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The Provision of Public Street Lighting Based on Risk Mitigation for Energy Efficiency and Environmental Protection

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Abstract

Public Street Lighting (PSL) is part of road infrastructure that is vital for the safety and comfort of road users. The availability of PSL can also boost the economic growth of a municipality because the longevity of activities from the population and the industry is increased. The crucial role of PSL is still not being offset with good availability and management most municipalities in Indonesia still cannot fulfill the needs of good PSL requirements and using a lot of electricity. This is due to the lack of PSL management in Indonesia is caused by the limitations of technical aspect management and lack of technological availability, limitations of the administrative function as well as lack of alternative financing scheme. To accelerate the availability of PSL and to optimize the management it needs an efficient provision scheme and mitigate risk caused by the ineffective management of PSL. The methodology that is being used in this research are problem solver and risk sharing approaches. The result of this research shows that compared to conventional procurement from the state budget, the Public Private Partnership (PPP) scheme can solve most of the provision and management problems of PSL. In the PPP scheme, there is a risk transfer of 80% from the government to the public sector so that PSL services are better, this is balanced by the positive value of Value for Money (VFM). The energy efficiency potential of the PSL PPP can reduce up to 53% of electrical energy use from replacing lamps in PSL. The use of LED lights makes waste from PSL more environmentally friendly because it does not contain mercury like traditional lamps which are widely used in PSL and reduces CO_2 emissions produced by electrical energy.The Government must promote the PPP scheme as part of innovative financing for the provision and management of PSL in Indonesia as there are only 3 out of 514 municipalities that has already implemented the PPP scheme for PSL Project.

Keywords: PSL, PPP, Energy Efficiency, Risk Sharing

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INTRODUCTION

The growth of a city is determined by the quantity and the quality of the infrastructure, one of the most used infrastructures is road. A good road cannot only be determined by seamlessness but also by the safety and comfort of the users. The main component of the road that can provide safety and comfort is the PSL. The appropriate and sufficient lighting in a particular location of the street is crucial in creating safety for the people (Jiang et al, 2015). Public street lighting (PSL) serves as a critical infrastructure within urban environments, ensuring safety, and security, and facilitating various societal activities during nighttime hours. The significance of PSL is underscored by its role in supporting public life, reducing crime, and enhancing overall well-being (Ali and Muslim, 2017). Outdoor lighting constitutes a significant part of the night activities of people in contemporary cities. Nevertheless, in many cases, this may result in the increasing and irrational use of it affecting the users of public areas, the environment, and driving safety (Skandali and Lambiri, 2018). Dark, undulated, and uneven road conditions can pose a risk of accidents and crime. Reflecting these conditions, the need

for public street lighting becomes a priority (Nadhiroh, et al, 2022). Many crimes and other crimes are suspected to occur in areas that are still dark and have minimal PSL (Riwukore, 2021). Residential areas that are provided with more lighting can reduce crime significantly,with the minimum outdoor crime index at night falls by 36% (Chalfin et al. 2019). Optimal lighting on highways will influence city growth because it will ensure pedestrian comfort and safety and reduce electricity expenditure (Bystryantseva et al., 2020). There is a positive relationship between road lighting and pedestrians' feeling of safety (Svechkina et al., 2020).The ever-expanding urban landscape, characterized by rapid population growth and urbanization, has led to a surge in energy consumption, particularly in street lighting systems (Mathaba and Manyake, 2023). As urban areas develop, public infrastructure such as street lights is also developing (Morwanto et al. 2023). A higher proportion of PSL lighting will bring benefits by increasing socio-economic development (Watson et al. 2023). There is a correlation between electricity consumption for PSL and GDP (Khayam et al. 2023). As cities continue to burgeon, the energy demand for street lighting escalates, contributing significantly to global electricity consumption. Presently, approximately 3.19% of global electricity generation is dedicated to public lighting, surpassing the output of hydro or nuclear plants (Bhagavathula and Ghibons, 2018). However, this substantial energy consumption is often accompanied by inefficiencies, as evidenced by reports indicating that urban street lighting systems in Italy contribute to a significant energy wastage of around 30% (Khalil et al, 2017).

Smart PSL development can generate benefits in city sustainability, increase energy efficiency, and increase safety for the community (Marwanto, 2023). Reducing the energy used for PSL will reduces the impact of carbon emissions and global warming (Omar et al. 2022).The escalating energy consumption in street lighting poses multifaceted challenges, ranging from economic burdens on municipal budgets to environmental concerns such as increased carbon emissions (Carli and Pellegrino, 2019). Furthermore, suboptimal management of PSL, exemplified by issues like weak databases, illegal connections, and high electricity bills, hampers its potential benefits This inefficiency is accentuated by the negative impact on safety, contributing to a higher number of accidents, especially during darker hours. Indonesia, the challenges are intricate, encompassing technical, social, and financial aspects, resulting in suboptimal Asset Performance of Street Lighting (APJ) conditions. The consequences are severe, ranging from high accidents due to dark road conditions to increased carbon emissions. Investment in the region is impeded by insufficient lighting (Wardhana, 2022).

Addressing the challenges posed by inefficient PSL necessitates a comprehensive solution that integrates energy efficiency, economic viability, and sustainable practices. An effective approach involves the adoption of multi-period planning strategies, acknowledging the unique characteristics of public street lighting systems and the need for long-term energy efficiency retrofits (Carli and Pellegrino, 2019). Moreover, the role of street lighting extends beyond mere illumination, encompassing crucial aspects such as crime prevention, economic contributions, and support for various societal functions (Nugraha and Desnanjaya, 2023; Welsh and Farrington, 2022). As cities worldwide strive to align with sustainable development goals, a strategic focus on energy efficiency in street lighting becomes imperative (Mathaba and Manyeke, 2023).

The large use of electrical energy has the potential to contribute to increasing emissions. According to Kurniawan et al., (2020), APJ contributes in increasing emissions because the power generation in this country is still dominated by fossil fuels, especially coal-fired power plants. APJ is a big responsibility for the Regency / City governments in Indonesia and many cities still apply inefficient technology (ADB, 2017). Most of the Public Street Lighting Lamps (LPJU) throughout the country still use old and inefficient lighting technology, thus consuming a very large amount of electrical energy 3,503.47 GWh/year. Therefore, efforts to save electrical energy in the LPJU sector is urgently needed (Karmiathi et al, 2019).

One of the purposes of electricity that is broadly utilized by society today is as a source of lighting. The augmented level of community mobility makes all activities need lighting. One that needs lighting significantly are the highways or public roads (Ibrahim et al, 2022). At Indonesia's city level, street lighting can be viewed as the fundamental energy consumer and greenhouse gas emitter. Likewise, public street lighting systems throughout Indonesia still uses inefficient innovation, bringing about a critical piece of a region's working consumption. We lead techno-economy examination and form funding components to help energy effectiveness (Kurniawan and Kurniawan, 2022). Local governments face several obstacles in implementing and deploying improved APJ technology. The successful implementation of such technologies, such as LEDs, depends on their economic impact and the effectiveness of technological interventions (Campisi et al., 2018).

Even though APJ is economically feasible, it cannot be implemented due to various obstacles, such as budget limitations, capital constraints, technological limitations, and awareness (Anggono et al., 2021). Public-private partnerships (PPPs) or energy performance contracts (EPCs) provide avenues for sharing risks and rewards. In a PPP, the private sector invests and operates the system, while in an EPC, the energy service company (ESCO) guarantees energy savings, creating a symbiotic relationship (ESMAP, 2014). Risk sharing models offer avenues to optimize energy efficiency while ensuring the sustained benefits of savings over time. The party with the greatest ability to control and manage risks should be assigned. Sensible distribution of risks gives motivating forces to all parties to forestall and limit the chances of risk (Pham, 2021).

In conclusion, the quest for energy efficiency in public street lighting is both a challenge and an opportunity. Through innovative models of risk sharing, we can not only mitigate the environmental impact of excessive energy consumption but also create economic efficiencies and enhance the overall quality of urban life. The research question of this study is how to create a PSL provision scheme that can achieve energy efficiency, environmental protection, and optimality. This research aims to delve into the intricacies of implementing such risk-sharing models to pave the way for a more sustainable and efficient future in public street lighting. The objective of this research is to generate PSL provision based on risk sharing that is efficient and optimal in management, provide energy efficiency of electricity dan to protection the environmental condition.

METHOD

This research is using a quantitative approach that associates with the measurement and analysis of the variable to generate results. The methodology being used is quantitative method. The research is being conducted from the period of September up to November of 2023. The data being used are primary and secondary. The primary data consists of an in-depth interview with the person in charge in two municipalities about risk management of PPP street lighting. The secondary data consisits of project brief from market sounding document and Public Private Partnership Infrastructure Project Plan in Indonesia 2023 from Ministry of Planing/Head of Bappenas. Secondary data was used to provide an overview of PPP PSL Projects in two sample districts, while primary data was used to validate the benefits and considerations for selecting PPP.The research population is all of Municipalities in Indonesia, while the sample being taken has criteria which is the Municipality that has implemented the PSL project using two schemes those are the conventional scheme using state budget and PPP with the condition of fulfilment of financial close with the scope of more than 5,000 light points The choice of conventional and PPP schemes is based on possible schemes that may be implemented by the municipality and there are benchmarks. The objective of using those criteria is to generate a comparison between those two schemes of PSL project within the same municipality. Based on the screening criteria it resulted in Municipality A that is in East Java and Municipality B that is in West Nusa Tenggara. The steps being done for this research are as follows:

a. The identification of option for PSL provision scheme in Indonesia.
b. Analysis of the comparison of the two schemes using problem solver approaches for an optimal PSL provision. The optimal scheme is the one that can solve all the problems and the effect it causes to get energy efficiency from electricity.
c. Risk identification that arises in the PSL management, that is obtained from the two municipalities that have implemented the 2 schemes of PSL provision. After it identified the risk then it analyzes the risk allocation with the approach that each risk must be allocated to the party that has:
   1) The ability to control the probability of risk occurrence.
   2) The ability to administer risk impact.
   3) The ability to bear the risk with the lowest cost.

After it has obtained the risk allocation from the two schemes, then the risk analysis is conducted to determine the efficiency of each scheme.

RESULTS AND DISCUSSION

The Option for Provision Scheme of PSL in Indonesia

The PSL management has a good chance for development as it has a constant source of income. The income comes from Tax on Particular Goods and Services/ Pajak Barang dan Jasa Tertentu (PBJT) of electricity generation or used to be called Tax on Street Lighting. According to Regulation No.1/2022, the amount of PBJT is maximum 10%. In 2021 the total revenue from various groups of consumers is IDR 279.094 trillion (PLN, 2021).

With the assumption that PJBT of electricity generation is at a median of 5% then it could generate revenue of IDR 13.954 trillion per year. According to Wardhana (2022), there is a potential increase of 5.66% per year for PJBT from electricity generation with the last 5 years average amount of IDR 12.848 trillion. If this amount is deducted with an electricity bill of IDR 5.130 trillion then there is a potential of ± IDR 8.824 trillion to be used as a source of funding for PSL. According to Ministry of Transportation Regulation No.27/ 2018, the provision of PSL consists of planning, placement and installation, operation, maintenance management, replacement, and abolishment. The convening of PSL is being done by the Minister for national road, the Governor for provincial road, the local Municipality for municipal road and the mayor for the city road. Therefore, the financing of the PSL will be aligned to the responsibility of the selected stakeholders. Indonesia has a few models for infrastructure financing those are government funding comes from state budget, foreign endowments (PHLN), National/Syariah bonds (SBN/SBSN) and municipal funding. Other sources of funding are PPP and Investment funding other than state budget (PINA) (Yesnat & Syanti, 2022). Those financing schemes can be used for PSL provision if it aligns to the necessary requirements. With a clear source of funding, the provision of PSL can implement innovative financing. The schemes of PSL financing that has implemented by the Government and municipalities are as follows:

1. State funding. Financing and funding of PSL comes from the State Budget. This scheme has limitations related to the prioritization and budgetary constraints that PSL provision sourced from the PBJT is considered mostly as a revenue source. With little too few amounts for PSL provision.
2. Endowments. The funding of PSL with endowments given from Ministries/Bureaus, Donors, and CSR. This scheme has limitation that is dependent on the capacity of the bestower of the endowments and usually it does not include maintenance thus it is potentially unsustainable.
3. Public Private Partnership (PPP). The funding provided by investors and investment return comes from availability payment. Several municipalities opting for PPP implementation but the number is still very limited. There are only 3 municipalities out of 514 municipalities that implemented the PPP scheme including the commercial close stage. One of the challenges of PPP implementation is the fiscal capacity constraints for the availability

of payment. The PJBT that received by the municipality intended to be National Revenue other than Tax (PNBP) cannot automatically be used for PSL provision.

PSL Provision Scheme using Problem Solver Approach

PSL is part of road infrastructure that is mandatory to be provided by the Central and Municipal Government according to the road types. This has been stipulated in Regulation No. 22/2009, Government Regulation No. 34/2006, Ministry of Public Works No. 13/PRT/M/2011 and Ministry of Transportation Regulation No. 27/2018. Although it has been made mandatory the majority of PSL is still not optimal and could endanger the safety of the road users. The government has issued various regulations to overcome classic regional government problems in managing PJU. However, these classic problems still exist and there have been no significant changes (Ferza and Pranasari, 2020).

Several researchers have identified the causes that hamper the PSL optimization, which are:

1. Problems in managing the PSL encompassed the technical, social, and other aspects such as the tenuous database for the installation, illegal connecting PSL, and charges of electricity that exceeded its estimation and actual use. (Berlian, et al. 2014).
2. The PJBT is not enough to manage the PSL, the lightbulbs on the PSL are still wasteful and contains high concentration of mercury, the limited amount of electricity meter, and the uneven distribution of electricity, the uncertainty for regulation to manage and administer PSL investment (Fathurrokhman, 2015).

The constraints for PSL management that have been mentioned above have negative impacts for the society, which are:

1. High number of accidents due to the suboptimal PSL function. The highest number of accidents occur between the hours of 00.00 to 06.00 due to roads in a such dark condition (Radik and Widowati, 2021). According to Hidayati et al (2023), In a conventional PJU system, the PJU lights will be on continuously at night until early morning without any control or monitoring. Apart from that, the use of PJU lights still requires a lot of power, wastes electrical energy, and is uncontrolled.
2. The high usage of electricity for PSL due to lightbulbs with high energy consumption resulted in high electricity bills and contributed to an increase in carbon emission. In 2021, the electricity bills for PSL are amounted to IDR 5.129 trillion (PLN, 2021). This number has the potential to increase up to 0.75% every year. According to the Ministry of Environment and Forestry (2020), the total GHG emission for electricity sector in 2019 is 273,523 $GgCO_2e$. The contribution for PSL electricity usage in 2019 is 1.48% (PLN, 2019). The indication for GHG emission from electricity sector is 4,048.14 $GgCO_2e$. This number could potentially increase along with the rises of electricity for PSL. This contradicts the Government target in the Paris Agreement.
3. The stall of investment due to the dark condition. Most of the industries and the manufacturing are doing their activities for 24 hours. The dark condition of the road could affect the industrial activities and the manufacturing thus affecting the investor appetite to invest.

Based on the previous explanation it has identified the problems, the cause, and the impact of the current PSL management. The problems, the cause and the impact would be the input and the parameter to select options for PSL provision that will be described on Table 1. The analysis will be conducted by using the sample of two municipalities that have implemented the State Budget (SB) scheme and PPP scheme. Those are Municipality A in East Java and Municipality B in West Nusa Tenggara. The PPP Scope for those two municipalities are shows in Table 1.

Table 1. The Problems, The Causes, and the Impacts for PSL Management as the Concluded Parameter through the Purchase Option of PSL

Parameter Code	Short Analysis	Scheme Option	
		SB	PPP
Problems			
1.1	Limitations on management.	X	Yes
1.2	Administrative constraint.	X	Yes
1.3	No alternative scheme for financing.	X	Yes
Causes			
2.1	The tenuous PSL DatabaseLemahnya database APJ terpasang.	X	Yes
2.2	*Illegal connecting* PSL.	X	Yes
2.3	High electricity bill.	X	Yes
2.4	Limited fiscal capacityKapasitas fiskal terbatas	X	Yes
2.5	PBJT is not enough to manage the PSL.	X	X
2.6	The wasteful lightbulbs.	X	Yes
2.7	The limitation for electricity meter on PSL.	X	Yes
Impacts			
3.1	Rise on crimes and accidents.	X	Yes
3.2	The uncontrolled usage of electricity.	X	Yes
3.3	The waste of budget for electricity payment.	X	Yes
3.4	The rise of glass house emission and carbon emission.	X	Yes
3.5	The stall of investment	X	Yes

Description: Yes: Can solve all problems/causes/impacts; X: Cannot solve all problems/causes/impacts

According to the problem solver approach analysis described in Table 1, the scheme for PSL provision through PPP can solve most of the causes and the problems as through PPP the municipality can revitalize the PSL using the manpower and the financial resources of an investor. The ability to solve problems in the provision and the management of the PSL shows that PPP scheme can eventually mitigate risks that could disrupt the population due to bad management of PSL. One area that has a lot of potential to be targeted for energy efficiency is street lighting (Kurniadi, 2023). The PPP scheme could generate energy efficiency from the regular mercurial lightbulb to an LED lightbulb. The conversion to LED lightbulbs could reduce electricity costs by up to 53% (Hasibuan et.al,2020). In almost every nation, LED (Light-Emitting Diode) street lighting is currently the most common type of public lighting. Although LED technology is a less expensive option, careful planning is required to achieve high efficiency (Abdullah et al, 2021). The most reasonable option for rejuvenating the road lighting framework is the retrofit of traditional lamps by LED lamps, as it is a feature with greater durability, lower power utilization and less requirement for network variations of electrical current (Bernades et al, 2020). On the two municipalities that were used as a sample for this research the Project Company (PC) that implemented the PPP Scheme has a lower service level agreement on the electricity level compared to the conventional scheme.

PSL Provision Scheme Analysis based on Risk Sharing Approach

Risk allocation on infrastructure investment including the PSL has different characteristics compared to other investments in other sectors. Infrastructure projects typically need a huge initial investment, the asset is long term, and with this comes a high risk that could affect changes over time due to huge uncertainty. (Handayani et al, 2023). Risk allocation becomes important when conducting the project. The risk sharing is done by allocating the risk

to the party that is capable of tackling and overcoming it. (Fadzlurrahman & Abubakar, 2019). To lessen cost and time delay, we need to identify, assess, and allocate proper risks (Hiyassat et al, 2020). The risks are assigned to the parties that can alleviate risks arising during the project execution. Subsequently, it is imperative for risk distribution with the target of limiting expenses. The instrument of risk distribution is intended to safeguard all stakeholders, and it is crucial to project achievement (Ding and Li, 2022)

The success of risk allocation is when the total cost for the project life cycle is minimized and efficient. Normally, the first stage for risk allocation is risk identification during the revitalization of PSL. In conventional procurement, it is assumed that the entire risks will be borne solely by the Public, while for the PPP there are risks that are shared and allocated to the private sector or in this case the Project Company. But this comes with a condition that the Project Company has the capacity and the capability to mitigate risk compared to the Public Sector.

According to the analysis result for risk identification for PSL management in 2 Municipalities that implement both the PPP and SB scheme, there is the potential for risks to arise coming from PSL management are (1) The risk related to energy consumption, (2) Design Risk and installation, (3) Contractor risk appointment, (4) Permit risk, (5) Access for PSL, (6) Product risk, (7) Equipment performance risk, (8) Electricity supply risk, (9) Construction latency and cost overrun, (10) Damage and theft, (11) Damage for PSL, (12) Revenue risk, (13) Inflation risk, (14) obsolescence risk, (15) Financing risk, (16), Force majeure risk, (17) Legal Risk, and (18) Disposal risk.

Based on the result of the risk identification, not all risks can be implemented with risk sharing. Risks that can be implemented with risk sharing are mainly associated with efficiency and is related to the rising cost of construction, construction latency, and the rising cost of Operation and Maintenance (O&M). Those are:

1. Risks related to energy use that happens when energy saving measures cannot be realized due to technical reasons.
2. Design risk and installation, that is risk associated with ineffective PSL design and installation.
3. Product risk, that is risk associated with low quality PSL products.
4. Equipment performance risk, that is risk associated due damage to the lightbulb, low level of lighting, or unsatisfactory response to customer complaints.
5. Risk of electricity supply, which is risk associated due to low voltages, fluctuating electricity voltages, electricity meters that are nonfunctional, and no electricity current.
6. Latency risk and cost overrun are associated with incomplete installation for the set amount of time thus causing a rise in cost.
7. Damage risk to other road assets and PLN pillar, that is risks associated with the PSL and other assets related to the PSL.
8. Obsolescence risk, that is risk due to the development of technology thus making the PSL obsolete during a certain amount of time.
9. Financing risk, that is risk associated to the unavailability of funding or capital for PSL provision.
10. Force majeure risk, that is risk due to prolonged operational disruption caused by fire, flood, and storm outside of human control.

These risks will be analyzed using two schemes of PSL provision, that is through the implementation on conventional procurement using State Budget (SB) and PPP. The shift of the risk allocation or the risk sharing from the Public Sector to investor, or the Project Company will be identified that there is proven efficiency (Table 2).

Table 2. Comparison of Risk Allocation between Conventional Procurement and PPP

Identification Result	Conventional Procurement		PPP	
	Government	Contractor	Government (GCA)	Project Company
Energy usage risk	✓			✓
Design and installation risk	✓			✓
Product risk	✓	✓		✓
Equipment performance risk	✓			✓
Electricity supply risk	✓		✓	
Latency risk and cost overrun	✓	✓		✓
The damage risk to other road assets and PLN pillar	✓	✓		✓
Obsolescence risk	✓			✓
Financing risk	✓			✓
Force majeure risk	✓		✓	✓

Based on the risk sharing analysis in Table 2, there is risk sharing percentage between the Government to the project company of 80%. The shift of risk allocation from the Government to the project company will be more efficient as the project company is considered to have the capability of managing resources. Efficiency can be measured through qualitative and quantitative Value for Money (VfM). In the PPP context in Indonesia, the main requirement for PPP implementation is the positive VfM. Since the sample is based on two Municipalities that have implemented PPP transactions thus it can be concluded that it has a positive VfM. Several risks that are crucial to PSL management are shared with the project company those are energy usage risk, design and installation, product, performance, damage, obsolescence, and financing the financing risk with the hope that it can be mitigated.

All through the world, PPPs are in many cases seen as a means of contracting for the development and maintenance of infrastructure services, utilizing the development and abilities of the private sector to manage activities that often utilize private finance (Carbonara and Pellegrino, 2018). A typical driver is the case that PPPs permit the public sector to utilize the experience and productivity that the private sector can bring to the supply of certain facilities and services that have generally been given and presented by the public sector (Himmel and Siemiatycki, 2017). Public Private Partnership (PPP) is a different way for the government to provide public goods and services that it cannot provide on its own because of budgetary constraints (Mulyani, 2021). The PPP scheme is appropriate for the arrangement of Street Lighting Equipment to utilize the Design-Build-Operate-Maintain (DBOM) type utilizing the accessible installment return system (Ibrahim et al, 2022).

PPP Scheme has the potential to be implemented in Indonesia as part of innovative financing scheme because there are only 3 out of 514 Municipalities that have successfully implemented PPP for PSL provision. Several motivating factors that can be considered for PPP implementation is PBJT as investment return for the project company, cheaper project cost as part of green financing and emission reduction from energy efficiency. For it to be well implemented it is important to remember that PPP will be conducted over a long period, which generally is carried out for a minimum of more than ten years and could exceed the mayor's term in office. The mayor as a Government Contracting Agency, needs to prepare a sustainable PPP team and rally support from stakeholders in the regions.

CONCLUSION

The conclusion of this research is that PPP scheme can overcome problems, mitigate risks arising from the bad and inefficient PSL management on its electricity usage. According to the analysis of problem solver risk approach, PPP scheme has more capacity to overcome problems than conventional procurement. While on the risk sharing analysis, PPP is considered more efficient as there are almost 80% risk shifted to the Project Company thus it generated a

more optimal result. Regarding electricity usage, the Public-Private Partnership (PPP) scheme enables the substitution of traditional lighting systems with Light Emitting Diodes (LEDs), which are capable of achieving up to 53% energy efficiency in electrical energy compared to conventional lamps widely used in these systems. The benefits of replacing lamps with LEDs through the PPP scheme will also be able to reduce CO_2 emissions from reduced electrical energy and waste produced by more energy-efficient lamps. For regional heads or mayor, providing lights through PPP can be done because the return on investment made by investors can be budgeted from PBJT which is paid by the community every time they pay for electricity services.

RECOMMENDATION

Central Government and Municipalities can implement PPP scheme to accelerate the provision and management of PSL in Indonesia, as there are only 3 out of 542 Municipalities that have implemented innovative financing for PSL management. Based on the PPP benchmark in Indonesia, the size of PSL provision through PPP is below IDR 100 billion and this figure is included in the small-scale PPP category.

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