RENEWABLE ENERGY IN INDONESIA:

Overview, Trends, Challenges and Opportunities for New Zealand SMEs in Renewable Energy Engineering, Construction and Consulting sectors

For: NEW ZEALAND TRADE AND ENTERPRISE

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Glossary of Acronyms / Abbreviations, Units

Acronyms

ASELI	Asosiasi Energi Laut Indonesia (Indonesian Ocean Energy Association)
BAPPENAS Perencanaan Development	Kementerian Perencanaan Pembangunan Nasional Republik Indonesia/Badan Pembangunan Nasional (Ministry of National Development Planning/National Planning Agency)
BLU	Badan Layanan Umum (public service agency)
BPP	Biaya Pokok Penyediaan Listrik (basic cost of electricity supply)
BPPT Application of	Badan Pengkajian dan Penerapan Teknologi (Agency for the Assessment and Technology)
BUMN	Badan Usaha Milik Negara (state-owned enterprises)
EAL	Energi Arus Laut (Ocean current energy)
EBTKE and Resources	Direktorat Jenderal Energi Baru Terbarukan dan Konservasi Energi (Ministry of New Renewable Energy and Energy Conservation). Under Ministry of Energy and Mineral
EPC	Engineering, procurement and construction
ESDM Resources)	Kementerian Energi Dan Sumber Daya Mineral (Ministry of Energy and Mineral
GoI	Government of Indonesia
IPP	Independent power producers
MVA	Mega Volt Amps
OWC	(Oscillating Water Column)
PLN	Perusahaan Listrik Negara - (national electricity company - state-owned)
PLTA	Pembangkit Listrik Tenaga Air (hydroelectric power plant)
PLTAL	Pembankit Listrik Tenaga Air Laut (tidal wave power plant)
PLTB	Pembangkit Listrik Tenaga Bayu (wind power plant)
PLTGL	Pembangkit Listrik Tenaga Gelombang Laut (wave power plant)

PLTGL-SB	Pembangkit Listrik Tenaga Gelombang Sistem Bandul (pendulum system wave power plant)
PLTP	Pembangkit Listrik Tenaga Panas bumi (geothermal power plant)
PLTS	Pembangkit Listrik Tenaga Surya (solar power plant)
PSP	Penugasan Survei Pendahuluan (preliminary survey)
PSPE	Penugasan Survei Pendahuluan dan Eksplorasi (preliminary and exploration survey)
RE	Renewable Energy
WKP	Wilaya Kerja Pertambangan - (geothermal mining/work area)
WPSPE	Geothermal survey and introduction study

Units

GW	Gigawatts
kW	Kilowatts
MW	Megawatts
MVA	Megawatt ampere
TW	Terawatts

1. Overview of Renewable Energy

a. Generic brief background on Renewable Energy in Indonesia and current status

Indonesia has been slow out of the blocks in developing renewable sources of energy, but the nation's natural potential is enormous. What is more, energy demand in Southeast Asia's largest economy is quickly rising. Electricity consumption is forecast to more than double by 2025, fuel consumption is set to rise even faster. Aside from the obvious positives such as reducing Indonesia's carbon emissions and meeting or even surpassing its Paris Agreement commitment, as well as finally breaking the nation's dependence on coal, renewables could bring off-grid power to the tens of millions of Indonesians who still have no access to a reliable electricity supply and, instead, rely on expensive, polluting power from diesel generators.

In the past, fuel subsidies and low electricity tariffs, logistical challenges, complex regulations, legal uncertainties and, not least, the abundance of cheap coal, deterred potential investors from funding development of renewable energy. Years of under-investment, and a lack of incentives have resulted in still only a very small portion of the country's energy mix being supplied by clean, renewable energy today. This leaves a lot of catching-up to do as Indonesia seeks to diversify its energy sources. The government's "fast track programme" to boost national power output now puts the focus on renewables after relying mainly on coal in its initial phase.

In an effort to reduce costly oil imports and bolster energy security, the government has begun to raise fuel and power prices and is beginning to design financial incentives to promote the development of alternative, clean sources of energy. Soft loans from development banks and multilateral investment funds such as the Clean Technology Fund are designed to mitigate risks for early investors. In addition, contract tender regulations have been simplified, and Indonesia's improving infrastructure is making projects in remote regions more viable. The result is an altogether brighter environment for renewable energy investment and technology partnerships.

The National Energy Plan (NEP14) is Indonesia's multi-sectoral energy policy enacted in January 2014 by the House of Representatives. It updated the 2006 national energy plan. It continues to be in effect and will expire in 2025 once it has reached its targets for Indonesia's energy mix. NEP14 was enacted to increase Indonesia's energy independence by developing new energy sources and increasing domestic use of locally produced fuel rather than exporting it abroad. This requires Indonesia to decrease oil imports by supplanting it with increases in coal and renewable energy production, as well as improving efficiency in energy production and consumption.

NEP14's targets for the 2025 energy mix are: 30% coal, 22% oil, 23% renewables, and 25% natural gas. By 2050, NEP14 targets renewables at 31% of the energy mix. The policy also

lays out steps to increase the electrification ratios, especially in rural areas. State electricity company Perusahaan Listrik Negara (PLN) releases a 10-year electricity supply plan every year, called Rencana Umum Penyediaan Tenaga Listrik (RUPTL). The latest RUPTL for 2019 - 2028 was released at the end of March 2019 (for details see Chapter 2. a) ii) on PLN).

Providing a reliable electricity supply to Indonesia's almost 270 million people, spread across thousands of islands, and to power the nation's economy is a huge challenge – one that calls for significant private-sector participation. Independent power producers (IPPs) are expected to gain a stronger foothold in Indonesia's power sector, since private capital is seen as indispensable to meet the country's urgent energy needs. However, Indonesia's government needs to provide a lot more incentives to be able attract the level of investment needed to exploit the country's enormous natural resources of clean, renewable energy. Recent years have seen a number of measures and legal changes aimed at attracting more investment into renewable energy projects.

Incentives:

Feed-in tariffs require PLN to purchase electricity from renewable energy producers at predictable prices (which vary from one area to another). This is vital in the current setup of Indonesia's energy market, where both the upstream and downstream sectors are still heavily regulated and controlled by state-owned companies. It is also preferable to case-by-case negotiations on power purchase agreements, as it provides the level of certainty that makes long-term planning easier for investors aiming to engage in multiple projects.

Government guarantees further reduce the financial risks for developers and IPPs. The Indonesia Infrastructure Guarantee Fund (IIGF) provides guarantees for the construction and operation of power plants in public-private partnerships (PPPs). The Business Viability Guarantee Letter (BVGL) pertains to the sale of electricity to PLN and helps producers attract long-term bank funding. The Geothermal Fund Facility (GFF) provides support for data acquisition and exploration activities, which is seen as particularly important to justify the high upfront costs for this type of energy.

Tax holidays and income tax reductions are also available for renewable energy projects, although these have been criticized for lacking clarity by not conforming to a consistent policy that is implemented in a coherent way across the country. Certain exemptions are also available for VAT and duties levied on the import of capital goods for renewable energy projects.

b. Availability of new and renewable energy sources and current utilization

Geothermal

Geothermal power is one of the most exciting opportunities in Indonesia and, unlike most other forms of electricity generation, it is dominated by IPPs. A country of exceptional

volcanic activity, Indonesia is believed to harbour around 40% of the planet's geothermal potential, with estimated resources and reserves totalling 28,000 megawatts (MW), with the majority of the resource on the islands of Sumatra and Java. However, it is difficult to more accurately assess the country's geothermal energy potential before a comprehensive national survey is conducted. The geothermal (panas bumi) directorate of Indonesia's Directorate General of New and Renewable Energy and Energy Conservation (EBTKE), under the Ministry of Energy and Mineral Resources, regularly updates resource estimates based on progress reports from the current 11 wilayah kerja pertambangan (WKP) - geothermal mining areas. The most current geothermal resource potential based on these reports according to EBTKE panas bumi is around 25,600 MW.

Although Indonesia has been slow to develop its abundant geothermal resources, it is now ramping up development and has newly overtaken the Philippines to become the world's second largest country in terms of installed geothermal energy capacity behind the US. By the end of 2018, Indonesia had installed 1,948.5 MW of geothermal capacity, compared with 3,639 MW in the US. Current government planning is to boost installed capacity to 7,241.50 MW by 2025, and to 10,003.50 MW by 2030. It goes without saying that exploration and development needs to speed up if the country is to meet its targets. Problems with tendering, permits, lack of incentives for the high costs of exploration and local opposition are blamed for holding up projects in some areas.

Hydroelectric power

Hydroelectric power boasts even greater potential than geothermal energy, estimated at around 75,000 MW. It is currently the most utilized source of renewable energy in Indonesia, with total installed capacity of around 6,000 MW. Potential hydropower sites are spread across the country, with high potential for large-scale projects seen in the under-served eastern regions of the country, such as Maluku and Papua. There has so far been little debate in Indonesia about the destructive impacts of large dams, although developers of a large China funded project in North Sumatra have agreed to evaluate the project following questions and opposition from Indonesian and some international environmental groups.[1] Hydropower developers face the geographic challenge that many of the sites for large-scale projects lie in isolated and usually forested regions with little or no infrastructure. Small-scale hydropower projects (defined as those generating less than 10 MW), on the other hand, are less bankable and face their own technical challenges, such as sourcing equipment from across the country or even from abroad – which present a challenge to project viability given the low capacity. However, micro and mini-hydropower projects enjoy support from the government and development agencies, and in some cases microfinance credit. Hydropower offers opportunities for suppliers and consultants working in tandem with public backers and local stakeholders.

Solar

[1] Bank of China to review funding of dam in orangutan habitat in Sumatra. Mongabay, 19/3/2019: https://news.mongabay.com/2019/03/bank-of-china-to-review-funding-of-dam-in-orangutan-habitat-in-sumatra/

Solar photovoltaic energy (PV) is one of the most neglected forms of renewable energy in Indonesia, although it too could contribute significantly to closing the gap between current installed capacity and the huge increase in future demand. Located on the equator, Indonesia is blessed with strong solar radiation, especially in eastern and southern regions such as East Java. Solar power is well suited for electrifying remote rural regions. The challenge with off-grid rural PV projects is that they are unfeasible on a purely commercial basis, while appropriate government programmes to subsidize PV installations are lacking. Grid-connected projects to sell PV electricity to PLN, meanwhile, are still largely untested in Indonesia, although interest is growing. November 2013 saw the launch of a tender for 80 sites totalling 140 MW, which foreign companies could participate in jointly with local entities. The government is trying to boost the local production of PV systems; using locally made equipment (at least 40%), which it aims to reward with higher feed-in tariffs. Despite the huge potential for solar power in Indonesia - an average of 4,800 kWh per square metre a day could potentially provide a massive 500,000 MW of electricity capacity - the current installed solar capacity in Indonesia is a mere 24 MW.[2] The Institute for Energy Economics and Financial Analysis (IEEFA), estimate around 14.7 MW of running solar power on Indonesia's electricity network, around 48 MW under construction, and a further 326 MW planned for construction. It became even more evident that the Indonesian government is ignoring the country's solar energy potential when state power company, PLN, only set a target of 908 MW of solar energy by 2028 in its 2019-2028 electricity supply business plan (RUPTL).

c. Possibility of new and renewable energy sources that are as yet untapped

Marine Energy

Since the issuance of Law No. 17/2007 RPJPN 2005-2025, efforts to develop a road map for the development of marine energy are underway. The Marine Law, passed by the DPR in September 2014, provides the basis for the marine development road map. There are three types of marine energy that can be utilized; wave; ocean currents (Tidal + Ocean current energy) and; ocean heat. Indonesia's Marine Energy Association - Asosiasi Energi Laut Indonesia (ASELI) estimates the theoretical energy potential of these three types of marine energy to total around 727 GW.

Wave Energy

The potential for generating energy from waves in Indonesian waters is considerable, with average wave heights of around 2-2.5 meters in the South Java Sea and 4-5 meters off the

[2] Renewable Energy Development: Large potential of solar power under-optimized: https://www.pwc.com/id/en/media-centre/infrastructure-news/march-2019/large-potential-of-solar-power-underoptimised.html

west coast of Sumatra in the Indian Ocean. In 2011 ASELI estimated the theoretical potential of wave energy to be around 510 GW, a technical potential of 2 GW, and a practical potential of 1.2 GW.

A small system to generate electricity from wave energy developed by students and lecturers of Tin Manufacturing Polytechnic in Bangka-Belitung province, received patent rights from the Indonesian Ministry of Law and Human Rights, with the cost of the patents being borne by the Ministry of Education. Research has also been conducted by M. Imron, T. Marine, Institut Teknologi Bandung (ITB).

Experiments using a horizontal PLTGL-SB (pendulum system) by Zamrisyaf (patent owner No. HAKI P00200200854) were able to produce 3 kW of electricity to provide lighting for 20 houses.[3] Harnessing just 20% of available wave power off Java's south coast using the PLTGL-SB pendulum system could potentially provide 6.5 GW, with a potential of 40 kW per meter of wave height. PLTGL-SB (horizontal / vertical) has similar electricity generation potential to hydropower, with 20 MW PLTGL from every 1 km^2 of sea area. The pontoon (small barge) used is partially submerged in water, with a 2 meter arm length, and a pendulum weighing 10 kg. Wave heights in the range of 0.5-1.5 m, producing 200 rpm, can generate 25.2 kW of energy. One pontoon unit consisting of 5 sets of pendula has the potential to generate 125 kW of energy.

Sea Flow Energy (ELS) - Tidal + Ocean Current Energy

Ocean currents in Indonesia are tidal due to the interaction of the earth, moon, sun, and geostropic currents because of the Coriolis force due to the Earth's rotation and the difference in salinity, temperature, and density. Tidal currents store hydrokinetic energy, and using a pendulum system (PLTGL-SB) this can be converted vertically into electrical power depending on fluid density, flow section, and flow velocity. The straits that funnel the throughflow from the Pacific Ocean to the Indian Ocean, such as the Lombok Strait, have the strongest currents, and therefore the largest electricity generation potential.

Indonesia has huge potential for marine energy - around 5.6-9 TW (5,600-9,000 GW) according to state planning agency, Bappenas. Indonesia's Agency for the Assessment and Application of Technology - Badan Pengkajian dan Penarapan Teknologi - (BPPT) estimate the theoretical potential of Indonesia's tidal currents at 160 GW, technically 22.5 GW, and practically 4.8 GW.

Bappenas supports EAL (Ocean current energy) as a reliable source of renewable energy to meet the demands of coastal communities in the outlying regions of the country, especially those that are off the PLN grid. The rate of tidal currents (tidal) on the coast is generally less than 1.5 m / sec, except in the straits between the islands of Bali, Lombok and NTT, where they can reach 2.5-3.4 m / sec. The strongest tidal currents were recorded in the Strait

[3] Modelling of vertical pendulum motion in the converter - ITATS e-Journal, 2017, (in bahasa Indonesia): https://ejurnal.itats.ac.id/iptek/article/download/100/60

between Taliabu and Mangole P. in the Sula archipelago, North Maluku at a rate of 5.0 m / s. Open Hydro Open Center Turbine technology with a 16m diameter, current rate of 2-5m / sec, has the potential to produce 2 MW of electricity.

In 2004, the BPPT / BPDP (Coastal Dynamics Assessment Center) built the first OWC (Oscillating Water Column) prototype on Parang Racuk beach, Baron, Gunung Kidul with a wave potential of 19 kW / wavelength. In 2006, an OWC Limpet / floating system was sited besides the fixed OWC.

In 2005: research into the characteristics of ocean currents was carried out by the Research Center for Marine Geology (PPPGL) in collaboration with the Oceanographic Study Program of ITB in the Lombok Strait and the Alas Strait using a 300 kW Kobold turbine.

2006 - 2010: BPPT research was conducted in several Nusa Tenggara straits (NTB and NTT), including S. Lombok, S. Alas (piloted in April 2012, 75 MW), S. Nusa Penida, S. Flores, and S. Pantar . Other straits that are estimated to have strong ocean currents are S. Sape, S. Linta, S. Molo, S. Boleng, S. Lamakera, and S. Alor. If one strait can be harvested with energy of 300 MW assuming 100 turbines each with a power of 3 MW, electricity will be generated around 3GW for 10 straits. In 2009, BPPT tested PLTAL prototypes of 2 kW and in 2011 it was 10 kW on S. Flores. The first prototype was built by PPPGL with T-files groups ITB and PT Dirgantara Indonesia, which were tested on S. Nusa Penida and were able to drive 5,000W electric generators.

In August 2015 PLN signed an MoU with PT SBS International Limited (UK) to build Indonesia's first commercial tidal wave power plant (PLTAL) in Nusa Tenggara Barat (NTB) - (S. Alas and S. Lombok) and S. Badung (Bali), with a first capacity of 12 MW, with plans to increase the capacity to 150MW at a cost of US$ 350 million.[4]

In March 2018, a Netherlands consortium, Tidal Bridge BV and PJB, signed a Head of Agreement (HoA) with the Indonesian Ministry of Public Works and Housing (PUPR) and the NTT Provincial Government for a joint venture, to build the Palmerah Pancasila Bridge with local integrated with ocean current turbines in the Larantuka Strait, spanning 810 meters between the islands of Adonara and Flores. The ocean-based private power plant project, called 'Tidal Bridge Indonesia' will become Indonesia's first marine power plant (PLTAL) and the largest in the world, with the potential to generate 20 MW. Tidal Bridge assumes that with the velocity of the sea flow of Larantuka Strait an average of 3.5 m / s, the installed capacity of each turbine is 16 MW with effectively generated energy of 6 MW. Assuming the installation of 5 turbines, the energy is generated on average by 30 MW. PLN also signed an MoU with Tidal Bridge BV to conduct feasibility studies and a study of network impacts in the context of energy utilization from the Ocean Flow PLT.[5]

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[4] PLN signs MoU with SBS International to develop tidal wave power plant, 20/08/2015: https://www.rambuenergy.com/2015/08/pln-signs-mou-with-sbs-international-to-develop-tidal-wave-power-plant/

[5] "Proyek Pembangkit Arus Laut di Larantuka, Flores Segera Direalisasikan" (Ocean Flow Generator Project in Larantuka, Flores to proceed immediately, Ekonomi 01/04/2018: https://ekonomi.bisnis.com/read/20180401/44/778722/proyek-pembangkit-arus-laut-di-larantuka-flores-segera-direalisasikan

Sea Heat

Ocean Thermal Energy Conversion, Ocean Thermal Energy Conversion (OTEC) is an effort to utilize temperature differences that occur at sea level and in the depths of the ocean to drive heat engines, so that heat energy is converted into mechanical energy. OTEC is grouped into 3 types, closed cycles, open cycles, and combined cycles (hybrids). Sea Heat prediction potential: 240 GW, technical 52 GW, and practically 41 GW. Based on research conducted in 2017 by the Marine Geology Research and Development (PPPGL) of the Ministry of Energy and Mineral Resources (ESDM), Indonesia has the world's largest potential for harnessing marine energy from Ocean Thermal Energy Conversion (OTEC). The research, carried out at 17 locations across Indonesia, from the west coast of Sumatra, south of Java, Sulawesi, North Maluku, Bali and Nusa Tenggara Tengah (NTT), estimated the energy potential to be around 41 GW.[6] In addition to producing electricity, the OTEC process also produces pure water due to evaporation of seawater.

[6] Fact Sheet Sea Trial Kapal Riset Geomarin III Di Perairan Selat Sunda (Sea Trial of Geomarin III Research Vessel in Sunda Strait Waters), 7/8/2017: https://www.mgi.esdm.go.id/content/fact-sheet-sea-trial-kapal-riset-geomarin-iii-di-perairan-selat-sunda

2. Government related stakeholders in Renewable Energy

a. Government Stakeholders

i. Ministry of Energy, Mineral and Natural Resources (MEMR) / Kementerian Energi dan Sumber Daya Mineral (ESDM)

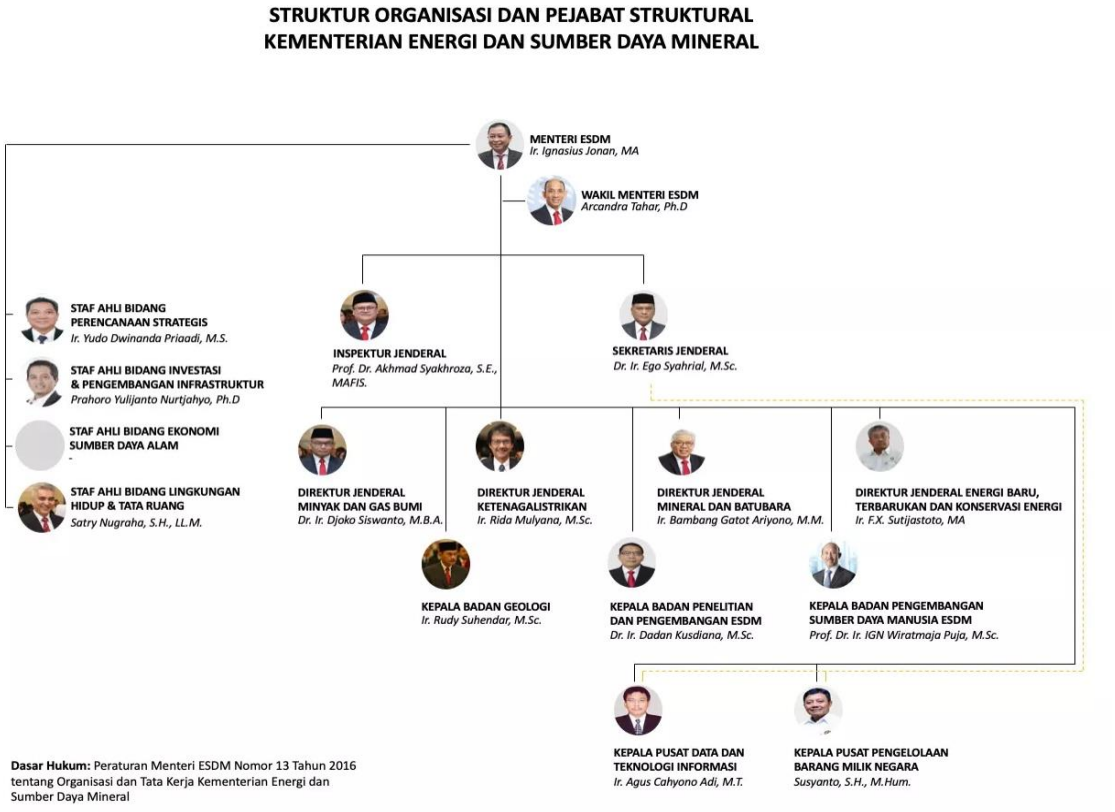
1. Roles

https://www.esdm.go.id/en/profile/duties-functions

- Formulation and determination of policies in the field of training, controlling and supervising of oil and gas, electricity, minerals and coal, new energy, renewable energy, energy conservation, and geology;
- The implementation of policies in the field of training, controlling and supervising of oil and gas, electricity, minerals and coal, new energy, renewable energy, energy conservation, and geology as well as management of Non-Tax State Revenue in the energy and mineral resources sector in accordance with legislation;
- The implementation of technical guidance and supervision on the implementation of policies in the field of fostering, controlling and supervising oil and gas, electricity, minerals and coal, new energy, renewable energy, energy conservation, and geology;
- Implementation of research and development in the field of energy and mineral resources;
- Implementation of human resource development in the field of energy and mineral resources;
- Implementation of support that is substantive to all elements of the organization within the Ministry of Energy and Mineral Resources;
- Training and providing administrative support within the Ministry of Energy and Mineral Resources;
- Management of property / wealth which is the responsibility of the Ministry of Energy and Mineral Resources; and
- Supervision on the implementation of duties within the Ministry of Energy and Mineral Resources.

2. Structure of organization, map of important decision makers

Figure 1. Ministry of Energy and Mineral Resources (ESDM) Organizational Structure



The Secretariat General is under the authority of and responsible to the Minister. A Secretary General leads the Secretariat General.

Duties and Functions

The Secretariat General is responsible for coordinating the implementation of the duties, development and administrative support to all elements of the organization in Ministry of Energy and Mineral Resources. In performing those duties, Secretariat General has the following functions:

1. coordinating the programs in Ministry of Energy and Mineral Resources;

2. coordinating and formulating plans, programs, and budget for Ministry of Energy and Mineral Resources;
3. developing and giving administrative supports including administration, personnel, finance, general affairs, cooperation, public relations, archive, and documentation of Ministry of Energy and Mineral Resources;
4. developing and maintaining the organization and management;
5. coordinating and formulating legal drafting as well as legal advocacy;
6. maintaining state-owned assets and the service of governmental goods/services procurement;
7. implementing other functions as mandated by the Minister.

The Inspectorate General is under the authority of and responsible to the Minister. An Inspector General leads the Inspectorate General.

Duties and Functions

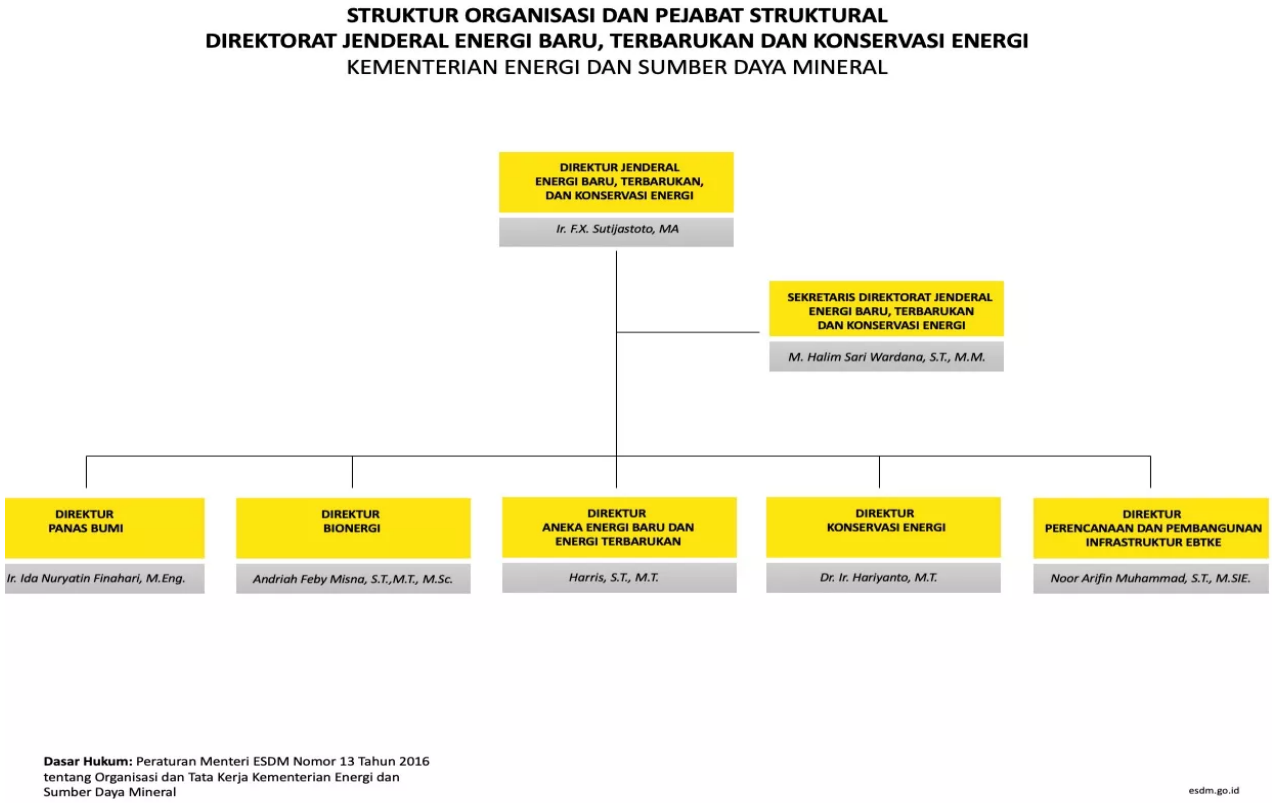
The Inspectorate General is responsible for internal supervision in the Ministry. In performing those duties, Inspectorate General has the following functions:

1. formulating technical policy for internal supervision in the Ministry;
2. giving internal supervision in the Ministry of Energy and Mineral Resources over the performance and finance through audit, review, control, and other supervisions;
3. performing supervision for certain purposes based on the assignment of the Minister;
4. formulating report of supervision in the Ministry;
5. managing the administration of Inspectorate General;
6. performing other functions assigned by the Minister.

ii. EBTKE and its related agencies / body

http://www.ebtke.esdm.go.id/

Figure 2. Directorate General of New Renewable Energy and Energy Conservation Organizational Structure



The Directorate General of New, Renewable Energy, and Energy Conservation is under the authority of and responsible to the Minister. A Director General leads the Directorate General of New, Renewable Energy, and Energy Conservation

Duties and Functions

The Directorate General of New, Renewable Energy, and Energy Conservation is responsible for formulating and conducting policy in the field of development, controlling, and supervision on geothermal energy, bioenergy, various new and renewable energy, and energy conservation. In performing those duties, Directorate General of New, Renewable Energy, and Energy Conservation has the following functions:

1. formulating policy in the field of development, controlling, and supervision for any activities of business, engineering, occupational safety, environment, as well as the construction of certain facilities and infrastructures on geothermal energy, bioenergy, various new and renewable energy, and energy conservation;

2. implementing policy in the field of development, controlling, and supervision for any activities of business, engineering, occupational safety, environment, as well as the construction of certain facilities and infrastructures on geothermal energy, bioenergy, various new and renewable energy, and energy conservation;

3. formulating norms, standards, procedures, and criteria in the field of development, controlling, and supervision for any activities of business, engineering, occupational safety, environment, as well as the construction of certain facilities and infrastructures on geothermal energy, bioenergy, various new and renewable energy, and energy conservation;

4. providing technical guidance and supervision in the field of development, controlling, and supervision for any activities of business, engineering, occupational safety, environment, as well as the construction of certain facilities and infrastructures on geothermal energy, bioenergy, various new and renewable energy, and energy conservation;

5. giving evaluation and report in the field of development, controlling, and supervision for any activities of business, engineering, occupational safety, environment, as well as the construction of certain facilities and infrastructures on geothermal energy, bioenergy, various new and renewable energy, and energy conservation;

6. managing the administration of Directorate General of New, Renewable Energy, and Energy Conservation; and performing other functions assigned by the Minister.

3. Organizational Structure

The Directorate General of New, Renewable Energy, and Energy Conservation consists of:

1. Secretariat Directorate General of New, Renewable Energy, and Energy Conservation;
2. Directorate of Geothermal Energy;
3. Directorate of Bioenergy;
4. Directorate of Various New Energy and Renewable Energy;
5. Directorate of Energy Conservation;
6. Directorate of New, Renewable Energy, and Energy Conservation Infrastructure Planning and Development.

3. Budget Cycle

Like all of Indonesia's Government Ministries, ESDM is allocated funds from the State Revenue and Expenditure Budget (APBN). The APBN is the annual financial plan of the Indonesian state approved by the House of Representatives and contains a systematic and detailed list that contains plans for state revenues and expenditures for one fiscal year (January 1 - December 31).

The ESDM budget for year 2019 is Rp 4.98 trillion (US$ 354.74 million), with 28.7% allocated for apparatus expenditure, 20.8% for the ministry's non-physical public expenditure and 50.5% for infrastructure expenditure. The ESDM budget has fallen significantly from the previous two fiscal years (2017 and 2018), when it was Rp 6.57 trillion (US$ 471.2 million) for both years.

4. Procurement system if any

As with all Government Ministries and State Owned Enterprises, to improve transparency and accountability, the procurement of goods / services whose funds are sourced from the State Budget and managed by ESDM, are managed through an e-procurement platform (LPSE). Interested suppliers of goods / services can take part in tender auctions through the ESDM office or via the internet from their respective offices. Qualification documents, procurement documents and other documents are available (in bahasa) at https://eproc.esdm.go.id/eproc4. Usage guides and updates are available at:
https://eproc.esdm.go.id/eproc4/publik/special

Figure 3. Procurement of Goods and Services in Indonesia

Different to most countries, Indonesia's public procurement is regulated not by a specific law, but by a Presidential Regulation. The latest Regulation that applies is no. 16 of 2018 concerning Public Procurement. Supporting documents and rules detail each procedure in the public procurement system, and provide guidance and technical guidelines. The main supporting documents regarding procurement are:

1. NPPA Regulation No. 11 of 2018 concerning Electronic Catalogs
2. NPPA Regulation No. 9 of 2018 concerning Guidelines for Procurement of Goods/Services throughProviders
3. NPPA Regulation No. 2 of 2018 concerning Amendments to NPPA Regulation No. 6 of 2016 concerning Electronic Catalogs and ePurchasing.

Public Procurement in Indonesia is carried out in a decentralized manner, and while improvements are regularly being made, it is still a rather complex system. Each government institution, both at the central and regional levels, has a special unit tasked with organizing procurement, both electronically and manually. For providers of goods and services who want to take part in the bidding, they need to register as provider in a special portal (Lembaga Pelelangan Secara Elektronik (LPSE)) provided by each government institution.

In 2008 the Indonesian government created INAPROC, a national e-procurement system to gather the procurement possibilities around the country in one place for informational purposes. The process of electronic procurement starts with the demand of the users (procurers) in each ministry, organization, and local government to each Procurement Service Unit [Unit Layanan Pengadaan (ULP) to procure a certain good, service or work. The ULP then will input the data related with the good/service procurement to the Electronic Bidding System (Sistem Pengadaan Secara Elektronik (SPSE)), which is integrated with the Electronic Procurement Services Hosts (LPSE) in each ministry, organization, and local government (province/regency/city).

The services available in the Electronic Procurement System are tenders regulated by the provisions of the NPPA Regulation No. 9 of 2018 concerning Guidelines for Procurement of Goods/Services through Providers. In addition, NPPA also provides Electronic Catalog facilities (e-Catalog), which are electronic information systems that contain lists, types, technical specifications and prices of certain goods from various services providers. According to Presidential Regulation no. 16 of 2018, in Indonesia there are various methods of public procurement that combine both electronic and print-based methods. Both apply simultaneously and have equal weight in the legal framework, although the existing version of the Presidential Regulation no. 16 of 2018 and its sub-legal acts encourage e-procurement mechanisms for all types of procurement.

The National Public Procurement Agency (NPPA) is the main body responsible for preparation and formulation of strategies in the area of public procurement, as well as determining policy and procedure standards.

The main functions of the NPPA are:

1.Monitoring and evaluating the implementation of public procurement rules;
2.Guiding and developing information systems and supervise the implementation of electronic procurement;
3. Providing technical guidance, advocacy and legal assistance;

NPPA is not an independent agency, since in carrying out its duties and functions it is subordinate to the State Minister of National Development Planning and is accountable directly to the President.

Indonesia's PPL ensures transparency of public procurement information. However, transparency clauses of the law span up until the tendering phase, with post-tendering phase information completely missing from the legislative framework. There is a single national e-portal INAPROC, which gathers information on procurement announcements from numerous electronic portals of the different central and local procuring entities. Additionally, there's a separate portal – LPSE, which shows information on individual tenders up until the signing of the contract. Another important portal is the SiRUP, which stores information on public procurement annual plans. In total, there are over 25 portals or applications dedicated to different phases of public procurement process. All of these portals or applications can be found on the website of NPPA.

Source: Recommendations for the Public Procurement System of the Republic of Indonesia, Hivos, IDFI, 2018: https://openupcontracting.org/assets/2019/04/Indonesia-Brief-on-Public-Procurement.pdf

iii. PLN

https://www.pln.co.id/

In 1972, in accordance with Government Regulation No. 17, the status of the National Electricity Company (PLN) became the State Electricity Public Company and the Holder of the Electricity Business Authority (PKUK) with the task of providing electricity for the public interest.

In line with the Government's policy of providing opportunities for the private sector to move into the electricity supply business, in 1994 the status of PLN shifted from a Public Company to a State Owned Enterprise (Persero). PLN is Indonesia's second-largest state company by assets.

PLN has been plagued by inefficiency in its operations and for many years has been threatened with reform. Although there have been improvements and the national electrification rate has seen considerable progress in recent years, problems still remain. The Ministries of FInance and Economics, amongst others, have criticized the running of PLN and the threat of reform remains. One of the biggest problems has been the Government's obligation to provide a subsidy to PLN for the difference between the government subsidized electricity tariff and the considerably higher cost to generate, transmit and distribute electricity to customers.[7]

Since the passage of a new electricity law in 2009 (Law 30/2009), PLN no longer has a legal monopoly over electricity generation, transmission and distribution, but it has a right of first refusal over any activity in the subsector and this is an effective deterrent for private enterprise in many cases. Even though there are glimmers of hope, PLN's effective monopoly continues to hold back the massive uptake of renewable energy that Indonesia needs to transition and drive the nation's economy in coming decades.

1. **Roles**

   PLN controls and manages all of Indonesia's power generation, transmission, distribution and retail sales of electricity. Charges for electricity are based on an electricity tariff set by the Government. PLN releases a 10-year electricity supply plan every year, called Rencana Umum Penyediaan Tenaga Listrik (RUPTL). The latest RUPTL for 2019 - 2028 was released at the end of March 2019.

2. **Structure of organization, structure of sub companies and the sub-companies related to renewable energy**

   The top level management, headed by the president director, reports to a government-appointed board. The board and the PLN management in turn report to the Minister of State-Owned Companies (MSOE).

[7] Law Number 19/2003 on State Owned Enterprises (SOEs)

Board of Commissioners

Oegroseno	- Independent Commissioner since October 2014
Darmono	- Independent Commissioner since October 2014
Ilya Avianti	- President Commissioner & Commissioner
Andy Noorsaman Sommeng	- Commissioner since July, 2017. Director General of Electricity at ESDM
Rionald Silaban	- Commissioner since February, 2017
Budiman	- Commissioner
Aloysius K. Ro	- Commissioner

Board of Directors

Sofyan Basir[8]	- President Director
Supangkat Iwan Santoso	- Director of Strategic Procurement
Sarwono Sudarto	- Director of Finance
Muhamad Ali	- Director of Human Capital Management
Syofvi Felienty Roekman	- Director of Corporate Planning
Amir Rosidin	- Central Java Regional Business Director
Wiluyo Kusdwiharto	- Sumatra Regional Business Director
Haryanto W.S.	- West Java Regional Business Director
Amir Rosidin	- Director

PLN Subsidiary companies

Figure 4. PLN Subsidiary Companies

Subsidiary Company	Business Activity
PT Indonesia Power (IP) www.indonesiapower.co.id	Engaged in the field of electricity generation and other related businesses. Established on October 3, 1995 under the name of PT PJB I. On September 1, 2000 it changed to PT Indonesia Power. PT IP subsidiary companies are:

[8] Sofyan Basir under investigation by KPK, Indonesia's anti-corruption agency, for bribery linked to construction of PLTU - Riau 1 coal plant in Sumatra, Kompas, 23/04/2019: https://nasional.kompas.com/read/2019/04/23/17165241/kpk-tetapkan-dirut-pln-sofyan-basir-tersangka-korupsi-pltu-riau-1

	- PT Cogindo Daya Bersama is engaged in cogeneration, distribute generation and operation & maintenance services - PT Artha Daya Coalindo is engaged in trading and coal transportation services - PT Indo Pusaka Berau with electricity supply activities from the production of the Lati PLTU in Berau, East Kalimantan.
PT Pembangkitan Jawa Bali (PTPJB) www.ptpjb.com	Engaged in the field of electricity generation and other related businesses. Established on October 3, 1995 under the name of PT PJB II. On September 1, 2000 it changed to PT PJB. Subsidiary of PT PJB which is engaged in operation and maintenance, namely PT Pembangkitan Jawa Bali Services, which is domiciled in Surabaya.
PT Pelayanan Listrik Nasional Batam (PT PLN Batam) www.plnbatam.com	Established on October 3, 2000 and engaged in electricity supply business for public interest in the Batam Island area.
PT Indonesia Comnets + (PT ICON+) www.iconpln.co.id	Established on October 3, 2000 and is engaged in telecommunications business.
PT PLN Tarakan	Established on December 15, 2003 and is engaged in electricity supply business for public interest in the Tarakan Island region, East Kalimantan.
PT PLN Batubara plnbatubara.co.id	PT PLN Batubara was established on September 3, 2008 and is a subsidiary engaged in the coal mining business as the main material of the Steam Power Plant (PLTU).
PT PLN Gas and Geothermal http://www.plngg.com/id/	PT PLN Geothermal is a subsidiary of PLN whose business sector is focused on the renewable electricity supply business, through the development and operation of high-quality economical geothermal power plants with good reliability.
PT Layanan Nasional Enginiring (PLN-E) www.pln-enjiniring.com	Established on October 3, 2002, PLN-E is a subsidiary of PLN which is engaged in engineering and construction.
Majapahit Holding BV	Majapahit Holding BV was established on October 3, 2006 and is a financial institution based in Amsterdam, the Netherlands, with the primary function of serving as a debt-issuing vehicle for PLN. No key executives and website are listed for the company.

PT Haleyora Power (HP) https://www.haleyorapower.co.id/	PT Haleyora Power (HP), established on October 18, 2011, was assigned by PLN to carry out security services for Electric Power Transmission and Distribution Operation and Maintenance based on the Decree of the Directors of PT PLN (Persero) Number 459.K / DIR / 2012 dated September 12, 2012, which was later replaced by the Directors Regulation of PT PLN (Persero) Number 0734.K / DIR / 2013.
PT Pelayaran Bahtera Adhiguna www.bahteradhiguna.co.id	PT Pelayaran Bahtera Adhiguna became a wholly owned PLN subsidiary company engaged in coal shipping in August 2011.

3. **Map of important decision makers related to renewable energy in particular**

In addition to PLN's Board of Commissioners, which is appointed by the government, the key decision makers on renewable energy related issues regarding PLN are the Minister of ESDM, the Director General of EBTKE, and the Minister of State Owned Enterprises (MSOE).

4. **Procurement system**

As with all Government Ministries and State Owned Enterprises, the procurement of goods / services whose funds are sourced from the State Budget and managed by PLN, are managed through an e-procurement platform (LPSE). PLN began using LPSE in 2011. Interested suppliers of goods / services can take part in tender auctions through the PLN office or via the internet from their respective offices. Qualification documents, procurement documents and other documents are available (in bahasa) at http://eproc-lpse.pln.co.id

5. **Tariff, rules and regulation related to each specific RE**

PLN publishes its electricity supply and business plan annually, covering a period of 10 years, called the Rencana Usaha Penyediaan Tenaga Listrik (RUPTL). PLN published the latest RUPTL for the years 2019 - 2028, in March 2019.[9]

[9] PLN electricity supply and business plan - Rencana Usaha Penyediaan Tenaga Listrik (RUPTL) 2019 - 2028:
Full RUPTLhttp://djk.esdm.go.id/pdf/RUPTL/RUPTL%20PLN%202019-2028.pdf
Summary ppt: http://www.djk.esdm.go.id/pdf/RUPTL/2019%2003%2018%20Diseminasi%20RUPTL%202019-2028.pdf

For the 2019 - 2028 RUPTL, PLN assumes economic growth at an average of 6.4% per year and, based on 2017 and 2018 electric power requirements, projects sales of electricity in 2028 to reach 433 TWh. The peak load in 2028 is projected to reach 67 GW. To meet the higher projected electricity demand, PLN plans up to 56 GW in extra capacity from construction of new power plants. PLN projects that the new power plants will require the development of 57 thousand kilometers (kms) of transmission lines, and 124 thousand megawatt amperes (MVA) of additional transformers. The projected electricity sales for 2019-2028 requires additional medium voltage network of 225 thousand kms, 248 thousand kms of low voltage network, and transformer capacity distribution of 34 thousand MVA, for the projected additional 16.9 million electricity customers.

The 2019 - 2028 RUPTL projects the 2028 energy mix to be:

Coal	54.4%
Natural gas (including LNG)	22%
Geothermal	9.6%
Hydropower	10.9%
Fuel	0.4%
Other RE (EBT)	2.6%

Solar

The 2019-2028 RUPTL includes ESDM Regulation Number 49 of 2018 concerning the use of Solar Power Generation Systems. This regulation permits PLN customers to install solar roof-top (Solar Atap) PLTS on the roof of their building.

PLN's support for the development of Rooftop PLTS (PV) includes:

1. PLN supports PLTS Atap by providing parallel facilities.
2. Create a billing system to accommodate export-import offsets and provide credit deposits from consumer of Solar PV.
3. Providing sufficient and appropriate reserve margin to balance the Solar PV intermittency.
4. Keep maintaining the reliability and quality of PLTS Roof consumers and their environment with maintain a balance of local supply and electricity needs.
5. Run a fair business scheme for customers and PLN.

Although this appears to be a progressive move, in practice, PLN customers who install solar PV are given no incentive as no subsidies are available to help most Indonesian people to be able to purchase and install solar PV, and they only receive a 60% of the PLN electricity tariff for energy they sell back to PLN.

Tariff

The basic cost of electricity supply - Biaya Pokok Penyediaan Listrik (BPP) increased by 9% in April 2029 in April 2019, however PLN and ESDM ensure that the extra cost will not be passed on to households and business until December 2019 at earliest.[10]

For the period 1 April 2018 to 31 March 2019, the BPP was Rp. 1,025 per kilowatt hour (kWh) - (US $ 7.66 cent per kWh). The BPP from April 1, 2019 to March 31, 2020 is Rp. 1,119 per kWh - (US $ 7.86 cent per kWh).

Since 2015, PLN has continued to withstand electricity tariffs, and has even reduced them. In 2015 the tariff for low-voltage customers was Rp 1,548 per kWh and the average fell by 5% to Rp 1,467 per kWh in 2018. For medium voltage customers, the electricity tariff is Rp. 1,219 per kWh and decreases by an average of 9% to Rp. 1,115 per kWh. Meanwhile, the tariff for high-voltage customers was set at Rp 1,087, then dropped by an average of 8% to Rp 997 in 2018. Meanwhile, in 2018, electricity subsidies again rose to Rp. 60 trillion, and were relatively conservative in Anggaan State Revenues and Expenditures (APBN) in 2019 amounting to Rp. 59.3 trillion.

In 2017, the Ministry of Energy and Mineral Resources issued Regulation No. 50/2017 on the basic cost of electricity supply. The government's decision to use BPP as the basis for setting feed-in tariffs for renewable energy provides no incentive at all for clean energy sources as they have to compete directly with electricity from much cheaper coal. The lack of clarity and sometimes random price fluctuation of the BPP makes it difficult for renewable energy developers to calculate long-term finance.

Geothermal Feed in Tariff:

The highest benchmark price of geothermal (PLTP) is based on a World Bank study conducted with a team of stakeholders from Indonesia's Ministry of Economy, Ministry of Finance, Ministry of Energy and Mineral Resources, PT PLN (Persero) and the Indonesian Geothermal Association (INAGA).

Figure 5. Geothermal Feed in Tariff

	Highest Benchmark Prices for Geothermal Energy (cents USD / kWh)[11]

[10] PLN ensures electricity tariffs will not rise as BPP increases by 9% in April, Kontan, 15/04/2019: https://industri.kontan.co.id/news/bpp-pembangkitan-nasional-april-naik-9-pln-pastikan-tarif-listrik-tidak-akan-naik

[11] Geothermal feed in tariff - (panas bumi): http://ebtke.esdm.go.id/regulation/9/feed.in.tariff

Year	Wilayah (Region) I	Wilayah (Region) II	Wilayah (Region) III
2019	13.4	19.4	27.0
2020	13.8	20.0	27.4
2021	14.2	20.6	27.8
2022	14.6	21.3	28.3
2023	15.0	21.9	28.7
2024	15.5	22.6	29.2
2025	15.9	23.3	29.6

Wilayah (Region) I : Sumatra, Java, Bali
Wilayah (Region) II : Sulawesi, NTB, NTT, Halmahera, Maluku, Papua,] Kalimantan
Wilayah (Region) III : Areas that are in Region I or Region II but the transmission system is isolated,
fulfillment of electricity needs is mostly obtained from power plants with fuel oil.

Solar Feed in Tariff:[12]

Ministerial Regulation ESDM No.17/ 2013 regarding sale of electricity from solar PV to PLN.

a. Prices and Criteria

1. The purchase price of electricity from PLTS PV (solar plant) for all capacities is set at 25 cents USD / kWh for the first 10 years and 13 cents USD / kWh for the second 10 years
2. If using photovoltaic solar modules with at least 40% domestic components (TKDN), given incentives so that the purchase price of electricity is set at 30 cents USD / kWh.
3. The purchase price includes all interconnection costs from the plant to the grid connection point of the PT. PLN (Persero).
4. Criteria for determining quota and location are the burden and capability of the PLN system to absorb the production of on-grid solar power plants with capacities between 1- 10 MW and isolated sub-system locations that are currently supplied in part or in full from PLTD-oil and BPP in the sub-system above the price of FiT in the draft Minister of Energy and Mineral Resources.

[12] Solar feed in tariff - (surya): http://ebtke.esdm.go.id/regulation/9/feed.in.tariff

b. Quota Offer Mechanism

1. The Director General of EBTKE offers a Capacity Quota to the Business Entity in accordance with the
   stipulation of the Capacity Quota.
2. If there is only 1 (one) Business Entity Quota offering, then it will be conducted through direct appointment.
3. If the Capacity Quota offer is more than 1 (one) Business Entity that registers, it is conducted through direct election.

c. Quota Determination Procedures

1. The Director General of EBTKE submits the amount of the Capacity Quota plan to PT PLN (Persero).
2. PT. PLN proposes the details of Capacity Quota to the Director General of EBTKE, no later than 30 days
   after the amount of Capacity Quota is delivered.
3. The Director General of the EBTKE sets a Capacity Quota taking into account the proposed details of
   Capacity Quota at the beginning of the year.

Hydro Feed in Tariff:

Ministerial Regulation ESDM No.12/ 2014 regarding sale of electricity from Hydro to PLN.[13]

Figure 6. Hydro Feed in Tariffs

No.	Electricity Network Voltage (Generating Capacity)	Wilayah (Region)	Purchase Price (Rp. / Kwh) Years 1 - 8	Purchase Price (Rp. / Kwh) Years 9 - 20	Factor F
1.	Medium Voltage (to 10 MW)	Java, Bali, Madura	1075,0 x F	750,0 x F	1,00
2.		Sumatra	1075,0 x F	750,0 x F	1,10
3.		**Kalimantan, Sulawesi**	**1075,0 x F**	**750,0 x F**	**1,20**
4.		NTB, NTT	1075,0 x F	750,0 x F	1,25
5.		Maluku, North Maluku	1075,0 x F	750,0 x F	1,30
6.		Papua, West Papua	1075,0 x F	750,0 x F	1,60
7.	Low voltage (to 250 kW)	Java, Bali, Madura	1.270,0 x F	770,0 x F	1,00
8.		Sumatra	1.270,0 x F	770,0 x F	1,10
9.		Kalimantan, Sulawesi	1.270,0 x F	770,0 x F	1,20
10.		NTB, NTT	1.270,0 x F	770,0 x F	1,25
11.		Maluku, North Maluku	1.270,0 x F	770,0 x F	1,30
12.		Papua, West Papua	1.270,0 x F	770,0 x F	1,60

• The price includes the connection fee from the plant to the PT PLN electricity network.

[13] https://jdih.esdm.go.id/peraturan/Permen%20ESDM%2012%20Tahun%202014.pdf

- Prices are negotiated using the highest benchmark price of Rp. 880, - / kWh for medium voltage, and Rp. 970, - / kWh for low voltage while still using Factor F.
- For irrigation dams / reservoirs, the above rates are multiplied by 90%.

Tariffs for Existing Dams

Ministerial Regulation ESDM No.22/ 2014 (Amending ESDM No. 12/2014)[14]

Figure 7. Hydro Feed in tariffs for existing dams

No.	Electricity Network Voltage (Generating Capacity)	Wilayah (Region)	Purchase Price (Rp. / Kwh) Years 1 - 8	Purchase Price (Rp. / Kwh) Years 9 - 20	Factor F
1.	Medium Voltage (to 10 MW)	Java, Bali, Madura	967,5 x F	675,5 x F	1,00
2.		Sumatra	967,5 x F	675,5 x F	1,10
3.		**Kalimantan, Sulawesi**	**967,5 x F**	**675,5 x F**	**1,20**
4.		NTB, NTT	967,5 x F	675,5 x F	1,25
5.		Maluku, North Maluku	967,5 x F	675,5 x F	1,30
6.		Papua, West Papua	967,5 x F	675,5 x F	1,60
7.	Low voltage (to 250 kW)	Java, Bali, Madura	1.143,0 x F	693,0 x F	1,00
8.		Sumatra	1.143,0 x F	693,0 x F	1,10
9.		Kalimantan, Sulawes**i**	1.143,0 x F	693,0 x F	1,20
10.		NTB, NTT	1.143,0 x F	693,0 x F	1,25
11.		Maluku, North Maluku	1.143,0 x F	693,0 x F	1,30
12.		Papua, West Papua	1.143,0 x F	693,0 x F	1,60

[14] https://jdih.esdm.go.id/peraturan/Permen%20ESDM%2022%20Tahun%202014.pdf

• For existing dams, the price is set at 90% of the electricity price of the Run-off-River hydropower plant.

6. PLN Budget cycle and procurement system

PLN's budget cycle follows the budget cycle for state owned enterprise - for the calendar year, starting in January, ending in December. Planning happens in Q4. For PLN procurement system please see 4. above.

7. PLN GG (gas and geothermal) – overview
http://www.plngg.com/id/

PT PLN Geothermal is a subsidiary of PLN focused on the renewable electricity supply business, through the development and operation of high-quality economical geothermal power plants with good reliability. PLN GG was initially called PT PLN Geothermal, focused on geothermal development. PLN GG was established in January, 2009 - Decree of the Minister of Law & Human Rights Number AHU-11269.AH.01.01. In April 2009 PLN Geothermal began development of several geothermal related projects and programs. In July, 2017, PLN Geothermal shareholders agreed to add the midstream gas business to company activities, and the company name was changed to PLN GG.

iv. Local government (if any)

Since the passage of Law on Local Government No. 22/1999, revised as the Law on Local Government No. 32/2004, local governments now play a greater role in administration. A consequence of political decentralization has been confusion and even conflict over the jurisdiction of the various levels of government. Local governments now effectively control the development of energy resources and the issuing of permits for infrastructure projects. Delays and difficulties in land acquisition and procurement of the various necessary permissions have interrupted the implementation of many projects, including ones of national priority.[15]

1. Budget cycle

The Local and provincial budget cycle follow the budget cycle for all government budgeting - for the calendar year, starting in January, ending in December. Planning happens in Q4.

[15] Summary of Indonesia's Energy Sector Assessment 2015, ADB: https://www.adb.org/sites/default/files/publication/178039/ino-paper-09-2015.pdf

2. **Procurement system**

   Provincial and local government procurement is mandated to use the e-procurement system - see Figure 3. Procurement of Goods and Services in Indonesia. However, in practice, not all provincial and local government units are yet using the e-procurement system. Each government unit does have a special unit to manage procurement. Check the links in Figure 3. to identify the relevant government unit and establish how procurement is managed.

3. **Connection with EBTKE, PLN and central government in terms of RE project sovereignty**

   All project licensing falls under the remit of the provincial or local government, although ESDM, EBTKE and PLN manage the regulatory and technical compliance.

b. Rules, Policy and Regulations

The government of Indonesia uses three main strategic plans to guide the nation's energy and electricity policy; Kebijakan Energi Nasional (KEN)[16] - the National Energy Policy; Rencana Umum Energi Nasional (RUEN)[17] - the General National Energy Plan, and; Rencana Umum Penyediaan Tenaga Listrik (RUPTL)[18] - the General Plan for Electricity Supply. KEN outlines the long-term vision and direction for national energy development; RUEN provides a more detailed description of data; while RUPTL contains details of energy infrastructure projects for a rolling 10-year period.

Although the energy vision outlined in KEN contains a mandate to maximize the use of Indonesia's renewable energy resources and RUEN details a specific target of 31% of the country's energy supply being generated from renewable energy by 2030, the 2019 - 2028 RUPTL appears to undermine these directives and targets.

i. ESDM / EBTKE Policy, Rules and Regulations for New and Renewable Energy[19]

Figure 8. ESDM / EBTKE Policy, Rules and Regulations for New and Renewable Energy

Regulation	Function
Regulation of the Minister of Energy	Concerning the use of Solar Power Generation Systems. This regulation

[16] Kebijakan Energi Nasional (KEN) 2014: https://www.bphn.go.id/data/documents/14pp079.pdf
[17] Rencana Umum Energi Nasional (RUEN) 2017 - General National Energy Plan: https://www.esdm.go.id/assets/media/content/content-rencana-umum-energi-nasional-ruen.pdf
[18] See footnote 8 on previous page.
[19] Regulations concerning new and renewable energy on ESDM: https://jdih.esdm.go.id/?page=peraturan&act=search

and Mineral Resources 49/2018	permits PLN customers to install solar roof-top (Solar Atap) PLTS on the roof of their building.
Regulation of the Minister of Energy and Mineral Resources 9/2018	Revoking regulation of the Minister of ESDM related to new, renewable, and energy business activities. * Revocating Regulation of the Minister of Energy and Mineral Resources No .21/2016
Regulation of the Minister of Energy and Mineral Resources 12/2018	Amendment to regulation of the Minister of ESDM No. 39 of 2017 concerning implementation of physical activities of new and renewable energy and energy conservation. * Changing Regulation if the Minister of Energy and Mineral Resources No. 39/2017
Regulation of the Minister of Energy and Mineral Resources 39/2017	Implementation of physical activities of new and renewable energy and energy conservation. *Amended By Regulation of the Minister of Energy and Mineral Resources No. 12/2018
Regulation of the Minister of Energy and Mineral Resources 14 2015	Regulation of the Minister of ESDM No. 14 of 2015 concerning procedures for the implementation, use, and settlement of administration of non-tax state from Geothermal activities in the Directorate General of New, Renewable, and Energy Conservation.
Regulation of the Minister of Energy and Mineral Resources 32/2014	Regulation of the Minister of ESDM No. 32 of 2014 concerning third amendment to the regulation of the Minister of Energy and Mineral Resources Number 15 of 2010 concerning list of accelerated projects of electricity development using new and renewable energy, coal, and gas related transmissions. * Changing ESDM Minister Regulation No. 15/2010
Regulation of the Minister of Energy and Mineral Resources 40/2014	Regulation of the Minister of ESDM No. 40 of 2014 concerning fourth amendment to the regulation of the Minister of Energy and Mineral Resources Number 15 of 2010 concerning list of accelerated projects of electricity development using new and renewable energy, coal, and gas related transmission. * Changing ESDM Minister Regulation No. 15/2010
Regulation of the Minister of Energy and Mineral Resources 10/2012	Regulation of the Minister of ESDM No. 10 of 2012 concerning implementation of physical activities for use of new and renewable energy.

Regulation of the Minister of Energy and Mineral Resources 2/2010	Regulation of the Minister of ESDM No. 2 of 2010 concerning list of accelerated projects of electricity development using new and renewable energy, coal, and gas related transmissions. * Revoking Minister of Energy and Mineral Resources Regulation No. 15/2010
Regulation of the Minister of Energy and Mineral Resources 9/2010	Regulation of the Minister of ESDM No. 9 of 2010 on determination of entry of engineering standard competence, field construction, sub-field maintenance and sub-field inspection. *Revoking Minister of Energy and Mineral Resources Regulation No. 030/2006
Regulation of the Minister of Energy and Mineral Resources 15/2010	Regulation of the Minister of ESDM No. 15 of 2010 concerning list of accelerated projects of electricity development using new and renewable energy, coal, and gas related transmissions. *Amended by Minister of Energy and Mineral Resources Regulation No. 40/2014
Regulation of the Minister of Energy and Mineral Resources 31/2009	Regulation of the Minister of ESDM No. 31 of 2009 concerning purchase of electricity by PT PLN (Persero) from electricity generators that use small and medium renewable energy or electricity power. *Revoking Minister of Energy and Mineral Resources Regulation No. 4/2012
Regulation of Minister of Energy and Mineral Resources 5/2008	Regulation of the Minister of Energy and Mineral Resources Number No. 5 of 2008 concerning determination and implementation of electrical engineering plant for new and renewable energy development of Micro-hydro power plant (PLTMH), Biomass power plant (PLTBM), Wind power plant (PLTB) and Solar power plant (PLTS).[20]
Regulation of the Minister of Energy and Mineral Resources 030/2006	Concerning determination and application of standards of electrical engineering competency for new and renewable energy development for Micro-hydro power plant (PLTMH), Biomass power plant (PLTBM), Wind power plant (PLTB) and Solar power plant (PLTS).[21] * Revoked yy Minister of Energy and Mineral Resources Regulation No. 9/2010

[20] Regulation of the Minister of ESDM No. 5 of 2008 concerning determination and implementation of electrical engineering plant for new and renewable energy development: https://jdih.esdm.go.id/peraturan/permen-esdm-5-2008.pdf

[21] Regulation of the Minister of Energy and Mineral Resources 030/2006 concerning determination and application of standards of electrical engineering competency for new and renewable energy development: https://jdih.esdm.go.id/peraturan/permen-esdm-30-2006.pdf

See footnote [12] for ESDM / EBTKE regulations preceding the above.
Also see: http://ebtke.esdm.go.id/regulasi_ebtke

ii. PLN Tariff, Policy, Rules and Regulation for New and Renewable Energy[22]

Figure 9. PLN Tariff, Policy, Rules and Regulation for New and Renewable Energy

Regulation	Function
Regulation of the Minister of Energy and Mineral Resources 49/2018	Minister of ESDM Regulation No. 49 of 2018 concerning the use of Solar Power Generation Systems. This regulation permits PLN customers to install solar roof-top (Solar Atap) PLTS on the roof of their building.
Regulation of the Minister of Energy and Mineral Resources 4/2012	Regulation of the Minister of ESDM No. 4 of 2012 concerning electricity purchase by PT PLN (Persero) from electricity generators that use new and renewable and small-scale energy or electricity power.
Decree of the Minister of Energy and Mineral Resources 3440 K / 21 / MEM / 2012	Decree of the Minister of ESDM No. 3440 K / 21 / MEM / 2012 concerning restriction of the PT PLN (Persero) electricity supply business plan in 2012.
Decree of the Minister of Energy and Mineral Resources 3314 K / 21 / MEM / 2011	Decree of the Minister of ESDM No. 3314 K / 21 / MEM / 2011 concerning restriction of the PT PLN (Persero) electricity supply business plan in 2011.
Decree of the Minister of Energy and Mineral Resources 2026 K / 20 / MEM / 2010	Decree of the Minister of ESDM No. 2026 K / 20 / MEM / 2010 concerning restriction of the PT PLN (Persero) electricity supply plan for 2010-2019.
Regulation of the Minister of Energy and Mineral Resources 32/2009	Regulation of the Minister of ESDM No. 32 of 2009 concerning prices for purchasing electricity by PT PLN (Persero) from Geothermal heat power plants.
Regulation of the Minister of Energy and Mineral Resources 31/2009	Regulation of the Minister of ESDM No. 31 of 2009 concerning electricity purchase by PT PLN (Persero) from electricity generators that use new and renewable energy or extra electricity.

[22] Regulations relating to PLN and new and renewable energy:
https://jdih.esdm.go.id/?page=peraturan&act=search_text

Regulation of the Minister of Energy and Mineral Resources 5/2009	Regulation of the Minister of ESDM No. 5 of 2009 concerning PT PLN (Persero) electricity purchase price guidelines from other cooperatives or business agencies.
Decree of the Minister of Energy and Mineral Resources 2780 K / 21 / MEM / 2008	Decree of the Minister of ESDM No. 2780 K / 21 / MEM / 2008 concerning restriction of the PT PLN (Persero) electricity supply plan for 2010-2019.

iii. How Associations and other non-government organizations can affect certain rules

Despite there having been many very good initiatives to demonstrate how renewable energy can easily meet and the exceed rising energy demand, in addition to reducing Indonesia's carbon emissions, creating millions of new jobs, and sparking Indonesia's economic transition, most of these fall on deaf ears. Although Indonesia's government are beginning to create the right policy, regulatory and financial incentives to finally speed up the massive uptake of renewable energy that is required, the change is happening far too slowly. Added to this is the imminent threat of Indonesia locking itself into fossil energy, especially coal, until around 2060, when the new coal plants coming online in the next few years will reach the end of their operational lives by then.

Although there are many strong NGOs, civil society groups and RE Associations, especially INAGA (Indonesia's Geothermal Association), they all have little influence in practice. The most effective advocacy for renewable energy, we would suggest, is to engage the relevant government ministries and agencies, as well as the large domestic and multinational businesses based in the country, in the positive business and economic arguments for renewable energy.

iv. The role of local government in deciding local regulation and rules for local RE projects

All project licensing falls under the remit of the provincial or local government, although ESDM, EBTKE and PLN manage the regulatory and technical compliance.

c. Indonesia politics and dynamic in Energy security and how it affects the development and progress of Renewable Energy

As with other countries, energy security in Indonesia is a crucially important issue, as it is an issue of survival, independence and sovereignty. Unfortunately, higher levels of government are deciding to continue the country's dependence on coal, as well as promoting a huge and risky increase in biofuel, mainly diesel produced from palm oil. This is unfortunate on several levels. First, the considerable government efforts and resources being used to promote palm biodiesel, would be much more effective if they were invested in clean, risk-free renewable energy, which does not threaten deforestation (and carbon emissions) from plantation expansion for the commodity.

Second, if the government continues to provide fossil fuel energy with large subsidies, while failing to provide the same incentives to accelerate the uptake of Indonesia's abundant renewable energy resources, this threatens the country's drive to transition it's economy away from resource extraction and exports, and towards manufacturing and service provision.

There are, however, positives if Indonesia matches the ambition that is clear in the National Energy Policy (KEN) - Kebijakan Energi Nasional, and the General National Energy Plan - (RUEN) Rencana Umum Energi Nasional[23], and President Jokowi's vision for Indonesia in 2045.[24]

[23] Rencana Umum Energi Nasional (RUEN) 2017 - General National Energy Plan: https://www.esdm.go.id/assets/media/content/content-rencana-umum-energi-nasional-ruen.pdf

[24] Indonesia 2045 Vision: http://luk.staff.ugm.ac.id/atur/BahanPaparanMPPN-VisiIndonesia2045-25September2017.pdf,
Launch PR from Bappenas: https://www.bappenas.go.id/id/berita-dan-siaran-pers/menteri-bambang-brodjonegoro-pdb-indonesia-terbesar-kelima-dunia-di-tahun-2045/

3. Renewable Energy Associations

General

1. METI

http://www.meti.or.id/

Masyarakat Energi Terbarukan Indonesia (METI) was established by a group of intellectuals, government officials, business people and professionals on May 5, 1999. The founders set up the organization as a platform to air their concerns about the continued use of energy from polluting fossil fuels and to advocate for the switch to Indonesia's abundant renewable energy resources.

METI is a forum for scientists, educators, regulators, developers and business organizations, Non Governmental Organizations (NGOs), associations engaged in the renewable energy sector and other stakeholders to discuss, exchange ideas and views on the practical and strategic issues related to harnessing the country's renewable energy resources in order to end Indonesia's dependence on fossil energy, and prevent deterioration of the quality of the environment resulting from the continuing uncontrolled and unsustainable use of fossil energy.

METI is committed to contributing to global efforts to combat the negative impacts of global climate change by generating ideas and solutions to global problems, especially through advocating and promoting the use of Renewable Energy.

Vision

Being effective means in order to continuously pursue the development and utilization of Renewable Energy to meet national energy needs in a sustainable manner and contribute to efforts to combat the effects of climate change.

Mission

Active role and effective in advocating, promoting and disseminating the benefits of Renewable Energy, related to the development and utilization of technology, socio-economic concepts, and the increased capacity of human resources which support the utilization of Renewable Energy.

Geothermal

2. INAGA

http://www.inaga-api.or.id/index.php

INAGA - Indonesian Geothermal Association (Asosiasi Panasbumi Indonesia - API) was established on September 25th, 1991 in Jakarta. INAGA is a nonprofit organization, which functions as a forum of communication, coordination and consultation in order to improve its capabilities, understanding, cooperation and responsibility of the role of geothermal energy development in Indonesia. INAGA is a member of IGA (International Geothermal Association).

Vision

To be a trusted partner of government, companies and professionals in the geothermal energy business, in encouraging and facilitating the development of Indonesia's geothermal potential as a main energy choice in order to support energy security and sustainable national economic growth and ensure the creation of Indonesia as the "Super Power" in geothermal energy utilization.

Mission

- Encouraging a conducive investment climate for geothermal development through close cooperation and mutual benefit between the government and employers, and to ensure the creation of government regulations, both national and local that are supportive and aligned.
- Overseeing the government road map for the development of geothermal energy as a new and renewable energy resource to meet the national energy mix target of 25/25 (25% of RE in 2025).
- To encourage the development of human resources and geothermal energy technology development through cooperation with governments, educational institutions, companies and professional organizations, both national and international, towards the independence of Indonesia as a "geothermal center of excellence".
- To socialize and educate the public about the potential, contributions and positive values, to support the creation of conducive conditions in geothermal development efforts.

Contribution

- INAGA has had active involvement in the drafting of academic papers for several geothermal regulations, and is invited to review draft regulations before they are enacted;
- Continuously seeking solutions for issues related to geothermal development in Indonesia and providing expert insights to the government.

- Advocating and facilitating the resolution of problems with geothermal development; and
- Designing and hosting seminars, talks, panel discussions, conventions & exhibitions in support of geothermal development.

Membership

INAGA currently has around 600 members including:

- Geothermal Companies (17): Star Energy, Pertamina Geothermal Energy, Supreme Energy, Geo Dipa Energi, Sarulla Operations, Ormat Geothermal Indonesia, Wijaya Karya Jabar Power, Hitay Energy Holdings, Bakrie Power, Dalle Energy, Jabar Rekind Geothermal, EDC Indonesia, Medco Power Indonesia, Schlumberger, Green Energy Geothermal, Sejahtera Alam Energi & Sintesa Banten Geothermal.
  Academic: Bandung Institute of Technology (ITB), University of Indonesia (UI),University of Gadjah Mada (UGM), University of Lampung (UNILA) and Trisakti.
- Regional Chapter: Central Java - Yogyakarta (DIY) and Lampung.
- Professionals and Individuals.

Solar

3. AESI (Asosiasi Energi Surya Indonesia) - Indonesia Solar Association

The Indonesian Solar Energy Association was inaugurated on December 15, 2016. The history of the establishment of AESI began when Luluk Sumiarso received an invitation from the Solar Energy Association in Germany to talk about various energy sources at a conference. Before coming to Germany, Luluk Sumiarso met with several other solar energy proponents and initiated the establishment of the Indonesia Solar Association (ISA).

At present AESI and several other institutions are campaigning for a "Million Solar Roof National Movement". The purpose of this National Movement is to support the National Energy Policy, namely the achievement of 23% renewable energy in the national energy mix by 2025, by encouraging and accelerating the construction of rooftop solar power installations in housing, public facilities, government and commercial office buildings, places of worship and industrial complexes, with a target of 1,000 MW of solar energy installed by 2020.

The aim of the Million Electric Solar Roof National Movement is:

- Encourage and accelerate the construction of roof photovoltaic solar power plants in housing, public facilities, government offices, commercial buildings, and industrial complexes, until they reach a target of 1,000 MW of installed solar energy capacity by 2020;
- Encouraging the growth of a domestic photovoltaic industry that is competitive and creates green jobs;
- Encourage the provision of electricity that is reliable, sustainable and competitive;

- Encourage and mobilize community participation to reduce greenhouse gas emissions and the threat of climate change, and contribute to the implementation of Indonesia's commitment to the Paris Agreement and efforts to achieve the Sustainable Development Goals (SDGs).

As reflected in the above declaration, the Million Solar Roof National Movement involves various stakeholders and actors across various levels, with AESI as one of the main partners. Achievement of the target needs to be supported by an integrated supporting ecosystem of; policies and regulations, technical expertise, public engagement and active support and; a reliable, simple and attractive funding mechanism.

4. Geothermal (PLTP)

a. Overview of Geothermal in Indonesia: historical background

Development of geothermal energy in Indonesia stretches back to the Dutch colonial era in the early 20th century, when the first exploratory excavations were made. The Government of New Zealand, and the country's world-leading geothermal expertise helped Indonesia to develop its first geothermal power plant over 40 years ago. Development since then has been very slow, due to the many regulatory, financial and practical obstacles, which block development of Indonesia's abundant geothermal resources to the level required.

b. Overview of Geothermal in Indonesia: Current situation

Geothermal power is one of the most exciting opportunities in Indonesia and, unlike most other forms of electricity generation, it is dominated by IPPs. A country of exceptional volcanic activity, Indonesia is believed to harbour around 40% of the planet's geothermal potential, with estimated resources and reserves totalling 28,000 megawatts (MW), with the majority of the resource on the islands of Sumatra and Java. However, it is difficult to more accurately assess the country's geothermal energy potential before a comprehensive national survey is conducted. The geothermal (panas bumi) directorate of Indonesia's Directorate General of New and Renewable Energy and Energy Conservation (EBTKE), under the Ministry of Energy and Mineral Resources, regularly updates resource estimates based on progress reports from the current 11 wilayah kerja pertambangan (WKP) - geothermal mining areas. The most current geothermal resource potential based on these reports according to EBTKE panas bumi is around 25,600 MW.

Although Indonesia has been slow to develop its abundant geothermal resources, the country passed the Philippines to become the country with the second largest installed capacity of geothermal energy behind the US. By the end of 2018, Indonesia had installed 1,948.5 MW of geothermal capacity, compared with 3.639 MW in the US. Current government planning is to boost installed capacity to 7,241.50 MW by 2025, and to

10,003.50 MW by 2030. It goes without saying that exploration and development needs to speed up if the country is to meet its targets. Problems with tendering, permits, lack of incentives for the high costs of exploration and local opposition are blamed for holding up projects in some areas. Many geothermal developers still fail to recognise the importance of comprehensive and open community engagement, consultation and involvement to the success of their projects.

c. Geothermal and Ministry of Energy (ESDM/ EBTKE):

i. Rules and regulations

Law no.21 2014 concerning geothermal energy:

- Geothermal is not a mining activity, so it can be developed in conservation forest areas.
- Geothermal for indirect use is falls entirely under the authority of the Central Government, while direct use can fall under the authority of Central, Provincial, or Regency / City Governments.
- The imposition of production bonuses is based on the percentage of gross production units given to the Regional Government.
- The government can carry out Exploration, Exploitation and / or Utilization by assigning SOE / BLU to develop geothermal energy.
- The regulation of geothermal development is more detailed in the Government Regulation on Geothermal for Direct and Indirect Use.
- Geothermal licensing, auctions, and the development and supervision of geothermal development are all under the authority of the Central Government.

<u>Government regulations, Presidential regulations, Ministry regulations:</u>

See Chapter 2, Government stakeholders, ESDM / EBTKE

ii. Commitment, support and current work from EBTKE

See Chapter 2, Government stakeholders, ESDM / EBTKE

iii. WKP (Geothermal work areas)

See WKP later in this section (e.).

iv. Issues and challenges

Indonesia's development of the country's abundant geothermal resources has been painfully slow, despite the first geothermal plant being developed in the early 70's with the help of New Zealand's geothermal expertise.

PLN's monopoly, prohibitively high exploration costs and financial guarantees for exploration licences, and unclear, non-existent and ever-changing regulations all held back the large-scale, systematic development of geothermal.

However, in recent years there have been positive developments, in funding, incentives and guarantees to mitigate the high up-front cost of exploration, as well as clearer regulations. One of the biggest remaining obstacles, as with all other sources of renewable energy in Indonesia, is the government's failure to provide a feed in tariff for geothermal that helps it compete with highly subsidized coal.

d. Geothermal and PLN

See previous section on PLN in Chapter 2 for:

i. Tariff, ii. PPA process and iii. PLN Gas and Geothermal

e. Current Geothermal process: from early WKP (geothermal work area) bidding, tender to COD

The stages of geothermal development in Indonesia consist of:

Open Area - Gov. Drilling - Offer - PSPE / Exploration - Feasibility Study - Exploitation - Operation

According to the latest EBTKE geothermal (panas bumi) update in March 2019, there are 22 WKPs (geothermal work areas), 2 geothermal survey and introduction studies (WPSPEs), and 26 Open Areas that have no developers.

(see ppt from EBTKE geothermal)

Figure 10. Geothermal Development by State owned enterprises (BUMN)

NO	NAMA BUMN	JUMLAH WKP	SUMBER DAYA (MW)	KAPASITAS TERPASANG (MW)	RENCANA PENGEMBANGAN SESUAI RUPTL 2019 – 2028	POTENSI PENGEMBANGAN UNTUK MENCAPAI TARGET RUEN	
						S.D. 2025	2026 - 2030
1	PT PLN (PERSERO)	11	1.442,5	12,5	367	-	145
2	PT PERTAMINA (PERSERO)						
	a. OPERASI SENDIRI OLEH: PT. PERTAMINA GEOTHERMAL ENERGI	10*	3.563	617	830	190	377
	b. KONTRAK OPERASI BERSAMA (KOB)	5*	2.547	1.204	235	110	440
3	PT GEO DIPA ENERGI (PERSERO)	4*	115	115	1210	-	20
TOTAL		**28**	**8.762,5**	**1.948,5**	**2.047**	**300**	**982**

WKP Kamojang-Darajat in Kamojang is managed by PT PGE and Area Darajat is managed through KOB PT PGE with Star Energy Geothermal Darajat II, Ltd.

Pangalengan WKP Wayang Windu Area is managed through KOB PT PGE with Star Energy Geothermal Wayang Windu, Ltd. and the Patuha Area is managed by PT Geo Dipa Energi.

As at March 2019 11 WKPs produced 1,948.5 MW, with a further 775 MW planned for development.

9 WKPs are at the exploitation stage, totalling 1.257 MW, with a further 22 WKPs totalling 1,690 MW at the exploration stage.

13 more sites, with potential for 555 MW are at the WPSPE (survey) stage.

22 Government drilled WKPs totalling 845 MW are, or will soon be, open for bidding

Figure 11. 22 Government drilled WKPs , totalling 845 MW, open to offer.

No	NAMA WKP	Renc. Pengembangan (MW)	PROGRES/ KENDALA	USULAN / SOLUSI
1	Gunung Galunggung	**110** Unit 1: 55 Unit 2: 55		
2	Jailolo, Malut	**20** Unit 1: 10 Unit 2: 10	▪ Masa eksplorasi telah berakhi 8 Des 2016 ▪ PT. SEGH telah mengembalikan IPB kepada pemerintah ▪ Telah terbit persetujuan pengembalian WKP oleh MESDM	▪ Direncanakan untuk menjadi area *Government Drilling*
3	Kotamobagu, Sulut	**80** Unit 1: 20 Unit 2: 20 Unit 3: 20 Unit 4: 20	▪ WKP telah dikembalikan ke Pemerintah ▪ Sebagian besar area prospek merupakan kawasan hutan konservasi	▪ Direncanakan ditugaskan kepada BUMN (Pertamina)
4	Iyang Argopuro, Jatim	**55**	▪ WKP telah dikembalikan ke Pemerintah ▪ Seluruh area prospek merupakan kawasan hutan konservasi	▪ Diperlukan Penetapan Kembali WKP untuk memperbaharui batasan luas WKP dan sumber daya yang dapat dikembangkan ▪ Setelah WKP ditetapkan akan dilelang ulang ▪ Akan dilakukan penugasan/lelang
5	Bora Pulu, Sulteng	**40**	▪ Penugasan pada BUMN/BLU	
6	Gn. Gede Pangrango, Jabar	**55**	▪ WKP hasil PSP ▪ Belum Lelang	

No	NAMA WKP	Renc. Pengembangan (MW)	PROGRES/ KENDALA	USULAN / SOLUSI
7	Gn. Endut, Banten	40	▪ Belum Lelang	
8	Gn. Ciremai, Jabar	**110** Unit 1: 55 Unit 2: 55	▪ Gagal Lelang tahun 2016	▪ Direncanakan ditugaskan kepada Geo Dipa
9	Laenia	**20** Unit 1: 10 Unit 2: 10	▪ Belum lelang	
10	Sembalun, NTB	**20** Unit 1: 10 Unit 2: 10	▪ Belum lelang	
11	Suwawa, Gorontalo	**20**	▪ Belum lelang	
12	Marana, Sulteng	**20**	▪ Gagal lelang karena tidak ada peserta yang mengikuti pelelangan tahun 2015	
13	Telaga Ranu, Malut	**5**	▪ WKP hasil PSP ▪ Belum Lelang	
14	Gn. Wilis, Jatim	**20** Unit 1: 10 Unit 2: 10	▪ WKP hasil PSP ▪ Gagal Lelang tahun 2016	
15	Sipaholon Ria-Ria, Sumut	**20** Unit 1: 10 Unit 2: 10	▪ Gagal lelang karena tidak ada peserta lelang tahun 2011	▪ Akan dilakukan evaluasi WKP

No	WKP	Renc. Pengembangan (MW)	Progres/Kendala	USULAN / SOLUSI
16	Gn. Pandan, Jatim	**40**	▪ Persiapan Lelang	
17	Songgoriti, Jatim	**20** Unit 1: 10 Unit 2: 10	▪ Persiapan Lelang	
18	Wapsalit, Maluku	**5**	▪ WKP Penetapan 2016 ▪ Belum Lelang	Rencana ditugaskan kepada PLN
19	Sumani, Sumbar	**20**	▪ WKP Penetapan 2017 ▪ Belum Lelang	Rencana ditugaskan kepada PLN
20	Waisano, NTT	**20** Unit 1: 10 Unit 2: 10	*Government Drilling*	
21	Cisolok Cisukarame, Jabar	**50**	▪ Izin eksplorasi berakhir pada 19 November 2016, dan PT Jabar Rekind mengembalikan IPB ke Pemerintah ▪ Telah terbit SK Pengakhiran PT JRB melalui Kepmen ESDM No. 2019 K/30/MEM/2018 ▪ Direncanakan akan diberikan penugasan kepada BUMN	
22	Guci, Jateng	**55**	▪ Telah terbit SK Pengakhiran PT SES melalui Kepmen ESDM No. 2017 K/30/MEM/2018	

f. Current Geothermal developers and stakeholders

Geodipa Energi Persero

1. Overview of Operations

PT Geo Dipa Energi (GDE) is a state-owned enterprise geothermal power company with concessions
in Dieng (Central Java) and Patuha (West Java). The government holds 93.33% of Geodipa's shares, with PLN
holding the remaining 6.37%. The funding strategy is based on a combination of independent funding
capabilities and external funding with guaranteed electricity sales to PLN through ESC with PT PLN (Persero).
Reserves of geothermal energy potential and ESC with PT PLN (Persero) are the main factors in obtaining
external funding in the form of development / multilateral bank loans and / or syndicated banks, private
equity and various other funding instruments.

In 2002 it was established as a PERTAMINA and PLN joint venture company to manage the geothermal energy
of Dieng and Patuha and operate the PLTP Dieng unit 1 (60 MW). In 2004 the agreement on the sale and purchase of electricity with PLN for the Dieng and Patuha sites was 400 MW each as outlined in the form of an Energy Sales Contract (ESC).

In 2006, Geo Dipa Energi received the management rights of the Mining Authority (WKP) of Dieng Area and Patuha Area from September 4, 2002.

In 2011 Geo Dipa Energi was declared a BUMN through Government Regulation No. 62/2011.

In 2012 Geo Dipa Energi was affirmed as the manager of the Dieng Plateau WKP, starting January 1, 2007
through Minister of Energy and Mineral Resources Regulation No. 2192.K / 30 / MEM / 2014.

2014, Operated the Patuha PLTP unit 1 (60 MW). and received confirmation as full management of the Patuha area starting January 2007 through Minister of Energy and Mineral Resources Regulation No. 2192.K / 30 / MEM / 2014.

2. Structure of organization, structure of sub companies and the sub-companies related to renewable energy

- Komisaris Utama (Chief Commissioner) - Tio Serepina Siahaan
- Komisaris Independen (Independent Commissioner - Aidil Hasibuan
- Komisaris (Commissioner) - Saleh Abdurrahman
- Direktur Utama (President Director) - Riki Firmandha Ibrahim
- Direktur Operasi dan Pengembangan Niaga - Dodi Herman
  (Director of Commercial Operations and Development)
- Direktur Keuangan (Finance Director) - M. Ikbal Nur
- Direktur Umum dan SDM - Aulijati Wachjudiningsih
  (Director General and HR)

3. Map of important decision makers related to renewable energy in particular

As with all other state owned enterprises, and similar to PLN, PT Geo Dipa Energi (GDE) has a government appointed advisory board. The key decision makers are the Minister of State Owned Enterprises, The Minister of ESDM and the Director General of EBTKE.

4. Procurement system

The funding strategy is based on a combination of independent funding capabilities and external funding with guaranteed electricity sales to PLN through ESC with PT PLN (Persero). Reserves of geothermal energy potential and ESC with PT PLN (Persero) are the main factors in obtaining external funding in the form of development / multilateral bank loans and / or syndicated banks, private equity and various other funding instruments.

See also Figure 3 Procurement system for Goods and Services in Indonesia.

5. Current drilling campaign

Dieng

Dieng, located in Central Java Province, is one of the locations of the Geo Dipa Energi Geothermal Power Plant (PLTP) project. With mountain contours, hot springs, solfatara, fumaroles and rocks indicate that Dieng is a potential location to be developed as a source of geothermal energy. The total potential of geothermal energy around Dieng is estimated at 400 MW.

At present, Geo Dipa Energi has successfully operated the Dieng Unit 1 project with a capacity of 60 MW which is connected to the Java-Madura-Bali network through an interconnection system. In addition, to meet the business targets, the capacity of the Dieng 2 and 3 projects will be increased and developed, each with a capacity of 55 MW.

The number of wells in the Dieng field provides the availability of higher technical data so that it can further increase the drilling success ratio.

Patuha

This project is located near gunung (mount) Patuha in West Java Province, around 40 km south of the city of Bandung. In 2014 Geo Dipa Energi successfully completed the construction of 1 unit PLTP in Patuha with a capacity of 60 MW. The total potential of geothermal energy produced around the area is estimated at around 400 MW. At present Geo Dipa Energi has formulated plans to develop the Patuha Unit 2 and Unit 3 PLTP each with a capacity of 55 MW which is the development of the Unit 1 Patuha Project.

Candradimuka

The Candradimuka Prospect Area is located in the West of the Dieng Area Contract in the city of Banjarnegara, Central Java. The presence of geothermal manifestations such as fumarole, hot springs, and the potential that signifies the Candradimuka Prospect Area has the potential to be developed into a Geothermal Power Plant (PLTP). Based on scientific studies conducted, the prospect area of Candradimuka is capable of producing 80 MWe of electricity.

6. Future exploration and exploitation plans

Dieng Development

Although Dieng only has 1 unit of PLTP operating at 60 MWe, in fact Dieng is estimated to have sufficient resources for the gradual development of 8 units of PLTP of 400 MWe. GDE will immediately prepare for the development of PLTP Dieng Unit-2 and Unit-3. Furthermore, in line with the spirit of optimization of geothermal resources, GDE will develop Binary PLTP as a

complement of existing PLTP by utilizing heat energy from brine produced. In addition, GDE prepares the development of small-scale geothermal power plants by utilizing idle wells, low-producing wells and excess steam.

Patuha Development

Like Dieng, Patuha Field has a total resource potential of not less than 400 MWe. For this reason, it is planned to gradually develop 7 (seven) new PLTP units to complete the existing PLTP-1 units which currently have an installed capacity of 60 MWe.

Candradimuka Development

The Candradimuka area is one of the prospect areas within the Dieng WKP besides the Dieng Field and the Mangunan-Wanayasa Prospect Area. The Candradimuka Prospect Area is located outside and west of the Energy Sales Contract Dieng Field Area. The Candradimuka Prospect Area Development has been started since December 2016 with the start of detailed geological, geochemical and geophysical (3G) surveys and is targeted to achieve COD (commercial operation). date in 2023. Geothermal resource potential The Candradimuka prospect is estimated at 54.5 MWe (P50) and has a separate reservoir with the Dieng reservoir.With the resources of 54.5 MWe, GDE has a development plan of 45 MWe, namely condensing main PLTP of 2 x 20 MWe and 5 MWe binary PLTP.

Furthermore, the Government positioned the Candradimuka Prospect Area development project as a pilot project for the use of Geothermal Sector Infrastructure Funding (PISP) managed by PT SMI for funding the exploration phase, where PISP is one of the Government's solutions to accelerating geothermal development in Indonesia.

Mangunan-Wanayasa Development

Like the Candradimuka Prospect Area, the Prospect Mangunan-Wanayasa Area is one of the Prospect Areas in WKP Dieng (Central Java). The Mangunan-Wanayasa Prospect Area is located in the west of the Candradimuka Prospect Area. Based on a previous study by the Asian Development Bank (ADB) in 2014, the Prospect Area of Mangunan-Wanayasa is estimated to have intermediate enthalpy resources. Although it does not have high enthalpy geothermal resources (such as Dieng Field and Candradimuka Prospect Area), in the future the development of the Mangunan-Wanayasa Area Prospect is expected to be attractive in line with the Government's commitment through special tariffs for medium enthalpies and intermediate enthalpy development technology the more mature.

Patuha North Development

Considering the maturity of the application of technology for the development of intermediate enthalpy geothermal resources in the future as well as the Government's commitment in developing these intermediate enthalpy geothermal resources, GDE tries to see opportunities

to develop geothermal resources in the northern part of Patuha. Patuha Utara is estimated to still be an outflow from Patuha Field. In North Patuha there are hot springs with a temperature of 41-70oC in Patuha Utara and thermal gradients of 14oC / 100m from wells of Core Hole Temperature (TCH-15).

Development of Geothermal Direct Utilization

Amorphous silica (SiO2) is a secondary mineral from the production of geothermal power plants (PLTP) available in massive quantities in the Dieng Geothermal Field. The deposition of Silica (Silica scaling) in wellbore and in production facilities is one of the main obstacles to production activities at Dieng. Silica deposit material, both deposited and dredged manually, is in the form of sludge and until now has not been utilized and is still accommodated in TPA (Final Shelter) which has the potential to result in environmental degradation. In harmony with this, GDE collaborates with the Geotechnology Research Center - LIPI produces paving block products by utilizing sludge from Silica deposition as an alternative raw material while also reducing the occurrence of environmental degradation due to the availability of excessive amounts of Silica deposition sludge at Dieng Field. This activity is expected to continue to be used for community empowerment through community development programs and improving environmental management performance.

In addition to the utilization of associated minerals, in the future, the GDE plans to directly use the brine produced and excess steam to provide added value for processing local commodities in the Dieng area (potatoes, vegetables and carica) and Patuha Field (Tea), as well as various other direct use applications.

7. Overlooking 2019-2022

To be completed in next version

Pertamina Geothermal Energy (PGE)

1. Overview of operation

PGE is a subsidiary of PT Pertamina (Persero) which was established in 2006, the Company is engaged in geothermal energy utilization based on Deed Number 10 dated December 12, 2006 and was approved by the Minister of Law and Human Rights of the Republic of Indonesia dated January 3, 2007. Since its establishment until now, COMPANY has never made a name change. Utilization of geothermal energy in Indonesia has been started since 1974, with exploration and exploitation activities by Pertamina, which identified 70 geothermal regions in the archipelago, which can be used to generate electricity. With share ownership of PT. Pertamina (Persero) 91.09% and PT. Pertamina Pedeve Indonesia 8.91%.

2. Structure of organization , structure of sub-companies and the sub-companies related to renewable energy

- Komisaris Utama (Chief Commissioner) - Pahala Nugraha
- Komisaris (Commissioner) - Herutama Trikoranto
- Komisaris (Commissioner) - Rida Mulyana
- Komisaris (Commissioner) - Faried Utomo
- Komisaris (Commissioner) - Arief Wahidin Soedjono

3. Map of important decision makers related to renewable energy in particular, and Procurement system

PT Pertamina Geothermal Energy has a partnership with PT Pertamina (Persero), a subsidiary and affiliate of PT Pertamina (Persero), as described in the following table:

Figure 12. PT Pertamina Geothermal Energy Procurement

Company	Procurement
PT Pertamina (Persero)	Fuel supply for operational activities in projects and areas. Procurement of IT services, and experts.
PT Pertamina Drilling Service Indonesia	Joint agreement on drilling services and / or other supporting services for geothermal wells in all geothermal projects.
PT Pertamina Lubricants	Contract for the procurement of lubricants required for projects and sites.
PT Pertamina Retail	Collaboration on providing fuel for project vehicle fleets.
PT Pertamina Training &	Procurement of training, procurement of individual

Consultancy	consultants, and procurement of workforce / outsourcing.
PT Patra Jasa	Hotel accommodation service provider.
PT Pertamina Dana Ventura	Financing home ownership / renovation with collateral and unsecured loans with interest borne by the company in the CHOP (Car & Home Ownership Program) program. PKPP (Pertamina Employee Welfare Financing).
PT Pertamina Bina Medika	Providing health services, medical check-ups, medical evacuation for all workers and on site clinics for all areas and projects.
PT Tugu Pratama Indonesia	Insurance Directors and Officers (D & O) Liability, property and cost of well control.
PT Mitra Tour & Travel	Provision of tickets and accommodation for workers.
PT Prima Armada Raya	Provision of light passenger vehicles for all projects.

5. Current drilling campaign

1983, Unit I Kamojang PLTP officially operates, with a capacity of 30 MegaWatt (MW) by utilizing geothermal energy from the Kamojang field in West Java Province.

1987, the Kamojang Unit II & III (2 x 55 MW) PLTP Area began commercial operations.

1996, Sibayak Monoblok Area PLTP officially operates, with a capacity of 2 MegaWatt (MW) located in the Mount Sibayak-WKP of Mount Sinabung, North Sumatra Province.

On August 21, 2001 the Lahendong Unit I PLTP with a capacity of 20 MW operated, utilizing geothermal energy from the Lahendong Field, North Sulawesi Province.

2007, the unit II Lahendong PLTP officially operates, with a capacity of 20 MegaWatt (MW) located in Lahendong WKP, North Sulawesi Province.

2008, Unit IV of the Kamojang PLTP officially operates, with a capacity of 60 MegaWatt (MW) located in WKP Kamojang, West Java Province.

Sibayak PLTP Area units I and II officially operate, with a capacity of 2x5 MegaWatt (MW) located in the Mount Sibayak-WKP of Mount Sinabung, North Sumatra Province.

2009, Lahendong Unit III PLTP officially operates, with a capacity of 20 MegaWatt (MW) located in Lahendong WKP, North Sulawesi Province.

2011, Lahendong Unit IV PLTP officially operates, with a capacity of 20 MegaWatt (MW) located in Lahendong WKP, North Sulawesi Province.

PGE Ulubelu Unit I & II Area (2x55 MW) commenced commercial operations, this WKP is located in Ulubelu, Lampung. Inaugurated by the President of the Republic of Indonesia on December 6, 2012.

PGE Kamojang Unit V (35 MW) area commenced commercial operation, this WKP is located in WKP Kamojang, West Java Province. Inaugurated by the President of the Republic of Indonesia on July 5, 2015.

Lahendong Unit V & VI (2 x 20 MW) PLTP North Sulawesi and Lampung Ulubelu Unit III PLTP (55 MW) began commercial operation. Inaugurated by the President of the Republic of Indonesia on December 27, 2016.

The Ulubelu unit IV PLTP with a 55 MW capacity began commercial operation on March 25, 2017

Karaha Unit I PLTP with a capacity of 30 MW began commercial operation on April 6, 2018

6. Future Exploration and Exploitation Plan

To be completed in next version

7. Overlooking 2019-2022

To be completed in next version

PT Sejahtera Alam Energy (SAE)

1. **Overview of Operation**

SAE is a joint venture Indonesian project company owned by STEAG PE GmbH (Germany) and PT Trinergy. The company is developing the “Baturraden” Geothermal Project in the Province of Central Java. The project area extends beyond the five regencies of Banyumas, Purbalingga, Tegal, Brebes and Pemalang.

The power plant will generate electricity for more than 220.000 households, utilizing the

heat which comes from Mount Slamet volcano and distributing into the Java-Bali Power Grid as part of the Fast Track II Program of Indonesia's 35 GW Agenda.

SAE's shareholders have withstanding experience in international power generation projects all over the world. Our project team members consist of highly qualified people, world leading experts, consultants and contractors in geothermal development and power generation.

Committed to conduct proper drillings and implementing the best power plant technology. Assuring excellence in health, safety and environmental protection.

The project will create multiplier effects to the economy, especially prosperity to the people surrounding the regencies and Central Java. The company claim that their operations can reduce Indonesia carbon emissions by around 205,000 tons per year.

2. Structure or organization, structure of sub-companies and the sub-companies related to renewable energy

- President Commissioner - Herman Afif Kusumo
- President Director - Daniel Molk
- Executive Vice President - Bregas Rochadi
- Project Director - Oliver Brock

3. Map of important decision makers related to renewable energy in particular

See above

4. Procurement system

To be completed in next version

5. Current drilling campaign

Figure 13. PT Sejahtera Alam Energy (SAE) Current Drilling Campaign

Project Name	Baturraden Geothermal Working Area (GWA)

Project Description	Development of Baturraden Geothermal Working Area (GWA) Mount. Slamet – Central Java Province
Company Name	PT Sejahtera Alam Energy
Main Office	Gedung Tambang d/h Wisma Eka Karma Jln Kapten Tendean 15 Jakarta, Indonesia
Geothermal Location	Baturraden – Mount. Slamet, Central Java, Indonesia
Transmission Line	Connected to Bumiayu Substation
Shareholders	STEAG GmbH (75%) and PT Trinergy (25%)
S. K. Menhukham	AHU-12059.AH.01.01. Year 2011
Company's Deed	No.05 Tgl. 02 March 2011
Company Registration Certificate	09.03.1.06.73490 Tgl. 21 November 2011
Taxpayer Registration Number	03.118.136.5-081.000 - 01 April 2012
IPB	SK. Menteri ESDM No.4577 K/30/MEM/2015

6. Future Exploration and Exploitation Plan

To be completed in next version

7. Overlooking 2019-2022

To be completed in next version

Sarulla Energy

1. Overview of Operation

Apart from tapping the rich geothermal resources, geothermal power projects are in line with Government's objective in which Sarulla Project can contribute 330 MW as part of the Government's plan in providing 35,000 MW electricity nationwide.

Sarulla Operations Ltd (“SOL”) is sponsored by a consortium of Medco, Itochu, Kyushu, Inpex and Ormat. The total investment of the project is USD 1.7 billion. The second amendment of the ESC (Energy Sales Contract) and JOC (Joint Operation Contract) between SOL, PLN and PGE was signed on April 4, 2013. SOL has built the world's largest Geothermal Power Plant in a single contract, with a capacity of 3 x 110 MW to contribute the electricity needs in North Sumatra.

The Sarulla project is located in Pahae Julu and Pahae Jae Districts, North Tapanuli Regency, North Sumatra Province. The first unit was operated commercially in March 2017, the second unit was operated in October 2017 and the third unit was started to operate in May 2018.

The geothermal power plants are fueled by steam and brine from production and injection facilities at Silangkitang and Namora-I-Langit reservoirs. The power plants utilize geothermal combined cycle units, which are more efficient than conventional flash type geothermal power plants. The plants capture the steam and brine from the wells and produce energy throughout the day which are intended for base load operation. The condensate steam and the brine water are re-injected to underground via wells to maintain sustainable geothermal resources.

2. Structure of organization, structure of sub-companies and the sub-companies related to renewable energy

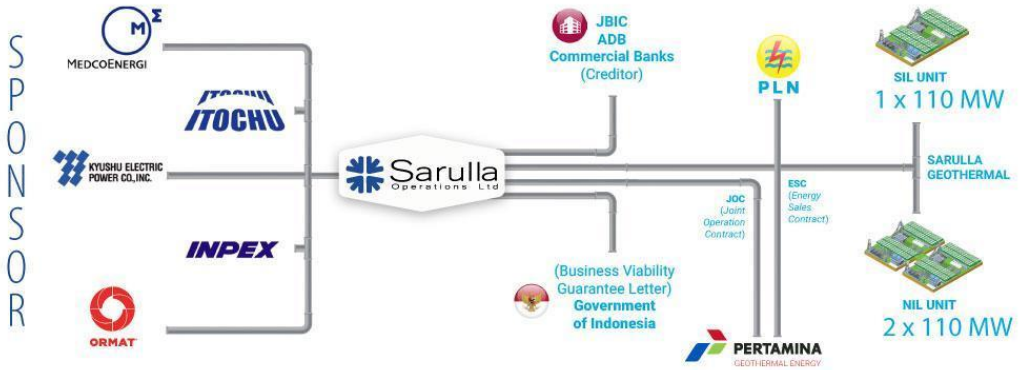
- Chief Executive (CE) - Shinchi Aburaya
- Chief Operating (CO) - William Lajousky
- Chief Financial Officer (CF) - Kunio Noda
- Chief Administration (CA) - Andrea Gunawan Diliharto

3. Map of important decision makers related to renewable energy in particular

See above

4. Procurement system

Figure 14. Sarulla Energy procurement system



5. Current drilling campaign

The Sarulla project is located in Pahae Julu and Pahae Jae Districts, North Tapanuli Regency, North Sumatra Province. The first unit was operated commercially in March 2017, the second unit was operated in October 2017 and the third unit started to operate in May 2018.

The Sarulla project has potential resources in Donotasik & Sibual-buali, South Tapanuli.

Namora I Langit (NIL)
Capacity 2x110 MW

SILANGKITANG (SIL)
Capacity 110 MW

6. Future Exploration and Exploitation Plan

To be completed in next version

7. Overlooking 2019-2022

To be completed in next version

Star Energy Geothermal (Chevron)

1. Overview of operations

In line with its long-term strategy to create real value for all its stakeholders, Star Energy acquired the 110 MW Wayang Windu geothermal generation facility in November 2004. While Jailolo Geothermal is the newest addition to the exploration portfolio in Star Energy's effort to develop other geothermal business that was successfully won on 2009.

Instrumental in the decision to invest in Unit 2 and Unit 3 at Wayang Windu is the potential revenue from CO2 emission credits that are generated by the project. Geothermal electricity generation, unlike coal or diesel or natural gas fired power, is virtually free of any greenhouse gas emissions. This means that the project, when certified by the United Nations, can generate greenhouse gas "credits". These credits have a significant monetary value when they are traded in world markets, where they can be purchased by polluting industries to offset their own greenhouse gas emissions. In this way, Star Energy is making a significant contribution to a cleaner, greener future in which climate change will hopefully become a diminishing threat to the world.

3. Structure of organization, structure of sub-companies and the sub-companies related to renewable energy

- President & CEO - Rudy Suparman
- Chief Financial Officer - Hendra S. Tan
- Vice President Operations Kakap - Wahyu Wicaksana
- Vice President Geothermal Operations Wayang Windu - Heribertus Dwiyudha
- Vice President Geothermal Operations & Maintenance Salak and Darajat - Suharsono Darmono
- Vice President Commercial & Business Development - Peter Wijaya
- Vice President Exploration & New Ventures - Hendry Manur
- Vice President Subsurface & Well Testing - Boyke Bratakusuma
- Vice President Finance Wayang Windu - Evy Susanty
- Vice President Finance Salak Darajat - Merly
- Senior Advisor Human Resources - PM Susbandono

4. Map of important decision makers related to renewable energy in particular

See above

5. Procurement system

To be completed in next version

6. Current drilling campaign

Wayang Windu

Located 40 km south of Bandung in West Java, Wayang Windu Power Generation is

operated by Star Energy Geothermal (Wayang Windu) Limited a wholly owned subsidiary of Star Energy. It is managed under a Joint Operation Contract with Pertamina to develop geothermal resources within the 12,960 hectare contract area. An Energy Sales Agreement between Star Energy, Pertamina and PLN, a state owned utility company, gives Star Energy the right to develop up to 400 MW of electricity - generating capacity over a period of 42 years, with each generating unit being scheduled to operate for at least 30 years. The JOC has the potential to ultimately deliver more than the already-contracted 400 MW of base load electricity to power hungry West Java.

The first Unit (110 MW) at Wayang Windu was completed in 1999, and has been producing at full capacity (with an availability rate of over 98%) since 2000. At the time of its installation, Unit One was the largest geothermal turbine in the world.

On 2nd of March 2009, the Indonesian Minister of Energy and Resources officially opened Wayang Windu Unit 2, with generation capacity from a single turbine/generator, of 117 MW. So, Wayang Windu is now delivering a total of 227 MW of electricity to its buyer, PLN, which dispatches the electricity into the West Java transmissions grid. The potential for significant further expansion at Wayang Windu became apparent during the development drilling for Unit 2. Some of the wells drilled for Unit 2 tested more than 50 MWe of steam, and are producing sustainability at over 40 MWe, probably the largest sustainability steam production in the world for a single well.

A third unit was added at Wayang Windu with generation capacity of 127 MW. Unit 3 came on stream by mid-2014. In February 2010, Star Energy finalized a US$350 million bond issue, the proceeds from which will be used partly to fund the initial drilling and development work for Unit 3, with that worth due to commerce in the middle of 2010, using a drilling rig designed and built to Star Energy Geothermal specifications.

Star Energy claim Wayang Windu as a world-class renewable energy facility, being operated to world class standards, adding that Wayang Windu delivers real benefit to all Star Energy stakeholders.

Subsurface and Steam Above Ground System

Heat energy from the earth is extracted in the form of geothermal fluids. The fluids from several production wells are combined and delivered through two-phase lines to the cyclonic separators where steam and residual water (brine) are separated. The steam is piped to the power station and the brine is returned to the reservoir through re-injection wells to help maintain pressure and prolong productivity of the reservoir. Steam from the separator is purified and dried in scrubbing lines and scrubber stations before entering the steam header in the power station.

Power Station

Dry-saturated steam from the steam header drives the turbine, which is coupled to a

generator. The turbine converts the heat from the steam into mechanical energy and the generator converts mechanical energy into electricity. The steam passes through the turbine and is condensed in a direct contact condenser. The condensed water is then pumped to a cooling tower. The hot condensate is air cooled in the cooling tower and some of the cooled water is recycled to the condenser to condense the steam. Excess of condensate is returned to the reservoir through condensate injection wells. Any non-condensable gas in the condenser is taken out by the Gas Removal System and dispersed to the atmosphere.

Star Energy Geothermal Salak

Star Energy Geothermal Salak, Ltd. (SEGS) works in partnership with two state-owned companies, Pertamina (oil and natural gas company) and PLN (electricity company). SEGS facilities, located around 70 km from Jakarta, the capital, supplies geothermal steam to generate electricity from a 180 MW power plant operated by PLN. We also supply geothermal steam and operate 197 MW power plants generating electricity for the Java-Madura-Bali grid.

An initial supply of steam was channeled in 1994, thus commencing Salak's commercial production, with 110 MW delivered to PLN. Then, in 2005, Salak achieved a generating capacity of 377 MW, which marked the Salak project as one of the largest geothermal operations in the world.

Star Energy Geothermal Darajat

Star Energy Geothermal Darajat II, Limited (SEGD II) works in partnership with two state-owned companies, Pertamina (oil and natural gas company) and PLN (electricity company). SEGD II supplies geothermal steam to the 55 MW power plant operated by PLN. We also supply geothermal steam and operate a total of 216 MW, supplying electrical power for the Java-Madura-Bali grid.

The commercial operations of Darajat geothermal project, which is located near Garut, West Java, was started in November 1994, with capacity near 145 MW. With the completion and upgrading of Unit III in 2009, total capacity of Darajat reached 271 MW.

Darajat Unit III facility has been registered as a Clean Development Mechanism project under the United Nations Framework Convention on Climate Change (UNFCCC)'s Kyoto Protocol, which generates Certified Emission Reductions (CERs). The significant result of this program is in its reduction of greenhouse gases, through the operation of a low-emission geothermal plant. Since December 2006, Darajat field has contributed a documented 6.2 million tons of CERs.

6. Future Exploration and Exploitation Plan

To be completed in next version

7. Overlooking 2019-2022

To be completed in next version

Supreme Energy Geothermal

1. Overview of Operation

Due to the promising prospect for geothermal energy in Indonesia, coupled with a huge demand for renewable energy as well as the need to increase its share in the proportion of the total energy mix, PT Supreme Energy was established in October 2007 by Mr. Supramu Santosa, an oil and gas industry veteran, and the former founder of the Star Energy Group. The company was specifically formed to capitalize on his vast knowledge and experience, and to further develop the geothermal energy sector.

Executives of PT Supreme Energy have extensive experience and knowledge of energy business in Indonesia. They have been very active and directly involved in oil and gas industry, as well as in the geothermal development and operations in Indonesia for the past 20 years. PT Supreme Energy has always employed a dedicated exploration team, whose members have had years of training and experience from major geothermal and oil and gas companies, with solid and proven world-class track records.

In early 2008, PT Supreme Energy was assigned by the Minister of Mineral Resources of the Republic of Indonesia to conduct four pre-feasibility studies in different areas in Sumatra, all of which were completed in 2009. In early 2010, the Liki Pinangawan Muaralaboh and Gunung Rajabasa geothermal concessions were awarded to Supreme Energy who teamed up in a consortium with ENGIE (previously GDF Suez), the leader and largest independent power producer in the world in a consortium. Following this award, the mining licenses were issued consecutively in April and May 2010. In December 2010, the concession for Rantau Dedap resource area was awarded to the same consortium.

Sumitomo Corporation joined the consortium in 2010 to develop the Muara Laboh and Rajabasa concessions together with Supreme Energy and ENGIE. PT Supreme Energy, ENGIE and Sumitomo Corporation are the shareholders of the Supreme Energy Muara Laboh and Supreme Energy Rajabasa project companies. As for Rantau Dedap project, Marubeni Corporation later joined the consortium and becoming the partner for further development of this project.

This industrial partnership brings together unmatched experience and strengths not only in the development, financing and construction of power plants, but also in the operation and maintenance by providing the necessary development, technical and financial support to explore and develop the above three concessions.

2. Structure of organization, structure of sub-companies and sub-companies related to renewable energy

- President & CEO - Supramu Santosa
- Executive Managing Officer - Radikal Utama
- Chief Operating Officer - Victor Van Der Mast
- Chief Financial Officer - Akio Kajimoto
- Vice President of Relations & SHE - Prijandaru Effendi
- Vice President of Business Strategy & Development - Nisriyanto
- Vice President of Support & Service - Win Sukardi

- Vice President of Finance & Accounting - Leksono
- Vice President of Exploration & Subsurface Engineering - Novi Ganevianto

3. Map of important decision makers related to renewable energy in particular

See above

4. Procurement system

To be completed in next version

5. Current drilling campaign

PT Supreme Energy Muara Laboh

Pre-feasibility Study

Under the Decrees of the Minister of Energy and Mineral Resource (ESDM) issued in 2008, PT Supreme Energy was assigned to conduct pre-feasibility studies in Liki Pinangawan Muaralaboh geothermal prospect. These assignments were completed in 2009 within the time specified in the decrees. The studies have successfully estimated

the possible reserves and established the concession area for each of the prospects based on the conceptual models constructed by the integration of geological, geophysical, geochemical data and prior wells. Geotechnical data was added in order to identify any constraints or hazards for development of the field. The earth science data acquired during the pre-feasibility studies was used to estimate resource size of the prospects.

Current Status

Following the tender award of the Muara Laboh concessions to the Supreme Energy Consortium in early 2010, a geothermal license (Ijin Panas Bumi/IPB – previously IUP) was issued to the project company. On March 2, 2012, the Power Purchase Agreements (PPA) between Perusahaan Listrik Negara (PLN) and PT Supreme Energy Muara Laboh (SEML) was signed and on the same day the Ministry of Finance of the Republic Indonesia issued the Government Guarantee Letter for the Muara Laboh project. The signing of the PPA and issuance of the Guarantee Letter resulted from several months of intensive and constructive negotiations between the parties, driven by the shared goal of accelerating the development of geothermal energy in Indonesia.

SEML has been working on the exploration program since 2010 and it has completed the Micro Earth Quake (MEQ) and Airborne topographic surveys, civil engineering studies, and land acquisitions, which were required for the exploration. Civil construction for exploration drilling has started upon the PPA signing. On September 21 2012, SEML did the First Exploration Well Drilling ML-A1. ML-A1 is a series of 6 drilling exploration wells in the Mining Working Area, which proved the existence of geothermal resources in Muara Laboh.

By the end of 2013, SEML has completed the exploration drilling program covering 6 wells (ML - A1, ML-B1, ML-C1, ML-E1, ML-H1, ML-H2). Well monitoring, data evaluation and reserve calculation were performed in 2014.

In 2014, SEML focused on the construction of admin and accommodation building, which completed on September 2014, meanwhile the feasibility study report of 6 wells exploration has been submitted to related government on September 2014.

SEML as the holder of a Geothermal Working license area of Liki Pinangawan Muaralaboh (LPM), has

managed to obtain certification of the amount of steam backup of an independent agency, appointed by the international banking. The reserves value of steam that has been certified by mid-2014 and the technical information of the EPC tender, confirmed that it is sufficient to build a power plant with a capacity of 80 MWe, where all electricity generation will use geothermal energy (PLTP).

PT Supreme Energy Rajabasa

Pre-feasibility study

Under the Decrees of the Minister of Energy and Mineral Resource (ESDM) issued in 2008, PT. Supreme Energy was assigned to conduct pre-feasibility studies in Gunung Rajabasa geothermal prospects. This assignment weascompleted in 2009 within the time specified in the decrees. The studies have successfully estimated the possible reserves and established the concession area for each of the prospects based on the conceptual models constructed by the integration of geological, geophysical, geochemical data and prior wells. Geotechnical data was added in order to identify any constraints or hazards for development of the field. The earth science data acquired during the pre-feasibility studies was used to estimate resource size of the prospects.

Current Status

Following the tender award of the Rajabasa concessions to the Supreme Energy Consortium in early 2010, a geothermal license (Ijin Panas Bumi/IPB – previously IUP) was issued to the project company.

On March 2, 2012, the Power Purchase Agreement (PPA) between Perusahaan Listrik Negara (PLN) and PT Supreme Energy Rajabasa (SERB) was signed and on the same day the Ministry of Finance of the Republic Indonesia issued the Government Guarantee Letter for the project. The signing of the PPA and issuance of the Guarantee Letter followed several months of intensive and constructive negotiations between the parties, driven by the shared goal of accelerating the development of geothermal energy in Indonesia.

The exploration program in Rajabasa has completed the Airborne topographic and MEQ survey. The engineering design for civil construction was started in August 2012. SERB has got

several licenses which are the Environmental Permit (UKL / UPL), location permit, sea water permit, and Business License for Temporary Electricity Supply.

Permits for the jetties at the pier-end were issued by the Minister of Transportation by the end of 2013 year. In April 2014 the Permit for exploration in Protection Forest (IPPKH) was issued by the Ministry of Forestry. This permit is a final requirement for the commencement of construction work in the area of the protection forest.

In 2014, SERB focused on engineering design related to Jetty construction, piping systems, sea water facilities, pumping facilities, and facilities for the supply of electricity generators. SERB has proactively conducted social and legal approach in order to improve situation and condition in the field. The construction activity of jetty began in early 2015 and was completed by the end of 2015.

PT Supreme Energy Rantau Dedap

Pre-feasibility Study

PT Supreme Energy has completed the pre-feasibility study of the Rantau Dedap geothermal prospect in March 2009 as assigned by the Minister of Energy and Mineral Resources. The study successfully estimated the possible reserves based on the conceptual model constructed by the integration of geological, geophysical, geochemical data and prior wells. Geotechnical data was added in order to identify any constraints or hazards for development of the field. The earth science data acquired during the pre-feasibility studies were used to estimate resource size of the prospects.

Project Updates

The concession for the Rantau Dedap has been awarded to Supreme Energy in early December 2010 and the Mining Area License was granted to the project company PT Supreme Energy Rantau Dedap (SERD). SERD received the assignment from the Minister of Energy and Mineral Resources through assignment letter No.5834/26/MEM.L/2011 September 30, 2011.

The exploration program began in 2011 and the Airborne topographic survey and civil engineering study were completed. The Heat loss survey, report, and the geoscientific interpretation were completed in February 2012.

In November, 2012 a Power Purchase Agreement (PPA) was signed with PLN for the Rantau Dedap project. The PPA signing marks a key milestone as it defines the contractual rights and obligations of the parties during the exploration phase, construction phase and operation phase –

conditions, which are necessary to start exploration drilling activities.

By the end of 2013, about 14 km of road has already been opened, and all of the required land acquisition had been completed. All of the planned civil construction was finalised in July 2014. SERD completed the construction of road access and well pad in November 2014 with a total of 4 well pad B, C, E, I and ± 42 km road accesses from Kota Agung – Tunggul Bute – Rantau Dedap.

The First Spud-in of exploration well RD-B1 was conducted on February 3rd 2014. In November 2014, SERD and the Asian Development Bank (ADB) confirmed that SERD fulfilled all conditions precedent and reached financial closing to get US$ 50 million facility agreement, provided by The Asian Development Bank (ADB), supported by the Clean Technology Fund, for the exploration program of Rantau Dedap geothermal project.

The exploration drilling continued until early 2015 with 6 wells completed - RD-B2, RDC1, RD-C2, RD-I1 and RD-I2. The short-term well test for RD-B1, RD-B2, RD-C1, RD-I1 and RD-I2 were completed in 2015 to maximize the potential of geothermal resources. SERD completed the feasibility study report, FEED and EPC tender in 2016.

6. Future Exploitation and Exploration Plan

To be completed in next version

7. Overlooking 2019-2022

To be completed in next version

viii. Other Players / Geothermal Developers

NB: This section to be completed in next version

1. Overview of operations
2. Structure of organization, structure of sub companies and the sub-companies related to renewable energy
3. Map of important decision maker related to renewable energy in particular
4. Procurement system
5. Current drilling campaign
6. Future exploration and exploitation plan
7. Overlooking 2019-2022

g. Competitor analysis

NB: This section to be completed in next version

i. Current players in Service and Consultancy of Geothermal

1. Pre-drill Geoservices work
   a. Description, scope of services and current project
   b. SWOT

2. Drilling & Operation
   a. Description, scope of services and current project
   b. SWOT

3. Geoscience Software and services
   a. Description, scope of services and current project
   b. SWOT

4. Post drill engineering work
   a. Description, scope of services and current project
   b. SWOT

5. Power Engineering
   a. Description, scope of services and current project
   b. SWOT

ii. Current players in Geothermal Plant operation

1. Geothermal Plant tools and assets provider
   a. Description, scope of services and current project

b. SWOT

2. Geothermal Plant Maintenance and Rehabilitation
   a. Description, scope of services and current project
   b. SWOT

iii. Current players in Geothermal supporting facilities

1. Infrastructure
   a. Description, scope of services and current project
   b. SWOT

2. Current player in Geothermal Capacity Building
   a. Description, scope of services and current project
   b. SWOT

h. Geothermal Funding

The government provides infrastructure funding for the geothermal sector or geothermal funds sourced from the 2017 State Budget and World Bank grants of Rp 3.7 trillion.

The 2017 state budget amounts to IDR 3 trillion, the remaining geothermal funds will get additional funds from World Bank grants amounting to US $ 55.25 million or around Rp700 billion. The government appointed PT Sarana Multi Infrastruktur (SMI) manages the fund.

Geothermal Director of the Directorate General of Renewable Energy and Energy Conservation of the Ministry of Energy and Mineral Resources Yunus Saifulhak said that geothermal contractors could apply for loans from the geothermal fund fund.

Based on the Regulation of the Minister of Finance (PMK) Number 62 / PMK.08 / 2017, funds for the provision of geothermal sector infrastructure can be used to mitigate the high cost of geothermal exploration for lending activities, capital participation and / or provision of geothermal data and information.

5. Solar Energy (PLTS)

Solar photovoltaic energy (PV) is one of the most neglected forms of renewable energy in Indonesia, although it too could contribute significantly to closing the gap between current installed capacity and the huge increase in future demand. Located on the equator, Indonesia is blessed with strong solar radiation, especially in eastern and southern regions such as East Java.

Solar energy (PLTS) has huge potential in Indonesia, the country with the largest solar power absorption in ASEAN. The average radiation intensity is 4.8 kWh / m2 / day which is equivalent to 112,000 GWp (10 times the potential of Germany). The provinces of Nusa Tengara Barat and Papua have the highest solar potential at 5.7 kWh / m2 / day, and Bogor in West Java the lowest at 2.56 kWh / m2 / day.

Solar power is well suited for electrifying rural regions with only 1 MW PLTS needing 1-2 Ha of land).. The challenge with off-grid rural PV projects is that they are unfeasible on a purely commercial basis, while appropriate government programmes to subsidise PV installations are lacking. Grid-connected projects to sell PV electricity to PLN, meanwhile, are still largely untested in Indonesia, although interest is growing. November 2013 saw the launch of a tender for 80 sites totalling 140 MW, which foreign companies could participate in jointly with local entities. The government is trying to boost the local production of PV systems; using locally made equipment (at least 40%), which it aims to reward with higher feed-in tariffs.

Despite the huge potential for solar power in Indonesia - an average of 4,8 kWh / m2 / day could potentially provide a massive 500,000 MW (500 GW) of electricity capacity - the current installed solar capacity (July 2018) in Indonesia is just 94 megawatts (MW). Despite the huge potential for solar power in Indonesia, an average of 4,8 kWh / m2 / day could potentially provide a massive 500,000 MW (500 GW) of electricity capacity. The current installed solar capacity (July 2018) in Indonesia is just 94 megawatts (MW).

Although the ESDM Ministry's target by 2020 is around 5 GW, the target in the PLTS Roadmap (2025) is much lower, at 870 MW or 50 MWp / year. It recently became even more evident that the Indonesian government is ignoring the country’s huge solar energy potential when state power company, PLN, only set a target of 908 MW of solar energy by 2028 in its 2019-2028 electricity supply business plan (RUPTL).

PLTS on the roof of buildings (rooftop) (PLTSA) such as the office of the Presidential Palace, Bogor Palace, Parliament Building, Office of the Coordinating Ministry for Economic Affairs, real estate buildings, etc. under review. The example of PLTSA that has been built is: PLTSA Sampoerna (April 2017) in Surabaya with a capacity of 63kWp which produces 93 MWh / year of electricity for offices and production facilities; PLTSA 400Wp is installed on the 3rd floor of SMAK St Louis 1, Surabaya. In the future, every household will be required to use PLTSA. The rooftop PLTS regulations are issued Nov 2018 (ESDM Candy No. 49 of 2018), and the Directorate General of EBTKE facilitates the national movement of a million solar roofs with a target of 1 GW by 2020. Unfortunately this is less attractive to investors, because the electricity export is recorded in electricity meters from the customer to PLN is only multiplied by the amount of 65%, not 100%,

with the reason that the customer needs to pay the electricity export and import transmission lines. The candy is requested to be reviewed.

Meanwhile, the purchase of Electric Power from PLTS Fotovotaik by PT PLN (Persero) can be seen in Permen ESDM no.19 / 2016 which is not the same on various islands in Indonesia (USD cents / kWh) (Java (150MWp): 14.5); Bali: 16 to Papua & West Papua: 25. The ESDM Regulation is renewed by Minister of Energy and Mineral Resources No. 12 of 2017 (No. 19/2016 still applies as long as it does not contradict) which explains that the purchase of electricity from PLN is based on the capacity quota from PLN with a minimum total package of 15 MW, and 85% of the local BPP (if the Local BPP> National BPP, or the same as the local BPP, if the local BPP = or <National BPP). For PLTS in Maluku, BPP reaches Rp. 2,900kWh. So, PLTS developers can sell electricity to PLN around Rp.2465 / kWh. However, for other regions that are more efficient, BPP is only Rp.1800 / kWh, and developers only get around Rp.1530 / kWh.

For regions that have very low BPP, for example Java, which is only around Rp. 900 / kWh, how many developers have to sell electricity to PLN? Article 5 paragraph 4 stipulates that PLTS in locations that have an average BPP lower than the national BPP, the maximum tariff is the same as the national BPP. As an illustration, currently the national BPP is around Rp. 1,400 / kWh, so the price of PLTS electricity in Java can reach that number. This means that the lowest PLTS electricity tariff with the current BPP is IDR 1,400 / kWh. However, this regulation only regulates the 'highest' purchase price, so PLN still has room to negotiate with developers (B to B).

Indonesian PLTS technology must be more effective and efficient (with the addition of certain electronic circuits) so that the electricity produced can be cheaper (for example 6-7 cents USD / kWh). However, Ministerial Regulation No.12 / 2017 caused developers to be reluctant to engage in EBT PLT, so they asked for the Candy to be reviewed.

PLTS Floating Cell (Floating PLTS) is being pursued in the Surabaya AL, as well as a feasibility study is being studied to determine PLTS in all reservoirs in Indonesia, no need for land acquisition.

As a maritime country, the application of electricity from PLTS is intended to assist fishermen by, e.g.:

- solar powered motorboat for fishermen (reducing fuel dependence)
- solar energy fishing lights (fish coming in the direction of light from PLTS); and
- solar powered refrigerator (catches are kept fresh)

Research:

PLTS Cirata 1.3MW (using Thin-film CIS technology, made in Japan, IDR 2.6 billion) was built by a subsidiary of PT PLN (PT PJB) near the Cirata PLTA (on 1.5 Ha of land, in Cadas Sari District, Tegal Waru District, Purwakarta Regency, West Java) and was inaugurated in October 2015. In addition to electrifying 3 Subdistricts in Purwakarta, the PLTS was also used as a research facility (Twinlet & central inverter) for PLTS operators throughout Indonesia.

Gen solar cell. III in the form of basic ingredients of organic matter and nano titanium oxide

powder (TiO2) are still being developed in order to get low cell prices and high efficiency of solar absorption.

Physics Engineering Student ITB uses black sticky rice extract as an organic solar cell substitute for synthetic silicon which is capable of producing an electric current of around 1.9 mA. Research on dye-sensed solar cell (DSSC) is still continuing (eg red dragon fruit extract).

The Sapu Angin Surya Indonesia team participated in a 3000 km (Darwin-Adelaide) solar car race in Australia.

Some examples of operational PLTS:

- Jakabaring 2MW PLTS (5,248 polycrystalline solar modules, 8 units of inverter capacity of 250kW, 4 transformer units, 3500m grid transmission lines, 1,897MWh / year) (in the Jakabaring area sports complex), on 2,5 hectares of land, operated by PDPDE Sumsel (April 2018) to support the Asian Games for the 18th August 2018. The PLTS is the result of Japanese Government donations (subsidies, EPC from Sharp, USD56 million) and Indonesia (Private USD83 million).

- PLTS Semau 450 kW, on Semau island, NTT, 45 minutes from Kupang, sea travel.
- PLTS Karangasem 1 MW (on grid), Bali (1.2 Ha produces 1 MW).
- PLTS on Sumba (Asia Calling TV).
- In 2014, PLTS were successfully built in 2 villages in the district. Pasean. Sentara in Bangkalan, 2 PLTS (10 units each) in Brekas Daja Ds (Modung Subdistrict), and Ds. Galis Daja (Kec. Kecang) was successfully built, and operated (Nov 2014).
- PLTS was built in 2 hamlets (Bejur & Lor Selor) (2015) in Ds. East Bajur, Kec. Waru, Pamekasan, Madura, East Java, cost Rp.2 billion.
- PLTS in Ds. Sungai Upih (Pelalawan, Kuala Kampar) (Feb 2015) was inaugurated for its use of Rp.9 billion; Previously, PLTS was in Ds. Solok River has also been used.
- PT Supisang PLTS 20 MWh (for 263 houses + 40 public facilities, APBNP Rp. 5.5 billion, KKP assistance), kec. North Coast, West Lampung, was inaugurated in March 2012. Op & maintenance costs around Rp. 30-50 thousand per house. Residents are trained to be able to operate it.
- The North Sumatra Mining and Energy Service has completed 250 PLTS, including 85 units in Satahi Nuli Village, Kec. Kolang, Kab. Tapanuli Tengah, 85 units in the village of Parausorat Sitabotabo, Kec. Saipar Dolok Hole, Kab. South Tapanuli, and 80 units in Napa Gadung Laut Village, Kec. Padang Bolak, Kab. Padang Lawas Utara. The construction costs around Rp. 1.8 billion.
- PT PLN operates a 600 kW PLTS (largest) in Morotai, North Maluku.
- 200 kWp PLTS on the Gili, P. Trawangan, 80 kWp in Tual, P. Dullah Laut, and 6 PLTS in 6 villages in East Halmahera Regency, North Maluku at the cost of PT Antam Tbk Rp. 1.4 billion with a capacity of 0.5 kW was also successfully built.

Existing and planned PLTS:

- PT Angkasa Pura I in collaboration with Sintesa Group & SunEdison built PLTS at 4 international airports (end of 2014) (Ngurah Rai / Bali 15MW, Djuanda / Surabaya, Sepinggan / Balikpapan, and Hasanuddin / Makassar) at a cost of US $ 45 million for a total power of 50 MW . The construction of the PLTS was completed at the end of 2015. Other Tambaloka airports, Maumere, Labuan Bajo followed.

- PLN targets small islands in the eastern Indonesian archipelago to build 22 MW PLTS on 100 remote islands with an island electricity system pattern. with funding support from the World Bank, PLN also built 5 PLTS in KIT, namely in Derawan, Raja Ampat, Wakatobi, Banda, and Trawangan.

SUMATRA

PT LEN Industri (BUMN) signed the MoU with Sunseap Enterprises Pte Ltd. formed the company PT LEN Sunseap Energy (Singapore) to install PLTS 50MWp in the Batamindo Industrial Area, Batam, Prov. Kep. Riau, which began in late 2015 with an investment of US $ 5 million.

The South Sumatra Provincial Government in collaboration with PT Sharp Construction (20 years) built 10MW (Phase I) on a 20Ha field near the Jakabaring lake, and 5000MW (stage II) along the East coast, Kab. OIC

PLTS on ex-mining land, PT Bukit Asam (Persero) Tbk, is agreed to be around 5 cents USD / kWh.

PLTS 20kW (150 houses) across S. Pengabuan, Kab. West Tanjab was built. The project was completed at the end of 2015.

5.4 MW Floating PLTS on Pekanbaru 5Ha lake, Kel. Lembah Sari, Kec. Coastal Tassel, in the city of Pekanbaru Riau contested by 2 PMDN investors, PT Ikhwan ET and PT Kharisma Ambhara Sakti.

North Sumatra

Plan: Spread PLTS (35MW).

Riau Islands

Kepri Spread PLTS (IPP, 20.8MW, 2020, PPA process).

Bangka Belitung

PPA Process: Spread PLTS (IPP, 8.68MW, 2020). PLN plans to build 170 kWp PLTS in Kep Bangka-Belitung (during the day, and diesel at night). BPP around Rp.4000-5000 / kWh.

West Sumatra

PPA Process: West Sumatra Spread PLTS (IPP, 16MW, 2020).

South Sumatra

PPA: Jakabaring PLTS (IPP, 2MW, 2019); PPA Process: Spread PLTS (IPP, 27MW, 2020).

Bengkulu

PPA Process: Bengkulu Spread PLTS (IPP, 1 MW, 2020).

Potential: Bengkulu Scattered PLTS (1MW).

JAVA

Banten

In 2015, the Banten Regional Government built 300 free PLTS in remote locations that were not affordable to PLN in the Regency. Pandeglang (100 units) and Lebak (200 units). One PLTS unit (in the form of 1 solar module, 1 inverter / ballast, 1 BCU (Battery Control Unit), 1 Battery) produces 50 Wp of power, for Rp.3 million.

The Ministry of Energy and Mineral Resources has built 1 PLTS unit (25 kW) in Wargasara village, kec. Tirtayasa, Kab. Serang, Banten for 320 families (2013). This unit adds 2 PLTS (15 kW) already in Pulo Panjang village, kec. Pulo Ampel.

Plans: Scattered PLTS (Unallocated, 50MW, 2025)

West Java

Plans: PLTS / B Scattered (Unallocated, 150MW, 2023).

Potential: PLTS Bekasi (150-600MW); Cirata (2 0 0 M W); Jatiluhur (100MW); Saguling (100MW); Jatigede (100MW).

Masdar (a subsidiary of Global Investment, Mubadala Investment Co. Abu Dhabi engaged in infrastructure projects such as energy, transportation, fast train TOD) signed the MoU (in Abu Dhabi, Middle East) with PT PJB (PLN subsidiary) for an ET project partnership in Indonesia, in order to meet the target of 23% ET in 2025 and 31% in 2050. Masdar conducted FS to build PLTST (Floating) in 10% of the Cirata reservoir area, West Java. (The cost of land acquisition is not needed, so Capex can be reduced). The price of the PLTST electricity that PLN will buy is still being negotiated. PLN's BPP in West Java is around 6.52 cents / kWh (Menpen ESDM No.12 / 2017). On the other hand, the UAE requested government guarantees not to nationalize the company. The estimated value of the project is around USD 300 million with a capacity of 200 MW (shares of PT PJB 51%, and Masdar 40%). PPA is signed around November 2017 at a price of around 6-7 cents / kWh.

Construction of a new Solar Cell factory in the LEN Technopark area, Rp.2T, 10Ha (PT Dahana complex) Subang, West Java is being explored with a new government (2015) to build the ICT Industry, Railway Signaling Industry, and Defense Electronics (Starstreak

missile) industry while anticipating ET requests (including PLTS) 5,600MW. This is to complement the construction of the previous PLTS plant (2011) which is operated by PT LEN Industri (Persero, BUMN) with a production capacity of 90 MW photovoltaic plants / year using Thin film technology which has an investment of US $ 125 million. The factory is located in West Karawang, Kab. Karawang, West Java, was built on a 28 ha former ISN textile factory.

Generation II solar cells (thin films) made by DN (Nano-PV) with a capacity of 90 MW / year in Cikarang, Jabar (designed by WW. Wenas, ITB + investors DN / Bakrie Power + LN / US investors, Head office in New Jersey USA) ordered by LN (10MW, Spain, 2009). The cheapest commercial prices in the world (0.8-0.9 USD / W).

Central Java

The Central Java Provincial Government targets the construction of 213 PLTS in Wonogiri, Sragen and Boyolali.

Plans: PLTS / B Scattered (Unallocated, 50 & 100 MW, 2021 & 2025).

Potential: TTS (hybrid) Tegal (220MW); PLTS of Gajahmungkur Reservoir (100MW); Kedung Ombo (100MW)

East Java

Plans: PLTS / B Scattered (Unallocated, 100 MW, 2025).

Potential: PLTS / B (Hybrid) Tuban (140MW); PLTS Karangkates Reservoir (100MW).

ITS Surabaya engineers launched a JALAPATIH solar power ship. Solar energy is stored in 114 Lithium ion batteries, which produce 2 kW of power, and drive 10 knots roaming 220 km. The technology is needed to electrify fishing boats in East Java. On the other hand, there are attempts to test solar-powered fishing vessels assembled by PPPTKP, Balitbang KP, KKP.

BALI

Procurement: Spread PLTS / B (IPP, 25MW, 2020);

Plan: Spread PLTS / B (IPP, 25MW, 2023);

Potential: Country (100MW); Amlapura (100MW); Camp (100MW).

The 1 MW PLTS project in Bangli, Bali is being sought by the Bangli Regional Government. Floating PLTS in Situ Mutiara (13km from Ngurah Rai Airport, Denpasar) will be built together with PLTS on the roof of Ngurah Rai airport

Samsung C & T Co. South Korea signed the MoU (2011) with the Indonesian government (involving PLN and local companies) to develop around 50 MW of solar power plants in Madura / Bali. Plans: PLTS Bali Spread: 50MW, 2019.

Nusa Tengara Barat (NTB

Procurement: PLTS Pringgabaya (IPP, 5MW, 2019); Selong (IPP, 5MW, 2019); Sengkol (IPP, 5MW, 2019); Kuta (IPP, 5MW, 2019);

Plan: Spread (Unallocated, 15MW, 2021).

Potential: (Dompu (1MW); Sape (1 MW).

Nusa Tengara Timur (NTT)

Construction: Atambua PLTS (IPP, 1MW), 2018) by PT Global Karya Mandiri; PLTS Maumere-Rope-Ende (IPP, 2MW, 2018) by PT Indo Solusi Utama.

Plans: Spread PLTS (Unallocated, 7MW, 2021).

Potential: West Sumba (10MW); East Sumba (10.1 MW).

PLTS totaling 840 units were placed at 16 translocating locations in Kab. Sikka, Ngada (Flores), and Kab. TTS (Timor Tengah Selatan) on Timor Island.

PLN (NTT) signed PPA with LEN (winner of the tender) to buy electricity (ESDM Candy no. 17/2013) from PLTS Oelpuah 5 MW in kec. Kupang Tengah, Kupang Regency (NTT) at a cost of Rp120 billion. Electricity passes through a 20kV transmission network. President Jokowi has inaugurated the IPP IPP. (Dec. 27, 2015) (largest in Indonesia). Price is still high: 22sen US $ / kWh.

The Japanese government helps residents of the village of Labuan Sangor, Maronge, Sumbawa, NTT by providing 2 solar water purifiers (made by Torey International) as donations from PT Bio Greenland (BGL), an investor in rambutan jatropha from Japan.

KALIMANTAN

West Kalimantan

Potential: Nanga Nyabau PLTS (50kW, Kapuas Hulu).

Central Kalimantan

Potential: Sei Pinang PLTS (200kW, Kapuas); Jangkang (150kW, Kapuas); Soruh (150kW, Kapuas); Kalanis (250kW, South Barito); Tabatan (75kW, South Barito); Lehai (100kW, South Barito).

East Kalimantan

Potential: Teluk Alulu PLTS (68kW), Maratua.

SULAWESI

North Sulawesi

Construction: Likupang PLTS (IPP, 15MW, 2019).

Gorontolo
PLTS Isimu, Gorontalo (IPP, 10MW,

South Sulawesi

Potential: Bult PLTS (EPC, 0.05MW); Sapuka (EPC, 0.05MW).

North Sulawesi

Spread PLTS (30MW), 2017-2023. PLTS (+ PLTD, Hybrid) Bombana (10MW).

West Sulawesi

PLTS (PLTS-1 Karampuang 201.6 kWp, PLTS-2 Karaeang 115.2kWp) made in the US in Mamuju (P. Karampuang) costs Rp.3 billion.

Maluku
Potential: Siatele PLTS (0,1MW); Apara (0.073MW).

North Maluku

Potential: PLTS Kosa (0,1MW) Tidore Islands.

PAPUA

Papua
Potential: My PLTS (0.138MW) Keerom; Bompai (0.024MW) Keerom.

Oksibil PLTS, the highest in the world (3000m above sea level) (300 kWp, 1280 solar panels, Rp. 14-18 billion) from China (inverter & solar cells) and New Zealand (interface) tested in the Bintang mountains, Papua.

West Papua

Potential: Dombok PLTS (0.075MW) ...

Domestic PLTS companies

Domestic PLTS contractor company, CV. Two Brothers (Pasuruan, East Java, solarpowerku@gmail.com), offering small to large PLTS (from 300 Watts to 100 MW), Pure sine wave real output, AC DC on grid or off grid, on 24 hours non-stop.

6. Hydro Energy (PLTA)

Hydroelectric power boasts even greater potential than geothermal energy, estimated at around 75,000 MW. It is also the most utilized source of renewable energy at present, with total installed capacity of around 6,000 MW. Potential hydropower sites are spread out across the country, with lots of potential for large-scale projects seen in the under-served eastern regions of the country, such as Maluku and Papua. Hydropower developers face the geographic challenge that many of the sites for large-scale projects lie in isolated and usually forested regions with little or no infrastructure. Small-scale hydropower projects (defined as generating less than 10 MW), on the other hand, are less bankable and face their own technical challenges, such as bringing in equipment from across the country or even from abroad – which seems overly burdensome for just a couple of megawatts. However, micro and mini-hydropower projects enjoy support from the government and development agencies, and in some cases microfinance credit. Hydropower offers opportunities for suppliers and consultants working in tandem with public backers and local stakeholders.

Throughout Indonesia, the potential for large and small-scale hydropower is around 75,670 MW (75.7 GW, spread over 1249 locations) (according to a 1983 study). Data from the Ministry of Energy and Mineral Resources states that the potential of the hydropower plant in Sumatra is around 15.6 GW (20.8%), Java 4.2 GW (5.6%), Kalimantan 21.6 GW (28.8%), Sulawesi 10.2 GW (13.6%), Bali, NTT, NTB around 620 MW (0.8%), Maluku 430 MW (0.6%), and Papua 22.35 GW (29.8%).

Then in 2011 the Government and PT PLN compiled the Hydro Power Master Plan which recommended that the development of total hydropower which was considered technically, economically and environmentally feasible until 2027 was 12,893.9 MW, in 89 locations, namely Sumatra 4,408.4 MW, Java 4,594 , 5 MW, Kalimantan 431 MW, Sulawesi 3239.6 MW, NTT 15 MW, Maluku 156.4 MW, and Papua & West Papua 49 MW. On the other hand, hydropower that has been built and can be utilized until 2014 is only 5,941 MW or 7.85% (PLTA 5,711 MW, PLTMH 230 MW) and the Director General of EBTKE targets 9,700 MW in 2015 through an acceleration scheme.

Examples of large and small hydropower plants in operation:

SUMATRA

North Sumatra

Asahan-1 (180 / 2x90 MW), Sigura-gura / Asahan-2 (286 / 4x71.5 MW), Stairs (223 / 4x55.75 MW), Lau Renun (82 / 2x41 MW), Sipansihaporas (50/33 +17 MW), Wampu (45 / 3x15 MW); Sionom HS (3x2,5MW); Hutaraja (2x2,5MW).

West Sumatra
Maninjau (68 / 4x17 MW), Singkarak (175 / 4x43.75 MW), Batang Agam (3x3,5 MW);

Bengkulu

Test (16 / 4x4 MW), Musi (210 / 3x70 MW);

Riau
Koto Panjang (114 / 3x38 MW), Talang Lembu (2x16 MW)

Lampung
Way Besai (92.8 / 2x46.4 MW), Batutegi (28 / 2x14 MW);

JAVA

West Java
Ubrug / Cibadak (27.9 / 2x10.8 + 6.3 MW) (currently dead, broken dam), Crooked (10.15 / 3x3.15 + 0.7 MW), Cikalong (19.2 / 3x3, 64 MW), Cirata (1000 / 8x126 MW), Saguling (700 / 4x178 MW), Jatiluhur (187 MW); Lamajan (19.2 / 3x6.4 MW), Parakan Kondang (9.92 / 4x2.48 MW);

Central Java
Sudirman (Mrica) (3x61,5 MW); Jelok (4x5 MW); Timo (3x4 MW); Wonogiri (2x6 MW); Garung (2x6 MW); Sempor (1x1 MW); Ketenger-1 and Ketenger-2 (2x3.5 MW); Ketenger-3 (1x1 MW); Wadaslintang (2x9 MW); Kedung Ombo (1x22,5 MW); Klambu (1x1.17 MW); Pejengkolan (1 x 1.4 MW); Sidorejo (1 x 1.4 MW); Gajah Mungkur (12.4 MW).

East Java
UP Brantas (281 MW): consists of 12 hydropower units, namely [Sengguruh (29 / 2x14.5 MW); Late (23.2 / 4x5.8 MW); Siman (10.8 / 3x3.6 MW); Selorejo (1x4.48 MW); Grying (3.2 / 2x1.35 + 1x0.5 MW); Golang (2.7 MW); Ngebel (2.2 MW); Wlingi (54 / 2x27 MW); Lodoyo (1x4,5 MW); Tulung Agung (2x23 MW); Wonorejo (6.3 MW); Karangkates / Sutami (105 / 3x35 MW)]; Write (2x7 MW);

KALIMANTAN

South Kalimantan
Right-handed (30 / 3x10 MW); North Sulawesi: Old Tonsea (14.38 / 1x4.44 + 1x4.5 + 1x5.44 MW); Tanggari-1 (1x17.2 MW); Tanggari-2 (1x19 MW);

SULAWESI

South Sulawesi
Balambano (110 / 2x55 MW), Larona (165 / 3x55 MW), Karebbe (90 / 2x45 MW), Bakaru (126 / 2x63 MW);

Central Sulawesi
Sulewana-Poso I (160 / 4x40 MW); Sulewana-Poso II (180 / 3x60 MW); Sulewana-Poso III (400 / 5x80 MW),

PAPUA

Papua
Orya Genyem (2x10MW).

Status of PLTA that are being / will be built in Indonesia (March 2018):

SUMATRA

Aceh
The potential for hydropower in Aceh is ~ 2,500MW, peak load requirements are ~ 450MW. Construction: 89 MW Peusangan PLTA (PLN, construction) (Peusangan-1 (ROR, 2x22,5 MW), 2020 and Peusangan-2 (ROR, 2x22,5 MW), 2021, Takengon, built by PLN whose civil works are carried out by Hyundai + PT PP Tbk, metal pek by Wika Amarta, pek 150 KV transmission line & substation network by PT Karunia Berakti + PT Karunia Berca with an investment of Rp.3 trillion. Peusangan's electrical energy will be channeled to the High Voltage Air Line (SUTT) 150 kV North Sumatra & Aceh via Takengon GI (Substation) and Bireun GI. Loans originated from JICA Rp.2.6 trillion; Krueng Isep hydropower (IPP, 20MW), 2019; Lawe Attitude PLTM (IPP, 7MW), 2019.

Krueng Bate (150MW) hydropower with underground methods (not disturbing protected forests etc.), in Kab. Aceh Barat Daya, Prov. Aceh is in demand by Chinese companies (PT Rich Land Power Investment Indonesia) to be built with an investment of Rp.2.6 trillion. Other PLTA functions: irrigation, community drinking water, tourism, and water reserves for the surrounding dry hamlets.

Plan: Spread PLTA / M (IPP, 582,2MW, 2021-2025).

Committed: Kumbih-3 hydropower (, PLN, 45MW), 2022.

Potential: Hydroelectric Power Plant Appears -1 (RES, 330MW); Jambo Papeun-3 (ROR, 25 MW); Kluet (ROR, 87MW); Kluet-1 (ROR, 41MW); Kluet-2, (ROR, 120MW); Meulaboh-5 (ROR, 43 MW); Peusangan-4 (FTP2), (ROR, 31MW); Kluet-3 (ROR, 24MW); Sibubung-1 (ROR, 32 MW); Unlimited 3 (ROR, 31MW); Teunom-1 (RES, 24MW); Teunom-2 (RES, 230MW); Teunom-3 (RES, 102 MW); Woyla-1 (250MW); Woyla-2 (RES, 242 MW); Woyla-5 (ROR, 56MW); Ramasan-1 (RES, 119 MW); Tripa-1 (ROR, 100MW); Tripa-4 (RES, 185 MW); Jambu Aye (RES, 160MW); Kla (ROR, 12MW); Lae Suraya (ROR, 240MW); Meurebo-2 (ROR, 59MW); Meurebo-3 (ROR, 100MW); Krueng Kluet (300MW); Krueng Meriam (48MW); Redelong (3x6MW); Ketambe (ROR, 19.4 MW); Mamas (ROR, 52MW); Meulaboh-2 (ROR, 37MW); Sibubung-3 (ROR, 22.6MW); Lawe Alas (RES, 151MW); Lawe Mawas (ROR, 50MW).
Potential: Lawe Gurah PLTM (4.5MW); Lhok Pineung (5.1 MW); Ketol A (10MW); Social Mangku (6.6MW); Subulussalam (7.4MW); Tembolon (Bidin-2) (3.1MW)

North Sumatra
The province of North Sumatra has the potential of extraordinary PLTM, which is more than 800 MW (> 110 PLTM) will be used as a Qibla for PLTM in Indonesia. The biggest problem: licensing.

Construction: Aek Sisira Simandame MHP (IPP, 4.6 MW, 2018); Lae Kombih-3 (IPP, 8MW, 2018); Construction (2019): Aek Tomuan-1 MHP (IPP, 8 MW); Batang Toru 1 (PPA, IPP, 7.5MW); Batang Toru 3 (IPP, 10MW); Section (IPP, 10MW); Rahu 2 (IPP, 6.4MW), Raisan Hutadolok (IPP, 7MW); Raisan Ngatimbul (IPP, 7MW); Sei Wampu (IPP, 9MW); Sidikalang-2 (IPP, 7.4MW); Sembelin 1 (IPP, 6MW).

Construction: Parlilitan PLTM (7.5 MW), Glare II (IPP, 7.5 MW); Hutaraja (5 MW); Rahu-2 (IPP, 6.4MW, 2018); Sei Wampu (IPP, 9MW, 2018); Parmonangan (IPP, 9MW, 2019); PLTA Pakkat (IPP, 18 MW, 2017).

Construction: Asahan-3 Hydroelectric Power Plant (FTP2) (PLN, ROR, 174 / 2x87 MW) (Rp. 2.3 trillion), and extended to 2023/24, hampered by cases of corruption in protected forests; Hasang PLTA (FTP-2) (IPP, 40 / 3x13 MW), 2019; Batang Toru PLTA (Tapsel) (IPP, 510, 4x125MW), (TapSel), 2021;

Study: PS Sumatra Pump Storage-1 (PLN, 500MW) (2027).
(PPA, 2020): PLTM Aek Pungga (IPP, 2MW); Aek Sibundong (IPP, 8 + 10MW); Aek Sigeaon (IPP, 3MW); Aek Silang 2 (IPP, 10MW); Aek Situmandi (IPP, 7.4MW); Anggoci (IPP, 9MW); Batang Toru 4 & 5 (IPP, 10 + 7.5 MW); Batu Gajah (IPP, 10MW); Huta Padang (IPP, 10MW); Kandibata 1 & 2 (IPP, 9.7 + 10MW); Kineppen (IPP, 10MW); Upper Ordi (IPP, 10MW); Parmonangan 2 (IPP, 10MW); Simonggo (IPP, 8MW); Zion (IPP, 10MW) (PT Citra Multi Energi); Sisira (IPP, 9.8MW); Sungai Buaya (IPP, 3MW); Lively Talent (IPP, 5MW) (2021);

The 2x300 MW Inalum Hydroelectric Power Plant was built by PT Inalum (already a BUMN) with a fund of USD700 million, and possibly operating in 2019 to produce 500 thousand tons of aluminum ingots.
Kumbih-4, (45MW) PLTA Medan, funding from Germany (2022).

PLTA Poigar (230MW) (2021).

Pump Storage (plan): Lake Toba (PST, 400MW) (2024); Sumatra PS1 (PST, 500MW) (2025); Sumatra PS2 (PST, 500MW) (2025).

Plans: PLTA Aek Kuala (ROR, 15.2MW); Lau Gunung (IPP, 15 MW); Siborpa (IPP, RES, 114MW); Sibundong-4 (IPP, 75MW); Ordi-5 (ROR, 27MW); Julu thigh (ROR, 2x9MW); Poring (40MW); Asahan-4 & 5 (RES, 20 + 40MW); Cinendang (ROR / RES, 80MW); Garoga (ROR / RES, 40MW); Munthe Tigabinanga (29MW); Sitanduk (55MW); Sei Wampu 1, 2, 3 (12 + 13.4 + 24.6MW); Aek Simonggo Parlilitan Tarabintang (85MW); Simanggo-2 (PLN, ROR, 90 MW); Simanggo-1 (ROR, 59MW); Sirahar (ROR, 35.4MW); Silau-1 (ROR, 52.3MW); Gunung-2 (ROR, 22.6MW); Renun-3 (ROR, 19,8MW); Renun-4 (ROR, 53,6MW); Renun-6 (ROR, 22.4MW); Ordi-1

(ROR, 40,8MW); Ordi-2 (ROR, 26,8MW); Year-3 (61MW); Meureubo-2 (59MW); Wampu (ROR, 84MW); If-2 (ROR, 42MW); Raisan-1 (ROR, 26MW); Ordi-3 (ROR, 18MW); Syria (ROR, 17MW); Toru-2 Hydroelectric Power Plant (ROR, 34MW); PLTA Toru-3 (RES, 228MW); Bah Karai PLTA (IPP, 12.6MW, 2027, postponed); Sidikalang-1 (IPP, 15MW); Mandoge (ROR, 3x10MW);

Spread Hydropower Plant (IPP, 341,3MW)

Potential: Bingai PLTM (7MW); Adian Nangka (1,5MW); Simare (3MW); Tanah Pinem (10MW); Aek Tulas (2MW); Kamangin Nagori (2MW); Pargaringan (8MW); Aek Godang (4MW); Aek Rambe (5,2MW); Aek Simadoras (5.1 MW); Bingai (7MW); Lae Luhung (10MW); Silinda (6MW); Tanjung Lenggang (10MW); Scattered (188,7MW); Karai-1 (IPP, 10MW); Karai-2 (IPP, 6MW); Lae Ordi-1 & 2 (IPP, 10MW); Rahu-1 (IPP, 8,2MW); Simonggo Tornauli (IPP, 8MW);

West Sumatra
Plans (2027): PLTA Pasaman (Unallocated, 48MW); Sumatra PS (PST, 500MW); Spread West Sumatra (IPP, 18MW, 2021-2025). Committed: Masang-2 (FTP2) (PLN, ROR, 44MW, 2023);

Construction: Guntung PLTM (IPP, 4MW, 2018); Induring (IPP, 2MW, 2018); Lintau-1 (IPP, 9MW, 2018); Siamang Bunyi (IPP, 2MW, 2019); Muara Laboh (FTP2) (IPP, 80 & 140MW, 2019 & 2025);
PPA (2020): Gumanti-3 PLTM (IPP, 6.5MW, 2019); Sludge Rod (IPP, 7.6MW); Bayang Nyalo (IPP, 6MW); Sileh Hill (IPP, 0.7MW); Muara Sako (IPP, 3MW); Downstream Violence (IPP, 3.6 MW); Upstream Violations (IPP, 9.8MW); Rabbi Jonggor (IPP, 4.5MW); Sako-1 (IPP, 6MW); Sikarbau (IPP, 2MW); Tarusan (IPP, 3,2MW); Tongar (IPP, 6MW); Tras (IPP, 1.6MW); Tuik (IPP, 6.3MW);

Potential: Pancung Taba MHP (3,2MW); Koto Lamo (5MW); Pasinggrahan (0.5MW); Pinti Kayu (10MW); Batang Patimah (2.8MW); Bukit Cubadak (9.2MW); Gumanti-1 (4MW); Capturing (3MW); Laruang Gosan (4MW); Muaro (0.7MW); Sianok Duku (6.6MW); Batang Anai-1 (1.4MW); Batang Anai-2 (7.2MW); Antokan Rod (1.5MW); Batang Samo (7MW); Batang Talu (3,1MW); Benteng Anai (1.4MW); Kanaikan (4,8MW); Lintau 2 & 3 (10 & 8.1 MW); Banana Lubuk (10MW); Lumpo (3MW); Nagari Kasang (2MW); Upper Upper Harassment (9.8MW); Sungai Aur (2,3MW); Sungai Garam Hydro (10MW); Telun Berasap (8MW); Air Betung (10MW); Air Pura 1 & 2 (8.4 & 9MW); Batang Lembang (1MW); Batang Sangir (9.8MW); Hydropower (10MW); Estuary Water (1.7MW); Ngalau Gadang2 (4,2MW); Passengers 1 & 2 (3.3 & 6MW); Sei Ludang 1,2 (8MW); koko Tarusan (10MW).
Potential: Masang-3 Hydroelectric Power Plant (PLN, RES, 89MW); Sinamar-1 PLTA (ROR, 20MW); Sinamar-2 (ROR, 26MW); Aquaman (79MW); Dusun Tangah (44MW); Lubu (28MW); Pasaman 1 & 2 (62 & 40MW); Batang Hari-4 (RES, 216MW); Gumanti-1 (ROR, 16MW); Anai-1 (ROR, 19MW); Kuantan-2 (RES, 272MW); Rokan Kiri-1 (RES, 183MW); Air Tuik (ROR, 24,8MW); Sirant-1 (ROR, 18,3MW); Tarantak Tumpatih-1 (ROR, 29.6MW);

Jambi
PPA Process: Spread Hydroelectric Power Plant (IPP, 350MW, 2021-2025).

Potential: Merangin-2 Hydroelectric Power Plant (ROR, 350 MW); Merangin-5 (RES, 21MW); Bangko 2 & 3 (87 & 93MW); Nilo PLTM (5MW).

South Sumatra
Construction: Komering PLTM (IPP, 1.4MW, 2019);
PPA (2020): Swipe PLTM (IPP, 4.92MW); Endikat (IPP, 8.01MW); Karyanyata (IPP, 4MW); Recognize (IPP, 3,6MW); Semendo (IPP, 9MW);

Potential: Combined MHP (4.5MW); Supreme Appeal Telecommunications (6MW); Air Dikit (6MW); Bindu 1 & 2 (10 & 10MW); Gilas (2,2MW); Kambas (1,2MW); Lawang Agung (2,5MW); Lematang-2 (8.6MW); Kidak Island (7.5MW); Pulau Panggung (9MW); Saka (10MW); Telema (6,7MW); Tj. Three / Tj. Agung (6MW); Scattered (115MW).

Potential: Lematang Hydroelectric Power Plant (RES, Unallocated, 42MW).

Bengkulu
Construction: Batu Balai / Manna MHP (IPP, 4MW, 2018); Sting-1 (IPP, 0.72MW, 2020);
PPA: Simpang PLTM (IPP, 3,1MW, 2018); Tunggang (IPP, 9,99MW, 2018); Muara Sahung (IPP, 9.9MW, 2019); Klaai (IPP, 2,6MW, 2020); Padang Guci (IPP, 6.0MW, 2017);
PPA: White Water Hydroelectric Power Plant (IPP, 21MW, 2019);

Plan: Spread PLTA / M (IPP, 21.25MW, 2021-2025).

Potential: Talang Ratu PLTA (18MW); Middle Year (13MW). Potential: Puguk (5,3MW); Note 1,2,3 (4.2 + 2 + 9.9MW); Use 1 & 2 (3 + 4MW); Aur Gading (IPP) (2.7MW); Starfruit (8MW); Kanzy 3 (6.5MW); Rivet (2.7MW); Downstream (9.9MW); Kinal (7MW); Kemumu Estuary (1,1MW); Nokan-1 (7.3MW); Pilubang (8MW); Seluma (6MW)

Lampung
Construction: Watermelon Hydroelectric Power Plant (FTP2) (IPP, 56 MW, 2018), funds from France.

Plans: Lampung Scattered PLTA / M (Unallocated, 110MW, 2023/24).

Potential: Semuong Hydroelectric Power Plant (34MW).
PPA: PLTM Way Pintau (IPP, 3,22MW, 2019); Batu Brak (IPP, 7.7MW, 2020); Complete Kemu (IPP, 7MW, 2020); Curup Gangsa (IPP, 1,2MW, 2020).

Potential: PLTM Besay (9.2MW); Sukarame (8MW); Right hand way (4,6MW)

JAVA

Banten
Construction: Cikotok PLTM (IPP, 4.2MW, 2018); PLTM Bojong Cisono (IPP, 1.5MW, 2018);

Potential: Lebak PLTM (6MW); Monthly (7MW); Cibareno (3MW); Cidano (1,5MW); Cikamunding (6MW); Cikidang & Cisimeut (2 + 2MW); Cisiih Cimandiri (8MW); Cisiih Leutik (4MW); Cisungsang 2 (3MW); Karang Ropong (Cibareno-1) (5MW): Nagajaya (6MW); Pasundan (6MW).

West Java
Funding (2018): Kalapa Nunggal PLTM (IPP, 3MW); Kertamukti (IPP, 6.3MW);

Construction (2018): PLTM Cilaki-1B (IPP, 9,69MW); Pusaka-1 (8.8MW); Cibalapulang-1, 2, 3 (IPP, 9 + 6.5 + 6 MW)

Funding (2019): Islamic Boarding School-1 (IPP, 1.8MW); Jayamukti (IPP, 2,3MW); Pareang (IPP, 2,8MW); Cimandiri (IPP, 4,4MW); Cileunca (IPP, 1MW); Cisomang (IPP, 4MW); Cikaengan (IPP, 5.1 MW); Cikandang (IPP, 6MW); Cibuni Mandiri (IPP, 2MW); Cibuni (IPP, 3.2 MW);

Construction (2019): Cibalapulang 2.3 (IPP, 6.5 + 6MW); Cicatih (IPP, 6.4MW, 2019); Cikopo-2 (IPP, 7.4MW, 2019, construction).

Construction: Upper Cisokan PST hydropower (PLN, 1,040 / 4x260 MW), 150 km southeast of Jakarta (S.Citarum) will operate in 2024 (1), 2024 (2), 2025 (3), and 2025 (4). This PLTA uses the first pumped storage system in Indonesia. The flooded land reached 805 hectares, namely 3 villages in the district. Submerged cavities (Bojongsalam, Sukaresmi, and Cicadas), while in Kab. Cianjur covers the district Cibeber and Kec. Bojongpicung. The PLTA is planned to only move at night, to overcome the burden of the Java-Bali peak. Upper reservoir is 10.5 km2 (small), dam II (lower reservoir) has an area of 355 km2 (large), a height difference of 200 m. During the day, there are 2,000 MW / day of idle electricity, then the electricity (from the PLTU / Indramayu coal and Labuhan) is used to pump water from B-II (S. Cisokan) to B-IPLTA Upper Cisokan Pumped Storage (Cirumanis S.) Meanwhile, at night (5-10 nights), water from B-I is poured into B-II via 4 turbines (4x260MW).

Construction (2019): Rajamandala Hydroelectric Power Plant (IPP, 1x47MW, 2019) on the Citarum River, Kec. Haurwangi, Cianjur. PLN cooperates with PT REP (US $ 150 million, full Turnkey, BOOT). PLN buys electricity for US $ 8.66 cents / kWh, for 30 years. Hyundai Engineering + Hyundai Amco signed a USD91.3 million contract with REP to build the Rajamandala Hydroelectric Power Plant.

Construction (2019): Jatigede Hydroelectric Power Plant (FTP2) (RES, PLN, 110 / 2x55 MW) (utilizing the Jatigede reservoir, damming S. Cimanuk) in Sanghiangbeuheung hamlet, Ds. Cijeunjing, Kec. Tomo & Jatigede, Kab. Sumedang), (for flood control in Cirebon and Indramayu) entered the Groundbreaking 4 May 2015, which was allegedly completed (COD) around 2019 with an investment of US $ 239,573 million, (BUMN China US $ 144,067 million remaining APBN), DN Contractor: PT WIKA, PT Waskita Karya, and PT PP; LN: Sinohydro (China). Problem: village flooding protests (11,469 households relocated). 137 hectares of land from 147.05 hectares (community 88.75 hectares, forestry 58.3 hectares) have been released, the remaining 10 hectares.
Funding (2020): Cibanteng (IPP, 4.2MW); Cikaso-3 (IPP, 9.9MW);

Procurement: Cikaengan-2 (IPP, 7.2MW, 2020).

Construction (2022): Cilaki-1A (IPP, 3,144MW);

Potential: PLTA Cibuni-3 (RES, 172MW); Cibuni-4 (RES, 105MW); Cikaso-3 (RES, 53MW); Cimandiri-3 (RES, 2x119MW); Cipasang (RES, 2x200MW); Wado (50MW); Maung (RES, 350MW); Rawalo-1 (RES, 10.3MW);

Potential: Caringin PLTM (4,3 MW); Ciarinem (3MW); Ciasem (3MW); Cibatarua Panyairan (8,22MW); Ciberang (5.8MW); Cikaengan Najaten (7.2MW); Cikancana (4,7MW); Cilayu Kulon (5,2MW); Cileat (5,2MW); Cimaja (3MW); Cirompang Mekarmukti (4MW); Retract (4MW); Gunung Guruh (3MW); Jatisari (5MW); Kanzy-5 (5MW); Kubang (0.4MW); Mekarwangi (5MW); Sand Jambu (5,1MW); Segrong (0,2MW); Sukamaju (7,5MW); Toblong (6MW); Cijampang-1 (1,1MW); Pakenjeng Bawah (5.7MW); Pusaka-3 (3MW); Cikaniki-1 & 2 (2.5 & 3 MW); Pakenjeng Atas (3,6MW); Lower Cikawung (2,5MW); Upper Cikawung (5MW);

Central Java

Construction: Banyubiru PLTM (IPP, 0.17MW, 2019); Lambur (8MW); Harjosari (9.9MW).

Funding: Karekan (IPP, 8MW, 2019); Key White (IPP, 0.9MW, 2019); Pageruyung (Damar) (IPP, 2,07MW, 2019); Pageruyung-1 (IPP, 4,4MW, 2019); Mill-1 (IPP, 0.35MW, 2020); Tanjung Tirta (IPP, 8MW, 2020);

Plan: Matenggeng Hydroelectric Power Plant (PST, Unallocated, 900 / 4x225 MW, Rp.5.9 trillion) Kec. Dayeuhluhur, Kab. Cilacap is funded by the World Bank. Groundbreaking is scheduled for late 2018, and is expected to operate in 2025 (4 units). In 2015 land acquisition began.

Potential: Maung Hydroelectric Power Plant (350MW); Rawalo-2 (10.3 MW).

Potential: Adipasir PLTM 1 & 2 (2x0,34MW); Ambal (2,1MW); Binangun (3.8MW); Dadapayam (3MW); Bracelet (0.3MW); Gumiwang (0,4MW); Gunung Wugul (3MW); Talisman (0.5MW); Kaliwadas (0.35MW); Mojoagung (1.6MW); Pagarpelah (3,2MW); Preng-1 (1,8MW); Preng-2 (4,5MW); Prukut Sambirata (1,5MW); Serayu-3 (3,5MW); Write (IPP) (9MW); Affect 1 & 2 (2.8 & 3.6 MW); Banjaran (1,8MW); Palumbungan (1.6MW); Logawa Sunyalangu (1.52MW); Bendosari (4MW); Logawa Babakan (1,34MW); Logawa Baseh Karangpelem (1,86MW); Pugeran (6MW); Serayu (8.62MW).

East Java

Construction: Lodagung PLTM (IPP, 1.3MW, 2018);

Funding: Taman Asri PLTM (IPP, 1,17MW, 2020); Kanzy-1 (IPP, 2,36MW, 2020);

Plans: PS Grindulu (PST, Unallocated, 1,040 / 4x260 MW, 2025); Hydroelectric Power Plant Spread (Unallocated, 137MW, 2025);

Potential: PLTA Karangkates 4 & 5 (RES, 100MW); Kesamben (2x18MW).

Potential: Nursing-1 PLTM (Upper Nursing) (2.12MW); Jompo-2 (Lower Nursing) (3.2MW); Kali Tengah (Sungai Tengah) (1.4MW); Acuity (3.3 MW); Sumberarum-2 (3MW); Bayu (3,6MW); Lodoyo-2 (10MW); Pacet (1,5MW); Zeelandia (2,18MW); Balelo (4,3MW);

BALI

Potential: Telagawaja MHP (4MW); Ayung (2,34MW); Tukad Daya (8,2MW); Sunduwati (2,2MW); Telagawaja Ayu (1MW); Sambangan (1.9MW); Tukad Balian (2,5MW).

Nusa Tengara Barat (NTB)

Construction: PLTM Sedau Kumbi (IPP, 1.3MW, 2018); Karang Bayan (IPP, 1.3MW, 2019); Bedil Stone (IPP, 0,6MW, 2019).

Funding: Koko Babak PLTM (IPP, 2,3MW, 2020).

Potential: Brang Rea-1 & 2 MHP (2.54 & 3.84MW); Bintang Bano (8.8MW).

Potential: Brang Beh 1 PLTA (12MW); Brang Beh 2 (6MW).

Hydro potential in Sumbawa, NTB is around 67.5 MW, while the potential of the PLTM NTB location: Lombok 3 locations (Muntur River 2.8 MW, Sungai Kokok Putih 4.2 MW, Pekat River 5.3 MW), Lombok Utara 10, Lombok Barat 15, Central Lombok 17, East Lombok 16, Sumbawa 17 locations (Brang Rhee River 16 MW, Sungai Bintang bano 40 MW, Brang Beh River 103.5 MW), West Sumbawa 9 locations, Dompu 9 locations, and Bima 5 locations. The PLTM is spread around NTB around 18.7 MW.

Nusa Tengara Timur (NTT)

Construction: PLTM Wae Roa - Ngada (IPP, 0.4MW, 2018); Sita - Borong (IPP, 1MW, 2018);

Potential: 1.2 Wai Rancang PLTA - Manggarai (ROR, 10 + 6.5MW); Kiwa Riam (42MW); Waterbang (15MW).

Potential: PLA Wae Lega (1.75MW); Harunda (1.6MW).

KALIMANTAN

West Kalimantan
Plans (2019): Breaking PLTM (PLN, 2.5MW); Mahap (PLN, 1.3MW); Jitan (PLN, 3,4MW); Kalis (PLN, 3MW).

South Kalimantan
Potential: Muara Jambi PLTA (RES, 284MW, Muara Jambi); Kusan (RES, 65 MW, 2023, Ground Spice); PLTM Riam Kiwa (10MW, Banjar); Muara Kendihin (0.6MW, Hulu Sungai Selatan); Kiram Atas (0.9MW, Banjar); Sampanahan (0.6MW, Kotabaru); Gendang Timburu (0,6MW, Kotabaru).

Central Kalimantan
Potential hydropower: Riam Jerawi (72MW), Katingan; Muara Juloi (284MW), Murung Raya.

East Kalimantan
Plans: Kelai PLTA (PLN, 55 MW, 2025); Tabang (PLN, 90MW, 2025).

Potential: Boh PLTA (RES, 270MW, Malinau); Long Bangun (ROR, 20MW, Mahakam); Mentarang-1 (RES, 300MW, Malinau); Tabang (RES, 270MW, Kutai).

North Kalimantan
Plan: Kaltara-1 hydropower (PLN, 90MW, 2025).
Potential: Kayan-1 Hydroelectric Power Plant (RES, 660MW); Kayan-2 (RES, 500MW); Kayan-3 (RES, 1200MW); Kaltara-2 (RES, 300MW), Bulungan.

SULAWESI

North Sulawesi
Plan: Poigar-2 Hydroelectric Power Plant (IPP, 30MW, 2023); Sawangan (ROR, PLN, 2x6 MW, 2024);

Funding: Dominanga PLTM (IPP, 3,5MW, 2019);

Procurement: Criminal (IPP, 2MW, 2022);

Potential (ROR): Poigar-3 hydropower (20MW); Minut 1,2,3 (14 + 27 + 12 MW); Mongondow (37MW); Ranoyapo 1,2 (81 + 27 MW).

Potential (ROR): PLTM Woran, Morea, Molobog, Kilotiga (4x0,6MW); Lobong-2 (0.5MW); Apado, Bilalang, Ulupeliang-2 (3x0,3MW); Kinali, Tangangah, Belengan (3x1,2MW); Salongo (0.9MW); Milangodaa 1,2 (2x0,7MW); Pilolahunga (0.8MW); Tincep 1,2,3,4 (0,4 + 1,1 + 2,2 + 0,4 MW); Ranowangko (I2,2MW). Totabuan 1 (5MW).

Central Sulawesi
Construction: Buleleng MHP (IPP, 1,2MW, 2018); Tomasa (IPP, 10MW, 2020);
PPA: Alani PLTM (IPP, 5.6MW, 2020); Poso Peaker Hydroelectric Power Plant (IPP, 320MW, 2019-21); Biak 1,2,3 (IPP, 4 / 1,5 + 1,3 + 1,2 MW, 2020);

Committed: Halulai MHP (IP, 1,2MW, 2019); Tomata (IPP, 10MW, 2020); Koro Kabalo (IPP, 2,2MW, 2020);
Potential ROR): Bambalo PLTM 2 (1.8MW); Dako (1.4MW); Sampaga (1,2MW); Lobu (5MW); Banasu (9MW); Batu Nobota (5MW); Kilo (10MW); Paddumpu (5MW); Yaentu (10MW); Ponju (3MW); Bengkoli (2,5MW); Bongkasoa (1.4MW); Pono (6MW);

Potential: Koro Yaentu Hydroelectric Power Plant (ROR, 17MW); Salo Karangana (RES, 103MW); Salo Pebatua (RES, 426MW); Lariang-7 (RES, 257,6MW), Kulawi (ROR, 150MW); La'a (ROR, 160MW); Lalindu (ROR, 50MW); Palu-3 (RES, 75MW); SR-1 (Bada) (RES, 420MW); SR-2 (Tuare) (RES, 720MW); Tinauka (RES, 300MW); Lariang-4 (ROR, 200MW); Gumbasa (ROR, 156MW).

Gorontolo
PLTM Yes (IPP, 2MW, 2020, Procurement); Bone Bolango (IPP, 9.9MW, 2021, PPA).

South Sulawesi
Construction: Bungin PLTM 3 (IPP, 5MW, 2018); Bantaeng-1 (IPP, 4,2MW, 2017); Learning (IPP, 8,3MW, 2018); Ussu Malili (IPP, 3MW, 2018).

Construction: Malea hydropower (FTP2) (ROR, IPP, 2x45 MW, 2020); Malea Hydroelectric Power Plant 15 MW, (Rp. 300 billion) Kec. South Makale, Tana Toraja, operates in August 2011. PT Malea Energi (Kalla Group) adds power to around 90 MW with a 4-year contract period and Rp. 3 trillion, expected to be completed in 2020. PPA was signed by President Jokowi on May 4, 2015. PT Malea Energy collaborated with Toshiba (PT Toshiba Asia Pacific Indonesia).

Committed: Pongbatik PLTM (IPP, 3MW, 2020);

Plans: Poko Hydroelectric Power Plant (PLN, 2x65MW, 2022); Bakaru-2 (ROR, PLN, 2x70MW, 2022);

Potential (IPP): Bonto Batu Hydroelectric Power Plant (ROR, 2x50 MW); Salu Uro (2x47,5MW); Kalaena 1 (2x37,5MW); Pongkeru (50MW); Seko 1 (3x160MW); Collision 1 (2x150MW); Paleleng (4x33,5MW). Buttu Batu (RES, IPP, 2x100MW, 2025); Spread Hydropower (IPP, 400MW, 2025).

Procurement: Ma'dong (IPP, 10MW, 2020); Malua (IPP, 4,6MW, 2022); Post-2 (IPP, 6.4MW, 2022); Potential (IPP) of Bambalu PLTM (0.3MW); Bontotene (Takapala) (1.7MW); Kahaya (4MW); Rongkong (8.1MW); Eremerasa (1,2MW); Kondongan (3,5MW); Pasui-1 (1.9MW); Mallawa (5MW); Baliase (9MW); Bakaru-3 PLTA (146MW), 2023; Masuni (RES, 400MW); Mong

(RES, 256MW); Stone (RES, 271MW); Karama-1 (RES, 800MW); Seko-2 (ROR, 90MW); Makale (ROR, 45MW).

Southeast Sulawesi
Construction: Lapai-2 PLTM (PLN, 2x2MW) 2018; Rongi (PLN, 0.8MW), 2018;

Plans: Lapai-1 PLTM (PLN, 2x2MW), 2019; Riorita (PLN, 2x0,5MW), 2019.

Plan: Konawe PLTA (PLN, 21 MW, 2023); Watunohu (ROR, PLN, 15.8 MW 2024);

Potential: Lasolo Hydroelectric Power Plant (IPP, 2x72,5MW, 2022); Tamboli (IPP, 22MW); PLTM Buleleng (PLN, 1.2MW).

West Sulawesi
Plan: Tabulahan Hydroelectric Power Plant (IPP, 2x10MW, 2023); Masupu (IPP, 2x17,5MW, 2023);

Potential: Tumbuan / Mamuju PLTA (IPP, 150MW). The PPP project for the Karama Hydroelectric Power Plant (IPP, 190MW) was reviewed. In order to avoid social problems, the height of the dam is reduced, so that the inundation decreases, and the capacity decreases to 190MW.

MALUKU
Plans: PLTM Nua (Masohi) (PLN, 2x4.4MW, 2020): Sapalewa (PLN, 2x4MW, 2022); Wai Tala Hydroelectric Power Plant (PLN, 54MW, 2027); Wai Tina MHP (ROR, IPP, 4x3MW, 2025).

PAPUA

Papua
Plan: Kalibumi PLTM (PLN, 2,6MW, 2019).

Plan: Digoel PLTM (PLN, 3MW, 2019); Amai (PLN, 1.4 MW, 2020); Walesi Blok II (PLN, 6x1MW, 2022); Orya-2

Hydroelectric Power Plant (PLN, 14MW, 2023); Baliem PLTA (PLN, 10 MW, 2027);

Potential: Sentani (ROR, 20MW, FS). The Baliem River has the potential of at least 7 hydropower plants in the future (800 MW, with an estimated fund of around Rp.5 trillion).

West Papua
Study: Waigo PLTM (PLN, 1.3MW, 2022), Sorong.
Pre FS: Warsamson Hydroelectric Power Plant (IPP, 20MW), Sorong.

PLTA plan in the future:

S. Memberamo has the potential to move a 10,000 MW hydroelectric power plant, Sentani (ROR, 20MW), and other rivers via PLTM spread over 2,000 MW.

Acceleration of water resources:
PLTA (5 GWe) will be built in 12 selected reservoirs from 261 reservoirs in Indonesia with an investment of Rp.100 trillion (2-3 million US $ / MW). The feasibility study of the construction of the hydropower plant will cost Rp.36-60 billion. Only 22 reservoirs have hydropower, and Indonesia needs 460 more reservoirs the size of the Jatiluhur reservoir, Purwakarta, West Java.

Dams for water reservoirs and irrigation:
Pandan Duri dam / 340 ha dam (Rp.728 billion), Ds.Suwangi, Kec. Sakra, Kab. East Lombok, NTB was completed with water sources from the Palung river. Submerged hamlets: Embung Raja, Mount Sager, Kelagaq, etc.

Reservoir
Dam / Dam to be built as many as 49 (from 2015-completed):
NAD: Krueng Keureuto (Rp. 1,68 Trillion, 2015), Jambo Aye; Improvement of Tiro reservoir (Rp.748 billion, 2015), Rukoh (Rp.410 billion, 2015). Problem: land acquisition.

Sumatra: Lausimeme (North Sumatra); Tiger Leap (Riau); Bintang Bano (West Sumatra); Estuary Sei Gong, Dompak, Busung (Kepri), Sukoharjo (Lampung), Segalaminder, Way Sekampung, Sukaraja III (Lampung);

Banten: Karian (largest III after Jatiluhur and Jatigede), kel. Pasirtanjung, Kec. Rangkasbitung, Kab. Lebak (Rp. 1.68 Trillion by Daelim Industrial Co. together with PT Wijaya Karya (Persero), and PT Waskita Karya (Persero), 2015-2019 completed); The dam area is 1,740 hectares, capable of accommodating 207.5 million m3 of water to irrigate the Ciujung irrigation area of 22,000 hectares. In addition, it supplies drinking water with a capacity of 9.1m3 / sec, and 1.8MW MHP; Other reservoirs: Sindangheula, Pamarayan (Banten);

West Java: Ciawi, Sukamahi, Cipanas, Leuwikeris, Sadawarna, Santosa, Sukahurip;
Central Java: Logung (Rp.620 billion, 2015, Kudus), Jlantah, Matenggeng, Pidekso;
DIY: Bener, Karangtalun;

East Java: Semantok, Bagong, Lesti, Wonodadi;

Bali: Telagawaja; Titab, the largest reservoir has a capacity of 350L / sec drinking water (Busung Biu, Buleleng, Bali); there are still problems with land acquisition (2017), physical development in 2018, groundbreaking in early 2015.

Nusa Tengara Barat (NTB): Bintang Bano, Tanju, Mila, Mujur;

Nusa Tengara Timur (**NTT)**: Raknamo: Rp. 710 billion, 2015, covering an area of 147 Ha,

(district of Kupang); Kolhua, (Kota Kupang); Rotiklot: APBN investment of Rp.450 billion, groundbreaking 28 Dec 2015, Ds. Fatuketi, Kec. Kakuluk Mesak, Kab. Belu, Atambua), Temef, Jawakisa (Governor's proposal) (TTS, Timor Tengah Selatan), Napunggete (Kab. Sikka); Lambo (Kab. Nagekeo), Manggarai;

Kalimantan: Tapin (South Kalimantan); Sepaku Semoi, Marangkayu;

Sulawesi: Lolak (Rp.850 billion, 2015), Kuwil Kawangkoan (Sulut); Karaloe, Paseloreng, Pamakulu, Jenelata, Nipa-nipa (Sulsel); Ladongi Pelosika (Southeast Sulawesi).

Jatibarang Dam (Ds. Talun Kacang, Kel. Kandri, Kec. Gunungpati, Semarang, Central Java), (construction since Oct 2009) has been in operation (11/5/2015). The reservoir was created to deal with the upcoming major floods in Semarang that had once happened in 1973, 1988, 1990 and 1993. He was able to accommodate flood water from the Kreo River 270m3 per second, up to 100 years. Other functions of the Jatibarang reservoir: 1.5MW MHP, raw water supply 10.9 million m3 (floating cages are prohibited), and tourism programs. Reservoir dimensions: 74m high, 200m peak length, and 10m peak width. The jatibarang reservoir was built at a cost of Rp.655 billion from JICA.

Marangkayu (Kukar, Kaltim) there are issues of land acquisition (Vico Indonesia oil & gas fields), progress 90% (Jan 2017)

PU (2014) plans to utilize 200 reservoirs for power plants (PLTA) by installing new turbines, in addition to irrigating rice fields.

Micro-Hydro (PLTMH)

In RIPEBAT (EBT Development Master Plan) 2010-2025, six provinces have large Micro-hydro (MHPs) potential such as (1) Papua (there are 52 rivers potentially up to 15.6 GW, including the Memberamo / 10 GW river; Derewo, Ballem, Tuuga / 1 , 6 GW; Wiriagar / Sun, Kamundan, Digul / 1.5 GW; Yuliana / 2.3 GW; Lorentz / 232 MW, and Kladuk); (2) East Kalimantan: S. Kerayan, Mentarang, Tugu, Mahakam, Boh, Sembakung and Kelai (total 6,743 MW); (3) South Sulawesi; (4) West Kalimantan; (5) North Sumatra; and (6) Aceh

PT Indonesia Power claim that the Cileunca PLTMH electricity production has a capacity of 1 (2x0.5) MW (at a cost of Rp. 13 billion), Warnasari village, Kec. Pangalengan, Kab. Bandung, can save Rp. 10 billion a year. Another example: Mbakuhau MHP 37 kW (100KK), East Sumba, 12 kW (2013) of electricity is used, while the rest is purchased by PLN (Cooperative gets Rp. 10 million / month).

If all MHP can reach a capacity of 500 MW, the cost savings will be around Rp.4.27 trillion and profits from certified emission reduction credits (CERs) of US $ 6 million, and there is village cash income (PADES, Village Original Income) of Rp.2 trillion / year. The Off-Grid system is recommended to be used in the village, namely the system for maintaining

electricity / electricity networks and electricity bills managed by the community / village cooperatives themselves, so that village independence and growth can be realized.

PTPSE (Center for Energy Resource Development Technology) BPPT successfully registered the CDM (Clean Development Management) pilot of the MHP from the UNFCCC (United Nations Framework Convention on Climate Change) for MHP in the village of Rantabella, Kec. Lotimojong, Kab. Lawu, South Sulawesi.

If the PLN network has entered the village, then the village can sell the electricity to the PLN (if the price offered by PLN is appropriate, through a long and tiring process). Example: MHP Curug Agung which was built in 1991, in 1995 competed first with PLN when the PLN electricity network entered the village. Finally in 2000, the electricity products entered the PLN network. Meanwhile, the 10kW Cintamekar MHP, Subang, West Java, sells all of its electricity products to PLN. The PLTMH Group is 85 kW, Garut is also entering the national electricity network.

PLTMH feed in tariffs are in accordance with ESDM Regulation No. 12/2017, which was later revised by Permen ESDM no. 43/2017, which is around 100% local BPP.

PLTMH that are being built / planned are:

Bengkulu: Sting (IPP, 0.7MW, 2020, PPA). The potential of MHP in Solok is Pinang Awam (462 kW), Koto Anau (167 kW), Sumani (625 kW), Balangir (500 kW), Liki Solok (60 kW), Jawi-Jawi (60 kW), and Lubuk Gadang (103 kW)

West Java: MHP Ketenger (IPP, 4x600 kW).
AHM (PT Astra Honda Motor) empowers the community by building 6.5 kW MHP, Cibarengkok River, for 63 families, in GHSNP, Sukamulya, Sukabumi, West Java, in collaboration with the IBEKA Foundation. The ongoing MHP project is in Kab. Bogor (IDR 855 million), Kab. Cianjur (Rp. 1.4 billion), Kab. Garut (Rp. 920 million). MHP entering the PLN line is Cijedil (3 kW) in Cianjur, Curug Agung (788 kW) in Subang, Cinta Mekar (120 kW), Jembelair (100 kW) in Purwakarta, and Cipayung (240 kW).

Central Java: Banyumas Regency Government built 12 MHPs with a total cost of Rp.300 billion. One of them is Kali Sasak MHP 4 MW Kec. Cilongok, Banyumas which is managed by PT BIJ (Banyumas Investama Jaya) in collaboration with PT IndoPower with funds of Rp. 60 billion for 8,000 households. Others, the Karangkengah 17kW PLTMH from the Prukut River (water discharge 300 liters / second) for 66 families, donations from PT IndoPower (investors) with the TNI (labor assistance).

Construction (2017): Banyumlayu (IPP, 0.46MW); Key White (IPP, 0.95MW); Banyubiru (IPP, 0.17MW);

Procurement: Danawarih MHP (IPP, 0.6MW, 2020)

Funding: Bulletproof MHP (IPP, 0.45MW, 2020)

Plan: Kaliwadas (IPP, 0.4MW, 2019), 2023; Talisman (IPP, 0.5MW, 2018); Bracelets (IPP, 0.3MW, 2022); Adipasir 1 & 2 (IPP, 2x0,34MW, 2022);
DIY: Semawung MHP (0.6MW), 2020. Selen Aik MHP 25 kW, Lombar PLTMH Cinta Mekar, 10 kW

East Java: Taman Asri MHP (IPP, 0.75MW, 2019);

West Kalimantan: Plan: Breaking (0.5MW), 2019.

South Kalimantan: Potential MHP: Muara Kendihin (0.6MW), Hulu Sungai Selatan; Kiram Atas ((0.86MW), Banjar; Sampanahan (0,6MW), Kotabaru; Gendang Timburu (0,6MW), Kotabaru.

East Kalimantan: Lobong MHP (1,300 kW), Kotamobagu, funded by ADB loan (PLN Project). The potential of MHP in East Kalimantan: Kerayan, Mentarang, Tugu, Mahakam, Boh, Sembakung, and Kelai rivers with a total potential of 6,743 MW.

North Sulawesi: Potential: Kilotiga MHP (IPP, 0.6MW, 2019); Tincep 1 & 4 (IPP, 0.4 + 0.4 MW, 2019);

South Sulawesi: Potential: Bambalu MHP (IPP, 0.3MW, 2019), Palopo-Toraja.

Southeast Sulawesi: Plans: Riorita MHP (PLN, 2x0,5MW, 2019)

Nusa Tengara Barat (NTB): Committed: Batu Bedil PLTMH (IPP, 0.55MW, 2019);

Nusa Tengara Timur (NTT): Construction: MHP Wae Roa - Ngada (IPP, 0.4MW, 2017);

RE Trends

Indonesia has been slow out of the blocks in developing renewable sources of energy, but the nation's natural potential is enormous. What is more, energy demand in Southeast Asia's largest economy is quickly rising. Electricity consumption is forecast to more than double by 2025, fuel consumption is set to rise even faster. Aside from the obvious positives such as reducing Indonesia's carbon emissions and meeting or even surpassing its Paris Agreement commitment, as well as finally breaking the nation's dependence on coal, renewables could bring off-grid power to the tens of millions of Indonesians who still have no access to a reliable electricity supply and, instead, rely on expensive, polluting power from diesel generators.

In the past, fuel subsidies and low electricity tariffs, logistical challenges, complex regulations, legal uncertainties and, not least, the abundance of cheap coal, deterred potential investors from funding development of renewable energy. Years of under-investment, and a lack of incentives have resulted in still only a very small portion of the country's energy mix being supplied by clean, renewable energy today. This leaves a lot of catching-up to do as Indonesia seeks to diversify its energy sources. The government's "fast track programme" to boost national power output now puts the focus on renewables after relying mainly on coal in its initial phase.

In an effort to reduce costly oil imports and bolster energy security, the government has begun to raise fuel and power prices and is beginning to design financial incentives to promote the development of alternative, clean sources of energy. Soft loans from development banks and multilateral investment funds such as the Clean Technology Fund are designed to mitigate risks for early investors. In addition, contract tender regulations have been simplified, and Indonesia's improving infrastructure is making projects in remote regions more viable. The result is an altogether brighter environment for renewable energy investment and technology partnerships.

The National Energy Plan (NEP14) is Indonesia's multi-sectoral energy policy enacted in January 2014 by the House of Representatives. It updated the 2006 national energy plan. It continues to be in effect and will expire in 2025 once it has reached its targets for Indonesia's energy mix. NEP14 was enacted to increase Indonesia's energy independence by developing new energy sources and increasing domestic use of locally produced fuel rather than exporting it abroad. This requires Indonesia to decrease oil imports by supplanting it with increases in coal and renewable energy production, as well as improving efficiency in energy production and consumption.

NEP14's targets for the 2025 energy mix are: 30% coal, 22% oil, 23% renewables, and 25% natural gas. By 2050, NEP14 targets renewables at 31% of the energy mix. The policy also lays out steps to increase the electrification ratios, especially in rural areas. State electricity company Perusahaan Listrik Negara (PLN) releases a 10-year electricity supply plan every year, called Rencana Umum Penyediaan Tenaga Listrik (RUPTL). The latest RUPTL for 2019 - 2028 was released at the end of March 2019 (for details see Chapter 2. a) ii) on PLN).

Providing a reliable electricity supply to Indonesia's almost 270 million people, spread across thousands of islands, and to power the nation's economy is a huge challenge – one that calls for

significant private-sector participation. Independent power producers (IPPs) are expected to gain a stronger foothold in Indonesia's power sector, since private capital is seen as indispensable to meet the country's urgent energy needs. However, Indonesia's government needs to provide a lot more incentives to be able attract the level of investment needed to exploit the country's enormous natural resources of clean, renewable energy. Recent years have seen a number of measures and legal changes aimed at attracting more investment into renewable energy projects.

Should President Joko Widodo win a second term, his new administration could potentially be bolder in enabling the faster uptake of renewable energy in Indonesia. It should be the new administration's priority to ensure that National Energy Policy and plans (KEN) and (RUEN), which detail bold plans for renewable energy, become easier to implement if the necessary improvements are made to PLN, and when renewable energy is able to compete on a level playing field with highly subsidized coal.

NB To be completed in the next version