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# Workshop Summary Report: Integrated Energy System Planning for Equitable Access to Sustainable Energy for Remote Communities in the APEC Region Using North Sulawesi as a Pilot Project/Test Bed

Manado, Indonesia | 28 March 2018

## APEC Energy Working Group

November 2018

APEC Project: EWG13 2017A

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# Capacity Building Workshop Manado, 28 March 2018

**'Integrated energy system planning for equitable access to sustainable energy for remote communities in the APEC regions using North Sulawesi as a pilot project/test bed'.**

**Four Points by Sheraton Hotel, Manado**
**Grand Ballroom**

## Summary Report April 2018

Gabriele Sartori, Project Manager
Dr Ariel Liebman, Project Overseer

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## 1.0 Introduction

The Capacity Building Workshop on 28 March 2018 was a significant milestone for the APEC funded project, 'Integrated energy system planning for equitable access to sustainable energy for remote communities in the APEC regions using North Sulawesi as a pilot project/test bed'. The workshop was held at the Four Points by Sheraton Hotel, Manado, North Sulawesi.

For more information on the background of the project and the Capacity Building Workshop please refer to the Discussion Paper in ANNEX 2, which was distributed to all workshop participants prior to the workshop in Manado.

The project builds on two previous APEC funded LCMT studies for Bitung (2015). This third project develops an innovative low-carbon energy roadmap for North Sulawesi and the Bitung KEK (Special Economic Zone or SEZ) in particular, resulting in practical information for local government, energy providers, businesses and finance institutions. This information enables more informed investment decisions, implementation of projects, and policy development. Importantly, outcomes of this project will be shared and benefit other APEC economies. Areas of interest for other APEC economies include:

1. **Modelling** of optimal least-cost, least carbon emissions-based electrification scenarios meeting community needs,
2. A public **web-based forum** for sharing learnings and data, and
3. **Policy-relevant action plans** for electrification of grid-edge APEC towns and communities, focusing on Bitung as a case study.

Key benefits to North Sulawesi include:
1. Increased ability to meet **reporting** obligations as part of the regional planning for the RUKD (Regional Electricity Plan) and, ultimately, the central government.

2. **Identification** of optimal mix of generation at the lowest possible price and the strongest possible affordable GHG emissions reduction trajectory.

Immediately prior to the workshop on 28 March, the local stakeholder group organised a site visit for the APEC experts, the Project Manager (PM) and members of Jakarta-based Ministries to Bitung Harbor, the SEZ, a PLN hydro plant and the Lahendong geothermal power station run by PERTAMINA.


A debrief workshop on the 29 March was organised by the Project Manager. At this debriefing, roles and responsibilities were clarified and a "go to" team was appointed to assist Castlerock Consulting, the modelling contractor. Also, attendees were briefed on the roles and responsibilities of APEC funded projects to manage expectations amongst key stakeholders.

**Attendees**

- Site visit: 13 (Including 1 researcher from Sam Ratulangi University)
- Workshop: 75 (Including 7 researchers from Sam Ratulangi University and ITB)
- Debrief Meeting: 20 (Including 3 researchers from Sam Ratulangi University)

**Purpose**

The workshop brought together APEC global energy experts from Russia, Malaysia, Thailand and Jakarta. Local stakeholders from the North Sulawesi Government, Bitung City, Bitung SEZ, PLN and PERTAMINA were also present. Castle Rock Consulting, the contractor in charge of driving the energy systems modelling was also present and presented their approach.

The purpose of the workshop was threefold:

1. **Explore** potential opportunities for sustainable energy systems planning, renewable energy sources as well as energy efficiency measures and demand-side management (DSM) options.

2. **Identify** the most appropriate personnel responsible for developing the model further (project outcome) and meet central government reporting obligations.

3. **Nominate** the persons responsible for collating and managing the data that will be critical as input data for Castlerock's energy systems modelling.

Since this project is a collaborative and capacity building project with North Sulawesi stakeholders as beneficiaries, it was essential that all participating parties are clear about their roles and associated benefits and responsibilities and that everyone's expectations are aligned.

## 2.0 Workshop proceedings 28 March

In the morning, various speakers from local and central governments outlined the significant potential this region offers for sustainable development such as: integrated renewable energy sources, energy efficiency and demand response and DSM in future energy systems planning. This project also complements the central government's program on smart cities, according to Mr Sugeng Mujiyanto, Director Energy Conservation, MEMR, Directorate General of New, Renewable Energy and Energy Conservation.

Speakers reinforced the governments' strong commitment to low carbon development in this region.

The speaker from the National Energy Council (DEWAN ENERGI NASIONAL, or DEN, in Bahasa) noted North Sulawesi was the only province that did not report their future energy demand projection figures to the National Energy Council, which makes planning on a national level difficult.

Clearly, North Sulawesi is currently lacking data gathering and reporting capabilities, which this project will remedy.

The APEC expert panel discussed the various low carbon opportunities for the region such as Energy Service Companies (ESCOs), EVs and biofuels, DSM and renewable energy sources. The panel from left to right: Mr Chrisnawan Anditya, ST., MT, Head of Planning & Reporting Division, Secretariat of Directorat General of Electricity, MEMR, former APERC researcher; Dr Nelly Segisova from Russia, expert on ESCOs; Dr. Nuwong Chollacoop from Thailand, specialist in EVs and biofuels, Prof. Nofri Yenita Dahlan from Malaysia, has undertaken similar modelling projects before. Three of the researchers/experts were involved with the APEC funded LCMT policy review in 2015, published in 2016. We trust all experts will provide ongoing support during the course of the project.

The afternoon workshop session was divided into three main groups;

1) Industry development in the SEZ,
2) Opportunities for renewables integration, energy efficiency measures and DSM, and
3) Energy systems modelling/planning.

Outcomes were drafted on butchers' paper and presented to the audience for further discussion. Some very important issues were tackled in these groups, like the future energy demand of the Bitung SEZ. Currently there is little reliable information available regarding the future manufacturing industry to be settled in the SEZ. The SEZ together with the expanded container harbor will represent the largest load factor and determine future energy demand in the region. As an industrial load, it will create opportunities for creative demand side management to avoid building unnecessary new electricity generation.

## 3.0 Key remaining challenge identified - The industrial SEZ load forecast

One of the key issues power system planners face in general is the forecasting of industrial customer segment loads. In the lead-up to the Capacity Building Workshop, when preparing for the discussion paper, it became apparent that the future industry/manufacturing load in the Bitung SEZ is uncertain. This was identified in the workshop as a remaining issue. Unlike the residential and small commercial load segments, which can be forecast more readily based on statistical demand forecasts correlated with population and economic growth trends, industrial loads are few and large, and often their realisation is delayed or cancelled entirely with other unexpected loads eventually appearing in their place. This makes it very difficult to forecast these loads and therefore to plan for them. This project will therefore focus on implementing a robust methodology to manage the uncertainty inherent in these forecasts.

## 4.0 Debrief meeting 29 March

The debrief meeting the following day addressed the very important questions of how the project team will obtain the currently missing information to undertake the modelling and who will need to be trained to use the model in the future. The local university Sam Ratulangi (UNSRAT) and BAPPEDA were identified as the main beneficiaries of this model. UNSRAT because of their modelling expertise and BAPPEDA because of their reporting responsibility to the national government agencies.

## 5.0 Gender Equality

The PM put a special focus on inviting female energy experts from other APEC economies so that there were the same amount of male and female experts/participants funded by APEC. The site visit participants on the 27 March were 50% male and 50% female. The debrief meeting had actually twice the amount of female than male participants. Although the workshop on the 28 March had twice as many male than female participants it needs to be noted that the most active participants in the afternoon workshop were female. Despite the workshop participants, the project is managed by a female and the modelling contractor is represented by a female. Females in this project are playing an important role and carry a lot of responsibility.

## 6.0 Conclusion

The region provides significant potential for integrated energy systems planning, using existing renewable energy resources such as hydro power and geothermal and new sources such as solar PV, wind and ocean energy technology. Both of the existing resources provide baseload electricity at zero-to-low emissions rate. The potential of wind and solar PV is not currently well mapped but will be assessed as part of the project. EVs, biofuels, ESCO's as well as demand side management options will also be considered as part of the generation mix that this project will seek to optimise.

The local provincial government and the City of Bitung are committed to low carbon development and attracting sustainable industries for investing in the SEZ.

They are, however, lacking technical and energy policy-development skills, as well as expertise in implementing energy-specific solutions. Despite the various APEC funded LCMT-reports providing recommendations on low carbon technologies and measures from 2014 to 2016, little has been achieved. This is partly due to the level of analysis being not detailed enough to be turned into a practical plan. Our project will remedy this in cooperation with the government of North Sulawesi, the City of Bitung, and Sam Ratulangi University.

It was strongly recommended that regional government put in place an energy champion, ideally leading a team of people, to implement recommendations and drive change. The energy champion(s) need to possess the technical skill set to understand modelling and the potential of renewables and energy efficiency integration. Likewise, it is important is that the team should have the authority to implement policies and programs to drive the recommended changes.

It was acknowledged that the region must develop this capacity to plan and develop energy solutions in order to break the cycle of depending on outside support.

## 7.0 Project Timeline

| | |
|---|---|
| April-May: | Strengthening the collaboration between Castlerock, UNSRAT, North Sulawesi Province, Kota Bitung, SEZ, PLN, MEMR and Ministry of Industry |
| End of May: | Finalization of data gathering |
| May to August: | Modelling and training |
| End August: | Draft findings |
| August: | Start developing the website with UNSRAT |
| September: | Uploading previous North Sulawesi low carbon activities on website |
| End September: | Final findings |
| October: | Outcomes workshop |
| November: | Final report published on the newly developed website and sent to APEC Secretariat to be published on APEC website |

## 8.0 Outlook

AIC will provide much needed expert support to the North Sulawesi region once they put in place the above-mentioned implementing authority. Once industry settles into the SEZ, this appointed person or group will be able to provide further modelling advice, more detailed energy efficiency pathways, and identify more opportunities to use DSM to balance the North Sulawesi grid together with PLN. AIC will be available for future specialist support, like undertaking hackathons for quick problem solving.

"Hackathons", bring opportunities for learning and problem solving to the forefront, as teams develop rapid (within one weekend), innovative solutions to the problems in energy and industry development the region faces today. Hackathons could be organised to identify solutions to current obstacles in attracting industry to the SEZ.

There might be additional funding opportunities available through APEC as the Project Manager has created a good working relationship with the organisation.

A large part of the PM's work will be to ensure the outputs of the project translate to outcomes by continuously engaging with the local stakeholders and helping them build to capacity and take ownership of the process under the guidance of the AIC Energy Cluster and the contractors, Castlerock.

***Terima Kasih!***


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**ANNEX 1**

Asia-Pacific
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# Discussion Paper for Capacity Building Workshop 28 March 2018 in Manado, North Sulawesi

## APEC Project EWG13 2017A
## Integrated Energy System Planning for Equitable Access to Sustainable Energy for Remote Communities in the APEC Regions using North Sulawesi as a Pilot Project/Test Bed

**Gabriele Sartori, Project Manager,**
**reviewed and approved by Dr. Ariel Liebman,**
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## Glossary

| | |
|---|---|
| Bappenas | National Development Planning Agency (*Badan Perencanaan Pembangunan Nasional*) |
| BAPPEDA | Regional Development Planning Agency (*Badan Perencanaan Pembangunan Regional*) |
| BLU | Public Service Agency (*Badan Layanan Umum)* |
| BOO | Build Own Operate |
| BOOT | Build Own Operate Transfer |
| BOT | Build Operate Transfer |
| BPJS | Social Security Agencies (*Badan Penyelenggara Jaminan Sosial)* |
| BPP | Electricity Generation Cost (*Biaya Pokok Pembangkitan)* |
| CNG | Compressed Natural Gas |
| DGE | Directorate General of Electricity (*Direktorat Jenderal Ketenagalistrikan*) |
| DGNREEC | Directorate General of New and Renewable Energy and Energy Conservation |
| DPR | House of Representatives (*Dewan Perwakilan Rakyat*) |
| EBTKE | New and Renewable Energy and Energy Conservation (*Energi Baru, Terbarukan dan Konservasi Energi*) |
| EPC | Engineering, Procurement and Construction FM *Force Majeure* |
| GEUDP | Geothermal Energy Upstream Development Project |
| GoI | Government of Indonesia (Central Government) |
| GR | Government Regulation (*PP* or *Peraturan Pemerintah*) |
| GW | Gigawatt (1,000 MW) |
| IDR | Indonesian Rupiah |
| IEA | International Energy Agency |
| INAGA | Indonesia Geothermal Association |
| IPP | Independent Power Producer |

| | |
|---|---|
| IUPTL | Electricity Supply Business Permit (*Izin Usaha Penyediaan Tenaga Listrik* sometimes referred to as *Izin untuk Melakukan Usaha Penyediaan Tenaga Listrik untuk Kepentingan Umum* - "IUKU") |
| IUPTLS | Temporary Electricity Supply Business Permit (*Izin Usaha Penyediaan Tenaga Listrik Sementara)* |
| kWh | Kilowatt hour |
| kV | Kilovolt |
| LMAN | State Assets Management Agency (*Lembaga Manajemen Aset Negara)* |
| LNG | Liquified Natural Gas |
| METI | Indonesian Renewable Energy Society *(Masyarakat Energi Terbarukan Indonesia)* |
| MKI | The Indonesian Electrical Power Society (*Masyarakat Ketenagalistrikan Indonesia*) |
| MMBtu | Million British thermal unit |
| MEMR | Ministry of Energy and Mineral Resources (*Kementerian Energi dan Sumberdaya Mineral*) |
| MoF | Ministry of Finance (*Kementerian Keuangan*) |
| MoSOE | Ministry of State-Owned Enterprises (*Kementerian Badan Usaha Milik* Negara) |
| MoPW | Ministry of Public Works |
| MoU | Memorandum of Understanding MSW Municipal Solid Waste |
| MTOE | Million Tonnes of Oil Equivalent MVA Megavolt Amperes |
| MW | Megawatt |
| NEP | National Energy Policy |
| NRE | New and Renewable Energy O&M Operations and Maintenance OJK Otoritas JasaKeuangan |
| PKUK | Authorised Holder of an Electricity Business Licence under the 1985 Electricity Law (*Pemegang Kuasa Usaha Ketenagalistrikan*) |
| PLN | The State-owned electricity company (*PT Perusahaan Listrik Negara*) |

| | |
|---|---|
| PPA | Power Purchase Agreement |
| PPP | Public-Private Partnership |
| PPU | Private Power Utility (electricity generated for own use) |
| PR | Presidential Regulation (*Perpres* or *Peraturan Presiden*) |
| PSAK | Indonesian Financial Accounting Standards (*Pernyataan Standar Akuntansi Keuangan*) |
| PTSP | One-Stop Services (*Pelayanan Terpadu Satu Pintu)* |
| RUKD | Regional Electricity Plan (*Rencana Umum Ketenagalistrikan Daerah*) |
| RUKN | National Electricity Master Plan (*Rencana Umum Ketenagalistrikan* |
| RUPTL | Electricity Supply Business Plan (Rencana Usaha Penyediaan Tenaga Listrik) |
| SHP | Small Hydropower |
| SOE | State-owned Enterprise |
| SPC | Special Purpose Company |
| TKDN | Local content (*Tingkat Komponen Dalam Negeri*) |
| UPTL US | Small Scale Electricity Supply Business (*Usaha Penyediaan Tenaga Listrik*) |
| VAT | Value Added Tax Withholding Tax |
| WHT | Withholding Tax |

## Preface

*This discussion paper has several important objectives.*

1. *First, it provides background information on previous studies on low carbon strategies in North Sulawesi and Bitung in particular.*
2. *Second, it provides important information relevant to planning integrated energy systems in North Sulawesi.*
3. *Third, it addresses the importance of data input for the project model so local stakeholders can produce future, integrated energy systems plans.*
4. *Fourth, there are questions – in **bold red**, for participants to workshop the answers.*
5. *And fifth, it ensures that all stakeholders have the same understanding of the project, its outcomes, its scope and its sense of timing.*

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## Introduction

The northern region of North Sulawesi is a pristine ecological environment. It's rapidly gaining a reputation as a hot-spot for eco-tourism that includes one of the world's best diving destinations. Presently, there's an application pending for sustainable fishing practices to maintain the delicate balance between commercial fishing and the environment. North Sulawesi also grows, harvests, manufactures and exports coconut products for a global market.

However, even with thriving industries like tourism, fishing and agriculture, some local communities exist without reliable electricity. This means, these communities miss out on further economic development opportunities and an improved lifestyle.

To change this, the local government is committed to implementing a smart, sustainable, integrated energy system. The strategic objective is to provide electricity, mainly using optimal mix of renewable energy sources and energy efficiency measures to reduce the carbon footprint as well as operational costs for plants. This will have a direct impact in alleviating poverty while meeting future growth plans.

APEC Project EWG13 2017A will focus on training team members and stakeholders how to plan and develop integrated renewable energy systems using global best-practices and leading technology. The project commenced in January 2018 and will be finalised in November 2018.

A positive outcome to this pilot project may prompt APEC to provide further funding to assist North Sulawesi in implementing LCMT recommendations and energy systems planning.

Bitung City is a rapidly growing district in North Sulawesi Province. Under the Government Regulation No. 32 of 2014 the area has been approved by the President of Indonesia as the Bitung Special Economic Zone (SEZ). Bitung SEZ is different from other SEZs in Indonesia. It aims to be a green developing zone which implies an imperative to minimise carbon emissions parallel with its industrial development. Since 2014 the city has been in the process of developing local low-carbon targets whilst aiming to improve the quality of life for its residents and industry.

In 2015, The Asia Pacific Energy Research Centre (APERC) conducted a two-part APEC funded peer-review. Its purpose was to assist Bitung City develop its plans and become a model for other towns. This undertaking was called, the Low Carbon Model Town assessment (LCMT). Part 1 contains background information on Bitung City as well as Bitung SEZ and provides context to Part 2, – which was produced by the APERC review team and addresses various energy issues. [0]

The findings and 64 recommendations for implementation in this policy review were delivered in 2016. There are topics such as: Legal Framework, Sustainable Urban Planning, Low-carbon Buildings, Area Energy Management Systems, Renewable Energy And Untapped Energy Planning, Transport, and Environmental Planning.

The New and Renewable Energy and Energy Conservation (EBTKE) of the Ministry of Energy and Mineral Resources (MEMR) conducted a Smart Energy City study in Bitung in 2016. [1]

*Both the regional government of North Sulawesi and the Bitung city leadership aspire to create a sustainable growth model that demonstrates leadership for not only Indonesia but other developing economies in the APEC region.*

However, according to the LCMT book/progress report, 2017, "…the city encountered some regulatory hurdles. The department of Energy and Mineral Resources of Bitung City, which is the acting agency of ministry as well as the technical agency conducting the LCMT assessment, was eliminated from the list of the municipality agencies. This was based on Government Rule No. 18 in 2016 about municipality agencies." [2]

This hurdle is significant because effective energy management systems and integrated renewable energy sources with energy efficiency measures are based on thorough planning. However, subsequent to various reports and studies sponsored by APEC and EBTKE, little economic development or energy systems planning eventuated from these recommendations. Further, no clear emissions reduction targets or any clean industry development plan has since been developed or implemented.

Demonstrating its commitment to this unique pilot program, this APEC funded project EWG13 2017A will undertake a hands-on approach to deliver a plan while training team members and stakeholders. The objective is to equip regional government and the city of Bitung with the knowledge and expertise to create future electricity system plans and integrating renewable energy sources complemented by energy efficiency measures as affordable prices.

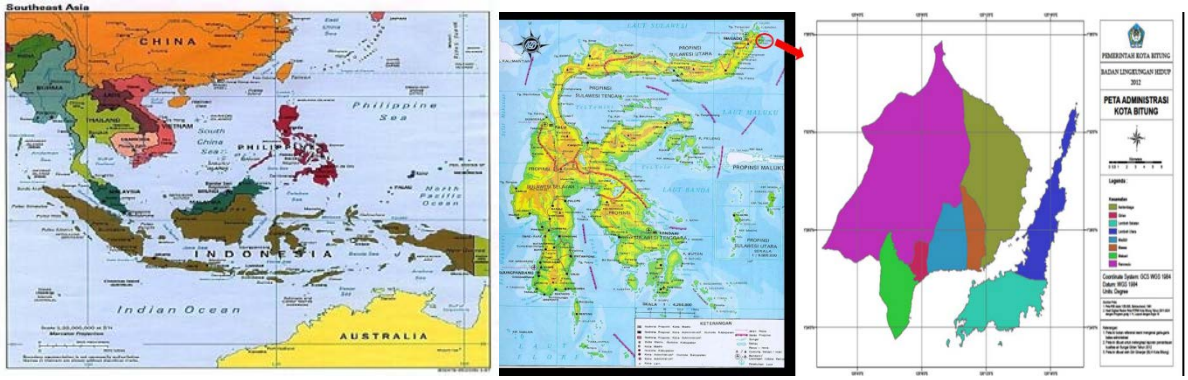
0 LCMT_Phase_5_Policy_Review_final_report
1 MEMR/EBTKE presentation, Paparan DEK 9 February 2018
2 Bitung City - LCMT book part 7, 2017

## 1.0 Background

Indonesia is a vast archipelago comprised of 17,508 islands which stretch over 5,000 kilometers (3,100 miles) across Southeast Asia and Oceania. Indonesia shares land borders with Papua New Guinea, Timor-Leste, and Malaysia, and maritime borders with Singapore, the Philippines, and Australia. With over 252 million inhabitants in 2014, Indonesia's large and diverse population makes it the fourth most populous economy in the world. Over half of the economy's population lives in the Java–Bali region, while the rest is spread across Sumatra, Sulawesi, Kalimantan, Nusa Tenggara and Maluku, Papua, and about 6,000 other smaller inhabited islands.

The North Sulawesi province is located on the northern peninsula of the island of Sulawesi, and lies south of The Philippines and southeast of Malaysia. It borders Philippines to the north, the Maluku Sea to the east, Gorontalo to the west and the Gulf of Tomini to the south. The province's capital and largest city is Manado, which is also the main gateway and economic centre of the province. Other major towns include Tomohon and Bitung. According to the 2016 census of Indonesia, North Sulawesi's total population is 2.771.159.

Due to its strategic geographic position, Bitung has the potential to become a centre of goods distribution and logistics supporters in the region. Also, the development of the Bitung hub port will open a wider access to Brunei Darussalam, Indonesia Malaysia, the Philippines – East Asia Growth A (BIMP- EAGA) and also to the international world. **For more information please refer to the LCMT book part 7**




Source: LCMT book part 7 Figure 1 Map of North Sulawesi/Bitung City

## 1.1 Energy Resources in Indonesia

According to MEMR, Indonesia has coal resources at around 120.5 billion tons, oil resources at around 3.69 billion barrels, and natural gas reserves at around 101.54 trillion cubic feet. At current production rates, this translates into 12 remaining years of oil reserves, 39 years of gas, and 146 years of coal.

Indonesia's renewable energy sources are also considerable. The economy is endowed with significant potential for hydropower (75,000 megawatts, micro and mini hydropower (1,013 MW), solar (4.80 kWh per square meter per day), biomass (32,654 MW), and wind (3 to 6 meters per second). It also holds 40% of the world's geothermal reserves (28,000 MW).[3]

3 https://www.adb.org/sites/default/files/institutional-document/189713/ino-energy-asr.pdf

MEMR also states, Indonesia's total primary energy supply in 2013 was about 1.61 billion barrels of oil equivalent (*footnote 6*). The majority of Indonesia's primary energy supply comes from fossil fuels: Oil (46.08%, coal 30.09%), and gas (18.26%).

The share of renewable energy sources in the energy mix is low: hydro power (3.21%), geothermal (1.15%) and biofuel (0.40%). Biofuel is mainly used in rural areas for basic cooking.

## 1.2 Energy Supply in Indonesia and in North Sulawesi Province

The State Electricity Corporation (PT PLN) is the only state-owned power utility company in Indonesia and the economy's only fully integrated power utility company. PT PLN is the major provider of all public electricity and electricity infrastructure in Indonesia, including power generation, transmission, distribution, and retail sales of electricity. PT PLN holds primary responsibility for achieving the government's accelerated generation targets through the Fast Track Programs (FTPs).

Since the passage of a new electricity law in 2009 (Law 30/2009), PT PLN no longer has a legal monopoly over electricity generation, transmission, and distribution, but it has a first right of refusal over any activity in the subsector which can be a significant disincentive for private investment in some cases.

Other State-Owned Enterprise (SOEs) are active in Indonesia's energy sector within their respective spheres of influence. PT Pertamina, Indonesia's state-owned oil and natural gas corporation, is the second-largest crude oil producer in Indonesia and a world-leading producer and exporter of liquefied natural gas (LNG). PT Pertamina Geothermal Energy is a subsidiary of PT Pertamina working in geothermal energy with concessions across the economy.

The private sector is expected to play a larger role in the energy sector. Electricity Law No. 30/2009 ended PT PLN's legal monopoly over Indonesia's power generation, transmission, and distribution, and created the legal basis for the private sector to enter each stage of the power sector. According to PT PLN, over half of the investment funding needed over 2015–2019 has been assigned to the private sector. However, private investment in the electricity sector has not met expectations.

Independent power producers (IPPs) are constrained by uncertainties over fuel supply, particularly coal and gas, and sometimes by poor access to the grid. Imprecise tariff regimes for geothermal, hydropower, and other renewable energy plants have also been an obstacle, although these are currently being clarified or revised. [4]

PLN issues an annual Electricity Supply Business Plan (RUPTL) which is approved by the Minister of Energy and Mineral Resources through decree. The RUPTL includes PLN's plan to procure electricity from private Independent Power Producers (IPPs). It has evolved from a loose guideline, which does not pinpoint exact locations PLN may wish to see IPP's developed, to a rulebook essentially requiring PLN to contract with IPPs whose projects appear on the RUPTL.

The previous 2016-2025 RUPTL set out somewhat ambitious plans to meet the Government's revised renewable energy target of 23% by 2025. For solar energy, the RUPTL states that there is a plan to develop 5,000MW by 2025. 100MW has been slated for the Java-Bali grid, 70MW in Sulawesi, 70MW in East Nusa Tenggara, 25MW in Maluku and 40MW in Papua. And for wind projects – with 330MW planned for the Java-Bali grid, 70MW in Sulawesi, 70MW in East Nusa Tenggara, 25MW in the Maluku and 40MW in Papua.

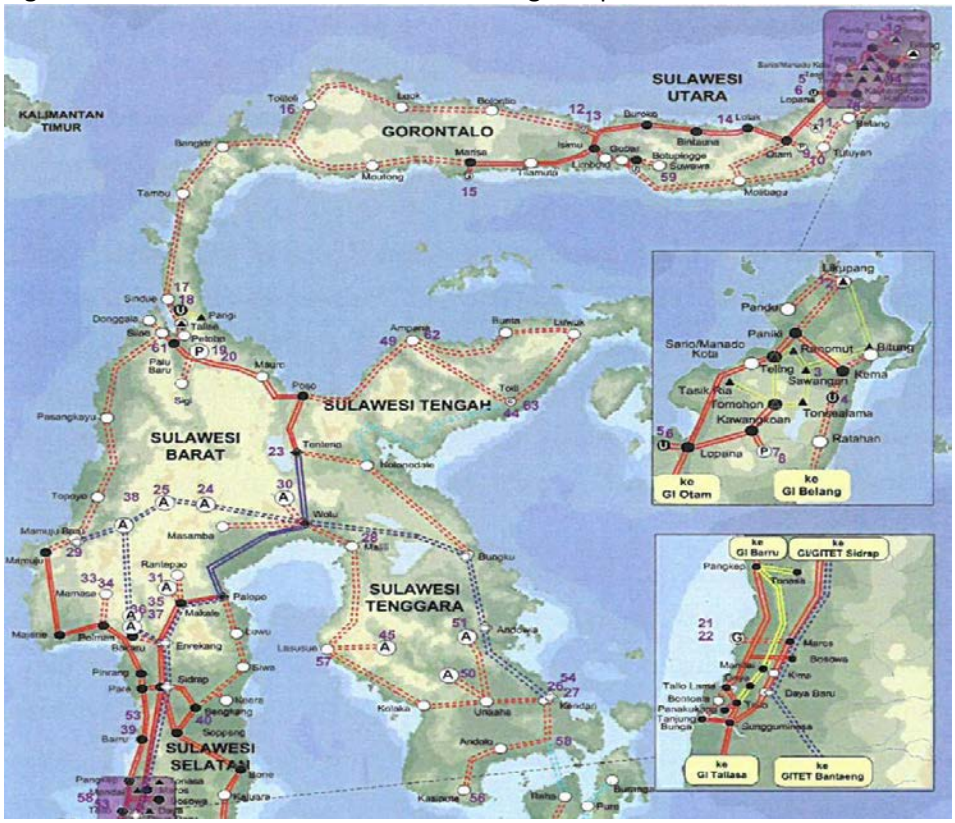
4 http://www.gbgindonesia.com/en/main/legal_updates/pln_s_2017_2026_electricity_supply_business_plan_issued.php

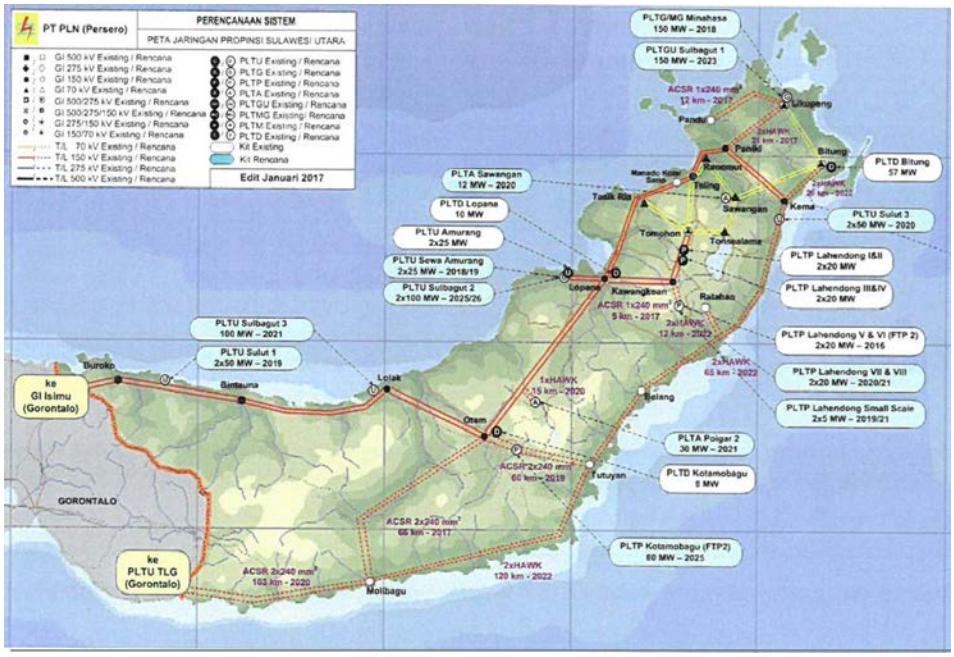
For geothermal projects, there is approximately 5 GW of new capacity allocated to IPPs, with a further 6.1 GW yet to be allocated. Hydro represents the largest renewable opportunity, with 5.5 GW allocated, and a further 9.1GW yet to be allocated. For both geothermal and hydro projects, no allocation for specific locations was released.

In the 2017 – 2026 RUPTL, PLN plans to deploy mobile power plants (MPP) to deal with short-term shortages of power in various locations in parts of Sulawesi.

**Question: In light of the above sentences "…but it (PLN) has a first right of refusal over any activity in the subsector which can be a significant disincentive for private investment in some cases." And, "…private investment in the electricity has not met expectations." what are the hurdles private investors face when entering this market? How would this impact Bitung and North Sulawesi for the APEC project? What do the modellers need to take into consideration when they model the scenarios?**

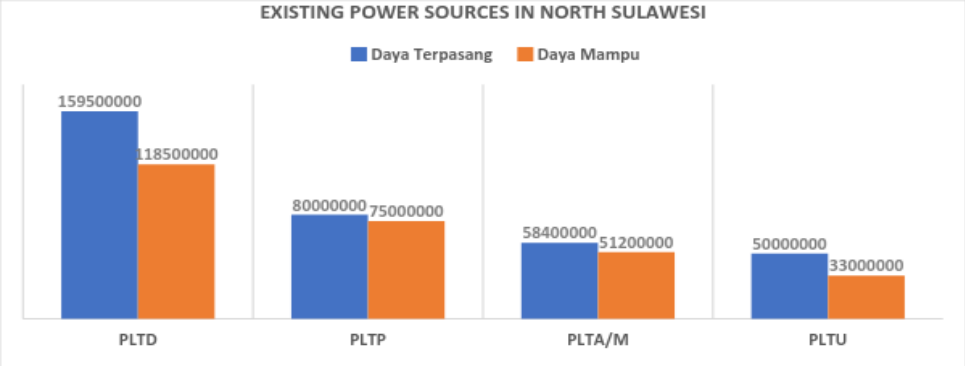
Figure 2: Transmission connections – existing and planned






Source: RUPTL 2017

North Sulawesi and South Sulawesi are currently not connected by high voltage transmission lines. It is planned for 2018 to connect Gorontalo to the northern most substation of the South Sulawesi grid system. Bitung now is connected to the North Sulawesi Electricity System only. The installed capacity of this system is 347 MW, consisting of diesel 159MW, geothermal 80MW, hydro 58MW and geothermal steam 50MW. The actual capacity is only 227 MW. Existing power sources in North Sulawesi can be seen in the below **Figure 3**



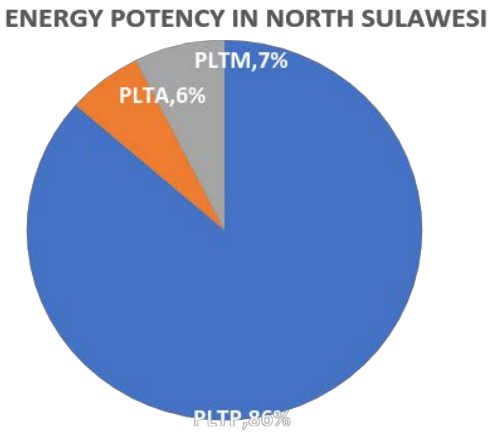

Source: LCMT book part 7

**Questions:**

1. **What influence will this interconnector have on the integrated renewable energy and energy efficiency systems planning in North Sulawesi?**
2. **What possible delays in interconnection need to be modelled and what are the implications?**

## 2.0 Potential renewable energy supply sources in North Sulawesi

North Sulawesi has both fossil energy and non-fossil energy sources including new and renewable energy. Potential non-fossil energy sources consist of water (hydro-energy), geothermal, solar, wind, Ocean Thermal Energy Conversion (OTEC), waves, sea current and biomass. North Sulawesi has huge renewable electricity potentials about 810 MW overall, mainly from geothermal energy of 700 MW, but also hydro 59.9 MW and micro hydro 50 MW. Refer to **Figure 4** Energy potentials in North Sulawesi.




Source: LCMT book part 7

### 2.1 Geothermal energy potentials

The geothermal energy potential in the province has been mapped by the Directorate of Geothermal, Directorate General of New, Renewable Energy and Conservation, Ministry of Energy Mineral Resources (DJETKE, nd). Geothermal potentials are sited in 10 locations and six municipalities such as Minahasa, North Minahasa, South Minahasa, Bitung, Tomohon and Bolaang Mongondow, and East Bolaang Mondondow, specifically in Airmadidi, Lahendong, Tompaso, Gunung Ambang, Kotamubagu, Kaleosan, Tanggari, Winero and Dua Saudara. The table of geothermal potentials can be seen below.

**Table 1** Geothermal potentials in North Sulawesi Province

| Area, Rsegency | Resources (MWE) | | Reserves (MWE) | | | Total | Installed | Status |
|---|---|---|---|---|---|---|---|---|
| | Speculative | Hypothesis | Possible | Probable | Proven | | | |
| Airmadidi, North Minahasa | 25 | - | - | - | - | 25 | - | Lahendong Tompaso GWA |
| Lahendong, Tomohon | - | - | - | 150 | 78 | 228 | 80 | |
| Tompaso, Minahasa | - | - | 130 | - | - | 130 | - | |
| Gunung Ambang, Bolaang Mongondow | - | - | 225 | - | - | 225 | - | Kotambugau GWA |
| Kotambubagu, Bolaang Mongondow | - | - | 185 | - | - | 185 | - | |
| Kaleosan, Minahasa | - | 51 | - | - | - | 51 | - | Lahendong GWA |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Tanggari, Minahasa | 10 | - | - | - | - | 10 | - | |
| Minero, Minahasa | 20 | - | - | - | - | 20 | - | Open area |
| Dua Sudara, Bitung | - | 2 | - | - | - | 22 | - | |
| Total | 55 | 79 | 540 | 150 | 78 | 896 | 80 | |

Source: LCMT book part 7; North Sulawesi Energy and Mineral Resources Agency,nd)

Especially in the East Bolaang Mongondow Regency, the Bolaang Mongondow Regency and the South Minahasa Regency, points in Ambang Mountain and Kotamubagu that have proximately 100 MW potentials covering 135.000 Ha (DJEBTKE, 2015). Manifestations of the geothermal energy are located in the Kotamubagu geothermal fields such as hot spring, fumarole, solpharatara, and alteration of rocks. Hence, a number of research studies were conducted to understand the potential. Based on these research findings, the area has been enacted as *Wilayah Kerja Panas Bumi* (Geothermal Operational Region) by the Ministry of Energy and Mineral Resource based on the Ministry Decree No. 2067/K/30/MEM/2012 on the 18 of June 2012 (DJEBTKE, 2015). [5]

**Questions: How feasible are these potentials? Has there been a cost/benefit analysis done to explore the mining and exploration costs?**

### 2.2 Hydro energy potentials

Beside geothermal potentials, other energy potentials in the province are hydro energy of 50 KW and for micro hydro energy is 60 KW that can be seen in table below. [6]

**Table 2**: Hydro Energy Potentials in North Sulawesi

| No | Location | Municipalities | Potentials (MW) | Status |
|---|---|---|---|---|
| 1. | Poigar I , Modoinding | South Minahasa | 2.4 | Operation |
| 2. | Poigar II, Modoinding | South Minahasa | 32 | Feasibility Study |
| 3. | Poigar III, Modoinding | South Minahasa | 14 | Feasibility Study |
| 4. | Tonsea Lama, Minahasa | Minahasa | 14 | Operation |
| 5. | Tangari I, Airmadidi | North Minahasa | 18 | Operation |
| 6. | Tangari II, Airmadidi | North Minahasa | 19 | Operation |
| 7. | Sawangan | North Minahasa | 17 | Feasibility Study |
| 8. | Tincep I, Sonder | Minahasa | 5.5 | SSI |
| 9. | Tincep II Sonder | Minahasa | 1.1 | SSI |
| 10. | Tincep II, Sonder | Minahasa | 2.2 | SSI |
| 11. | Tincep IV, Sonder | Minahasa | 0.65 | SSIs |
| 12. | Woran | South Minahasa | 0.55 | SSI |
| 13. | Ranoketang Tua, Amurang | South Minahasa | 1.17 | SSI |
| 14. | Mobuya, Modoinding | South Minahasa | 3 | Operation |
| 15. | Morea, Belang | Southeast Minahasa | 0.60 | SSI |
| 16. | Molobog, Nuangan | East Bolaang | 0.63 | SSI |
| 17. | Lobong I, Passi | Bolaang Mongondow | 1.6 | Operation |
| 18. | Lobong II, Passi | Bolaang Mongondow | 0.47 | SSI |

| | | | | |
|---|---|---|---|---|
| 19. | Mokobang I | Bolaang Mongondow | 0.97 | SSI |
| 20. | Mokobang I | Bolaang Mongondow | 1.57 | SSI |
| 21. | Apado, Passi | Bolaang Mondondow | 0.28 | SSI |
| 22. | Kinali, Passi | Bolaang Mondondow | 1.18 | SSI |
| 23. | Bilalang, Passi | Bolaang Mondondow | 0.28 | SSI |
| 24. | Salongo, Bolaang Uki | South Bolaang | 0.91 | SSI |
| 25. | Duminanga, Bolaang Uki | South Bolaang | 0.53 | SSI |
| 26. | Milangodaa I, Bolaang Uki | South Bolaang | 0.72 | SSI |
| 27. | Milangodaa II, Bolaang Uki | South Bolaang | 0.77 | SSI |
| 28. | Pilolahunga, Bolaang Uki | South Bolaang | 0.77 | SSI |
| 29. | Ulung Peliang I, Tamako | Sangihe | 1.8 | Operation |
| 30. | Ulung Peliang I, Tamako | Sangihe | 0.28 | Operation |
| 31. | Belengan, Manganitu | Sangihe | 1.21 | SSI |
| 32. | Minut I | North Minahasa | 21 | SSI |
| 33. | Minut II | North Minahasa | 27 | SSI |
| 34. | Minut III | North Minahasa | 12 | SSI |
| 35. | Sangkup I | North Bolmong | 45 | SSI |
| 36. | Sangkup II | North Bolmong | 14 | SSI |
| 37. | Ranoyapo I | Southeast Minahasa<br>South Minahasa | 81 | SSI |
| 38. | Ranoyapo II | Southeast Minahasa<br>South Minahasa | 14 | SSI |
| 39. | Poigar | South Minahasa<br>Bolaang Mongondow | 46 | SSI |
| | Total | | 400,34 | |

Source: LCMT book part 7; North Sulawesi Energy and Mineral Resources Agency, nd.

### 2.3 Biomass energy potentials

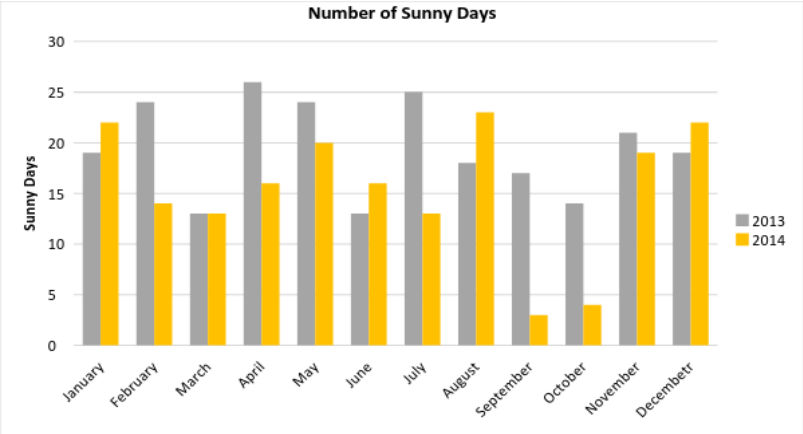
Bitung and its surrounding areas of Manado, Minahasa Utara and Tomohon are planning to build a biomass recycling plant. This will include a biomass energy generator to that produces biogas. Supplementing biogas will be wind energy. A comparison study in Palu City has been conducted in order to study the potential of biogas to generate electricity to the city. [7]

## 3.0 Energy Supply Potentials in Bitung

### 3.1 Solar energy potentials

Bitung has a high potential for solar photovoltaic energy. The percentage of sunny days in a calendar year averages 80%. Government buildings will be installed with solar panels. The street lights will be changed into solar lights. Owners of outdoor industrial facilities will be encouraged to convert to solar powered light. Number of sunny days in Bitung can be seen in **Figure 5** below. [8]

**Figure 5:** Number of sunny days in Bitung

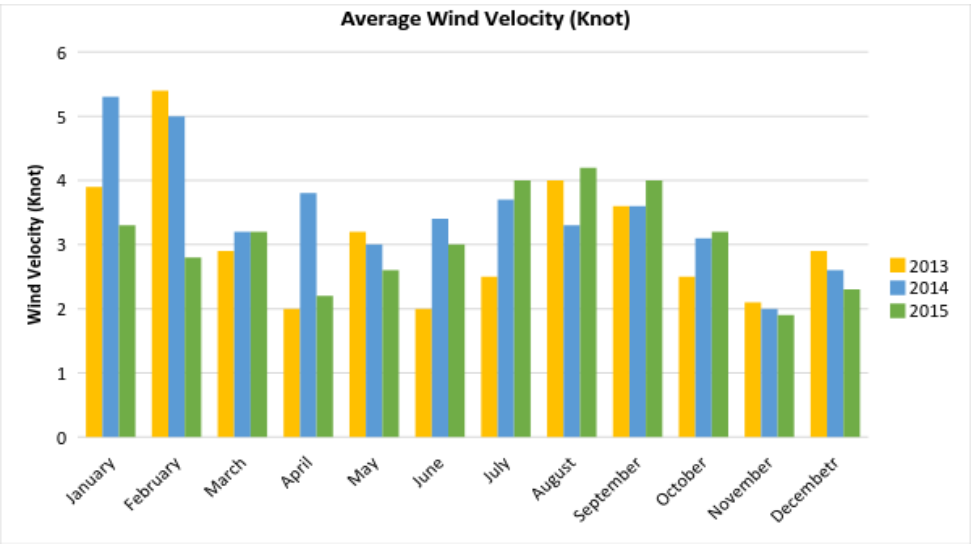



Source: LCMT book part 7

### 3.2 Wind energy potential

Bitung is located next to the Sulawesi Sea and has a high potential for wind energy. According to the report of Natural Resource Bureau of North Sulawesi, it is estimated that Lembeh Island, adjacent to Bitung, could produce 3-5 KW[MW?] of wind energy (Natural Resource Bureau, 2011). Morphology of the island is long with a low mountain range support for catching the wind. Also, Bitung is located at the foot of Mount Dua Sudara which also has potential for wind energy as shown in Figure 6. [9]

**Figure 6:** Average wind velocity




Source: LCMT book part 7

### 3.3 Sea current energy potential

Lembeh Strait as a narrow passage with constant currents. This creates a high potential for sea current energy generation. However, more information is required on the cost and capability of this energy source before it's included in the model. Lembeh Strait can be seen in photos below. [10]

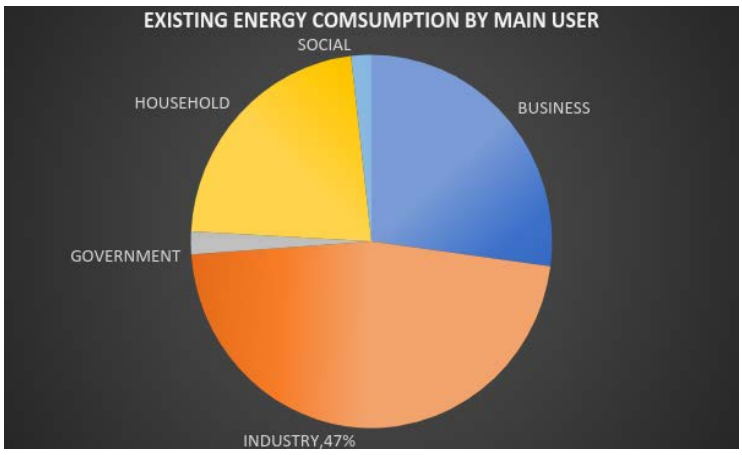
**Figure 7: Lembeh Strait**

Source: LCMT book part 7

## 4.0 Energy consumption in Bitung

The LCMT Book part 7 claims that half of the energy consumption in Bitung is from industry followed by business and household. The total energy consumption in 2016 was 108 MW. The figure of the energy consumption in the city can be seen below.

**Figure 8: Existing energy consumption of Bitung**

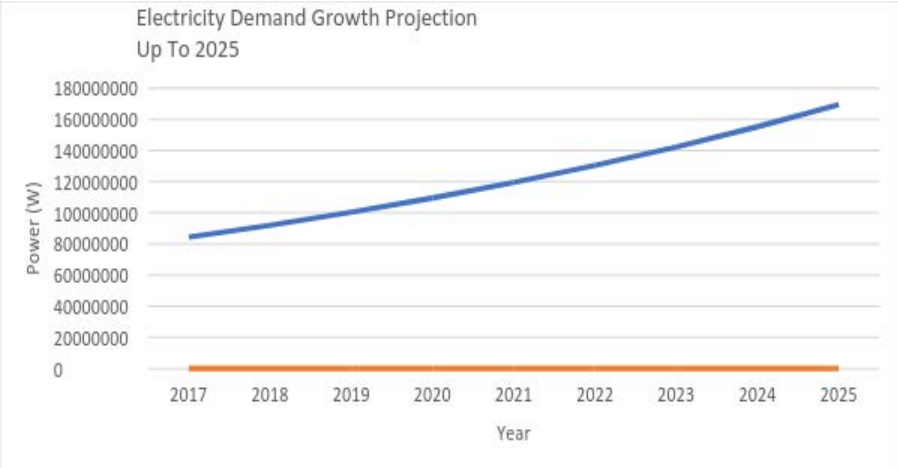



Source: LCMT book part 7

Later in the book the electrical energy demand in Bitung is not 108 MW as stated earlier but about 80 MW and it is expected to increase up to 110 MW in 2020. There is a 26 MW difference that requires attention. The book further estimates that with the proposed implementation of a Special Economic Zone (SEZ) status, this demand will increase significantly. It is estimated that this new economic development zone will increase the electricity demand up to 250 MW in 2020. This will double the current electrical demand. Electricity demand can be seen in Figure below

**5, 6, 7, 8, 9, 10 Bitung City - LCMT book part 7, 2017**

**Figure 9: Electricity Demand Projection**




Source: LCMT book part 7

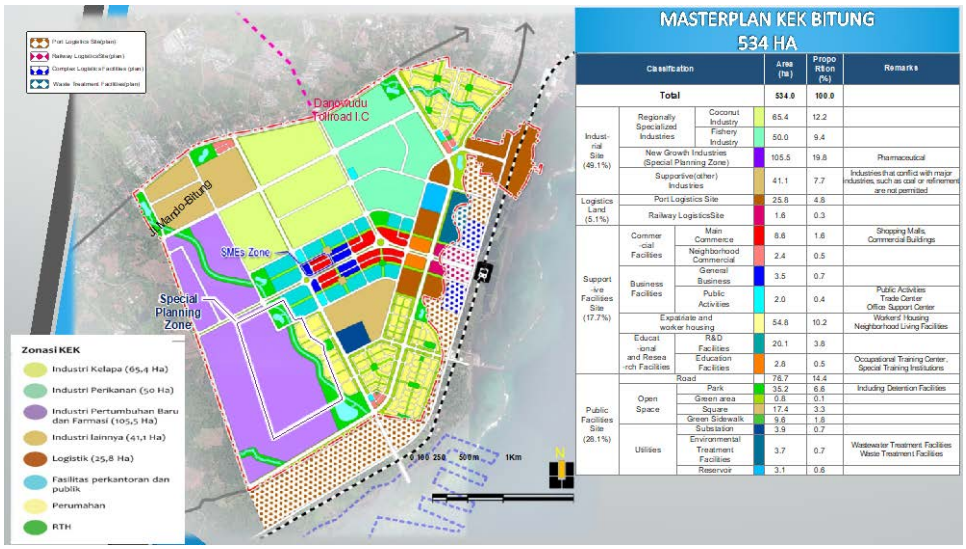
**Questions;**

1) **On what basis were these energy demand figures gathered?**
2) **What assumptions triggered a future energy demand – that's more than double in size of the 2016 demand?**
3) **Are the energy consumption figures leading up to 2025 realistic or optimistic (overly ambitious)?**

### 4.1 Industrial potential in North Sulawesi – Bitung

According to the LCMT book 7 the progress of SEZ determines the progress of LCMT recommendation implementations. It further points out that the Government of the North Sulawesi Province and Bitung City must first prepare supporting policies before the LCMT recommendations can be implemented.

**Figure 10: Masterplan of Bitung SEZ**




MASTERPLAN KEK BITUNG
534 HA

| Classification | | | Area (ha) | Proportion (%) | Remarks |
|---|---|---|---|---|---|
| Total | | | 534.0 | 100.0 | |
| Industrial Site (49.1%) | Regionally Specialized Industries | Coconut Industry | 65.4 | 12.2 | |
| | | Fishery Industry | 50.0 | 9.4 | |
| | New Growth Industries (Special Planning Zone) | | 105.5 | 19.8 | Pharmaceutical |
| | Supportive(other) Industries | | 41.1 | 7.7 | Industries that conflict with major industries, such as coal or refinement are not permitted |
| Logistics Land (5.1%) | Port Logistics Site | | 25.8 | 4.8 | |
| | Railway LogisticsSite | | 1.6 | 0.3 | |
| Supportive Facilities Site (17.7%) | Commercial Facilities | Main Commerce | 8.8 | 1.6 | Shopping Malls, Commercial Buildings |
| | | Neighborhood Commercial | 2.4 | 0.5 | |
| | Business Facilities | General Business | 3.5 | 0.7 | |
| | | Public Activities | 2.0 | 0.4 | Public Activities Trade Center Office Support Center |
| | Expatriate and worker housing | | 54.8 | 10.2 | Workers' Housing Neighborhood Living Facilities |
| | Educational and Research Facilities | R&D Facilities | 20.1 | 3.8 | |
| | | Education Facilities | 2.8 | 0.5 | Occupational Training Center, Special Training Institutions |
| Public Facilities Site (28.1%) | Road | | 76.7 | 14.4 | |
| | Open Space | Park | 35.2 | 6.6 | Including Detention Facilities |
| | | Green area | 0.8 | 0.1 | |
| | | Square | 17.4 | 3.3 | |
| | | Green Sidewalk | 9.6 | 1.8 | |
| | Utilities | Substation | 3.9 | 0.7 | |
| | | Environmental Treatment Facilities | 3.7 | 0.7 | Wastewater Treatment Facilities Waste Treatment Facilities |
| | | Reservoir | 3.1 | 0.6 | |

Source: LCMT book part 7

Out of the 18 companies that have applied for a licence to operate in the Bitung SEZ, 9 are not yet registered and 8 hold a principle licence. Only 1 company has received a business licence. The industries covered include; fishing-related industries like freezing fish and cold storage as well as logistics, pharmaceutical, coconut product manufacturing like ropes etc., active carbon and cement.

**Table 3: Status of companies applying for a business licence**

**DAFTAR PERUSAHAAN EXISTING DI KEK BITUNG (INSIDE 534 HA)**

| NO | NAMA PERUSAHAAN | BIDANG USAHA | STATUS PERUSAHAAN | KETERANGAN |
|---|---|---|---|---|
| 1 | PT. CONBLOCK INDONESIA SURYA | Industri Beton | Izin Prinsip | PMDN |
| 2 | PT. TRANS CONTINENT | Logistik | Belum Terdaftar | - |
| 3 | PT. SARI USAHA MANDIRI | Perikanan & Cold Storage | Belum Terdaftar | - |
| 4 | UD. IMANUEL | Perikanan | Izin Prinsip | PMDN |
| 5 | PT. MARINA NUSANTARA SELARAS | Perikanan & Cold Storage | Belum Terdaftar | - |
| 6 | CV. GILONTAS | Gudang Penyimpanan | Belum Terdaftar | Non - Operasional |
| 7 | PT. INDO LAUTAN MAS | Perikanan & Cold Storage | Izin Prinsip | PMDN |
| 8 | CV. PURI BITUNG GEMILANG | Sabut Kelapa | Belum Terdaftar | - |
| 9 | UD. FILADELFIA | Ikan Beku | Belum Terdaftar | - |
| 10 | PT. TRITIS INTERNATIONAL | Tepung Kelapa | Izin Prinsip | Non - Operasional |
| 11 | UD. GRACIA | Pengolahan Ikan | Izin Prinsip | PMDN |
| 12 | CV. NELAYAN | Perikanan | Izin Prinsip | Non - Operasional |
| 13 | PT. MAPALUS MAKAWANUA CHARCOAL INDUSTRY | Industri Karbon Aktif (Arang) | Izin Usaha | PMA |
| 14 | PT. ANUGERAH TIMUR MAKMUR | Pengolahan Ikan | Izin Prinsip | PMDN |
| 15 | PT. MITRA DUTA OPTIMAL | Gudang Penyimpanan | Belum Terdaftar | - |
| 16 | PT. ALAM BARU REKOR | Produksi Es dan Cold Storage | Belum Terdaftar | - |
| 17 | PT. ANEKA GAS INDUSTRI | Produksi Gas & Distributor | Izin Prinsip | PMDN |
| 18 | PT. INDOWORLD | Santan Kelapa / Nata de coco | Belum Terdaftar | - |

Source: FASILITAS DAN KEMUDAHAN di KEK BITUNG Berdasarkan pp No.96 tahun

In order to estimate energy consumption requirements, it's important to understand the timing of participating businesses and their plans to ramp up operations and production. These are critical data inputs into future load curves and estimated future demand.

**Questions;**

1) **Is there a realistic timeline in place?**
2) **How much is the expected installed capacity and annual power demand for each company listed in the Table above?**
3) **Are there potential regulatory hurdles that hinder the investment process?**
4) **Would more detailed guidance document for investors such as a cost-benefit analysis support the Bitung administration or the SEZ management department in attracting more investment?**
5) **How do we estimate the likelihood of any one of the projects getting up? Is this even a meaningful question given there is a somewhat all-or-nothing character to the SEZ development.**

## 5.0 Previous studies undertaken for Bitung and North Sulawesi as future LCMTs

At the 9th APEC Energy Ministers Meeting (EMM9), held 19 June 2010, in Fukui, Japan, the "Low

Carbon Paths to Energy Security" were initiated,

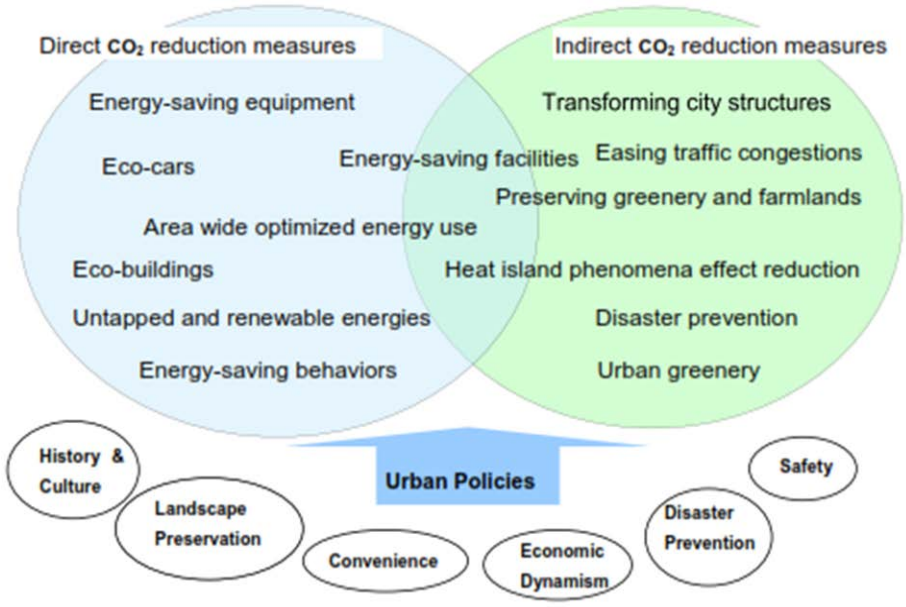
*"It is vital to manage rapidly growing energy consumption by urban areas within APEC. Therefore, low-carbon technologies must be incorporated into city planning to boost energy efficiency and reduce fossil energy."*

APEC LCMT activities were developed under the APEC Energy Working Group (EWG) and implemented by Asia-Pacific Energy Research Center (APERC).

The APEC LCMT project consists of three activities:
1. Development of the Concept of the Low Carbon Town,
2. Feasibility studies (F/S), and
3. Policy reviews of planned town and city development projects.

Low Carbon Town (LCT) refers to towns that have a clear target of CO2 emissions reduction and comprehensive measures to achieve these reductions for sustainable development. This concept can be applied to areas planning to be built (Greenfield) and existing areas already built (Brownfield).

**Figure 11: Concept of LCMT**




Source: MEMR/EBTKE presentation, Paparan DEK 9 February 2018

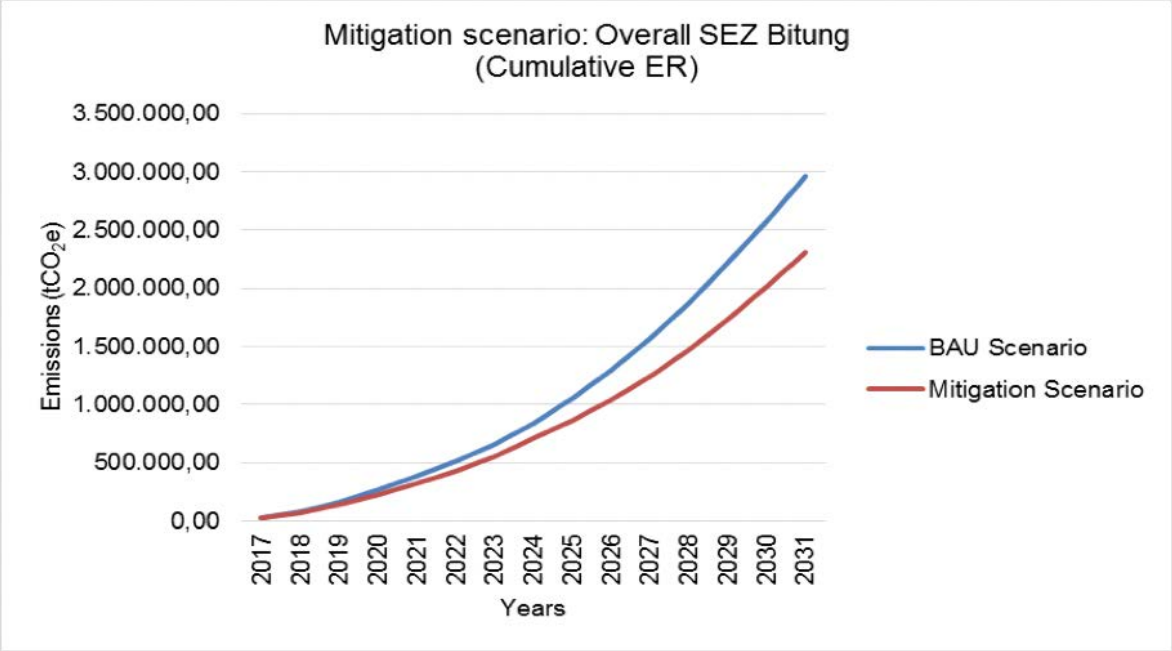
## 5.1 SouthPole Group's feasibility study for Bitung

In November, 2015, the SouthPole Group developed a detailed feasibility study of Bitung for APERC LCMT. Its focus was on a low carbon development strategy (LCDS) and an implementation roadmap for an industrial greenfield development within the Special Economic Zone (SEZ).

In summary the LCDS for the SEZ Bitung outlines these high-level objectives they create; a greenhouse gas (GHG) baseline and Business-As-Usual (BAU) scenario; GHG Emissions Reductions (ER) and Sustainable Development (SD) targets; and introduce a list of potential Low Carbon Measures (LCMs)

for each identified design category and sector of the city's economy. [11]

**Figure 12: Mitigation Scenario for SEZ Bitung**




Source: South Pole Group, 2015

The Feasibility Study concludes by looking at the scores resulting from the impact and cost assessment of the selected LCMs. The sectors that should be prioritised by order of importance are;

1. Energy
2. Waste
3. Transportation
4. AFOLU (Agriculture, Forestry and Land Use)

**Question: What activities have been undertaken by the BItung City/SEZ/North Sulawesi Government since 2015 to meet the proposed objectives?**

## 5.2 APEC LCMT Policy Review Bitung City 2015

In 2015, a team of six experts conducted the APEC LCMT Policy Review in Bitung City, North Sulawesi Province, Indonesia (see Appendix A). They stayed in Bitung City from 30 November to 2 December 2015. Their review provided a total of sixty-four (64) recommendations. The review included eight (8) different focus areas. Three (3) of these areas are energy-related such as: area energy management systems; renewable energy and untapped energy planning and; energy efficiency. [12]

11 APEC_LCMT_Phase 5_Final Feasibility Study Report

**Questions;**

1) **What is hindering the implementation of the energy related recommendations?**
2) **Is there a need to build a technical and managerial skill base in the region?**
3) **Are there any regulatory issues that need to be addressed to successfully implement these recommendations?**
4) **Are the recommendations specific enough to be implemented or do they need more detailed 'how to' guidelines?**

## 5.3 EBTKE's Smart Energy City Study 2016

EBTKE conducted a study in Bitung as part of their Smart Energy City program in 2016 focussing on nine (9) criteria. [13]

1. E-Governance and Good Governance
2. Spatial Planning and Implementation of Green Building
3. Energy Supply Availability
4. Waste Energy Management and Utilisation
5. Renewable Energy Utilisation
6. Smart Transportation
7. Energy City Management and Energy Saving
8. Public Participation and Institutions
9. Sustainable Economic Benefit

Its objectives were:

1. Conducting a study toward of a potential implementation and development of smart cities in Indonesia.
2. Obtaining survey data, database and analysis potency of implementation and development of this concept focusing on smart energy in Indonesia that illustrates the real condition and actual application and development concept of the smart city in Indonesia.
3. To develop evaluation and mapping policies and programs for energy conservation which have been or will be implemented.

**Conclusion of the EBTKE study**

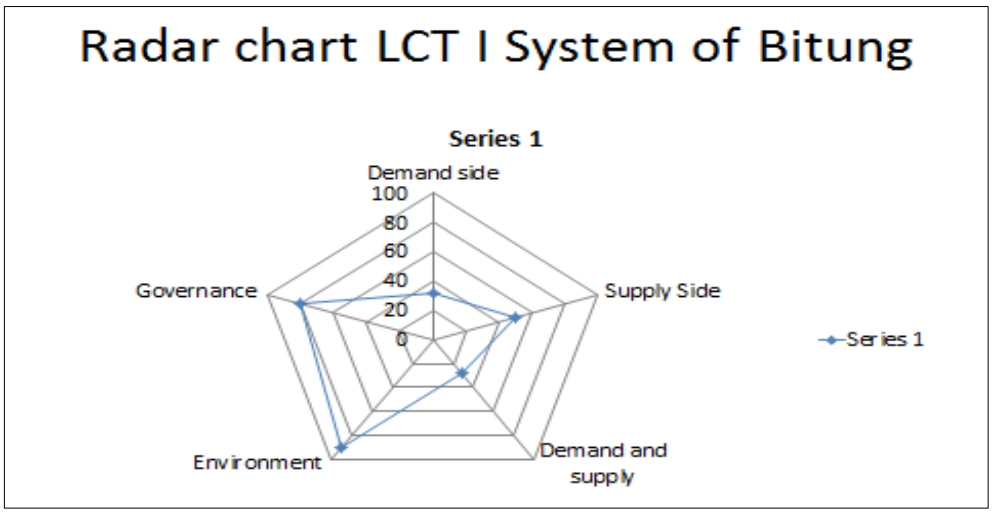
1. There is a need to implement energy conservation across all sectors, integrating all the programs.
2. The infrastructure for smart grid as a foundation for a smart city and low carbon town need to be developed.
3. The transportation sector is one of the existing and/or future problems as in most of the cities. There is a need to assist the city in developing low carbon mass transportation.
4. Renewable energy must be developed through long-term, integrated energy planning. Its development requires private sector involvement.
5. There is a need for good governance by local and the economy's government to develop supporting policies, provide funding and skilled human resources to support the infrastructure of sustainable energy development.

**Question; What steps can EBTKE take in order to support implementation of energy conservation measures that result in a smart grid city in Bitung and the surrounding region of North Sulawesi?**

## 6.0 Progress of LCMT implementation to date

The LCMT program uses self-assessment guidelines to monitor the implementation of its recommendations. In the LCMT Book part 7 reports that, according to the self-assessment undertaken in Bitung in 2017 via surveys and discussions with experts, the environmental and resource aspects are the most successful areas of implementation. They are followed by governance. The least successful aspects are energy demand and supply. The LCMT implementation in Bitung is currently focused on environment, transportation and education. Radar Chart of LCT I System can be seen in Figure below. [14]

**Figure 13: Radar Chart LCT I Bitung**




Radar Chart LCT I System of Bitung - Source: LCMT book part 7

### Supply side

Potentials for wind generated energy are developed by a corporation called Bayu Ltd. They have obtained a principal permit that covers eight kelurahan in two sub-districts. The potential energy to be generated is expected to be 30MW.

### Demand side

The fourth aspect of LCMT assessment is demand side. The assessment shows that LCMT implementation is not optimal yet, especially on the side in the city. Only one of the three sub-elements, *transportation*, achieved progress. While, the other two sub-elements*, town structure and buildings,* are less developed.

**Women's organizations involvement**

Public awareness campaigns are being initiated by various concerned stakeholders such as the women's organisations, PKK and Dharma Wanita, an organization of wives of government employees. The two organisations launched a movement called 'Go Green'.

Source: LCMT book part 7

### 6.1 Challenges of implementation

The LCMT book part 7 analyses the challenges of LCMT implementation in Bitung as follows;

1. Lack of a general energy management plan.
2. Measures that have an effect on GHG emissions reductions from the demand side could not be implemented due to the slow development in the Special Economic Zone (SEZ).
3. Lack of *Rencana Umum Energy Daerah Sulawesi Utara* or, North Sulawesi local energy general plan that is the mother plan for the Bitung energy plan.
4. According to the LCMT book, there is no technical agency in place to drive the energy management plan for Bitung. This resulted in a lack of coordination between local government, provincial government and the central agency. This is especially affecting the general energy planning area and the implementation of the LCMT.
5. Local government must be capable of developing and communicating the plan's progress to the upper level of government. And, vice versa; upper-level government's targets and concerns must be communicated at the provincial level.

**Questions:**

1. **If the biggest challenge is the missing energy development plan, what would it take to establish one?**
2. **Who should be responsible for its development?**
3. **Would a reinstatement of the Energy and Mineral Resources of Bitung City's technical agency support the implementation of LCMT and EBTKE recommendations?**

4. **Would it have the authority to develop an overarching plan for sustainable investment recommendations in the SEZ and would it be capable of energy systems planning?**
5. **Is there an overarching plan in place to deploy energy conservation measures and increase the renewable energy supply? Would the energy management plan cover this?**
6. **Why is there a slow development in the SEZ?**

## 7.0 Proposed approach of APEC funded project EWG13 2017A

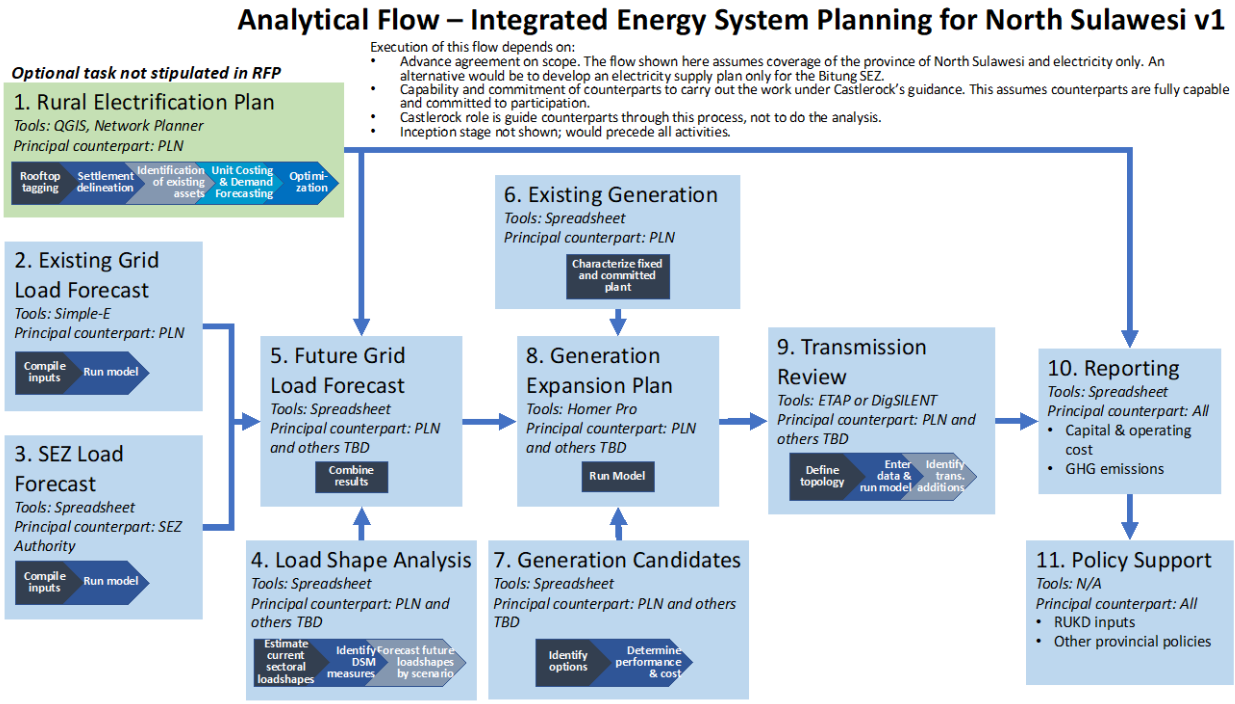
This project will focus on the electricity-related recommendations provided by the various previous studies. It appears that the main reason why the implementation of energy-related recommendations failed, is due to a lack of structure and capability of energy systems planning.

This project will provide a skeleton of an electricity systems planning framework and quantitative models for local stakeholders to use in the future. This will enable them to continue their LCMT implementation process and fulfil their regulatory requirements under the RUKD.

The chart below is an overview of the proposed Integrated Energy Systems Planning for North Sulawesi. It contains 11 boxes that require input data/information from local stakeholders.

At the workshop participants CastleRock Consulting and the project management team will seek information from stakeholders as input into these boxes.

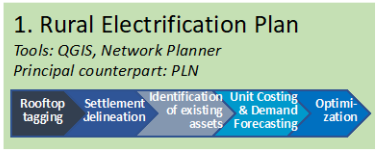
**Figure 14**




Source: Castlerock Consultants

## 7.1 More detailed explanation of the 11 input boxes, provided by Castlerock Consulting

### 1. Rural Electrification Plan

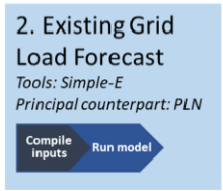



This task entails the development of an electricity access plan for communities in North Sulawesi that currently have no electricity supply. The following five-step approach will be used for preparation of this plan:

- *Roof top tagging*: Households will be manually identified ("tagged") based on publicly available satellite imagery (e.g., Google earth, Bing Maps, HERE maps)
- *Settlement delineation*: Individual household tags will be aggregated into settlements. A "settlement" is a group of households that can be served solely by low voltage (LV) feeders. Two households are in the same settlement if they are within a specified distance of one another. This maximum distance is referred to as the "proximity criterion".
- *Identification of existing assets*: The geospatial coordinates of the routing/location of existing Medium Voltage (MV) lines and any isolated diesel units will be compiled. PLN is the sole source of this information.
- *Unit Costing and Demand Forecasting*: This step entails (i) defining performance and unit costs of each the three candidate technologies to be considered (grid extension, PV mini-grids, or individual household systems); and (ii) preparation of an electricity demand model that forecasts demand based on settlement population, economic growth, and population growth.
- *Optimization*: The unit costs, technology performance, demand forecasting model and geospatial data (MV line routings and settlement locations) are entered into the open-source *Network Planner* model to determine the least-cost means of serving each currently unelectrified settlement. Summary outputs include capex, opex and number of households served by each technology, with details available by settlement.

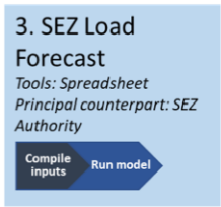
### 2. Existing Grid Load Forecast

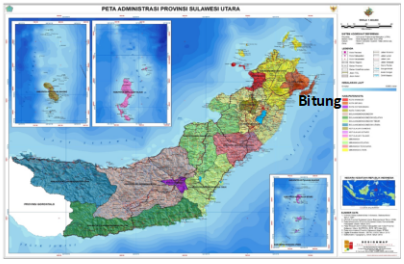
PLN's Simple E model will be used to forecast future electricity demand on PLN's existing North Sulawesi network. It is expected forecasts will be disaggregated by residential, commercial and industrial classes, and will be based on estimates of growth of regional GDP and population. Past forecasts should be evaluated for accuracy against actual sales to confirm the model formulation.




### 3. SEZ Load Forecast

Information regarding expected future tenants in the Bitung SEZ will be compiled from the SEZ authority. This information will include expected industry, size and date of operations for each future tenant. Indonesian and international data on electricity intensity for each tenant industry can be applied to estimate future demand arising from the new SEZ. These results will be compared with PLN's estimates of loading on the planned 70/20kV Bitung substation.

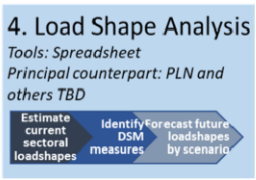



**North Sulawesi Administrative Map**

## 4. Load Shape Analysis

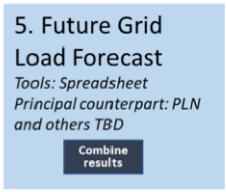
This step aims to estimate future average daily system load shapes by sector (residential, commercial, industrial). PLN's current average system load shape for the Sulutenggo system will be disaggregated into sectoral load shapes based on: normalized sectoral load shapes derived from load research conducted elsewhere in Indonesia; forecasts of sectoral energy sales from Steps 1, 2 and 3; and estimates of system network losses. Normalized sectoral load shapes will be scaled by energy sales forecasts for each sector, taking into account losses by voltage level, and recombined to derive a forecast of the future system load shape.




Various demand scenarios will be considered. Likely candidates include: (i) A demand-side management (DSM) scenario that considers the impact of potential DSM measures on these sector load shapes. The costs associated with these programs would also be estimated; (ii) different regional GDP growth scenarios; and (iii) accelerated transport electrification (e.g. introduction of electric vehicles, EVs).

## 5. Future Grid Load Forecast

The total future grid forecast will combine the results of Steps 1 through 4 to estimate future energy and peak demand on PLN's Suluttenggo system over the next 10 years (or the duration to be determined). A range of forecasts will be presented to reflect the various scenarios defined in earlier steps.



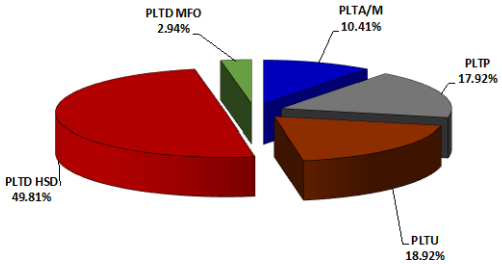

## 6. Existing Generation

This step will characterize all existing and committed generating plants that are connected to the North Sulawesi Grid System, as defined by the most recent available RUPTL. The generation mix and existing power balance are also be presented. The data needed from PLN Suluttenggo is as follows:

a) Type
b) Rated and net power
c) Owner (PLN, IPP, Renting)
d) Identification of must-run units
e) Historical or planed energy production/capacity factor by season and/or time of day
f) Specific fuel consumption
g) Forced and planned outage rates
h) Fixed and variable operating costs
i) Year in service (if committed plant not yet operating)
j) Generation stack on typical day-types


| | Name | In Folder | Grid | Out of Service | Act.Pow. MW | Par.no. | Active Power MW |
|---|---|---|---|---|---|---|---|
| | GorontaloPkr(3-4) | MARISA PEAKER 150KV | Grid | | 19.8 | 2 | 39.59999 |
| | LMVPP | AMURANG 150KV | Grid | | 13.714 | 7 | 96.00878 |
| | MinahasaPkr G(4-6) | LIKUPANG 150KV & MINAHASA PKR | Grid | | 19.8 | 3 | 59.39999 |
| | PLTP Lahendong(1-3) | LAHENDONG 150KV(1) | Grid | | 19. | 3 | 57.00000 |
| | PLTP Lahendong(4-6) | LAHENDONG 150KV(2) | Grid | | 19. | 3 | 57.00000 |
| | PLTU Amurang(1) | AMURANG 150KV | Grid | | 23.75 | 1 | 23.75000 |
| | PLTU Amurang(2) | AMURANG 150KV | Grid | | 23.75 | 1 | 23.75000 |
| | PLTU Gorontalo FTP(1) | PLTU GORNTALO | Grid | | 23.75 | 2 | 47.50000 |
| | PLTU Molotabu(1) | MOLOTABU 150KV | Grid | | 11.9 | 1 | 11.89999 |
| | PLTU Molotabu(2) | MOLOTABU 150KV | Grid | | 11.9 | 1 | 11.89999 |
| | PLTU Sulbagut(1) | PLTU GORNTALO | Grid | | 40. | 2 | 80.00000 |
| | PLTU Sulut(1) | BOROKO 150KV | Grid | | 47.5 | 1 | 47.50000 |

**List of Existing Generation Plant in NS Grid System 2017**




**Generation Mix in NS Grid System 2016**

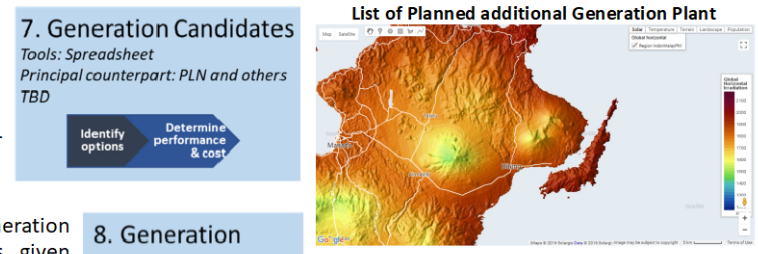
## 7. Generation Candidates

This task will identify and characterize potential sources of generation that could be candidates to help meet future electricity demand. These candidates will be entered into the generation expansion plan to determine least-cost additions to the generation mix to ensure demand is satisfied. These candidates will be characterized by the same parameters as for existing generation. These candidates will include:

- Solar photovoltaic
- Wind
- Geothermal
- Run-of-river hydro
- Any uncommitted plant in PLN's most recent RUPTL

| NO | PROYEK | ASUMSI PENGEMBANG | JENIS | KAPASITAS (MW) | COD | STATUS |
|---|---|---|---|---|---|---|
| 1 | Minahasa Peaker | PLTG/MG | PLN | 150 | 2018 | Rencana |
| 2 | Talaud | PLTU | PLN | 2x3 | 2018 | Konstruksi |
| 3 | Tahuna | PLTMG | PLN | 10 | 2018 | Rencana |
| 4 | Sulut 1 | PLTU | PLN | 2x50 | 2019 | Rencana |
| 5 | Tahuna | PLTMG | PLN | 10 | 2020 | Rencana |
| 6 | Sawangan | PLTA | PLN | 2x6 | 2020 | Rencana |
| 7 | Tahuna | PLTMG | PLN | 10 | 2024 | Rencana |
| 8 | Kotamobagu I (FTP 2) | PLTP | PLN | 20 | 2025 | Rencana |
| 9 | Kotamobagu II (FTP 2) | PLTP | PLN | 20 | 2025 | Rencana |
| 10 | Kotamobagu III (FTP 2) | PLTP | PLN | 20 | 2025 | Rencana |
| 11 | Kotamobagu IV (FTP 2) | PLTP | PLN | 20 | 2025 | Rencana |
| 12 | Kilotiga | PLTM | IPP | 0,6 | 2019 | Potensi |
| 13 | Sulut | PLTS | IPP | 20 | 2019 | Rencana |

List of Planned additional Generation Plant

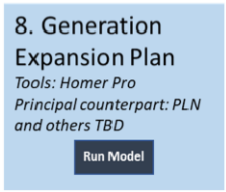


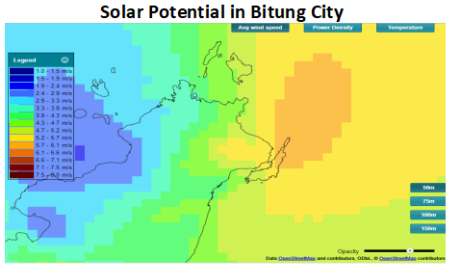



Solar Potential in Bitung City

## 8. Generation Expansion Plan

This step entails determination of the least-cost generation expansion plan under the various demand scenarios, given the existing and committed generation and generation options. A suitable generation expansion planning model will be used for this purpose. Because variable renewable energy (VRE) generation will be considered, this model should accommodate chronological dispatch. Homer Pro was developed for mini-grid design, but is a readily accessible, low-cost model that can be applied for this purpose. Open-source models, such as SWITCH, can also be considered depending on counterpart capacity.



Wind Potential in Bitung City

## 9. Transmission Review

This step assesses the adequacy of PLN's proposed transmission development plan to serve demand under the various scenarios of the least-cost generation expansion plan, and will identify any transmission upgrades that may be required.

This step begins with a comprehensive review of PLN's transmission development plan in the regional grid system which includes, but is not limited to:

a) HV transmission additions and connection year
b) HV conductor used and its configuration
c) HV substation planning and commissioning year
d) HV substation bay line expansion plan

Using the least-cost generation expansion plan and load forecast for each scenario, a computer-based simulation will be carried out to evaluate whether PLN's transmission expansion plan can accommodate required load flows during peak conditions. If not, adjustments to this plan will be identified. This analysis will rely on DigSILENT PowerFactory or ETAP, to be agreed with counterparts.

PT PLN (PERSERO)
WIL.SULUTTENGGO
AP2B SISTEM MINAHASA

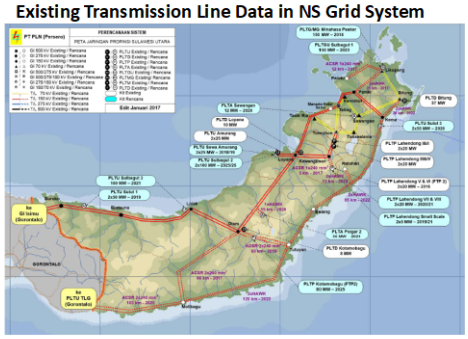
DATA TRANSMISI PER TRAGI AP2B SISTEM MINAHASA
TRANSMISSION DATA

| No. | Jurusan Branch | Jumlah Tower Tower No. | Tegangan Operasi ( kV) Voltage | Route Km | Kms | Q / mm | I Nom ( Amp) | Thn OP Year of Operation | Ket Remarks |
|---|---|---|---|---|---|---|---|---|---|
| A. TRAGI SAWANGAN | | | | | | | | | |
| 1 | Tonsealama - Tomohon | 28 | 70 | 10.033 | 20.166 | 185 | 535 | 1983 | Up Rating 2003 |
| 2 | Tomohon - Teling | 65 | 70 | 17.000 | 34.000 | 173.1 | 520 | 1989 | |
| 4 | Ranomut - Teling | 14 | 70 | 3.245 | 6.430 | 185 | 535 | 1983 | Up Rating 2004 |
| 5 | Savangan - Ranomut | 57 | 70 | 19.655 | 39.310 | 185 | 535 | 1972 | Up Rating 2004 |
| 6 | Tonsealama - Savangan | 24 | 70 | 7.832 | 15.664 | 185 | 535 | 1972 | Up Rating 2003 |
| 7 | Tanggari I - Savangan | 20 | 70 | 5.896 | 11.792 | 213 | 610 | 1987 | |
| 8 | Tanggari II - Savangan | 15 | 70 | 3.800 | 7.600 | 150 | 470 | 1998 | |
| 9 | Savangan - Bitung | 108 | 70 | 28.850 | 57.700 | 185 | 535 | 1983 | Up Rating 2004 |
| 10 | PLTA Tonsealama - GI. T.Lama | 3 | 30 | 0.378 | 0.756 | 240 | 350/535 | 1983 | |
| 11 | Bitung - Likupang | 110 | 70 | 31.000 | 31.000 | 240 | 645 | 2007 | |
| 12 | Panikl - Tanjung Merah | 80 | 150 | 27.152 | 54.304 | 240 | 645 | 2015 | |
| 13 | GIS Teling-Panikl | 37 | 150 | 11.551 | 23.102 | 240 | 645 | 2015 | |
| | Total A. | 444 | | 127.743 | 224.438 | | | | |
| B. TRAGI LOPANA | | | | | | | | | |
| 1 | Tomohon - PLTP Lahendong | 24 | 150 | 7.694 | 15.388 | 240 | 645 | 1996 | |
| 2 | Tomohon - Tasikiria | 70 | 150 | 26.040 | 52.080 | 150 | 470 | 1996 | |
| 3 | PLTP Lahendong - Kavangkoan | 62 | 150 | 9.940 | 19.880 | 240 | 645 | 1996 | |
| 4 | Kavangkoan - Lopana | 68 | 150 | 22.165 | 44.330 | 240 | 645 | 1996 | |
| 5 | Lopana - Otam | 208 | 150 | 70.700 | 141.400 | 240 | 645 | 2000 | LII Operasi 2009 |
| 6 | Lopana - PLTU Amurang | 56 | 150 | 17.875 | 35.750 | 240 | 645 | 2011 | |
| 7 | Lolak - Otam | 111 | 150 | 37.530 | 75.160 | 240 | 645 | 2009 | Operasi 2010 |
| 8 | Lopana - GIS Teling | 152 | 150 | 45.000 | 90.000 | 240 | 645 | 2014 | Operasi 2014 |
| | TOTAL B. | 761 | | 237.004 | 474.008 | | | | |
| C. Tragi Palu | | | | | | | | | |



Existing Transmission Line Data in NS Grid System



NS Provincial Grid Map

**ANNEX 2**

Asia-Pacific Economic Cooperation

# Capacity Building Workshop Manado, 28 March 2018

**'Integrated energy system planning for equitable access to sustainable energy for remote communities in the APEC regions using North Sulawesi as a pilot project/test bed'.**

## Four Points by Sheraton Hotel, Manado
## Grand Ballroom

## Agenda

| Time | Item | Who |
|---|---|---|
| 8:00 | Registration | |
| 8:30 | Welcome, introduction and house keeping | Ms Gabriele Sartori, AIC and Project Manager |
| 8:40 | Importance of project for the North Sulawesi region | Mr Tinungki, Head of Energy Agency, North Sulawesi |
| 9:00 | Importance of the project from the national government policy view | Mr Sugeng Mujiyanto, |
| 9:20 | Integrated energy planning to promote energy security and environmental protection | Mr Walujanto Syifa, Head of General Energy Planning Division, National Energy Council |
| 9:40 | Potential and importance of smart grid development in North Sulawesi | Mr Eddie Widiono, Chair of Smart Grid Indonesia, former Head of PLN |
| 9:50 | Avoiding energy oversupply and new built through energy conservation in North Sulawesi | Mr Andi Novianto, Head of Energy Productivity, Coordinating Ministry of Economic Affairs |
| 10:00 | Tea Break | |
| 10:15 | Progress of the SEZ Bitung industrial development – Opportunities and Challenges | Ms Jenny Karouw, Secretary of Regional SEZ Bitung Council |
| 10:35 | PLN's future energy supply strategy for North Sulawesi | Mr Edisson Sipatuhar, PLN |

| | | |
|---|---|---|
| 10:55 | The APEC project EWG13 2017A – project objectives | Dr Ariel Liebman, AIC |
| 11:15 | The modelling concept to identify least cost, least carbon energy supply for the region | Ms Chitra Priambodo, Castlerock Consulting |
| 11:35 | The spirit of least cost, least carbon emission energy supply and why it is so important for this region | Ms Farida Zed, Ex Director Energy Conservation, MEMR |
| 11:55 | Lunch Break | |
| 12:30 | Integrating RE sources and EE measures into electricity networks – lessons learnt from other economies. APEC energy experts panel<br>• Prof Nofri Yenita Dahlen, Malaysia<br>• Nelly Segisova, Russia<br>• Nuwong CHOLLACOOP, Ph.D. Thailand<br>• Mr. Chrisnawan Adityia, Jakarta<br>• Ms Farida Zed | Ms Gabriele Sartori |
| 14:00 | Electricity systems planning in North Sulawesi - the challenges and opportunities of integrating renewable energy sources and energy efficiency measures into the existing structures<br>• Chitra Priambodo, Castlerock<br>• Edisson Sipatuhar, PLN<br>• Mr. Salvius Patangke, GM PERTAMINA<br>• Prof. Pekik Dahono, ITB<br>• Prof. Dr. Benny Pinontoan, UNSRAT<br>• Mr. Jefry Lugang Director of Bitung SEZ<br>• Mr. Chrisnawan Adityia, Directorat General of Electricity of MEMR | Dr Ariel Liebman |
| 15:10 | Tea break | |
| 15:30 | Workshop in groups:<br>• Industry development in the SEZ<br>• Energy efficiency, Renewable energy and DSM integration<br>• Energy systems planning (technical) | Ms Gabriele Sartori,<br>Dr Ariel Liebman,<br>Ms Chitra Priambodo |
| 17:00 | Summary of workshop and outlining next steps | Dr Ariel Liebman,<br>Ms Gabriele Sartori<br>Ms Henriette Jacoba Roeroe |
| 17:45 | End of workshop | |
| 18:00 | Dinner | |