including a whole district or province. Furthermore, Porter (1998) reveals that an industry cluster is a network that consists of a set of inter-related industries (core industries, supplier industries, supporting industries, and related industries), parties/ institutions that generate knowledge/ technology (including universities and R&D), institutions which role is bridging institutions (e.g., brokers and consultants), as well as buyers, that are connected to one another in a chain of the value-improvement process (the value adding production chain).

In the attempt to developing industrial clusters and territorial development, funding is certainly needed and it would normally be more interesting if the Foreign Direct Investment takes part in these developmental efforts.

2.2 Resource-Based View

The Resource-Based View (RBV) regards a company as a collection of resources and capabilities (Penrose, 1959). Conner (1991) inserts that a company's resources or its internal factors as sources for competitive advantage and economic rent. On the other hand, the Market-Based View puts more trust in external factors or the industrial environment as sources for competitive advantage and economic rent. The RBV theory discusses resources and internal capabilities of a company and their relationship with strategic decision-making. In addition, the RBV theory explains how a company's resources influence the outcomes and competitive processes externally. Also, it explains the factor of corporate competition and the role of corporate internal resources on the company itself in determining competitive outcomes. RBV is a theory that is rooted in the economy, in addition, the RBV is both content-oriented and strategy formulation-oriented.

Top management plays an important role in determining their company's strategies. These strategies will provide directions what the company should do and, more importantly, what they should not do (Porter, 1996). Strategic leadership is the ability of business leaders to influence others in making decisions for short-term success and long-term sustainability amidst market changes and market demands (Rowe, 2001). Rowe reveals that essentially corporate leadership creates values (wealth creation) for companies using 3 (three) patterns of leadership, namely: strategic leadership through entrepreneurship, managerial leadership (prioritizing stability, short-termed and reactive), as well as visionary leadership that promotes the future success and dare to take risks.

Hart (1995) develops the RBV into a Natural Resource-Based View. Hart notes the importance considering natural environment in the attempt to creating sustainable competitive advantage. In his argument, businessmen are interconnected with pollution prevention, product stewardship and sustainable development. Seen from this perspective, geothermal resources that Indonesia owns are certainly a resource that is very likely to be developed and processed in a sustainable manner. In the context as a policy maker, RBV is seen as a state resource and the government formulates strategies for its utilization in order that it creates value and eventually can make the policy as the attractiveness and competitiveness of geothermal energy compared with fossil energy. In so doing, the policy issued by the government attract investments in this geothermal industry itself.

2.3 Issues on development of cluster in previous study

Several key issues in the development of industrial clusters:

- Policy-driven clusters, interfirm interactions and firm internationalization: Some insights from Malaysia's multimedia super corridor (Christopher Richardson, Mo Yamin and Rudolf R. Sinkovics, 2012). In a case study on Multimedia Super Corridor, it is found that interfirm interactions within the cluster is initiated by policy makers by organizing events such as workshops, conferences and seminars. From these interactions, knowledge related to their respective industrial business increases, especially in terms of technology and market conditions and the world conditions globally so that will open up the opportunities for cluster development.

- Knowledge, clusters and competitive advantage (Stephen Tallman, Mark Jenkin, Nick Henry and Steven Pinch, 2004). Knowledge sharing among companies within one cluster can be a way to create competitive advantage by obtaining

knowledge development tailored to the conditions of each company. It definitely will influence the performance of the companies, especially in the resulted outputs.

- Industrial cluster: An approach for rural development in North East India (Rinku Das and Ashim Kumar Das, 2011). Development of rural areas is carried out among others by establishing industrial clusters, in which the industry will have easy and good arrangement of the supply of raw materials and their marketing that led to production-cost efficiency.

- The developing strategy of green energy industry cluster – A case study of the solar photoelectric industry in Taiwan (Maw-Shin Hsu and Feng-Jyh Lin, 2012). In designing a strategy for a certain industrial cluster, aspects necessary to analyze include: local advantage, technology development, personnel training and government policy.

- Industrial clusters, entrepreneurial culture and the social environment: The effect on FDI distribution (Antonio Majocchi and Manuela Presutti, 2009). The findings of this study indicates that the distribution of Foreign Direct Investments (FDI) is driven by the presence of industrial clusters, foreign firms and entrepreneurial culture. While the environmental conditions in Italy do no affect the distribution of FDI.

- Identification and empirical analysis of Shaanxi industrial cluster (Jijiao Jiang, Junheng Cheng, 2012). This article identifies and examines the initial step in building an industry cluster, i.e. selecting a competitive industry by considering the location and the resources of the cluster to be built. The input and output analysis is a tool that can be used to determine the type of the competitive industry mentioned earlier.

- Interfirm knowledge exchanges and the knowledge creation capability of clusters (Andac T. Arikan, 2009). In an industrial cluster, innovation can be created with the presence of the ability to create knowledge. It is developed from interaction among the industries in the cluster to exchange knowledge.

- The organization of regional clusters (Simon J. Bell, Paul Tracey and Jan B. Heide, 2009). Organizational arrangement to succeed the existence of a cluster is influenced by culture and levels of transactions of the existing industries. Also, in practice, it is revealed that this organizational arrangement can be hierarchical and relational in nature.

- How to manage strategic alliances in OEM-based industrial clusters: Network embeddedness and formal governance mechanisms (Hsin-Mei Lin, Heng-Chiang Huang, Chih-Pin Lin and Wen-Chung Hsu, 2012). To improve corporate performance of companies within one industrial cluster, companies can perform strategic alliances with other companies in the same cluster. The background for the companies in the same cluster to form an alliance is relational, structural and positional embeddedness.

- The structure and evolution of industrial clusters: Transactions, technology and knowledge spillovers (Simona Iammarino and Philip McCann, 2006). In the later development, the existence of a cluster is adjusted due to changes in knowledge, structures and technology.

2.4 Territorial development approach

The absolute territorial development approach is used when performing the work because it is expected that the geothermal development with an industrial cluster-based concept will grow the economy of the local community and tax revenue for the region as well as attract investors to invest in geothermal development. There are several ways to define the development of geothermal-based industrial clusters, such as by applying the theories of the economic base, the multiplier effect associated with the input-output theory and the location theory, the central place theory and the growth pole theory (Haggett, 2001).

3. POTENTIALS OF NORTH MALUKU PROVINCE

3.1 Food crop potentials

The potential of sufficiently wide areas, especially for some food crop commodities such as rice with a harvested area in 2003 that reached 16,409 ha with a production of 60,131 tons, corn with a harvested area of 2,464 ha and a production of 3,778 tons, sweet potato with a harvested area of 3,321 ha and a production of 28 387 tons, cassava with a harvested area of 8,585 ha and a production of 103,297 tons, groundnut with a harvested area of 1,547 ha and a production of 1,748 tons. Other agricultural commodities that are also commonly cultivated in this region are, soybeans, green beans, vegetables such as potatoes, cabbage, mustard greens, tomatoes, red onion, spring onion, garlic and fruits like avocados, oranges, star fruit, breadfruit, durian, guava, mangos teen, papaya, banana, rambutan and salak as data from the Regional Planning and Development Agency (BAPPEDA) of North Maluku Province in 2011.

3.2 Plantation potentials

In the plantation sector, there is a considerable potential for coconut plantation, which is indicated by the condition that the majority of the population of this region commercialize these commodities. It is recorded that there are 10 types of plantation commodities in North Maluku Province which sustains the plantation sub-sectors. Types of the main commodities are cacao, clove and coconut. Among these commodities, the highest average productivity level is in South Halmahera Regency, North Halmahera Regency and West Halmahera Regency .

3.3 Potentials of the forestry sector

Forest areas of the North Maluku Province in 2003 cover an area of 3,184,910 ha, consisting of protected forest by 702, 539 ha, limited production forest by 572,845 ha, production forest by 552,227 ha, forest intended for forest protection and nature conservation by 48,836 ha and conversion forest by 1,308,463 ha. This wood potential is utilize for the production of plywood that reaches 28,371 tons to be exported with an export value reaching 11,476 million U.S. Dollars and sawn timber that reaches 329,000 tons with an export value reaching 62 million U.S. Dollars (data from January to September 2003). The total area of coconut

plantation is 162,393 ha with a production of 121,831 tons of coconut in 2003. Other commodities that are also quite potential and cultivated by the majority of the population are clove with a total area that reaches 10,882 ha and the production in 2003 that reached 6,528 tons; nutmeg, with a total area of 9,833 ha and a total production in 2003 that reached 5,899 tons; cocoa, with a total area of 26,686 ha and a total production that reached 19,998 tons; nutmeg, with a total area of 9,833 ha with a production of 5,899 tonnes; coffee, with a total area of 4,025 ha and a production of 2,414 tons as data from the Regional Planning and Development Agency (BAPPEDA) of North Maluku Province in 2011.

3.4 Livestock potentials

Types of livestock with an access to agribusiness development are: beef cattle and poultry (domestic poultry, broilers, layers and ducks). In general, North Maluku Province has land suitability, where livestock development includes vacant land, grazing fields, coconut plantation and yards. The area of North Maluku Povince is an expanse that can be used as an area for concentrated livestock development.

3.5 Marine and fishery potentials

Considering the characteristics of North Maluku Province that consists of 76.28% of water areas, it can be said that the development of the main potential of the area in several sectors, particularly fishery and marine sub-sectors, has a very promising prospect. The available potential of the fishery and marine sub-sectors is as many as 694,382.48 tons per year with a sustainable potential by 347,191.24 tons per year, and from such a number, there is only 26.51% of it that has been utilized or approximately 92,052.21 tons per year as data from the Regional Planning and Development Agency (BAPPEDA) of North Maluku Province in 2011.

3.6 Mining potentials

Mineral potentials of metal and non-metal such as nickel-cobalt, copper, gold and silver are superior commodities to be developed further. Halmahera Island has a quite prospective potential for gold deposits, epithermal gold deposits found in Gosowong area with a potential contained in the magnetic arc. In relation to nickel minerals, nickel ore supply planning for consumption of plant *Feni* years 2000 – 2030, the plant will requires as much as 48.75 million tons. However, so far there is only 16.355 million tons of them, so that there is a shortage of as many as 32.395 million tons of nickel ore. Sources of lateritic nickel sediments in the area of Weda bay that contains approximately 92 million tons have not been explored in details so far.

North Maluku Province is dubbed as a natural geological laboratory because of its position on the collision of three tectonic plates, namely the Australian plate moving toward the south, the Eurasian Plate moving from the west and the Pacific Plate from the west. Several mineral resources or minerals are found scattered in almost all areas of North Maluku Province, such as: Copper, Uranium, Gold, Nickel, Coal, Aluminum/ Bauxite, Magnetite, Iron Sand, Titanium, Manganese, Asbestos, Kaolin, Diatomite, Gems, Chromite, Quartz Sand, Limestone, Pumice Stone, Granite, Talc, Oil and Gas, Geothermal Potentials, and Water Resources.

Table 1: Mineral resources and reserves of North Maluku Province (Source: Geological Agency MEMR, 2011)

Commodity	Resources (ton)	Reserves (ton)
Gold	5,040,000	5,450,000
Nickel	344,300,000	211,070,000

Similarly, for mining operations, these operations are supported by the availability of potential mines, particularly the exploitation of gold and nickel. In addition, there are other mineral potentials that have not been processed consisting of as much as 18 types of minerals including minerals class A, B and C. The level of production in the same year reached 11.67 million U.S. dollars export value.

3.7 GEOTHERMAL POTENTIALS

North Maluku Province has geothermal potentials in 13 locations, i.e. in Mamuya, Akelamo (North Halmahera Regency), Jailolo, Ibu, Kalbesi (West Halmahera Regency), Akesahu (Tidore Regency), Indari, Labuha, and Songa Wayau (South Halmahera Regency). And by the end of 2012, the Geological Agency announced the total estimated geothermal potential in North Maluku Province 427 MW, with the folowing details presented in Table 2.

Table 2: Geothermal potentials per Regency/city in North Maluku Province (*Source: Geological Agency MEMR, 2012*)

Location No.	Area	Regency/ City	Res (MW)		Rev (MW)			Ins (MW)
			Sp	Hp	Ps	Pb	Pv	
237	Mamuya	North Halmahera	-	7	-	-	-	-
238	Ibu	West Halmahera	25	-	-	-	-	-
239	Akelamo	North Halmahera	25	-	-	-	-	-
240	Jailolo	West Halmahera	-	-	75	-	-	-
241	Kie Besi	West Halmahera	25	-	-	-	-	-
242	Akesahu	Tidore	-	-	15	-	-	-
243	Indari	South Halmahera	25	-	-	-	-	-
244	Labuha	South Halmahera	25	-	-	-	-	-
245	Songa Wayaua	South Halmahera	-	-	140	-	-	-
273	Kramat (P.Taliabu)	Kepulauan Sula	10	-	-	-	-	-
274	Air Madidi/Losseng (P.Taliabu)	Kepulauan Sula	30	-	-	-	-	-
275	Auponia (P.Mangola)	Kepulauan Sula	20	-	-	-	-	-
276	Bruokol (P. Mangola)	Kepulauan Sula	5	-	-	-	-	-
Sp = Speculative; Hp = Hypothetical, Ps = Possible; Pb = Probable; Pv = Proven; Ins = Installed; Res = Resources; Rev = Reserve								

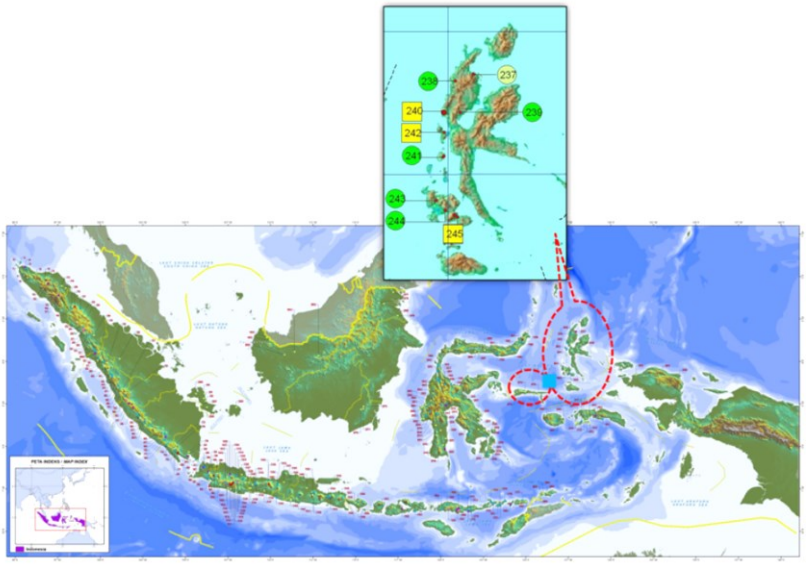

Figure 4: Geothermal locations in North Maluku (Geological Agency, 2012)

3.8 Tourism Potentials

Tourism potentials that can be found in this area consist of cultural and archaelogical tourism, historical tourism, and customs known as the Sultanate of Moloku Kie Raha. Historical relics from the past among others are Kadaton Sultan Ternate and Kadaton Sultan Tidore. The potential of marine tourism, in the forms beautiful islands and beaches with sea garden and ornamental fish species, is a major potential to develop marine tourism. Natural attractions like stone pits spreading almost throughout the region, forest tourism that can be intended for the benefit of the national parks with the tenth-largest endemic species in the world. With such potentials, the development will be directed to locations with interactions of tourist activities.

4. ANALYSIS ON THE DEVELOPMENT OF A GEOTHERMAL-BASED INDUSTRIAL CLUSTER

4.1 The Development of a geothermal power plant

Geothermal energy can be a driving force for regional development because it serves as a resource. Geothermal energy can also be used as a means of seed sector development such as coffee, cocoa, clove, and the likes that require drying. The Development of Geothermal Power Plants can provide a dual effect since the existence of electrical energy makes it possible for establishment of plants by investors.

Electric power is one of important sources of energy for economic growth and increased prosperity of the society. The more increased the economic growth and prosperity of the society, the more the demand for electricity. Between electric power and economic growth, there is a very close relationship which affects each other. Industrialization will not grow well unless supported by sufficient power supply with good quality. Since current industries generally use electric power as the driving force for their production machinery.

North Maluku Province has ferronickel projects from PT Antam intended to improve nickel ore processing activities and establish the mining-based global corporations with world-class standards. The plant requires 260 MW of electric power. The potential of electric power that can be supplied from the existing geothermal energy of North Halmahera Regency and West Halmahera Regency reaches 104 MW, meaning that a half of the requirements can be supplied from geothermal power generating plants that can be developed in the attempts to supporting the nickel mining-industrial cluster of PT Antam and PT Eramet.

Population growth and efforts made by the government that are generally public-spirited, such as building housing, providing water supply, home industries, agriculture, plantation and others necessary to support the growth of business run by the community that is now being intensified with the support of the government, all of which will lead to the expansion of urban and rural areas, this expansion of urban and rural areas will certainly cause a lot of problems, some of these problems are widespread electric service areas, increasing demands for electric power by the customers and high needs in a good service for electricity. Therefore, it is extremely recommended that good electrical services and low operational costs are taken into account when planning power systems transmission network systems as well as distribution planning. Thus, electricity users can enjoy it and investors will also become interested to invest.

The main obstacles to the development of investments in electricity in North Maluku electricity Province are low demands, scattered population, despite abundant energy resources. For examples, in North Maluku Province, after making calculation, the geothermal potential that can be developed reaches 427 MW. However, the great potential is found in Bacan Island, South Halmahera Regency (190 MW) and Sula Archipelago Regency (65 MW). Both regencies require a very small amount of electricity, each less than 5 MW. Electricity needs in Ternate City, Tidore City, Sofifi City, and the growth of Nickel-mining industries make electricity demands in the middle are of North Maluku Province have increased significantly.

Therefore, theoretically interconnection of electrical energy in Maluku Province can be done starting from Sula Archipelago Regency and then to South Halmahera Regency, connected to the existing network in Central Maluku Regency.

4.2 The Development of Plantation and Tourism Industries

Geothermal energy is a source of heat energy contained in the earth that can be used in two ways, i.e. direct use and indirect use as illustrated in Figure 3. Utilization of geothermal energy for direct use or for non-electrical purposes will naturally tend to utilize the heat energy in place without having to convert the energy into another form of energy such as electrical energy. In general, the utilization of geothermal energy can be divided into several groups, namely:

1. Baths, a pool and hot-water therapy

2. Room heating and cooling including heating an area

3. Agribusiness (especially agriculture, greenhouse heating and soil sterilization, animal husbandry and fishery)

4. Industrial processes

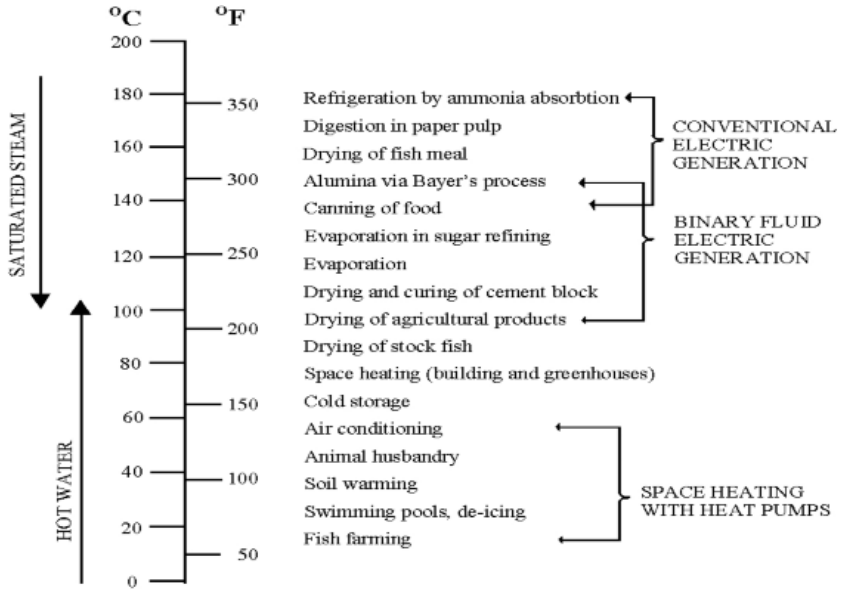

Figure 5: Geothermal utilization based on the temperature (Lindal Diagram)

In general, the geothermal fluid temperature required for direct use is lower than that for geothermal power generating plants. In some countries, the development of the geothermal direct use is carried out individually. However, nowadays it has involved large-scale projects, such as for the purpose of heating an area (Iceland and France), greenhouse complexes (Hungary and Russia) or industrial processes (New Zealand and the USA). The development of the direct use of geothermal energy in Indonesia is still limited to purposes such as hot water baths like the ones in Ciater, Subang Regency and Cimanggu, Bandung Regency, whereas some places of geothermal manifestations such as craters, hot springs, and hot mud pools are made into natural tourist attractions.

Mount Tangkubanparahu, *Kawah Putih* dan *Kawah Burung* are places visited by domestic and foreign tourists where geothermal manifestations become the tourist objects.

In relation to the direct use of geothermal energy in Indonesia, although it is still limited to research, but it is quite successful such as the drying of coconuts into copra, coffee ore, clove, cocoa, and other agricultural and plantation products which need drying.

5. STRATEGIES FOR THE DEVELOPMENT OF GEOTHERMAL-BASED INDUSTRIAL CLUSTERS IN NORTH MALUKU PROVINCE

Consistent with the research by Wahyuni (2012) on Special Economic Zones (SEZ) in Indonesia, Malaysia, Thailand and China, improvements are suggested for the following aspects:

- Location, infrastructure, regulation
  Determination of the location for the SEZ should be in line with the infrastructure (e.g. if the location is near to the airport, export activity shall be a priority). The cluster approach requires investors to create economic effects and the government as the creator of regulations and favorable climate.
- Good governance and market systems
  The cluster approach needs to be coupled with the bottom-up procedure. Indonesian decentralization systems must be accompanied with regulatory transparency, good governance and good market systems.
- Human resources and transfer of knowledge
  The quality of labor plays an important role in competitiveness. Thus, investments in capacity building are necessary.
- Government reforms and good cluster strategies
  Indonesia needs cluster strategies that are coherent and free from authority misappropriation, a key contact point should be established for investors (e.g. MIDA in Malaysia).
- Long-term commitment and prominent leadership
  It takes a clear time frame to implement policy transparency and reliable cluster strategies. The type of leader that is required is a humble, practical, and realistic one.

Furthermore, Wahyuni states that cluster formation in developing countries results mainly from market forces or “accidental reasons”. Well-designed cluster formation initiatives will speed up the process and generate spill-over effects that increase economic performance within and among the clusters. Strategic initiatives in each country vary but they usually focus on improving market information, workforce development, supply chain improvement, quality standards, branding, forward integration, and process improvement.

The cluster-based approach is a realistic way as a catalyst for reforms/ improvements. The effectiveness of the government in the development of these clusters can be improved by taking into account the following elements:

- Developing and communicating clear economic vision (objectives, priorities, timelines, concreteness, roadmap) informed to relevant parties in order to gain support
- Developing a value chain and gap analysis
  Government and stakeholders perform assessment by making inter-cluster comparison with the same clusters elsewhere and finding a gap where improvements can be made (e.g. to develop palm oil, we should assess the development of palm oil in Malaysia, and to find a gap in the power of Malaysian sectors, we can make improvements and innovation)
- Restructuring programs and services to support clusters
  There is a paradigm shift between the traditional model of economic development which is commonly orieted to policies; incentives; and individual needs into the new model, i.e. the inter-firm collaboration or cooperation or education and research institutions, resulting in a joint effort of the entire clusters.
- Investing in learning and knowledge transfer
  Government plays a role in understanding and diffusing knowledge. Therefore, there should be an increase in the system, from re-activeness into pro-activity. Infrastructure, training and education of workers are a priority necessary to be carefully planned and take a future-oriented vision.
- Promoting technology
- The government must make investments in R & D and technology development
- Developing data or information which is available for all stakeholders
  Availability of statistical information and data to determine the success of a certain cluster (through surveys and other new tools)

A cluster survives since it manages to increase diversity and sophistication to achieve greater productivity and efficiency. To establish high quality and dependable SEZs in Indonesia, the government and the private sector should realize connectivity among clusters accompanied with a comprehensive understanding of the strategies and national and regional competitiveness.

6. CONCLUSIONS

The concept for the development of a geothermal-based industrial cluster in North Maluku Province is developed following the needs of mining industries for the construction of the smelters and other direct utilization around the location area. Nickel industries situated in North Maluku Province with the largest energy needs for power generation in the construction of smelters in 2014 are: PT Aneka Tambang and the Eramet Group (PT Weda Bay Nickel) by 275 MW and PT Nusa Halmahera, which up to this present requires 20 MW. The total amount of electricity required only for the mining industries is 295 MW.

The analysis conducted in this paper remains above the surface. Nevertheless, the potentials for the cluster development to creating competitiveness of North Maluku Province are widely opened as the attempts made for equitable distribution of development. For that reason, it is necessary study in a more comprehensive manner the stages and strategies for the development of this cluster by

referring to the success tips proposed by Wahyuni (2012) in a study on the special economic zones in Indonesia, Malaysia, Thailand and China.

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