



# Indonesia's Financially Sustainable Electricity Sector

GSI REPORT



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## Executive Summary

Indonesia's power sector faces a number of challenges, notably the need to meet rising demand for electricity and to serve consumers in geographically remote regions. Indonesia's energy mix is currently dominated by coal, with attendant negative public health and environmental impacts. At the heart of Indonesia's power sector is PT Perusahaan Listrik Negara (PLN), the state-owned electricity company that operates most of the power generators and is the sole provider of transmission, distribution and retail sales of electricity.

This paper reviews the ability of the Indonesian electricity sector to meet Indonesia's need for electricity in a financially sustainable way, following the Financial Sustainability Electricity Sector (FSES) analytical framework developed by the International Institute for Sustainable Development's Global Subsidies Initiative. The report analyzes the ability of the power sector to cover costs, to provide reliable demand, to make necessary investments and to operate according to environmental and social norms. The key findings are as follows:

- Despite the government's efforts to increase electricity tariffs over time, subsidies are still an important part of PLN's revenues, playing an essential role in bridging the gap between costs and revenues from electricity sales.
- Subsidies are predominantly being paid to areas with higher population densities. This is somewhat at odds with the objective to increase access to electricity.
- Investments in Indonesia's power sector are being reflected in the positive evolution of indicators tracking capacity and demand and in the overall improvement of supply quality. However, the country experiences remarkable differences at the regional level. Bottlenecks in the transmission and distribution sector should be addressed to improve service in underserved regions.
- The government's efforts to promote investment have led to significant deployment of new capacity. Given the rapid growth, it is important to monitor the efficiency of the investments and ensure that they meet the needs of consumers, and are consistent with targets to increase the role for sustainable electricity.
- Perhaps the largest challenge for Indonesia's electricity sector is to move beyond providing electricity to delivering electricity in a sustainable manner. Despite well-aligned targets to increase the share of renewables in the power sector, efforts to deploy more renewable energy have been slow and it is far from certain that current targets will be reached. The country should also study the most efficient way to achieve near-universal access to electricity by 2020, evaluating the potential of decentralized generation based on renewable capacity for remote islands.

To conclude, key challenges for sustainability in the power sector include the continued use of subsidies to prop up the sector and the increasing reliance on coal to meet demand, which poses serious health impacts in urban areas and costs to society through carbon emissions. The "true cost" of coal generation should be considered in the price of electricity, including the environmental externalities of coal use.



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## Acronyms and Abbreviations

ADB	Asian Development bank
CEER	Council of European Electricity Regulators
FSES	Financial Sustainability of Electricity Systems
FTP	Fast Track Programme
GDP	Gross Domestic Product
GSI	Global Subsidies Initiative
GW	gigawatt
IDR	Indonesian Rupiah
IISD	International Institute for Sustainable Development
IPP	independent power producer
km <sup>2</sup>	squared kilometer
kWh	kilowatt per hour
MW	megawatt
PPA	power purchase agreement
PLN	PT Perusahaan Listrik Negara (State Electricity Corporation)
Rp	Indonesian rupee
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
T&D	transmission and distribution
TWh	terawatt per hour
USD	United States dollar



## 1.0 Introduction

As the supplier of reliable power to households, commercial enterprises and industries, the electricity sector is a key driver of social and economic development. In order to fulfill this role over the long term, the power sector needs to be financially sustainable. This paper reviews the ability of the Indonesian electricity sector to meet the needs of Indonesians.

Indonesia's power sector faces a number of challenges, including: a comparatively low rate of access to electricity in a country spread across an archipelago, the need to make significant investments to meet rising consumption and the need to serve consumers in geographically remote regions (Asian Development Bank [ADB], 2015). The electricity sector is supported by subsidies to cover a shortfall in revenues from power sales. However, the majority of subsidies support urban consumers, focusing on the country's economic growth centres rather than on remote areas that, in general, have poorer access to electricity.

The government has established a multi-year program to support the sector through investment in generation and transmission and distribution (T&D). The program of investment provides government guarantees, conversion of debt to equity, debt restructuring and other subsidies. Investments come from both Perusahaan Listrik Negara (PLN, the state electricity corporation) and private investors, notably in the generation area, through independent power producers (IPPs) and power purchase agreements (PPAs) (Tharakan, 2015).

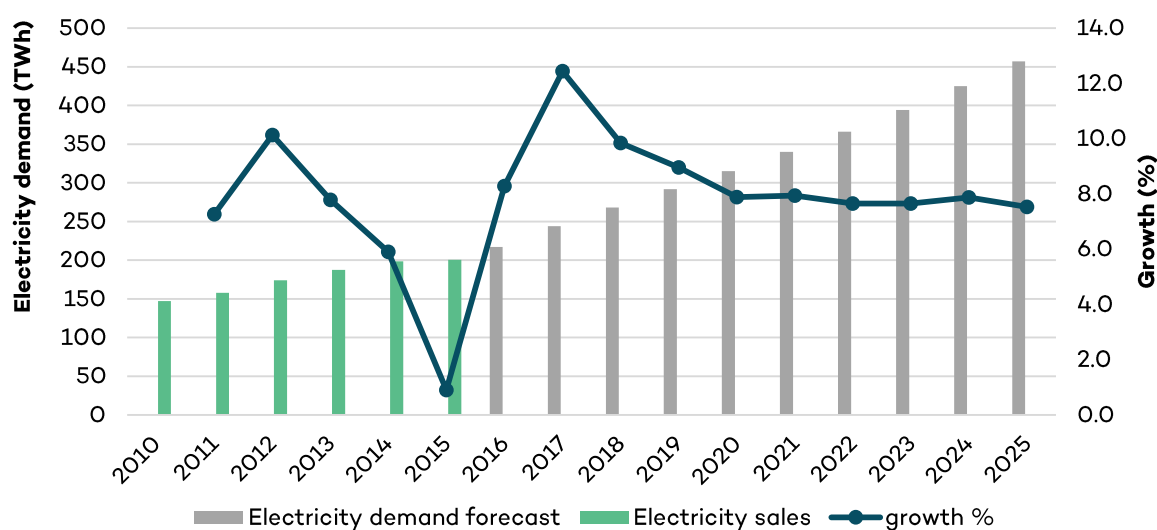
The following sections will examine these challenges from a closer perspective following the Financial Sustainability Electricity Sector (FSSES) analytical framework developed by the International Institute for Sustainable Development's Global Subsidies Initiative (IISD-GSI) (Nguyen, Bridle, & Wooders, 2015). The FSSES analysis focuses on four criteria:

- Ability to cover costs
- Ability to provide reliable demand
- Ability to make necessary investments
- Ability to operate according to environmental and social norms

### 1.1 INDONESIA'S CONTEXT

Indonesia is the largest economy in Southeast Asia. In 2015, this archipelago country had a population of 258 million people (and growing) and a GDP of USD 862 billion (IDR 11,544 trillion).<sup>1</sup> The GDP is expected to grow by more than 5 per cent between 2016 and 2018 (World Bank, 2016). At this growth rate, Indonesia's Ministry of Energy and Mineral Resources (2012) estimates that domestic demand for electricity could nearly triple between 2010 and 2030. Figure 1 represents the actual electricity demand between 2010 and 2014 and the corresponding forecast until 2025, including the year-on-year growth. Electricity demand growth is expected to stabilize at around 7.5 per cent as of 2020.

<sup>1</sup> Currency conversion made for this research is as follows, unless stated otherwise: USD 1 = IDR 9,087 (2010); USD 1 = 8,779 (2011); USD 1 = 8,800 (2012); USD 1 = 10,460 (2013); USD 1 = 11,878 (2014); USD 1 = 13,392 (2015); USD 1 = 13,500 (2016). Source: Indonesia (2015, 2016a).



**Figure 1: Indonesia's actual and forecasted electricity demand and year growth**

*Source: PT PLN (Persero) (2010, 2011, 2012, 2013, 2014, 2016)*

For a decade, Indonesia has been striving to transform and upgrade its power system in order to meet the needs of its growing economy and population. The government aims to provide almost universal access to electricity by 2019, up from an electrification rate of 80.5 per cent in 2013 (Tharakan, 2015). In addition, Indonesia is also pursuing the transformation of its primary energy mix by increasing the share of new and renewable energy to 23 per cent in 2025 and to 31 per cent in 2050 in order to reduce dependence on fossil fuels (ADB, 2015). In line with this, Indonesia has set an official goal as part of its Intended Nationally Determined Contribution to reduce greenhouse gas emissions by 29 per cent in 2030 compared to a business-as-usual scenario or by as much as 41 per cent with additional international support (Republic of Indonesia, 2015).

At the heart of Indonesia's electricity system is the state-owned electricity company, PLN. PLN operates as a vertically integrated utility company, operating power generation, transmission, distribution and retail sales of electricity. PLN is the single buyer of electricity, though not the sole generator of electricity; IPPs also operate generation assets. In terms of electric lines, PLN owns around 97 per cent of connections, with the remaining 3 per cent delivered by the regional line ministers and regional governments (Pemda) (ADB, 2016).

## 1.2 GOVERNMENT'S ELECTRICITY PLANS

In order to supply the expected increase in demand, Indonesia launched the Fast Track Programmes (FTP) in 2006 under the PLN's Electricity Power Supply Business Plan. The FTP aimed to support large-scale investments in power plants. The government has defined three FTPs, expecting to achieve 35 gigawatts (GW) of additional capacity by 2019. Table 1 summarizes the three steps of the FTPs, in terms of objectives, supported generation sources and financing participation.

**Table 1: Indonesia's government FTP summary**

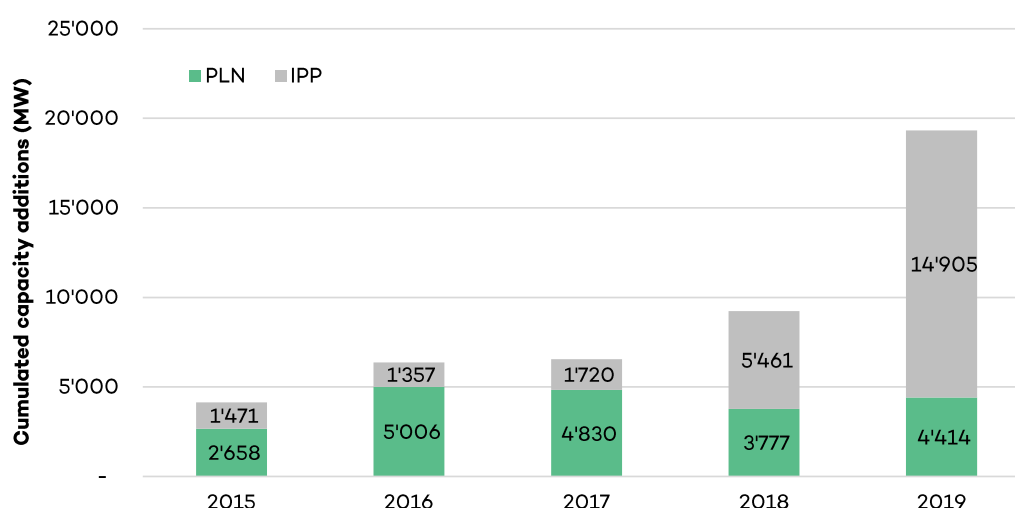
Period covered	FTP-1	FTP-2	FTP-3 (35 GW program)
	2006–2009	2010–2014	2015–2019
<b>Additional capacity objective</b>	9,975 MW	17,458 MW (FTP1 + additional)	35,627 MW (FTP1 + FTP2 + additional)
<b>Supported generation sources</b>	Coal	Coal (10,520 MW, 60%), geothermal (4,855 MW, 28%), gas (280 MW, 2%) and hydro (1,803 MW, 10%)*	Coal (19,813 MW, 56%), gas (12,908 MW, 36%), hydropower (1,971 MW, 5%), geothermal (725 MW, 2%), and other energy sources (356 MW, 1%)**
<b>Type of participation (state or private)</b>	PLN (backed by government loan guarantees, debt to equity conversions and debt restructuring)	70% private (11,659 MW), 30% PLN (5,799 MW)	70% private (25,068 MW), 30% PLN (10,559 MW).
<b>Actual capacity added</b>	7,645 MW operational, 1,541 in commissioning phase, 585 MW in construction, and 34 MW terminated.	n/a	n/a

\*This is the accumulation FTP1 + additional in FTP2

\*\*This is the accumulation FTP1 + FTP2 + additional in FTP3

Source: ADB (2015); Indonesia (2016b)

Private capacity investments are expected to grow, following the government's FTP-3, also known as the 35 GW program. In this phase, the role of IPP generation is expected to grow by more than 10 times between 2015 and 2019. Figure 2 displays the expected capacity growth under FTPs between 2015 and 2019, showing that the large increase is expected mostly from IPPs. In order for PLN to fulfill its commitment as part of the 35 GW plan, PLN estimates it will need to make investments of USD 40.1 billion in 2015–2019 in addition to private IPP investments of USD 43.4 billion (Tharakan, 2015).

**Figure 2: Indonesia's generation expansion plans under FTPs 2015–2019**

Source: PT PLN (Persero) (2016)





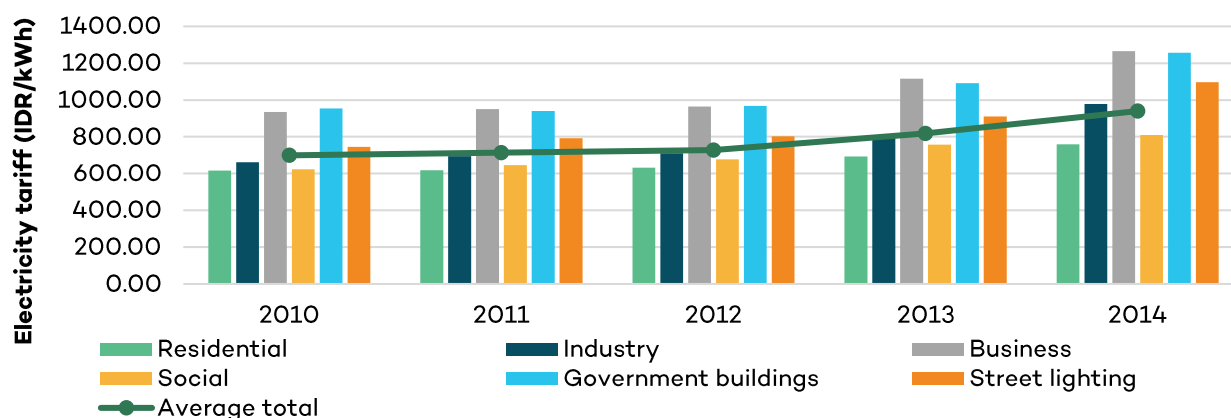
## 2.0 FSES Assessment

### 2.1 ABILITY TO COVER COSTS

Any economic activity that aims to be financially sustainable must cover its costs through the revenues it can generate. In the case of Indonesia's electricity sector, the balance between costs and revenues is crucial to ensuring that the sector can meet the country's energy needs both now and in the future. This section will look at the balance between the revenues driven by the electricity sales and the cost of generating, transporting and distributing this electricity to consumers.

PLN's most significant revenue stream comes from power sales, contributing to more than 96 per cent of the total revenues and equalling IDR 187 trillion (USD 16 billion) in 2014. Electricity prices paid by consumers are set by the government. However, prices are set at a lower level than would be needed for PLN to recover its costs, as will be demonstrated later.

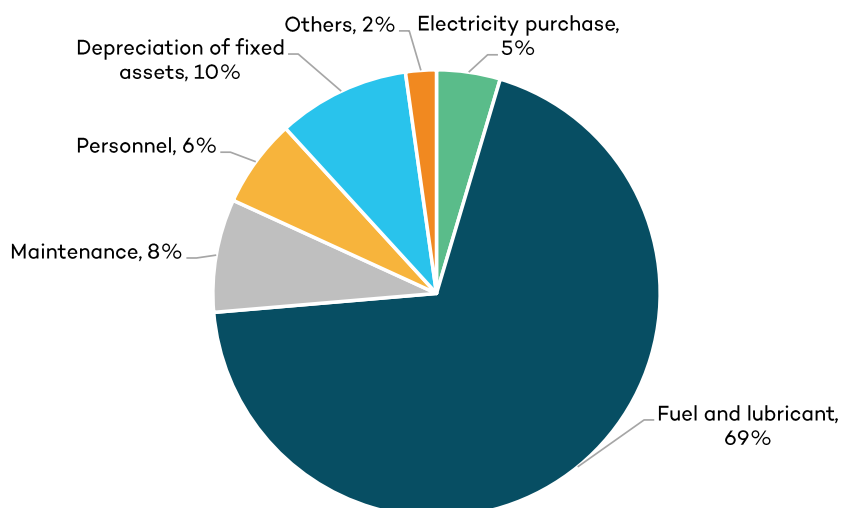
PLN classifies its tariffs based on a range of consumer classes and connection types. Government buildings and businesses pay the highest unit price and residential and social customers the lowest. The tariffs for the six main categories of consumers over time are shown in Figure 3. The graph also shows that electricity tariffs have experienced an increase over the past few years. Consequently, revenues from electricity sales have grown at an average rate of 16 per cent between 2010 and 2014. The cost of electricity supply has also grown over time at an average rate of 15 per cent in the same period (2010–2014).



**Figure 3: Evolution of electricity tariffs by consumer class**

Source: PT PLN (Persero) (2014)

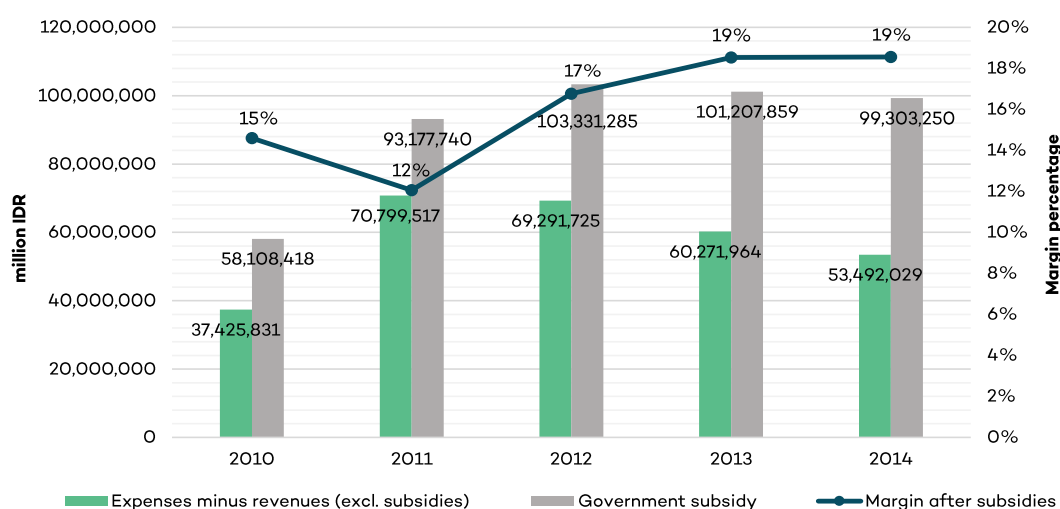
According to the Ministry of Finance Regulation No. 170/PMK.02/2013 (Ministry of Finance, 2013), PLN's operational expenses should cover all the costs associated with the supply of electricity. Figure 4 provides a snapshot of these costs for 2014, when total operational expenses amounted to IDR 247 trillion (USD 21 billion). The large majority of expenses are devoted to the purchase of fuel and lubricants (notably coal and natural gas), representing 69 per cent of the total, followed by costs of depreciation of fixed assets (10 per cent) and maintenance (8 per cent). The share of electricity purchased from IPPs is small, but has seen steady growth in recent years, increasing from IDR 4,120 billion (USD 453 million) in 2010 to IDR 11,359 billion (USD 956 million) in 2014. This growth is projected to continue due to government policies to incentivize private sector investments in the electricity system (Tharakan, 2015).



**Figure 4: Breakdown of PLN's operational expenses in 2014**

Source: Pusdatin ESDM (2014)

Revenues from power sales have been consistently lower than the cost of operating the electricity system. The difference between costs and power sales is known as the “operational gap.” The subsidy provided by the government is designed to offset the operational gap so that PLN can cover its costs even though power sales are not sufficient to cover the costs of operation. The data from PLN’s financial reporting shows that the subsidy is consistently greater than the operational gap. Government subsidies to PLN contributed 34 per cent of total operational revenue in 2014, or IDR 99 trillion (USD 8 billion). When subsidies are included as a source of revenue, PLN manages to make a profit. Figure 5 shows the operational gap, the subsidy and the profit margin. According to the government’s methodology, subsidy transfers are calculated to raise PLN’s revenues to the level of production costs plus a margin of 7 per cent (Tharakan, 2015). Nevertheless, it should be noted that subsidies that guarantee that utilities remain solvent lower the incentive to reduce costs and improve efficiency.



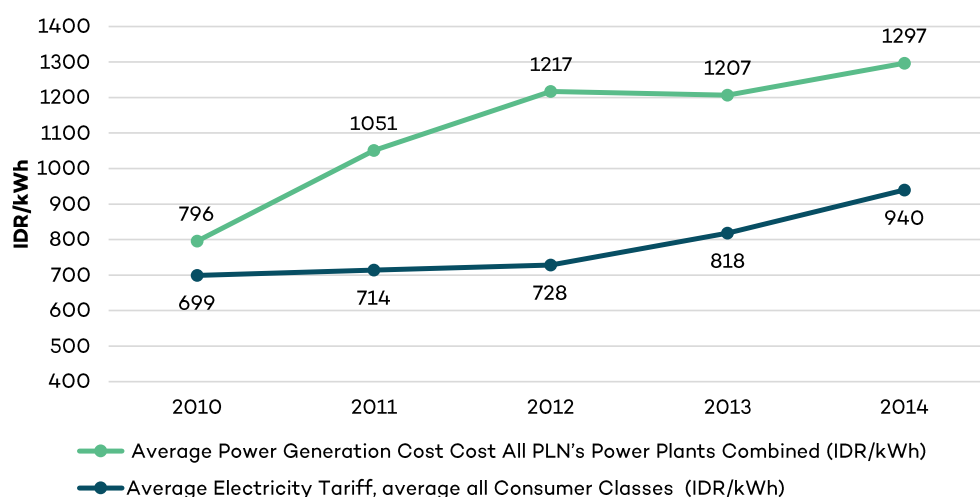
**Figure 5: PLN's expenses, revenues, subsidies and profit margin**

Source: PT PLN (Persero) (2014)



For PLN to cover more of its costs through electricity sales, tariffs need to rise faster than costs. Between 2010 and 2014 this was not always the case. Generation costs and electricity tariffs are shown on a per-unit basis in Figure 6. From 2010 to 2012 electricity tariffs remained relatively constant, rising only by around 2 per cent each year. Over the same period, costs rose much faster, by 32 per cent in 2011 and 16 per cent in 2012. The difference between costs and tariffs rose until electricity tariffs covered only 60 per cent of generation costs. However, after 2012 the pattern went into reverse. A modification of tariff classes in a concerted effort to reduce subsidies led to a rise in average tariffs (Tharakan, 2015). As tariffs were increased the growth of costs slowed, in part due to international trends. By 2014 tariffs had risen to cover 72 per cent of costs.

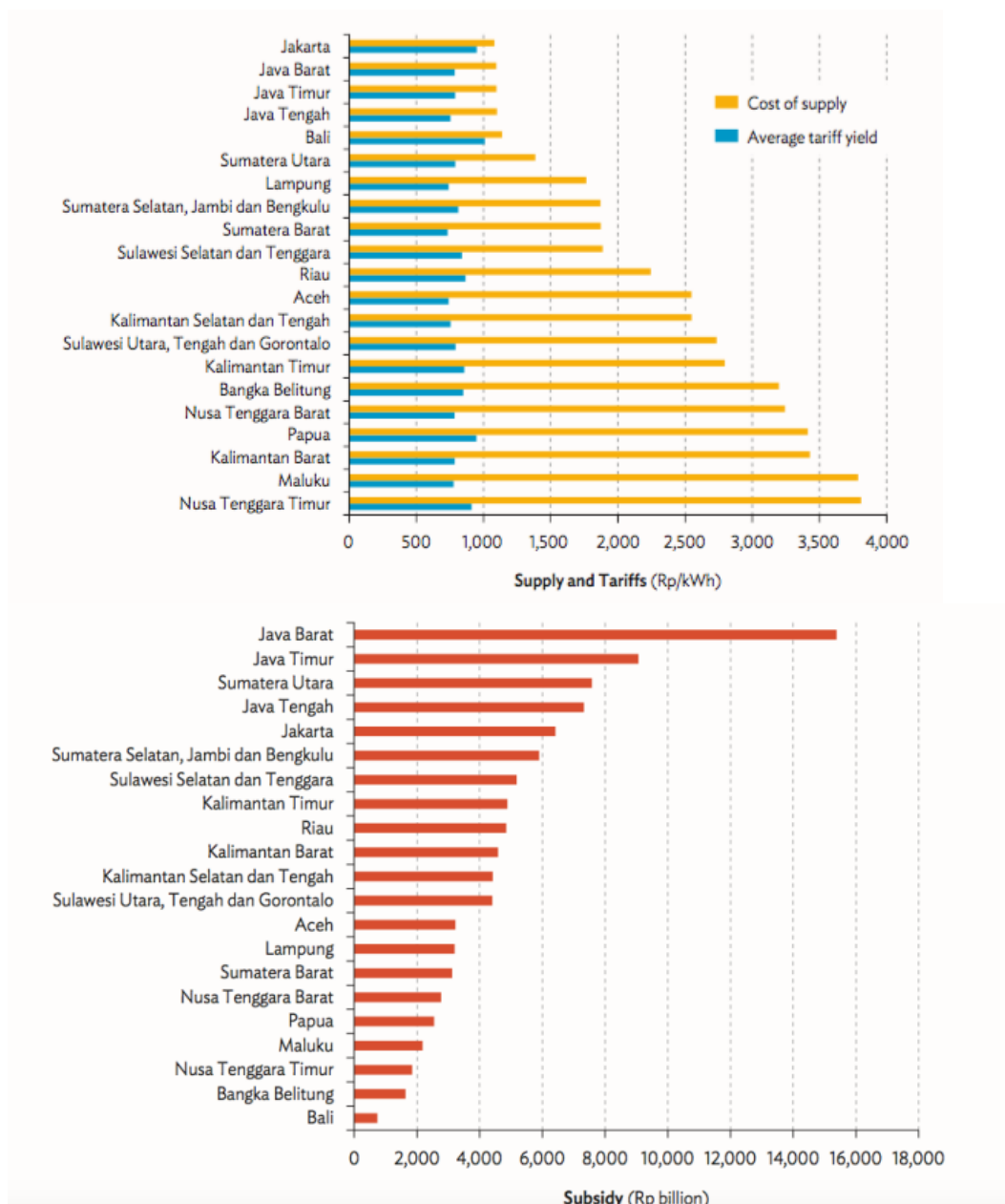
While the gap between costs and revenues has fallen, the subsidies paid to PLN have only decreased by an average of 2 per cent since 2012 (see Figure 5). During this time, PLN has reported profits of 19 per cent. These profits are due to the presence of subsidies bridging the gap. The government's theoretical cost-plus calculation of subsidies allows for a profit of 7 per cent, indicating that subsidies could be reduced more rapidly without breaching this guideline.



**Figure 6: Cost of generation compared to average electricity tariffs.**

*Source: PT PLN (Persero) (2014)*

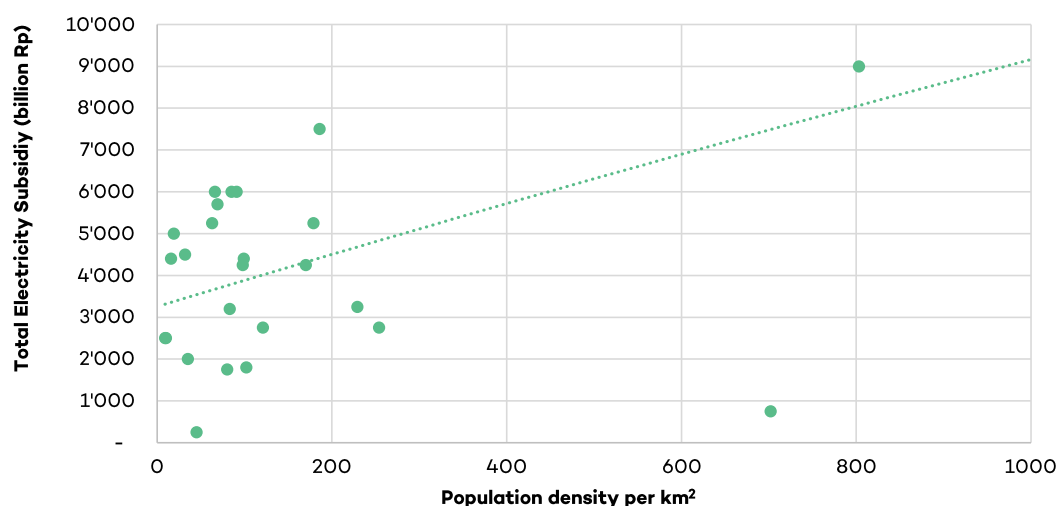
The cost of providing electricity is not uniform across Indonesia but varies widely from region to region. As shown in Figure 7, the cost of supply is significantly lower in Java compared to other parts of the country, particularly regions in the eastern part of Indonesia. By contrast, the unit prices of electricity are similar all over the country (regional variations of tariff yields can be explained by differences on the tariff class mix).



**Figure 7: Cost of supply and tariff yield by region (above) and total electricity subsidy by region, 2013 (below)**

Source: ADB (2016)

The difference between the cost of supply and average tariffs show that, on a per-unit basis, the more remote areas generally receive larger subsidies. However, the greater number of consumer subsidies are larger in urban areas in absolute terms. Figure 7 shows the total electricity subsidy per region in 2013. Regions with low cost of supply (and higher population density, like Java or Jakarta) receive much higher subsidies than other less-populated regions where unit costs are higher, such as Papua or Maluku—and where electrification rates are also lowest. This indicates that the bulk of the subsidies are not being allocated to remote areas but to urban populations. Figure 8 represents electricity subsidies compared to density of population, where a relationship can be observed between the two parameters.



**Figure 8: Subsidies versus population density**

*Source: Own elaboration with data from ADB (2016)*

In conclusion, it can be observed that, despite the government's intentions to increase tariffs over time, subsidies are still an important part of PLN's revenues, playing an essential role in bridging the gap between costs and income from electricity sales. Due to the ad hoc government regulation of tariffs, there is a disconnect between international fuel prices, which make up the bulk of the generation cost, and the revenues from power sales. To permanently remove subsidies, tariffs would need to follow costs more closely and tariffs would need to rise to reflect costs. The subsidy is being paid primarily to areas with higher population densities. This is somewhat at odds with key priorities of the Indonesian government to increase the electrification rate and capacity in remote areas (Tharakan, 2015)

## 2.2 ABILITY TO RELIABLY MEET DEMAND

Electricity is strongly linked to socioeconomic development. Given Indonesia's growth targets related to urbanization and industrialization, a reliable supply of electricity that is able to cover its increasing demand is crucial to enabling the expected development.

The ability of an electricity system to provide reliable power is affected on one hand by the generation capacity, and on the other hand by the quality of the grid. In order to evaluate both elements, this report will study the following:

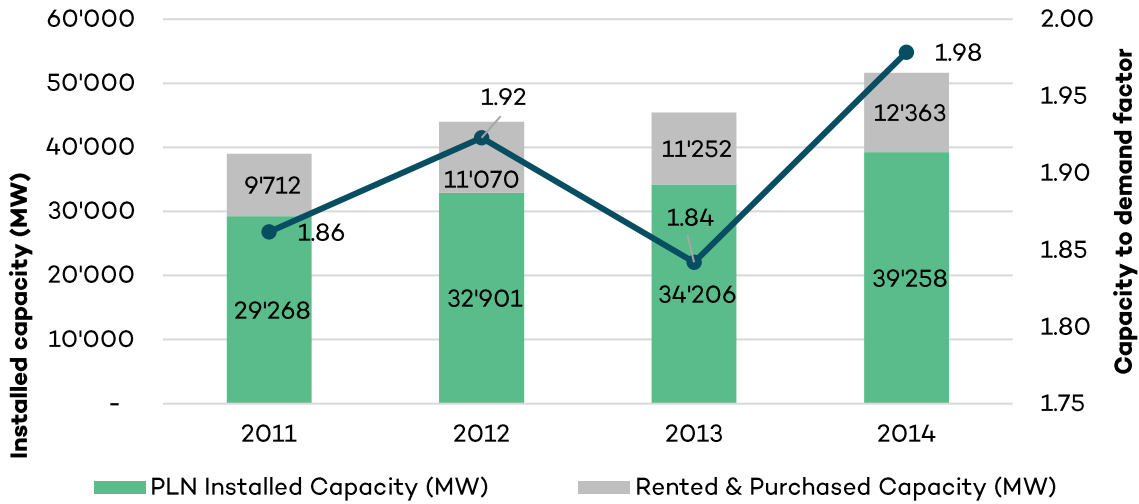
- The ability to generate the needed electricity (capacity to demand factor)
- The ability to supply the peak load (reserve margin)
- The ability to deliver electricity (duration of power outages)

Installed power capacity in Indonesia grew at an average rate of 10 per cent between 2012 and 2014, including both PLN's and additional private new capacity investments. Growth of total power generated by both PLN and IPPs grew by around 8 per cent over the same period (PT PLN (Persero), 2014).

Calculating the ratio between growth in installed capacity and generation indicates whether investment in capacity is keeping pace with increases in the expected demand. The capacity-to-demand factor in Indonesia has consequently been improving to get close to two in 2014. Nguyen, Bridle and Wooders (2015) found that a ratio of two is typical on a review of 110 countries across the globe by IISD. Considering that most of the generation capacity in Indonesia is from non-intermittent



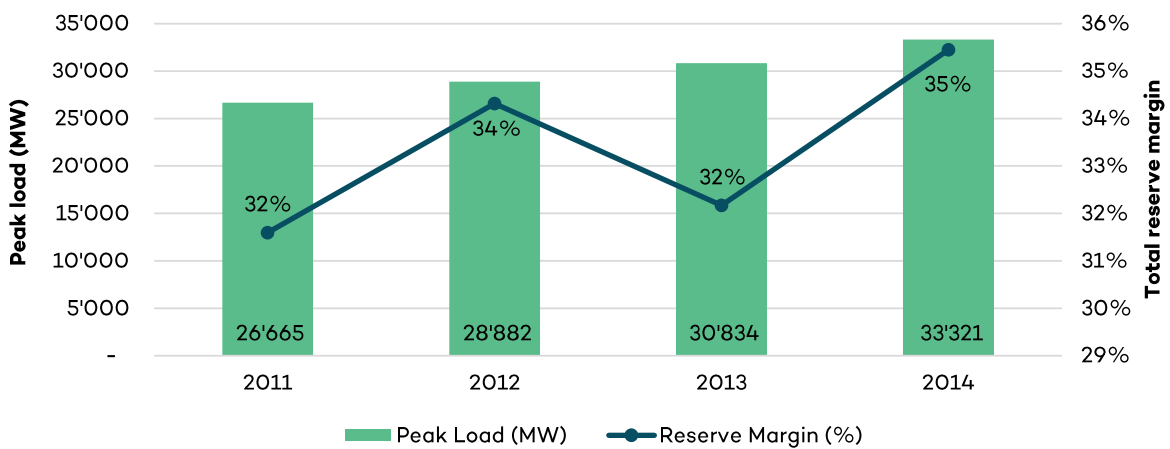
sources (solar and wind represent less than 0.1 per cent of total installed capacity), a factor of almost two means that the generating system has the potential to meet almost twice the current electricity demand under perfect operational conditions. Figure 9 represents the total installed capacity and the corresponding capacity-to-demand factor over the period 2011–2014.



**Figure 9: Total installed capacity (PLN-owned, rented and purchased) and capacity-to-demand ratio**

Source: PT PLN (Persero) (2014)

Another important factor to consider is the ability to meet the peak load. Figure 10 represents the peak load demand evolution and the reserve margin over the period 2011–2014. Peak load in Indonesia has grown at an average rate of 7.5 per cent in the period, whereas the reserve margin has oscillated around 33 per cent. The reserve margin is an indicator of available additional capacity beyond the peak load demand, helping to estimate whether an electricity system is well dimensioned. IISD considers that a reserve margin of 10 to 20 per cent of normal capacity is usually required to ensure that the system can handle surges of demand (Nguyen, Bridle, & Wooders, 2015). Values above 30 per cent indicate system inefficiencies, since there is more capacity than needed to cover for the peak demand. However, in the case of Indonesia, where demand is rapidly growing, an excess of reserve margin can help to counterbalance sudden demand peaks.

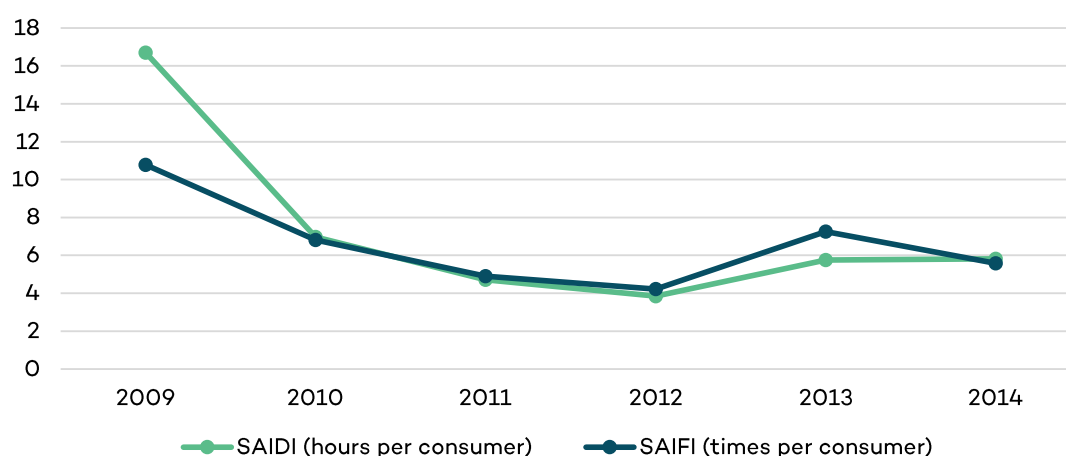


**Figure 10: Peak load and total reserve margin, 2011 to 2014**

Source: PT PLN (Persero) (2014)



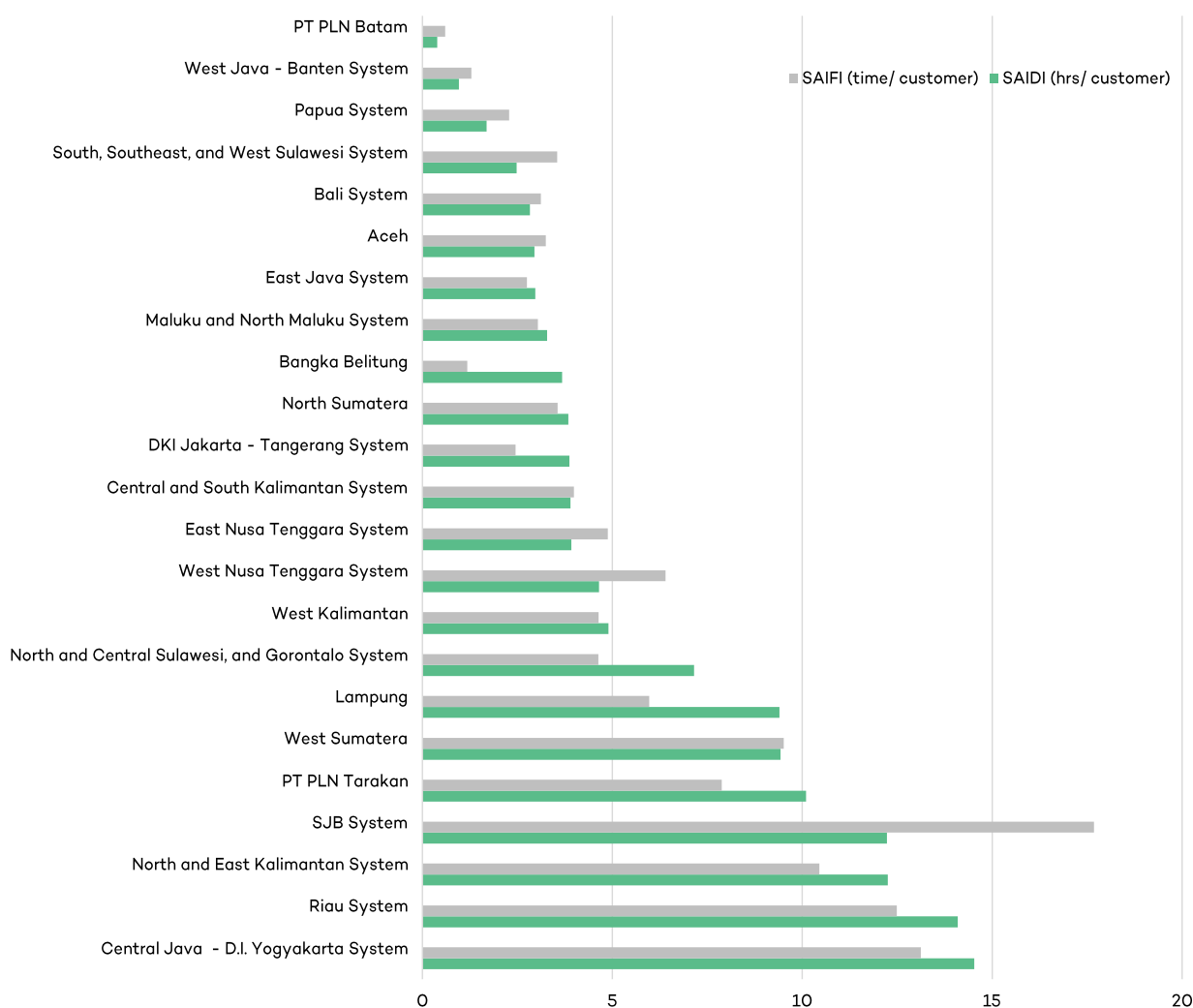
To evaluate the capacity to deliver the generated electricity, the hours of blackouts per consumer (the System Average Interruption Duration Index [SAIDI] coefficient) and the times of power interruption per consumer (the System Average Interruption Frequency Index [SAIFI] coefficient) are used as indicators. Figure 11 represents the evolution of SAIDI and SAIFI between 2011 and 2014. Both indicators have experienced a very positive evolution over that period. SAIDI has reached values closer to those of the developed world, but SAIFI has still not reached average values. The Council of European Electricity Regulators (CEER) reported average SAIDI values for Eastern European countries of between 5 and 10 hours (CEER, 2015). Values in Western European countries are mostly below 3.5 hours (T&D World, 2015). In the case of SAIFI, the CEER reported values are all well below 2.



**Figure 11: Evolution of SAIDI and SAIFI coefficients, total Indonesia**

*Source: PT PLN (Persero) (2011, 2014)*

Despite the positive overall picture of power supply reliability, large regional differences in terms of power outages exist, as reflected in Figure 12. The values of SAIDI and SAIFI vary significantly per region, going from less than half an hour on the island of Batam to more than 14 hours in Central Java. The reasons of these differences are unknown and can be the result of poor T&D infrastructure or the lack of optimized electric power flows between different interconnected regions.



**Figure 12: SAIDI and SAIFI coefficients per region**

*Source: PT PLN (Persero) (2014)*

Although the ability to reliably supply electricity in Indonesia is increasingly meeting international averages and improving over time, the country experiences remarkable differences at a regional level. With any program of investment there is a risk that overinvestment or underinvestment will lead to inefficiencies, so it is important that the evolution of generation capacity in relation to demand is closely monitored to assure that investments in power generation are optimized and adapted to the growth in demand, in order to avoid reaching inefficient reserve margins. At the same time, bottlenecks in power T&D have to be identified to ensure equal quality of supply in the country.

### 2.3 ABILITY TO MAKE INVESTMENTS

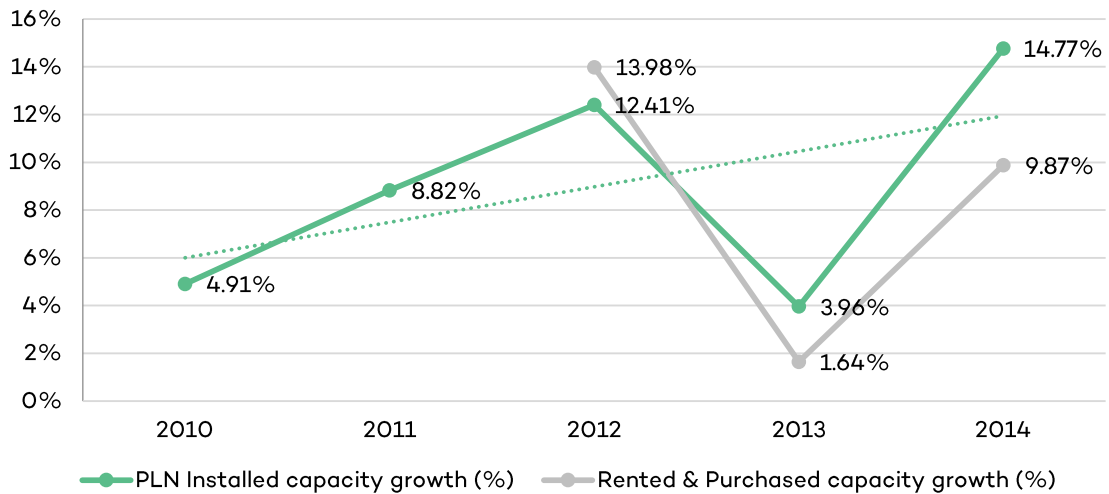
A key part of the financial sustainability of a country's electricity sector is the ability to upgrade and improve power production through timely and necessary investments. In a country like Indonesia, where demand is expected to grow at an average rate of 8.5 per cent by 2025 (PT PLN (Persero), 2016), unlocking investments to meet this increase will be a key determinant of the socioeconomic development of the country. In addition, Indonesia's National Energy Plan (Kebijakan Energi Nasional) emphasizes diversification, environmental sustainability and maximum use of domestic





energy resources, implying a boost of investments on renewable energy sources by 2050. Last but not least, investments in T&D infrastructure to supply the increasing demand will also determine the success of government’s plans. In order to assess the historical level of investment, this report will evaluate the change in total generation capacity compared to the demand and the increase of transmission lines.

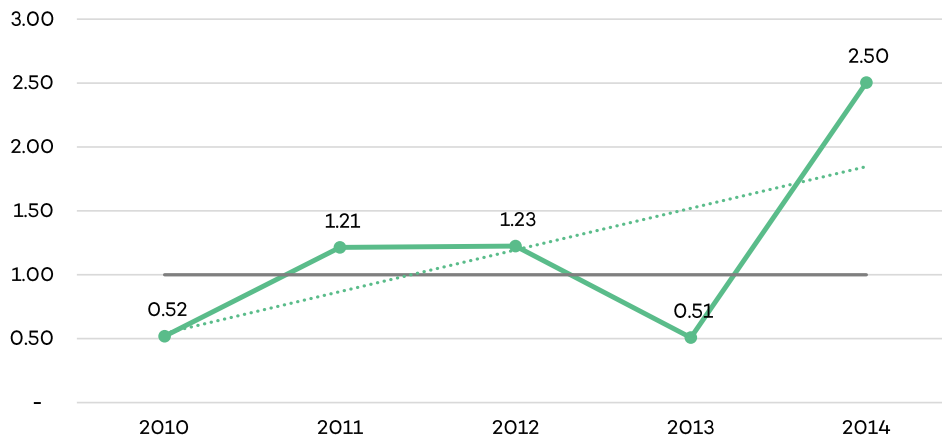
Installed capacity has grown in the period 2010–2014. Figure 13 shows the evolution, in percentage, of PLN capacity and of the rented and purchased capacity. It shows, that both have experienced important growth over the past years, increasing at an average combined rate of 10 per cent. These increases have notably been completed under the government’s three FTPs, introduced in 2006, as presented in the introduction.



**Figure 13: Generation capacity growth 2010–2014**

Source: PT PLN (Persero) (2010, 2011, 2012, 2013, 2014)

The ratio of installed capacity to demand growth indicates the ability of the sector to invest in capacity at a comparable rate to demand growth. It is represented in Figure 14 (based on PLN capacity, exclusively). A value greater than 1 indicates that capacity is installed faster than demand is growing. In the case of PLN, except for 2010 and 2013, the ratio has stayed above one and followed an increasing trend. Rented and purchased capacity have evolved in parallel between 2012 and 2014.

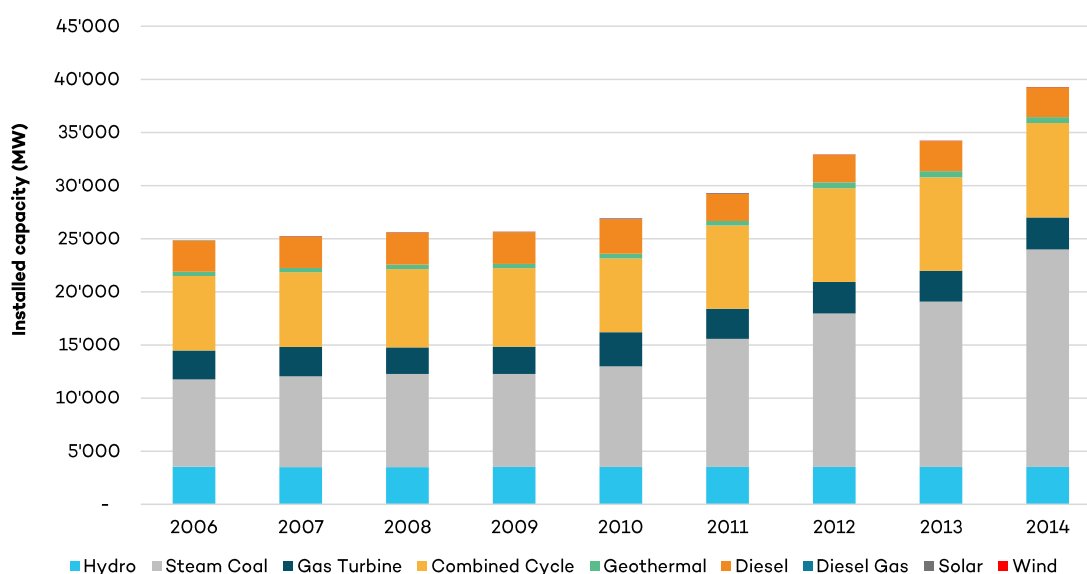


**Figure 14. Ratio of PLN's installed capacity to demand growth**

Source: PT PLN (Persero) (2010, 2011, 2012, 2013, 2014)



Fossil fuels dominate Indonesia's electricity sector, with almost 90 per cent of total power generation. Figure 15 represents the evolution of PLN's capacity mix between 2006 and 2014. Investments in energy capacity in Indonesia have mostly been focused on the development of steam coal, which grew by an average of 13 per cent between 2006 and 2014 and in 2014 represented over 50 per cent of the total generation capacity. Coal was followed by geothermal and combined cycle, which grew, on average, by 5 per cent and 3 per cent respectively over the same period. Hydro also plays a relevant role in the capacity mix, but it has seen no growth between 2006 and 2014. Despite the high potential of renewables, these have experienced only a minimal increase since 2006. The role of coal is expected to continue to be prominent, providing around 50 per cent of the additional generation capacity of the 35 GW plan (The Interpreter, 2016).

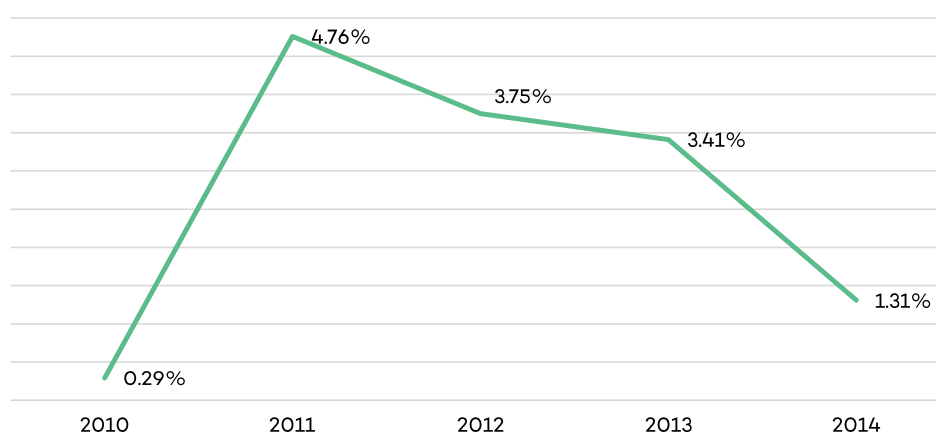


**Figure 15. Evolution of PLN's power generation capacity mix per source**

Source: PT PLN (Persero) (2014)

In addition to the investments in generation capacity, the transmission and distribution networks are also expecting a considerable expansion. Figure 16 represents the growth of transmission lines (in kilometres, expressed in percentage growth) in the period 2010–2014. The total installed transmission line infrastructure has increased over the past years, but there has been a decline in the growth since 2011. Indonesia has one of the lowest electrification rates in the region,<sup>2</sup> requiring investment in T&D grids in order to improve service to the parts of the population living in remote areas, to eventually achieve universal electricity access in the country. If the growth in generation capacity is followed by a lack of investment in T&D, there is a risk of creating bottlenecks, distorting the electricity system and of not being able to sell significant volumes of generated electricity. For generators, this means curtailment of sales and financial losses. However, a centralized electricity grid is not necessarily the best solution to provide electricity in remote areas. In some cases, investment in off-grid solutions can provide a similar service at a cheaper cost in regions with low population density.

<sup>2</sup> Compared to peer countries like Malaysia, the Philippines or Thailand.



**Figure 16: Year on year increase of transmission lines between 2010 and 2014**

*Source: PT PLN (Persero) (2014)*

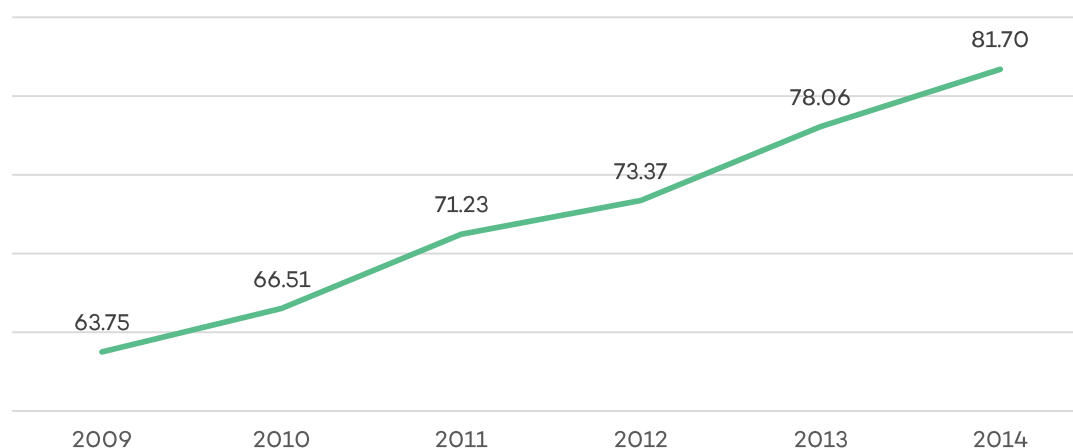
The government of Indonesia has ambitious plans to meet a growing electricity demand and improve the service. The government has provided support for capital investments in generation and T&D to PLN in the form of government guarantees, converting some debt to equity, debt restructuring and subsidies. In addition to PLN's investment, the government has taken steps to promote private investment, notably in the generation area, through IPPs and PPAs (Tharakan, 2015).

This section demonstrates that, overall, the government's efforts are going in the right direction, but given the rapid growth, attention must be paid in terms of monitoring demand-to-capacity growth ratios and in assuring that investments in new capacity are followed by corresponding investments in T&D and/or in off-grid electrification solutions. Investments in renewables should also be incentivized, in order to diversify the electricity generation mix.

## 2.4 ABILITY TO MEET SOCIAL AND ENVIRONMENTAL NORMS

For an electricity system, meeting social and environmental norms implies that the system is able to supply reliable and sustainable energy to the large majority of the population, minimizing the harmful effects of pollution and dependence on fossil fuels. Within this section, the report will evaluate the electrification rate and the proportion of renewable energy in Indonesia's generation mix.

Indonesia has made good progress in recent years in terms of improving access to electricity. In 2014, Indonesia's electrification rate was 81.7 per cent, representing an annual average increase of 5 per cent since 2009 (see Figure 17). The government aims to achieve near-universal access by 2020 (Tharakan, 2015). That is a challenging target, given that in 2016, 10.4 million households are still without access to electricity and, in addition to that number, there is natural growth of some 900,000 new households per year (ADB, 2016). At the same time, the implementation of the latest phase of the FTPs (the 35 GW plan) has gotten off to a very slow start. Since the launch of Phase III in May 2015, just 223 MW has been added to Indonesia's power capacity, and power plant projects are experiencing significant delays due to problems with carrying out tenders, land rights and local opposition (IISD-GSI, 2016).



**Figure 17: Evolution of Indonesia's electrification ratio in percentage (PLN's connections)**

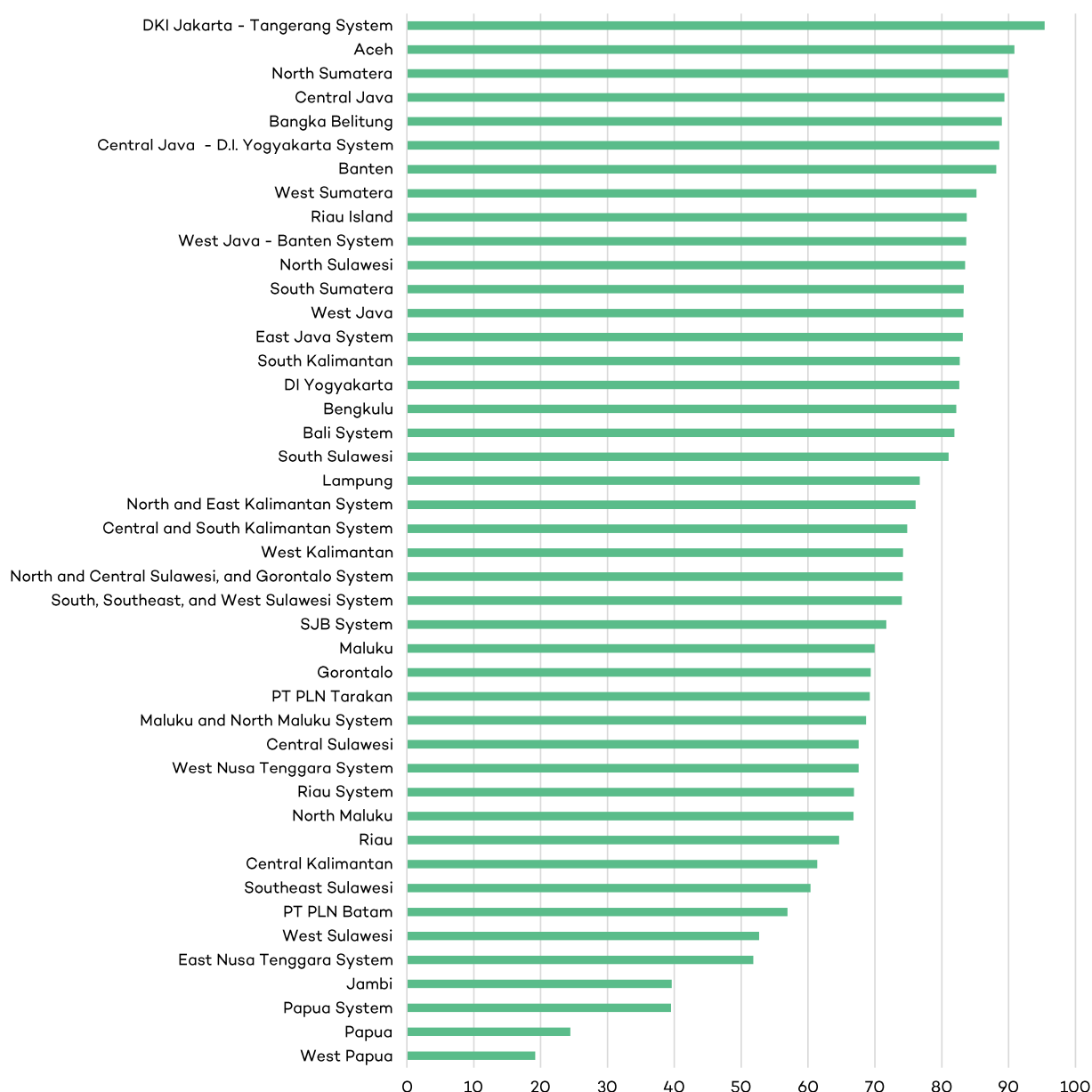
*Source: PT PLN (Persero) (2014)*

Figure 18 shows the electrification rates per region in 2014. Even though total electrification in Indonesia is advancing well, there is work to be done, notably in Eastern Indonesia, where electrification rates are much lower than in western parts of the country such as the islands of Jakarta and Sumatra. However, given the density of population, the number of households without electricity access is still higher in the west: out of 10.4 million households without electricity access, 46 per cent live in the region of Java and around 23 per cent live in the eastern regions of Indonesia.

Another important factor in the sustainability of Indonesia's electricity sector is the proportion of renewables in their capacity and generation mix, as represented in Figure 19. Indonesia has a target of increasing the share of renewable energy in its primary energy mix to 23 per cent by 2025 and to 31 per cent by 2050 (Indonesia, 2014). As observed in Figure 19, the country is still far from that target and the trend, considering the priorities of the FTPs, is going in the opposite direction. Despite the net growth of renewable capacity<sup>3</sup> between 2006 and 2014, the percentage decreased by almost 40 per cent, from 16 per cent of the total mix in 2006 to only 10 per cent in 2014. The corresponding percentage of renewable generation remained more stable in the period, oscillating around 12 per cent of the total generation mix.

<sup>3</sup> Renewable capacity in this case includes geothermal, hydro, solar and wind.



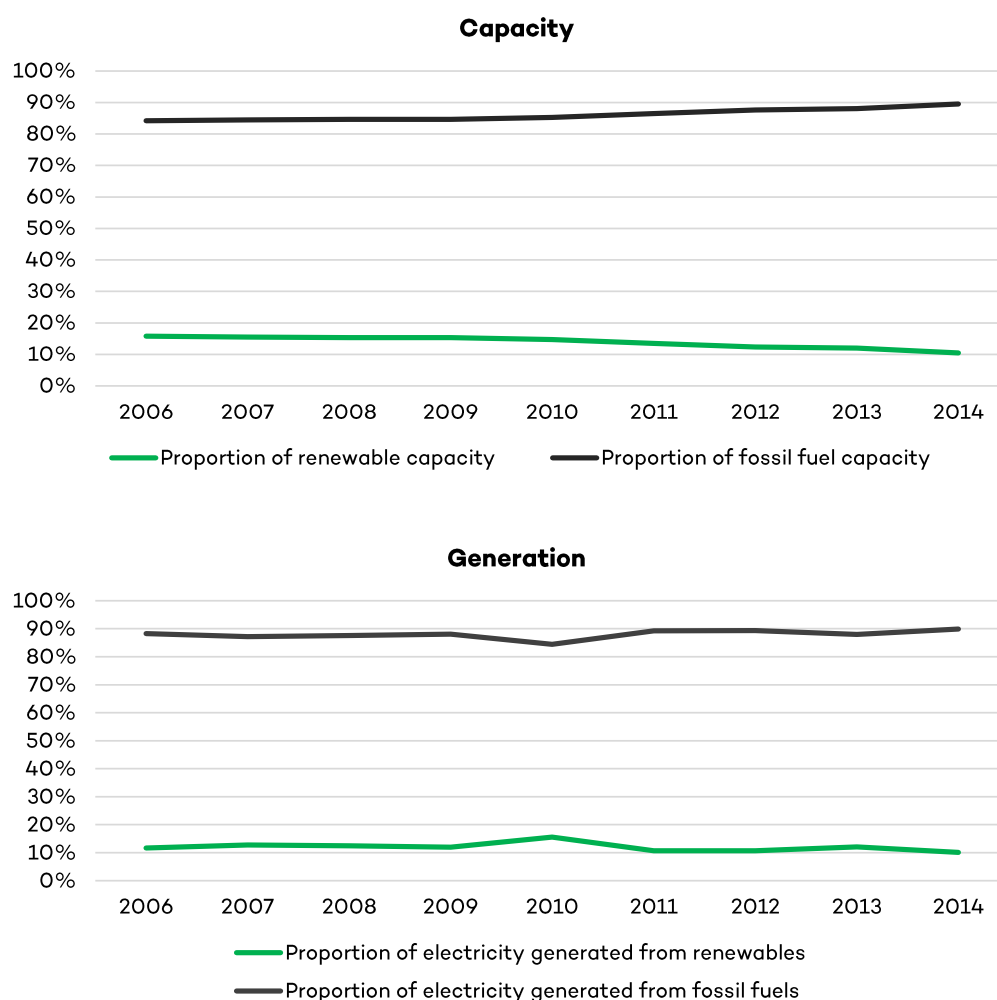


**Figure 18: Electrification rates per region in 2014 (percentage)**

*Source: PT PLN (Persero) (2014)*

Thus, coal is the dominant energy supply source in Indonesia, representing almost 60 per cent of total electricity generation in 2014, and experienced a capacity growth of 13 per cent between 2006 and 2014 (PT PLN (Persero), 2014). While many other countries are looking to drastically reduce dependence on coal for electricity generation, Indonesia is scaling up, not least via the FTPs. Current estimates suggest that energy-related emissions will double over the next 25 years, and energy-related carbon dioxide emissions will increase to more than 800 million tonnes in 2035 (Tharakan, 2015). The most considerable factor in this equation is Indonesia's power sector, where coal plays a dominant role (Pusdatin ESDM, 2014).

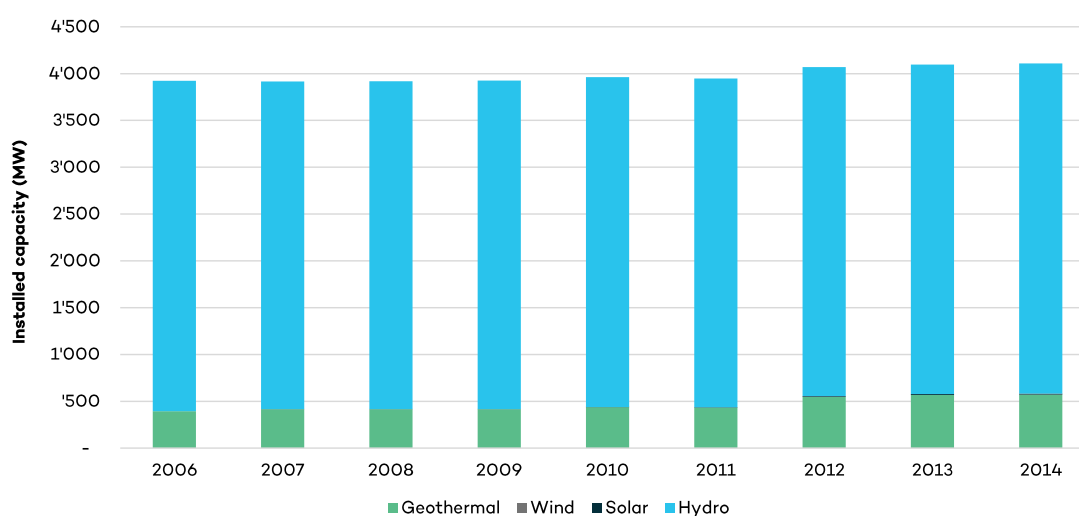
In 2025 the government is targeting coal to (still) account for 30 per cent of Indonesia's primary energy mix. Projections estimate coal will equal 25 per cent of Indonesia's primary energy mix in 2050. While this would see the total share of coal in the energy mix decline, the projected growth in total energy consumption implies a large expansion in coal power production.



**Figure 19: Evolution of PLN's renewable power capacity (above) and generation (below)**

*Source: PT PLN (Persero) (2014)*

Geothermal and hydropower are the main sources of renewable energy in the country. Wind has been part of the Indonesian energy mix since 2007 and solar since 2010, but despite important initial growth, both of them represent a minority part of the total power generation mix. Figure 20 shows the evolution of renewable installed capacity. Hydro is the most important renewable source, representing 86 per cent of total renewable capacity and 9 per cent of the total electricity mix, followed by geothermal, which represents 14 per cent of the renewables and 1 per cent of the total mix.



**Figure 20: Evolution of renewable installed capacity 2006–2014**

*Source: PT PLN (Persero) (2014)*

Nevertheless, Indonesia is estimated to hold 40 per cent of the world's total potential of geothermal energy. This could potentially provide around 28 GW of generation capacity (Tharakan, 2015). Although the FTPs incentivize investments in geothermal and hydro, investments in wind and solar have been limited (see FTPs investment priorities on table 0.1). Most of the investments in recent years have been attracted by coal, growing at an average rate of 12.5 per cent between 2007 and 2014. In the same period, hydro has seen no net growth while geothermal grew by an average of 5 per cent (PT PLN (Persero), 2014). To conclude, it seems questionable whether Indonesia's electricity sector is able to meet social and environmental norms.

The government's target to increase the share of renewables is ambitious and well aligned with providing sustainable electricity for all in Indonesia. However, on the ground, efforts to deploy more renewable energy have been slow and it is far from certain that Indonesia will actually be successful in reaching its targets. As demonstrated above, investments so far focus almost exclusively on coal-fired power plants, and efforts to increase the share of renewable energy have so far not materialized in the energy mix.

Coal currently covers around 50 per cent of electricity capacity, and even if the government is successful in reducing this to 30 per cent in 2025 (as targeted in its National Energy Plan), this would leave Indonesia dependent on coal-fired electricity for decades to come, offsetting the environmental and social benefits from the increase in renewables. This would happen at the same time as many of its peer countries are leaving coal for renewables. Even though coal is seemingly the second cheapest generation source, after hydro, its use comes with considerable externality costs, which are not included in the real price. Keeping coal as a dominant energy source would have significant implications on local air pollution, health and the environment throughout Indonesia, and leave Indonesia's electricity sector as one of its most prominent carbon dioxide emitters in 2035 (Greenpeace, 2015).

Indonesia also faces a serious challenge in achieving near-universal access to electricity by 2020. First, power plant projects on Java are struggling with delays, leading to only minor power capacity increases since 2015. Second, expanding electricity access becomes increasingly difficult and expensive as the rate increases, since adding remote areas to the grid is much less cost efficient than for populated ones (ADB, 2016). This poses questions around whether Indonesia could prioritize decentralized generation based on renewable capacity for remote islands. As shown in previous sections, the current subsidy distribution scheme favours areas with high population density and may not be the most efficient method for achieving electricity access in rural and less-populated areas.



### 3.0 Conclusions

The electricity sector in Indonesia is increasingly able to provide reliable power to existing customers. In response to rising demand, a program of investments is planned to ensure that demand does not outstrip supply and the indicators of reliability continue to improve.

The costs of providing electricity are not being met entirely by the sale of electricity. The current pricing system has led to an under-recovery of costs, and the gap is currently being filled by subsidies to the sector. Pricing reforms that automatically set the price of electricity to guarantee cost recovery and remove political decision making for power pricing would be a positive step to ensure that public funds can be freed up for other priorities.

A key challenge for the sustainability of the power sector is the increasing reliance on coal to meet demand. Coal generation is associated with air pollution, which has serious health impacts in urban areas and costs to society through carbon emissions. Despite government targets for the increased use of renewable energy sources, their share of the electricity mix is in decline. Action is required to prevent a serious decline in air quality and failure to meet renewable energy deployment targets.

The environmental externalities of coal use should be incorporated into the price of electricity so that the cost to generators reflects true the cost to society. Environmental fiscal measures such as carbon taxes and fossil fuel taxes that can internalize these costs should be explored.







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