



Forecasting of Using Electricity Consumption at ITERA (Institut Teknologi Sumatera) until 2025, to Improve Application of Renewable Energy in Lampung Province

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Abstract Institut Teknologi Sumatera (ITERA) is a new campus located in Lampung province- Indonesia. It is almost 6 years old, within large data on the total population human activity in this 275-hectare campus around 9500 persons, so that necessary to forecasting energy demand in the future, ITERA can project programs that are in line with the Indonesian government, specifically increasing using of renewable energy. which the government has a national energy policy in 2025 of 23%. Mostly in Lampung province, the electricity produced is still dominated by fossil energy (e.g., coal, diesel, etc), therefore as a campus with a technological background, ITERA must be able to bring a paradigm shift to be used from electricity consumption in the surrounding areas. The results of this study will project electricity usage in ITERA over the next 5 year, where electricity usage in ITERA 2019 is 2.472 GWh or 6,775 KWh/day, expected with a development strategy to implementing the efficiency of green energy, so that can meet the challenges of reducing CO2 emissions and energy-saving behavior, also keep sustainable impact for Indonesia.

Keyword:

ITERA, forecasting, electricity, strategy, renewable energy

1. Introduction

Institut Teknologi Sumatera (ITERA) was established through by Presidential Regulation No. 124 of 2014, with the mandate: *"to provide academic education and be able to organize vocational education in a number of certain scientific and / or technological clusters, and if it meets the requirements of ITERA, it can organize professional education in accordance with statutory provisions"*. Based on Strategic Planning by ITERA, have high hopes in advancing, developing, and disseminating science, technology, art, and humanity to improve the health of the Sumatran population with the motto of being smart, friendly, and a forest campus. We are open to all elements of society who want to actively

participate in sharing ITERA's vision and mission, as well as the electricity consumption is grown higher by the number of population in ITERA also.



Figure 1. Appearance one of ITERA Buildings

ITERA which is located in Lampung province, to be precise in South Lampung district. It has a lot of renewable energy potential that can be exploited, this is in line with the government's *"itera for Sumatra"* program and sustainable development goals (SDGs) with examples of reducing inequality, handling affordable clean energy, driving the economy to grow, and being able to deal with climate change[1]. PT. PLN as the largest electricity service provider company in Indonesia has an Electricity Supply Business Plan (RUPTL) for 2019-2028 which states that the potential of Lampung province from renewable energy is 9,612 MW with resources of potency that can be seen in the picture below.

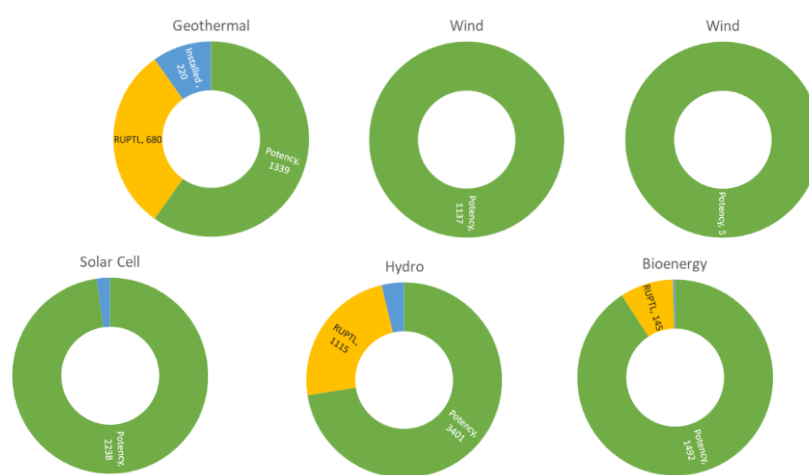


Figure 2. Potential of Renewable Energy in Lampung Province

2. Strategy Implemented

2.1 Efficiency Energy

Energy saving actions in government regulator parallel with ITERA program for reduce the electricity consumption in this campus, towards will be supervised by the building management system, with concept green campus, building at ITERA have a good illuminated for an energy-saving lamp, good ventilation and minimize air conditioning usage. So, it can

reduce the consumption of electricity. In line with the explanation about potential renewable energy in above paragraph, we have studies related to the use of renewable energy[2][3][4], one of is utilization of solarcell, not to overly burden the electricity bill and we can make research or innovation developed by lecturers and students from that. When the solar cell power plant (distributed generation) can joined to PT.PLN connection, except reduce of pay bills monthly, it also helps develop renewable energy potential, especially in ITERA.

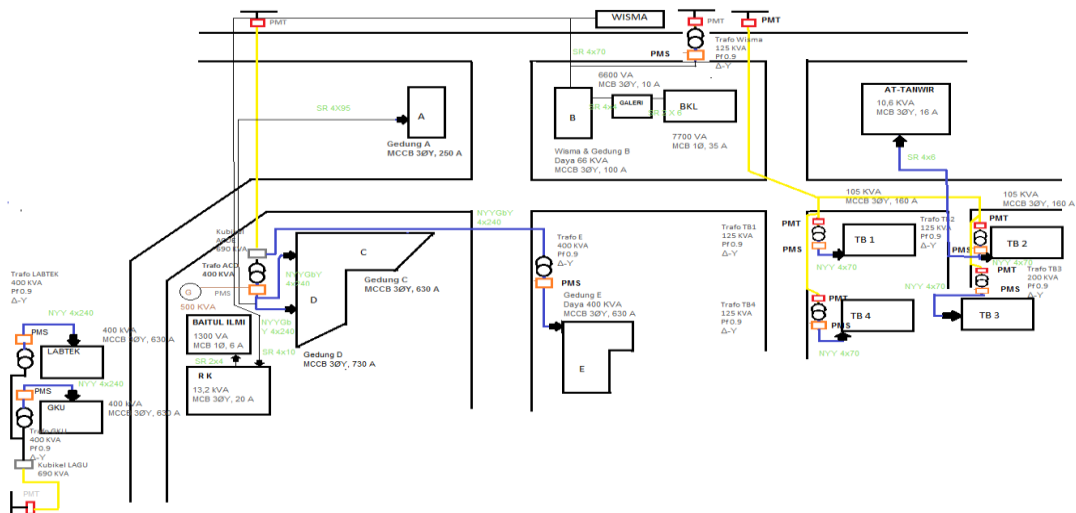


Figure 3. Electricity Connection at ITERA

Currently ITERA has a total installed power electricity of 1,965.7 MW with an average bill of IDR 350,000,000 / month. Seeing the location of itera area of 275 hectares, and the high potential for solar cells. It is necessary to use existing buildings in ITERA to be developed into PLTS. So that ITERA is able to reduce bill costs and meet the increasing power requirements from year to year.

ITERA is included in the distribution network consumers in the PT. PLN Lampung area, so that it can implement a solar cell power system that is connected to the network as described in previous studies[5][6]. There are many benefits in using this concept:

- Investment for long term and maintenance costs are greatly reduced because there is no need for a battery,
- When the power from solar cell power is greater than the load (electricity own usage), the excess power can be distributed/sold to the electricity grid. So, our electricity bill can be reduced,
- More environmentally friendly because it there's no battery waste that requires special treatment and is less friendly to the environment,
- Network reduction (transmission and distribution) energy.

2.2 CO2 Emission

Indonesia's annual greenhouse gas emissions were 2.4 billion tonnes of CO2 equivalent (GtCO2e) in 2015, or equivalent 9.2 tonnes of CO2e / capita[7]. Indonesia's emissions represented 4.8% of the world's total global emissions for that year. The average for other countries such as China are 9.0 tons CO2e / capita, England are 7.7 tons CO2e / capita, and the European Union are 8.1 tons CO2e / capita. However, it should be noted that Indonesia's total emissions vary widely from year to year, mostly as a result of forest fires.

Figure 3 below taken from the biennial report from Indonesia's last Ministry of Environment and Forestry to the United Nations Framework Convention on Climate Change (UNFCCC)[8], provides an overview of how Indonesia's peatland fires can transform overall emissions. Indonesia's climate commitment targets emission reduction of 29-41% by 2030, This commitment was presented to the UNFCCC ahead of the climate conference in Paris (Paris Agreement). Indonesia ratified the Paris Agreement in 2016, with the aim of decarbonizing the economy through the following stages:

- Implement policies or regulatory for improved land use and spatial planning,
- energy conservation and development of clean and renewable energy,
- improved waste management.

The existing renewable energy power plants in Indonesia's only about more than 10,151 MW in 2019 with most portion is geothermal power plants[9] within this country had a vast potency of renewable energy around 432 GW such as hydro, solar cell, geothermal, wind, etc. However, the total capacity of renewable energy power plant still increase year by year, in line with the government has pledged to increase the share to 23% of renewable energy by 2025 and 31% by 2050.

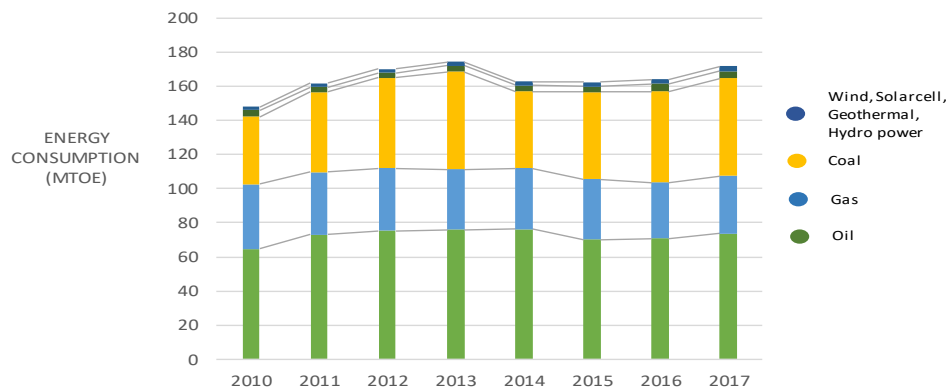


Figure 4. Carbon Brief Energy Consumption Indonesia

3 Forecast Electricity Consumption ITERA

According to the information provided as the new campus from Indonesia, ITERA still increasing the construction of few buildings to support educational activities. The amount of energy needed for each building to be built on ITERA land reaches an average of 250 kVA. Because development planning with a target of 2 buildings/year. So, from this data it can be concluded that ITERA electricity needs are increasing by around 500 kVA every year. When the usage electricity is 6,775 KWh/day or 2.472 GWh/year with assumption of mean by cost of electricity by PLN is IDR 1,075/kWh[10], we can find a solution by using a mathematical model approach for knowing how many electricity ITERA needs. then ITERA electricity forecasting demand in the next 6 years is illustrated in the following table below, which data started from 2015.

Table 1. Forecast Electricity Consumption ITERA

Year	Forecast Peak Load (kVA)	Forecast Customer PLN (MW)	Forecast Bill PLN/Year
2015	305.15	0.34	IDR 3,591,938,081.25
2016	578.75	0.65	IDR 6,812,552,081.25
2017	1,126.15	1.26	IDR 13,256,163,759.38
2018	1,733.65	1.95	IDR 20,407,198,134.38
2019	2,383.67	2.68	IDR 28,058,804,915.63
2020	3,055.97	3.43	IDR 35,972,616,290.63
2021	3,483.02	3.48	IDR 36,444,025,425.00
2022	5,574.62	5.57	IDR 58,329,133,425.00
2023	6,136.56	6.13	IDR 64,208,872,800.00
2024	10,577.68	10.57	IDR 110,677,765,575.00
2025	10,577.68	10.57	IDR 110,677,765,575.00

To meet the needs of electrical energy, this year the use of ITERA has been calculated as 1.97 MW, which is slightly different from the forecast because there are things that are beyond the calculation, such as by pandemic Covid-19 situations. And the ITERA requirement fulfillment ratio can be fulfilled 100% if the forecasting figure for the coming year does not change if the assumed factors, such as price per kVAh, average hours of use per day, and normal utility return. So, we need something strategy for fulfilling aspects and utilization our land for making the renewable energy source like as solar cell.

Like the study that has been described average intensity of sunlight in South Lampung is 5.234 Wh / m². If the efficiency of the solar cells that is installed is a panel with an average of 10% that can capture the total energy exposed to its surface, then for a panel of 1.5 m x 0.6 m, 120 Wattpeak at 5 hours (10.00am-02.00pm) the maximum radiation intensity is 0.105 kWp. If included in the ITERA electricity development plan, in 2020 we need 1 hectares of land for 1 MW back-up fullfill our electricity usage, also through reduing our pay bills to PLN after we built solar cells, and can reduce carbon emissions by using solar cells power clean energy without batteries. In figure below we shown you our next project for implemented the strategy of fullfill our electricity usage.

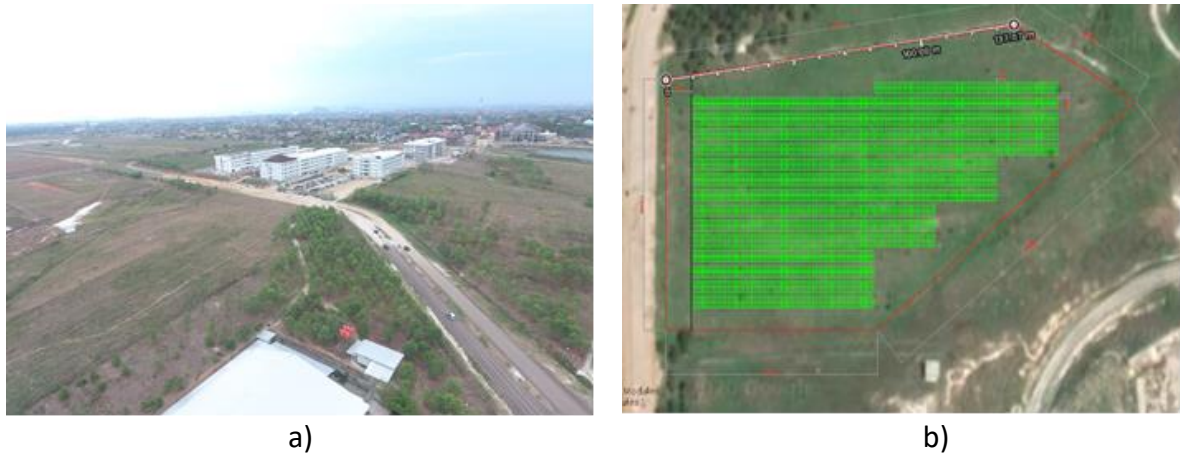


Figure 5. a) Location ITERA Solar Cells Power, b) Layout Plan ITERA Solar Cells Power

4 Summary

ITERA expected with a development strategy to implementing the efficiency of green energy with our building management system and behaviour from our academicians, so that can meet the challenges of reducing CO₂ emissions in next year, within built a solar cell power plant connected to PLN Network for reducing our bill along to fulfilling our electricity consumption. Make use of potency in renewable energy sources not limited in solar cell, next step we will develop another sources for making a sustainable impact in Indonesia especially Lampung Province.

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