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by Haidar Ali

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GRADEMARK REPORT

FINAL GRADE

70/100

GENERAL COMMENTS

Instructor

This is a very nicely written essay. It has a good structure and a nice flow to the conclusion. It draws on extremely well chosen examples and uses data very well to back up and illustrate its argument.

The essay scores additional marks for showing a wide range of frameworks from the module can be applied to a setting. It nicely links market failures to technology and then to governance/policy, highlighting unintended consequences and emergent policy problems. The literature on innovation is well chosen and used in an intelligent way, showing an ability to apply abstract concepts to a particular empirical setting. The explanation of the context is very well done and clear.

Overall this is a very nice piece of work. Well done.

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Executive summary (232 words)

Indonesia is well-endowed with plentiful supply of renewable and non-renewable primary energy sources, however, the energy policy towards 2050 indicates a desire to maintain the current dominance of the non-renewable energy supply. This would appear to indicate a lock-in of the existing energy system which favours coal-fired power plants. Thus, we explore policy interventions which can support more sustainable and inclusive supply for power generation in light of market failures.

Indonesia is the world's second largest exporter of coal, in 2018 it accounted for 16.6% ($20.6 billion) of global export. Thus, non-renewable coal-fired power-plants are the preferred choice of supplying generation of electrical power, where, coal accounts for 57.2% of fuels for Indonesia's generation of power. However, while these plants can provide significant economies of scale and capacity for urban regions, they are the largest emitter of greenhouse gases (GHG) and the most inefficient of the fossil fuel-based power plants. Moreover, government subsidies on electricity prices has provided significant disincentives for the state electricity company to invest in efficiency, upgrading capacity or creating more connected power networks.

On the renewable technological opportunities, Indonesia is blessed with significant potential for geothermal, hydropower and solar. It already has the third largest installed capacity for geothermal energy and over 75GW of potential for hydropower. In 2015, Hydropower generated 16.6% of the world's total electricity, where, it also represented 70% of all renewable electricity.

Introduction (517 words)

Indonesia general background

As a member of the G20 and a recipient of ODA (Official Development Assistance) funds, Indonesia presents a multifaceted case study for sustainable and inclusive development for the energy sector. The development of the energy sector for Indonesia has helped it to grow its economy averaging at 5-6% annual growth since the Asian financial crisis of 1997. It is now currently the second largest exporter of coal (mostly to China and India) and has until very recently been an exporter of oil and a member of OPEC. The energy market is also supported by the mining and quarrying sector which represents 10.1% of the primary sector of the economy (Asian Development Bank, 2017).

Market failure, natural monopolies, subsidies, regulatory barriers and "lock-in"

In this paper, I argue that Indonesia is "locked-in" to the non-renewable energy sector which has contributed to Indonesia's recent economic growth, whereas, there is compelling evidence for the potential of renewable energy sector. We will explore patterns of innovation and systems of innovation in the energy sector with respect to electricity power generation and examine market failure, government interventions and the role of firms in the innovation process.

Natural monopolies

Market failures occurs when there is inefficient supply of goods/services or exchange. In energy systems, because of the large fixed costs of plants over several years, it requires a large load factor to split the costs, thus, natural monopolies emerge, requiring economies of scale which cause barriers to entry. When this is not sufficiently regulated, a single supplier can increase output and prices over time with poor services, if barriers to entry reduce, more suppliers may enter but not necessarily improve prices or services. Over time, governments may intervene to set up codes to increase quality standards (or even nationalise). Additionally, prices do not reflect negative externalities such as pollution, thus, the social cost is under-priced and over-supplied.

Subsidies

Indonesia's policy response has to been to setup a state-owned enterprise PLN as the state electricity provider which has monopoly over power generation. Moreover, until recently, Indonesia provided large subsidies which reduced the average cost of electricity. The subsidy was worth over $3bn in 2017 (PwC, 2018).

Year	Average Cost (IDR/kWh)	Average Tariff (IDR/kWh)	Subsidy (IDR Trillion)
2012	1,374	728	103.3
2013	1,399	818	101.2
2014	1,420	940	99.3
2015	1,300	1,035	56.6
2016	1,265	991	60.4
2017	1,318	1,105	45.7

Figure 1: Electricity subsidy in Indonesia. Source: PwC (2018)

While the subsidy has provided cheaper tariffs to average consumers, in reality it has stalled the capacity for further generation and reduced incentives to innovate and reduce costs. This is because, the state electricity provider (PLN) has disincentives to increase supply, if it does so, it will increase its costs which cannot be met by the consumer prices, instead it will seek financing from the state which will have to further subsidise from the central budget. Thus, a negative feedback loop has been created to disincentivise investment and innovation.

There have now been policy reforms to reduce subsidies and increase average tariffs towards the average cost of providing electricity. The subsidies are retained for the most poor and remote communities, although the government has yet to decide whether this will be in the form of direct cash transfers or credits (Asian Development Bank, 2017).

Main body (1,605 words)

Indonesia has an ambitious plan 11 to increase its energy mix to decrease its reliance on non-renewable energy sources and increase its share of new and renewable energy sources from the current 4% of the overall energy use to 31% by 2050.

We will now explore concepts from Science, Technology and Innovation (STI) to discuss technological changes and consider market failure policy interventions for renewable and non-renewable technologies.

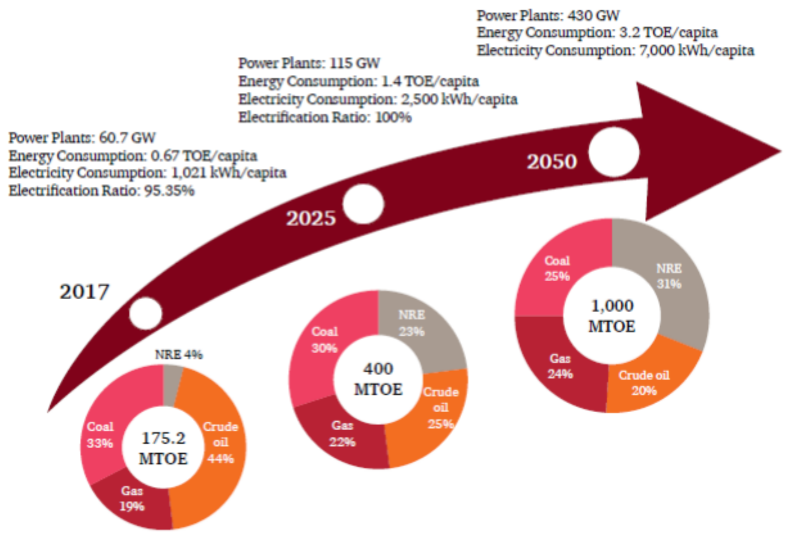

Figure 2: Indonesia's strategy to rebalance its energy mix. Source: PwC (2018)

Patterns of innovation

According to innovation theorist Joseph Schumpeter, there are five different types of innovation: new products, new methods of production, new sources of supply, the exploitation of new markets, and new ways to organise business. Whilst economists have tended to focus on the first two, innovation theorists have highlighted the importance of the other areas (Fagerberg *et al.,* 2006).

Discussion on the innovation process for renewable and non-renewable technologies

In the case of non-renewable coal-fired power plant, firms are incentivised to increase efficiency from the current baseline of 33%. Recent research and development (R&D) in coal-fired power plants has been able to deliver incremental production technology. Such technologies have been able to increase the pressure of super/ultra-critical power plant “boiler” at very high temperatures causing water to instantly, which in turn allows it to become more fuel efficient, increasing efficiency from 33% to 50% while at the same time also reducing greenhouse gases (GHG).

Innovations tend to cluster in sectors such as the “high-tech” sectors and in geographical regions. For example, Germany has pioneered investments in renewable solar technology by providing R&D subsidies to stimulate efficiency of solar cells. Other countries are now using the benefits that has accrued via “technology transfer”. Moreover, innovations do not work in silos, in the case of solar it also relies on complementary innovations such as battery technology to increase efficiency and performance.

Discussion on processes for technological change

Kline and Rosenberg (2009) argue that innovation does not operate along “the linear model” which states that there are well-defined stages of innovation, from research (science), to development, production and marketing in a “linear” manner. They argue that this is too general and applies to very few subsets of innovation and that it ignores several “feedback loops” within the innovation stages. It is a dynamic process where R&D is not sufficient to stimulate and sustain technological change, instead complementary investments are needed within “national systems of innovation” to increase the linkages between the different actors.

Pavitt Taxonomy

The Pavitt (1984) taxonomy states that the rates of technical change and direction in any sector depends on: sources of technology, nature of users’ needs and possibilities for appropriability.

In the non-renewable sector, power plants operate at economies of scale in “production intensive” firms. For coal-fired power plants, sources of technology are external to the firm and innovation diffuses via technology-embodied capital-assets such as machinery, supplemented by R&D activities carried out by the state to improve the efficiency. Production engineering departments improve processes by reducing “bottlenecks”. Thus, the source of process technology is in-house and through suppliers of specialised machinery. Consumers are price-sensitive, in Indonesia, this also relates to the central government due to their role in subsidising electricity tariffs.

Firms operating in the renewable sector, however, are science based for e.g. specialising in solar technology through systematic R&D, often through government subsidies such as in the case of Germany. As this is a highly competitive area, there is high levels of appropriability via patents and tacit know-how. Users for renewable technology can be firms that are operating power plants or consumers directly, the former is price-sensitive due to operating at large scale, whereas, consumers value performance, especially in remote areas where access to electricity is unreliable. Thus, the type of users is mixed.

The Pavitt taxonomy is predictive of the non-renewable coal-fired power sector, it predicts that innovation is largely external to the firm in the form of specialised machinery. In 2017, Indonesia imported $4.1 billion (Workman, 2019) of electrical power equipment, this helped it to achieve a national electrification target of 97.7%. However, Archibugi (2001) argues that there are some limitations, such as concentrating on the manufacturing sector and that analysis at the firm level are extrapolated at the industrial level without making clear the distinction between the two. In later revisions, information technology was also included in the taxonomy to account for services sectors.

Market Failure and Policy interventions

We will now discuss key policy interventions in the power sector in response to the following market failures: natural monopoly, negative externalities (pollution) and poor governance.

Demand side solutions: reduce demand and increase information awareness

As Indonesia's GDP has grown, demand for energy has risen twice as much and is outstripping supply. Therefore, there needs to be tariff mechanisms which reduces both the demand for electricity power as well ensuring that consumers pay tariff closer to the recoverable costs to ensure that the government bill for subsidies reduce as well as allowing some breathing-room to invest in upgrading existing power plants.

A study by Dapice and Cunningham (2011) suggests that a 10 per cent tariff increase will result in a short-term reduction in demand by 2-3 per cent. This would increase current electricity tariffs to cost-price as well reduce energy demands in the short term.

The other method of reducing energy demands is to increase awareness of energy efficiency products such as lighting, more efficient appliances and machinery.

Supply side solutions: Incentivise private sector to invest in power generation

Indonesia's state electricity provider PLN can make more use of Power Purchasing Agreement (PPA) from the private sector. When PLN agreed a price of ten cents per kWh for geothermal electricity it attracted significant interests in investment projects.

The other challenge for Indonesia is to attract large firms to bid for tenders to build large powerplants particularly for geothermal. This arises because Indonesia does not maintain high quality surveying-maps to understand the quality of geothermal fields. Drilling costs are estimated to cost in the region on $3-5m, therefore, present large barrier to entry for firms to invest. Instead, the government can facilitate investment by conducing its own feasibility studies and provide firms assurance that there is potential for exploitable geothermal energy (Asian Development Bank, 2017).

Role of firms

The energy market contains incumbent firms, particularly in the non-renewable sector. New entrants are slowed-down through large barriers to entry such as economies of scale and the need for complementary assets. For e.g. large financing is needed to develop power plants to last 50-100 years supported by dynamic appropriability such as technical know-how.

Long-term economic growth is sustained by innovation, which is largely created by new firms in response to "technological opportunities". In the case of Indonesia, patents in geothermal technologies shot up in response to regulation to make electricity prices more competitive (PwC, 2018).

Role of International Donors

Indonesia is a recipient of ODA funds. Accordingly, we see donors playing a role in the innovation process either through "technology transfer" of technical assistance or through trade of technological-capital-embodied machinery. Several interventions are aimed at increasing and supporting Indonesia's government policy capacity and capability to manage technological changes. These usually occur through coordination of "master plans" and supporting the government on feasibility studies and providing recommendations for financing, resourcing and planning.

The critique of donor intervention in the innovation process is that their "technical assistance" disappears once they leave Indonesia. There needs to be more transparent sustainability indicators which demonstrates that government bureaucrats are learning the tacit know-how and becoming "intelligent clients" in being able to assess investment opportunities. Moreover, the Indonesia government should also strengthen its own internal investment programmes which includes investing in universities to produce specialised and skilled workers.

The table below summarises the key donor interventions/investments in the power sector in Indonesia over the last ten years, from multilateral actors such as ADB and World Bank to European countries: UK, Germany, France, Denmark, Netherlands; and New Zealand.

Project Name	Year Approved	Amount ($ million)
Asian Development Bank		
Policy and Advisory Technical Assistance to Indonesia for Sustainable and Inclusive Energy Program	2014	1.0
Asia Energy Efficiency Accelerator	2013	2.9
Java–Bali 500-Kilovolt Power Transmission Crossing	2013	224.0
Planning a Pilot Carbon Capture and Storage Activity	2013	0.23
Scaling Up Renewable Energy Access in Eastern Indonesia	2013	2.0
Sustainable Infrastructure Assistance Program (grant from DFAT)	2013	20.0
Geothermal Power Development Program (grant from DFAT)	2010	1.8
Java–Bali Electricity Distribution Performance Improvement Project	2010	50.0
West Kalimantan Power Grid Strengthening Project	2010	50.0
Enhancing Private Sector Participation in Infrastructure Provision	2007	2.0
Renewable Energy Sector Development Project	2002	161.0

Asian Development Bank Private Sector Operations Department		
Rantau Dedap Geothermal Power Project	2014	50.0
Sarulla Geothermal Power Development Project	2013	300.0
Loan to Indonesia Eximbank	2011	100.0
Japan International Cooperation Agency		
Java–Sumatra Interconnection Transmission Line Project	2010	400.0
Lahendong and Ulubelu Geothermal Power Plant Projects	2009	260.0
Kamojang Geothermal Power Plant Extension Project (Engineering Services)	2009	10.0
Asahan Hydroelectric Power Plant Construction	2009	276.4
Peusangan Hydroelectric Power Plant Construction	2009	260.2
KfW (Germany)		
1000 islands REEP Phase 1	2015	110.0
Emission Reduction Investment Program	2015	100.0
Energy Efficiency Programme-Rehabilitation of Power Plant	2014	200.0
Rehabilitation of Kamojang 1-2-3 Geothermal Power Plant	2014	69.0
Review and update of existing FS for 9 mini hydropower plants	2014	1.0
Sumatera Pumped Storage (with ADB)	2014	1.7
Update of Existing Studies on Poko and Bakaru II Hydropower Project	2014	1.5
Feasibility Study for Sustainable Hydropower Project	2012	2.9
Geothermal Exploration Seulawah Agam	2010	8.9
Java–Sumatra Interconnection Transmission Line Project	2010	74.6
Seulawah Agam Geothermal Power Plant		64.4
Agence Française de Développement (France)		
Financing of a 500-Kilovolt transmission line in Jakarta	2013	109.1
Financing of a Master Plan for the development of the power network of the Jakarta conurbation	2013	1.1
Strengthen the electricity transmission network in Jakarta	2012	20.0
Building of an electrical transmission line in West Kalimantan (cofinancing with ADB)	2011	49.5
Java–Bali Electricity Distribution Performance Improvement Project (with ADB)	2009	50.0

World Bank		
Indonesia Second Power Transmission Development Project	2014	325.0
Smart Grid Capacity Building	2014	N/A
Update of Existing Studies on Poko and Bakaru II Hydropower Project	2014	N/A
Carbon Capture and Storage	2013	N/A
Geothermal Tariff Development	2013	N/A
Quasi Equity to Supreme Energy (with IFC)	2013	6.0
Clean Stove Initiative	2012	N/A
Financing Options for Medium Hydropower Project in Outer Islands	2012	N/A
Gas Development Master Plan	2012	N/A
Implementation of Performance Based Regulation for Electricity Sector	2012	N/A
TA for Capacity Building to PT Pertamina Geothermal Energy	2012	6.95
Geothermal Clean Energy Investment Project	2011	300.0
Upper Cisokan Pumped Storage Power Project	2011	640.0
Extended Deployment of an Enterprise Resource Planning System	2010	30.0
Netherlands		
Renewable Energy Program	2010	6.0
New Zealand		
Geothermal Human Resources Development Plan	2014	3.8
Development of Indonesia's Geothermal Human Capacity and Capability	2012	0.4
New Zealand Association of Southeast Asian Nations Scholarships	2011	3.0/year
Technical Assistance for Capacity Building Trust Fund	2011	7.4
Danida (Denmark)		
Environmental Support Programme	2013	50.0
United Kingdom		
UK Climate Change Unit Programming	2011	43.1

ADB = Asian Development Bank, DFAT = Department of Foreign Affairs and Trade, FS = feasibility study, IFC = International Finance Corporation, REEP = Regional Energy Efficiency Program, TA = technical assistance.

Note: Amount is US dollar equivalent.

Source: Asian Development Bank.

Figure 3: List of all donor projects in Indonesia in the energy sector. Source: Asian Development Bank (2017)

Governance, Institutional support and Lock-in

Indonesia should strengthen its institutional capacity and coordination abilities across diverse ministries and departments with stake in the energy sector. The biggest single reform would be to increase certainty around land rights to ensure that sustainable renewable power plants such as geothermal power plants can have assurance to build (PwC, 2018). This may be in the form of an independent "energy ombudsman" to negotiate a fair deal between the government, investors, land holders and local communities.

Moreover, the non-renewable sector demonstrates considerable lock-in whereby technological systems and institutions can become intimately interlinked, feeding off one another to form techno-institutional-complex (TIC), (Unruh, 2000).

The coal sector was the largest financier for the recent general elections in Indonesia (Morse, 2019). This indicates that the energy sector is highly politicised and explains why even when renewable technology becomes cost-competitive by 2050, the share of coal in the energy mix remains the single biggest fossil fuel primary energy source (*see Figure 2: Indonesia's strategy to rebalance its energy mix. Source: PwC (2018)* ***Error! Reference source not found.***).

The World Bank has explored governance failures in the context of Russia's coal sector; they found positive impact when subsidy management was transferred to an independent agency and transparent mechanisms for subsidy disbursement was put in place. The conclusion of their report was that corrupt practices were antipoor by circumventing the voices of the poor and marginalised communities who bear the costs of large costs of electricity by inefficient, misallocation of resources (Lovei and McKechnie, 2010).

Discussion and conclusion (568 words)

Let us now reflect back on some of the strength and weaknesses of the policy implications that we have drawn and the frameworks that we have used.

The overall policy implication I have drawn is one of market failure and we have addressed several facets such as natural monopolies, lock-in and governance failures.

Even though Indonesia has ambitious plans to increase its share of renewable energy by 2050, the transition process of "regime" is locked-in to a politicised energy sector. Therefore, policy interventions have focussed on subsidies and tariff management and introducing innovation via capital-embodied technology through support of donor funding. However, in order to meet the supply of long-term demands of power needs in Indonesia, consumers will need to take collective action to support liberalisation of the protective energy sector. This is a major issue for Indonesia and has thus far deterred major investments.

Moreover, the Asian Development Bank (2017) suggests that to reduce the GHG carbon footprint, Indonesia should invest in ultra/super-critical plants. However, key obstacles to investing in Indonesia is often due to inadequate land rights and an efficient process to resolve this, several policy recommendations include assigning an "energy ombudsman" to adjudicate land right processes.

After independence from the Dutch, Indonesia introduced the "1985 Electricity Law", allowing sale of power back to the state-owned enterprise electricity provider PLN via creation of Independent Power Producers (IPPs). In 2002, the government created reforms ("2002 Electricity Law") to allow electricity tariffs to be market priced. However, this law was challenged and deemed to be unconstitutional, thus, re-enacting the 1985 Electricity Law. Consequently, from 1999-2004, there has been very little private investments in power projects or empowerment of innovative firms (PwC, 2018).

Additionally, Indonesia's lack of high-tech product export market has induced little technology-based innovation (OECD, 2014). As a result, patents are low due to lack of research capacity. Thus, Indonesia should support public research institutions to carry out research to support scientific-evidence based policy and provide an enabling environment for new firms. This is supported by our discussion on the "systems of innovation" view whereby linkages of several actors help drive innovation processes. However, unless there is significant investment it is unlikely that Indonesia will be able to "catch-up" with respect to the technological frontier of renewable energy sector (Bell and Pavitt, 1993).

We did not discuss the idea of inclusive growth which would have been very interesting to discuss as a detailed topic in itself, this is because Indonesia is an archipelago country composed of more than 16,000 islands. There are three major power grids, and 600 smaller, isolated grids (PwC, 2018). This means that electricity cost is cheaper in the three major power grids and expensive in the smaller scale islands. Here, I think there is scope for renewable energy to dominate as there are no opportunities for scale, where the non-renewable sector dominates by being price-competitive.

In terms of technology policy, there is no one size fits all. Though, substantial experience comes from planning and implementing technology policy. Installing experts in innovation within a public organisation (such as through donor intervention) does not necessarily lead to strides in innovation processes, instead we find that there are several complementary factors at play which will not be solved by "hiring-in" technical assistance. Instead, a longer-term approach of building tacit knowledge of innovation processes embedded within the state is needed to support innovation in the long term.

References

Archibugi, D. (2001) Pavitt's Taxonomy Sixteen Years On: A Review Article. Economics of Innovation and New Technology. [Online] 10 (5), 415–425. Available from: doi:10.1080/10438590100000016.

Asian Development Bank (2017) Indonesia: Energy Sector Assessment, Strategy, and Road Map. [Online]. 6 September 2017. Asian Development Bank. Available from: https://www.adb.org/documents/indonesia-energy-sector-assessment-strategy-and-road-map.

Bell, M. & Pavitt, K. (1993) Technological Accumulation and Industrial Growth: Contrasts Between Developed and Developing Countries. Industrial and Corporate Change. [Online] 2 (1), 157–210. Available from: doi:10.1093/icc/2.1.157.

Dapice, D. & Cunningham, E. A. (2011) Squaring the Circle: Politics and Energy Supply in Indonesia. [Online]. Ash Center. Available from: https://ash.harvard.edu/links/squaring-circle-politics-and-energy-supply-indonesia.

Dosi, G. (1993) Technological paradigms and technological trajectories. Research Policy. [Online] 22 (2), 102–103. Available from: doi:10.1016/0048-7333(93)90041-f.

Dutu, R. (2016) Challenges and policies in Indonesia's energy sector. Energy Policy. [Online] 98513–519. Available from: doi:10.1016/j.enpol.2016.09.009.

Fagerberg, J., Mowery, D. C., Nelson, N. R. (2006) Oxford Handbook of Innovation; by Jan Fagerberg, David Mowery & Richard Nelson. Reciis. [Online] 2 (2). Available from: doi:10.3395/reciis.v2i2.174en.

Gokkon, B. (2019) Indonesia may achieve renewables target, but still favors coal for power. [Online]. 7 February 2019. Mongabay Environmental News. Available from: https://news.mongabay.com/2018/03/indonesia-may-achieve-renewables-target-but-still-favors-coal-for-power/.

Hermawati, W., Putra, P.B., Hidayat, D. & Poerbosisworo, I.R. (2016) Influential Factors of Evidence-Based Energy Policy-making: Government Regulation on Targeting Renewable Energy in Indonesia. STI Policy and Management Journal. [Online] 1 (1). Available from: doi:10.14203/stipm.2016.55. http://dx.doi.org: 10.1787/9789264204485-en

IEA (2010) Renewable Energy Essentials: Hydropower. [Online]. IEA Webstore. Available from: https://webstore.iea.org/renewable-energy-essentials-hydropower.

Kline, S.J. & Rosenberg, N. (2009) An Overview of Innovation. Studies on Science and the Innovation Process. [Online] 173–203. Available from: doi:10.1142/9789814273596_0009.

Knapp, J. & Kuznets, S. (1970) Modern Economic Growth: Rate, Structure and Spread. Economica. [Online] 37 (145), 104. Available from: doi:10.2307/2552017.

Lovei, L. & McKechnie, A. (2010) The costs of corruption for the poor: the energy sector. [Online]. 1 July 2010. The costs of corruption for the poor: the energy sector (English) | The World Bank. Available from: http://documents.worldbank.org/curated/en/343191468762311247/The-costs-of-corruption-for-the-poor-the-energy-sector.

Morse, I. (2019) The Natural Resource Oligarchy Funding Indonesia's Election. [Online]. 11 April 2019. The Diplomat. Available from: https://thediplomat.com/2019/04/the-natural-resource-oligarchy-funding-indonesias-election/.

Mujiyanto, S. & Tiess, G. (2013) Secure energy supply in 2025: Indonesia's need for an energy policy strategy. Energy Policy. [Online] 6131–41. Available from: doi:10.1016/j.enpol.2013.05.119.

Nightingale, P. (2014) What is Technology? Six Definitions and Two Pathologies. SSRN Electronic Journal. [Online] Available from: doi:10.2139/ssrn.2743113.

Norton Rose Fulbright (2015) Indonesian power projects: Global law firm: Norton Rose Fulbright. [Online]. Global law firm I Norton Rose Fulbright. Available from: https://www.nortonrosefulbright.com/en/knowledge/publications/954feb7e/indonesian-power-projects.

OECD (2014) National Intellectual Property Systems, Innovation and Economic Development: With perspectives on Colombia and Indonesia, OECD Publishing.

OECD (2015) Innovation Policies for Inclusive Growth. [Online] Available from: doi:10.1787/9789264229488-en.

Pavitt, K. (1987) objectives of technology policy. [Online]. 1 August 1987. OUP Academic. Available from: https://doi.org/10.1093/spp/14.4.182. Anon (1995) The 'National System of Innovation' in historical perspective. [Online] Available from: doi:10.1093/oxfordjournals.cje.a035309.

Pavitt, K. (1984) Sectoral patterns of technical change: Towards a taxonomy and a theory. Research Policy. [Online] 13 (6), 343–373. Available from: doi:10.1016/0048-7333(84)90018-0.

PricewaterhouseCoopers (2018) Power in Indonesia: Investment and Taxation Guide 2018 - 6th Edition. [Online]. PwC. Available from: https://www.pwc.com/id/en/pwc-publications/industries-publications/energy--utilities---mining-publications/power-guide-2018.html.

Speir, J.P. & Chandler, A.D. (1992) Scale and Scope: The Dynamics of Industrial Capitalism. Southern Economic Journal. [Online] 58 (4), 1153. Available from: doi:10.2307/1060269.

Teece, D. (1993) Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. Research Policy. [Online] 22 (2), 112–113. Available from: doi:10.1016/0048-7333(93)90063-n.

Unruh, G.C. (2000) Understanding carbon lock-in. Energy Policy. [Online] 28 (12), 817–830. Available from: doi:10.1016/s0301-4215(00)00070-7.

Workman, D. (2019) Coal Exports by Country. [Online]. 29 July 2019. World's Top Exports. Available from: http://www.worldstopexports.com/coal-exports-country/.

Wu, Y.-C.J. (2017) Innovation and entrepreneurship education in Asia-Pacific. Management Decision. [Online] 55 (7), 1330–1332. Available from: doi:10.1108/md-05-2017-0517.