IESR

A Roadmap for Indonesia's Power Sector:

How Renewable Energy Can Power Java-Bali and Sumatra

Summary for Policy Makers

in cooperation with:

MONASH University

MONASH ENERGY MATERIALS AND SYSTEMS INSTITUTE (MEMSI)

The Australia-Indonesia Centre

Agora Energiewende

IMPRINT

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Study by:

Monash Grid Innovation Hub/Australia Indonesia Centre
Monash Energy Materials and Systems Institute
Monash University
Wellington Rd, Clayton VIC 3800 | Australia
T: +61 9905 1049
www.monash.edu | memsi@monash.edu

Institute for Essential Services Reform
Jalan Tebet Barat Dalam VIII No. 20 B
Jakarta Selatan 12810 | Indonesia
T: +62 21 2232 3069 | F: +62 21 8317 073
www.iesr.or.id | iesr@iesr.or.id

Agora Energiewende
Anna-Louisa-Karsch-Straße 2
10178 Berlin | Germany
T: +49 30 700 14 35-000 | F: +49 30 700 14 35-129
www.agora-energiewende.org | info@agora-energiewende.de

Study team:

Dr. Ariel Liebman - Monash Grid Innovation Hub
Warwick Forster - Apogee Energy
Mentari Pujantoro and Philipp Godron - Agora Energiewende
Fabby Tumiwa, Jannata Giwangkara, and
Agus Tampubolon - Institute for Essential Services Reform

The summary for policy makers was written by:

Fabby Tumiwa, Institute for Essential Services Reform
Mentari Pujantoro and Philipp Godron, Agora Energiewende

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Foreword

Dear reader,

Indonesia is the world's 4th most populous country on a continuous growth trajectory. To supply the increasing electricity demand, the government is emphasizing the role of fossil, and, in particular coal-fired generation, which is supposed to grow to 65% of total generation. At the same time, it stipulates that by 2025, Renewable energy shall make up 23% of primary energy mix, up from 8% today. Policy focus is on hydro and geothermal resources, while solar and wind power play only a negligible role.

Globally, the trend is very different: power systems around the world are increasingly being shaped by renewables. Solar and wind – driven by significant technology cost reduction - have been at the forefront of power sector investment for years and will continue to play the decisive role in modernizing and decarbonizing power systems globally.

Against this background, we conducted a model-based powers system analysis, performed with the PLEXOS model which is widely used for power sector analysis. The study focuses on the Java-Bali and Sumatra systems, which is where the majority of the population lives and about 90% of the electricity is produced and consumed. The model assesses both the demand and supply dimensions of the power system.

Looking ten years ahead, we have assessed different pathways for the Indonesia's power system: what are the impacts of a moderate electricity demand growth on investment and power plant utilisation? What is the impact of adding considerable shares of wind and solar capacity to system cost, and how will the system ensure security of supply?

Fabby Tumiwa

Executive Director

IESR | A Roadmap for Indonesia's Power Sector:
How Renewable Energy Can Power Java-Bali and Sumatra

Executive Summary

A Roadmap for Indonesia's power sector: how renewable energy can power Java-Bali and Sumatra summary for policy makers was produced by Monash University's Grid Innovation Hub partnering with the Australia Indonesia Centre, supported by Agora Energiewende and the Institute for Essential Services Reform (IESR). The study modelled different pathways for Indonesia's power system to reliably meet energy and climate targets for the period 2018 to 2027. The study focuses on Java-Bali and Sumatra where the majority of the population lives and about 90% of the electricity is consumed. The model assesses both the demand and supply dimensions of the power system.

Analysis was performed with the PLEXOS power system simulation and planning software system, which is widely used internationally for power sector analysis. The study identifies the impact of reduced demand on generation investment, utilisation and power system cost and assesses the impact of adding considerable shares of wind and solar capacity to the system.

Key Findings

- **The Ministry of Energy and Mineral Resources and utility PLN have continuously overestimated energy demand in Java-Bali and Sumatra.** If PLN continues with its current plans, there is likely to be an overbuild of 12.5GW of coal, gas and diesel, resulting in approximately US$12.7 billion in wasted investment. This would burden PLN's finances and eventually have to be covered by the Indonesian public.
- **The risk of lower than planned utilisation of thermal power plants may increase as demand projections are overestimated and as renewables become cheaper.** Once renewables are built, they produce electricity at almost zero marginal cost. This could result in additional losses for PLN, which is locked into long-term power purchase agreements with Independent Power Producers.
- **Java-Bali and Sumatra could reliably meet growing electricity demand in the next 10 years through a doubling of the share of renewable energy.** The cost of doubling the share of renewables through investment in wind and solar is comparable to the current high fossil-fuel pathway. Greenhouse gas emissions would be reduced by 36%. The development of renewables would bring important additional co-benefits, reduce negative health and environmental impacts and provide job opportunities throughout the country.
- **A high renewables scenario coupled with realistic energy savings would result in a cost saving of US$10 billion over ten years as compared with the current RUPTL plan** if the cost of capital and cost of technology is brought down in line with international prices. This would require an ambitious long-term strategic plan, clear intermediate targets and implementing regulations in place.
- **Even with 43% renewables, the security of supply of the power system is maintained.**

Recommendations

To develop a reliable, cost-effective energy system which avoids wasted capital and serious environmental impacts, MEMR and PLN should:

- Review best practice approaches and techniques in demand forecasting around the world and implement such an approach in

Indonesia;

- Integrate the potential of energy efficiency for forecasting future electricity demand;
- Review current proposals for new coal-fired power stations in the Java-Bali and Sumatra systems and apply current prevailing costs for renewable technology in developing future plans to asses alternative cost-effective and low carbon pathways;
- Develop and assess alternative scenarios and low carbon electricity pathways in the National Electricity Plan (RUKN) which integrate medium and higher renewable energy penetration in various electricity systems; and
- Adopt an ambitious long-term strategic plan with clear intermediate targets for renewable energy expansion, supporting policies and streamlined implementation at national, provincial and local levels.

photo: PLTB Sidrap / Biro Pers Istana

Introduction

Indonesia has seen strong growth in GDP as well as in electricity demand in the past decade. The government is expecting continuous growth, with electricity demand projected to double by 2030 (RUKN, 2016). To supply the increasing demand, the government is emphasizing the role of coal-fired power, which is supposed to grow to 65% of total generation. At the same time, it stipulates by 2025, renewable energy shall make up 23% of generation, up from 8% today (RUEN, 2017 and RUKN, 2016).

Each year, Perusahaan Listrik Negara (PLN), the state-owned electricity utility, publishes an Electricity General Plan (Rencana Umum Penyediaan Tenaga Listrik or RUPTL), which maps in detail the development of electricity demand and supply for the next 10 years. According to the latest RUPTL (2018 – 2027), the 23% renewables target would be reached by 2025. Due to lack of a longer-term target, however, renewable share would then decrease afterwards. PLN still puts a clear focus on conventional and fossil-fueled generation in the power mix, with only very negligible shares of solar and wind.

Globally, the trend is very different: power systems around the world are increasingly being shaped by renewables. In an effort to modernise power systems, taking advantage of the dramatic drop in prices of solar PV and wind, and looking for a more sustainable power mix, countries and energy companies are strongly investing in these technologies. Since 2015, more investment has gone into renewable energy around the world each year than in conventional fossil fuel generation. India, in 2017, for the first time, invested more in renewables than fossil fuel generation (IEA, World Energy Investment 2018) – simply because electricity from wind and solar has become cheaper than from new gas and coal fired power plants. In addition, renewable energy has the co-benefits of reductions in carbon emissions and air pollution.

Against this background, we conducted a model-based analysis of different pathways for Indonesia's power system. We have focused on the Java-Bali and Sumatra systems, which is where the majority of the population lives and about 90% of the electricity is consumed. By mid-2020, Sumatra and Java will be connected via a submarine cable, thereby integrating the systems of these three large islands.

The model assessed both the demand and supply dimensions of the power system. It took into account the opportunities of the impressive renewable energy technology cost drop in the past decade, particularly on solar and wind energy, assessing alternative pathways to current power mix planning and meeting Indonesia's energy and climate targets while still ensuring the reliability of the power system.

The study used the 2018 RUPTL as a baseline with regard to existing and future generation builds, as well as peak demand and energy growth. Analysis was performed with the Australian PLEXOS model, which is widely used globally for power sector analysis. Input data combined international sources on technology cost with Indonesia-specific knowhow provided by a range of national experts in workshops and bilateral discussions. The power system was modeled for a 10 year time-span, for the period 2018 to 2027, with hourly time steps. It takes into account supply and demand on a provincial level as well as inter-provincial transmission capacity restrictions.

The two main objectives of the study relate to demand development and wind and solar investment in Java, Bali and Sumatra. We:

a. identify the impact of reduced demand on investment, utilisation and power system cost and;
b. assess the impact of adding considerable shares of wind and solar capacity to the system.

The setup and key differentiating parameters of the scenarios assessed are presented in Figure 1.

Demand

Scenario	Demand	Investment
RUPTL	High	Fixed
RUPTL_ Low gen	Moderate	Fixed
RUPTL_ Low cap	Moderate	Optimised

Renewable Energy Share

Scenario	New Capacity Build	Capex and WACC
RUPTL_ Low cap	According to RUPTL	Standard
RE_Medium	Fossil Fuel + Renewables	Standard
RE_High	Renewables*	Standard
Energy Transition	Renewables*	Low

*with OCGT for system reliability

Figure 1 Scenarios and key drivers

The study's main findings are presented below.

Overestimating Demand Growth and Underestimating The Potential of Energy Efficiency Increase The Risk of Stranded Assets

Estimating the energy demand trajectory over longer periods of time is very challenging, in particular in emerging economies that have become used to high growth figures. Governmental projections are often driven by political targets more than by sound evidence, and the potential of more efficient appliances in the industrial sector and building stock (AC, light bulbs, etc.) is often underestimated.

Indonesia is no exception: in its annual Ten-Year Plans, PLN has consistently overestimated electricity demand growth. Typically, demand has been expected to more than double in a 10-year horizon. According to the RUPTL 2008, Java-Bali electricity demand today was expected to have reached 250 TWh by 2017. In reality, it stood at 170 TWh, i.e. about two thirds of the projection.

Even though growth rates have been reduced recently, notably in the 2018 RUPTL (as compared to RUPTL 2017), the growth path for Java-Bali and Sumatra system for the next decade still projects demand values that are 20-50% higher than those to be expected when following the growth trajectory of the past decade. Therefore, in the analysis, we have modeled an alternative growth path more reflective of the pathway of the last decade. This is particularly true for Java-Bali, where demand is already at a higher level, while for Sumatra, a level of growth somewhere between historical trends and RUPTL 2018 projections is assumed (Figure 2).

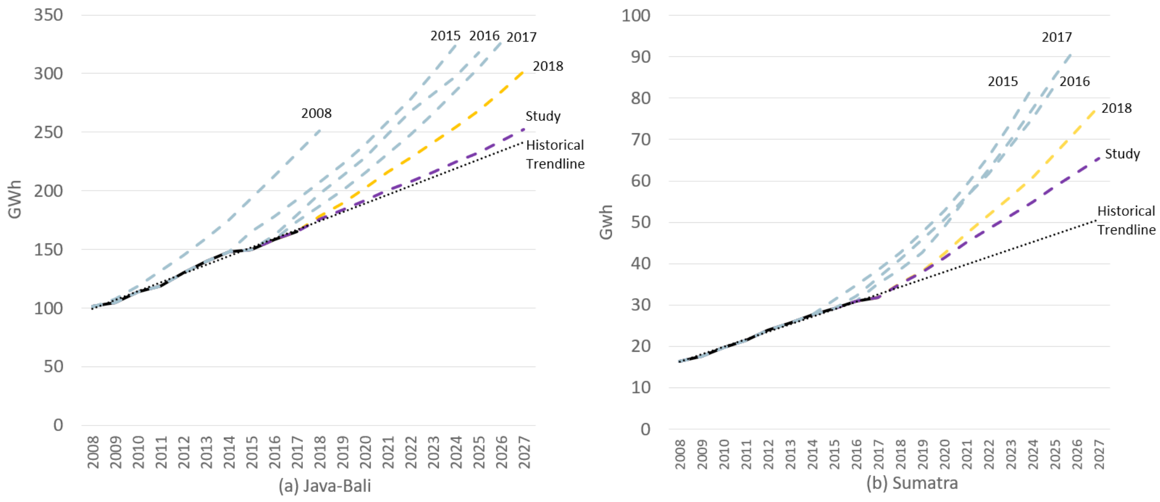

Figure 2 Historical demand and demand projection in Java Bali and Sumatra: a tendency to overestimate the future demand growth

Comparing demand of the RUPTL baseline case with the moderate demand growth scenario reveals the magnitude of difference and impact on the existing and planned power generation fleet. In a scenario where the growth in Java-Bali and Sumatra reflects the growth of the past decade, electricity demand in 2027 would be 16% lower than what is assumed in the 2018 RUPTL. This means from 197 TWh in 2017, demand would increase to 322 TWh in the moderate scenario, rather than to 382 TWh.

The moderate demand growth will imply:

a. There will be considerably fewer power plants needed to meet the demand and;

b. b) if, nevertheless, all the power plants in the RUPTL 2018-2027 were built, power plants would run at lower utilisation rates, putting their business case in question and, effectively, increasing overall system and levelised generation cost.

Reduced demand results in a reduction of additional generation capacity requirements by approximately 12.5 GW, mainly of coal, CCGT and OCGT (about 3 GW each), and diesel (-1.6 GW). In essence, there would be 12.5 GW of capacity built that is not required to meet demand. In the capacity assessment, outages for maintenance as well as forced outages have been taken into account, according to current standards in Indonesia.

Building these extra 12.5 GW of plants would require unnecessary investment of about 12.7 billion USD; total investment cost would increase from 39.7 billion USD to 52.4 USD. This would, by the year 2027, increase annual capital cost of the power plant fleet by 28%.

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[1] Demand would be lower by 49 TWh in Java Bali and 11 TWh in Sumatra, translating to 64.4 TWh less generation needed, if power system losses of about 8% are taken into account

[2] Combined Cycle Gas Turbine

[3] Open Cycle Gas Turbine

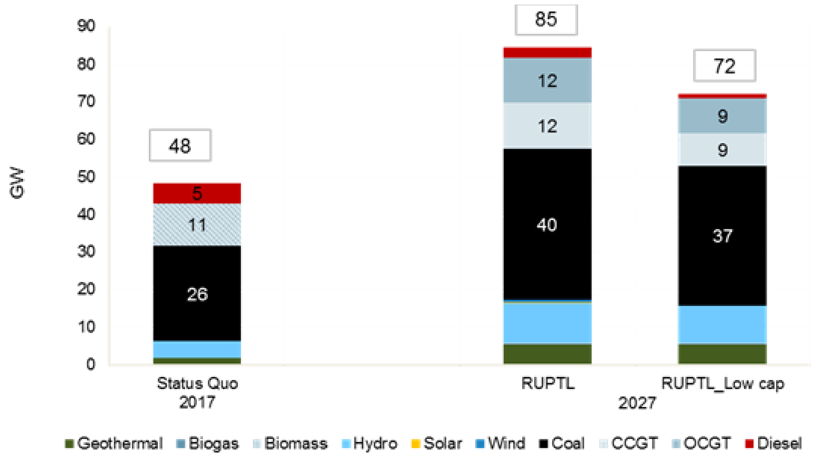


Figure 3 Installed capacity in 2027 between RUPTL and the optimised system

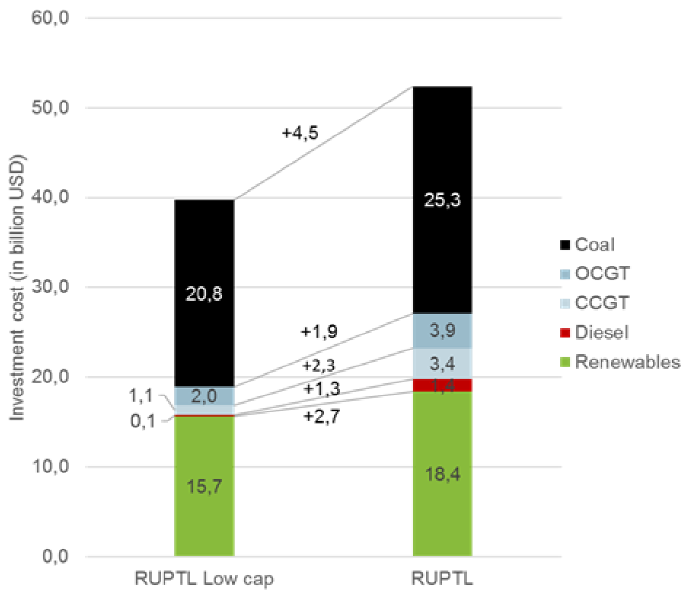


Figure 4 Difference in investment cost due to overbuilt of 12.5 GW capacity

If all power plants are built according to RUPTL 2018 plan, but demand growth turns out to be more moderate, utilisation of thermal power plants will drop, since a higher number of power plants will generate the same amount of energy. As renewables power plants – e.g. geothermal, hydro, solar and wind - generate at zero marginal cost, this will mainly affect thermal power plants, meaning coal utilisation will, within the next 10 years, decrease by an average rate of 8%. The impact becomes even more pronounced when looking at the change in utilisation on a more disaggregate basis.

Figure 5 depicts the change in utilisation rates of coal power plants for the different demand scenarios. Each circle represents one province: it is evident that there are several provinces where utilisation of both existing and new coal power generation drops by more than 10 percentage points, and some where utilisation will reduce by about 20 percentage points. For gas, given the CCGTs and OCGTs higher short run marginal cost, utilisation would even drop further. It is still probable that the new built plants would be utilised to a much lesser extent than planned, thus increasing the risk of stranded assets. Given that thermal power plants are increasingly being built by Independent Power Producers with long-term power purchase agreements with PLN, this means that PLN will likely be paying for electricity it does not need, thereby burdening the Indonesian taxpayer with additional debt.

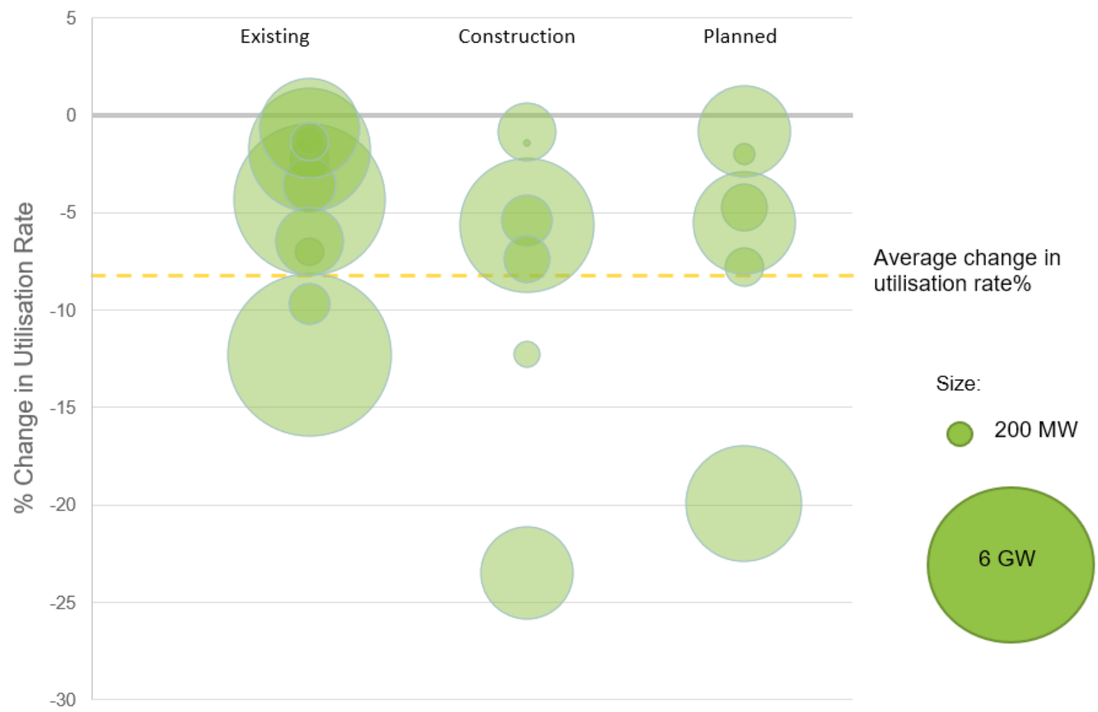


Figure 5 Changes in utilisation rate between high demand (RUPTL) and lower demand scenario (RUPTL Low gen). Each point represents 1 coal power plant in 1 province. The power plants are grouped into 3 status: existing, under construction, and planned

As mentioned before, forecasting demand is not an easy business, and the risk of over-investment needs to be weighed against the political goal of supplying citizens and the economy with sufficient energy. However, recent developments of strongly increasing reserve margins and delays in projects due to lack of demand demonstrate that overinvestment is a real issue for Indonesia already today.

The risk of lower utilisation of power plants than originally planned may increase with renewables becoming cheaper, as these technologies, once they have been built, produce electricity at almost zero marginal cost. At the same time, wind and solar plants can be developed in a much more flexible way. In well-developed renewables markets, time from planning, to start of operation, ranges between two years (for wind parks) and six months (for solar PV) and these projects can be developed economically in a very modular way, adapting project size to the needs. Efficient thermal power plants, in contrast, have sizes between 400 MW (for gas) and more than 1 GW (for coal), and require much longer lead times. The risk of unnecessary investment is therefore much lower with renewables power plants.

Indonesia Has a Vast Potential of Diverse Renewable Energy Sources, Which Easily Allows for Doubling The Currently Planned Share of Renewables within The Next Decade

Indonesia has abundant renewable energy potential from a variety of resources - well beyond what is available in most other countries around the globe. Being located on the so-called “ring of fire” on the Pacific tectonic plate, Indonesia is one of the most attractive countries for geothermal development. Since 2018, Indonesia has the second highest geothermal capacity (almost 2 GW) in the world, only trailing the United States; resource potential is estimated to be at 11 GW, reserves at another 17 GW. Technical hydropower potential, according to the International Hydropower Association, is about 75 GW, with 8 GW economically feasible already today – on top of the existing 4 GW. While many large dam projects raise environmental and social questions, there is also remarkable potential for (individually) much smaller projects.

In terms of solar and wind power, Indonesia is only at the very beginning of tapping its huge potential. Solar irradiation is at attractive levels all across Indonesia, due to the high number of daylight hours and rather low cloud cover throughout the year. Limitations, in particular in densely populated Java, are rather driven by land availability. Nevertheless, out of estimated ~200GW of potential across the country, ~30 GW are estimated for Java Bali, and more than 90 GW for Sumatra. Due to relatively low wind speeds in many regions, as well as land restrictions, wind potential has for a long time been underestimated. Recent meso-scale modelling as well as technological progress which allows wind turbines to harvest lower wind speeds reveals there is actually more potential and suitable locations than previously thought. According to these assessments, wind potential is estimated at ~6 GW for Sumatra and 24 GW for Java-Bali.

Based on the potential above, we have calculated three different power mix scenarios, which mainly differ in their share of wind and solar power. As a baseline scenario, we use the RUPTL_Low cap. It reflects the technological preferences expressed in the RUPTL, i.e. some investment in geothermal and hydro, but major focus on coal (+ 11 GW in 10 years), as well as gas (+ 7 GW), assuming, however, moderate demand growth. We compare this baseline with two scenarios that are based on the same demand assumptions, but different generation mix:

- RE_Medium assumes a mix of investment in fossils and renewables, while;
- RE_High looks at an investment pathway mainly focusing on renewables, with no new investment in coal and CCGT beyond that already under construction.

Figure 6 depicts the installed capacity and generation mix of each scenario. While in the baseline scenario, renewables – mainly hydro and geothermal – make up nearly 19% of annual generation, in the alternative scenarios, renewables shares increase to 31% (RE_Medium) and 43% (RE_High). By 2027, the installed capacities of solar and wind in the RE Medium scenario are 19 GW and 8 GW respectively. In the high renewables scenario, there will be in total 35 GW of solar and 19 GW of wind installed across Java Bali and Sumatra. This would mean less than 30% of currently estimated solar and wind potential is exploited.

In the high renewables scenario, annual capacity additions would be 3.5 GW of solar and 1.9 GW of onshore wind. As comparison, in India, the country has installed 55 GW of solar and wind in the last 10 years.

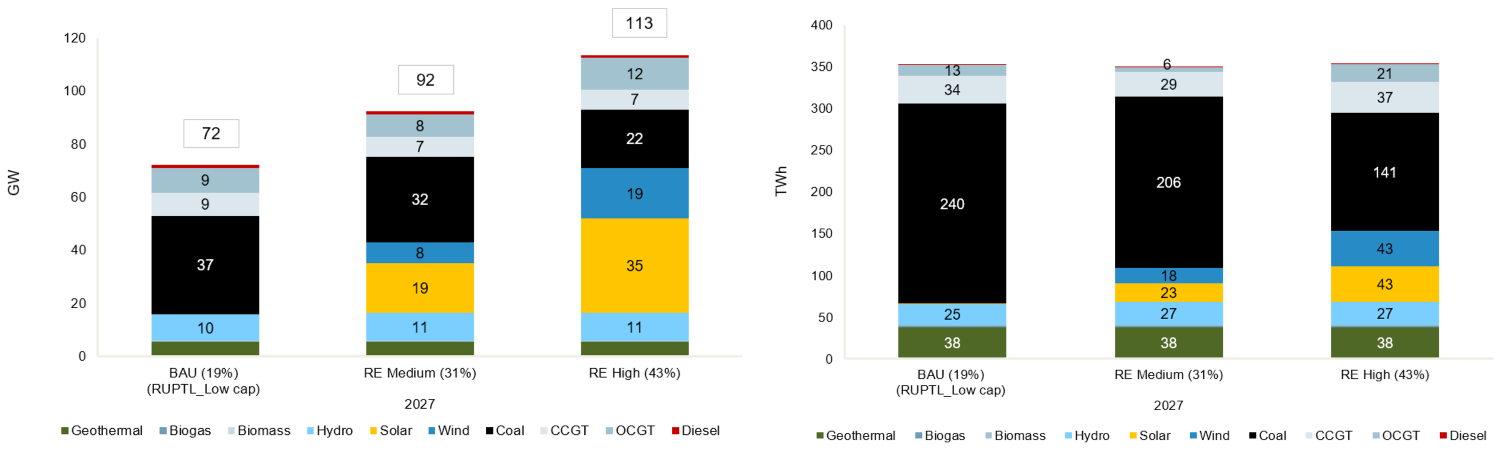


Figure 6 Installed capacity and generation per technology in each scenario. Renewables percentage in bracket.

To reach India's renewable energy target of 160 GW of wind and solar in 2022, annual capacity additions are 20-30 GW per year for solar PV and 6 – 10 GW per year for wind. In Germany, annual capacity additions are 2.9 GW per year for onshore wind and 2.5 GW per year for solar PV, but this is after the country has developed 105 GW of solar and wind in the past decade. Therefore, the high renewables scenario is feasible to achieve, provided the right policies are in place.

Due to higher non-thermal output in the renewables scenario as compared to the RUPTL planning, emissions go down from 0.76 to 0.64 ton/MWh in RE Medium and to 0.49 ton/MWh in RE High scenario, dropping by 16% and 36% respectively.

While Indonesia's NDC still allows for an overall significant increase in the power sector's emission to 2030, the RE High scenario would result in a decrease in the power sector's emission, thereby contributing to greater greenhouse gas reductions. Mitigation from the power sector is a low hanging fruit that should be explored in reducing CO2 emission.

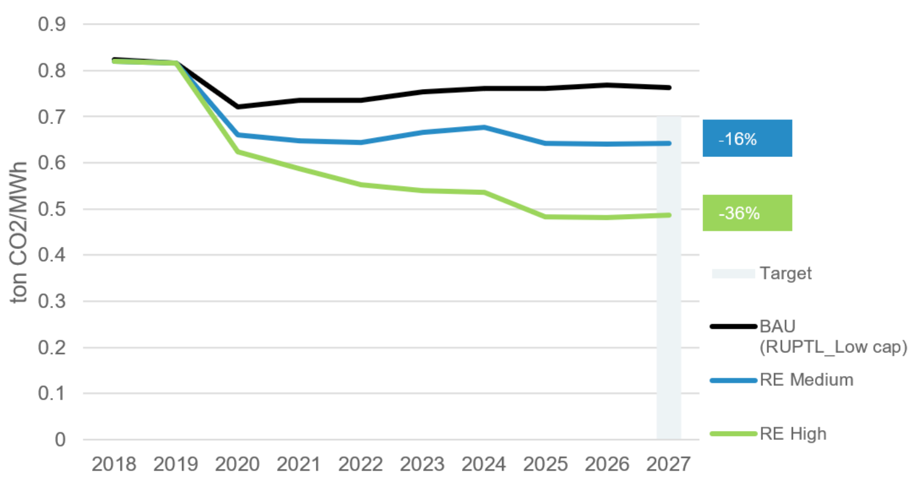


Figure 7 Emission intensity of power sector in each scenario

A High Renewables Scenario Coupled with Realistic Energy Savings Could Result in a Cost Saving of US$10 Billion Over Ten Years

Fulfilling the growing electricity demand means deploying significant amount of investment. Therefore, it is paramount for the country to consider the future trend on the cost, thus reaching the political target (be it electrification ratio, RE shares, CO2 emission, or even welfare) in the most economical way. The financial impacts of the transition to a larger penetration of renewables in the Java-Bali-Sumatra system are investigated by reporting the total operating and annualised investment costs for the period 2018-2027. Figure 8 shows the total system cost for the five scenarios – RUPTL, RUPTL_Low cap as baseline, Medium and High Renewables and Energy Transition scenarios.

We see that using a consistent set of assumptions the simulations show that the RUPTL_Low cap baseline scenario comes at lowest overall cost of 135.4 billion USD over the ten-year period. The system with 31% renewables (RE Medium) has 4% higher system cost compared to the RUPTL_Low cap; while the High Renewables scenario, with ~43% renewable, increases the system cost by 7%. However, the overall system cost of the High Renewables scenario is $7.7 billion less than the current RUPTL plan, taking into account efficiency savings and lower demand.

Wind and solar technology cost drops have repeatedly been faster than anticipated. The impact of lower technology cost and a lower risk perception of investors is shown in the Energy Transition scenario. Assuming that cost of capital could be reduced from 10% to 8%, in line with global trends, and a steeper learning curve for solar and wind, the total CAPEX for the Energy Transition scenario would be reduced by 20% and the system cost could be down by 10 billion USD, at the same level of the RUPTL baseline scenario. And keep in mind: none of the scenarios takes into account externalities such as cost for environmental impact, CO2 emissions, health, or social effects.

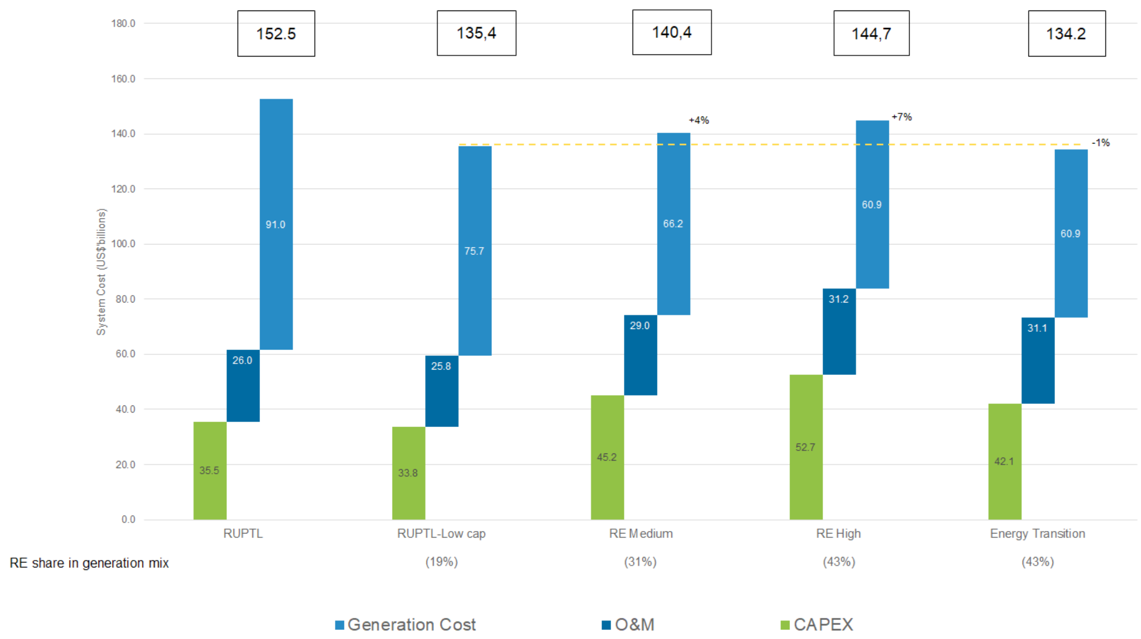


Figure 8 Total operating and investment cost for Java-Bali-Sumatra 2018-2027

Conducive Investment Environment is Key to Enabling Higher Renewable Penetration and Reducing Overall Costs

Systems with higher shares of renewables have very different cost structures from those with high shares of fossil generation. Producing power from renewables requires high upfront investment, but subsequently allows power production for 25 years and more at operating cost of close to zero. While technology cost tends to standardise across competitive global markets, interest paid on both debt and equity is very different from country to country, and has a strong impact on total cost, as mentioned above.

In a sensitivity analysis, we singled out the impact of different levels of cost of capital for funding solar and wind projects in Java-Bali and Sumatra system. The result shows that at a weighted average cost of capital (WACC) of 7.5% for wind and solar, the High Renewables system is at the same cost, even slightly lower, compared to the baseline scenario.

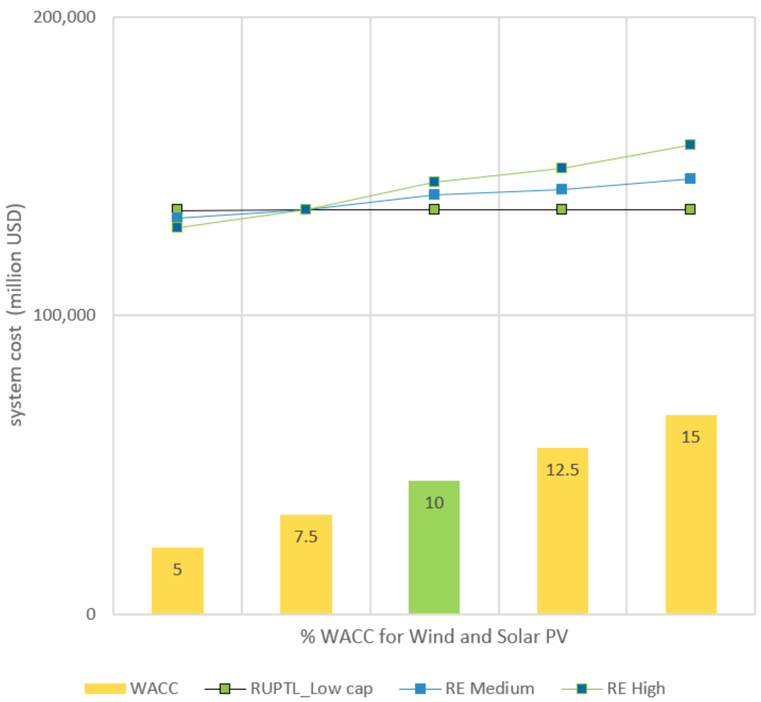


Figure 9 Sensitivity Analysis on Different WACC for Wind and Solar PV (Column in green: assumption used in the model)

While this may seem very ambitious in the Indonesian context today, countries where wind and solar markets are well developed, such as Chile, Mexico, Dubai, India, or Germany show that WACC can be as low as 5% or even less. The regulatory environment in Indonesia will thus be key to enabling higher renewables penetration, as the cost of capital is largely driven by the risk perceived by the investors.

In addition to assessing impact of improved investment condition for renewables in Indonesia, the model also calculated the impact of coal prices, as the power system is quite dominated by coal-fired power plants.

Figure 10 depicts the change in total system cost under different coal price assumptions. The result of our analysis indicates that all scenarios are sensitive to changing coal prices but not as strongly as one may expect. This is due to the fact the in all scenarios, due to the large existing coal fleet, there is considerable coal capacity. By 2027, even in the High RE scenarios, there are 22 GW of coal fired power plants in the Java Bali and Sumatra system, producing 40% of all generation. Based only on coal price increase, the coal price would need to reach record levels for the High Renewable scenario to be on par with the baseline scenario. While this may be realistic under the current development in world market coal price, the Domestic Market Obligation policy caps the coal price at 70 USD/ton. However, should the country, in line with the announced "clean coal" policy, increase environmental standards, by using coal with higher calorific value for its power plants or by imposing other pollution-reduction measures, generation cost by coal plants, which today is very low in international comparison, would increase, shifting the balance to renewables-based systems.

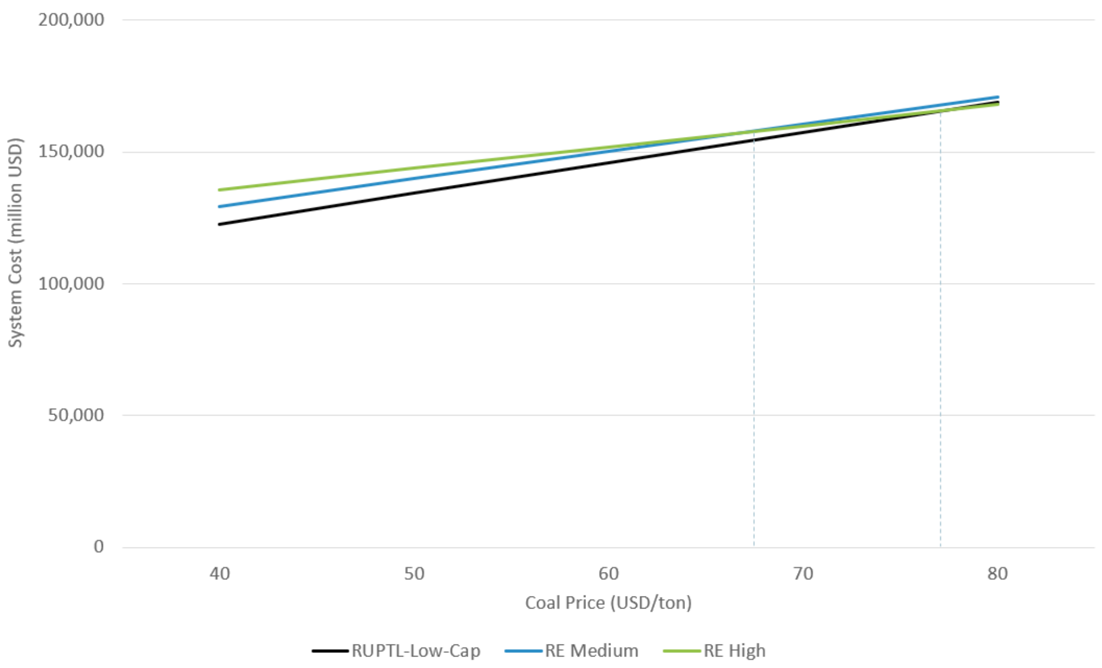


Figure 10 Fuel Cost Sensitivity of each Scenario.

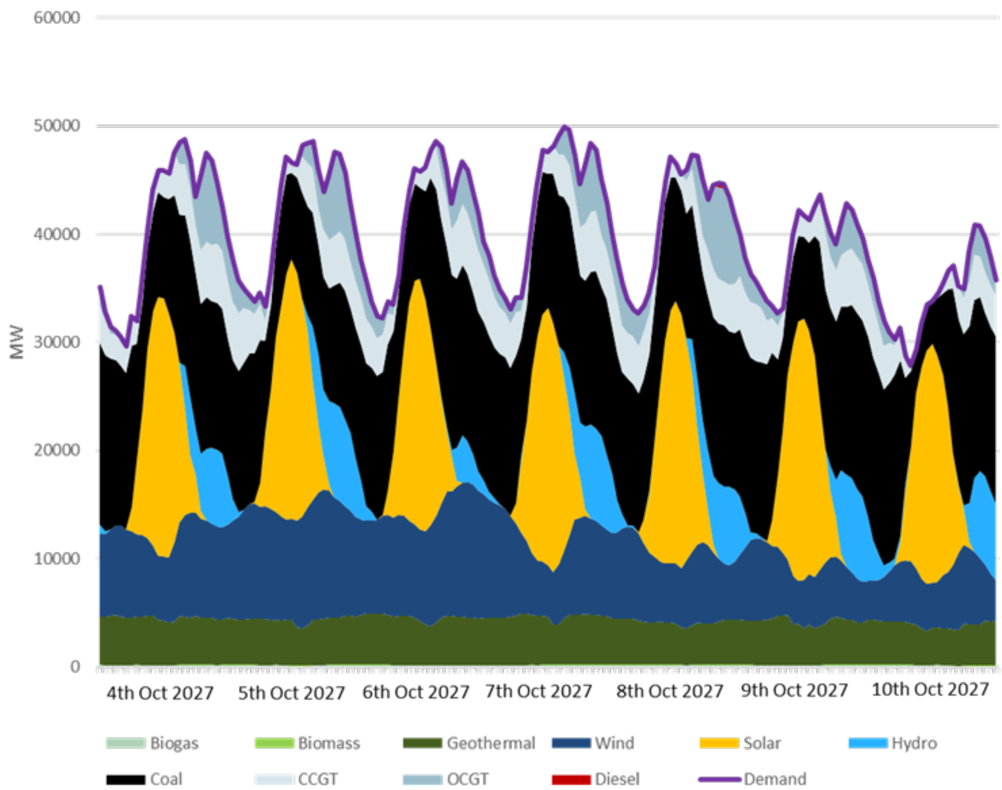
[4] In this model, the assumption for coal calorific value is 4200 kcal/kg.

Even with High Shares of Wind and Solar, Security of Supply of The Indonesian Power System Can be Guaranteed

Increasing the share of wind and solar PV leads to a fundamental transformation of the power system. Increasing variable RES output is often associated with the need for enhanced power system flexibility and affects the role played and the contribution made by the remainder of power generation portfolio.

In the High RE scenario, almost one quarter of the average annual generation comes from wind and solar. Still, at such shares of variable renewables, the system can provide sufficient energy at every hour of the year. To illustrate this, hourly generation profiles during two sample weeks with changing wind and solar contributions are shown in Figure 11. One can observe that during the day time, the peak load pattern aligns with the Solar PV feed-in. In some hours, especially around midday, solar and wind generation can make up 60% of total demand; in this case around 30 GW. In the days with low wind and solar generation, the hydro power generation increases and provides the bulk of balancing, but also coal, CCGT and in particular very flexible OCGT plants contribute to power system flexibility.

Residual power plants, e.g. hydro, gas, and coal power plants have to respond rapidly to an increase or decrease of solar and wind generation, in essence: operate more flexibly. The flexibility challenge is manageable from a technical perspective, yet it is important to note that flexible operation will impact power plant economics and may change cost efficiencies between gas and coal technologies.



[5] We use a conservative assumption that coal can ramp up and down 2 MW/min, CCGT 10 MW/min, and OCGT 20 MW/min

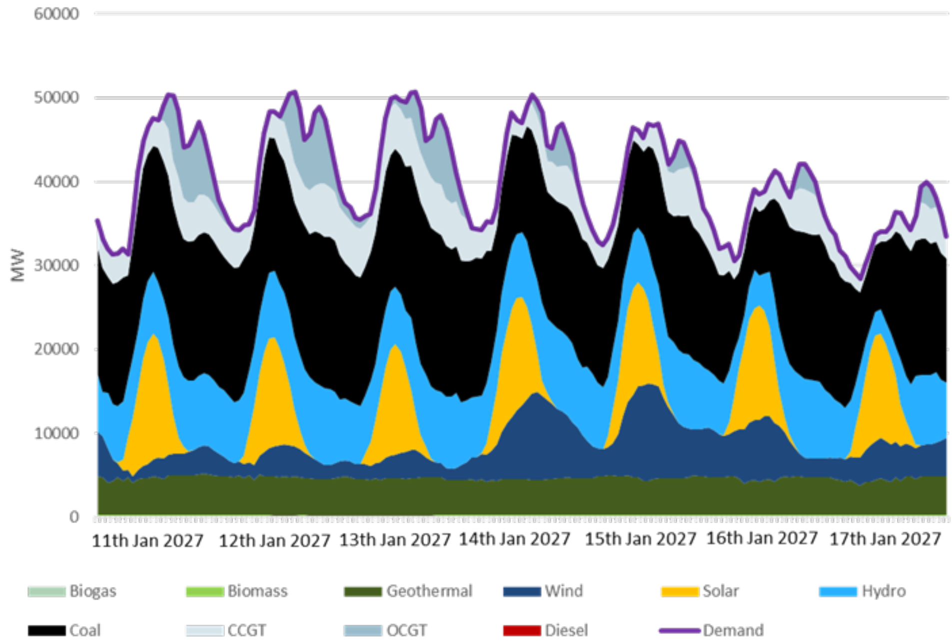


Figure 11 Hourly generation in a week with high solar and wind (October 2027) and low solar and wind (January 2027)

photo: PLTS Kupang / jabartoday.com

Conclusion and Outlook

By the end of 2017, there was roughly 6 GW of renewable energy capacity installed in Java Bali and Sumatra, (mainly hydro and geothermal), providing 8% of overall generation in Java-Bali and Sumatra (RUPTL, 2018). According to the National Energy Plan (2017), the share of renewable generation should increase to 23% by 2025 and the renewable capacity should be 33% of the total installed capacity in 2025.

Following this course, it means in 6 years the country needs to install over 30 GW of renewables out of 106 GW of total installed capacity. However, the 2018-2027 RUPTL, being the major reference in power sector development, only plans 14.3 GW of renewables plants, mainly hydro and geothermal. Reaching the target and following the growth trajectory will require stronger efforts, more than what is currently planned in RUPTL 2018-2027. Solar and wind, so far almost ignored, provide an attractive potential to reach the target.

The simulations demonstrated that a renewable pathway, taking into account a higher share of solar and wind power, is economically feasible and does not put security of supply at stake. While adding 19 GW of wind and 35 GW of solar capacity in one decade will require a considerable amount of investment, a 40% renewable system can be developed at similar cost levels as a system planned under the RUPTL, today focusing very much on coal. In the end it is hard to predict whether a renewables pathway or a fossil pathway will come with slightly higher costs, as many uncertainties prevail in a 10 year horizon – be they world market prices for coal, further cost drops for wind and solar, or the cost of borrowing money in dynamic global financial markets.

There are, however, a number of certainties that should be taken into account by Indonesian policymakers when framing their future energy system: reducing reliance on fossil will not only reduce the risk of being impacted by global fuel prices on coal and gas, but also come with great environmental, social and health benefits and allow Indonesia to meet its climate change mitigation commitments under the Paris Agreement. Incentivizing investment in wind and solar across the archipelago, on top of that, has the potential for directing money flows and economic benefits to regions that are currently less developed.

Policy and regulation will be key for enabling higher renewables penetration in Indonesia. In order to attract investors, ensure competition and bring down cost of capital, it is paramount to have an ambitious long-term strategic plan with clear intermediate targets, e.g. an annual renewable investment pathway, supporting policies and streamlined implementation at national, provincial and local level.

Institute for Essential Services Reform
Jalan Tebet Barat Dalam VIII No. 20 B
Jakarta Selatan 12810 | Indonesia
T: +62 21 2232 3069 | F: +62 21 8317 073
www.iesr.or.id | iesr@iesr.or.id

@IESR @iesr.id