

Introduction

As Indonesia remains one of the fastest developing countries in the world, it is becoming increasingly difficult to meet its future energy needs. Analysts note that rising energy consumption follows an increase in GDP, which is exactly what Indonesia is experiencing. Yet, as a result it is struggling to meet its energy demand. Problematic for Indonesia is that its generation capacity growth for electricity has been lower than demand growth in electricity. From 2002 to 2012 the International Energy Agency estimates that Indonesia's energy consumption rose by a [staggering](#) 44 percent, and has been increasing at roughly 7 percent per year. Further, as of late 2014 just 84.3 percent of the [population](#) had access to electricity; millions of Indonesians are without electricity. Indonesia is well endowed with natural resources, but similar to other developing countries, poor government policies have not utilized this wealth efficiently. Inefficient government energy policies and rising consumption coincided with Indonesia's declining oil industry.

The research paper examines opportunities and challenges facing Indonesia's energy sector and evaluates the policies that have been implemented to strengthen its energy sector. Also examined area the risks that exist to keeping these policies from being successful. Last, provided are a number of policy prescriptions for Indonesia to meet its growing energy needs. Indonesia faces a number of risks such as natural disasters, gridlock in parliament, and geopolitics. More generally, meeting its energy needs faces challenges by endemic corruption, inadequate infrastructure, and impediments to necessary foreign direct investment, amongst others. However, not all is gloomy in Indonesia as it has many opportunities to meet its energy needs. The greatest source of future power maybe lie in its largely untapped geothermal potential – Indonesia has 40 percent of the world's capacity. If the Indonesian government can execute a number of policy changes such as increasing its geothermal energy capacity and attracting the necessary foreign direct investment to meet its needs, it likely can alleviate its energy shortage and meet its growing needs into the future.

Opportunities

The opportunities section identifies eight opportunities that Indonesia can utilize. These include the following: a new president, favorable demographic composition, the creation of the ASEAN Economic Community (AEC), natural gas, shale deposits, coal reserves, nuclear energy, and renewable energy from a multitude of sources. First, Indonesia has much potential

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in its ambitious new president. In October 2014 Indonesia elected, Joko Widodo (Jokowi), its second president sworn in from direct elections. As Indonesia is a young democracy, Jokowi is a new type of leader in Indonesia, one without ties from Indonesia's political and military elite. Jokowi is a fresh face in Indonesian politics, committed to making hard decisions, and implementing policies (even if unpopular) to do what is best for Indonesia's energy future.

Second, Indonesia has favorable demographics. Currently Indonesia has a population of roughly 250 million people, however this is projected to rise to 280 million by 2030. A young median age for a country is typically deemed positive, Indonesia's median age is quite young, at [23.06](#) . The energy production sector needs a lot of labor to operate and Indonesia is not short of people. By comparison to many countries, Indonesia is not likely to suffer from aging of its population.

Third, the AEC can help Indonesia meet its growing energy needs. The AEC, scheduled to come in to effect in late 2015, has the goal to strengthen, and integrate all of the Southeast Asian economies into a single market. Indonesia has a large, youthful population, however it lacks human capital to work energy-related jobs. One of the components of the [AEC](#) is the free flow of skilled labor. This makes it easier for non-working professionals that have technical skills that Indonesia may lack in the energy sector to travel to another country within ASEAN and acquire technical skills that may be difficult to acquire in Indonesia alone.

Fourth, with 104.4 Tcf of natural gas, Indonesia has a large supply of reserves which can help meet its future energy needs. In the world, Indonesia has the thirteenth largest proven natural gas reserves. However, half of its natural gas is exported. Despite Indonesia exporting a large amount of natural gas, Indonesia could rely on these [large reserves](#) to meet its growing consumption demand.

Fifth, Indonesia's natural gas reserves share many similarities with its coal deposits. Indonesia is well endowed with coal reserves, however it is the world's largest coal exporter, and only uses about 20 percent of what it produces. Most of its deposits are found at mines in eastern Kalimantan and southern Sumatra. To boost electricity generation, the government has discussed the possibility of a moratorium on the export of its coal. Indonesia's [large coal reserves](#) are likely to be used well into the future.

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Sixth, Indonesia also has the potential for unconventional resource development in the form of shale gas and coal-bed methane. Indonesia's [coal-bed methane reserves](#), although speculative, are estimated at 570 Tcf and coal-bed methane at 450 Tcf. Shale gas is in the works for the future, as Indonesia plans to

[award](#) 10 shale gas blocks in 2015 to foreign companies. At present it has not developed these resources, so these unconventional resources provide energy.

Six, nuclear power also can provide energy for Indonesia in the future. At present the archipelagic state does not use nuclear power. This is in part because nuclear power has a [negative stigma](#) attached to it, as a result of nuclear power disasters in the past such as Fukushima in 2011. Despite backlash to nuclear energy, a 2001 study found that a nuclear power plant could provide 2 gigawatts (GW) by 2016 to its Java-Bali grid which accounts for 75 percent of the country's grid capacity, and a further increase to 6-7 by 2025. This is a huge amount considering Indonesia's total installed grid capacity is currently at [46 GW](#).

Seven, while Indonesia does not utilize many renewable energy sources available, there are a few that can provide a lot of energy to its grid. These include: geothermal, hydro, biomass, offshore wind, and solar. Of all of the potential sources, geothermal stands out as Indonesia's best opportunity for utilizing renewable energy. The archipelagic state is situated on the ring of fire, and it contains an estimated 29,000 megawatts (MW) of electricity generated from geothermal, the highest amount in the world. However, at the moment Indonesia is currently using just [1,200 MW](#) of its total geothermal capacity, or 6.9 percent of the country's energy mix. Geothermal is notable because it provides a constant supply of energy, in comparison to most renewable energy sources that offer an intermittent supply.

Indonesia also has a lot of potential for hydropower, at 29,000 MW. Like geothermal, Indonesia is using far from hydropower's full potential, as its total installed capacity is just 6,850 MW. The reason for this is because most of the [hydropower potential](#) is found on the outer-lying islands, where less of the population inhabits.

As with geothermal and hydropower, Indonesia is not using much of its solar power potential. Its solar power [potential](#) is estimated at 50,000 MW, while installed capacity is at just [22.4 MW](#). Sunny Indonesia can benefit from solar power to meet its growing demand.

Indonesia is also endowed with great biomass energy potential, which is estimated at 49,000 MW of possible capacity. Thus far, only 500 MW is being used. Indonesia's biomass potential comes from many sources, which are pal, cassava, molasses, jatropha, curcas, nyamplung, and corn.

Of the renewable energy sources mentioned, Indonesia's potential for wind energy and wave energy is less researched, and its potential is suspected to likely be very small. This is because wind in Indonesia is slow, at just 3-6 meters per second. Its installed capacity is just 1.87 MW, but more research is being done to see if there is any additional potential from wind that the government may not be aware of through possible installation of offshore turbines. Instead, perhaps Indonesia could benefit from wave energy, as it has been estimated that 49,000 MW could be generated. Further research is also being done to get a better grasp on Indonesia's wave energy potential. Since Indonesia has a large coastline with over 17,000 islands, [wave energy](#) appears as a great opportunity.

Levelized Cost of Electricity Generation for Different Technologies [c/kWh]

Coal	
6.33	
Gas	7.25
LNG	10.12
Nuclear	12
Oil	
18.33	
Geothermal	8.04

Source: [Economic Indicators Assessment of NPP Project in Indonesia](#)

Challenges

Despite Indonesia's numerous opportunities for meeting its future energy needs, many challenges exist. Indonesia just experienced a smooth transition of power from its recent presidential election, but it is still a nascent democracy. It was under rule by the brutal and corrupt dictator Suharto, who resigned in 1998. By comparison, in the [World Bank's Governance Indicator's in 2013](#), the United States (US) ranked in the percentile range 90-100

th

for government effectiveness while Indonesia fell between the 25-50

th

percentile. Identified here are a total of seven challenges which include: poor governance, subsidies, depleted oil reserves, expiring product-sharing contracts (PSC), slowing economic growth, growing demand, and lack of human capital. Poor governance has led to challenges such as regulatory uncertainty, unattractive cost-recovery arrangements, land acquisition difficulties, poor fuel quality, poor infrastructure, and endemic corruption.

Additionally, Indonesia suffers from the diesel and electricity subsidy, which drained the government's budget, and discourages energy conservation. When global markets effects increase Indonesian diesel and electricity prices, the government pays even more money for these subsidies. For years subsidies have diverted funds away from the Indonesian government. In November 2014 Indonesia eliminated petrol subsidies and put a cap on the diesel subsidy. However, an additional \$1.4bn in 2015 is still earmarked for the [diesel subsidy](#) , taking money away from the government. The diesel subsidy still exists, using up funds that could be spent on energy capacity growth. Further, an electricity subsidy has kept Indonesian electricity prices below the market price, and diverted government funds to pay for this subsidy. This is reported to

[cost the government](#)

\$6.2bn in 2015, or 5 percent of the total government budget.

Further, Indonesia's oil reserves and also its production capacity are depleted. As of the beginning of 2014, Indonesia's oil reserves may run out in 12 years. Its reserve-replacement ration is at [50 percent](#) , comparatively gas is 127 percent. Indonesia used to be a net oil exporter, before exiting from OPEC in 2009; its oil reserves are at just 4 billion barrels in 2013. Foreign investment into new oil fields is badly needed for new production but it does not appear that there is much conventionally recoverable oil in Indonesia's reserves. Its oil and gas industry is also at risk from its expiring PSCs. Within the next ten years, 72.5 percent of Indonesia PSC for oil and gas are set to expire. The government needs to act on these PSCs or else it will face a windfall of decreased energy production. If the issue is not addressed then contractors will cut investment in their blocks as it is [too](#)

[risky](#)

to pour money into a block that they may not get a renewal on.

On a more general scale, Indonesia faces slower economic growth because exports has weakened. In 2014 it slipped to its slowest level of growth in five years, following years of high, sustained rates. By the numbers, it [slowed](#) from 5.58 percent GDP growth in 2013 to 5.01 percent in 2014. This is in part due to weak commodity prices, which its export market relies heavily on, and also slower growth from its trade partners as well. For example, China is

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Indonesia's second biggest export destination, and its economy has been slowing in recent years.

By 2020 Indonesia's GDP is expected to increase by 60 percent, to \$8,200, which will result in more Indonesians buying expensive items that use energy such as automobiles and refrigerators. As a result of increased energy demand, energy consumption is expected to rise by almost [30](#) percent by 2020.

Lastly, Indonesia faces a challenge in human capital. On the surface, it may appear that Indonesia does not have a labor shortage, due to its large, young population. However, Indonesia's labor pool lacks the necessary technical skills needed. In one example, it was reported in late November 2013 that Indonesia is [short 30,000 engineers](#) annually. Human capital is severely needed in Indonesia to grow its economy and meet its energy targets.

Relevant Actors

Some of the relevant actors in securing Indonesia's energy future include the following: Perusahaan Listrik Negara (PLN), Pertamina, Ministry of Energy and Mineral Resources, Ministry of Finance (MoF), and foreign investors.

PLN has a monopoly over all of Indonesia's energy distribution. Although it is the nation's sole electricity provider, it is heavily dependent on government subsidies for electricity. As a result, PLN has little financial resources to further develop Indonesia's power grid, while demand has outpaced the electricity supply. Thus, PLN is dependent on private sector financing to increase the state's generating capacity. At the end of 2013, PLN [supplied Indonesia](#) with a total of 46,104 MW. PLN will rely heavily upon the government's push to increase FDI into Indonesia's electricity generation sector.

Pertamina is Indonesia's state-owned oil and gas company and is active in the upstream and downstream oil, gas, and geothermal energy sectors. It is possibly the most important company in Indonesia's energy sector as it leads in Indonesia's natural gas and geothermal development – two key sources of energy which Indonesia is rich in. However, over Pertamina's entire history, it has been mismanaged and corrupt. Despite its tattered history, new policies by President Jokowi are trying to address its repeated shortcomings. Part of why Indonesia's oil

production has fallen so drastically is a result of Pertamina's [mismanagement](#) of Indonesia's oil and gas fields.

Similar to Pertamina, Energy and Mineral Resources may well be the most important ministry for making sure Indonesia has adequate energy supply for the future. It also has a long history of being mismanaged and corrupt. Most recently its minister, Jero Wack, [resigned](#) in September 2014 after being named a suspect in a corruption case. In terms of energy production, Energy and Mineral Resources ministry is tasked with entering in PSCs with energy companies. However, the Energy and Mineral Resources ministry like Pertamina is currently being reformed. Its new minister, Sudirman Said was appointed due to previous anti-graft efforts.

Foreign investors are also very important to Indonesia's energy growth as it lacks the necessary technical ability and capital. Indonesia is a large developing country, but it faces many challenges for investors. Indeed, one study assessing Indonesia's investment environment favorability to foreign investors [ranked](#) it 133rd out of 157 countries. The factors include many of the problems mentioned in Indonesia's challenges in poor governance, such as lack of infrastructure and regulatory uncertainty.

Indonesia's MoF is also an important actor as it executes financial management of Indonesia, such as the control of state subsidies like the ongoing diesel subsidy. It is led by a US-educated economist, Bambang Brodjonegoro, who was a big factor behind Indonesia's ending of its petrol subsidy.

Policy Processes that Follow

Since the new transition of government in October 2014, several new energy policies have been put in place that have strengthened Indonesia's energy security prospects. These include ending the oil subsidy, scaling down the electricity subsidy, easing the FDI process, land procurement, and an overhaul of Pertamina and Energy and Mineral Resources ministry's leadership. In November 2014 Indonesia finally scrapped its wasteful petrol subsidy. This subsidy kept petrol prices below market price for years, which increased oil consumption and smaller government budget. As a result, this is expected to save the government [\\$20bn in 2015](#) for spending on development such as badly needed infrastructure, and also decrease oil consumption. The government also reduced its electricity subsidy by charging households that

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have a capacity of 1,300 VA or more at the market rate, as of January 1st

, 2015. This is reported to

[save the government](#)

\$680m, or 8 percent of the electricity subsidy total budget.

The new administration is addressing its growing electricity demand by planning to build 35 GW of new power plants from 2015 to 2019 (from an existing capacity of 46 GW), which will be 60 percent coal, and a mix of other sources. The government tasked PLN to lead the construction and management for new construction, which will heavily rely on public-private partnerships, both domestic and foreign investors.

Regarding renewable energy, the government wants to double its current capacity, from 10.7 GW to 21.5 GW by 2019. New hydro plants are expected to provide the bulk of this increase, at 75 percent of this total renewable energy capacity being added. However, [\\$35bn of investment](#) is needed and this target is likely to be difficult to meet. The bulk of this investment is needed from foreign investors.

To increase FDI inflows, in January 2015 Indonesia's government created a trial run for one-stop service for foreign investors and is supposed to speed up licensing procedures. The results remain to be seen but this is a positive step forward as red-tape is a constant complaint from foreign investors. To increase FDI specifically in the oil and gas sector, Indonesia [remove](#)
[d](#) a tax on land and buildings for oil and gas firms. FDI is badly needed as Indonesia's energy sector suffers from underinvestment.

Since land procurement has always been an issue for foreign investors, a new law is coming to effect in 2015 is supposed to accelerate the process. Land procurement has been one of the biggest stumbling blocks to adding new power plants, and is the biggest reason why Indonesia underutilizes its large geothermal energy potential. This new rule is supposed to give stricter time tables to speed up the land acquisition process in the benefit of the public interest. However, the results of this process cannot be evaluated until 2016 or 2017 as the land process could take up to [500 days](#).

To address the issues with corruption and poor management in Pertamina and the ministry of Energy and Mineral Resources, several steps were taken. In late 2014 the new government

appointed a new President Director for Pertamina, and replaced all of its board of directors. The government also created an oil and gas reform team, made up of academics, anti-corruption proponents, and government officials, specifically to provide recommendations to clean up Pertamina and the oil industry at large. Further, the new Energy and Mineral Resources minister [removed](#) the directors from the top five posts within that ministry and at the time of this writing is in the process of selecting new directors. [\[1\]](#)

Risks

Securing Indonesia's energy future is not without risks. These risks include supply shocks that can increase the price of energy such as natural disasters and geopolitics. Additional risks include adverse global market/pricing conditions, electricity outages, and gridlock in parliament. Natural disasters present perhaps the biggest risk to Indonesia's energy security. Due to its location, Indonesia is prone to natural disasters. As Indonesia is situated on the ring of fire, this presents the potential for disruptions to its energy security from volcanic eruptions, floods, earthquakes, and tsunamis. The most recent natural disaster was the 2004 tsunami that hit Indonesia's northern-most Aceh province. It killed [200,000 Indonesians and caused \\$4.4bn](#) in damage. Floods regularly occur during the rainy season, from December to March. In the capital, Jakarta regularly floods every year – floods cost roughly \$380m [in losses](#) in 2014. This is particularly disruptive to business and energy development because Jakarta is the heart of Indonesia's business and economic activity.

Indonesia is also prone to geopolitics affecting its energy sector. These come from mainly two sources: the South China Sea disputes and piracy along the Malacca Strait. In the South China Sea, China claims virtually all of the South China Sea as its own. Indonesia's Natuna gas field, located in the Natuna waters from its Natuna island chain is at risk from Chinese aggression. It is one of the largest recoverable undeveloped gas fields in the world, at 46 Tcf, or 40 percent of Indonesia's total natural gas reserves. The Natuna gas field is located within Indonesia's exclusive economic zone (EEZ), however it [overlaps](#) with China's nine-dashed line map. Tensions have been rising in this area as China has been increasingly assertive in the SCS, from [placing an oil rig](#) (although it was removed earlier than planned) in waters claimed by Vietnam, to [island building](#) in waters contested with the Philippines. These tensions in the South China Sea could disrupt Indonesia's energy production and transportation.

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Indonesia is also prone to piracy and oil spills along the Malacca Strait, one of the world's chokepoints for oil. Japan, Taiwan, and South Korea receive 75 percent of their oil imports from Africa and the Middle East [from this strait](#), while China receives 37 percent of its total demand. Additionally, in 2005 piracy was so high that Lloyd's Market Association of London designated the Malacca Strait a "war risk zone". The situation improved a few years after that designation, but 2014 experienced a dramatic increase in attacks. In 2014 there were 107 attacks and attempted piracy attacks – a [700 percent increase](#) in five years. Indonesia has limited funds and a large coastline, guarding against piracy in this strait is challenging. Piracy could disrupt its energy imports.

Adverse global market/pricing conditions could also affect Indonesia. Due to lower global oil prices, Pertamina's oil revenue decreased by 20 percent in 2014 compared to 2013, dropping from [\\$3.06bn to \\$2.4bn](#), which lowers Indonesia's government expenditures as well. In another example, China's slowing economic growth has decreased government revenues on coal and palm oil in the first quarter of 2015. Some analysts expect the US to [flood the markets](#) with liquefied natural gas (LNG) in 2015, which could negatively affect Indonesia's revenues from LNG exports. As Indonesia still heavily relies on commodities for its government's finances, and is one of the world's top exporters of these commodities, this weakens the government's development of its energy sector.

Electricity outages in Indonesia are still common, and could continue to happen if generation capacity growth is lower than the growth in demand. The system is also too interconnected, which leads to [domino-like electricity outages](#) that carry on from one region to the next.

From the political realm Indonesia also faces the risk of gridlock in parliament. This causes a delay, or complete halt, to policies implemented by the executive branch. As Indonesia's current president plans to implement significant reforms to its energy sector, it helps if its president has a majority in parliament. Indonesia's parliament tends to frequently, and unexpectedly, change in numbers. There is little loyalty within the coalitions formed by parties. For example, in 2014 President Jokowi won the presidential election by just six percent, and he did not enter office with a ruling majority party coalition. Prabowo's coalition, the losing candidate, had a controlling majority in parliament and delayed a lot of Jokowi's policies. In fact, his coalition even went as far as passing a law that reversed direct elections, the platform that allowed Jokowi to be elected. [\[2\]](#)

Policy Prescriptions

Recommended below are some improvements which include: renew the expiring PSCs, remove the diesel subsidy, focus future electricity capacity on geothermal and nuclear sources, focus short-term energy capacity on natural gas, build human capital in the energy sector, and incentivize foreign investment. The low-hanging fruit would be to fast-track the renewal of the expiring PSC contracts. Foreign investors need to always plan for the long term and if the government is able to accelerate the process, then foreign investors are more likely to renew these contracts as well.

Indonesia's new administration removed the oil subsidy but left the subsidy for diesel in place. The diesel subsidy is taking away over \$1bn for the government budget in 2015. Due to the low global price of diesel, politically this is the time to remove the wasteful policy because the consumer will feel the subsidy removal the least at present.

To provide for clean generation of energy, Indonesia should focus its energy development on geothermal and nuclear. Currently it is trending towards increasing its energy mix through coal. These are both capital intensive, and production would be years away due to the scope of these projects, however both provide long-term benefits. In the short-term Indonesia should replace building coal plants with natural gas plants. To complement, Indonesia should direct more of its gas production towards domestic consumption. Some analysts predict that the price of natural gas could [fall drastically](#), similar to oil in 2014. The expected price drop is due to a likely glut in world liquefied natural gas (LNG) supply, which would reduce Indonesia's revenue on its natural gas exports. Therefore, its natural gas is better served for domestic use rather than being exported. As nuclear power has a negative stigma attached to it, a public awareness campaign about the benefits of nuclear power for Indonesians should be implemented to alleviate the concerns for this source of energy.

Human capital must be developed. While Indonesia's universities are not ranked high, it should increase its funding for science, technology, engineering, and math education at university level or increase the amount of students studying abroad that can learn the latest skills needed for the energy sector. One possible way to develop Indonesian technical skills at tertiary level is for Indonesian university to partner with top universities in the world through exchange programs.

Incentivizing foreign investors must be the focus. Indonesia is highly dependent on FDI to meet its plan to double renewable energy capacity, total grid capacity, and increase oil and gas production. The one-stop trial process for foreign investors was recently implemented and must be expanded if it is successful. Another possible way to increase FDI is to lower taxes in the

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energy industry. Indonesia's government revenue from taxes on FDI will not decrease if the amount of investment increases enough.

Indonesia has the resources necessary to meet its future energy needs. With effective governance, management, and the help of foreign investors, its needs can be met. It still has a long way to go in its development but Indonesia appears to have a warm future.

[\[1\]](#) These post include directors for oil and gas, mineral and coal, electricity, new-renewable and energy conservation, and national energy council.

[\[2\]](#) The law reversing direct presidential elections was later overturned.

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