ENERGY TRANSITION IN A NUTSHELL:
8 Q & A on the German Energy Transition and Its Relevance for Indonesia

in cooperation with

IESR Institute for Essential Services Reform

Agora Energiewende

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IMPRINT

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FOREWORD

Energy transitions are happening around the globe and are here to stay. In India, 10.4 GW of solar capacity was installed last year alone, making India the third biggest solar market worldwide (BridgetoIndia, 2018). In less than five years, this figure will rise to 100 GW (Chandrasekaran, 2018). In China, solar and wind accounted for 183.6 GW and 183.2 GW respectively or total 19.2 percent of Chinese total installed capacity in 2017. Compared to 2016, the capacity addition in 2017 increased by 68.8 percent for solar energy and 10.5 percent for wind energy (Chinaenergyportal, 2018). According to the International Energy Agency (IEA), investments in renewable energy sources have been outscoring those for conventional resources for several years in a row.

While only recently, wind and solar power were considered relevant sources of electricity only for affluent societies who would be ready to pay more than for traditional power generation technologies, the economics have changed. The main driver for making wind and solar mainstream is the impressive learning rates of these technologies. In many countries around the world, it is cheaper already today to build a new solar PV or wind plant than building new thermal power plants. And it will not be long until it will even be cheaper building new wind and solar PV than utilizing existing gas and coal fired power plants, according to Bloomberg New Energy Finance (BNEF). Compared to operating existing coal power plant it wil be cheaper to build and operate new solar PV in Indonesia by 2027/2028 (Carbon Tracker, 2018).

Let us be clear: The energy transition brings about fundamental changes in how investments are structured, as most of the investment is upfront, while the fuel – wind or solar irradiation – come for free. It brings about fundamental changes also on how power systems are operated, due to the variability of wind and solar. Traditionally, systems have been built upon a bulk of baseload power from thermal power plants running around the clock. With wind and solar, we see a paradigm change from baseload to flexibility. Flexibility is needed to provide necessary short and mid-term balancing of the variability of wind and solar, through flexible hydro, bio- or thermal power plants, demand response or battery storage, for example. The transition will be challenging to technologies and actors that cling to the past, but also offer many opportunities to those who embrace new technologies and business models.

In Indonesia, with the energy transition still being in its very early stages, a lot of misperceptions persist on its associated cost, on its impact on power system reliability, and on the broader economy. It is evident that every country has to find its own design and own way of implementing the energy transition. Nevertheless, as basic technical and economic properties of power systems are the same, there is something to learn from experiences elsewhere. To bring this knowledge, IESR has partnered with colleagues from German think tank, Agora Energiewende, to look at the experiences made in Germany as a frontrunner of the energy transition and assess what this would mean for Indonesia. The outcome of our analysis is found in this publication. It is intended as a starting point for a wider debate in Indonesia on this topic.

Based on these discussions, IESR will seek to develop a scenario for the energy transition in Indonesia, by taking into account the knowhow of a wide range of stakeholders in the country, as well as international experience, to make it a successful endeavor, and providing least cost, reliable and sustainable energy to all Indonesian people.

Fabby Tumiwa
Executive Director

1. WHAT IS THE ENERGY TRANSITION ABOUT?

The German Energy Transition or Energiewende is a long-term energy and climate strategy that is based on developing renewable energy and improving energy efficiency. It involves a fundamental transformation of Germany's power system, including a shift from coal and nuclear to renewable energy. The Energiewende first started decades ago. A broad consensus has emerged on the need for this transformation.

The German Energiewende: a long-term energy and climate strategy

The German Energiewende (which is usually translated as "energy transition") is a long-term strategy for the development of a low-carbon energy system that is based on renewable energies and improved energy efficiency. The Energiewende is an integrated policy that addresses all sectors of the economy. The Energiewende has its roots in public opposition to nuclear power, in the sustainable development movement, and in public support for action on climate change.

It is driven by four main political objectives: fighting climate change (through a reduction of CO_2 emissions), phasing-out nuclear power, improving energy security (through a reduction of fossil-fuel imports) and guaranteeing industrial competitiveness and growth (through industrial policies targeting technological, industrial, and employment development).

Wind energy and solar PV are the backbone of the German Energiewende. As wind and solar energy are now cost-competitive with conventional energy sources, high penetration of these technologies is becoming a worldwide phenomenon, rather than taking place in only a few countries. It changes the way power systems operate, from the original logic of baseload, mid-load and peak load generation, to a modern, intelligent system, where flexibility is becoming the new paradigm of the power sector.

This transformation of the economy is creating new business opportunities for German industry, but is not without its challenges. As part of the Energiewende, ambitious mid and long-term targets have been set in all energy sectors (power, heat, and transportation) reaching as far forward as 2050 (see Table 1). Reaching these targets will require a fundamental transformation of Germany's power system, including a shift from coal and nuclear to renewable energy, which will cover at least 80 percent of Germany's electricity consumption by 2050. Reaching the long-term decarbonization objectives in the other fossil-fuel intensive sectors (transportation, heating and cooling) will require progressive electrification. Accordingly, the fundamental transformation of the power system is crucial.

Table 1. Key German Energiewende targets

		Status Quo	2020	2022	2025	2030	2035	2040	2050
GHG emissions	Reduction of CO_2 emissions in all sectors compared to 1990 levels	-27.6% (2017)*	-40%			-55%		-70%	-80 - 95%
Nuclear phase-out	Gradual shut down of all nuclear power plants by 2022	12 units shut down (2017)	Gradual shut down of remaining 7 reactors						
Renewable energies	Share in final energy consumption	13.1% (2017)	18%			30%		45%	Min. 60%
	Share in gross electricity consumption	36.1% (2017)*		40-45%			55-60%		Min. 80%
Energy efficiency	Reduction of primary energy consumption compared to 2008 levels	-5.9% (2017)*	-20%						-50%
	Reduction of gross electricity consumption compared to 2008 levels	-2.9% (2017)*	-10%						-25%

Source: Agora Energiewende (2018) ; AGEB (2017)

Why does Indonesia need to embark on its own energy transition?

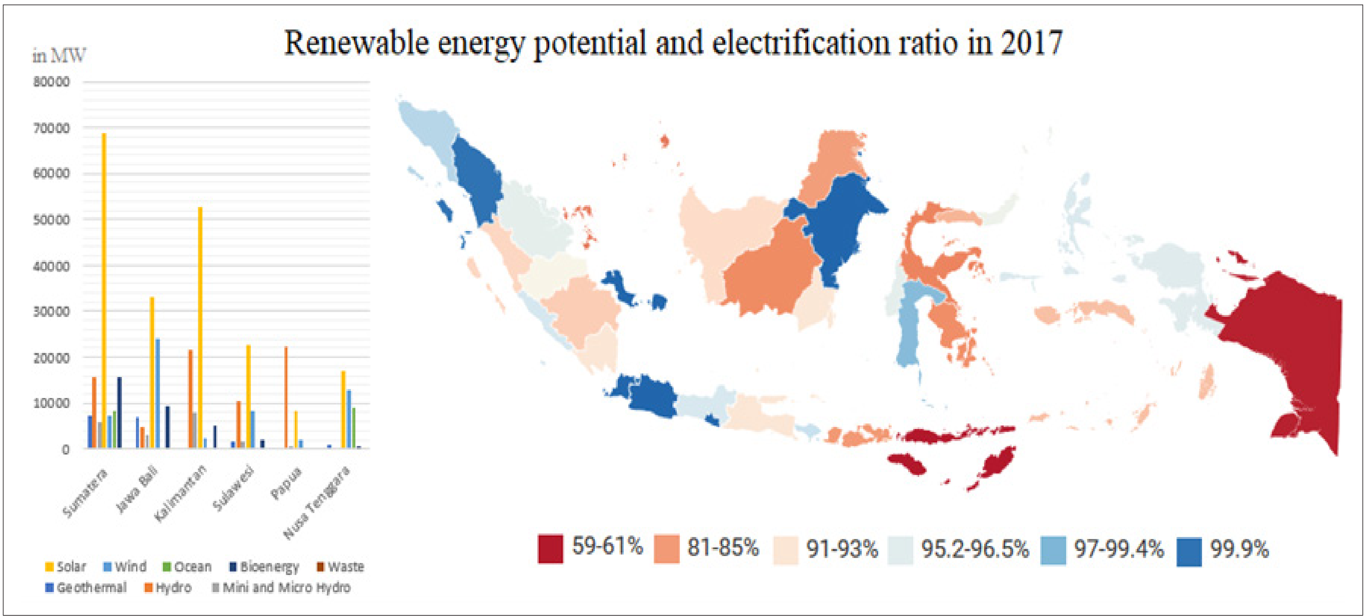
Energy transition, i.e. shifting from fossil fuel power plants to renewable energy sources is aligned with the latest Indonesian National Energy Policy (KEN). It urges the national energy development priority to be based on the principle of maximizing the utilization of renewable energies. It will secure long term energy supply with locally available resources, allow for and benefitting from the largely untapped potential of renewables support energy access in any angle of Indonesia, despite the challenges the archipelago offers. The declining cost of solar and wind (and storage) will allow for mitigating environmental concerns (e.g. poor air quality) throughout the country. Wind and solar power can provide cheap and clean energy, open an option to decentralize energy supply, which in turn can provide local jobs and values creation, and facilitate the modernization and diversification of Indonesia's energy system.

Enabling the sustainable electrification of Indonesia's outer islands

Indonesias unique characteristic as an archipelago country with the need to electrify a large number of small outer islands cause the national electricity company (PLN[1]) to use diesel fuel generator to generate electricity. This technology is chosen because it needs short amount of time for the construction and installation and low capital investment. According to Electricity Statistics 2017 from Directorate General of Electricity (DGE) of MEMR, there are around 4,665 PLN's owned diesel generators with total installed capacity reaching 5.89 GW all over Indonesia. Most of these diesel generators are located on the eastern part of Indonesia, where the electrification ratio is still medium.

Diesel generators may have cheap capital expenditure (Capex), but the operational cost (Opex) is high due to the expensive price of diesel. Based on data from PLN's Statistic 2017, average price of diesel used for the generator is Rp. 7,644.2/litre or around US$ 0.5/ litre[2], burdening PLN's financing situation, as the generation price is not fully recovered from consumers. As renewables are getting cheaper, shifting from diesel generation to renewables at remote and island systems easily is an economically viable option.

Additionally, eastern part of Indonesia has big potential of renewable energy. Tapping into this potential - and combining with either existing diesel or, even better with battery systems, will contribute to cheaper and more reliable access to electricity.



* source: author's compilation using data from djk.esdm.go.id

Figure 1
Renewables potential and electrification ratio in Indonesia

1 PLN (Perusahaan Listrik Negara) is an Indonesian state-owned company and the only electricity utility in Indonesia which has monopoly on electricity transmission and distribution and generates the majority of the electrical power. In 2017, PLN owns approximately 71 percent of the total installed capacity.

2 As per October 19th, 2018 exchange rate: 1 US$ = Rp. 15,200.

Declining cost of solar and wind

Solar and wind costs continue to drop and on par with fossil fuels. Renewable energy report 2017 from IRENA mentioned that the global weighted average cost of electricity from utility scale solar PV plants fell from US$ 0.36 to US$ 0.11/kWh between 2010 and 2016. Furthermore, auctions result in Abu Dhabi, Chile, Dubai, Mexico and Saudi Arabia suggest that at good sights and under suitable regulatory frameworks, prices a low as US$ 0.03/kWh will be achieved in 2019. On the other hand, on-shore wind global weighted average cost of electricity (for location with good resources) have fallen from US$ 0.085 to US$ 0.07/kWh. Looking at recent auction results, there is possibility that this cost will be as low as US$ 0.03/kWh in 2019 or 2020 in areas with excellent wind sites (IRENA, 2017).

Electricity storage systems prices also show a declining trend. In Germany, for example, small-scale household Li-ion battery costs have fallen by over 60 percent since late 2014. By 2030, lithium-ion battery costs for stationary applications could fall to below USD 200 per kilowatt-hour for installed systems (IRENA, 2018).

This declining cost of solar and wind plus storage should be used as a catalyst to shift the electricity generation preference from centralized conventional to the distributed renewables technology. Moreover, as renewables and storages technology getting more competitive compared to fossil fuels, large consumers/ international companies, investors and large banks will channel more funding to renewables projects.

Mitigating environmental concern

Air quality and its impact on health is another major concern to shifting from dirty fossil fuels to clean renewables. To get a perspective, below are the Indonesia's air quality situation (Air Visual, 2018):

- Four cities in Indonesia have Air Quality Index (AQI) higher than 101, which belong to the group categorized as Unhealthy for Sensitive Groups and Unhealthy; and
- Jakarta is ranked in position three among major cities in the world that have the worst AQI (153 - Unhealthy).

Power generation from coal has a major impact to air pollution in major cities. This brings about high health cost to the society and creates growing demand from citizens for cleaner industries. Wind and solar substituting polluting coal plants will help ease environmental concerns and health-related costs.

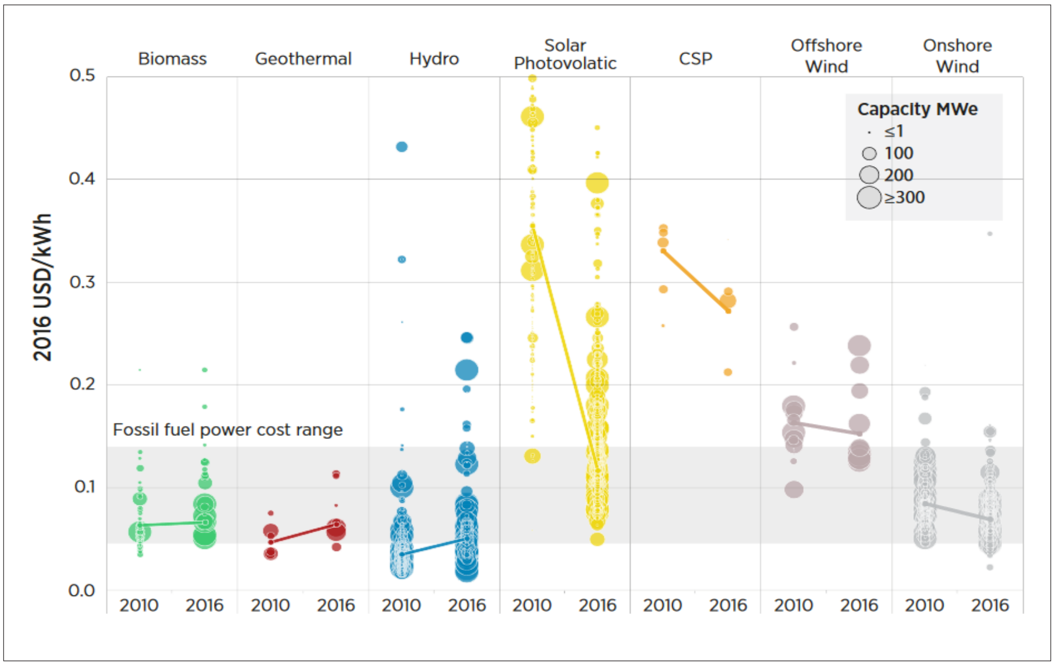


Figure 2
Global weighted levelized cost of electricity and renewable (IRENA, 2017)

2. WHAT ARE THE FRAMEWORKS AND KEY POLICIES IN ENABLING THE GERMAN ENERGIEWENDE?

The Energiewende is supported by an integrated policy that addresses all sectors of the economy. Energiewende policies started more than two decades ago. It sets targets and favouring energy efficiency and renewable energy development. The liberalization of the German electricity and gas market that took place at the end of the 1990s allowed new and innovative actors to enter the market and challenge the business model of the large utilities. In 2010, the German government adopted Energiekonzept or Energy Strategy, an overarching and long-term energy strategy calling for a renewables-based economy by 2050. The implementation of Energiewende is also supported by the strong and early involvement from regions and municipalities.

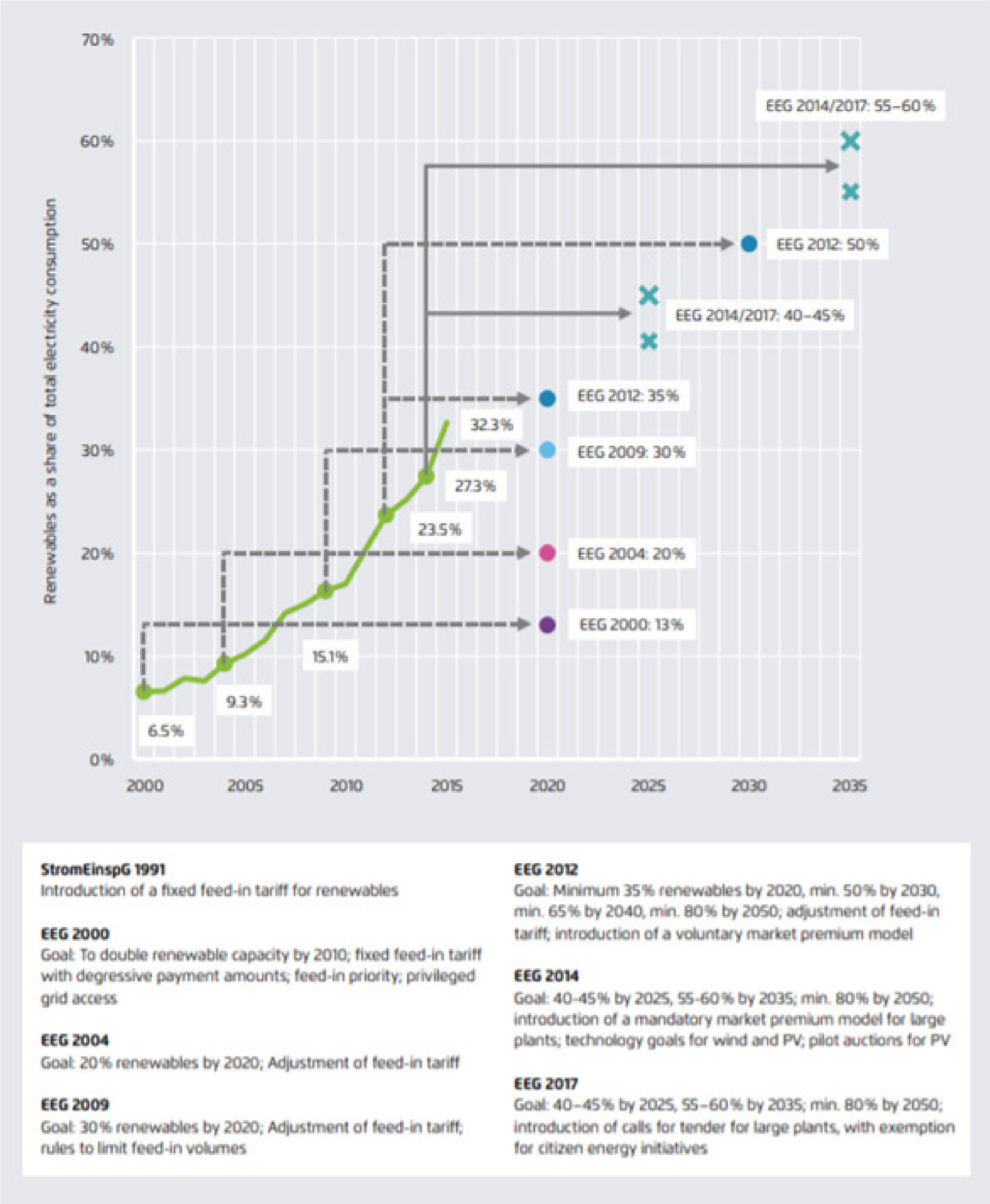
The liberalization of the energy market

Acknowledging the transformative nature of the Energiewende, a structural change in the German energy sector was paramount. The initial step taken was the liberalization of the energy market, as regulated under the Energy Industry Act (Energiewirtschaftgesetz – EnWG). Formerly state-woned, integrated utilities, at the end of the 1990ies, have become private entities, with distinguished business units for generation, transmission, and distribution (unbundling). The liberalization shall enhance competition and drive down consumer prices, while, guaranteeing security of supply and sustainable power production. The EnWG 2005 amendment led to the establishment of a new actor in the energy sector, the Federal Network Agency. It monitors the unbundling of formerly integrated utilities, ensures fair access and use of the powergrid for all users and justified network charges by transmission and distribution system operators. The unbundling eventually led to Transmission System Operators (TSOs) becoming fully independent from utilities. The four TSOs continue ensuring reliable access by adopting the operation to meet the challenges of penetration of variable renewable energy, thus developing into enablers of the energy transition.

The Renewable Energy Act ensures continuous and sustainable growth of renewable energy

The development of renewable energy in Germany has been supported since the 1990s by a regulatory regime which guarantees reliable investment conditions for renewable energy producers through a fixed remuneration for twenty years (feed-in tariff) and priority access to the grid. The German Renewable Energy Act (EEG) has been continuously modified over the years. Each new set of rules has sought to stimulate innovation, to speed up technological development and cost degression, and to improve the integration of electricity from renewables into grid and market. Thanks to this support scheme, the share of renewables in power consumption has grown continuously, from 6.5 percent in 2000 to 36 percent in 2017, and renewables have become a mature market. With each new set of EEG rules, the mid and long-term targets have been raised.

In 2016, the German government amended the Renewable Energy Act, the EEG 2017 (entered into force in January 2017), as well as other important energy regulations. The core change to the Renewables



Source: Agora Energiewende (2016)

Figure 3
Gemany's renewable energy act development

Energy Act is that support for renewable energy projects will now be mostly determined by market mechanisms, by means of an auction system, rather than being fixed by the government through the feed-in tariff system. According to the German government, this new auction system will ensure that the expansion of renewables proceeds at a steady and controlled pace and at low cost. At the same time, small scale projects, such as rooftop solar PV, continue to receive FiT, which are adjusted continuously according to market developments.

Supporting policies from Pan-European to local level

Combining wind and solar generation from different regions with demand across Europe through cross border system integration helps smoothen the variability of wind and solar and enables the power to flow from resource-rich areas to where the power is needed. On the European level, policies have focused on improving the regional coordination of both transmission system operation and planning. On the planning side, The Ten Years Network Development Plan (TYNDP) is key. The TYNDP is drafted by the European Network of Transmission System Operators (ENTSO-E) based on input of European TSOs and wide range of consulted stakeholders and is later adopted by the European Commission[3].

In addition to European level policy, regions and municipalities play an important role in accelerating the energy transition. In the multi-level governance, the municipalities have the autonomy to define and implement their own policy as they see fit within the larger framework. Many regions and municipalities have formulated their own renewable energy targets which are sometimes more ambitious than those on the federal level. They thus serve as a test field and driver for certain regulation or concepts, which, if they turn out to be successful, can later be applied more widely. They are actively participating, for example through building codes, the provision of energy (municipal electricity supplier -Stadtwerke) and designating priority areas for renewable energy plants. In fact, almost 50 percent of the German renewable energy projects is citizen-owned. The municipalities profit by creating local added value, modernized infrastructure, reducing pollution, and creating local jobs.

What are the policies and regulatory frameworks needed to promote the energy transition in Indonesia?

First and foremost is the commitment from the national government to renewable energy development. It shall be expressed through ambitious national targets and a consistent policy design down to implementation procedures on the local level. This is to create a stable and attractive environment for national and international actors to invest on renewable energy deployment in Indonesia. In parallel, the electricity grid system planning will have to be in line with the set targets and be able to absorb the renewable energy without additional cost. As renewable energy projects mature and costs come down further, a competitive market can help to obtain least cost renewable energy.

3 European Network of Transmission System Operator, represents 43 TSOs from 36 countries across Europe. It aimed to support implementation of EU energy and climate policy.

Existing Policy/Regulation Frameworks on Clean Energy in Indonesia

Through law no. 30/2009 on electricity article 6 clause 2, Indonesia has set a priority to electricity from New and Renewable Energy (NRE) to ensure the sustainability of national electricity supply. This national commitment is further defined in National Energy Policy/KEN (Government Regulation No. 79/2014) and the General Planning for National Energy/RUEN (Presidential Regulation No. 22/2017) which stipulate the country's ambitious target on utilizing 23 percent renewable energy (RE) in its primary energy mix or equal to 45 GW of RE power plant by 2025. However, the General Planning for National Electricity (RUKN) organized by Directorate General of Electricity, and the state-owned utility company's Electricity Supply Business Plan (RUPTL) prioritizes what seems to be the cheapest source of electricity in the short run to fulfill the electricity development need in the future (PLN, Interview, 28 August 2018).

As a business entity, PLN is pressured by the need to lower their electricity generation cost to increase revenue and reduce electricity subsidy. The PLN stance is in line with the government objective. The current presidency (Joko Widodo 2014-2019) interest is to ensure economic growth and development of infrastructure. On energy sector, Jokowi has focused on energy security, maintaining low electricity prices, reducing subsidies and universal access to electricity. However, despite showing positive attitude toward RE, the presidency fails to exhibit definitive action to achieve the committed renewable energy target. (Bridle et al.)

The Ministry of Energy and Mineral Resources (MEMR) regulation No. 50/2017 is a clear manifestation of this political stance. The regulation stipulates that the tariff for RE power plant is set to be lower than local cost of generation (Biaya Pokok Produksi - BPP) (Figure 4). Government rationale for this regulation is to promote renewable energy development in undeveloped region of Indonesia, particularly the eastern region, while also fulfilling the energy access objective. However, it also means putting renewable energy to compete directly with subsidized coal power plant (subsidy given to both upstream, through tax reduction for coal mining company, and downstream, through capping the cost of coal for domestic electricity generation).

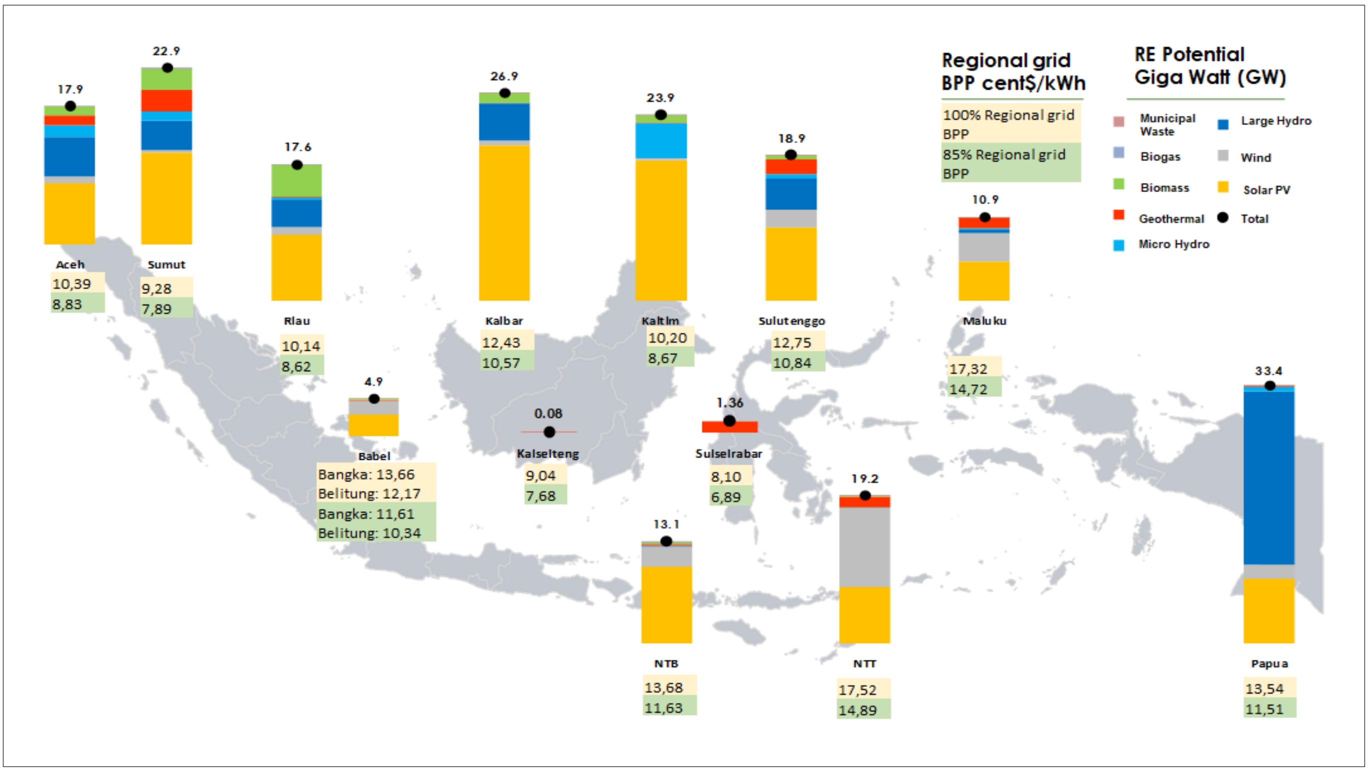


Figure 4
RE tariff set from regional BPP value (in cent$/kWh) and RE potential of Indonesia (in GW) (DGNREEC, 2018)

The MEMR Reg. 50/2017 has discouraged private investors from entering renewable energy market in Indonesia. The regulations also serve an opposite effect from the government intentions on bolstering energy security by attracting investment on small-scale/off-grid renewable energy in the eastern part of Indonesia. In general, the investors are more inclines to developing large-scale project on area with relatively good electricity infrastructure and access (e.g Sumatera and Sulawesi) due to lower cost of electricity provided by the larger scale project and the lower risk perceived for project on an existing infrastructure (Kennedy, 2018).

Barriers for Energy Transition in Indonesia

Barriers for energy transition in Indonesia can be categorized into regulatory barriers, market barriers, and technical barriers (Purwanto and Pratama 2017).

All the following barriers need to be addressed accordingly to promote energy transition in Indonesia.

- **Regulatory barriers: lack of coordination between government institutions, regulatory uncertainty, and frequent amendments to legislation.** There are conflicting interests, even between government institutions, on how to shape the power sector. Ministry of Energy and Mineral Resources (MEMR), who is responsible in navigating the energy and electricity policy, has issued national policy (KEN and RUEN) directing the energy transition in Indonesia. However, PLN, the state-owned company which controls more than 95% electricity supply in Indonesia, is operating under Ministry of State-Owned Enterprises (MSOE) whose main interest is to make sure all the state-owned companies have positive financial balance at the end of the year. Moreover, the Ministry of Finance (MoF) has concern over the electricity subsidy that is becoming a burden as the electricity demand is growing. Therefore, designing transformative policies is challenging as it may not be aligned with all the ministries interest and thus requires extensive deliberation and coordination.

The regulatory trend shows frequent changes in recent years. This has increased uncertainty for investors since they see these changes as additional investment risk and increase investment cost due to expense on understanding and incorporating the new regulation into the project (Bridle et al., 2017). In fact, regulatory uncertainty is seen as the top barriers from investor perspective based on a recent PwC survey (PwC & APLSI, 2018).

- **Market entry barriers: the energy subsidies (fossil fuel), regulated electricity tariff, and renewable energy tariff.**
  The energy (fossil fuel) prices in Indonesia is still subsidized and the electricity price is heavily regulated with intention to provide "cheap" energy to the people. Both issues have political motives and therefore, are very difficult to change. The conditions, however, have implications on competitiveness of immature Indonesia renewable energy industry that is forced to produce electricity at lower or equal cost with subsidized fossil fuel power according to the last MEMR regulatio.

- **Technical barriers: geographic condition, fragmented grid, and limited technical capability.**
  The geographic condition has created a hindrance in providing equal access of energy to all the provinces in Indonesia. Moreover, Indonesian grid system is fragmented and consists of 8 interconnected networks, over 600 isolated grid, and other smaller grid on remote cities and villages (Purwanto and Pratama 2017). This condition makes integration of VRE more challenging, as it limits the ability of the grid to mitigate the variability of wind and solar.

Strong leadership and commitment to ensure smooth energy transition

Indonesia already has the basic policy/frameworks and target laid out for renewable energy development. What lacking is the consistency of the derivative regulation. This can be done if the president does convey a clear vision towards the development of renewable energies. The vision shall then be translated by the relevant ministry into an integrated policy framework that tackles the renewable energy development barriers.

PLN's position towards renewable energy can be a deciding factor for the success of the energy transition in Indonesia. As a single off-taker of electricity, PLN is still reluctant to increase renewable development mainly because of two reasons: the variability of renewables requires adjustments in system operation, and wind and solar electricity generation cost seems to be higher than fossil fuels – a judgement that is increasingly been challenged by global price trends, though. A successful energy transition policy will need to address the risks of PLN in integrating the renewables (initial cost and variability) as well as supporting its business transformation. The first one can be done by increasing the competitiveness of renewable energy through suitable support mechanisms, while the latter will require a comprehensive planning on integrating renewable energy to the business portfolio, considering the geography and grid condition in Indonesia.

Conducive investment environment allows renewable development to take-off

Globally, renewable technology cost has decreased significantly in recent years and makes it competitive with other conventional technology. To gain benefit from this market, Indonesia should build an attractive and conducive environment for investment in renewable energy to attract investor (as well as technology and knowledge) to the country. By keeping the stability of investment environment and updating the related policy as necessary to respond to market change, Indonesia can simultaneously increase its renewable energy capacity and develop its local industries. To further support the local, Indonesia may also introduce an additional financing instrument/ policy that can copy a working policy in small medium enterprise (SME) sector such as KUR (Kredit Usaha Rakyat)[4].

4 KUR is stipulated under ministerial regulation No. 11/2017 from Coordinating Ministry for Economic Affairs. Under KUR scheme, the government provide a credit guarantee and allow bank to provide loan with low interest rate to eligible user. Recently the interest rate has been decreased into 7% per year from 9% per year.

Comprehensive grid development plan may avoid additional cost

To address the variability of renewable, the grid system development plan has to be in line with the renewable energy deployment narrative. This is to avoid additional cost of retrofitting when integrating renewable energy to the system. There will also be a need to assemble a specific plan for each main grid (on each main island), considering the renewable potential, renewable deployment plan, grid current condition and key strategy to address variability such as flexible power plant operation or including storage systems (pumped hydro storage).

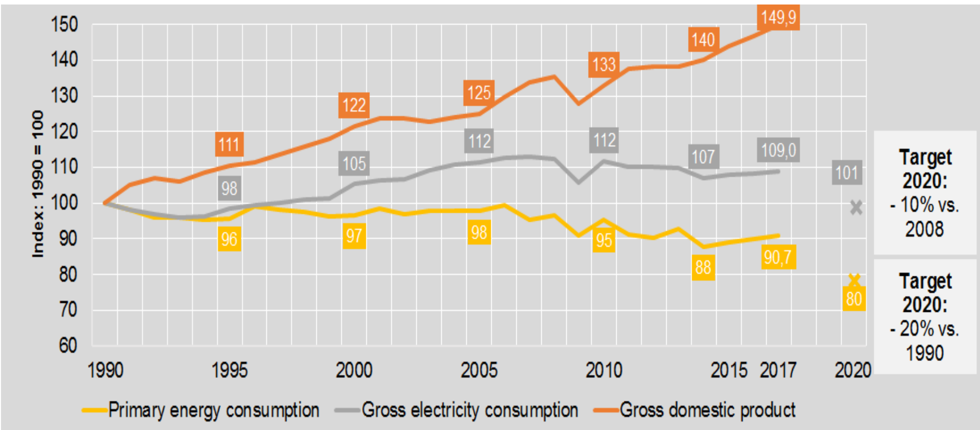
In summary, the successful energy transition in Indonesia requires a strong commitment from the top government figure in order to provide a favorable and stable policy design in renewable energy deployment. This is to attract investors and allow cheap renewable energy to take off. At the early phase of the process, a combination of comprehensive grid planning, and adaptation from PLN are key to integrate renewable energy and avoid stranded investment in generation and the grid. During the process, the government may update the policy in respond to market development and allow for more competition by introducing auction system to get an optimum electricity generation cost that reflect the actual condition and benefits all of the stakeholders.

3. WHAT IS THE IMPACT OF THE ENERGY TRANSITION TO THE DOMESTIC ECONOMY?

Since 2008, the German economy has spent between 2.3 percent and 2.5 percent of annual GDP on its power system. Spending was similar in the mid-1990s but lower in 2000 (1.6 percent). The development of renewable energy and promotion of energy efficiency have stimulated significant investment, encouraging employment and growth. However, given its transformative nature, the Energiewende is crowding out investment and employment in conventional energy sectors. Furthermore, energy intensive companies are shielded from rising power costs, in order to preserve their competitiveness and prevent industrial flight. Thanks to energy efficiency, Germany has successfully decoupled economic growth from energy consumption.

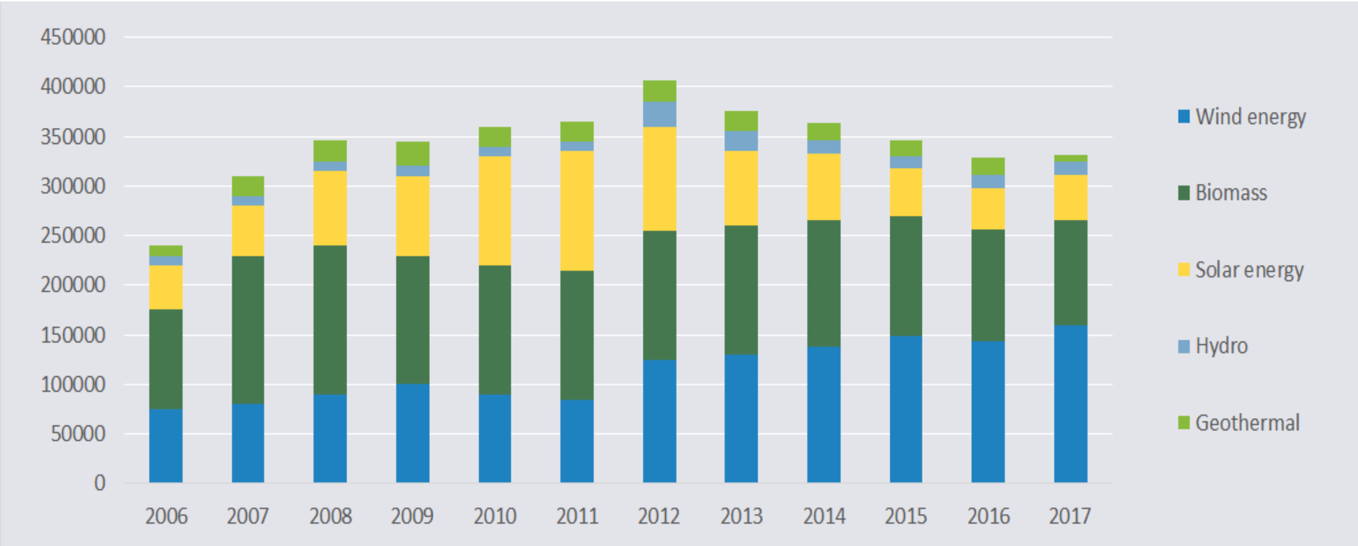
The development of renewable energy is contributing to German GDP growth, and, thanks to energy efficiency, Germany has decoupled economic growth from energy consumption

As a percentage of GDP, total spending in Germany on the power sector has not varied significantly over the last ten years. Since 2008, Germany has spent 2.3 percent to 2.5 percent of annual GDP on its power system, a level similar to the mid-1990s, but higher than in 2000 (1.6 percent). In absolute terms, power system expenditures have risen (from about 60 to 70 billion euros annually) but this increase has been offset by higher GDP. The Energiewende is a process of socio-economic transformation and an important investment program, encouraging growth and innovation in new low-carbon sectors (renewable energy, energy efficiency, new energy services, and alternative transportation). Total investment in renewable energy across all sectors from 2000 to 2015 was 235 billion euros, corresponding to an annual average of 16 billion euros. These investments have contributed to German competitiveness in green technology while also supporting GDP growth. In the decade to come, investment in the power sector is expected to reach about 15 billion euros annually, 9–10 billion euros of which will be invested in new renewable capacity. Furthermore, Germany has managed to decouple economic growth from energy consumption (as can be seen in Figure 5).



Source: AGEB (2017)

Figure 5
Gross domestic product, primary energy, consumption and electricity production, 1990 - 2017 (indexed, 1990=100)



Source: IRENA (2018)

Figure 6
Employment in German Renewable Energy Sector (2006-2017)

In 2017, the German renewable energy industry supported 332,000 jobs

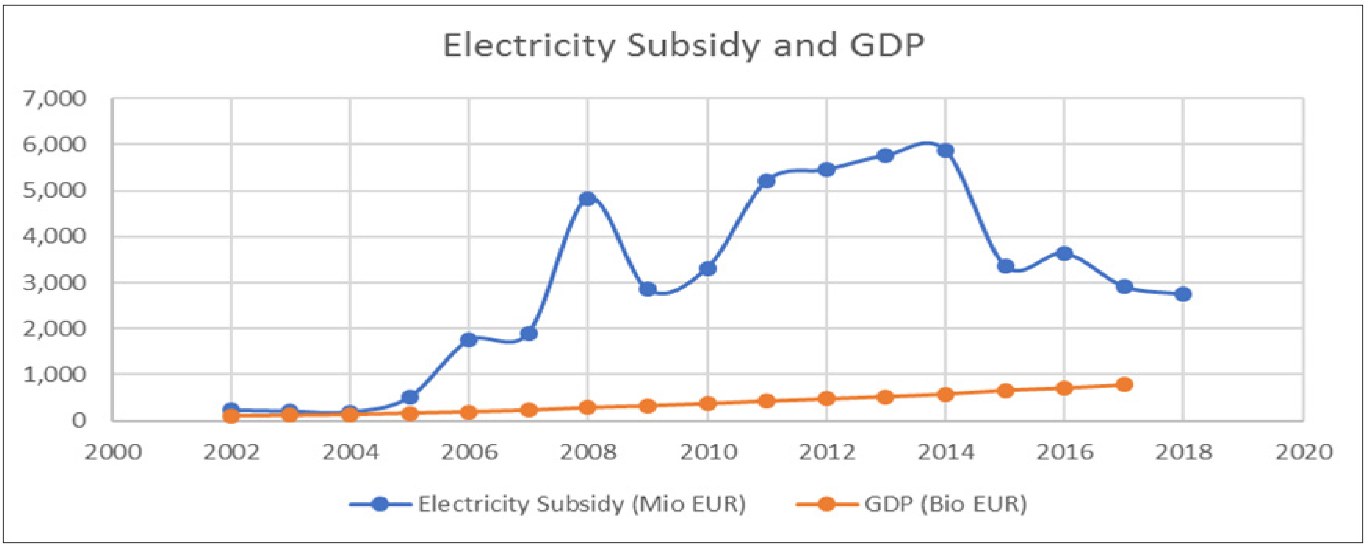
The Energiewende has had an important impact on the employment structure of the energy sector. In 2017, the renewable industry alone accounted for approximately 332,000 jobs, twice as much as in 2004. The wind energy sector is the biggest employer (about 160,000 jobs in 2017) followed by the biomass sector (106,000 jobs). The German solar energy sector (45,500 jobs in 2015) experienced a profound restructuring between 2012 and 2015, losing about 70,000 jobs as a consequence of strong competition on the global market and slow-down of national demand (+1.2 GW installed capacity in 2016 compared to + 7.5 GW annual growth from 2009 to 2012). Nevertheless, the solar energy sector remains an important employer. According to a study commissioned by the Federal Ministry for Economic Affairs and Energy, the net impact of the Energiewende on employment in Germany is moderately positive, with an annual net increase of 18,000 jobs up to 2020 in comparison to a scenario without the Energiewende.

What impact will the energy transition have on the Indonesian economy?

Indonesia has spent between 0.15 percent to 1.70 percent of its annual GDP on electricity subsidy from 2002 to 2017, mainly targeted at people who live in poverty, but some subsidies have missed the target in past. These subsidies are a burden to the state budget, fluctuating, hard to predict and partly depending on the fuel cost. In the other hand, renewable energy use (almost) no fuel, therefore risk of fluctuating fuel cost is irrelevant. In addition, renewables investments are not per se more expensive than other resources. Although in the early stage renewables will require some support, but with reduced risk perception of investors, prices will go down. Renewables also create local value creation. Even without local manufacturing capacity, local job will benefit from significant installation and maintenance works. In combination with energy efficiency, it can bring additional benefit to the economy, through incentivizing the investment, lowering electricity bills and making the industry more competitive.

Shifting the Energy Subsidy

The Government of Indonesia allocates subsidy for energy in forms of electricity, petrol and cooking fuels. Based on data from Indonesia's Ministry of Finance, the general trend for electricity subsidy went up from 2002 to 2014 (with subsidy in 2014 being the highest). However, from 2014 onwards, the subsidy shows a downward trend.



Data source: Ministry of Finance, 2018
Note: Using the exchange rate from https://www.xe.com/

Figure 7
Electricity Subsidy and GDP
(2002 - 2017)

According to the 2009 Electricity Law, electricity price and subsidy are set by the government based on the approval by the parliament every year. The subsidy amount is based on the difference between the average cost of electricity production proposed by PLN and the average electricity pricing set by the government (IISD and IESR, 2011). There are several priorities in electricity subsidies that are defined in the Electricity Law No. 30/2009: (1) people who live in poverty; (2) electrification in undeveloped areas; (3) electrification in isolated areas and border areas; and (4) rural electrification.

To carry out the mandate of this electricity law, the Government applies electricity subsidy on target (Subsidi Listrik Tepat Sasaran) beginning January 2017. With this new policy, the government will only give electricity subsidy to household consumer connection of 450 VA and some household consumer in 900 VA connection with considerably destitute condition. These group of people are given subsidy to make sure they can afford electricity and therefore improve their living conditions.

The Ministry of Energy and Mineral Resources (MEMR) proposed a rise in electricity subsidy, from 2,748 Million Euro in 2018 to 3,325 in 2019. This increase is due to an increase in 450 VA new customers as a follow-up of the electricity in the village program (Program Listrik Masuk Desa). This additional subsidy is also used for the cost of installing new electricity lines for the poor, in expectation that it will increase the electrification ratio near 100 percent by 2020.

The energy transition process in Indonesia requires investment to develop renewable energy and improve energy efficiency towards low carbon development. In order to achieve 38.3 percent of renewable energy share in total electricity generation in Indonesia by 2030 – mentioned as Reference Case 2030 in the Indonesia REmap – the average annual investment of 13.2 billion euros during 2015-2030 is required (IRENA, 2017). It is expected that the annual required investment for renewable electricity will be apparently less than 1 percent of the GDP until 2030.

Installing more renewables instead of coal-fired power plant will reduce the burden (fuel subsidy) on the state budget. However, it also means that the country needs to mobilize more renewables investments, which can be redirected from the energy subsidy.

Renewable energy investment started to grow

In recent years, the media has reported on increasing renewable energy investment especially in renewable electricity. During January-September 2017, there were more than 60 signed renewable electricity projects, i.e. micro hydro, biomass and solar, from only 14 and 16 in 2015 and 2016 respectively (Investor Daily, 2017a). In the absolute term, total installed capacity from these 64 projects will be amounted to 1,100 MW. With the investment cost of USD 1.5 – 2 million per MW, total investment will reach up to USD 2.2 billion (Investor Daily, 2017b). However not all these PPA could materialize into actual capacity addition. As mid-2018, there are still 45 PPA that have not yet received financing.

Renewable electricity development in Indonesia can bring economic benefits to local community

In many smaller islands and remote villages in Indonesia, where there is no electricity access, renewable energy sources are the cheapest option and can bring economic benefits. For example, installation of 120-kW of micro-hydro power plant in Cinta Mekar Village in West Java can provide electricity to 102 households in the area. It leads to the increased village revenue which is reinvested in the village development (IESR, 2011). Another case study is from Kamanggih Village in East Nusa Tenggara. The 35-kW of micro-hydro power plant built in 2011 provides electricity to 148 households. It is utilized for lighting at nights and also improving economic activities in the village (IESR, 2018).

In some villages, electricity from the PLN grid is sometimes limited that they need to use diesel generation-set (genset) for electricity at night. Due to the higher cost of diesel, PLN in East Kalimantan connects electricity to the houses for a limited time at the day. To provide electricity at night, people have to spend around 0.7 to 2 USD /day for the diesel genset. Using renewable electricity (e.g. solar PV and battery storage) can reduce the fuel expense they used for their diesel genset (IESR, 2017). Similar to in East Kalimantan, people in Harowu Village in Central Kalimantan also reduce their expenditure on fuel for genset after they install 15-kW micro-hydro power plant (WWF, 2015).

Installation of renewables, for example wind farm in Sidrap, South Sulawesi also provided benefits to the local economy. With 30 wind turbine generators, this wind farm has 75 MW of installed capacity. The construction of this wind farm utilized 40 percent local content (Tingkat Komponen Dalam Negeri/TKDN) and employed around 1,150 local workers (Sylke Febrina Laucerenco, 2018).

In two IRENA's reports regarding value creation in the photovoltaic and wind energy sector, an income generation and job creation can be realized in the country where the projects are located. Specifically, value creation in photovoltaic and wind energy sector can be divided into these segments of activities (IRENA, 2017b; IRENA, 2017c). Even if considerable part of manufacturing takes places outside of Indonesia, local job will benefit from significant installation and maintenance works. An increase in the photovoltaic and wind energy investment would mean an increase in the available jobs along the value chain. In a scenario with total 104 GW installed renewable capacity in Indonesia by 2030, the potential for job in renewable energy sector increase from just 100 000 today to 1.3 million jobs in 2030. At present, more than 90 percent of the renewable energy jobs are in the labour-intensive palm oil-based biodiesel industry, but this would be more diversified if investments in other areas increase. The scaling up the renewable energy technology market will stimulate technology transfer and provides significant opportunities for localising parts of the value chain. Finally, the impact on overall welfare – a broader indicator that includes not only the economic dimension but also social and environmental factors – is estimated to be between 3.6 percent and 5.8 percent in 2030 (IRENA, 2017a).

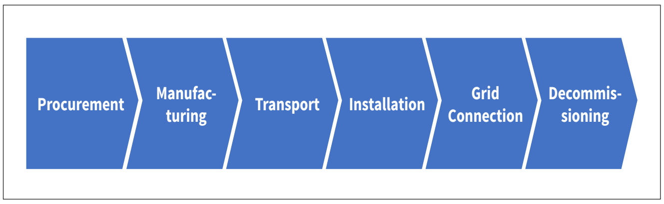


Figure 8
Value Chain in Renewable Energy Project

Significant household electricity bill savings due to growing energy efficiency technologies

Energy efficiency improvements in Indonesia since 2000 have prevented additional 9 percent energy use[5] in 2017. This in turn prevented 65 Mt CO2-eq in emissions and reduced oil imports by 6 percent. The shifting from energy-intensive industry sectors to less-intensive manufacturing and service sectors, as well as shifting towards more efficient modes of transport make the greatest contributions to overall efficiency gains (IEA, 2018).

In the energy efficiency 2018 report, IEA also written, that the biggest opportunities for energy savings in Indonesia come from buildings (38 percent) and industry (35 percent). In buildings, two-third are due to efficiency in space cooling and in appliances. Meanwhile in industry, efficiency is gained from the less energy-intensive manufacturing sectors (IEA, 2018).

There are currently several home appliances with energy efficiency technologies in Indonesia, namely Compact Fluorescent Lamps (CFLs) bulb, Light Emitted Diode (LED) and Inverter Air Conditioner (AC). Corresponding to a big campaign of energy efficient lamps and its associated benefits over a decade, Indonesian consumers saved USD 3.3 billion on their electricity bills in 2016 (IEA, 2017). IEA also projected that with the same market share in 2016 (30% of total light bulbs in 2016), LED lamps could save almost USD 560 million per year by 2030.

The energy efficiency standard and labelling of AC and CFLs bulb that enacted through the Government Regulation untap the saving potential from the Indonesian households, the third largest energy consumer in Indonesia. If 15% of the household electricity consumption saved from these energy efficient appliances, the national electricity consumption could be saved up to 28,040 GWh (Ministry of Energy and Mineral Resources, 2018). With the electricity tariff of Rp 1,352 per kWh, total saving in electricity bills would reach around Rp 37.9 trillion in a year.

5 Energy use covers the residential, industry and services, passenger and freight transport sectors. It excludes non-energy use {i.e. feedstocks) and energy supply.

4. WHERE DO GERMANY AND INDONESIA STAND IN TRANSFORMING THEIR ENERGY SYSTEMS?

Renewable energy has become a key pillar of the German power system. In 2017, renewables accounted for about 36 percent of Germany's power consumption. After years of falling costs, wind energy and solar PV have become the backbone of the German power system transformation. Progress in the area of energy efficiency has been more moderate, as power consumption is only 4 percent below its 2008 levels.

Renewable energy has become a key pillar of Germany's power system

Historically, power generation in Germany has been based on hard coal, lignite and nuclear. The German electricity mix has undergone significant diversification over the last twenty years. This evolution is characterized by:

- A substantial increase in renewable energy (from 3.6 percent of the power production in 1990 to 33 percent in 2017, corresponding to 36.3 percent of national power consumption). Wind energy and solar PV are the two renewable energy technologies with the largest growth potential in Germany, far ahead of other renewables such as biomass, hydro power, marine energy or geothermal energy. The further growth potential of biomass is limited because of costs, land-use constraints and sustainability concerns. Wind and solar PV have undergone considerable development, primarily thanks to the feed-in tariff system introduced by the German Renewable Energy Act (EEG) (see Q2). In recent years the costs of these technologies have dropped dramatically due to technological progress and economies of scale.
- A progressive phase-out of nuclear power (11.6 percent of domestic power production in 2017, down from 27.7 percent in 1990), At current growth rates, renewable energy sources will be able to more than compensate for the phase-out of nuclear by 2022.
- Continuous large-scale generation using lignite (22.6 percent in 2017) and hard coal (14.4 percent in 2017), with lignite power production remaining almost constant over the last twenty years and hard coal slowly declining.
- Moderate decrease in power consumption over the last ten years (about -0.5 percent annual average).

Since 2014, renewables produced more electricity than lignite, evolving from a niche technology into a major pillar of the power system.

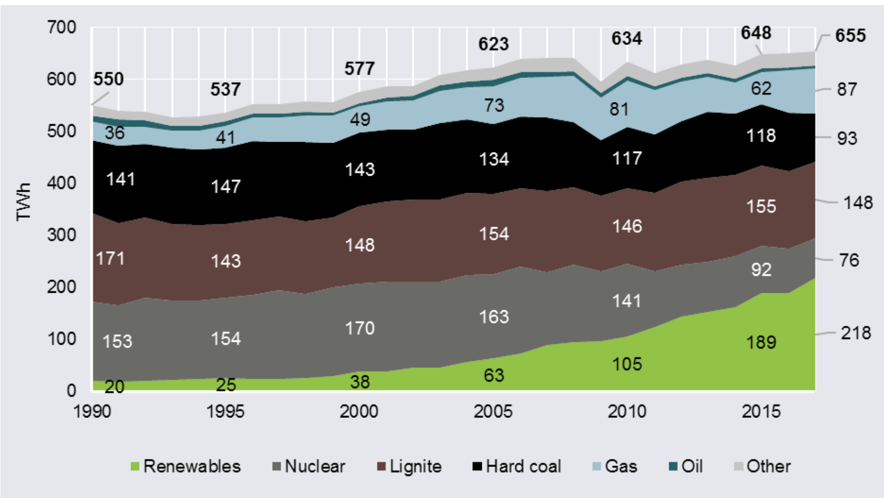
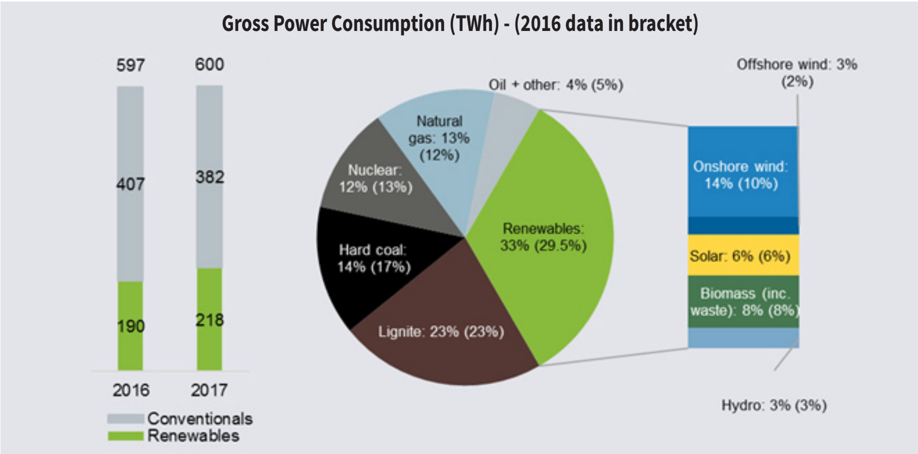


Figure 9.
Germany Gross Power Generation by type (1990-2017)



Source: AGEB (2017)

Figure 10
Germany Gross Power Consumption in 2017 (2016 data in bracket)

How about energy transition in Indonesia?

Indonesia has immense renewable energy potential, to install at least 533 GW of solar energy, 75 GW of hydro, 19 GW of mini/micro-hydro, 33 GW of bioenergy, 29.5 GW of geothermal energy, 18 GW of tidal energy, and 9.3 GW of onshore wind energy (IRENA, 2015). Despite this huge potential, Indonesia is lagging well behind many other countries in developing renewables. In 2017, renewables only accounted for 12.5 percent of total electricity generation, mostly from hydro and geothermal energy, while the remaining generation was provided by coal (57 percent), oil (6 percent), and natural gas (25 percent). Solar and wind energy remain almost entirely unused.

Indonesia's primary energy intensity was still high at 565 TOE/million $GDP compared to the OECD countries at 139 TOE/million $GDP (ADB, 2015). Its energy elasticity, i.e. the percentage change in energy consumption to achieve one percent growth in GDP, has consistently been above 1.0 in the last five years (RUEN, 2017).

Heavy reliance on coal to generate electricity

Indonesia has long relied on fossil fuel to generate electricity. The Indonesian power sector has undergone some changes over the last forty years.

- After the oil crises in 1970s, Indonesia started to reduce its oil-based electricity generation from 56% in 1971 to only 23 percent in 2009. The decrease continues until 2017 where oil only made up less than 6 percent of total electricity generation.

- The coal-based electricity production had increased from zero in 1971 to 42 percent of total electricity generation in 2009. As the share of oil in generation continues to decline, coal fills in the gap and becomes the main source of electricity in Indonesia. By 2017, coal contributed to more than 57 percent of electricity generation in the country. This figure would likely soar as the state-owned utility, PLN, has planned to build more than 26 GW of coal power plants by 2027 (PLN, 2018). The recent electricity demand growth, however, did not reach the expected growth used when planning the massive coal plant development in Indonesia. The oversupplied power and declining renewables prices will pose the country to the risk of stranded assets.

- Gas-based electricity had grown from zero in 1971 to 22 percent in 2009. There is no significant relative increase from 2009 to 2017 where gas covered 25 percent of electricity generation in Indonesia.

- The renewables only comprised 3.4 percent of total electricity generation in 1990 and had only been increased to 6 percent in 2009 (excluding hydro). By 2017, the renewables (including hydro) comprised 12.5 percent of power generation in Indonesia. The growth in renewable energy is primarily due to hydro and geothermal investment, leaving other types of renewables underutilized. Increase in renewables is expected to remain low under current regulatory conditions, as the current FIT scheme does not provide sufficient incentives for investors to start investing in new technologies in Indonesia.

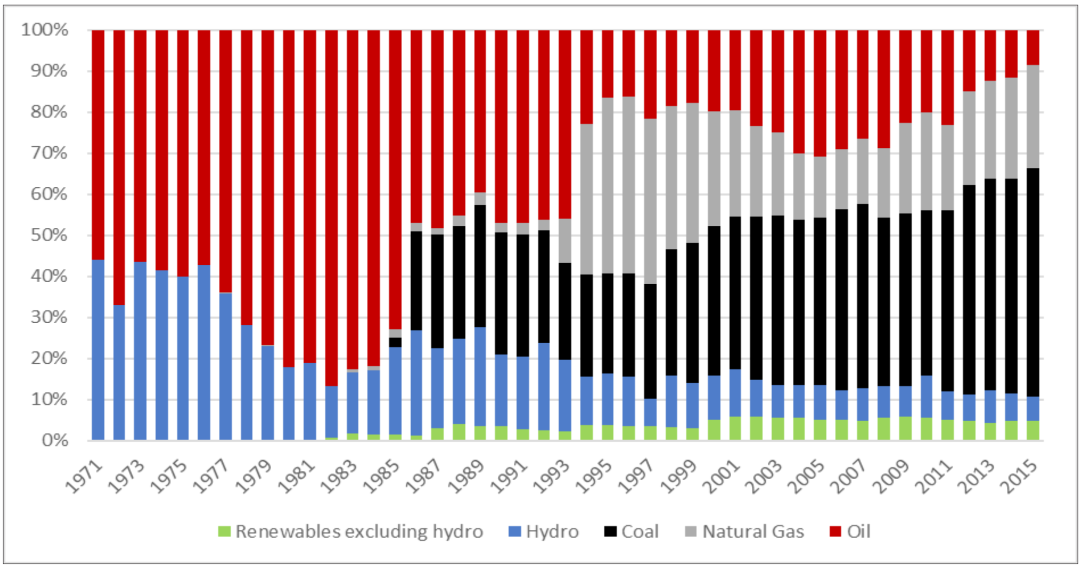


Figure 11
Electricity generation by sources (percent of total)

Source: World Bank Indicator (2018)

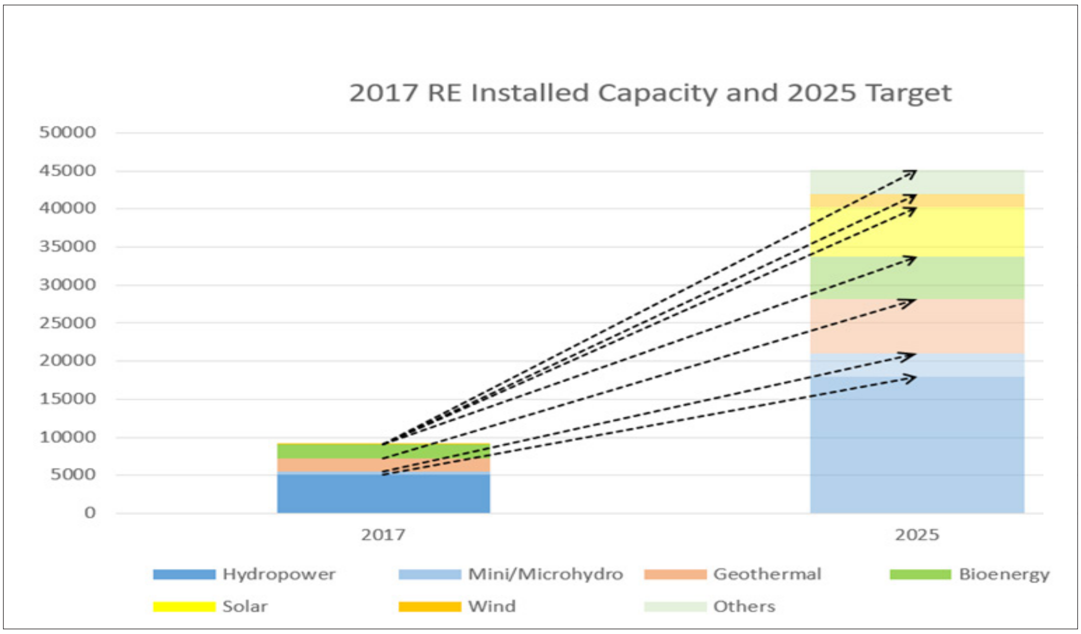


Figure 12
Required Annual Capacity Addition to Meet the 23 percent Renewables Target in MW

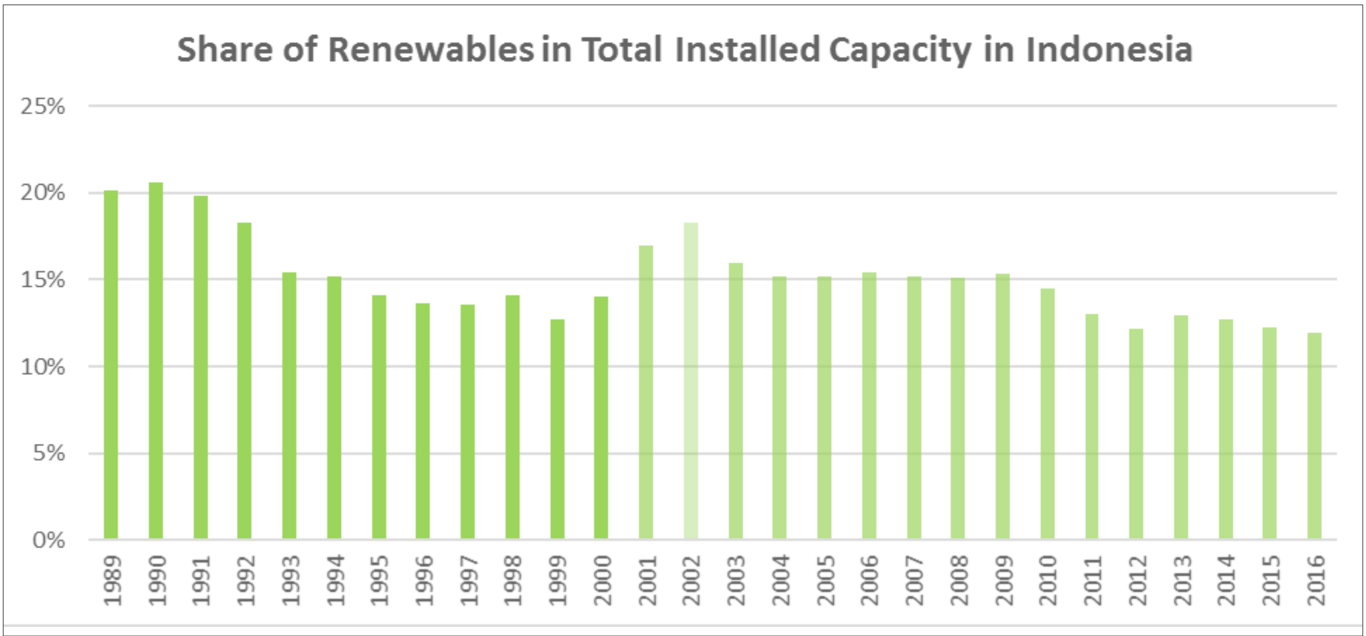
(Data source: Capaian EBTKE Triwulan I 2018 for 2017, RUEN for targets).
Note: The 2017 data is preliminary, data is patchy.

Sluggish development of renewable energy

The Indonesian government through the National Energy Policy (KEN) has set targets to increase the share of renewable energy in the primary energy mix to 23 percent by 2025 and 31 percent by 2050. The targets were then translated into the General Planning for National Energy (RUEN), which was stipulated in 2017 to provide a roadmap to achieve the national energy targets set in KEN. To reach these targets, Indonesia needs to install at least 45 GW of renewables, up from 9 GW today. The annual capacity additions need to increase by a factor of ten, from 440 MW annually during the past decade to 4.5 GW annually until 2025.

To achieve universal electricity access and boost production growth, President Joko Widodo made commitment to build a total of 35,000 MW of power plant capacity. Since his inauguration in 2014, total installed capacity of power plant in Indonesia continues to increase with an average increase of 2.25 GW/year. From the ambitious 35,000 MW plan, 1.4 GW has been put in operation until mid-2018. Around 16.5 GW are in construction phase, 13.5 GW are under negotiation, while the rest are currently under planning and procurement phase (MEMR, 2018). A major reason for the delay, beside the technical and non-technical issue in delivery, is the fact that demand is growing not as steeply as planned. Sales of PLN, who has monopolized power sales, have increased by 4.7 percent in 2017 (PLN, 2018), while the plans foresaw a growth of 8.3 percent. This condition forces PLN to postpone commercial operation date of a considerable amount of power plant projects in the program. On top of that, PLN is shaken by corruption accuses: The Corruption Eradication Commission (KPK) is currently investigating graft case pertaining to coal power plant construction in Riau, Sumatera.

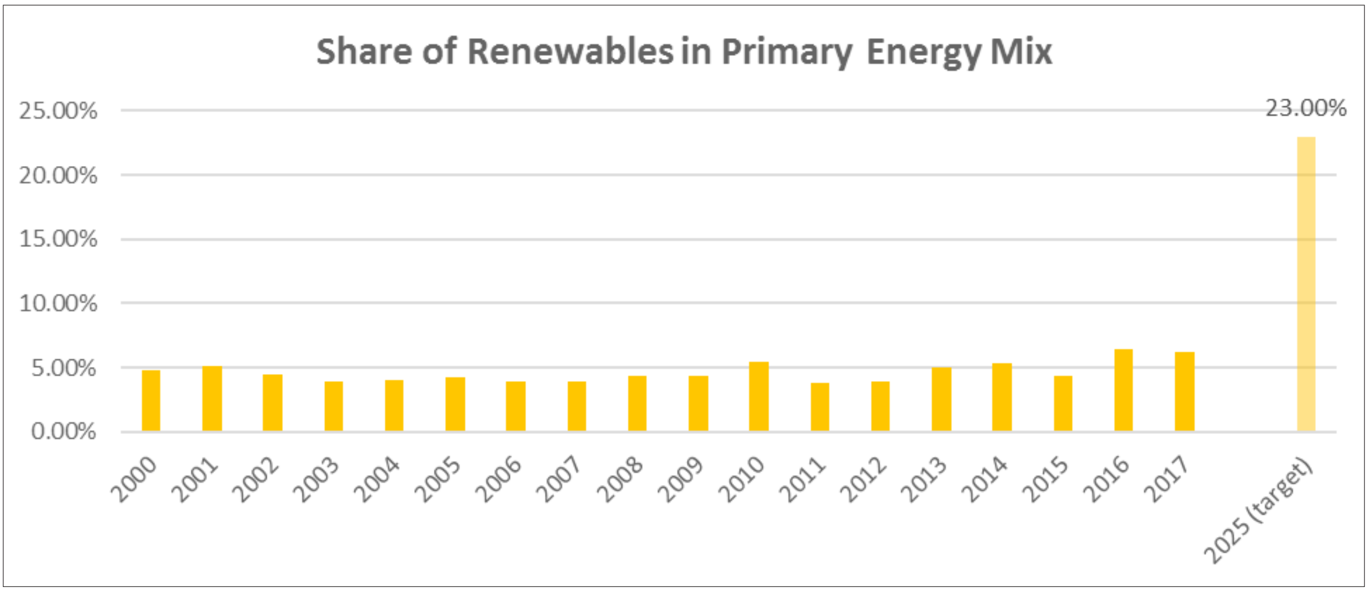
More than half of the capacity under the 35-GW-program is planned to by coal-fired power plants. The renewable energy sources planned in this program mostly come from large-scale hydro and geothermal, ignoring the attractive biomass, solar and wind potential in the country. Rather than increasing, the share of renewables seems to be decreasing as demand growth. The share of renewables in the installed capacity mix had shown a declining trend between 1989 and 2000 (including PLN, captive and private companies). The share had also decreased from around 17 percent in 2001 to 12 percent in 2016 (including PLN and private companies). In fact, the share of renewables in primary energy is much less than the targeted 23 percent share. By 2017, the share of renewables in the primary energy only reached 6.24 percent (MEMR, 2018). This number was less than the share in 2016 at 6.45 percent. If the trend, along with delay in commissioning, continues, Indonesia is set to miss its 23 percent renewables target.



Source: Electricity Statistics

Figure 13
Year-on-Year Renewables Capacity in Indonesia

Note: excluding off-grid bioenergy system, data on 1989 to 2000 includes PLN, captive, and private power, data on 2001 to 2016 includes PLN and private power, data on 2002 includes PLN capacity only.



Source: Handbook of Energy & Economic Statistics of Indonesia

Figure 14
Share of Renewables
in Primary Energy Mix

5. WILL INVESTMENT IN RENEWABLES IN THE POWER SECTOR ALONE SUFFICIENTLY REDUCE GERMANY'S CO_2 EMISSIONS?

Not really. In 2017, after declining for four consecutive years, coal power generation and CO_2 emissions in the German power sector were below their 2010 levels. However, German greenhouse gas emissions have slightly increased over the past three years, because of insufficient emission reductions in the heating, transportation and industrial sectors. Nevertheless, the strong competitiveness of existing coal power plants has had a negative impact on Germany's overall CO_2 emissions. In order to meet its climate targets, Germany needs to gradually phase-out coal power.

The power sector is still a large CO_2 emitter, but its emissions are below 2010 levels and have been declining for three years running

Germany has adopted ambitious climate targets and aims to reduce its greenhouse gas emissions by 40 per cent in 2020, at least 55 percent in 2030, at least 70 per cent in 2040 and by 80–95 percent by 2050 (over 1990 levels). In 2017, greenhouse gas emissions were 27.7 percent below 1990 levels and the emissions of the power sector were below 2010 levels. However, it is unlikely that Germany will reach the 2020 target. The Federal Government projected that under the current adopted measures, Germany's greenhouse gas emission will fall 34.7 percent by 2020 (816 Mt CO2). This would be equivalent to reduction of 90 Mt CO2 within four years, a significant reduction that has happened between 2006 and 2009 in the course of the world economic crisis. While the 2020 target will most probably be missed, the government has underlined its commitment to the 2030 target.

Over the past three years, the overall greenhouse gas emissions have slightly increased, because of insufficient emission reductions in the industrial, heating and transportation sectors. The German power sector – which is still highly dependent on coal – is the largest emitter, responsible for about 40 percent of overall national greenhouse gas emissions (328 Mt CO_2 in 2017). The decarbonization of the power sector is therefore essential for reaching climate targets.

The most recent investment decisions for new coal power plants in Germany were made about 10 years ago. One of those projects (Datteln 4) is still under construction, but otherwise there are no plans to build new coal power plants in Germany.

Since 2014, coal power generation and CO_2 emissions in the power sector have been slightly declining

The CO_2 emissions of the power sector increased in 2012 and 2013, despite the development of renewables and increased energy efficiency (a counterintuitive development known as the "Energiewende paradox"). These high emissions are explained by the high competitiveness of coal power plants, which are still responsible for 40 percent of total electricity generation in Germany. As a consequence of low coal and CO_2 prices (in the context of a weak European Emission Trading Scheme), coal-power production levels in Germany have been high, crowding-out less polluting natural-gas power plants, both in Germany and in neighboring countries. This has led to high CO_2 emissions as well as historically high exports (with benefits for neighboring countries, which profit from lower electricity prices).

Germany needs to gradually phase-out coal power in order to meet its climate targets

The emissions of the power sector are expected to decline further. However, this declining trend in the power sector is not sufficient to meet the 2020 and 2030 reduction targets, leaving further reduction efforts necessary. A set of complementary policy measures have been adopted in order to close this gap, including the retirement of old lignite power plants (2.7 GW, about 13 percent of old lignite power capacity in Germany). Once off the market, these plants will remain for four years in a "climate reserve" and will only be activated if there is a danger of a severe power shortfall. After four more years, the plants will be shut down completely. Ultimately, there is no alternative to the phasing out of coal power if Germany is to fulfill its climate goals. In view of trends in the energy economy (including persistent low coal and CO_2 certificate prices), targeted action must be taken, as market-based instruments will not be sufficient. Therefore, the new coalition government has set up a "Coal Commission", which was tasked to come up with a comprehensive plan for phasing out coal power generation (see Q6).

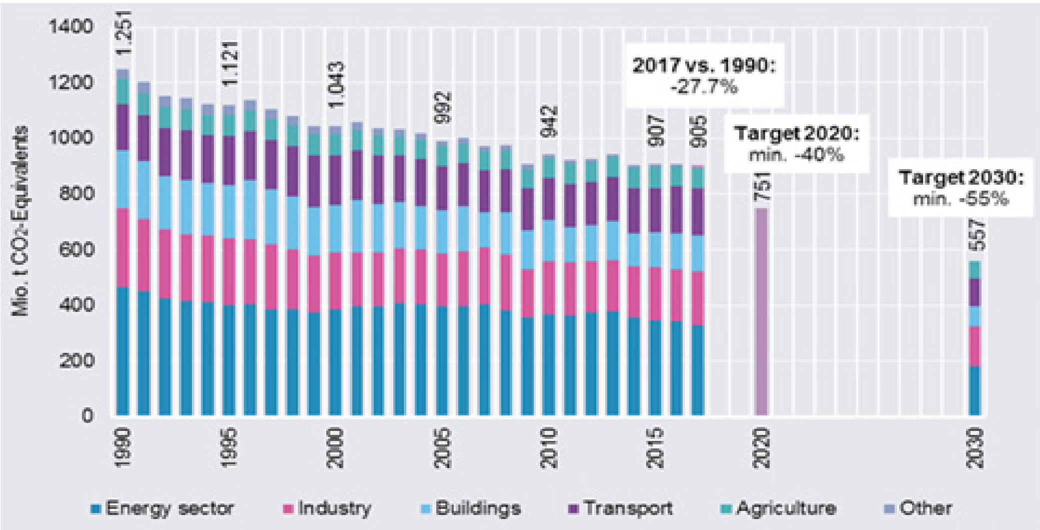


Figure 15
Greenhouse gas emission by sector, 1990 - 2016, together with reduction targets for 2020 and 2030

Source: UBA (2017)

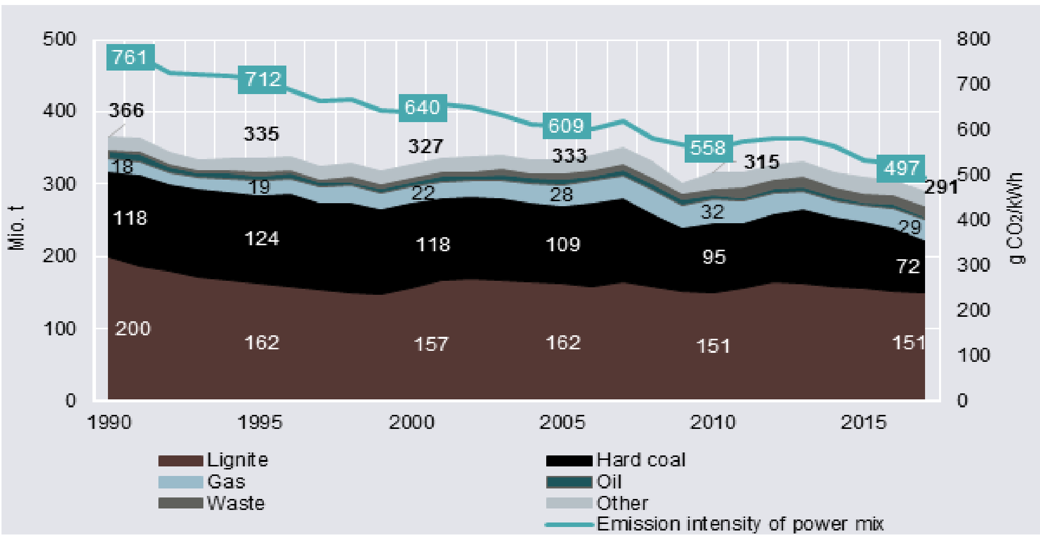


Figure 16
Greenhouse gas emission by power source

Source: UBA (2017)

What is the negative environmental impact of coal power plants in Indonesia?

Coal power plants are one of the major contributors to environmental pollution in Indonesia. The CO_2 emission from energy sector contributes 16.3 percent of Indonesian GHG emission and has kept increasing with annual rate of 6.3 percent between 2000-2016. The emission standard for coal fired power plants is significantly lower than in other countries, imposing a high risk on health (premature deaths from stroke, heart disease, and lung disease) and environment (water and coal ash pollution). Moreover, the increasing share of coal power plant in the electricity mix will contribute to Indonesia to missing its emissions reductions targets.

The Coal Power Plant Emissions put human health at risk

The emission standards for coal power plants set by Indonesian regulation are considerably lower than in other countries, including China and India (see table 1). These low standards, combined with a lack of penalties and an inadequate monitoring system have allowed coal power plants to pollute the environment beyond international practice and put human health at particularly high risk.

There are numerous health risks caused by pollutants from coal power plant. For instance, particulate matter (PM) which comes directly from burning of fossil fuels or indirectly from chemical reactions with other pollutants, can penetrate the respiratory system, enter into the bloodstream, and increase the risk of lung disease and cardiovascular disorder. Several studies showed that pollutants from operating coal power plant in Indonesia can potentially cause 7,100 premature deaths annually and the number will increase to 28,300 premature deaths if all the coal power plant under old energy scenario (excluding the 35 GW plan) are built and completed. The study also showed that Indonesia is projected to have the highest premature death in South East Asia (Harvard and Greenpeace, 2015; Koplitz et.al., 2017).

Considering the impacts explained earlier, new regulations on emission standards are being discussed. These will include a categorization of the emissions standards based on power plant COD as well as a new standard on mercury (Interview, Ministry of Environment and Forestry representative, Sept. 9, 2018). However, it is also necessary to develop a strategy to manage the existing coal power plants emissions and future reduction of coal capacities in order to meet Indonesia's climate goal.

Table 2. Emission Standards for Coal-Based Power Plants in Major Countries

	PM	SO_2		NO_x		Mercury
		New plants	Existing plants	New plants	Existing plants	
EU	50 – 100	200	400	200 (after 2015)	500 (till 2015)	0.03 (Germany)
US	22.5	160 (after 2005)	160 (1997 – 2005)	117	117 (after 2005); 160 (1997 – 2005)	0.0001 – 0.006
China	30	100	200; 400*	100	100 (2004 – 11); 200 (before 2004)	0.03
India	100 (till 2003); 50 (2004-16)	100	600 (<500MW); 200 (≥500MW)	100	600 (till 2003); 300 (2004-16)	0.03
Indonesia	150 - 100	750	750	850	750	None

Source: World Resources Institute Asia. Environmental Science and Technology.
Unit: mg/Nm3
*SO2 standards of 400 mg/m3 for four provinces with high sulphur coal

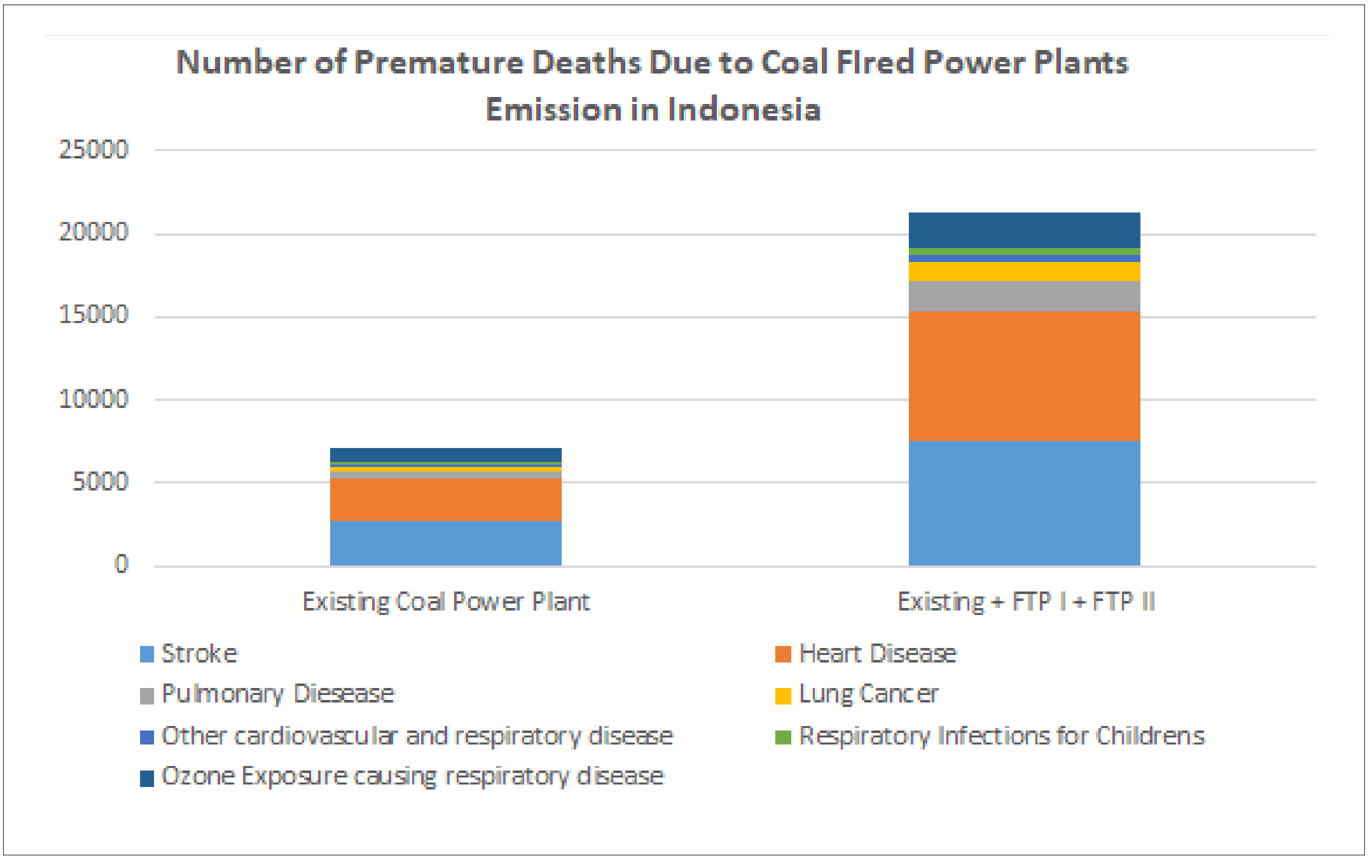


Figure 17
Number of Premature Deaths due to Coal Power Plants Emission in Indonesia

Reaching Indonesia's climate goal means the exit from coal-based electricity

In 2015 during the COP-21 in Paris, an agreement, known as Paris Agreement, was formulated. The central aim of the Paris Agreement is to mitigate the impacts of climate change by reducing carbon emissions globally – and, thus, by every country. To reach these ambitious goals, appropriate financial flows, a new technology framework and an enhanced capacity building framework will be put in place, thus supporting action by developing countries and the most vulnerable countries, in line with their own national objectives. After entering into force on 4 November 2016, all parties required to put forward their best effort through nationally determined contributions (NDCs) and to strengthen these efforts in the years ahead (United Nations Framework Convention on Climate Change, 2016). In the first NDC Indonesia set an unconditional reduction target of 29 percent (CM1) and a conditional target up to 41 percent (CM2) below BAU scenario by 2030. The target is based on the business as usual (BAU) case at 2030, which included the impact of 35 GW program that has a considerable share of coal power plant. Emission from the energy sector is projected to be 18.8 percent less compared to BAU. However, the projected emission is still significantly higher, 219 percent increase compared to its 2016 value.

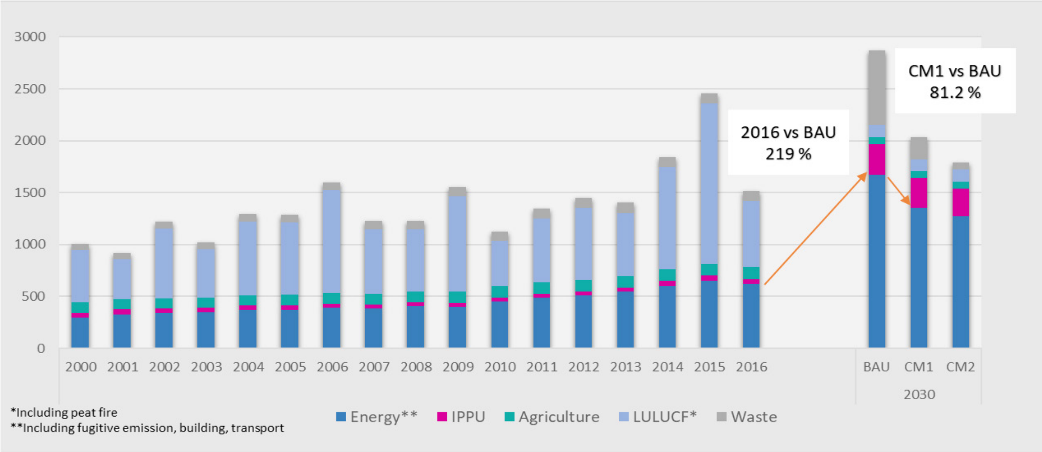


Figure 18
Greenhouse Gas Emission by sector, 2000-2016, with NDC target (in Mt CO2 eq.)

Source: Laporan Inventarisasi GRK & NDC. MoEF (2017)

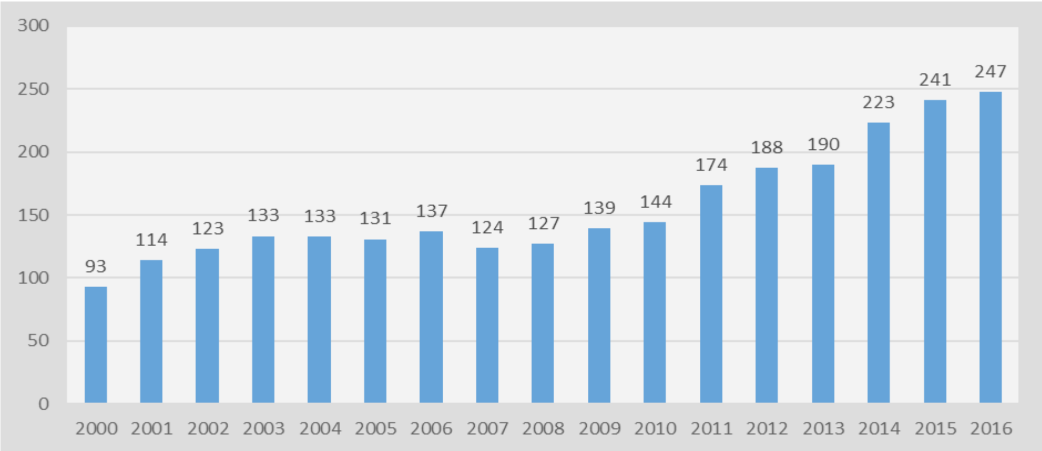


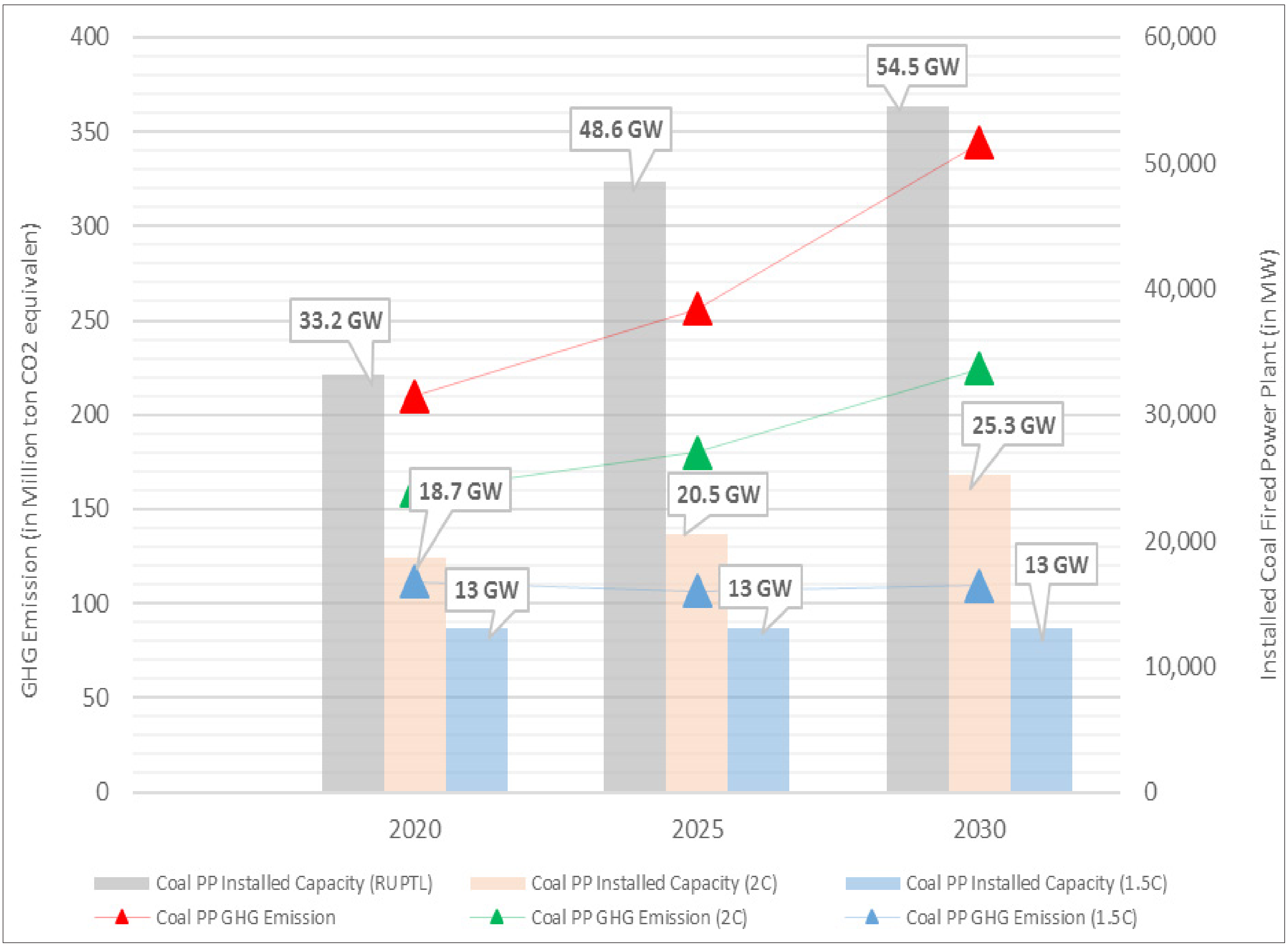
Figure 19
Greenhouse Gas Emission in Energy Industry Subsector, 2000-2016

Source: Laporan Inventarisasi GRK. MoEF (2017)[6]

The mitigation actions in the electricity sector are defined by three main programs: construction of renewable power plants, implementation of Clean Coal Technology (CCT), and cogeneration in power plant system. In 2016, the three programs have contributed 4.01, 2.16 and 1.03 million Ton CO_2-e emission reduction respectively, which means a total reduction of 7.20 million Ton CO_2-e or 2.91 percent of total emission from energy industry (247.42 million Ton CO_2-e). The figures show how miniscule the penetration of CCT technology and its impact on Indonesia's emissions today are; indeed, globally, "clean coal" technology has not delivered substantially to CO2 emissions. Renewable energy power plants, despite limited installed capacity, has contributed to a larger extent to GHG emission reductions.

Climate Action Tracker (CAT), an independent scientific analysis, reported in mid-2018, that maximum allowed GHG Emission Level (excluding land use, land-use change, and forestry/ LULUCF) for Indonesia in 2030 to be compatible with 2°C target is 1,075 and with 1.5°C is 523 Mt CO2e. In this scenario, the maximum emission levels in 2030 for power plant are 262.5 for 2°C target and 127.7 for 1.5°C target. However, Indonesia's GHG Emission Level in the NDC, is too high for reaching both the values for the 2°C target, let alone the 1.5°C target. To reach the 1.5°C target, there are 18.4 GW overcapacity of CFPP in 2020, 35.6 GW in 2025 and 41.5 GW in 2030.

6 Energy Industry Subsector consist of three categories: electricity & heat production, petroleum refining, and coal processing. Practically, GHG emission for electricity production can be reflected by the energy industry subsector figures since 94 percent emission of this subsector is from electricity production.



* source: author's compilation

Figure 20
Indonesia's Total and Power Sector GHG Emission Level based on Climate Action Tracker

6. HOW CAN EXISTING FOSSIL GENERATION BE PHASED OUT SUSTAINABLY?

Germany has decided to phase out both coal mining and the utilization of nuclear energy. These decisions followed decade-long debates in society and among policymakers. They were made on the basis of broad stakeholder involvement, taking into account the interests of all involved stakeholders, from the companies, employers, regions, environmentalists and others.

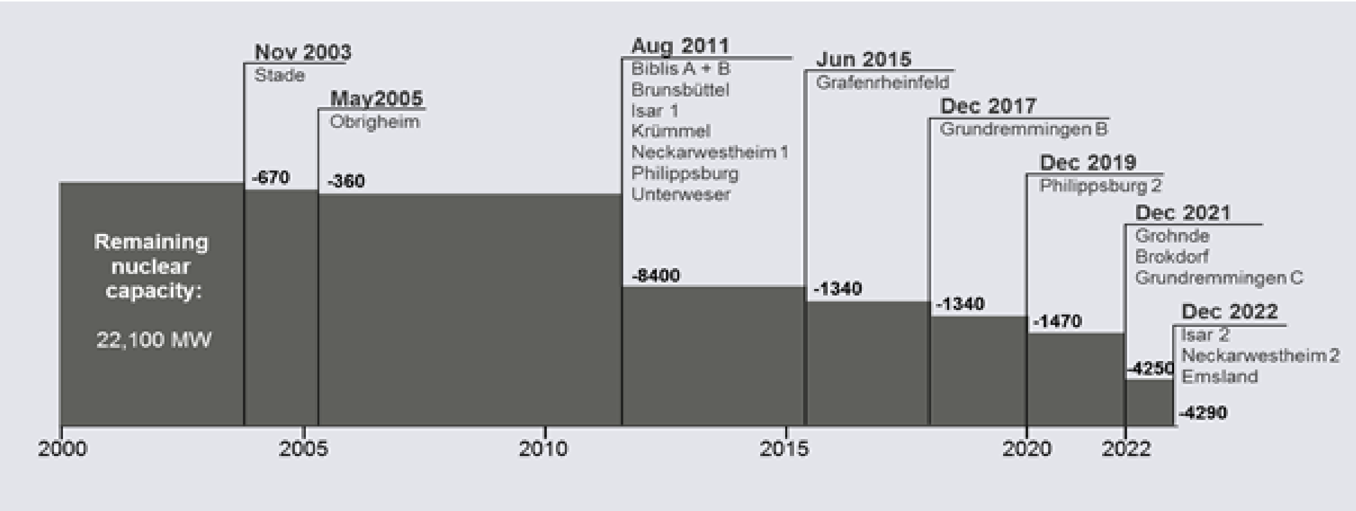
The phase-out decision was prepared by convening a round table with all relevant stakeholders in order to build trust, negotiate key economic, technical, environmental and social issues and finally reach a consensus. Since reliable framework conditions that enable planning for the future are essential for the energy sector, there are defined 'expiration dates' that all stakeholders can rely on, a clearly defined reduction path, and legal certainty on the trajectory of the incremental phase-out. There is a consensus today that in order for Germany to fulfil its climate goals, there is no alternative to phasing out coal in power generation – different opinions do exist on the when and how.

After the long discussion and debates on German energy future, there is a broad consensus for the phase-out nuclear

A program to develop nuclear energy was launched in West Germany in the 1950s, although it faced heavy public opposition from the start. In the 1970s and 80s, a fierce anti-nuclear protest movement blocked development at potential reactor sites; several planned nuclear facilities were never realized. The Chernobyl disaster in 1986 was a first turning point in government policy. No new reactors were constructed in Germany after the accident. Then, in 2002, a first law was adopted to phase out nuclear energy by 2022. Eight years later, in 2010, the government decided after a controversial debate to delay the nuclear phase-out until 2036. However, this decision was immediately reversed after the nuclear accident at Fukushima Daiichi in March 2011. In June 2011, the government reinstated the previous nuclear phase-out policy in an historic instance of cross-party support.

Reaching a consensus on nuclear and coal

To reach a consensus, the German cabinet invited the impacted stakeholders to a series of round table discussions. This provided a venue for building the trust and negotiating key issues of the phase out, thus all stakeholders have a sound foundation to plan for the future. In the case of the nuclear phase-out, a commission was set and tasked to define 'expiration date' that all stakeholders can rely on, a clear trajectory for a phase-out (decommissioning) plan, a financing mechanism and compensation for the nuclear sector, and a suitable site for storing the nuclear waste. The responsibility for decommissioning, deconstructing the plants, and packaging the radioactive waste lie with the utilities, but the German state takes over the responsibility for storing nuclear waste. The state administered fund will ensure that the financing, decommissioning and waste disposal is guaranteed in the long term. The decommissioning of the power plants is on track (Figure 21). Since 2011, 11 GW of nuclear capacities have been decommissioned, the remaining 10 GW will be closed gradually until 2022.



Source: Agora Energiewende

Figure 21
The remaining nuclear capacity in Germany until 2022

A commission has been set up to agree on a phase-out plan for coal-based electricity

Until well into the 1950s, coal was the dominant primary energy source in Germany with a share in power generation of almost 90 percent. Coal only lost its dominance in the power supply towards the end of the 1970s with the construction of the first large nuclear power plants. Despite the phase out of hard coal mining in Germany (which was much more expensive than importing coal from abroad), coal maintained its strong position in electricity generation (37% in 2017). Hard coal and lignite are part of the regional identity in major industrial areas of Germany. Coal was and is more than simply a fuel or commodity in these regions.

However, Germany's climate change mitigation targets defined the exit from coal-based electricity. There is a general understanding today on this, but differing opinions on the "when" and "how" of a phase out. In 2018, the government has set up a Special Commission on Growth, Structural Economic Change, and Employment (the so-called Coal Commission), which consists of ministries representatives, most impacted federal states, and experts from NGO, labor union, research and academia, industry associations, and member of the party. The commission is tasked on developing concrete prospects and economic transition plan for the coal region, define a clear end-date and intermediate steps for phasing out coal (most probably in the 2030s) by the end of 2018. This process is expected to find a solution based on a consensus from cross-party, structured dialogue with all key stakeholders, that would provide the power companies, employees, and concerned regions sufficient time and resources to prepare for the transition.

Coal context in Indonesia

Indonesia is one of the world's largest producers and exporters of coal, which makes a significant contribution to Indonesia GDP, exports, government revenues, employment, and perhaps most importantly, the economic development of the remote regions where mining operations are located. According to data from Statistics Indonesia (Badan Pusat Statistik or BPS), Indonesia Gross Domestic Product (GDP) in 2017 reached 13,588 trillion rupiah and out of this value, 504.2 trillion rupiah (around 3.7 percent) comes from mining of minerals and coal. Additionally, Directorate General of Mineral and Coal (a directorate under Ministry of Energy and Mineral Resources), which oversees mining activities, reported that in 2017, this sector provided employment to about 200,000 people, both local and international (international workers are around 1.3 percent of the total), mostly in rural communities.

Domestic coal consumption is relatively small in Indonesia, as majority of the coals are exported. However, in recent years, there has been an increase in domestic sales as Indonesian government launched its 35 GW generation capacity program, where 16.3 GW is new coal capacity (katadata, 2016). Moreover, several big Indonesia mining companies (for example Adaro Energy) have expanded into the energy sector, as prolonged low commodity price made it unattractive to keep the focus on exporting coal, hence becoming integrated energy companies that consume their own coal (Indonesia Investments, 2018).

Does Indonesia Need to Phase-Out Coal?

Not necessarily. Unlike Germany, Indonesia has a growing energy demand. As there is still a need to increase electricity supply, phasing out existing generation is not at the center of the debate. However, this may change if Indonesia continues investing in new coal fired power plants despite lower demand growth and the global trend of reducing coal utilization. As power plant investments are investments for up to 40 years, focusing on coal comes with high financial risks. These financial risks, including health and environmental risks, can be avoided if Indonesia follows the energy transition pathway.

There is a global trend for reducing coal utilization

Globally there is a trend for reducing the use of coal. Bloomberg New Energy Finance (BNEF) reported in their New Energy Outlook 2018, that coal generation will peak globally around 2027, before falling sharply to just 11 percent of world electricity by 2050. This is driven by: a) the economics of coal power plant that is no longer competitive to other type of generation, including renewables; b) health concern, and c) the likelihood of stranded assets and capital destruction. As power plant investments are investments for 40 years, focusing on coal comes with high financial risks, especially seeing the trend of coal declination in global energy mix.

Taking a deeper look at battery storage development, study by International Renewable Energy Agency (IRENA) reported, that by 2030 battery system installation costs could fall between 50 percent and 60 percent. Battery lifetimes and performance will also keep improving, which in turn reduce the service cost (IRENA, 2017). This trend of declining cost of battery electricity storage and renewables will play a crucial role in accelerating energy transition and could reduce dependence on coal.

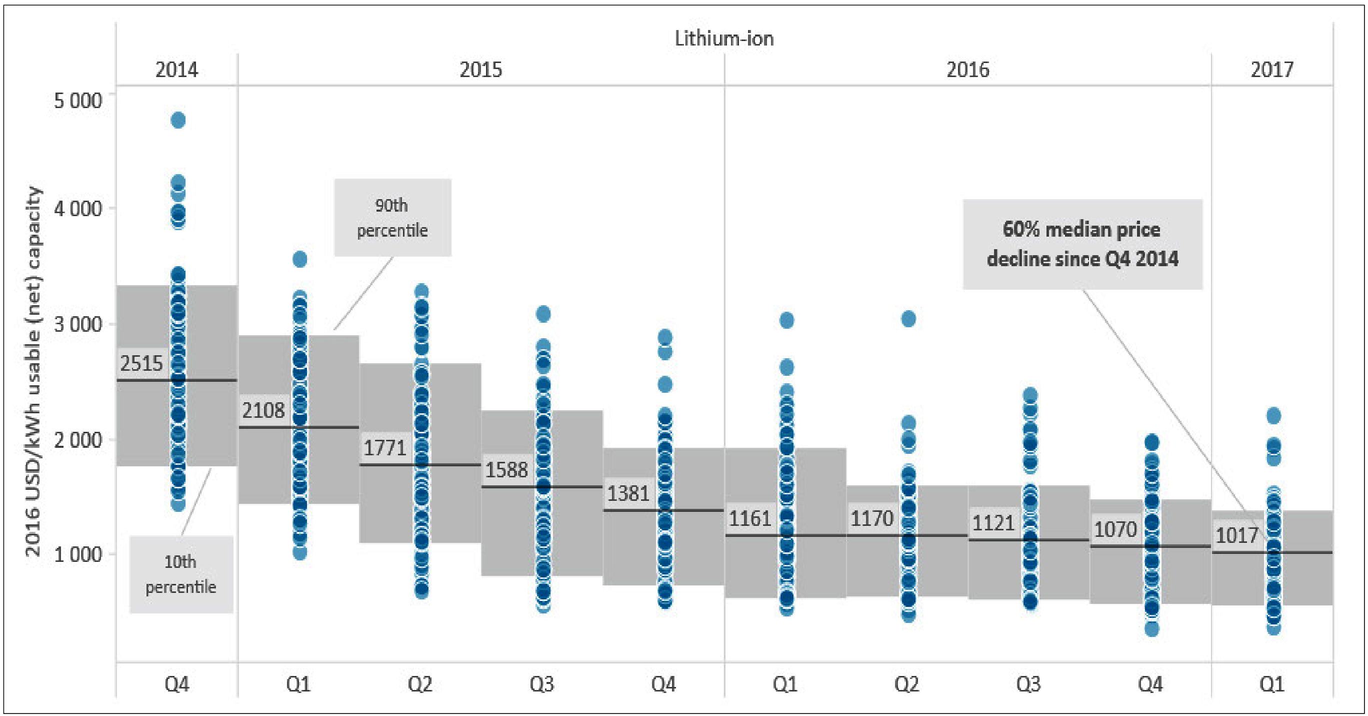


Figure 22
Declining price of households PV systems with battery storage in Germany from Q4 2014 to Q1 2017 (IRENA, 2017)

Additionally, climate change is another driver for phasing-out coal. Based on the International Energy Agency's (IEA) recent report, almost 40 percent of global electricity is produced from coal power plants, making carbon pollution from coal a leading contributor to severe respiratory diseases and to climate change. To counter this, a global movement and cooperation between a diverse range of governments, business and organizations collaborate to create "Powering Past Coal Alliance" that will work together to accelerate the transition toward clean energy and to phase out existing traditional coal power.

Coal long-term competitiveness is in doubt

Comparing global trend on coal and renewables development to Indonesia, we can see that in Indonesia, cost of electricity generation from coal is still cheaper compared to renewables. PLN Statistical Report 2017[7] reported that coal cost is around 53 USD/MWh. As a comparison, a result from Indonesian solar auction[8] in 2015 were ranging from 180-250 USD/MWh. The global weighted average price for Geothermal is 70 USD/MWh and for solar is 100 USD/MWh (IRENA, 2017a). However, when the externality costs are included, coal is no longer the most economical option in Indonesia due to air pollution costs and carbon emissions costs, which in total are estimated to combine to up to 100 USD/MWh (Figure 23) (Richard Bridle, 2017).

7 Exchange rate used to convert value from Rupiah to US$: 1 US$ = Rp. 15,200
8 In 2015, the Indonesian Supreme Court issued a decision requiring MEMR to revoke a previous auction regulation for solar PV. Until then, seven tenders had been conducted for the purchase of solar power (Baker and McKenzie, 2015)

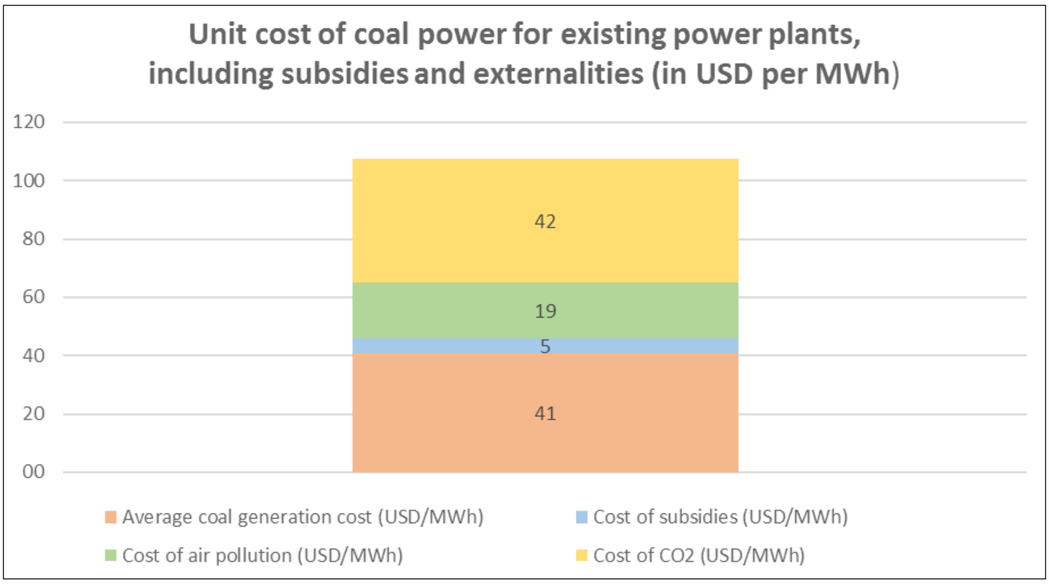
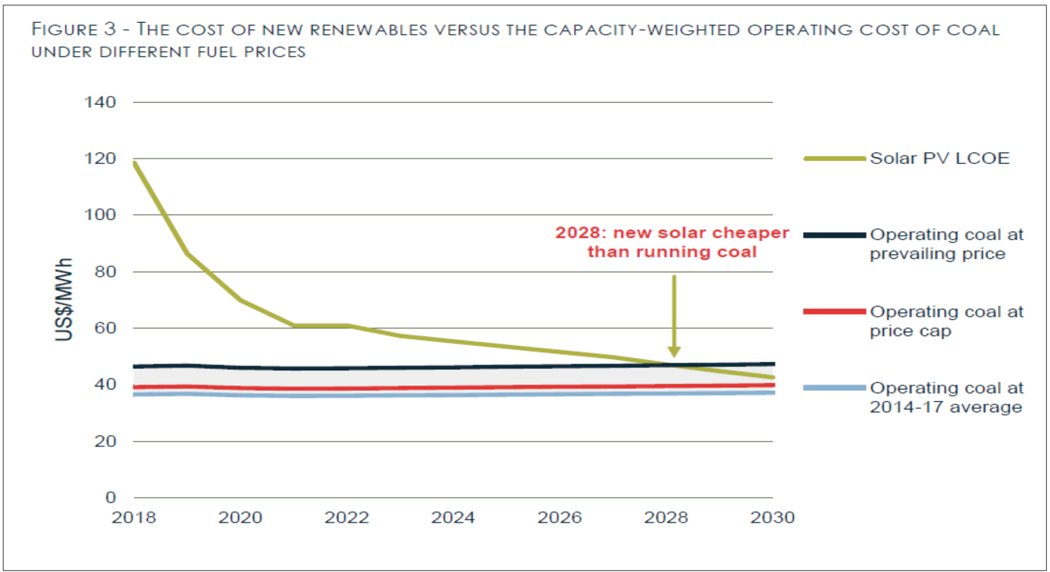


Figure 23
Unit cost of coal power for existing power plants in Indonesia in USD per MWh (IISD, 2017)



(Source: Carbon Tracker Initiative, 2018)

Figure 24
The cost of new solar PV versus operating cost of coal under different fuel prices

Even without a tighter air pollution regime, the rapid cost reduction of solar PV may lead to the fact that building new solar PV is more economically sensible building new, or even operating existing coal power plants. Under the domestic coal price cap (70 USD/ton), this inflection point is projected to occur in 2030. Following this instance, the newly built coal fired power plant, which normally runs for 30-40 years, will face early retirement. Under the Paris Agreement scenario, average lifetime of Indonesian coal power plant is reduced to 16 years (24 years less) and the coal power plant owners' risk on losing 34.7 billion USD due to stranded assets (Carbon Tracker Initiative, 2018).

And moreover, despite being one of the largest coal exporters, the ratio of reserves to production that Indonesia has is relatively small. According to BP Statistical Review of World Energy June 2018, Indonesia reserve to production (R/P) ratio by the end of 2017 is only 49. That means, if the current production is kept at the current rate (2017 production rate), in 49 years, Indonesia coal reserves will be depleted. This could be another important factor to consider in deciding, until when Indonesia will rely on coal as a source of electricity generation, and when and at what speed it will be phased out.

7. IS SECURITY OF SUPPLY IN GERMANY THREATENED BY RELIANCE ON RENEWABLES?

No. Germany's electricity supply is stable despite a high share of renewables. The German power system is one of the most reliable in the world. The variable output of renewables is successfully managed with power system flexibility. The base load operation of power plants has been significantly reduced, without damaging security of supply.

Electricity supply in Germany is stable despite a high share of renewables

Although renewables are currently responsible for 36 percent of electricity consumption, the German power system continues to be one of the most reliable in the world, with a very low level of unplanned capacity shortages (12.8 minutes in 2016). In principle, the reliability is enhanced by the flexibility of the power system and achieved by:

- Various active grid management measures. Some regional constraints on the grid – especially on the north/ south axis – nevertheless make various active grid management measures necessary to ensure system stability, including the redispatch[9] of conventional generation and, as a measure of last resort, curtailment of variable renewables.
- Increasing grids and transmission capacities for exports/imports
- Introducing several reserves capacity to ensure supply security in "emergency situation"
- Variable renewables currently represent 20 percent of annual power consumption in Germany. On an hourly basis, power plants (gas, but also nuclear and coal) have to respond flexibly to rapid changes in power supply and demand. As shown in Figure 26, conventional power plants are already being operated in a flexible manner to manage variable feed-in. During the depicted example week in March 2016, the base load operation of nuclear and coal power plants was significantly reduced while RES generation was high.

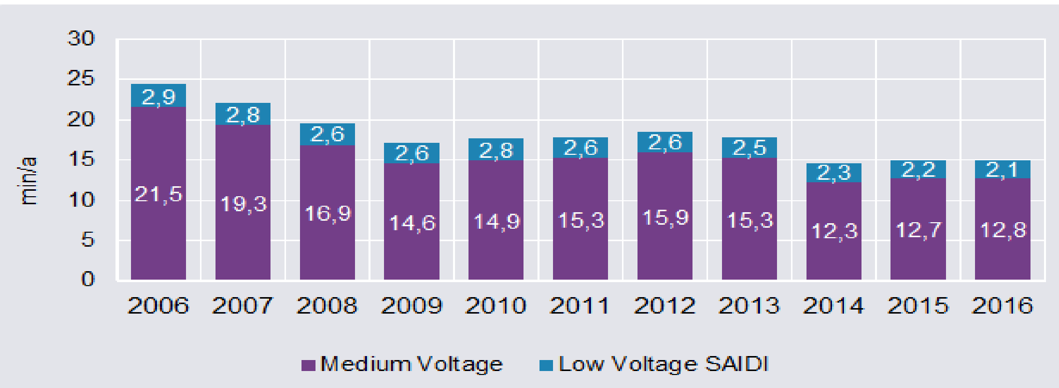


Figure 25
German System Average Interruption Duration Index

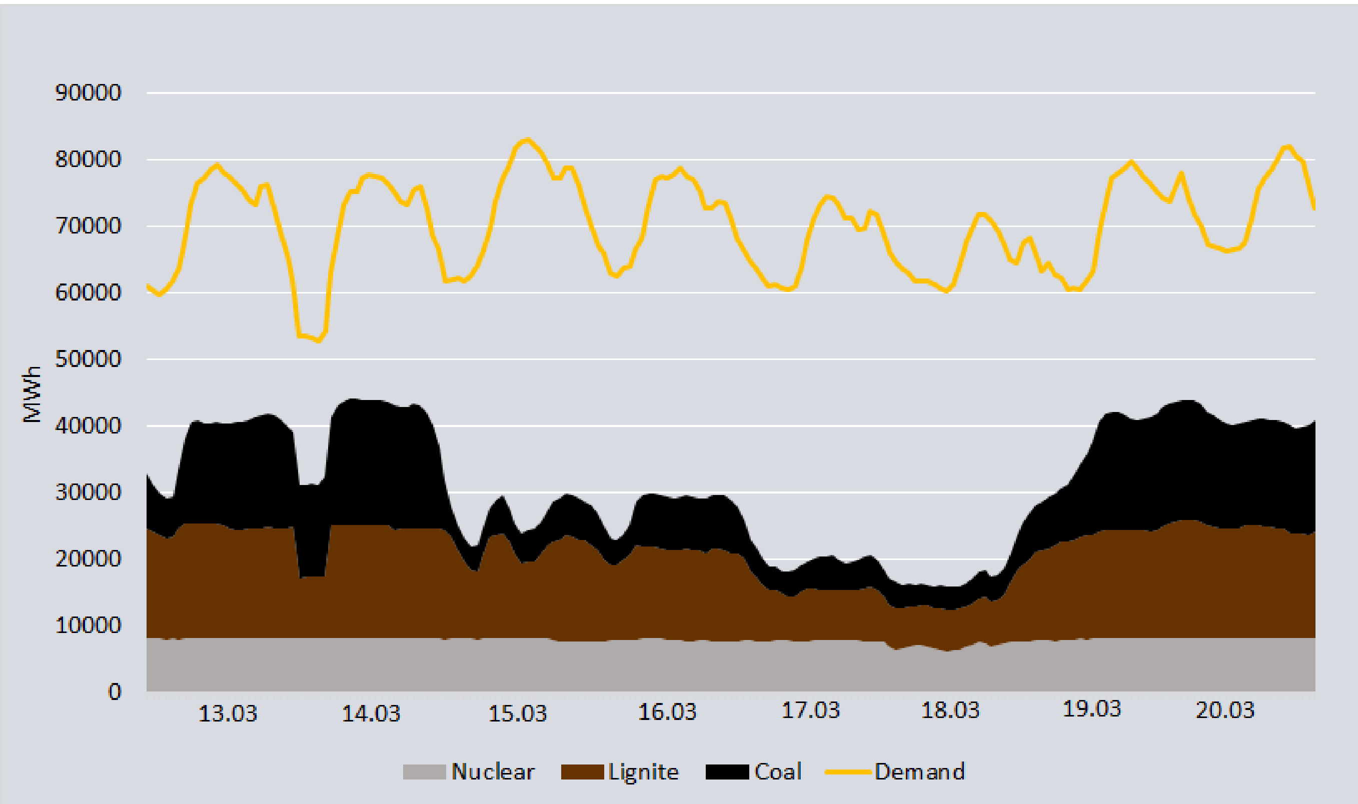
Source: CEER (2017)

9 Redispatch is a means of resolving transmission congestion by changing generator output levels. By lowering the real power output of one or more power plants and at the same time increasing the real power output of one or more other power plants, it is possible to relieve congestion while keeping the total real power in the grid close to constant. Adjusting the output of generators that produce congestion could be a lower cost, faster solution for improving transmission flows than building new lines.

Several other flexibility options exist to incorporate variable energy sources into the power system. These include, for example, demand-side management, the expansion of grid infrastructure (including smart grid solutions) and, in the long-term, expanded storage capacities. This paradigm shift will become increasingly important as Germany moves towards more than 50 percent renewables by 2030. Against this backdrop, incentives to promote market efficiency are being redesigned within the scope of new electricity market legislation. Market prices or, in a non-market system, comparable mechanisms need to reflect the benefits of flexibility, in order to leverage technical potential in the most cost-efficient way. Furthermore, priority must be given to the gradual phase-out of inflexible baseload supply.

Improved forecasting, highly responsive control systems and flexible markets enable the integration of a high share of renewables, even in extreme situations

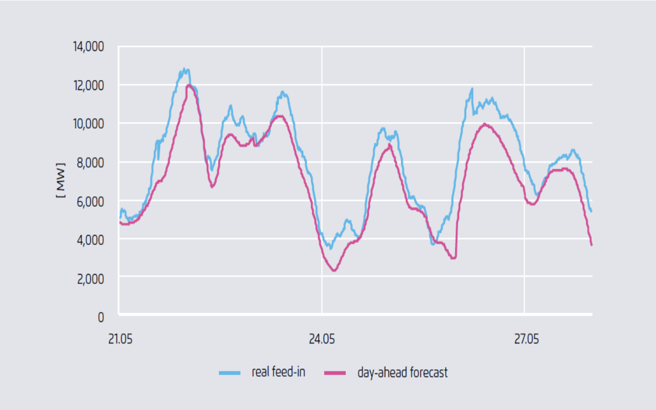
Variable output must not be confused with uncertain output, as the forecasting of wind and PV generation has made significant progress. A good example of an extreme situation is the solar eclipse of 20 March 2015. Due to the eclipse, electricity production from solar PV dropped by 5 GW within 65 minutes and ramped



Source: Agorameter (2018)

Figure 26
Power generation from nuclear, hard coal and lignite power plants and demand in Germany, 13 to 20 March 2018

up again by 13 GW within 75 minutes, as depicted in Figure 28. To manage the impact of the solar eclipse, transmission system operators across Europe coordinated system operations ahead of and during the event. Furthermore, flexibility was traded on short-term markets. As a result, electricity supply remained stable during the hours of the eclipse. While such steep fluctuations in feed-in are unusual today, they will occur more frequently in 2030, when roughly 50 percent of electricity will be produced by renewables.



Source: 50Hertz (2015)

Figure 27
Difference between day-ahead wind energy forecast and real feed-in (week in May 2015 in the North-East of Germany)

Source: Agora Energiewende (2015)

Figure 28
Solar power production in GW during the solar eclipse on March 20, 2015

What is the impact of increasing renewable energy on the Indonesian electricity system?

To date, the share of renewables in Indonesia's power system is still low and is mostly dominated by large-scale hydro and geothermal. Variable renewable energy (VRE), such as solar and wind, only account for less than 1 percent of total installed power capacity. In May 2018, the largest wind power plant in Indonesia was inaugurated in South Sulawesi and has since being closely monitored for its power production and its impact to the grid. Regardless of the VRE share, Indonesia is already facing challenges in grid reliability, thus increasing PLN's reluctance to accept more share of VRE. However, the impact of VRE to the grid is negligible when the share is still low (up to ~10 percent). If any, impact may occur limited at a very local level close to the connection points. At this level, there is no additional sophisticated measure, even grid upgrade, necessary.

The existence of variable renewable energy (VRE) in Indonesia's power system

Three predominant renewables in the current Indonesian power sector are large scale hydro, on-grid and off-grid bioenergy, and geothermal. These types of renewables are preferred by PLN, as their dispatch can be controlled, which facilitates their integration. Indonesia has been making effort to integrate more VRE into its power system, but the progress is slow. In 2017, Ministry of Energy and Mineral Resources recorded 70 power purchase agreements (PPAs) signed by PLN and IPPs totaling 1,214 MW, of which 45 MW comes from solar power[10]. According to MEMR's report, 4 solar power plants are currently in construction preparation stage. Combined installed capacity of solar, wind, and micro hydro power plant as of July 2018 is barely 315 MW[11], a mere 0.5 percent of total Indonesia's installed power capacity. Based on IEA classification[12], Indonesia belongs to phase one from four stages of VRE deployment, where variability

10 MEMR, 2017, *Ministerial Performance 2017 and Outlook 2018*
11 MEMR, 2018 (IESR report for ICEF)
12 OECD/IEA, 2017, *IEA Insight Series 2017*

of VRE will be insignificant against that of overall electricity demand due to its small number. If there is any impact, it will be localized or near point of connection.

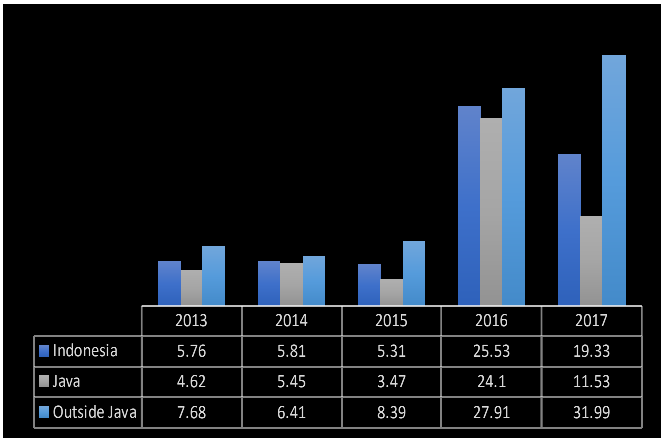
There are only two notable variable renewable energy power plants completed and currently in operation. In December 2015, President Joko Widodo inaugurated Indonesia's current largest solar power plant in Kupang, East Nusa Tenggara. The power plant capacity is 5 MW, built to solve then ~ 4 MW power deficit in Kupang grid system. In July 2018, the president also marked the commissioning of 75 MW wind power plant in Sidenreng Rappang (Sidrap), South Sulawesi.

Regardless the low share of VRE, there are existing grid challenges to overcome

Similar to other developing countries, being connected to electricity grid does not equal continuous 24-hr supply. There is a significant number of villages across Indonesia receiving less than 8-hr electricity supply, many of which depends on diesel-fueled generator. Those connected 24-hr to the grid also experience blackouts and low-voltage supply.

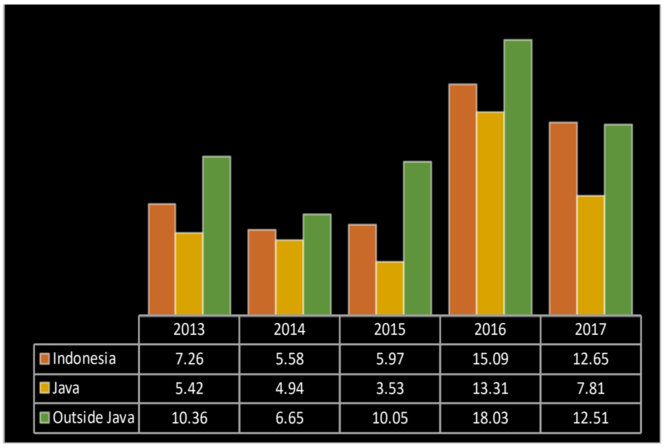
Two challenges associated with power system reliability in Indonesia are grid overload in Java Island system and supply deficit for systems outside Java. While supply in JAMALI grid is considered sufficient, lack of system performance reliability is mainly caused by below-standard voltage transfer in high voltage transmission substation and overburdening of 150/20 kV transformers. There are many 150/20 kV transformers operating over 80% of its capacity in Java Island grid[13], particularly in cities with a lot of high-density neighborhood. As such, consumers experience low voltage electricity and/or blackouts. A real-time electricity supply monitoring[14] performed by IESR provided evidence of this condition, as 39 percent of monitored location experience low voltage electricity (under 200 V) resulting in MCB trip in several households.

Lack of grid reliability in Indonesia power system is also apparent from recorded SAIDI and SAIFI[15] aas shown in Figure 29 and Figure 30. During the last 2 years, there has been a substantial increase in outage duration and frequency across Indonesia: average outage duration in 2016 was five times higher than that of previous year and 2016's average outage frequency was also tripled. Delays in power plants and transmission-distribution lines constructions occurred during that period, causing major power deficit and worsening power system reliability.



	2013	2014	2015	2016	2017
Indonesia	5.76	5.81	5.31	25.53	19.33
Java	4.62	5.45	3.47	24.1	11.53
Outside Java	7.68	6.41	8.39	27.91	31.99

Figure 29
Recorded SAIDI 2013 – 2017[16]



	2013	2014	2015	2016	2017
Indonesia	7.26	5.58	5.97	15.09	12.65
Java	5.42	4.94	3.53	13.31	7.81
Outside Java	10.36	6.65	10.05	18.03	12.51

Figure 30
Recorded SAIFI 2013 – 2017[17]

13 RUPTL PLN 2017 - 2026
14 IESR, *Electricity Supply Monitoring Initiative*, https://iesr-esmi.id
15 SAIDI: System Average Interruption Duration Index, SAIFI: System Average Interruption Frequency Index
16 PLN Statistics 2013 - 2017

PLN concerns towards integrating VRE

PLN has been reluctant in accepting more VRE into its power grid due to concerns on grid reliability and power quality. For example, in Kupang, a 5 MW solar power plant was constructed to improve the reserve margin in the area. However, due to doubts in PLN regarding the limited capacity of the Kupang power grid and the variability of the solar power, only a small amount of electricity from solar power plant is accommodated (around 1 MW) (Pos Kupang, 2016; statement from PLN representative, 2016). This is also the case with wind power. Among two wind turbines with a capacity of each 100 kW in Selayar, South Sulawesi, PLN chose to operate only 1 turbine. The island has a peak load of 2,500 kW, of which 200 kW is expected to be contributed by renewable energy. While it is estimated that power grid could handle 10-15 percent of peak load values in renewable generation, PLN lacks confidence to integrate more VRE into its grid.

Impact of VRE to the grid is negligible at early stage

In 2017, the share of wind and solar in Indonesia's power generation was still below 1 percent. Therefore, Indonesia still falls under Phase One of the IEA's VRE deployment and integration categories. At early level of VRE deployment, of which VRE generation only accounts for 2-3 percent of electricity demand, the impact of the VRE to the residual load is quite negligible. The VRE generation can be considered as negative load, where it is not yet necessary to manage/schedule the output or even changing the operation of existing power plant. Regardless of VRE plant sizes, the impact of VRE may only occur close to the connection point. It means challenges related to system integration will be limited to their immediate surroundings and often does not need certain upgrade or adjustment on the original grid setup. IEA summarizes issues and approaches to this local system integration challenges as follows:

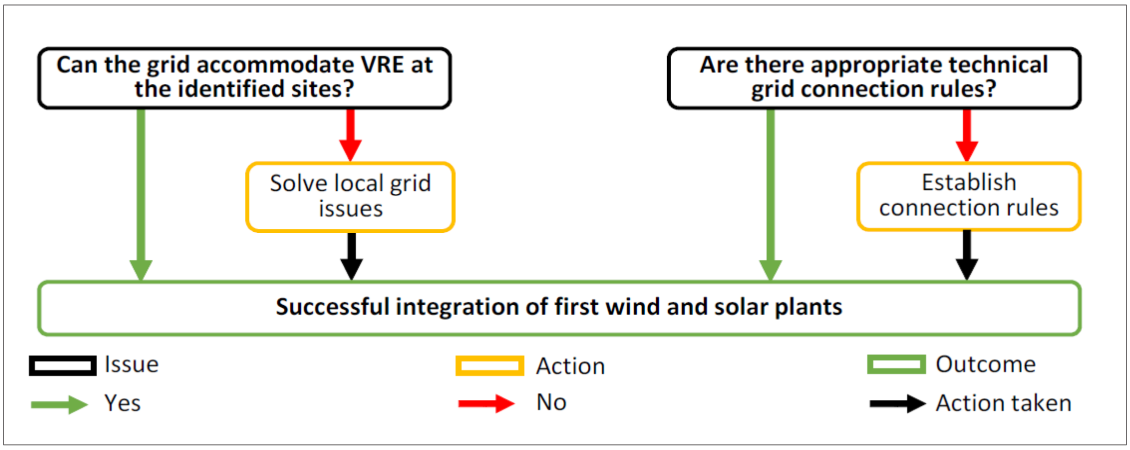


Figure 31
Phase One tasks center on finding workable solutions to connecting the first plants to the grid[17]

For countries with low VRE penetration, such as Indonesia, grid reinforcement is usually not required. New grid assets are also not necessary if several issues emerge from the integration, of which can be addressed by improvements in transmission system capability or enhanced system controllability. When VRE deployment enters Phase Two and higher, as in the case for Germany, special protection schemes and more advanced measures such as flexible thermal power and additional storage are then more pertinent to consider. It is also advisable to perform sound technical assessment on grid capability and to integrate VRE into the system gradually.

17 OECD/IEA, 2018, *System Integration of Renewables: An Update on Best Practice*

8. HOW ARE UTILITIES AFFECTED BY THE ENERGY TRANSITION?

The energy transition has challenged the four major German utilities. Their market share decreased from more than 80 percent to 50 percent in less than a decade. They opposed the energy transition for many years. Only very late, their management acknowledged that future business opportunities would largely come from renewables and small-scale customer-oriented solutions. Recently, they have radically adopted their business models, committed to innovation and larger investments in energy transition technologies and products, and increased their profitability.

Rapid deployment of renewable energy can disrupt the electricity marke

The speed of renewable energy growth is disrupting electricity markets worldwide. Even in a pioneering country of the energy transition like Germany, more than 60 percent of power is still supplied by conventional sources. However, even relatively small shares of wind and solar have significant impact on power markets, as they reduce the utilization of nuclear, coal and gas fired power plants, putting business case rationales of the past in question. Wholesale power prices in Germany decreased by 55 percent between 2011 and 2016 (IEEFA).

This profound transformation has severely challenged the major German utilities. Following electricity market liberalization and privatization at the turn of the century, four large utilities had emerged, namely E.ON, RWE, ENBW and Vattenfall, which had a combined market share in power generation of 82 percent in 2009. This has decreased to just above 50 percent in 2016. Market value of E.ON went down from 56 billion Euro in 2009 to less than € 20 billion in 2016. During the same period, RWE took impairments of almost € 16 billion due to write-downs of mainly German power plants that were earning less or no money.

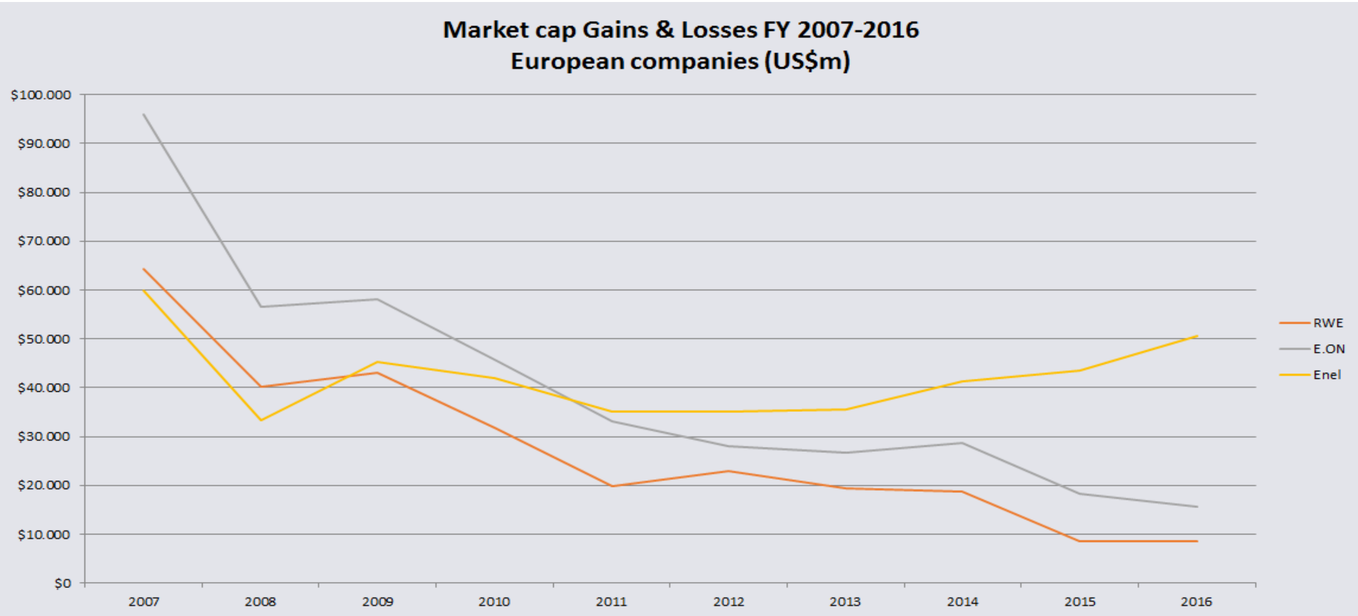
Lower margins in the thermal generation business, but also the emergence of new downstream technologies such as small-scale PV, storage or smart appliances fundamentally challenged the utilities' business models, which was centered around large thermal power plants. The German utilities, for more than a decade, were not up to meeting this challenge. Initially, and for much too long, they were ignoring, then openly combating the political will for phasing out nuclear energy and strongly expanding the share of wind and solar, which they considered as too expensive by far, and difficult to integrate securely into the system. By 2009 still, more than 30 GW of new coal fired power plants were planned, despite the fact that policy makers had shifted focus away from nuclear and CO2-intense technologies to renewables; many of these coal fired power plants were never put into operation, or have proved to become stranded investments. This was due to "a combination of missing capabilities and a very strong [cognitive] frame stuck in conventional, centralized generation, which only broke very late" (Ossenbrink, et. al., 2018).

When the management realized years later, that future business opportunities would largely come from low-cost renewables and small-scale customer-oriented solutions, the utilities were late-comers, struggling to compete with agile investors from start-ups to large data-driven companies like Google and others.

Dealing with the energy transition: Transforming the utilities' strategies and business models

While some argue that the energy transition invariably had to lead to the decline of the utilities, others, that have embraced the change much earlier, prove this argument wrong. ENEL, for example, former state-run Italian utility, has radically transformed its business model to one based on renewables early on, as well as becoming a frontrunner in the roll-out of smart meters, as a basis for smart business models; as a result, its market capitalization increased by more than 40 percent between 2011 and 2016.

business to RWE, while RWE will hand over its grids and retail business to E.ON. This will leave E.ON as Europe's largest operator of electricity grids and retail, while RWE will be the continent's second-largest producer of green energy, plus continuing some thermal (coal and gas) business. Some analysts see this deal as a signal for the end of the



Source: Thompson Reuters in IEEFA (2017)

Figure 32
Market cap Gains and Losses
2007-2016 European Companies

More recently, however, there are signs that German utilities are embracing the energy transition, radically transforming their strategies and business models:

- In EnBW's updated 2025 strategy, conventional power generation does not play a major role anymore. Instead the company focuses on wind parks, transmission and distribution grids a telecommunication. Vattenfall, in an effort to decarbonize its business, has sold its entire lignite assets to Czech company LEAG in 2017, now focusing on renewables and end consumer business.

- Changes in E.ON and RWE, the two largest utilities, are even more fundamental. Both had split up their renewables, network and end consumer business from thermal generation a few years ago. In 2018, they have initiated a large asset swap, which will see E.ON sell all of its renewables

era of integrated utilities that generate electricity, own the supply grid and control the relationship with the customer, expecting that more deals of this nature would follow. While all four German utilities have undergone a late, painful and not always straightforward transformation, they have also become more innovative than before, rolling out new customer-focused small-scale business models, that could become their backbone of future growth.

The extent to which the electricity industry is focusing on energy transition technologies today is also reflected by the strategy of the power sector industry association, BDEW, which is urging the new German government to continue with key aspects of the energy transition, namely RE build-up, grid capacity increase, where needed, storage, and with the shut-down of nuclear and coal plants, and the incentivization of flexible gas plants.

How will the energy transition impact PLN?

As the sole electricity utility, PLN plays a very substantial role in ensuring a successful energy transition. Ignoring PLN's role and capabilities may circumvent political initiatives aimed at promoting energy transition. On the other hand, PLN risks also great future losses, if it is late to change (or does not change at all) and adapt to the global trend on energy transition. Understanding the challenges and opportunities of the energy transition for its business model will be key for PLN in order to mitigate potential negative impact and rather benefit from future opportunities.

PLN plays a very substantial role in ensuring a successful energy transition

As a sole electricity utility, PLN plays a very substantial role in ensuring a successful energy transition for three main reasons. First, PLN still dominates the business of electricity generation, transmission, distribution and sales. Second, PLN is a government-owned company and well connected to public entities and policy makers and likely to be influential in the policy-making process. Failing to consider its interests and capabilities may lead to situation where PLN undermines political initiatives aimed at promoting the energy transition. Third, PLN has considerable knowledge and assets in operating power plants and supplying electricity. These capabilities and assets may be deployed to efficiently manage and execute the energy transition (Fanny Frei, Simon R. Sinsel, Ahmed Hanafy, & Joern Hoppmann, 2018).

Mobilizing finance for investment in renewable energies is another challenge that needs to be tackled by PLN, which relates closely with PLN's financial transparency. In a recent report, the Institute for Energy Economics and Financial Analysis (IEEFA) wrote that the data used to calculate the cost of PLN's electricity production or BPP (Biaya Pokok Produksi) is undisclosed. Considering that the BPP is used as a basis for other calculations, e.g. Independent Power Producer (IPP) tariffs, basic electricity pricing for consumers, and even subsidy calculations, the transparency of its calculation is of high relevance. Moreover, data related to the transmission, distribution and operation of the country's power system is also difficult to access. For investors, this data is important to analyze the performance of Indonesia's power system and to study where future investment would make most sense. The utility's procurement system (direct appointment or award system) is legally sound, but opens opportunities for corruption, collusion and nepotism); moreover, power supply auctions suffer from lack of transparency (Elrika Hamdi, 2018). These issues increase uncertainty, financing cost and, eventually power generation cost.

Global renewable trend challenges PLN business model

The disruptive technologies of renewable energy, which began in the 1970s with the first R&D investments of solar, wind, biofuels, and geothermal, are mainstream around the globe today. IEA reports that for several years in a row, investment in renewable energy sources (RES) was higher than in thermal power generation. The IEA projects that renewables will continue to be the fastest-growing source of generation in the coming decades, while coal and fossil fuel-sourced investment in general will slow down further. The trend of wind and solar cost decrease is expected to continue. The cheaper they become, the higher the risk for conventional plants not to be utilized as planned, thus becoming stranded investments.

What's more, rooftop solar power has reached grid parity in many countries, offers house owners a clean and competitive alternative to buying power from PLN. As the cost of solar roof systems come down, more people will be able to generate their own power and sell the surplus, converting their home into a prosumer entity – and reducing the power demand from PLN.

Indonesia has announced to increase its renewable energy mix to 23 percent by 2025 in line with its commitment to reducing its greenhouse gas emissions. However, as the only electricity utility in Indonesia, PLN, still provides electricity to the end consumers via large-scale, fossil fuel-based generation (mostly coal-based). The share of variable renewable energy (VRE) is increasing at a very low pace. Up until now, PLN

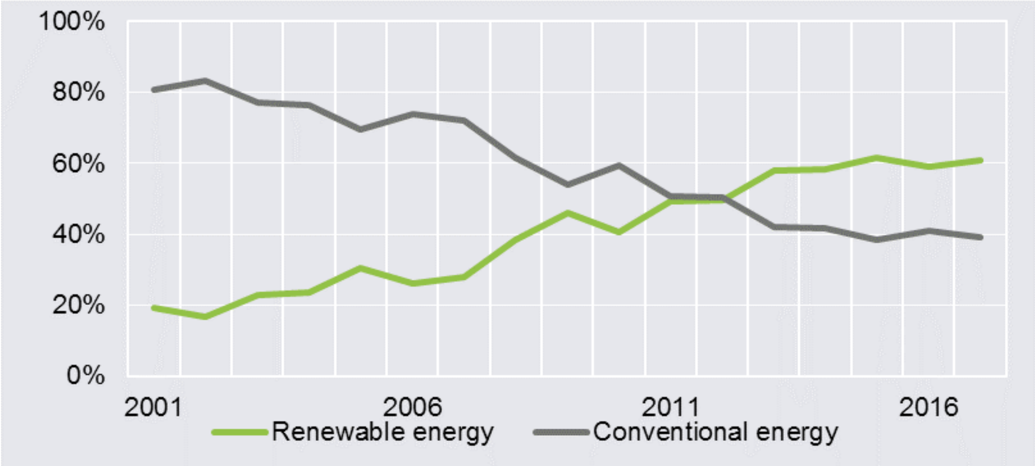


Figure 33
Share in new capacities (without large hydro power plants) 2001 - 2017 (Source: IRENA, FS-UNEP)

still operates using traditional energy utilities model. It means, PLN operates across the entire value chain of energy utility: generation-trading-transmission-distribution-retail. PLN focuses its business on profit generation through the sale of power to end consumers from (an increasing number of) large-scale power plants that are mainly using non-renewable fuels.

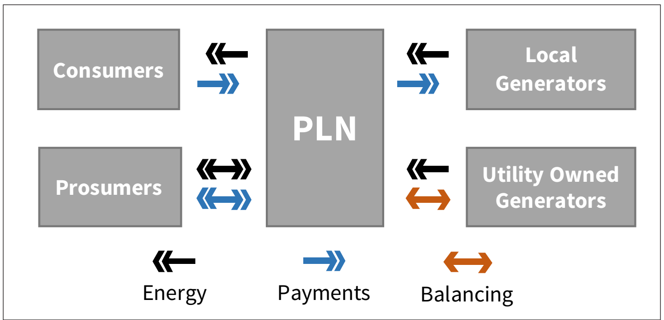


Figure 34
PLN Business Model
(adapted from (Scott T. Bryant et al., 2018))

Embracing energy transition provides PLN with new revenue options

Experiences in countries where the energy transition is more advanced clearly indicate that traditional utility business models, focused on large scale generation are under pressure. As the world sees an increase in renewable energies installations, demand for clean energy by many industries, smart grids and steep learning rates of storage options, these large power plants lose market shares, putting their profitability in question. However, should PLN embrace the energy transition, there is an opportunity to increase in its profitability in the near future. Some options that need to be considered by PLN are as follows:

- Diversifying its portfolio, i.e. by increasing investment in renewables and tapping into green bond/sukuk, would reduce fuel dependency and risk of volatile fuel price.
- Providing energy services through increasing number of renewable energies
- With the increasing demand of more energy efficient building and industry technologies, revenue stream from energy selling may decrease. Taking into account new energy management options could provide PLN with new service revenue options in the medium term that would moderate long-term demand growth (IEEFA, 2018).
- On top of activities related to renewable energy and energy efficiency, PLN also should take into account the effects of decentralization, as well as system integration and balancing (e.g. electric storage, demand-response, virtual power plants or vehicle-to-grid), by integrating it to its' business portfolios, in order to ensure a clean and reliable electric supply (Fanny Frei et al., 2018).

All in all, PLN should asses what short and long-term changes it needs to incorporate into its business model, to be able to respond to customer needs and political commitments.

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