ENERGY TRANSITION PARTNERSHIP

Powering Prosperity and Enabling Sustainability in South East Asia

The Southeast Asian Energy Transition Partnership (ETP) is a multi-donor platform that brings together government donors, philanthropies and Southeast Asian governments to accelerate the energy transition in Southeast Asia.

Procurement For Services

Concept Note

Grid Modernization and Detailed Design for Upgrading Java-Bali Control Center

Indonesia
March 2021

Procurement for Services

I. Background

Southeast Asia's impressive economic growth has created enormous opportunities and challenges. People in the region have benefitted from raised income and substantial poverty reduction, but they have also been exposed to increasingly higher levels of air pollution and hazardous emissions mainly due to the use of fossil fuels. In fact, the remarkable GDP growth in the last couple of decades has been largely fuelled by fossil energy sources, leading Southeast Asian countries to lead the global growth rate for CO_2 emissions per capita.

Energy demand is forecasted to grow by an average of 5% per year until 2035 across the region, which provides an opportunity to transition the economy to clean energy resources. The alternative is business as usual (BAU), fossil fuel-based power generation, which will undeniably lead to higher levels of carbon emissions, a consequent worsening of the climate emergency, health, well-being, and productivity of people in the region.

The next few years will be a critical window for reducing carbon emissions and delivering on the Paris Agreement. The latest Intergovernmental Panel on Climate Change (IPCC) report emphasizes that the GHG emissions need to reduce by half by 2030 if global warming is to be limited to safe levels by 2050 and Southeast Asia is critical to the success of the international community to achieve this objective.

An energy transition driven by renewable energy (RE), energy efficiency (EE) and sustainable infrastructures would allow countries in the Southeast Asian region sustain their economic growth, while ensuring environmental sustainability and energy security. Renewable energy sources have become very competitive and together with energy efficiency, they provide new opportunities for investment, growth and jobs while leading to environmental sustainability and safer climate.

The ETP is a unique new platform that brings together government donors, philanthropies and Southeast Asian (SEA) governments to fund (1) support an improved delivery environment to accelerate the energy transition in Southeast Asia, (2) improve coordination between other relevant initiatives in the region, including capital investments and technical assistance, and (3) promote communication and knowledge sharing among stakeholders in the region on energy transition. The Partnership is set up for an initial period of five years from 2020 to 2025 and works initially with Indonesia, the Philippines and Viet Nam, with a potential to expand to other Southeast Asian countries.

ETP's strategic objective to accelerate energy transition in Southeast Asia is predicated on the region's rapid growth and large populations that drive energy demand, which is expected to double by 2035. To abate damage to the human and natural capital of the region and to the world through greenhouse gas (GHG) emissions and the consequences of

climate warming, there is a tremendous opportunity to supply this demand with renewable energy and to forge rapid energy transition. With the initial countries of intervention, Indonesia, the Philippines and Viet Nam, having committed to energy transition through their climate commitments, they are implementing significant change through policies, regulations and programs to extend renewable energy and energy efficiency. ETP's theory of change rests on four pillars of

1. Strengthening the renewable energy (RE) and energy efficiency policies (EE) enabling environment by enhancing the institutional planning and implementing capacities and improving RE and EE policies, regulations and Laws;

2. Increasing public and private investments flow in EE/RE by supporting improvement of policies, regulations and laws encouraging investments such as fiscal and financial policies and increasing availability of project finance, de-risking instruments and bankable projects.

3. Increasing the amount of RE integrated in smarter grids by providing technical knowledge and expertise for grid planning and operation and by increasing availability of investments for grid upgrades.

4. Strengthening human capital, knowledge and public awareness by fostering RE/EE knowledge that is accessible to relevant stakeholders and to the public supporting the development of a strong local workforce to enact the energy transition

To make a significant difference, ETP has assessed barriers to energy transition in Indonesia. Among these, the capacity of the transmission and distribution grid network, dispatching technology, control technology for optimizing and integrating renewable energy into consumption is a critical impediment. Grid network is a prerequisite for feeding electricity to the consumption. PT Perusahaan Listrik Negara (PLN) is an Indonesian government-owned corporation responsible for electricity generation, transmission and distribution in Indonesia. PLN generates the majority of more than 80% of the country's electrical power, 70% concentrated on the Java-Bali grid of the total electricity production capacity of 53,920 megawatt (MW) and electricity production of 245.52 terawatt hours (TWh, 2019) servicing 69.6 million consumers.

The current grid control system for the Java-Bali has reached end of life, and will no longer be supported by the vendor (Siemens Spectrum 4) beyond 2021. Further delay in its replacement will compromise system availability and network security. PLN also seeks to support Indonesia's commitment to reduce the environmental impact of electricity provision and implement significant additional renewable energy in the energy mix increasing its current share from 12% to 23% by 2025.

Thus, a conventional replacement of the grid control systems in line with the existing system would not allow for adequate or safe expansion of renewable electricity generation and the supporting transmission system due to insufficient data management processing capabilities and controls. Operating the power system with increasing and flexible

participation of renewables requires new features and functionalities that currently are not available in the existing SCADA system and cannot be incorporated modularly.

The required replacement presents the opportunity to modernize the Java-Bali grid control system in support of extensive renewable electricity expansion. Indonesia ratified its commitment to the Paris Agreement through law No. 16/2016. As part of the mitigation action, Indonesia will increase its renewable energy development in accordance with National Energy Policy and Planning (RUEN). PLN follows the Indonesian Energy Supply Business Plan (RUPTL) defining a 10 year electricity development plan for all its operating areas. The RUPTL includes demand forecasts, expansion plans, electricity production forecasts and fuel requirements among others to determine projects to be developed by PLN and independent power producer (IPPs) investors.

In view of this, PLN will need to modernize its energy control technological structure based on a modern SCADA Energy Management System (EMS) to supervise, monitor, operate and plan its current and future electrical system considering the expected growth in demand and in generation, mostly based on intermittent renewable energies. The detailed design will include a multi-disciplinary analysis required for the planning, design, supervision, integration and commissioning of the main SCADA EMS Control Center (MCC) and Disaster Recovery Control Center (DRC), for both new buildings need to be designed and engineered.

This procurement exercise will contribute to the objectives of ETP to expand smart grids in Indonesia and will:

- Enable PLN to implement its plan to change the primary energy mix via an energy transition that ultimately aims to displace coal and other fossil fuel based generation with clean energy from renewable resources.

- Support Indonesia with its commitments under the Paris Agreement, renewables participation in the electric generation energy mix must increase from 6% to 23% by 2025 and 30% by 2030. Demand is expected to reach 35,000 MW which will be satisfied mostly with generation expansions based on renewable energy.

II. Description of Scope of Work

1. Rationale

Indonesia is the world's 4th most populous country with 267 million people. Its economy is growing rapidly and is forecast to return a growth of 6% in 2022, as the pandemic related slowdown recedes.[1] This implies significant growth in electricity demand, estimated at around 5% per annum. It also generates a significant share of 1.5% of the global greenhouse gas (GHG) emissions, some 40% of which stems from the energy sector. Rapid action to reduce curtailment of the current renewable energy and integration of the planned additional renewable energy supply is critical in arresting the GHG emissions.

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[1] IMF Article IV, 2020.
https://www.imf.org/en/Publications/CR/Issues/2021/03/01/Indonesia-2020-Article-IV-Consultation-Press-Release-Staff-Report-and-Statement-by-the-50131

Despite the impressive economic growth overtime, Indonesia's renewable energy resources account for only 12% (2020) of our total primary energy production supply (TEPS) capacity, well short of the national energy policy target of 23% of capacity by 2025. In Indonesia, the energy sector is regulated and controlled by the State through a set of State-owned power enterprises (SOEs). Perusahaan Listrik Negara (Persero) (PLN) is Indonesia's national power utility that serves over 75.7 million customers, making PLN one of the largest electric utilities in the world by number of customers.[2] PLN is the sole buyer, transmitter and distributor in electricity in Indonesia. The power supply comes from a mix of its own generation, totaling 45,381 MW, and purchases from independent power producers (IPPs), totaling 17,327 MW.

Government policy for RUEN provides that by 2025, 23% of the total national electricity energy will be produced from Renewable Energy (RE) generators. New projects in the near future will add Intermittent Renewable Energy (IRE) such as the Windpark Power Plant (PLTB) in Cirebon (84MW); PLTB Sukabumi (100MW); PLTB Tuban (66MW); PLTB Tegal (67.5MW); and PLTB Lebak (100MW), Solar Power Plant (PLTS) in Cirata (100MWp); PLTS Bekasi (50 MWp); PLTS Subang (50MWp); PLTS Pemalang (50MWp); and PLTS Pasuruan (50MWp).

The operation of the IRE will require changes to the operations and dispatch planning model, advance real time system control, accurate and timely weather forecasts and energy management system (EMS) applications that properly model the IRE. To support the power system frequency and voltage stability, construction of energy storage systems (i.e. Battery Storage Systems - BESS) and interconnections with high voltage direct current (HVDC) will be used to mitigate the intermittent behavior of renewables generation and to store surplus generation used for hours of the day when the energy source is not available (i.e. – during nights for solar). In the existing SCADA/EMS[3] Spectrum Power version 4.6 there are no provisions for the modeling and monitoring of renewable energy, storage systems and high voltage direct current.

Power market is considered by PLN to be the most appropriate transactional model to economically and efficiently to continue meeting the load-generation balance considering the industry trends and the planned changes in the electricity energy matrix. This model is able to provide transparency of information, and an equal playing field for participants in the grid (investors in generation, independent power producers (IPPs), transmission, distribution, customers, and government), while at the same time fulfilling the load regulation objectives regarding security, reliability and economy.

The SCADA/EMS needs to anticipate and have provisions for this new model because the power market system is very dependent on its readiness. Information needs from participants, both from the public and regulators require a SCADA/EMS Master Station that can provide technical and market information by means of an Enterprise Service Bus (ESB) architecture, allowing for a high level of integration between different applications.

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[2] PLN Statement of Intent on Sustainable Financing Framework. 2020.

[3] SCADA stands for Supervisory Control And Data Acquisition Energy Management System. A SCADA system is a common process automation system which is used to gather data from sensors and instruments located at remote sites and to transmit and display this data at a central site for control or monitoring purposes.

1. Scope

The government policy for RUEN and its mandatory compliance from PLN will require increasing by 2025 the renewable generation share to 23% of the total system generation. Projects in execution and planned for the expansion of renewables account for 717.5 MW (417.5 wind, 300 solar). To dispatch this intermittent generation, the existing automatic generation control (AGC), production forecasting tool, intra-hour unit commitment tools among others are not available in the current system and should be available by the end of 2022. The Java-Bali control center monitors generation and transmission of power to the grid for nearly 100 million consumers. The control center makes real time decisions which power generation plans are deployed and when to optimize electricity production to the grid. For the renewables this is extremely important as the input from renewables (solar/wind) varies and the automated system ensures sufficient power while optimizing load considerations to remove risk of (currently) blackouts. The larger the share of IRE, the more nuanced and advanced the control system is needed to enable recognizing weather changes prior to their occurrence. This optimization modernization will enable system stability and grid operators to confidently increase IRE into consumption.

2. Objectives

The detailed design for the Java-Bali Control Center is the core of the Java-Bali grid facilitates the acquisition of a robust modern, reliable and secure supervision and control platform, compliant with international standards and industry best practices, required to operate safely and with high reliability. The grid modernization is critical for enabling integration of the renewables irregular supply to the energy mix and consumption. The current supplier has indicated that 'patching-up' the system components will no longer work. The detailed design will enable acquisition of a system that is fully capable of integrating IRE, while the current system requires curtailing of renewable energy and relates to system interruptions. PLN is planning the system upgrade in tandem with additional investments into the grid, which include training of at least 10,000 staff to enable grid modernization overhaul and use of the new technologies and adding of at least 11.5GWh of rooftop solar panel generation.

The Project will result in detailed engineering designs for two new buildings hosting the Main Control Center (MCC) and Disaster Recovery Center (DRC); the Advanced Control Center system SCADA/EMS and its supporting systems, which will include technical aspects, operational aspects, organizational aspects and other related aspects required to create a more reliable, efficient and economical operation of the Java-Bali electric power system.

3. Scope

The scope of work in this technical assistance includes:

(1) Development of the basic and detailed engineering for the Main Control Center (MCC) and Disaster Recovery Center (DRC) buildings; and

(2) Development of the basic engineering and technical specifications of the SCADA/EMS system for the MCC and DRC.

4. Expected Outcomes

The Project delivers a critical component for modernizing the main Java-Bali grid and enabling renewable energy integration into consumptions, concurrently reducing interruptions to the energy service and curtailment of the variable renewable energy (Graph 1) . In this vein, the Project will:

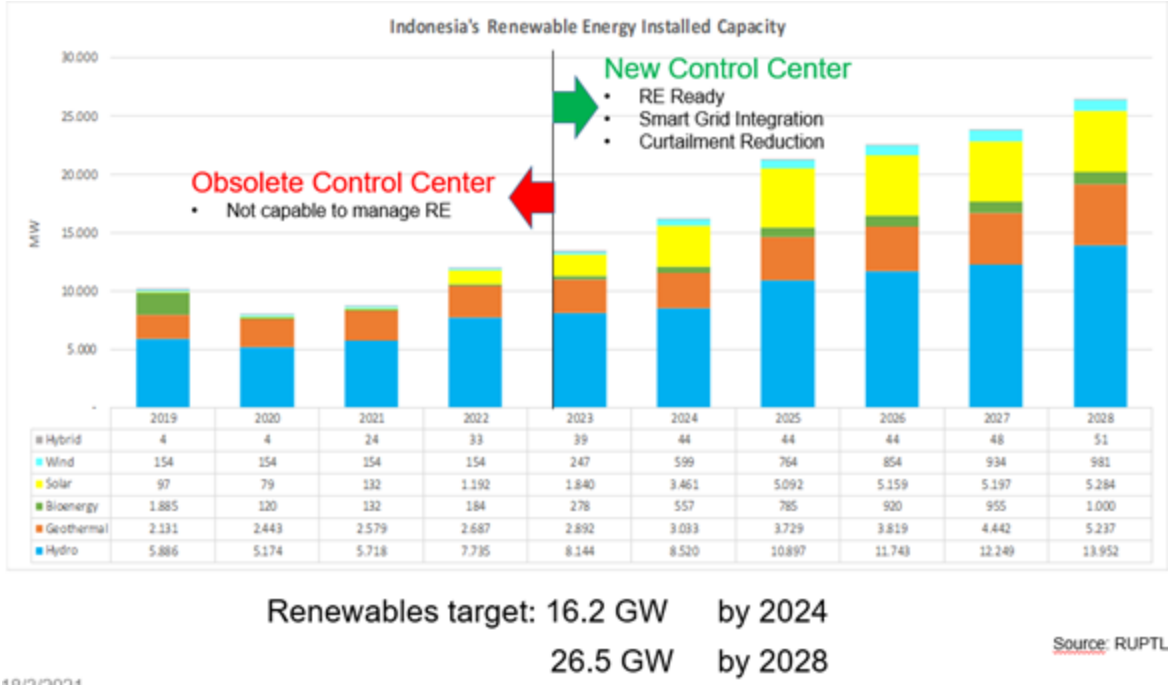
- Strengthen PLN's operations by enabling a detailed engineering design that will advance its operations to first-in-class operation in terms of its ability to optimize integration of irregular renewable energy into the grid and consumption.

- Strengthen PLN's operations by advancing its capacity to reduce outages and interruptions to energy services and reduce curtailment and improve efficiency.

- Foster innovative technologies in the main energy grid that, in turn, enable all other grid modernization investments to deliver their value addition and integration of additional renewable energy currently available and under planned and future investments into the grid.

- Enhance operational efficiency and management of the energy control and demand and supply optimization solutions through the use of advanced technology to reduce peak energy consumption thus reducing the need for execution of the coal-fired power generation pipeline and paving way for coal-phase out discussions.

Graph 1. New Control Center Capacity to Integrate Renewable Energy to Java-Bali Grid



	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Hybrid	4	4	24	33	39	44	44	44	48	51
Wind	154	154	154	154	247	599	764	854	934	981
Solar	97	79	132	1.192	1.840	3.461	5.092	5.159	5.197	5.284
Bioenergy	1.885	120	132	184	278	557	785	920	955	1.000
Geothermal	2.131	2.443	2.579	2.687	2.892	3.033	3.729	3.819	4.442	5.237
Hydro	5.886	5.174	5.718	7.735	8.144	8.520	10.897	11.743	12.249	13.952

5. Description of Specific Activities

All activities below shall be conducted in close coordination with and based on instructions of PLN and the ETP Secretariat and involve:

- evaluation of technologies,
- proposing of the best SCADA/EMS systems and solutions for the project
- preparation of detailed engineering designs, drawings and project related documents for the construction of the infrastructure housing the control system (for MCC and DRC)
- preparation of tender documents
- analysis of key sector trends, organizational and control system inventory, strategic Vision for the New Control Center, financial planning, preliminary environmental impact assessment, operations reorganization plan, implementation plan, evaluation criteria. preparation of tender documents, preparation of budget plan, and assistance in the tender process.
- weekly meetings, task reports and deliverables in accordance with the terms of reference, monthly progress reports and accumulative progress and obstacles encountered, and final report.

The terms of reference for the project are in Annex 1, together with timeline and budget estimates.

6. Timeline:

Key Deliverables	
Detailed plan with milestones, technology review and output and results framework	1 month
MCC and DRC building planning consulting services	5 months
Advanced Master SCADA/EMS Planning Consulting Services	20 months

7. Budget:

The preliminary project cost estimate is $2.5 million, inclusive of the contingencies and training on the new technology. Table 1 provides a breakdown of the estimated cost.

Table 1. Breakdown of cost estimates for the Detailed Design of the Java-Bali Control Center Upgrade

Consultancy Budgetary Estimates

		Cost USD	Estimated Hours		Average USD/sq.m
1 MCC and DRC Buildings Consultant Services					
1.1 Architectural	$	590,753.61	2954	$	118.43
1.2 Structure	$	295,376.81	1477	$	59.22
1.3 Mechanical and Electricity	$	295,376.81	1477	$	59.22
	$	**1,181,507.23**	**5908**	**$**	**236.87**
2 SCADA/EMS Consultant Services					
2.1 SCADA/EMS	$	600,000.00	3000		
2.4 Control Room	$	100,000.00	500		
2.2 Data Center	$	90,000.00	450		
2.3 Communications	$	84,000.00	420		
	$	**874,000.00**	**4370**		
3 Preliminary Studies (Technologies,Market..)	**$**	**120,000.00**	**600**		
4 Preparation of Tender documents	**$**	**70,000.00**	**350**		
5 Training (forecasting, optimization, new technologies)	**$**	**250,000.00**	**1250**		
Total Consulting Estimates (w/o VAT)	**$**	**2,495,507.23**	**12478**		
		10%			

8. Procurement Process:

    1. Requirement Definition / Sourcing (*ca. 14 calendar days*):
        a. ETP Steering Committee reviews and clears Draft TOR
        b. Partner (PLN) conducts Request for Information (RFI) process with UNOPS as observer - independent process and already ongoing
        c. Results of RFI will determine whether UNOPS will conduct an open or limited Request for Proposals (RFP) process - a limited RFP process would only include entities identified by the PLN RFI process, requires confidence that it includes enough entities that can submit compliant bids and requires internal UNOPS approval
    2. Solicitation (*ca. 14 calendar days review / tender set-up; 21 calendar days for advertisement*):
        a. UNOPS IPMG reviews and certifies infrastructure designs and technical specifications; this step will include energy infrastructure experts
        b. UNOPS publishes solicitation documents - either in open or limited call - on the UN Global MarketPlace (UNGM) and through other sources and media
        c. UNOPS manages any RFP clarifications and amendments
    3. Evaluation (ca. 5 calendar days)
        a. Evaluation team assembled and approved - this will include energy infrastructure experts
        b. Evaluation conducted, recommendation made
    4. Award and Contract Issuance (ca. 10 calendar days)
        a. UNOPS Contracts Committee approves recommendation

b. Contract issued
c. Contract posted on UNGM (for transparency)

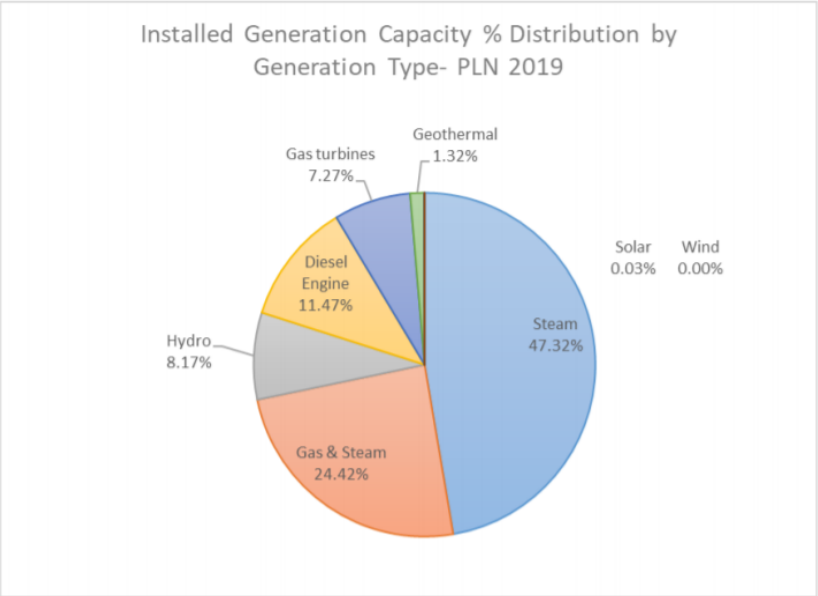
Description of the Java-Bali Grid and Control System

The largest electricity system in Southeast Asia: PLN is the largest electricity provider in Indonesia, a country that represents the largest electrical energy demand in the ASEAN countries[4] with a participation over 36% of the total energy consumption, representing 66% more usage than the second largest electrical energy consumer country in the region (Thailand). The country percentage of electrification in 2019 was 95.75%, representing a substantial increase from 2015 figure of 86.2%.

Demand: Inter-annual demand growth for the year was 4.65% based on the amount of invoiced energy. The average cost of electricity was 0.081 US$/KWhr. The total peak demand for the 2019 was 41.67 MW and the total reported electrical energy generation[5] represented 269 terawatt hours (TWh), being the total billed energy 245.5TWh. The above represents 9.6% losses (technical and non-technical). The total number of customers served was 75.7 million. PLN's Load Factor in 2019 was 76.41%, its Capacity Factor 50.68% and the Demand Factor of 37.7%.[6]

Generation: PLN has a total installed energy supply capacity of 43.856MW, which belongs to PLN, with a peak availability of 84%. To satisfy the demand, independent power producers (IPPs) contribute with an installed capacity of 20.066MW to a grand total of 58.506MW in Indonesia. PLN's generation fleet is mostly fossil fueled – accounting for 90 % of the installed capacity, hydropower amounts to 8.17%, with the rest of the capacity relating to other technologies, including renewable energy supply. This can be reviewed graphically in Figure 1.

Figure 1. Indonesian electricity generation by source fuel, 2019.



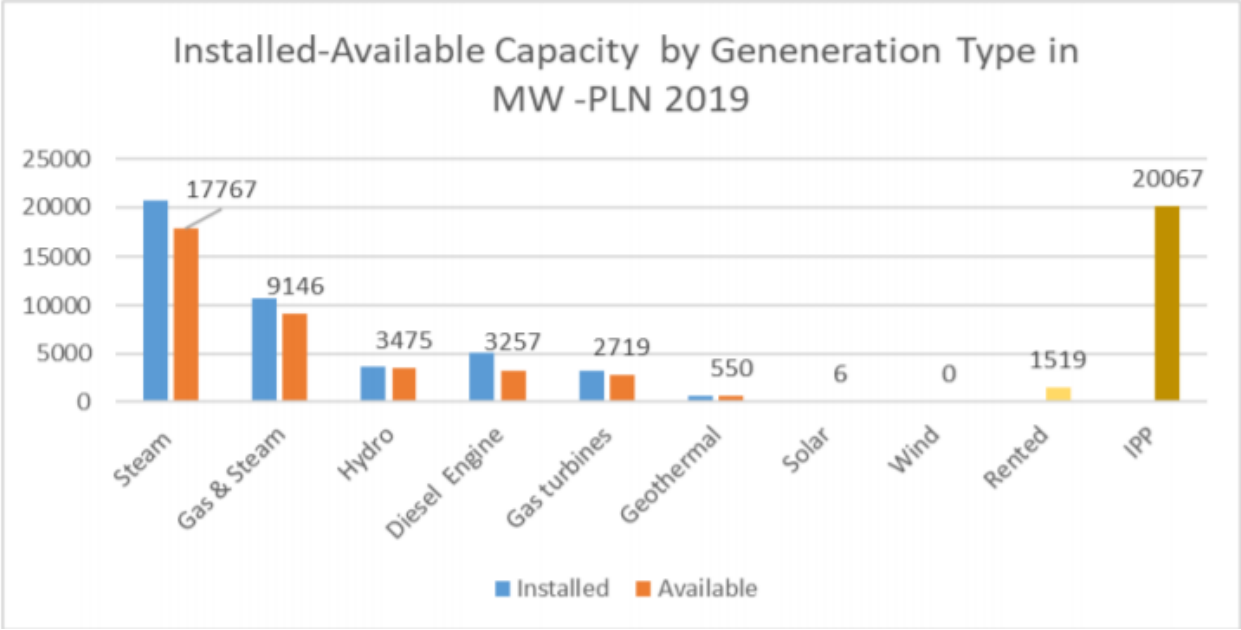
The total system available capacity including PLN, IPPs and rented generation is shown in figure 2.

[4] ASEAN: Association of South-east Asian Nations - Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand and Viet Nam

[5] Net generation (total generation – plant ancillary services)

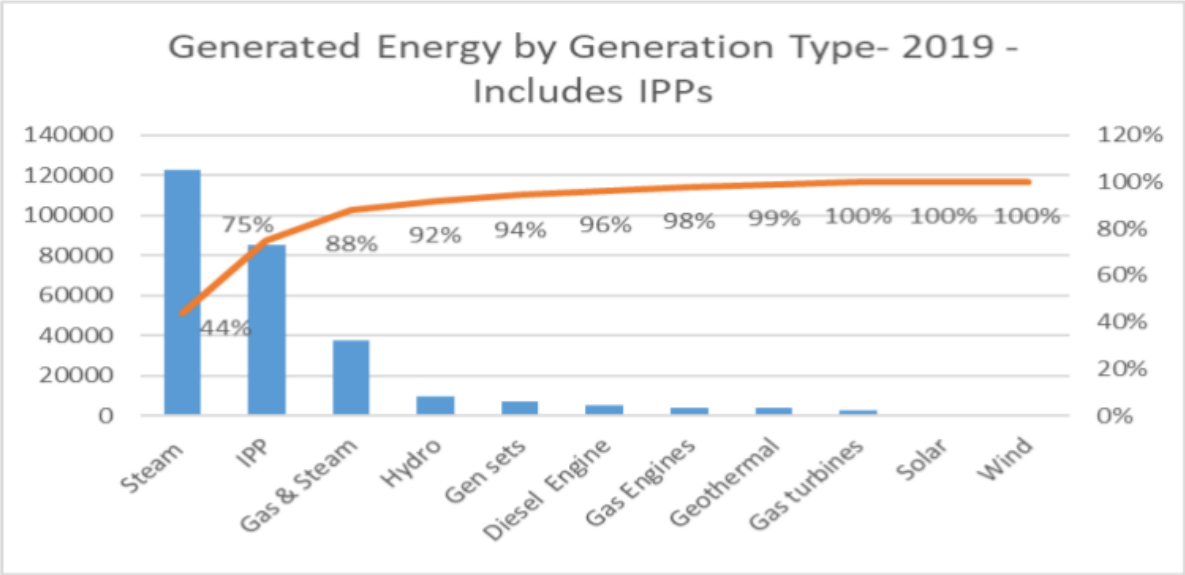
[6] Load factor: average demand/peak demand; Capacity factor: actual generation/generation at 100% capacity usage; demand factor: maximum demand/connected load.

Figure 2. Total System Available Capacity: PLN, IPPs and Rented Capacity, 2019.



In terms of energy production by plant type, steam, IPPs and gas-steam power units' account for 88% of the total produced energy. Hydro's contribute an additional 4%, the rest of the technologies all together contribute 8%. IPPs total contribution in terms of energy production represents 31% and in terms of installed capacity and 34% of the available total country's generation capacity. This can be better analyzed in **Figure 3.**

Figure 3. Generated Energy by Generation Type, includes IPPs, 2019.



There are a total of 435 generator units in Java and 6,233 generation units country-wide, of which 5,091 are small diesel engine generators. A total of 54 projects, representing 1,025 MW are ongoing. From this,a solar farm of 2.21 MW is reported as under construction. **Table 1** presents the number of generator units and its available capacity.

Table 1. Number of Generator Units by Source Fuel, 2019.

Number of Generator Units	Hydro	Steam	Gas turbines	Gas & Steam	Geothermal	Diesel Engine	Gas Engines	Solar	Wind	BioMass	Gen sets (rented)	IPP	Total
Java	99	42	25	59	7	105	3				11	84	435
Outside Java	144	74	43	13	11	5091	122	89	5		371	270	6233
Projects in execution		17		1			29	7					54
Capacity in MW													
Java	2421	15830	1962	9314	377	460	3	0	0	0	21	9785	40175
Outside Java	1163	4372	1226	1038	203	3232	1217	12	0	1	1819	7351	21633
Projects in execution		549		357			117	2	0				1025

Fuel use in electricity generation: Fossil fuels (including biofuels) account for the majority of the energy production representing 88% of the total. Coal represents 62%, natural gas accounts for 22% and the rest of the fossil fuel are 4%. Only 12% of the energy production corresponds to other fuels, including hydro, geothermal, solar and wind. **Figure 4** shows the energy generation distribution in percentage by fuel type, while **Figure 5** shows the total generated energy by fuel type and the accumulated generation in percentage in a Pareto accumulated percentage of total generation. For the year, 84% of the energy generation was produced using carbon and natural gas.

Figure 4. Energy Generation Distribution by Fuel Type, 2019.

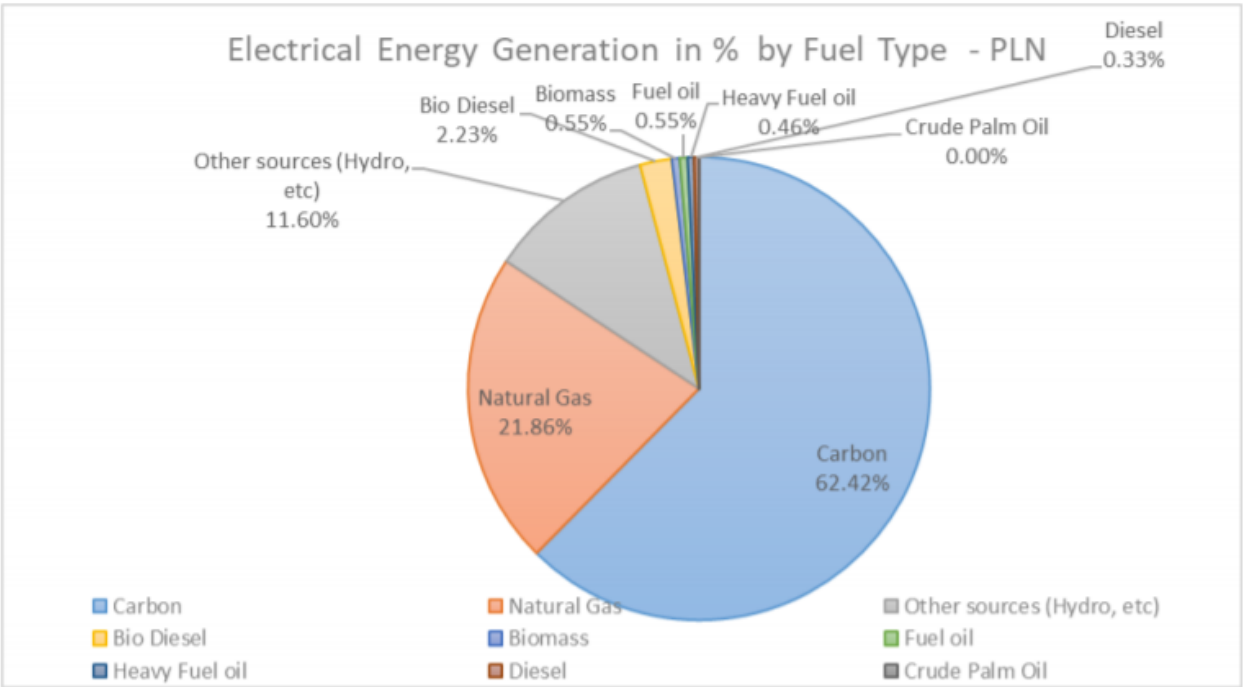
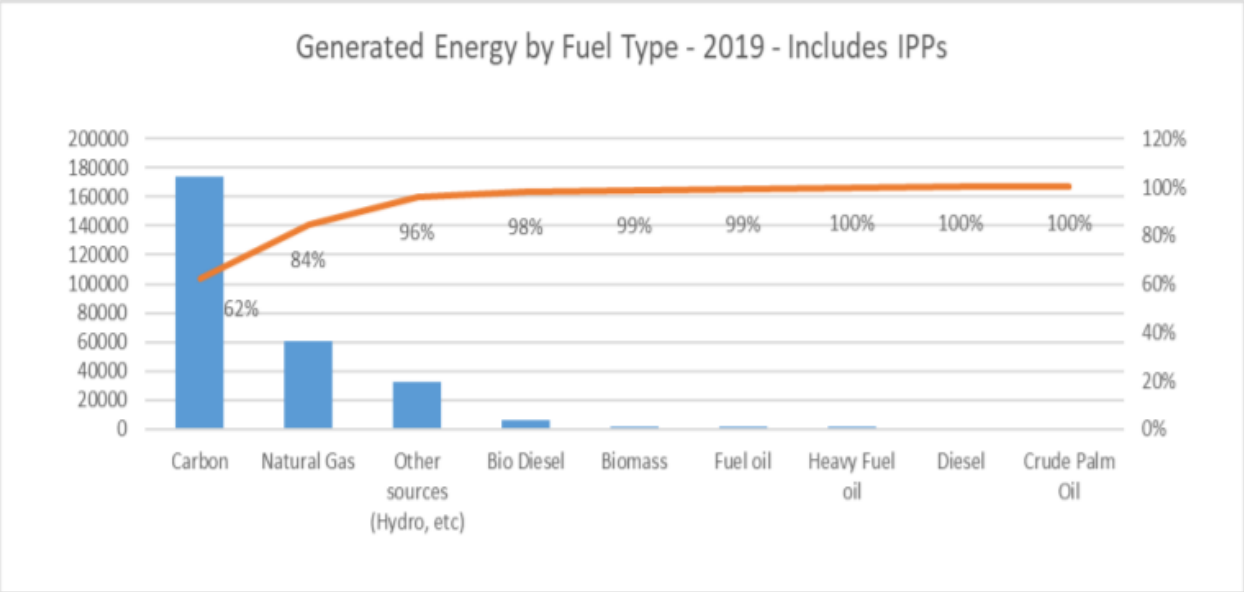


Figure 5. Total Generated Energy by Fuel Type, 2019.



Transmission Systems: To deliver the generated power a vast transmission network is deployed in Java island and in the rest of the country. Java has a 500 kV as a backbone for interconnections within the island, which allows transfer of the electricity generation from remote locations to the major load centers. A network of 150 KV along with 70kV power lines perform regional transmission and sub-transmission function to feed the electricity loads to distribution substations and the reliability of the networks is enhanced through meshed connections. Outside of Java island, the transmission level is 275kV comprising regional transmission and sub-transmission in similar voltages as in Java (150 and 70 kV). **Table 2** shows the total length in Km of transmission lines per KV level. Data is split into Java and the rest of the country. Km of Power Lines 500KV 275KV 150 KV 70KV 25-30KV Java and Outside of Java.

Table 2. Transmission Lines by kv, 2019.

Transmission Lines Kilometers					
Km of Power Lines	500KV	275KV	150 KV	70KV	25-30KV
Java	5250		15503	2996	97
Outside Java	0	3648	29061	2401	4
Indonesia totals:	5250	3648	44564	5397	101

PLN Power Transformer Inventory and MVA capacity				
High Voltage Level (KV)	**Units-Java**	**Units-Rest of Ind.**	**MVA-Java**	**MVA-Rest of Ind.**
500	75	0	36348	0
275	0	37	0	9748
150	1076	672	63597	28786
70	128	133	3151	2748
<30	0	2	0	30

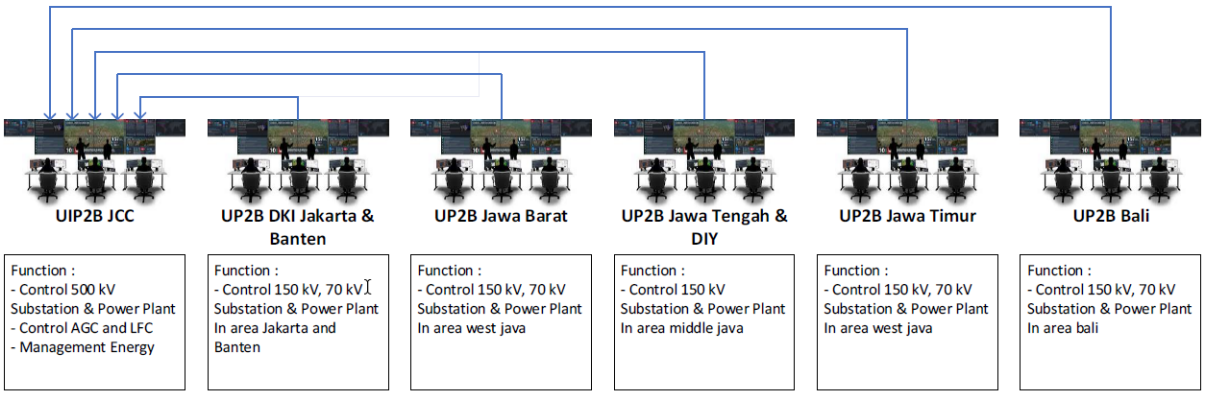
The Java-Bali electrical network serves an area of 134 square kilometers with a population of 155 million, spread over 5 provinces (4 in Java and 1 in Bali) and two special regions. To serve the electricity requirements 4 geographical services areas are defined. All areas are interconnected with an extra-high voltage network of 500 kV integrated by 5,250 Km of transmission lines disposed in a meshed network with several radial lines to supply a peak demand of 26.657 MW[7] and an energy of 269,022.39 GWhr. The total of step-up and step-down transformers in 500kV is 75 representing 36,348 MVA of power conversion capacity.

For regional transmission and sub-transmission, a complex network of 150kV and 70 kV with transmission lines totalizing 18,466 Km is required and a total of 672 power transformers with an aggregated capacity of 63,597 of capacity allow feeding load into distribution voltage levels from where electrical power is delivered to the final consumers.

To monitor and control this geographically scattered and complex equipment layout PLN relies on 6 separate control rooms; one performing as the higher hierarchy control facility which monitors the 500 kV power network and executes the secondary power regulation (Automatic Generation Control (AGC)). The other five perform regional supervision of the power transmission carried out by 150kV and 70kV networks.

The technological infrastructure supporting these control centers is a Sinaut Spectrum V4.4 provided by Siemens that went alive in 2005 that was updated for the last time in 2008 to a V6.4 version. This is a distributed system using a proprietary multi site communication scheme with a centralized database in the main facility (JCC) and one operational/real time database in each of the control rooms. Each system supports standard remote terminal units (RTU), as shown in Figure 6, communications protocols and some proprietary (discontinued) protocols. Also ICCP (inter-control center protocol) is available and working as part of the supervisory control and monitoring platform.

Figure 6. Central Java-Bali Control System with Remote Terminal Unit Control Units.



The total of data points currently monitored amounts near 190,000, which are periodically collected in 661 Remote Terminal Units, including 18,300 controllable points, 38,000 analog values, 132,000 status points, 250 set point commands, 685 tap position readings and 30 accumulator points conform the population of monitored and controlled points. Besides the SCADA point monitoring functions the platform has a historian, event recorder, communication controls supervision and alarming subsystems; all interfaced through workstation consoles, where substations one lines and overview displays present to the operator's information relevant for the control of the network.

In addition, the main control room has generation management functions (AGC) and security real time analysis functions (state estimator, bus scheduler, network status processor). For operator's

[7] Year 2019

studies a set of parallel study move applications are available being the most important the Dispatcher's load flow. For training purposes an Operator Training Simulator is available.

Until 2016, the existing system served all of PLN supervision and control needs, but hardware technological obsolescence, EOL (End of Live) of all software components, limited availability of spare parts from aftermarket, vendors discontinued support security gaps and non-compliance with NERC CIP policies and the unavailability to increase the data bases to allow the modeling and monitoring of new equipment determined the need for a full replacement of the platform considering into the new design al alternate supervision scheme.

From PLN power systems operation experiences with the existing system, the new conceptual design of the replacement control center facilities is based on one main site (MCC) and a disaster recovery control center (DRC), both located in separated and dedicated buildings with mission critical design that will replace the 6 existing control rooms.