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Flores Geothermal Island – Developing a Strategy and Master Plan

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1. ABSTRACT

Flores Island in the East Indonesian Province of Nusa Tenggara Timor is blessed with abundant geothermal resources. Being one of the least developed areas in Indonesia it features prominently in the Indonesian Government's long and medium-term development planning. Recent rural electrification efforts are aimed at making electricity available to almost 100% of the population of 2 million. A new 70-150kV transmission grid is being constructed which will ultimately join several previously unconnected local grids thereby improving the ability to match growing demand with new supply in the future. With support from the Government of the United Kingdom, the Ministry of Energy and Mineral Resources (MEMR) prepared a Geothermal Roadmap for Flores. MEMR has issued a regulation proclaiming Flores Island as a Geothermal Island (FLOGIS) with a Vision to establish an island development model that utilizes geothermal energy as a primary energy source and is capable of being replicated throughout regions in Indonesia with similar geothermal potential characteristics. The Vision also seeks to achieve direct use of geothermal energy within the agricultural, plantation, fishery and tourism sectors and to attract geothermal investment in the island of Flores. Under a partnership agreement (Geo-INZ) the Government of New Zealand is supporting the efforts of the Government of Indonesia to develop a Strategy and Master Plan to implement this Vision. This paper presents the progress to date and discusses the future plans of multiple stakeholders working collectively to achieve this Vision.

1. INTRODUCTION

Flores Island is located in the East Indonesian Province of Nusa Tenggara Timor (NTT). It is one of the least developed and poorest areas in Indonesia. Around 22% of the population of 1.87 million [2015] are considered to be below the poverty line, which is more than double the national average of just under 10%. 1 in 3 of its children suffer from stunted growth which in itself is a strong indicator of poverty. Given these statistics, there is no surprise the area features prominently in the Indonesian Government's long and medium-term development planning.

With regard to electricity consumption and rural electrification, the national ten-year Electricity Development Plan (RUPTL 2019), indicates that approximately 60% of households in NTT are consumers of PLN, the state-owned national electricity company. Currently around 60% of the electricity consumed in NTT is by households, with business at 25%, public at 12% and industry at 4%. The industry statistic indicates a low level of industrial development in NTT when compared to the national average where industry accounts for 33% of total electricity consumption. Electricity consumption by connected households in NTT is also low, being only 70 kWh/month when the national average is 124 kWh/month (2018 data, RUPTL 2019).

PLN's forecast for NTT for the next ten years indicates an increase in electricity consumption of 133% through:

1. a growth in household consumption from 70 to 80 kWh per month per household in conjunction with a doubling of the total household consumption due to a doubling in the number of residential customers (PLN's plan is for almost 100% of households to be connected as consumers by 2028, though PLN has met some challenges in gaining access to the land required for the required electricity supply infrastructure)
2. an almost twofold increase in both the number of business customers and in their total electricity consumption, in conjunction with a 20% increase in the consumption per business customer, and
3. a twofold increase in the number of industrial customers in conjunction with a fourfold increase in their total electricity consumption, corresponding to a doubling of the consumption per industrial customer.

If growth of 113% over ten years is a realistic target, how can this be achieved? Could geothermal support higher growth than this?

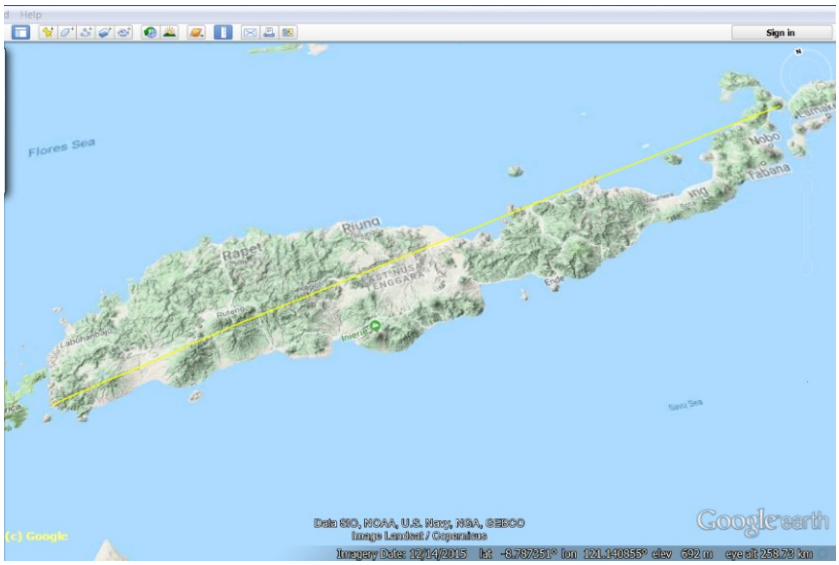
2. GEOTHERMAL ENERGY SOURCES IN FLORES

Referring to

Figure 1 it can be seen that Flores Island is a long island (350 km from end to end), lying east-west at the eastern end of the Sunda Arc. As noted by Nasution et. al. (2002) "Geothermal prospects are mostly associated with post volcanic activities and distributed on high altitude volcanic terrains along the island. They are divided into three segments, the West Flores pros prospects, Central Flores prospects and East Flores prospects. Major geothermal prospects are Wai Sano, Ulumbu and Wai Pesi (West Flores), Mataloko, Bobo and Langageda (Central Flores), and Sokoria, Lesugolo, Jopu, Detusoko and Oka (East Flores)".

PLN notes in the 2019 RUPTL (page B-132) "The province of East Nusa Tenggara has potential primary energy sources consisting of geothermal energy and water which can be used for electricity generation. The geothermal potential available is around 1,334.5 MWe at 24 locations being Wai Sano - West Manggarai, Ulumbu - Manggarai Barat, Waj Pesi - West Manggarai, Gou - Inelika - Ngada, Mengeruda - Ngada, Mataloko - Ngada, Komandaru - Ende, Ndetusoko, Sukoria - Ende, Jopu - Ende, Lesugolo, Oka — Ile Angie - East Flores, Atadei - Lembata, Bukapiting - Alor, Roma-Ujelemng - Lembata, Oyang Barang - East Flores, Sirung (Isiabang-

Kuriali) - Alor, Adum - Lembata, Alor Timur - Alor, Mapos – East Manggarai, Rana Masak – East Manggarai, Rana Kulan - East Manggarai, Ulugadung – East Manggarai and Amfoang – Kupang".

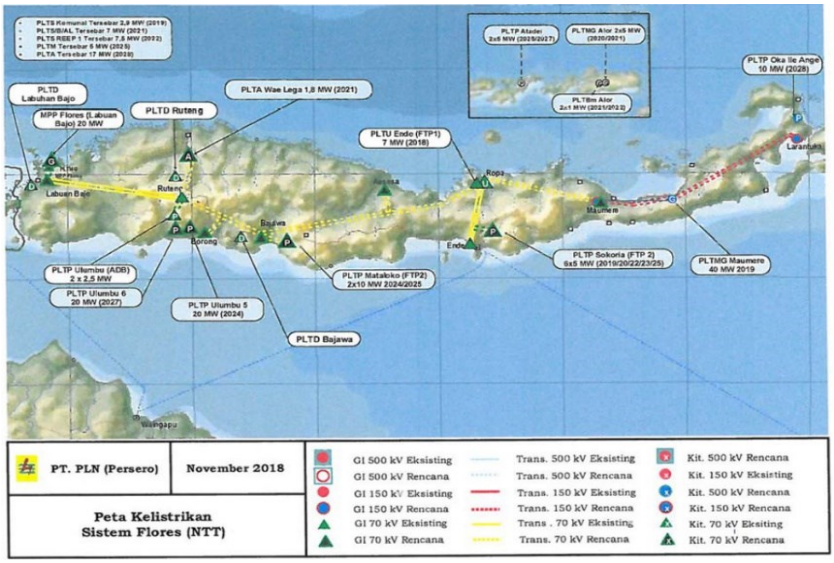


Geothermal energy sources have been discovered by drilling at Ulumbu, Mataloko and (most recently) Sokoria. At Ulumbu and Mataloko PLN has already developed and operated small geothermal electricity power plants for some years. At Sokoria an Independent Power Producer (KS Orka) is in the process of developing a small geothermal electricity power plant. PT SMI plans to undertake exploration drilling at Waisano in 2020 in an attempt to discover an exploitable geothermal energy source.

PLN is planning to connect a number of discrete, isolated and un-interconnected isolated power grids so as to form one interconnected grid to service the entire island.

Figure 1: The figure above shows Flores as 350km southwest-northeast

The first development of a geothermal electricity project in Flores was at Ulumbu, where the World Bank and the NZ Government supported exploration drilling in the mid-1990's. Development was stalled by the Asian Financial Crisis of the late 1990's and restarted a decade later. Currently it is understood that 4 x 2.5MW generating units have been installed at Ulumbu.



To date PLN:

1. Has installed two separate 70kV double circuit connections between: Labuan Bajo & Ruteng; Ende & Ropa
2. Is constructing 70kV double circuit connection between Ruteng and Maumere (i) via Ruteng-Bajawa (2019) and (ii) via Maumere-Ropa (target COD 2019)
3. Plans to install a 150kV double circuit connection between Maumere and Larantuka (target COD 2021)

PLN is planning a number of geothermal projects in its generation expansion plan for Flores. PLN's plan for geothermal project development, as described in the 2019 RUPTL, is presented in the table below. A total of 13 new generation units are planned (in addition to the existing 4 units at Ulumbu and a single unit at Mataloko).

Figure 2: Figure B9.2 from RUPTL 2019

Table 1: Table B9.10 from RUPTL 2019 (translated)

Tabel 9.10 Rincian Rencana Pembangunan Pembangkit (Generation Development Plan Details). Geothermal Projects Only.							
Item	**Location**	**Geothermal**	**Project & Unit #**	**Capacity (MW)**	**Planned COD**	**Status**	**Owner**
4	Flores	PLTP	Sokoria 1 [FTP2]	5	2019	Contracted	IPP
5	Flores	PLTP	Sokoria 2 [FTP2]	5	2019	Contracted	IPP
21	Flores	PLTP	Sokoria 3 [FTP2]	5	2020	Contracted	IPP
37	Flores	PLTP	Sokoria 4 [FTP2]	5	2022	Contracted	IPP
44	Flores	PLTP	Sokoria 5 [FTP2]	5	2023	Contracted	IPP
46	Flores	PLTP	Mataloko 2 [FTP2]	10	2024	Planned	PLN
47	Flores	PLTP	Ulumbu 5	20	2024	Planned	PLN
52	Flores	PLTP	Atadei 1 [FTP2]	5	2025	Planned	PLN
53	Flores	PLTP	Mataloko 3 [FTP2]	10	2025	Planned	PLN
54	Flores	PLTP	Sokoria 6 [FTP2]	5	2025	Contracted	IPP
58	Flores	PLTP	Atadei 2 [FTP2]	5	2027	Planned	PLN
59	Flores	PLTP	Ulumbu 6	20	2027	Planned	PLN
62	Flores	PLTP	Oka-Ile-Ange 1 [FTP2]	10	2028	Planned	PLN

Total	110	
FTP2 = Fast Track Program (Phase 2)		

2. NATIONAL DEVELOPMENT PLANNING

PLN Perspective

PLN notes in the 2019 RUPTL: *The economic condition of NTT Province is quite good in the manufacturing, trade and agriculture sectors, which contributed 56%, while the communication, finance and services sectors contributed around 30%. NTT has abundant natural resources, one of which is the potential from the mining of manganese ore which is quite abundant on the island of Timor. In the future, this manganese mine will be processed into semi-finished materials by building a smelter industry. In addition, in NTT the fisheries industry will also be developed including seaweed cultivation and the growth of the salt industry as a path to national food security. The tourism sector is being developed with the iconic Komodo as one of the "new 7 wonders of nature" and diving spots is on the islands of Alor, Rote and Labuan Bajo. The development of the tourism sector is expected to increase local economic growth with tourist visits and the development of new star-rated hotels, villas / resorts and inns. In addition, PLN will also support the government's program by meeting the electricity needs of community health centers in remote sub-districts of several districts in East Nusa Tenggara Province. From historical data on exploitation and considering trends in economic growth. population growth and increasing electrification ratio in the future, the 2019-2028 electricity demand projection [can be seen in Table B9.8], with an average energy sales growth of 10 years around 8.8%.*

Current National Development Planning (BAPPENAS Perspective)

The current national five-year development plan for Indonesia (RPJMN 2020-2024[1]): *Seeks to move Indonesia from a middle-income nation to a middle-high-income nation that is prosperous, fair and sustainable. Infrastructure development is identified as one of the strategic choices which can accelerate the growth and equity of the Indonesian economy. The attention of the government in infrastructure in recent years has contributed to improving the quality of infrastructure in Indonesia. Things that still need to be accelerated include the development of economy-driving infrastructure, equitable distribution of basic services throughout Indonesia, and infrastructure development to sustain the development of various cities along with urbanization in Indonesia. In the period 2020-2024, infrastructure development will be prioritized in three main focus areas, namely: Infrastructure for Equitable Development, Infrastructure for Economic Development, and Infrastructure for Urban Development. Development in these three main focus areas over 2020-2024 will be supported by energy development, electricity, and the implementation of digital transformation. Attention will also be focused on promoting disaster resilience, gender equality, good governance, sustainable development, and human capital and social culture as mainstream factors in the framework of infrastructure development.*

In an effort to achieve the intermediate scenario GDP growth targets in the RPJMN 2020-2024 (low: 5.2%pa, medium:5.4%pa, high: 5.5%pa), infrastructure spending needs are estimated at Rp 6,421 Trillion or an average of 6.08 percent of GDP (provisional calculation) so that the capital stock of infrastructure will reach 50 percent of GDP in 2024. However, the ability to supply is only 3.46 percent of GDP, so that there is a significant gap in infrastructure funding. For this reason, creative endeavors are needed to encourage the participation of the community and business entities through the scheme of Government Cooperation with Business Entities (PPP) and Government Non-Budget Investment Financing (PINA). In addition, the Government will also make several efforts to increase infrastructure funding capacity, such as reviewing tariff policies, increasing fiscal capacity and reallocating government spending.

The direction of policies and strategies which aim to improve access and supply of energy and electricity evenly, reliably, efficiently, and sustainably are listed below. Many of these are relevant to FLOGIS and should be considered in the development of a strategy and master plan for FLOGIS. A number of these are currently being implemented. For the energy sector, the policy direction in the RPJMN is to fulfill energy needs by prioritizing the increase in renewable energy (EBT) with a strategy to accelerate the development of renewable energy generation, whereas in the Environment sector the RPJMN applies the Low Carbon Development strategy.

1) *Diversification of energy and electricity to meet the needs, through*
   - (a) *utilization of new and renewable energy (EBT) such as geothermal, water, solar, and biomass;*
   - (b) *utilization of clean energy based mini / micro grid development;*
   - (c) *construction of Pumped Storage Hydroelectric Power Plants; and*
   - (d) *the use of high efficiency and low emission (HELE) technology.*
2) *Increasing the efficiency of energy and electricity utilization, through*
   - (a) *the development of the Energy Service Company (ESCO);*
   - (b) *expanding, rehabilitating and uprating transmission and distribution systems;*
   - (c) *developing management information systems and data control;*
   - (d) *developing and utilizing smart grid technology.*
3) *Strengthening and expanding energy and electricity supply services, through*
   - (a) *adding electricity generation, transmission and distribution capacity;*
   - (b) *fulfillment of electricity in priority areas;*
   - (c) *providing assistance to install new electricity for poor households;*
   - (d) *support for providing primary energy (gas and coal) for electricity;*
   - (e) *increasing domestic refinery capacity;*
   - (f) *improvement of natural gas infrastructure;*

[1] https://www.bappenas.go.id/files/rpjmn/Narasi%20RPJMN%20IV%202020-2024_Revisi%2014%20Agustus%202019.pdf (Chapter 6)

(g) *developing fuel / LPG buffer / operational reserves; and*

(h) *economically least cost fuels utilization for cooking (urban gas network, LPG, and electric and clean cook stove);*

(i) *increasing the capability of national engineering engineering for power plants and gas / oil infrastructure supported by domestic industries;*

(j) *Expansion of fuel distribution at one price.*

4) *Improvement of energy and electricity governance, through*

(a) *improvement of the duties and functions of the regulatory body;*

(b) *strengthening the independence of the transmission system operator;*

(c) *the application of power wheeling to encourage EBT projects to sell directly to customers;*

(d) *review energy price / tariff policies and their implementation so as to achieve economic prices to encourage national economic growth;*

(e) *reviewing the EBT price policy based on the generation of cost of supply (BPP); and*

(f) *implementation of an optimal method of determining revenue requirements.*

5) *Developing funding and financing policies, through*

(a) *developing targeted subsidies through direct subsidies and reallocation of expenditure;*

(b) *the application of tariff adjustments and / or government support for PT PLN's financial increase;*

(c) *re-application of automatic tariff adjustments; and*

(d) *utilizing cheap financing, alternative instruments and asset leverage.*

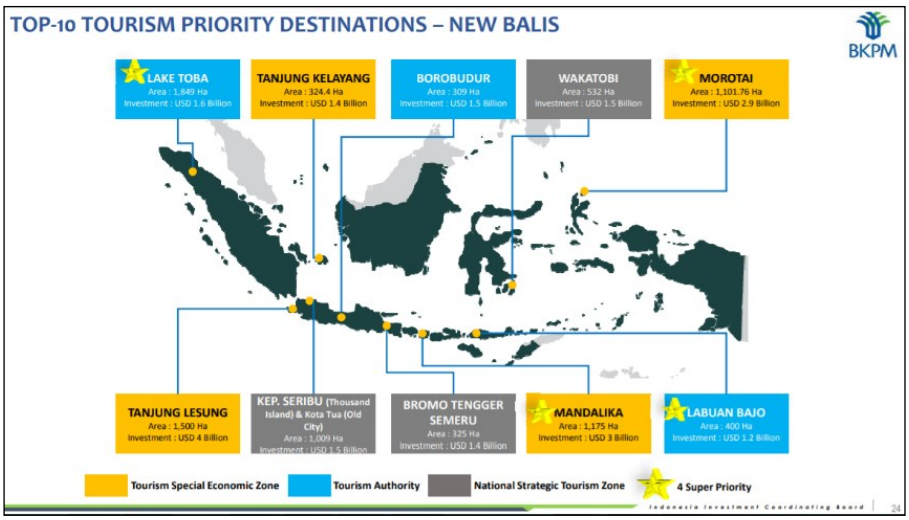


Figure 3 **GoI Plan for 10 "New Balis" (from BKPM 2018 & 2019)**

With reference to Figure 3, the GoI is planning to develop a Tourism Special Development Zone at Labuan Bajo and has given this a "Super Priority" status. This development is expected to be based on the principles of sustainable and socio-eco-tourism and should come to symbolise local wisdom and culture. This concept has been promoted by the President of Indonesia since at least 2015. How it fits in with other tourism development plans for Indonesia can be seen in the presentation made in London and Athens by the Investment Coordination Body of Indonesia (BKPM).



Figure 4 **GoI Priority Infrastructure Projects in NTT**

With reference to Figure 4, the Final Draft Medium Term National Development Plan (RPJMN 2020-2024) indicates there will be several infra-structure development programs in Flores Island such as the Labuan Bajo Port and Labuan Bajo Airport to support the Labuan Bajo Special Economic Zone (KSPN) and promote Labuan Bajo as a Top 10 Tourism Priority Destination (with Super Priority status). These projects also include an expansion project (Unit 5) at the existing Ulumbu geothermal field. Per PLN's RUPTL (refer Table 1), the planned capacity of Unit 5 is 20 MWe.

3. PREVIOUS WORK ON GEOTHERMAL MASTER PLAN – UK (DFID) – JAPAN (JICA)

Geothermal prospects on Flores Island have long featured in electricity development planning for this under-developed part of Indonesia. In 2007, JICA included Flores Island geothermal prospects in a Master Plan for Geothermal Electricity Development.

In 2016 the Government of the United Kingdom, through DFID, supported EBTKE in the development of a Geothermal Roadmap for Flores. The roadmap was completed in 2017.

4. FLOGIS PROCLAMATION – STAKEHOLDERS – ESSENTIAL ELEMENTS

In 2017, the Minister of Energy issued a Ministerial Decree (KEPMEN ESDM 2268 K/30/MEM/2017) establishing Flores Island as a Geothermal Island (FLOGIS). The basis for the proclamation (is presented in the decree as follows:

"Considering:

a. That Indonesia is an archipelago that needs to strive for equitable distribution of its development in the framework of energy security through the availability and independence of energy throughout the territory of Indonesia;
b. That energy availability in the archipelago and / or outer islands is essential for the improvement of economic capacity and poverty reduction through the development of geothermal potential;
c. That the geothermal potential of Flores Island is a dominant energy source being developed as primary energy to meet the energy needs, therefore it can be a geothermal island which can be replicated in all regions with similar geothermal potential characteristics in Indonesia;
d. That the island of Flores has natural resources potential in the form of plantations, fishery, minerals and the tourism sector which can be managed by utilizing geothermal resources;
e. That based on the considerations referred to in a, b, c and d,

it is necessary to formulate a Decree of the Minister of Energy and Mineral Resources on the Establishment of Flores Island as Geothermal Island".

The decree then goes on to state the Vision for Flores Geothermal Island:

1. A Geothermal Island is an island whose energy needs in the most part can be met through the utilization of geothermal energy, with maximizing the geothermal potential of Flores Island to meet its baseload electricity requirements being the most important need.
2. Establishment of a Geothermal Island is intended to:
    a. Improve coordination between the Government, the Provincial Government of Nusa Tenggara Timur, Regencies/Cities on Flores Island, and the Electricity Supply Business License Holders in the planning, implementation, monitoring and evaluation of the "Flores Island as a Geothermal Island" Program;
    b. Expedite the utilization of geothermal in an effort to reduce dependence on fossil / conventional energy;
    c. Establish an island development model that utilizes geothermal energy as a primary energy source and is capable of being replicated throughout Regions in Indonesia with similar geothermal potential characteristics;
    d. For direct use of geothermal energy, as a value-added increase in results within the agricultural, plantation, fishery and tourism sectors; and
    e. Attract geothermal investment in the island of Flores.
3. In the framework of the implementation of the Flores Geothermal Island Program:
    a. The Ministry of Energy and Mineral Resources shall coordinate with the relevant Ministries, the Provincial Government of East Nusa Tenggara, the Government of the Regency of Flores Island, the Business Entities holding Electricity Supply Licenses, and all stakeholders to support the program including in the preparation of plans and budgets; and
    b. The Director General of New Energy, Renewable Energy and Energy Conservation shall prepare and establish a Geothermal Island Road Map as a reference for the implementation of the Program.
4. To coordinate implementation of the program, the Director General of New Energy, Renewable Energy and Energy Conservation on behalf of the Minister of Energy and Mineral Resources will establish a Team in accordance with legislative provisions.

EBTKE has established the Team and the Team has met several times starting in the middle of 2017. Under the Geothermal Partnership between the governments on Indonesia and New Zealand (GEO-INZ), the NZMFAT has been supporting these activities under a work stream that focuses on geothermal master planning in East Indonesia. Jacobs New Zealand Limited (part of the global Jacobs Engineering Group) has been supporting MFAT's activities.

A. There are many stakeholders in developing Flores Geothermal Island. These include:
B. Users of energy, both in the form of heat and geothermal electricity
C. The Ministry of Energy, particularly EBTKE, but also Energy Planning and Electricity Regulation
D. BAPPENAS, the national planning board, and its associated entities at Provincial and District level
E. PLN across its various roles in generation, transmission, distribution, retailing and social service support
F. Other electricity business enterprises (eg geothermal IPPs)
G. Other Infrastructure Development SOEs (eg SMI)
H. The Ministries of Tourism, Fishery, Industry, Agriculture, Spatial, Finance
I. The Ministry of Disadvantaged Regions
J. The MPR group for geothermal (check correct name). DPR. KADIN
K. National and International NGOs (WWF)
L. Development Banks and Funding Institutions (World Bank, UNDP)

5. WHAT DOES AUTHENTIC DEVELOPMENT LOOK LIKE?

In an under-developed area such as Flores Island with a population approaching 2 million, how should "equitable distribution of its development in the framework of energy security through the availability and independence of energy" be considered and what would it look like in reality if it was successful?

The answer to this question will differ depending on the viewpoint of a stakeholder. In regard to electricity, residential customers of PLN consume 42% of all the electricity sold in Indonesia. On average they consume 124 kWh/month. In NTT they consume 60% of the electricity sold but the average consumption at 70 kWh/month is almost half the national average. In NTT 60% of households are PLN customers, indicating that there is still some way to go to achieve 100% electrification. The situation in Flores, which has 37% of the households in NTT, is likely to be less than this as more people live in rural areas. Data is not readily available for the Flores Regencies, but in 2015 approximately 50% of the rural consumers in Manggarai were not connected to PLN. However, it should be noted that PLN is making good progress towards 100% electrification of Flores Island, often under difficult conditions (of terrain and land access).

PLN forecasts the number of residential consumers in NTT to rise from 650,000 in 2018 to 1,250,000 in 2028. PLN also forecasts their average consumption will remain at 69-73 kWh/month until 2024 and then rise to 80 kWh/month by 2028.

Over the ten-year time frame 2018-2028, PLN forecasts a total growth in electricity consumption of 133% (from 920 GWh to 2140 GWh). The following table indicates PLN's forecast growth in total number of customers and total electricity consumption in NTT over the ten-year timeframe of the current (2019) RUPTL:

Table 2: Analysis of PLN Ten Year Forecasts for NTT (per RUPTL 2019)

Class	Increase in number of customers per class	Total increase in consumption per class of consumer	Portion of Total Electricity In 2018(act)	In 2028
Residential	92%	119%	60%	56%
Business	88%	113%	25%	23%
Public	175%	195%	12%	15%
Industrial	100%	272%	4%	7%

The basis for PLN's forecasts is not known. However, it is noted that although customer base is forecast to grow, average consumption per customer is not predicted to grow significantly, except for industrial consumers (they almost double their average consumption).

These forecasts provoke some questions:

1. Are PLN's forecasts reasonable? Are they too high? Are they too low?
2. Are they based on independently verifiable scientific analysis?
3. If average consumption of electricity per household is an indicator of development status (higher consumption = higher standard of living), how can this be increased from the current 70 kWh/month (for connected consumers) towards the national average of 124 kW/month (as this would imply that households have both the means and the desire to purchase more electricity)?
4. A variation of the previous question can be presented this way: 80% of the population of Flores live in rural areas. An average household has 5 persons. Those households that are connected consume around 70 kWh/month. How can development occur in a way that these households have more income and a desire to spend some of this on purchasing more electricity?
5. If central government provides sustained support for development NTT, what are realistic growth scenarios for sectors such as tourism, fisheries, agriculture and industry, and how will these manifest themselves in electricity demand growth?
6. There is very little industry on Flores. PLN has forecast a fourfold (300%) increase in total electricity consumption by industry in the ten-year planning horizon. However, this is from a very low starting point. In regard to industry, what can realistically happen on Flores in a ten-year timeframe?
7. There are indications that current electricity demand would be higher if electricity supply was more reliable. PLN is planning a 70kV/150kV transmission grid which will stretch from Labuan Bajo in the west to Larantuka in the east. When this interconnection is completed over the next ten years and electricity demand and electricity supply can be more effectively matched, how will this affect electricity demand?

6. REALISTIC DEVELOPMENT TARGETS

Many questions were presented in the preceding section. Attempting to answer them may allow realistic development targets and plans for Flores Island to be developed. But another set of questions must also be addressed when considering development targets and plans:

- How can realistic development targets be determined in a holistic manner?
- What range could occur?
- Could the presence of the significant and abundant geothermal resources on Flores influence development targets?
- Could the latter occur:
    - By making more electricity available?
    - By making heat available?
    - By being a tourist attraction in their own right (spas, hot pools, hotels etc)?

7. MASTER PLAN

Because there are so many stakeholders, so many elements and dimensions of "development" to consider, and so many opportunities presented by the presence of geothermal on Flores Island, the Team has accepted a suggestion by Jacobs that a Master Plan, based on a carefully thought-out Strategy, should be an effective way to define, promote and manage the concept of FLOGIS. Such a plan can be a living document. It can be adjusted in real time to reflect changing circumstances and changing priorities. It can be used to inform development investment by GoI and by other parties including developers, institutional investors and lenders.

In order to develop a Strategy which would then inform the Master Plan it is necessary to consider:

- Economic growth scenarios (eg low, medium, high)
- How this growth drives energy demand
- How energy demand is met by energy supply
- How geothermal can be part of the energy supply solution
- How geothermal development is affected by spatial (land), social and environmental considerations
- How the development of geothermal energy sources can be prioritized to support geothermal energy supply
- What constraints there are on funding this development and how can these be removed

8. DEVELOPING A MASTER PLAN

Development Planning

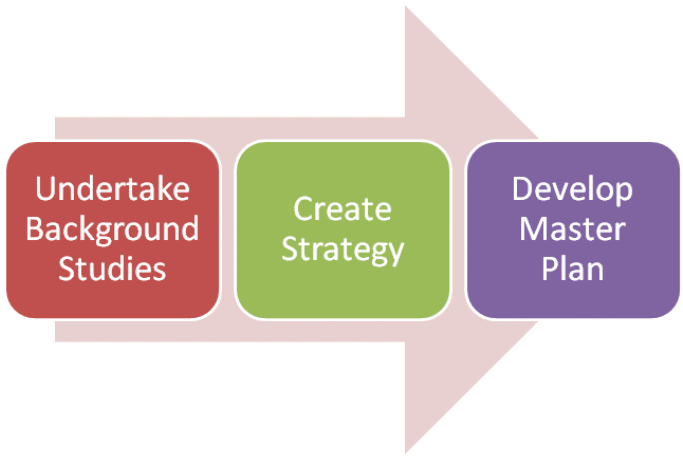
At a National level, Medium Term Development Planning (RPJMN 2020-2014) is undertaken, in consultation with the provinces (in this case NTT). Government funds development activities, with support from external parties. Because of this EBTKE is working with BAPPENAS to ensure FLOGIS is embedded in the upcoming 5-year medium term development plan for 2020-2024 which is being finalised in 2019. EBTKE, with the support of BAPPENAS (Directorate for Energy, Mineral Resources and Mining) has agreed that:

Because: *The Ministerial Decree lays out a high level Vision for Development of Flores Geothermal Island*

Then:

A. A Strategy and a Master Plan are needed to implement this Vision
B. Several major stakeholders must be involved in such a Strategy and Master Plan [many, but not all, are listed in the decree]
C. Two phases are proposed:
    1. Phase 1 is preparation of the Strategy and an initial Master Plan.
    2. Phase 2 is implementation of the Master Plan (likely to start with some pilot project activities)

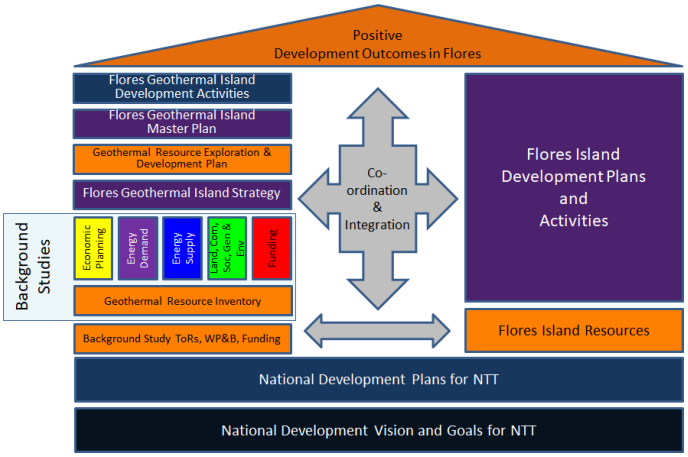
Background Studies

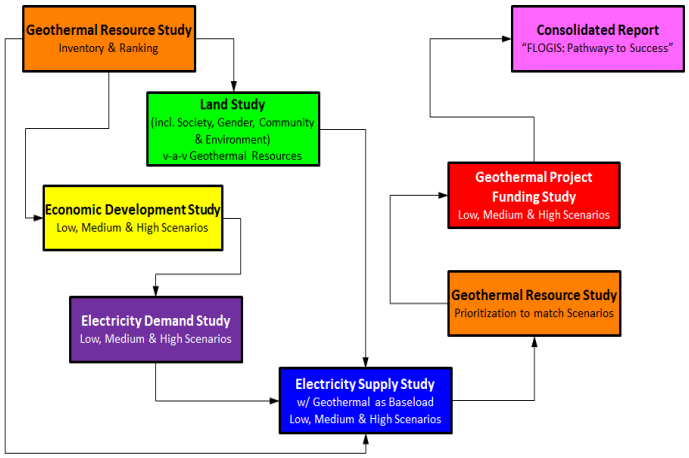


The approach agreed upon to create the Strategy and Master Plan is presented in the adjacent diagrams.

To create a FLOGIS Strategy it is necessary to know:

1. What geothermal resources are (or may be) present, what needs to be done to improve knowledge of these, and which ones to prioritize.
2. How do land, social, environmental factors affect or constrain development of these resources?
3. What are realistic economic development growth scenarios for Flores?
4. How do these scenarios affect electricity demand on Flores?
5. Given realistic time frames for exploring and developing geothermal resources on Flores, how can geothermal (and other RE) help meet this demand?
6. What funding is needed to support this geothermal (and other RE) development?





A set of background studies would help to answer these questions. The rationale for such background studies is:

- ➔ Scientific research is needed in order to understand the constraints that hinder economic development in NTT.
- ➔ Understanding the constraints will allow solutions to be considered.
- ➔ Successful implementation of such solutions will foster economic development.
- ➔ It is realistic to expect a range of economic development growth rates to occur.
- ➔ Therefore a set of development growth scenarios covering low, medium and high development growth pathways is needed to:
  - o inform low, medium and high electricity demand growth scenarios.
- ➔ The electricity demand growth scenarios can be met by a corresponding set of electricity supply growth scenarios combination of renewable energy, geothermal energy as baseload (per the FLOGIS Vision) and other traditional energy sources (coal, gas, oil).
- ➔ The geothermal contribution in the supply growth scenarios will inform the prioritising of geothermal project/prospect planning and development for each scenario.
- ➔ The spatial, environmental and social aspects of potential and current geothermal development areas will also need to be considered when prioritising the geothermal projects and prospects.
- ➔ The geothermal prioritisation and the results from other investigations will inform a Strategy and Master Plan (including a Funding Plan) to achieve this.

9. CURRENT STATUS AND PLAN FOR NEAR FUTURE ACTIVITIES

Currently Jacobs is undertaking the study related to inventory and ranking of geothermal energy sources on Flores Island (the Geothermal Resource Study) under the umbrella of Geo-INZ. This work is being undertaken collaboratively with the Geothermal Sub-Directorate of Badan Geologi, and in close co-operation with EBTKE, thereby leveraging off the capacity development work streams in Geo-INZ.

With the approval of MFAT, Jacobs will also undertake the Electricity Supply Study under Geo-INZ. Following the latter study, Jacobs will prepare the second part of the Geothermal Resource Study which covers the prioritization of geothermal energy sources on Flores Island to meet the supply requirements identified in the Electricity Supply Study.

The United Nations Development Program (UNDP), under its Market Transformation towards Renewable Energy and Energy Efficiency (MTRE3) Program, has agreed to fund and manage (in close collaboration with EBTKE) the four other studies related to Economic Development, Energy Demand, Spatial (including land, gender, community, environment) and Funding. It is anticipated the Funding Study will also be supported by the World Bank.

When all the studies are complete, a Consolidated Report is proposed which will tie them all together and make recommendations for a Strategy and Master Plan, to be discussed and debated with the various stakeholders.

As of the reference date of this paper (end of 2019) Jacobs has prepared an inventorisation and preliminary ranking of geothermal energy sources on Flores Island (the Geothermal Resource Study). The UNDP has also completed the other studies related to Economic Development, Energy Demand, Spatial (including land, gender, community, environment) and Funding. In early 2020 Jacobs will review the UNDP funded studies and then prepare an Energy Supply Study to meet the projections in the Energy Demand study. This Supply Study will identify the appropriate quantum and timing of geothermal baseload electricity in the supply mix. The Geothermal Resource Study will then be updated to include a prioritization of geothermal resources to match this geothermal baseload electricity supply plan.

After the completion of all these studies, a Consolidated Report will be prepared. The target completion date is end of the first quarter in 2020. This Consolidated Report will then be used by EBTKE and other stakeholders to prepare a Strategy. When agreement is reached on the Strategy, a FLOGIS Master Plan will be prepared to implement the Strategy and achieve the Vision as presented in Section 4.

10. ASPIRATIONS

As noted in the Ministerial Decree, FLOGIS is intended to establish an "island development model that utilizes geothermal energy as a primary energy source and is capable of being replicated throughout Regions in Indonesia with similar geothermal potential characteristics". Already there is interest in applying this concept in North Maluku where both the socio-economic conditions and the potential for geothermal energy sources are similar to Flores Island.

11. CONCLUSION

If the concept of Flores Island as a Geothermal Island (FLOGIS) can be successfully implemented, it should support meaningful, authentic and sustainable development on Flores. The approach being taken to develop the concept is to undertake in-depth studies and use the findings from these to prepare a Strategy and use this to inform a 10-20 year Master Plan. EBTKE is the owner of the FLOGIS concept, and the people of Flores Island are the intended beneficiaries of the economic growth that a planned and sustained development of geothermal energy could bring. The approach involves collaboration among many stakeholders. It has been slow to start but has begun gathering momentum in 2019. With further support from various partners (Government of New Zealand, World Bank and others) it is envisaged that the founding Strategy and an initial Master Plan can be completed in 2020. Once this is done, the plan can be tested with some pilot activities or projects. If successful, it is expected that the Master Plan will be a living document – a document that is regularly updated to reflect past achievements and future opportunities.

12. REFERENCES

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