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Governance of Street Lighting Provision in System Context, Driver, and Collaboration Dynamics Dimensions

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Abstract

Energy efficiency is currently a very popular topic because the world's need for energy continues to increase every year. Street lighting is one sector that has great potential to be targeted for energy efficiency. The use of energy-saving street lighting technology is not easy to realize, due to limited technical knowledge, namely, the components of street lighting do not meet the Indonesian National Standard. Meanwhile, non-technical problems are limited budgets in providing street lighting. If the procurement of street lighting is associated with government budget constraints, then it is not wrong for the provision to be handed over to businesses or private entities. In this study, researchers analyzed the process of collaborative governance and the Public-Private Partnership scheme in providing street lighting in the city of Bandung. This study uses a qualitative approach. Determination of the sample by using critical sampling. Data collection techniques by performing observation, interview, documentation tracing, and audiovisual while the operational design in this study uses an integrative framework for a collaborative governance approach, namely system contexts, drivers, and collaboratives dynamics.

Keywords: Public-Private Partnership, Street Lighting, System Contexts, Drivers, Collaboratives Dynamics.

Introduction

Energy efficiency is currently a very popular topic because the world's need for energy continues to increase every year. Street lighting is one sector that has great potential to be targeted for energy efficiency. The use of energy-efficient street lighting is widely implemented in various countries. In comparison, the city of Akola in India with a population of about 400 thousand invested around $120 thousand with an energy

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reduction of around 2.1 million KWh or a savings of about 56% a year or around $133 thousand1. From the report, the investment project only takes less than 1 year for the repayment period. Therefore, projects like this will be implemented in Maharashtra and Madya Pradesh provinces and this success gives the option to explore carbon finance sources from the World Bank and the Government of India through CDM (Clean Development Mechanism). Even though the project was an investment in street lighting using only T5 lamps and not yet LED lamps that were even more economical than T5 which at that time was more efficient than conventional lamps2.

While the city of Los Angeles in the US, with a population of 3.8 million, invested $56.9 million in energy reductions per year, and in years 1-5, an estimated 68.6 thousand KWh (40%)1. Based on the report, the project began in 2009 to 2014 by replacing 140 thousand lights from more than 209 thousand conventional street lighting with LED lights that strengthen the quality of street lighting, reduce pollution, improve road safety, save energy, and finance. The project's funding consists of a city loan of $40 million, $3.6 million from SMALF, and $13.2 million from the LA Department of Water and Power rebate1.

Kota Ann Arbor, Michigan, has also embarked on a pilot LED energy-efficient street lighting project. That became one of the first in the US to be installed downtown by cutting $1.39 million for half its budget by replacing LED street lighting3. Meanwhile, in the City of San Antonio, Texas, the City Council has agreed to pay about $14 million to replace new LED lights and explained that this would save the equivalent of 5.1 megawatts over 15 years4. Rotterdam launched the use of LED energy-efficient energy-efficient manufacturing in the summer of 2007 and is expected to reduce CO2 emissions by 50% compared to 1990 levels by 2025 levels5.

As mandated in Paris Agreement Article 4.19, Indonesia formulated a long-term strategy for managing low greenhouse gas emissions by 2050. The Government of Indonesia is committed to reducing voluntary greenhouse gas emissions (unconditional reduction) by 26% until 2020, then increasing to 29% from 2020 to 2030 and a reduction of 41% for the conditional reduction in the business as usual scenario6. One of the infrastructures that support emission reduction and energy conservation programs is street lighting. Street lighting energy conservation is carried out by increasing energy use efficiency and saving 20% of electric power7.

In Indonesia, there are currently 143,348 street lighting systems that contribute 4.95% of the total electricity load with the energy use of 3,140 GWh. Using an annual capacity factor (8,760 hours per year) and 60% plant efficiency, one 600 MW class plant must operate to meet the needs of street lighting in Indonesia8. A study from the Center for Electricity Technology Research & Development (2022) shows that

electricity consumption of 3,140 GWh a year, requires Regional Revenue and Expenditure Budget (APBD) funds of IDR3.13 trillion, and electricity subsidies for street lighting reach IDR827.4 billion.

In street lighting, steps that can be taken to improve energy efficiency use include using energy-efficient lamps, metering (kWh meters), and intelligent lighting systems as an overall SL status setting and control9. Under Regulation of the Minister of Transportation Number 27 of 2018, the lights used in SL infrastructure at least use a Light Emitting Diode (LED), High-Pressure Charge Lamp, or Low-Pressure Discharge10. Light Bulbs are widely used in some areas, including Bandung City, causing electricity consumption to be high11. In addition, LED lights with dimming capabilities can reduce power usage by up to 50% without sacrificing much of the level of light produced (compared to High-Intensity Discharge Lamps). Dimming helps minimize power consumption at certain times, such as midnight, when community activities begin to decrease12.

Meterization is used to replace the subscription system still used by some light points. Meterization will provide a more precise measurement of the electricity consumption of each lamp unit/pole. Size using meterization can be supported by installing an intelligent lighting system. The interconnection carried out by this system will provide centralized support to control and regulate several indicators, such as solid lighting settings. It recorded electrical power consumption or kilowatt-hour (kWh) meters (in conjunction with meterization), monitored the performance of electronic devices, and centralized remote control. It censored and recorded data on environmental conditions and monitored the damage or failure of SL13. One thing to note is that in the Regulation of the Minister of Transportation Number 27 of 2018. it is stated that intelligent lighting system applications must be in the form of open-source applications and do not need to use specific software to access it so that integration will be easy.

The use of energy-saving street lighting technology is not easy to realize, due to limited technical knowledge, namely, the components of street lighting do not meet the Indonesian National Standard (SNI)14. Meanwhile, non-technical problems are limited budgets in providing street lighting. If the procurement of street lighting is associated with government budget constraints, then it is not wrong for the provision to be handed over to businesses or private entities. So far, the street lighting facilities managed by the government can be said to have failed. Street lighting installed on road sections has not been able to provide more value for the government, especially revenue from street lighting taxes.

Theoretically, the opening of government cooperation channels with business/private entities seen from the concept of New Public

Management (NPM) is the opening of public space for business entities to participate in providing the best public services. The NPM paradigm emphasizes changes in the form of government relations from a centralized bureaucracy to inter-organizational collaboration so this paradigm is the beginning of the emergence of the concept of collaborative governance15. Conceptually, collaborative governance studies highlight the characteristics of cooperation among the three pillars, namely government, private sector, and society. Then the concept of network governance16 which emphasizes the network that must be forged for the realization of governance; partnership governance17 which requires long-term partnerships; new public governance18 which emphasizes criticism of NPM; sound governance19 which describes the international government system in its interactions with other countries and their governments in an independent, independent, and direct way.

The issue of cooperation between the government and business/private entities has long been raised and has colored the pattern of development in developing countries. Therefore, it cannot be denied that the Public-Private Partnership (PPP) issue has attracted the attention of researchers to study the success or failure of a collaboration. For example, examines government cooperation with business entities in building historical buildings as cultural heritage owned by the Government of Taiwan so that they can be used as tourist taxis20. The results of the study state that this collaboration does provide financial benefits to the government, but this cooperation framework is not accompanied by a promotion mechanism. Cooperation is only limited to building and then handed over to the government.

Revilla, in his research, tried to describe the object studied, namely collaboration between the government and business entities in providing public facilities and managing public facilities in Spain21. The results of the study found that there is a very significant relationship between the government and business entities that have products to achieve the goals of cooperation.

Pal & Pal, examined the success of the Government of India in improving the quality of health services through the PPP model22. The findings in this study are that there is cooperation in the field of feeding services or providing food (catering) for patients in hospitals. In addition, cooperation with the association of doctors was also found to work together to provide services to patients. The time in this cooperation varies between regions with each other, and it is emphasized that the cooperation involves several elements such as universities, NGOs, and private companies.

Zhang & Jia examined PPP implemented in China, where it was examined in terms of legal justice on cooperation contracts carried out

by the government with business entities23. The power of law in cooperation procedures greatly affects the achievement of objectives and the effect lies in the social, economic, and knowledge transfer effects for the government. The government through the team formed can run the project independently when the cooperation has been completed.

Bourgarin examines the performance of PPP in the energy sector24. This research shows that PPP performance is very good under the contract agreement between the government and business entities. A contract that confirms the time of completion of work and the costs to be saved. During the cooperation, Bourgarin did not find any inhibiting factors from the cooperation. It's just that the PPP implemented is not transparent in terms of innovations held, besides that quality improvement is also not improved by business entities. In this case, the business entity only submits the results of the work to the government.

Based on the explanation above, Street Lighting (SL) energy conservation infrastructure can collaborate with the Public-Private Partnership (PPP) scheme25. To meet the street lighting target, Indonesia Government will need $359.2 billion in infrastructure investment, and only 73.5% of the investment value will be delivered through State Budget and State-owned Enterprises projects26.

Likewise, the Bandung City Government projects infrastructure needs through the Public-Private Partnership scheme of IDR60 trillion. Meanwhile, the Bandung City Government Revenue and Expenditure Budget is very minimal, namely IDR7.42 trillion per year. To support socio-economic activities and realize sustainable development, the City of Bandung needs to overcome the problem of financing gaps. Innovation and strategies are needed to reduce the financing gap, namely by developing a cooperation scheme for non-government budget financing27.

As a Metropolitan City, Bandung has 37,592 street lights. Based on calculations using the Indonesian National Standard Number 7391 of 2008, an additional 36,664 street lights are needed to meet the total electricity demand of 9.18 MW. When replaced with LED lights, the full electric power will be reduced to 4.8 MW. The cost of electricity for street lighting before using LEDs was IDR27.5 billion per year. After using LEDs, the amount will be IDR16 billion per year. So that the City of Bandung can save an operational budget of IDR11.5 billion per year8.

According to Sader, the implementation of infrastructure is the responsibility of the government28. The government is obliged to fulfill its socio-economic responsibilities to the people and to ensure that public services can be carried out properly for the whole

community. In this context, the Bandung City Government wants to realize various infrastructure projects with a PPP mechanism worth approximately IDR60 trillion8. However, the ability of Bandung City Budget is insufficient, which is only around IDR6 trillion, so private assistance is needed with the PPP mechanism.

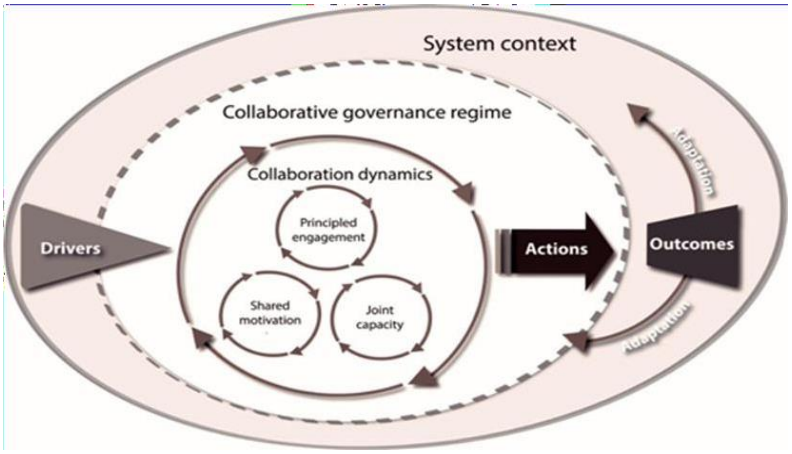
Literature Review

Researchers take the collaborative governance theory developed by Emerson, et al29. These ideas and theories are used as an entry point to explore collaborative governance in the provision of street lighting infrastructure in the city of Bandung, which involves various parties, both formal institutions, non-formal institutions, and community groups collaborating to achieve the goals of the program.

Collaborative governance by Emerson, et al is defined: "... as the processes and structures of public policy decision making and management that engage people constructively across the boundaries of public agencies, levels of government, and/or the public, private and civic spheres to carry out a public purpose that could not otherwise be accomplished29.

The collaborative governance framework, according to Emerson, et al, has 3 (three) dimensions, namely: the system context, the concept of collaborative governance, and the dynamics of collaboration (See Figure 1)29. First, the system context generates opportunities and influences the dynamics of collaboration. From the system, context will emerge driver components, such as leadership, consequence incentives, dependencies, and uncertainty, which help set the direction of collaborative governance. Second, the concept of collaborative governance consists of collaboration dynamics and collaborative actions. Conditions at the beginning of collaboration can facilitate or prevent cooperation between stakeholders. Many frameworks confuse context systems with drivers. Conversely, frameworks that separate contextual variables from drivers, without the encouragement of collaboration, will not be successfully revealed. Third, the dynamic dimension of collaboration consists of three components, namely: principled engagement, shared motivation, and capacity for joint action.

Figure 1. Integrated Framework for Collaborative Governance29



Goldsmith & Eggers, states that there are important things that can be used as criteria for the success of collaborative governance, namely: Networked Structure, Commitment to a Common Purpose, Trust Among The Participants, Governance, Access to Authority, Distributive Accountability/Responsibility, Information Sharing, Access to Resources30.

Agrawal & Lemos stated that collaborative governance is not only limited to government and non-government stakeholders but is also formed on the existence of multi-partner governance which includes the private sector, society, and civil society. So that the idea arises of the need for multi-partners in collaborative governance to see the process of providing street lighting infrastructure in the city of Bandung31.

Other experts call collaboration with the term partnership. A partnership occurs when the private sector replaces the public role, while collaboration occurs when the public and private sectors carry out active functions. Therefore, Parente defines Public-Private Partnership as:"..an agreement or contract, between a public entity and a private party, under which: (a) the private party undertakes government function for a specified time, (b) the private party receives compensation for performing the function, directly or indirectly, (c) the private party is liable for the risk arising from performing the function, and (d) the public facilities, land or other resources may be transferred or made available to the private party"32. While Yescombe, says: "PPP must be seen within the overall context of the public sector reform movement known as New Public Management (NPM), which encourages: 1) Decentralization of government;2) Separating responsibility for the purchase of public services from that of their provision; 3) Output or performance-based measurements of

public services;4) Contracting out public services to the private sector;5) Privatization of public service33.

The PPP scheme should reflect the allocation of risk; the person in charge of financing; and the status of cooperation asset management, where the form of PPP in general, namely: 1) built-own-operate; 2) build-own-operate-transfer; 3) build-operate-transfer; 4) build-transfer-operate; 5) rehabilitate-operate-transfer; and 6) develop-operate-transfer (See Table 1).

Table 1. Model PPP

	Own	Conceive	Design	Build	Operation & Maintenance	Financial Responsibility
Design-Bid-Build	Public	Public	Private by fee contract		Public	Public
Design-Build	Public	Public	Private by fee contract		Public	Public
Build-Operate-Transfer (BOT)	Public	Public or Private	Private by fee contract			Public
Design-Build-Finance-Operate (DBFO)	Public	Public or Private	Private by fee contract			Public
Build-Own-Operate (BOO)	Private	Public or Private	Private by contract (concession)			

Source: United States Department of Transportation, Federal Highway Administration. Available: www.fhwa.dot.gov/ppp/options.html

According to Hua34 and Vladimir35, the reason for cooperation with the private sector in public services is because the inefficiency and incompetence of the government are the results of monopolization in the field of public services. The concept of PPP appears to prevent the slowness of services provided to the community carried out by the government and increase the efficiency and effectiveness of services. These factors are the impetus and consideration for the government to shift public affairs to the private sector so that the government will concentrate more attention on more important matters.

Methods

This study uses a qualitative method with a case study approach. This qualitative method is used to provide a broader perspective for

researchers to analyze facts and phenomena from the collaboration process between the public and private sectors. The researcher's background as a government official who has been a member of the Public-Private Partnership tries to act objectively in data processing so that the result of this research can be one of the considerations in preparing an appropriate and implementable policy recommendation for the Bandung City government.

The strategy to be applied in this study is a case study. Researchers used a single instrumental case study research, by taking the case of collaborative governance in the provision of street lighting in the city of Bandung.

The process of determining the object is done by purposeful sampling. According to Creswell, purposeful sampling is selecting the best people or places that can help researchers understand a phenomenon36. As far as examining collaborative governance in the provision of street lighting in the city of Bandung, researchers will focus on stakeholders who were involved in the collaboration at that time. Therefore researchers will take some of these stakeholders as samples in this study.

The next step is data collection which, according to Creswell36 and Gay, et al37, is an attempt to limit research and collect information through observation and interviews, both structured and unstructured, documentation, visual materials, and efforts to design protocols for recording and recording information. In-depth interviews were conducted to explore comprehensive information from the respondent's experiences as stakeholders, which were conveyed orally in opinions and personal perceptions. The information conveyed will be recorded and then transcribed in written form. This interview was conducted with several members of the PPP and representatives of the Chambers of Commerce and Industry. The PPP members interviewed are PPP members who have strategic positions within the PPP institutional structure and long experience structuring PPP. The PPP members interviewed came from various Bandung City Government Regional Apparatus Organizations. Namely the Development Planning, Research and Development Agency, Spatial Planning Service, Public Works Service, Department of Communication and Information, Economic Section of the Regional Secretariat, Environment and Sanitation Service, Investment Service and One-Stop Services, Financial and Asset Management Agency, Government Goods and Services Procurement Section, and Transportation Service. The topics interviewed were related to the implementation of Bandung Mayor Regulation Number 287 of 2016 concerning the Formation, Main Duties, Functions, Job Descriptions, and Work Procedures of the Technical Implementation Unit for Government Cooperation with Business Entities.

The Chambers of Commerce and Industry representatives interviewed were the most influential figures, and have long been involved in the bidding process for the Public-Private Partnership scheme in the city of Bandung. The topics interviewed included the company's experience in participating in street lighting auctions, and interactions with Bandung City Government PPP members. The interview process was carried out by first agreeing on a meeting plan and guaranteeing the security of the respondent's data to create a comfortable atmosphere during the interview.

The operational design in this study uses An Integrative Framework for a Collaboration Governance approach (see Table 2).

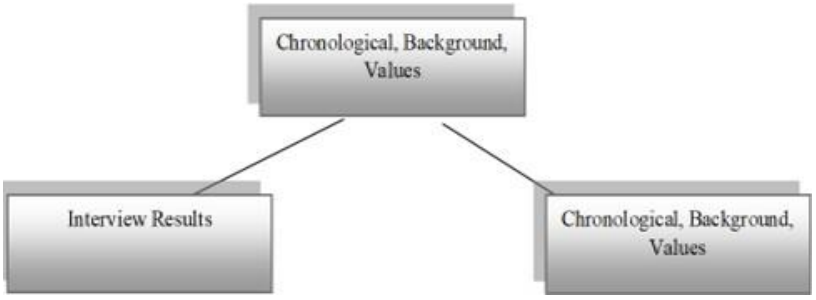
Table 2. Parameter Dimensions & Operationalization29

Study Aspects	Dimensions	Operational Parameters	Parameter Inquiry Item Number
Collaborative Governance	System Context	1. Resources Conditions; 2. Policy and Legal Framework; 3. Level of Conflict/ Trust; 4. Socio-economic conditions; 5. Prior Failure to Address Issues; 6. Political Dynamics/ Power Relations; 7. Network Connectedness	1) Resources owned; 2) Legal policies and frameworks; 3) Conflicts between interests and levels of trust; 4) Portrait of the condition; 5) Failures encountered at the beginning; 6) Political dynamics and power relations; 7) Related networks (connectedness to networks);
	Drivers	1. Leadership; 2. Consequensial Incentives; 3. Interdependence; 4. Uncertainty	1) Leadership support; 2) Consequential incentives; 3) Interdependence; 4) Uncertainty in managing public issues;
	Collaboratives Dynamics	I. Principled Engagement	1) Discovery in running the PPP scheme; 2) PPP scheme definition;

Study Aspects	Dimensions	Operational Parameters	Parameter Inquiry Item Number
			3) Deliberation in choosing PPP 4) Determination of the initiator;
		II. Shared Motivation	1) Mutual trust; 2) Internal legitimacy; 3) Shared commitment;
		III. Capacity for Joint Action	1) Procedural arrangements; 2) Knowledge 3) Resources

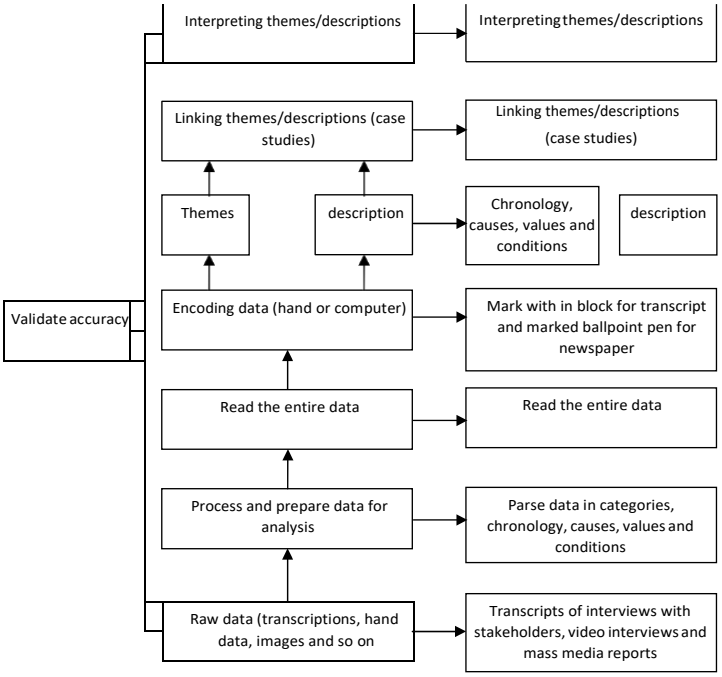
While the Reliability & Validity procedure goes through 8 stages, namely 1) triangulation; 2) Checking Members; 3) creating a solid description; 4) clarifying bias; 5) presenting different (negative) information; 6) using a long time; 7) conducting debriefings with colleagues; and 8) inviting outside auditors (see Figure 2).

Figure 2. Triangulation



The next stage is data analysis and interpretation. Data analysis according to Gay, et al37 is an attempt by qualitative researchers to summarize the collected data accurately and reliably (see Figure 3).

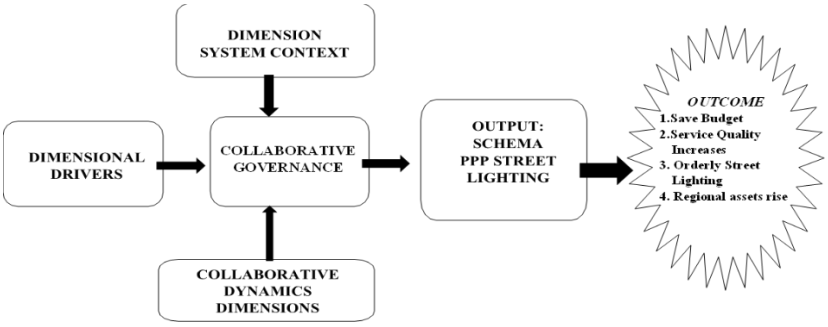
Figure 3. Data Analysis



The purpose of this research is to explain the process of collaboration in the provision of street lighting infrastructure in the city of Bandung, which is then described based on three collaborative processes between PPP members and private parties or business entities in the city of Bandung according to Emerson et al29. This collaboration process will be explained descriptively by conveying facts and social phenomena based on observations, literature reviews, and in-depth interviews. Next, the Public-Private Partnership scheme will be analyzed for the provision of street lighting in the city of Bandung based on the results of observations, literature reviews, and in-depth interviews.

Based on findings in the field, shows that collaborative governance theory from Emerson, et al29 is already able to describe the mechanism and process of organizing street lighting in the city of Bandung. Then to clarify the research, the researcher describes a research model that describes the empirical picture and the suitability of the theory to the research outcome (See Figure 4).

Figure 4. Collaborative Governance Thinking Framework in the Provision of Street Lighting



This research was conducted in Bandung City, West Java Province. The choice of research with a case study of street lighting in the city of Bandung is the first to be carried out in Indonesia. This has become a separate reason for researchers to make Bandung City a research location so that it is hoped that it can become a lesson learned for other regions that will implement the same policy. The implementation of this research is for 15 months (starting from January 2021 to March 2022).

Results and Discussion

Result

Technical Analysis and CO2 Emissions of LED Lights

Street Lighting (SL) in Bandung City is spread on existing roads with several types of SL, but on the other hand, there are still roads that do not have SL, especially environmental roads. The main street in Bandung City already has SL, both single-arm SL and double-arm SL. The construction and repair of SL in 2022 reached 343 SL points built on protocol roads and housing spread across the city of Bandung. SL was built in 2021, as many as 480 SL, and in 2022 made, as many as 300 SL. SL development from 2021 to 2022 amounted to 1,131 points. In 2023 there were an additional 26,793 SL points, bringing the total SL in Bandung City to 27,924 units spread across six development areas. The SL smart system concept has been applied to some SL points. SL smart system distribution points are located on Tamansari Street, Surapati Street, Merdeka Street, City Hall Plaza, Cisangkuy Street, Bengawan Street, and Buah Batu Canal Street (see Table 3).

Table 3. Street Lighting Smart System Distribution Point

No	Location Name	Types of Lights	Number of Dots
1	Tamansari Street	LED 120	16
2	Surapati Street	LED 120	80
3	Merdeka Street	LED 90	20

No	Location Name	Types of Lights	Number of Dots
4	City Hall Plaza	SODIUM 250 W	28
5	Cisangkuy Street	LED 70	28
6	Bengawan Street	LED 70	43
7	Buah Batu Canal Street	LED 120	128
			343

Source: Research Results (2022)

Based on the table above, the lamps used in SL are primarily still using conventional lamps. The followings are the types of non-LED lights used in Bandung and the specifications in general (see Table 4).

Table 4. Types of Non-LED Lights

Types of Lights	Fitting Type	Age (Hour)	Bright	Ra Index (%)	Power (Watt)	Voltage (Volt)	Mercury Substances (mg)	Operating Temperature (degree of Celcius)
 SOUND 250	E40 [E40]	20.000	20.500 lm 4500 K	65	250	240	33	550
 SOUND 150	E40 [E40]	30.000	15.000 lm 2000 K	25	150	100	20	450
 SOUND 70	E27 [ES]	28.000	5.600 lm 2000 K	25	70	90	16.3	350
 HPLN 250	E40 [E40]	16.000	12.700 lm 4100 K	45	250	135	38	350
 HPLN 125	E27 [E27]	16.000	6.200lm 4.200 K	45	125	125	19.0	350

Types of Lights	Fitting Type	Age (Hour)	Bright	Ra Index (%)	Power (Watt)	Voltage (Volt)	Mercury Substances (mg)	Operating Temperature (degree of Celcius)
 HPIT 250	E40 [E40]	20.000	20.500lm 4500 K	65	250	128	33	550
 Sodium	BY22D [BY22d]	18.000	32.000 1800 K	0	180	240	0	150

Source: Research Results (2022)

The advantages of LED lamps in general can be seen from the study of Soni & Devendra38 which provides an overview of the advantages of LED lamps in the form of significant energy and cost savings compared to the use of conventional lamps. Some of the advantages of LED lights are as follows:

1) Due to the high efficiency of LEDs, it is very useful to use batteries or energy-efficient devices.

2) The resulting light is cooler and more pleasant

3) LED lights can emit the desired light without using a color filter as required by conventional lamps so far.

4) This LED light can be designed to focus the light without using a mirror.

Table 5. Investment Comparison of Conventional Lamps with LEDs (Rupee)38

Lighting System	Annual Savings	Investment	Return Time
Existing conventional lamps	No	No	No
CFL	47,450	27,570	6 months
LED	101,105	113,000	14 months

From Table 5 it can be seen that the replacement of conventional lamps (incandescent lamps) with CFL and LED lamps is indicated by the large savings and investment in the value of the Indian Rupee. LED lamps show extraordinary savings, which are about 2 times more efficient than CFL lamps, but require a larger investment fund of about 4 times. While the payment period between the two types of lamps has a ratio of about 2 times for LED lamps compared to CFL lamps. The case from the table occurred in India.

This shows that scientifically and objectively LED street lighting is very economical because it will reduce electricity payment expenses from the Regional Government by almost half if conventional street lighting (CFL) is replaced with LED street lighting. The researcher provides this

picture from a non-commercial source to be free from the business interests of the lamp manufacturers. Because so far, there are no examples of pilot project cases that have been implemented in several streets, for example, to show how efficient LED street lighting is compared to non-LED street lighting.

According to an E-Street study, Project Report – Intelligent Road and Street Lighting in Europe, page 20, changing street lighting from HPS (high-pressure sodium or metal halide lamps) to LED street lighting can improve efficiency by up to 40%. In the City of Ann Arbor, USA, an investment of USD3.3 million to replace a total of 1,400 street lighting lamps or the price of a lamp is USD472 or the equivalent of around IDR4.5 million at an exchange rate of IDR9500. LED street lighting can direct light to objects, thereby reducing energy and light pollution, long lasting lamps of up to 10 years thereby reducing maintenance costs and reducing energy use by up to 50%. In addition, it also reduces the impact of CO2 emissions by up to 40%. Especially if the use of LED street lighting is accompanied by automatic control so that there will be savings of up to 80%39.

In terms of CO2 emissions, the comparison between LED lamps, incandescent lamps and compact energy-saving lamps (CFLs) can be seen as follows:

Table 6. Comparison of the Environmental Impact of Conventional and Energy-Saving Lamps

Environmental Impact	LED	Incandescent lamps	CFL
Mercury content	There aren't any	There aren't any	Yes - mercury is a toxic substance and can be harmful to health and the environment
CO2 emissions (30 pieces per year)	451 pounds/year	4500 pounds/year	1051 pounds/year

Source: Comparison Chart: LED Lights vs Incandescent Light Bulb (incandescent lamp) vs CFL.

Notes. 1 pound = 0.45 kg

From Table 6, LED lamps are lamps that emit the lowest CO2 emissions between incandescent lamps and CFL lamps, which is only about 10% of the CO2 emissions of incandescent lamps or 42% of the emissions of CFL lamps. So it seems that CO2 emissions from LED lights are the lowest. Likewise, if the comparison uses the 1000 lumens level, the energy required for LED lamps is only 4 watts while for incandescent lamps is 60 watts and each emits CO2 emissions of 2 kg per KwH for LED lamps and 60 kg per KwH.

In general, the use of non-SL LED lamps has not attracted much interest from the market, especially among households, because they are relatively expensive40. However, corporate groups have widely used this type of LED lamp due to its high-cost savings and longevity and use in factories, and sales of LED type lamps grow almost 5 times every year40.

Discussion

System Context Dimensions

The Bandung City Government 2022 provides a Regional Revenue and Expenditure Budget for the Street Lighting Program in the amount of IDR96,703,578,447. However, the financial capacity of the Bandung City Government to run the Street Lighting Program is still far from ideal. The investment requirement for the Bandung City Street Lighting Program is estimated to require a budget of IDR1.5 trillion (See Table 7).

Table 7. Feasibility Study Analysis

Investment Scope	**Scenario**			
	1	**2**	**3**	**4**
Lamp Replacement	207,409,273,761	207,409,273,761	207,409,273,761	207,409,273,761
Pole Replacement	104,103,379,710	104,103,379,710	104,103,379,710	-
Cable Replacement	251,180,380,472	251,180,380,472	-	-
Construction of a New Street Lighting	184,707,527,312	-	-	-
Construction of a New Pole	199,116,700,002	-	-	-
New Cabling	387,830,639,406	-	-	-
Smart Street Lighting	168,806,400,000	91,196,800,000	91,196,800,000	91,196,800,000
Total Estimated Investment (IDR)	1,503,154,300,663	653.889.833.943	402.709.453.471	298,606,073,761
Number of Street Lighting Installed	52,752	28,499	28,499	28,499
Estimated Annual Income Needs (IDR)	271,250,000,000		78,750,000,000	61,250,000,000
Percentage of Revenue Needs from Street Lighting Tax	155%	73%	45%	35%
Smart Street Lighting Energy Saving	30%	30%	30%	30%
Estimated Annual O & M Cost (Percentage of Capex)	1%	1%	1%	1%
Period				

Investment Scope	Scenario			
	1	2	3	4
Construction (Year)	2	2	2	2
Operational (Year)	18	18	18	18
Investment Feasibility				
NPV (IDR)	375.780.209.509	140.719.854.315	81.616.651.507	61.768.156.752
IRR	15%	15%	15%	15%
Payback Period (Year)	10	8	8	8

Source: Research Results (2022)

"In the context of street lighting, for the scope of replacing LED lamps and installing smart feeders/controls, the cost savings (including maintenance and electricity costs) is 15 percent (total gross value), equivalent to 22 percent in Net Present Value (NPV). In addition, replacing lamps and installing smart feeders can be done in less than 1 year compared to the 5 years it takes if done through traditional procurement. In addition, later in the 1st and 2nd years, the Public-Private Partnership model will be able to finance 10 thousand new street lights, where the same amount can only be carried out in the 6th and 7th years through traditional procurement" (Head of Bandung City Public Works Service)

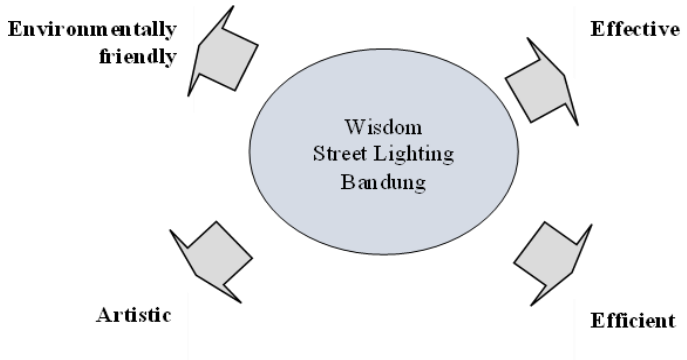
The policy for developing street lighting in the city of Bandung is driven by the many functions and activities of the city, both during the day and at night, where at night the socio-economic activities of the community need to be supported by good, adequate, and sustainable lighting. Trading activities, tourism, and some activities that are usually carried out at night are activities that have become the main characteristics and functions of the city of Bandung. Seeing the condition of the city and the need for street lighting development, a policy for developing street lighting is needed that is optimal and evenly distributed throughout the city of Bandung. This is under the statement expressed by an informant from the Bappelitbang City of Bandung as follows:

"...referring to development policies, conditions, potentials and problems that exist in the city of Bandung relating to the development and arrangement of street lighting, the concept of developing street lighting is formulated, namely developing environmentally friendly, effective, efficient and artistic street lighting in supporting socio-economic activities and realizing the main functions and roles of the City of Bandung within the scope of West Java Province and Nationally. Environmentally friendly street lighting means the use of environmentally friendly lighting technology and provides safe lighting for the public and other users. Effective street lighting means placing street lighting points, setting the distance between poles, setting the

pole height, and using the right type of lamp so that it will provide maximum lighting but still be effective and efficient. Efficient street lighting means the use of lamp technology that is energy efficient and has a long life so it saves energy use and takes a long time to replace lamps. Artistic street lighting means the use of artistic designs of street lighting poles and other accessories, characteristic of the city of Bandung and in line with the values of urban design that will be developed" (Head of the Development Planning, Research, and Development Agency)

Referring to the explanation above, the concept of the Bandung Street Lighting development policy can be described as follows (Figure 5):

Figure 5. Street Lighting Development Policy Concept



Based on the explanation above, it can be seen that the existence of a policy & legal framework in the Public-Private Partnership scheme is very important in efforts to attract partners from the private sector/business entity. However, the researcher argues that in an era of open competition, the consideration for choosing an investment destination is no longer based on the aspect of comparative advantage, but on the aspect of competitive advantage.

Implementation of the current policy & legal framework is still constrained by the behavior of public services that have not been able to realize good governance. The implementation of the policy & legal framework is still faced with obstacles from local regulations (various regional regulations) that are not fully aligned with national policies. In addition, there is still corruption that is almost universal in all regions of Indonesia and state institutions, causing potential investors to be less interested in investing in Indonesia, especially in the city of Bandung. This is in line with the opinion of the Chairman of the Bandung City Chamber of Commerce and Industry as follows:

"…while developing countries which are Indonesia's competitors in attracting foreign capital have been able to improve both in terms of legal aspects, bureaucracy, and speed of licensing services as well as quite attractive incentives. The progress achieved by competing

countries by trying to develop a paradigm of liberal investment law regulation is growing rapidly. Because of that the challenges faced by Indonesia are still quite heavy. The challenge for the development of universal investment law policies is that national investment law policies must be able to safeguard and protect national (domestic) interests in an open competitive era between developing countries in the struggle for foreign investment. In an era of open competition, an exception to various international principles and laws is possible if a host country can provide rational and strong arguments about why a country is given exceptions to legal provisions that apply universally. So, in my opinion, the existence of a policy and legal framework made by the government is very good, but there is something even more important, namely its implementation" (Chairman of the Bandung City Chamber of Commerce and Industry)

Business/private entities assess that information regarding the Public-Private Partnership (PPP) scheme in Street Lighting infrastructure projects is still minimal. So the government needs to provide more in-depth explanations to business entities so they want to be involved in PPP projects. This is under the informant's explanation as follows:

"…..not only regarding PPP information, but the private sector also needs to know the benefits that can be received. They also need to know the challenges and obstacles in implementing projects using the PPP scheme. Of course, it must be traced where the problems are, even though the business entity has shown goodwill to assist in project development. In my opinion, this PPP scheme requires a lot of bureaucratic processes, so it is feared that it could hinder project development. This PPP scheme is considered to require a lot of bureaucratic processes in the institutions involved in each project offered… If it already exists, we also need to know what the actual mechanism for implementing PPP in the Bandung City Government is, so that it can become a reference for the private sector. In addition to the PPP implementation mechanism, his party also needs to know more about the benefits received by private developers for those who wish to participate, including recognizing the challenges and obstacles in implementing the Street Lighting PPP project" (Chairman of the Bandung City Chamber of Commerce and Industry)

The Bandung City Government's efforts to streamline the Street Lighting Public-Private Partnership project were rejected by the legislature (Bandung City Council) because the executive (Bandung City government) was deemed to have never asked for Bandung City Council approval beforehand. PPP has an unfavorable impact in the eyes of investors. Investors are of course worried about the political conditions in the city of Bandung. Risks from a political perspective, for example, there is a change in regional heads (mayors). Replacement of regional heads is very likely to have an impact on changing decisions

that have been agreed upon by regional heads Previously, other political risks such as changes in laws and regulations and changes in tax provisions. In other words, in terms of legal certainty and a sense of justice, investors are still the biggest homework for the Bandung City Government at this time. Investors give the lowest score to the Bandung City Government in that sector. This is in line with the World Bank report entitled Doing Business41: Training for Reform, which was released in early November 2018, which deserves attention because according to the World Bank's assessment the level of ease of doing business in Indonesia, including the city of Bandung, has decreased from 72nd place last year to 73rd. this year. As the World Bank reports, Indonesia's EoDB (Ease of Doing Business) rating has decreased due to four main factors, namely related to licensing issues, investor protection, ease of cross-border trade, and related to enforcement of trade contracts. If examined further, the downgrade of Indonesia's EoDB rating is due to the still high business uncertainty factor (the level of uncertainty over investment is still high). The four factors that led to the downgrade of EoDB's rating boil down to business uncertainty.

Investors are concerned about business uncertainty considering the risk of business uncertainty is a business interruption (investment disruption). Lagarde42 in his book: Legal Risk of Investment in Developing Countries, states that in developing countries the biggest business risk is legal issues, causing uncertainty that results in business interruption (investment disruption). The four factors that led to the downgrade of Indonesia's EoDB rating only boil down to one thing, namely, investors need an investment climate that can provide legal certainty for investors. Regarding the issue of enforcing contracts (implementation of commercial contracts), investors have not been able to feel legal certainty over the implementation of business contracts made.

Based on the explanation above, researchers concluded that the system context dimension is an environmental condition that overshadows the sustainability of collaborative governance. This system context creates opportunities and constraints that affect other parameters of collaborative governance. The elements of the system context that create opportunities to influence collaborative governance in this study are policy and legal framework; level of conflict/trust; portrait of socioeconomic/cultural conditions, health, and diversity; and network connectedness. While the elements of the system context that have the potential to become obstacles or obstacles to the sustainability of collaborative governance are resource conditions; prior failure to address issues; and political dynamics/power relations. Furthermore, this system context gives rise to drivers, namely elements of leadership, consequential incentives, interdependence, and uncertainty, which encourage

initiating and setting the direction of Collaborative Governance Regimes (CGR).

Driver Dimensions

Regarding the context of collaborative governance in the provision of Bandung City Street Lighting, the role of leadership is very decisive for the sustainability of this Street Lighting PPP. In the leadership of the Mayor of Bandung, Ridwan Kamil, it can be said that the concept of collaborative governance greatly influenced the success of Bandung Juara's vision-mission. Ridwan Kamil's participatory leadership style (managing his city with decentralization, collaboration with units in the Bandung City political system, innovative and based on love for the City of Bandung), helped the Bandung City Government realize its vision and mission which was also appreciated with many awards for the City of Bandung. Regarding the construction of Street Lighting, the Mayor of Bandung consistently encourages the PPP scheme to be implemented. The scheme is predicted to be the latest solution to accelerate the growth of Bandung City development by involving business entities. Bandung City can be a modern city with various supporting public facilities.

"The PPP scheme is believed to accelerate regional infrastructure development. At least the promise of the Mayor of Bandung to build street lighting in the city border areas can be completed through the PPP scheme. The calculation is that the project to build Street Lighting can be completed in 2 years with the PPP scheme, while if forced to use the regional budget, it will take a long time. The simple PPP type earlier this year was already groundbreaking. If it's simple, for example, building Street Lighting to the city limit area should be possible. That's the simplest, it's not difficult. Pay first using his money first, the logic is like that" (Mayor of Bandung)

To realize the Street Lighting PPP project, the Bandung City Government provides incentives in the form of risk compensation for business/private entities. The Bandung City Government is proposing an increase in street lighting tax (PPJ) as a way to pay for its obligations. The PPJ tariff for the use of electricity originating from the State Electricity Company (PLN) for the Social group (S3) is set at 6% or a 3% increase from the rate previously stipulated in Regional Regulation No. 20 of 2011. Other tariff increases for the Household group (R1, R2, and R3) with a power of 900 VA and above, namely 8% or an increase of 2% from the previous rate. Tariffs for small business groups (B1) and medium businesses (B2) are proposed to increase to 8% or 2% higher than the rates in the previous regional regulation. The tariff for large business groups (B3) is set at 8% or an increase of 2%. Meanwhile, the tariff for the small industry group (I.1) remains at 2.5%. And the tariff for the middle industrial group (I.2) to large industrial groups (I.3-I.4) remains at 3%. However, the proposed PPJ

increase was opposed by the Regional People's Representative Council (DPRD) which was currently discussing the revision of the Regional Regulation on Regional Taxes.

"We reject the proposal submitted. The increase (PPJ) is of course less impartial and only burdens the community. The decision to refuse has become the decision of the Special Committee and the Perda has entered finalization, it only remains to be ratified through a plenary meeting. Currently, the economic condition of the community, including in Bandung, is still unstable. On the other hand, the Regional People's Representative Council (DPRD) is also considering the central government's plan to withdraw subsidies for the Electricity Tariff (TDL) as of January 2021. The DPRD asks the Bandung City Government to find other alternatives to save on electricity payments. On the other hand, the existence of street lighting itself is still uneven while the people have paid their taxes" (Chairman of Special Committee V, Regional People's Representative Council/DPRD)

For business/private entities, incentives or rewards from PPP street lighting projects are very important. According to Iossa & Martimort43, procedures for providing incentives or rewards are things that can be taken into consideration for PPP success. Likewise the opinion of Qizilbash44, PPP is a collaboration between the government (public sector) and business entities (private or NGOs), to develop new ways of producing and distributing public services, sharing risks and rewards, in which all parties (public, private sector, and the public) benefit from this transaction. Liu & Hiraku45 citing the opinion of Teisman & Klijn46, emphasizes that the PPP scheme is based more on a shared decision-making framework than on a principal-agent relationship. In this context, the problem in the PPP Street Lighting must be sought for a solution by both parties. The basic principle of PPP is mutually supportive cooperation between participants, sharing of resources, risks, responsibilities, and rewards between the two parties involved. According to Estache47, the government must improve capabilities which include; (1) the ability to identify projects that will be financed by PPP (for example projects that create high social value); (2) the ability to define service characteristics; (3) the ability to agree on rewards/incentives.

Based on the explanation above, it can be concluded that the driving elements that can encourage the development of collaboration are leadership, interdependence, and uncertainty.

Dimensions of Collaboration Dynamics

At least in the last five years, many innovations in infrastructure financing have been created. Two reasons drive the growth of this innovation. First, government support is not as long as it matches the characteristics of the PPP project or helps increase the project's

financial feasibility to the desired extent, for example, VGF (Viability Gap Funding). With the limitation that VGF cannot dominate (does not exceed 50%) construction costs, not all infrastructure projects that are not financially feasible can be supported with this instrument. Second, the government's fiscal constraints are also limited, for example, grants for partial construction. In practice, the government also often experiences financing difficulties by providing physical grants by building part of the construction through the State Revenue & Expenditure Budget/Regional Revenue & Expenditure Budget.

On the other hand, even though clear regulations have been enacted, until now street lighting infrastructure projects in the city of Bandung, with the PPP scheme, have not attracted much interest from investors. One of the causes of these projects being less desirable is because the capital required by investors is too large with very high risk, even though we all know that investment in Street Lighting infrastructure is slow yielding or a slow rate of return on capital. Until now the Bandung City Government has been too fixated on big projects to cooperate with business entities, while the scheme offered is Build-Operation-Transfer (BOT). This scheme is of course burdensome for investors because the biggest risk is in their hands. For example, if an investor is interested in building Bandung City Street Lighting, then usually the local government plays a role when providing land and concession agreements, the rest during construction until the operation is fully carried out by the investor, so that if during operation it turns out that the Street Lighting loses money, then the loss will be borne by the investor until the concession period ends. If breakthroughs are not sought, PPP will forever be a discourse and merely a paper tiger.

One possible solution is to adopt a PPP system in Japan known as the Public Finance Initiative (PFI), which is a scheme to use private capital for the construction/provision of public facilities/infrastructure in return (Provision) for the services provided. For example, if there is an investor who is willing to build street lighting, the investor will build and operate the street lighting, while the government will repay the construction and operating costs of the street lighting within a certain period according to the contract.

The advantage of the PFI scheme is that investors will get a guarantee that the investment that has been issued will bring profit, while the government benefits from the availability of good street lighting services. The PFI scheme is more or less the same system when we buy a vehicle with a credit scheme, where the leasing party buys the vehicle then we repay them in installments. In addition to the alternatives above, the Bandung City Government should not only focus on large projects offered under the PPP scheme but also offer cooperation in a smaller scope and involve local investors so that they can foster a sense of belonging and mutual pride when providing

infrastructure. Street lighting can be fulfilled by the nation's children. The researchers here are only trying to convey simple suggestions so that we care that the provision of Bandung City Street Lighting infrastructure is our shared responsibility.

Another pressing issue in the implementation of PPP street lighting in the city of Bandung is building stakeholder trust. What's more, the World Bank still emphasizes that infrastructure projects in Indonesia are of low quality, unprepared, and not well planned. This is the main obstacle for the Bandung City Government to mobilize more business entity capital into various infrastructure development projects. In a report titled Infrastructure Sector Assessment Program released in June 2020, the World Bank explained that Indonesian infrastructure projects were not prioritized based on clear criteria or selection.

"The project's reputation in Indonesia is low quality and poorly planned. In Indonesia, the decision to use the PPP scheme is made before the Pre-feasibility Study or Outline Business Case (OBC) is complete. They are not sure whom to communicate with and who will ensure the government's commitment in mobilizing infrastructure project funds"41

The success and failure of PPP Street Lighting are due to many factors and characteristics that vary between countries. This factor is from a technical or application aspect, as Carbonara et al48 stated that PPP applications vary widely between countries, from sector to sector, and from project to project. Up to the philosophical aspect, as stated by Nsasira et al49, the criticism of PPP lies in the fear of privatization, that the government will effectively pawn the future. It is also feared that the government will pay higher costs to the private sector in the long term than if the PPP facility was built by the government.

Therefore, internal legitimacy is very important because it is an element to form a shared commitment. Trust or internal legitimacy in this study refers to individual belief in other actors to be able to carry out their roles and responsibilities within a collaborative framework. Internal legitimacy also refers to the moral nature of leaders to govern, make and carry out political decisions. Legitimacy is part of authority, and authority is part of power. That is, legitimacy, power, and authority are interconnected in building a political condition of a government. These three things also support the success of the government being run.

In the context of the PPP street lighting scheme in Bandung City, this legitimacy is reflected in a development policy document called the Bandung City Regional Long Term Development Plan 2005-2025. The regional vision is based on current conditions and strategic issues for the next 20 years, as well as exploring community aspirations and perceptions that have been carried out. Based on this understanding,

it is very rational that in the next twenty years, steps and actions to stabilize development (reorientation, re-functionalization, restructuring, revitalization, and re-actualization) of development must be carried out jointly by the government of Bandung City and the active participation of its people and politically supported. by the legislature. Thus the strengthening of future development requires efforts that are more innovative, intelligent, and directed, but still friendly in increasing the acceleration of development to achieve the prosperity and welfare of the community.

The conclusion from the dynamics of this collaboration is whether or not the dynamics are determined by three components, namely the mobilization of shared principles, shared motivation, and the capacity to take joint action, in which there are various elements. The dynamics are in the form of a cycle, where each component influences the other (so do the elements, and it is undeniable that these elements can affect cross-component elements).

The Collaborative Governance Financing Scheme

Cooperation with the private sector is one of the financing models that can be developed. There are various forms of financing like this. The details of the cooperation model between the Regional Government and the private sector, more commonly known as the Public Private Partnership (PPP). The PPP model is indeed currently popular for building infrastructure because of the Government's limitations in capital expenditure, while the need for infrastructure development is very urgent and needs to be carried out to increase economic growth and people's welfare.

The legal basis used by the Regional Government in cooperating with other parties, both between government agencies and with third parties, is based on Law No. 32 of 2004 concerning the Regional Government, Law No. 1 of 2004 regarding the State Treasury, as well as various derivative Government Regulations from the Law such as PP No. 50 of 2007 concerning Procedures for the Implementation of Regional Cooperation, PP No. 38 of 2008 (Amendment to PP No. 6 of 2006) Regarding Management of State/Regional Property, and Permendagri No. 22 of 2009 regarding Technical Guidelines for Regional Cooperation Procedures and various related laws and regulations.

As stated in various applicable laws and regulations, the purpose of the cooperation is to achieve efficiency and effectiveness of the Regional Government in achieving the goal of accelerating regional economic development and improving people's welfare. Cooperation with third parties arises because of the limitations of the Regional Government in various matters, for example, human resource expertise, funding for development, and various other matters.

The mechanism for cooperation between the Regional Government and third parties is as follows:

a) The regional head or one of the parties can initiate or offer a cooperation plan to other regional heads and third parties regarding certain objects.

b) If the parties as referred to in the letter accept, the cooperation plan can be increased by making a joint agreement and preparing a draft cooperation agreement which at least contains: the subject of the cooperation; cooperation object; scope of cooperation; the rights and obligations of the parties; cooperation period; termination of cooperation; coercive circumstances; and dispute resolution.

c) The regional head in preparing the draft cooperation agreement involves related regional apparatus and may ask for opinions and suggestions from experts, provincial regional apparatus, Ministers, and related Ministers/Heads of Non-Departmental Government Agencies.

d) The regional head can issue a Power of Attorney to finalize the draft form of cooperation.

e) Further provisions regarding technical instructions as referred to in letters a, b, and c shall be regulated by a Ministerial Regulation.

Thus, the initiative for this cooperation can be carried out by the Regional Government or a third party. Third parties, in this case, are Ministries/Non-Departmental Government Agencies or other designations, private companies with legal entities, State-Owned Enterprises, Regional-Owned Enterprises, Cooperatives, Foundations, and other domestic institutions with legal entities.

In the context of this study, the focus of third parties is other than Departments/Non-Departmental Government Agencies. In cooperating with third parties who are not Ministries/Non-Departmental Government Agencies, it is necessary to consider the following matters:

Local governments should consider cooperating with legal entities in the following situations:

1) Public service cannot be provided by the local government because the local government is constrained by local financial resources or expertise.

2) The involvement of legal entities is believed to be able to improve the quality of service or/and accelerate regional development and can increase regional own-source revenue compared to when it is handled solely by the local government.

3) There is support from consumers/users of the public service for the involvement of legal entities.

4) The output of these public services can be measured and the rates calculated, so that the cost of providing these public services can be covered by the tariff income.

5) There are legal entities that already have a good "track record" in working with local governments.

6) There is an opportunity for competition from other legal entities.

7) There are no regulations prohibiting legal entities from being involved in the public service.

So, the factors mentioned above must be a serious concern for the Regional Government so that this cooperation is effective. Because, if these factors are not met, cooperation with legal entities should not be carried out because there will be no benefits for the community and regional development.

While the cooperation model between the Regional Government and legal entities there are 4 major groups with the following details:

1. Service Contract, there are several types of service contracts, namely:

1) Operational/Maintenance Contract, namely the Regional Government contracts out with a business entity to operate/maintain a public service facility.

2) Management Contract, namely the Regional Government contracts out with a legal entity to manage a facility/infrastructure owned by the Regional Government.

3) Lease Contract, namely a legal entity leasing a certain infrastructure facility on a contract basis to the Regional Government to be operated and maintained by the regional government for a certain time.

4) Concession Contracts, namely legal entities that are given concession rights or are responsible for providing management services for part or all of the certain infrastructure systems, including the operation and maintenance of facilities and the provision of services to the community, and the provision of working capital. For concession contracts, the contract length can be long-term (more than 25 years).

2. Build Contract, there are also several types of Build Contracts, namely:

1) Build-for-Delivery Contract, namely the business entity obtains the right to fund and build a facility/infrastructure, which is then continued with its management and can withdraw contributions for a certain time to obtain a return on investment capital and reasonable profits. After that period ends, the business entity transfers its ownership to the local government.

2) Transfer of Build Contracts, namely business entities are responsible for constructing infrastructure/facilities, including financing them and after the construction is complete, control and ownership of these infrastructure/facilities are handed over to the Regional Government. Furthermore, the regional government hands it back to the business entity to be managed for a certain time to return its investment capital and obtain a reasonable profit.

3) Build Lease Contract, namely the legal entity is given the responsibility to build the infrastructure including financing it. The local government then leases the infrastructure through a lease-purchase agreement to a legal entity for a certain time and after the contract period ends, the government receives control and ownership of the infrastructure.

3. Rehabilitation Contract, there are several types of rehabilitation contracts, namely:

1) Manage and Transfer Rehabilitation Contract, namely the local government contracts a legal entity to repair an existing public facility, then the business entity manages it within a certain time according to the agreement and then returns it to the government if the business entity has obtained a return on capital and profit at a certain level. reasonable.

2) Build-Add Manage and Transfer Contracts, namely legal entities that are given rights based on contracts with local governments to add certain facilities to existing public facilities. Then the legal entity is given the right to manage additional buildings until the legal entity can obtain a return on capital and profit at a reasonable level.

4. Joint Contract, namely the Regional Government together with business entities to form a joint legal entity in the form of a company to build or/and manage an asset owned by the joint venture, including all activities that fall within the business scope of the joint venture.

By looking at the various cooperation schemes available, it seems that the most likely to be implemented in the energy-efficient LED street lighting replacement program is through the Build-Use and Handover Contract scheme. This model of financing mechanism has the advantage that the Regional Government does not need to issue/participate in the capital but only needs to issue a permit. This scheme can accelerate the fulfillment of infrastructure needs in areas that need it. So in this case, the Business Entity (Third Party) must provide capital for investment costs. Most importantly, the Regional Government "must" provide the payment or allocate it from the APBD, which in this case is obtained from savings in paying electricity bills for street lighting after using LED energy-saving lamps. If these

requirements cannot be met, there is a possibility that the street lighting replacement program will not receive support from the DPRD. Because each model of cooperation must obtain approval from the DPRD.

From the various financing mechanisms that have been discussed previously, in the view of researchers, there are 3 options that in terms of rules and convenience can be used by the Regional Government shortly. However, according to the researchers, there is 1 scheme that can be developed by combining the Build Use Transfer cooperation scheme with the Government Investment Center (PIP) loan so that the pattern of cooperation contracts with the private sector (PPP) with the Build Use Transfer pattern can be grouped into 2 types of patterns, namely The Build-Delivery Contract Pattern with PIP Loan Funding, the Build-Delivery Contract Pattern with the usual pattern (the private party uses its funds or a bank loan). Thus, there are 4 types of schemes, namely private cooperation schemes with 2 types of models, then Regional Loans through Banking, in this case, Regional Development Bank (BPD) Banks, whose shareholders are generally Provincial Governments and Regency and City Governments within the Province, and regional loans through the Central Government Investment (PIP). Details of the advantages and disadvantages of each financing scheme can be seen as follows:

Table 8. Cooperation with the Private Sector Using the Build-to-Deliver Contract Pattern PIP Loan Funding Pattern

Excess	a) The Regional Government does not need to issue/participate in capital, it only needs to issue a permit. b) Encouraging accelerated fulfillment of infrastructure needs in areas that need it. c) It's easier and faster to implement because it only requires a discussion of the budget for rent in the DPRD. d) Interest is lower than the regular Build-to-Deliver pattern, so the investment value is higher.
Lack	a) There is a possibility that after the expiration date, the assets received by the Regional Government from the business entity will no longer have economic value or be damaged. b) The investment value is lower compared to other banking and PIP schemes because the private sector also needs to get a profit margin and risks that must be borne.

Source: Minister of Home Affairs Regulation No. 21 of 2009, processed

From the Build Use Transfer model with PIP Loan funding, the interest rate can be reduced according to the PIP interest rate, namely the BI rate plus 2%. So actually the company is only an SPV (Special Purpose Vehicle) for this contract, to make it easier for the local government to invest in replacing conventional Street Lighting lamps with energy-

saving LED Street Lighting lamps. Moreover, if this SPV is a regional company that already exists and is financially healthy, then the interest rate and ease of getting a loan from PIP will be lower and easier.

Meanwhile, an illustration of the installment capacity and the amount of investment from this pattern can be seen in Table 9. It can be seen here that the investment value is much larger than the ordinary Build-to-Devey pattern because the interest charged is the Bank Indonesia interest rate, which is below the commercial loan interest. banking. The investment value is IDR429.5 billion, or higher than IDR32.9 billion.

Table 9. Illustration of Installment Capacity Based on Savings Value for the Build-Use-Delivery Private Partnership Model with the PIP Funding Pattern

BOT Private Partnership Model	PIP interest + profit margin = 7.75% + 10% = 17.75%				
Electricity Bill Savings	Service Lease Installment Capacity IDR (million) Year 1	Service Lease Installment Capacity IDR (million) Year 2	Service Lease Installment Capacity IDR (million) Year 3	Investment Value IDR (million)	Loan Value Plus Interest and Profit margin IDR (millions)
10%	219.416	219.416	219.416	429,525	658.248
20%	438.832	438.832	438.832	859,051	1.316.495
30%	658.248	658.248	658.248	1,288,576	1.974.743

Source: Researcher's calculations (2022)

Of the various schemes available, there are 4 types of financing schemes for replacing conventional Street Lighting lamps with LED Street Lighting lamps.

First, from a regulatory point of view, it is clear and easy to implement for local governments who are interested. Second, there is no need for fundamental policy changes to obtain this financing scheme. Among the three types of financing schemes, if sorted based on feasibility and convenience, is the Public Private Partnership scheme with the Build, Operate, Transfer/BOT pattern. Because this pattern is the easiest for the Regional Government, namely there is no need to provide counterpart capital and only provide monthly payments as fees enjoyed by the Regional Government for the services that have been provided by the private party. In general, the risks from this scheme are almost non-existent. Because all installations for replacing LED Street Lighting lamps according to the agreed specifications have been

installed by the private party with investment costs by the private party and their maintenance. So practically there is almost no risk at all for the Regional Government unless the private sector does not carry out proper maintenance, for example not replacing broken or dead lamps. However, according to specifications, Street Lighting LED lamps will last up to 50,000 hours. This means that if the lamp is used every day for 12 hours it will last for about 11 more years. Thus, there should be no replacement of LED lamps during the contract period if the contract is for 3 years.

Table 10. Cooperation with the private sector under the Build-Use-Delivery Contract pattern

Excess	1) The Regional Government does not need to issue/participate in capital, it only needs to issue a permit. 2) Encouraging accelerated fulfillment of infrastructure needs in areas that need it. 3) It's easier and faster to implement because it only requires a discussion of the budget for rent at the Regional People's Legislative Assembly.
Lack	1) There is a possibility that after the expiration date, the assets received by the Regional Government from the business entity will no longer have economic value or be damaged. 2) The investment value is lower compared to other schemes because the private sector also needs to get a profit margin and risks that must be borne.

Source: Minister of Home Affairs Regulation No. 21 of 2009, processed.

Of the various financing schemes available for investing in replacing conventional street lighting with LED street lighting, only 4 schemes are worth considering. First, from a regulatory point of view, it is clear and easy to implement for local governments who are interested. Second, there is no need for fundamental policy changes to obtain this financing scheme. Among the three types of financing schemes, if sorted based on feasibility and convenience, is the Private Partnership scheme with the usual Build, Operate, Transfer (BOT) pattern and a combination with PIP loans. Because this pattern is the easiest for the Regional Government, namely there is no need to provide counterpart capital and only provide monthly payments as fees enjoyed by the Regional Government for the services that have been provided by the private party. In general, the risks from this scheme are almost non-existent. Because all installations for replacing LED street lighting according to the agreed specifications have been installed by the private party with investment costs by the private party and their maintenance. So practically there is almost no risk at all for the Regional Government unless the private sector does not carry out proper maintenance, for example not replacing broken or dead lamps.

However, according to specifications, LED street lighting lamps will last up to 50,000 hours. This means that if the lamp is used every day for 12 hours it will last for about 11 more years. Thus, there should be no replacement of LED lamps during the contract period if the contract is for 3 years.

From the administration side, it is also easier for the Regional Government to do so, because it only announces public offers to private parties with existing technical specifications for the required service works. What is needed is only discussion in the budget with the DPRD, so that the speed and certainty for the procurement of these services is much faster and easier. However, in terms of costs, this scheme is the most expensive compared to the other schemes, because by paying the same rent or service installments as the other models, the investment value is the smallest compared to the other 2 models.

An illustration of the financing scheme for the Private Partnership model with the Build-Use-Delivery Contract pattern can be seen in Table 11. Street lighting tax revenues throughout Indonesia in 2021 amounted to IDR2.19 billion, so if there is a 10% savings, then the savings are used to pay bills amounting to IDR219 billion50. This is assumed to be the capacity to be paid in installments due to savings. The assumption of a 10% savings is because the replacement of conventional street lighting with LED street lighting is not carried out massively due to limited funds, which is only around Rp. savings of about 70% - 80%. This is what causes the low savings that can be made with this scheme. Therefore, this assumption is very conservative, and in the illustrative schema, it is only given an assumption of up to 30%. However, if there is a saving of up to 50%, then the available funds for investment payments will be greater.

Table 11. Illustration of Installment Capacity Based on Savings Value for the Build-Use-Delivery Private Partnership Model

BOT Private Partnership Model	Commercial interest + profit margin = 12% + 10% = 22%				
Electricity Bill Savings	Service Lease Installment Capacity IDR (million) Year 1	Service Lease Installment Capacity IDR (million) Year 2	Service Lease Installment Capacity IDR (million) Year 3	Investment Value IDR (million)	Loan Value Plus Interest and Profit margin IDR (millions)
10%	219.416	219.416	219.416	396.535	658.248
20%	438.832	438.832	438.832	793.069	1.316.495

30%	658.248	658.248	658.248	1.189.604	1.974.743

Source: Author's calculations (2022)

Whereas loan schemes through banks, especially BPDs, are cheaper in principle, because the interest rates are very competitive or not much different from PIP, moreover the Regional Government does not need to provide matching funds as equity participation. In Table 12, you can see the advantages and disadvantages of regional loans with bank credit.

Table 12. Regional Loans through Banking

Excess	1) Local Governments can do more quickly for infrastructure development and its facilities. 2) Encouraging accelerated fulfillment of infrastructure needs in areas that need it. 3) No need for equity participation for matching funds (especially Regional Development Banks).
Lack	1) Interest charged is market interest minus risk premium (range 1-3%) or roughly close to 9-10% at this time. 2) A permit from the Regional People's Legislative Assembly is required

Source: Minister of Home Affairs Regulation No. 21 of 2009, processed

Table 13. Illustration of Installment Capacity Based on Savings Value for Banking Loan Models (BPD)

Banking Models	Commercial interest -3% = 9% (assuming 12% commercial interest)				
Electricity Bill Savings	Installment Capacity IDR (million) Year 1	Installment Capacity IDR (million) Year 2	Installment Capacity IDR (million) Year 3	Investment Value IDR (million)	Loan Value Plus Interest IDR (millions)
10%	219.416	219.416	219.416	518.305	658.248
20%	438.832	438.832	438.832	1.036.610	1.316.495
30%	658.248	658.248	658.248	1.554.915	1.974.743

Source: Author's calculations (2022)

Regional loans with bank credit, especially BPD, seem to be the most feasible because they are cheap in terms of interest costs, and there is no need for matching funds for projects that have been requested for funding from the Bank, but with a moderate investment value compared to the other two schemes.

Meanwhile, loans under the PIP scheme are schemes with the highest investment value. This is because the interest rate charged is the lowest, with the SBI plus 2% benchmark. However, a matching fund of 30% of the investment value is required.

Table 14. Regional Loans through PIP

Excess	1) The interest charged is SBI interest +2% for medium-term loans, so it is relatively not burdensome for Regional Governments whose projects are non-commercial in nature. 2) Encouraging accelerated fulfillment of infrastructure needs in areas that need it.
Lack	1) Assessment of the project proposal depends on the priority of the sector which is the priority of the PIP. 2) Requires inclusion of own capital for counterpart funds of 30% of the project value, although counterpart funds are not absolutely in the form of cash capital, but can be in the form of "in kind" such as costs for conducting feasibility studies, costs for the preparation team, monitoring and evaluation and other costs related to the activity. 3) The permit from the Regional People's Legislative Assembly is required

Source: Minister of Home Affairs Regulation No. 21 of 2009, processed.

Table 15. Illustration of Installment Capacity Based on Savings Value for the PIP Loan Model

PIP models	SBI Interest +2%=7.75% (assuming SBI Interest = 5.75%)					
Electricity Bill Savings	Installment Capacity IDR (million) Year 1	Installment Capacity IDR (million) Year 2	Installment Capacity IDR (million) Year 3	Investment Value IDR (million)	Loan Value Plus Interest IDR (million)	Matching Fund 30% Investment Amount IDR (millions)
10%	219.416	219.416	219.416	534.075	658.248	228.889
20%	438.832	438.832	438.832	1.068.150	1.316.495	457.779
30%	658.248	658.248	658.248	1.602.225	1.974.743	686.668

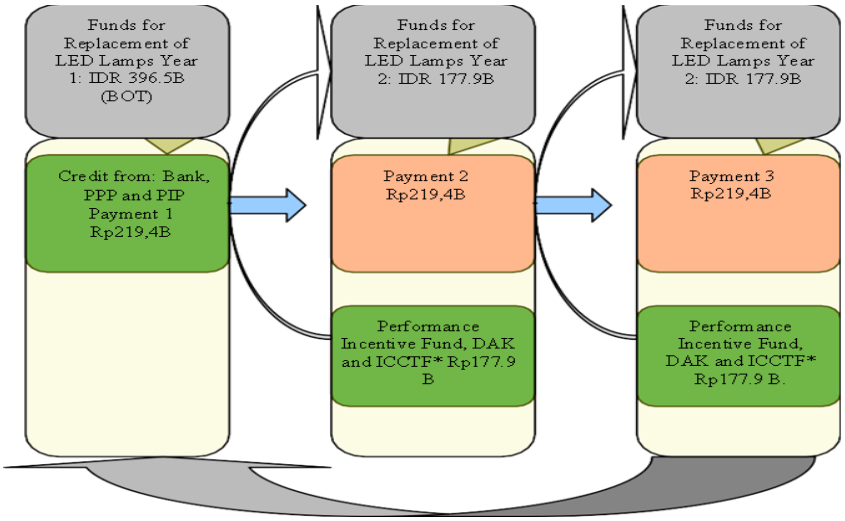
Source: Author's calculations (2022)

So nationally, if there is a savings of 10%, there will be market demand for LED street lighting of IDR534 billion for a loan scheme through PIP. Meanwhile, if you use a banking scheme, especially BPD, there will be a market demand for LED street lighting in the amount of IDR518 billion. Meanwhile, the value of the demand for LED street lighting is IDR386.5 billion under the build-use-handover (BOT) scheme of private cooperation.

If the credit pattern is only an inducement to bring in various other funding (or can be categorized with a revolving fund system), then the scheme will be as shown in Figure 6. Initially, funds for replacing LED street lighting lamps were obtained from credit sourced from an institution such as a bank. Regional Development (Bank BPD), Private

Partnership (PPP), and PIP. With these funds, the activity of replacing street lighting with energy-efficient LED street lighting will accelerate energy savings while simultaneously reducing CO2 emissions. Due to the decrease in CO2, the Regional Government must be given incentives in the form of Regional Incentive Funds which are associated with the success of reducing CO2 gas. In addition, within the framework of the National Action Plan for Reducing Greenhouse Gas Emissions (RAN-GRK), funding for CO2 reduction can also be allocated from the Special Allocation Fund (DAK) for the environment so that it can contribute to the RAN GRK. Because the RAN GRK is one of the national priority programs, it is only natural that part of the environmental DAK is allocated to replace conventional street lighting with LED street lighting.

Figure 6. BOT Funding Scheme with Additions from DID, DAK and ICCTF



Source: Author (2022)

*ICCTF funds are not yet available, but they are included because they are potential sources of funding, but the amount is not yet known.

While the funds that are expected to be used also in the second year are funds from the ICCTF. These funds are expected to be available in the second year since the launch of the project to replace conventional street lighting with LED street lighting, due to energy savings and reduction of CO2 gas, thus attracting the ICCTF "transformation fund" to be used to accelerate CO2 reduction. With the addition of DID, DAK, and funds from the ICCTF, in the second year, there will be new investment or replacement of additional street lighting with LED street lighting, so there will be a minimum demand for LED lights of IDR177.9 billion without ICCTF funding (assuming that 10% of the DAK for the environment in the amount of IDR479.7 billion is allocated for the LED

lamp replacement project, which is in the amount of IDR47.9 billion, and 10% from the Regional Incentive Fund in the amount of IDR1.3 trillion, which is IDR130 billion and unfortunately the ICCTF funds have not been can be included in the calculation assumptions because there is no clear mechanism yet available and how much can be distributed).

This process will continue to be repeated in year 4 where it starts again with new credit for acceleration after the installments are paid off in year 3. Thus, the amount of demand that can be calculated using a conservative scenario, at a minimum there will be a demand for energy-saving LED street lighting of almost IDR400 billion and continues around IDR177.9 billion in the second and third years if using a 3-year credit period, and continues with new credit in the fourth year of a minimum of around IDR400 billion again and IDR177.9 billion in the second and third installment years and so on. This scheme is the most conservative scenario.

This large demand potential is very attractive to potential investors, both domestic and foreign because the market is growing rapidly under government policies that promote a pro-environmental economy and accelerate the achievement of the RAN GRK. Especially with the issuance of the second amendment to Government Regulation Number 1 of 2007 concerning Income Tax Facilities for Investment in Certain Business Fields and/or in Certain Regions. So various fiscal and tax facilities have been made available with PP no. 52 of 2011 where one of the sectors covered is the industrial sector of gas tube lights (electric exhaust lamps) with the code KBUI 27402 which includes compact lamps made of LEDs with a minimum investment of IDR50 billion and employment of at least 300 people if it is an investment new business or if it is an expansion of an existing business, then it absorbs at least 100 people and businesses that are integrated with its components.

This income tax facility contains the following:

1) net income reduction of 30% of the total Investment, charged for 6 years each of 5% per year;

2) accelerated depreciation and amortization, as follows:

Tangible Fixed Asset Group	Benefit Period	Depreciation and Amortization Rates Based on the Method	
		Straight line	Declining Balance
I. Non-Building:			
Group I	2 years	50%	100% (charged at
Group II	4 years	25%	once)
Group III	8 years	12,5%	50%
Group IV	10 years	10%	25%

			20 %
II. Building : Permanent	10 years	10%	-
III. Not permanent	5 years	20%	-

1) the imposition of Income Tax on dividends paid to foreign tax subjects of 10%, or a lower rate according to the applicable Double Tax Avoidance Agreement; And

2) compensation for losses that are longer than 5 years but not more than 10 years provided that:

a) an additional 1 year: if the new investment in the business sector as regulated in paragraph (1) letter a is carried out in an industrial area and a bonded area;

b) additional 1 year: if employing at least 500 Indonesian workers for 5 consecutive years;

c) additional 1 year: if the new investment requires investment/spending for economic and social infrastructure at the business location of at least IDR10,000,000,000.00;

d) additional 1 year: if spending research and development costs in the country in the framework of product development or production efficiency of at least 5% of the investment within a period of 5 years; and/or

e) additional 1 year: if using raw materials and/or components produced domestically at least 70% since the fourth year.

3) The Income Tax facility as referred to in paragraph (1) can be utilized after the Taxpayer realizes the investment plan of at least 80%.

4) The Minister of Finance issues a decision on granting Income Tax facilities after considering the proposal from the Head of the Investment Coordinating Board.

With this tax facility, the electrical equipment sector, such as LED street lighting, will receive tax facilities through PP No. 52 of 2011 so that investment in this field will be even more attractive to potential investors and factories wishing to expand in the business fields covered in the PP.

Conclusion

Based on the results of the research and discussion of the research results, the following conclusions can be raised:

a) System context is an environmental condition that overshadows the sustainability of collaborative governance. This system context creates opportunities and constraints that affect other parameters of collaborative governance. The elements of the system

context that create opportunities to influence collaborative governance are policy and legal framework; portrait of socio-economic/cultural conditions, health, and diversity; network connectedness; and level of conflict/trust. While the elements of the system context that have the potential to become obstacles or obstacles to the sustainability of collaborative governance are resource conditions; prior failure to address issues; and political dynamics/power relations. The system context gives rise to drivers that encourage the initiation of collaborative governance.

b) The driver elements that can encourage the development of collaboration are leadership, interdependence, and uncertainty.

c) Poses collaboratives dynamics are interactive cycles of elements driving shared principles, shared motivation, and the capacity to perform collective action, in which there are various elements. The dynamics are cyclical, where each component influences the other (so do the elements, and it is undeniable that they can affect cross-component elements).

d) Of the various financing schemes available, 4 types of schemes are the most appropriate in terms of convenience and speed and terms cost or interest. Meanwhile, other schemes are still underdeveloped and require improvements and changes in terms of regulations and policies. In addition, the role of obtaining financing for the 4 types of schemes rests with the Regional Government. Outside of the 4 schemes, the role or control does not rest with the Regional Government, making it difficult to make it happen to ask the Regional Government to do so. Appropriate schemes are financing through cooperation with the private sector with 2 variants, namely the usual and PIP funding for the private sector, loans through Bank BPD, and loans through PIP (Government Investment Center) directly to the Regional Government.

e) With the cooperation financing scheme with the private sector, the installment capacity is a saving of 10% or IDR219 billion for investment for 3 years, which is worth at least IDR396.5 billion, which means there will be a demand for LED street lighting worth IDR396.5 billion or nearly US$40 million. However, if the banking scheme is Bank BPD, then the value of the demand is much greater, namely around IDR518 billion. Moreover, if DID/DIK and DAK Environment funds can be used as successors in the second year after the project uses credit funds, the demand will continue by at least around IDR177.9 billion in the second and third years. And if ICCTF funds are added, the available funds will be even greater. Moreover, if ICCTF funds can cover the shortfall of IDR177.9 billion, which equates to savings of IDR219 billion, then in the second year, conventional SL lamps can be replaced with LED street lighting with a minimum amount of IDR219 billion.

f) The obstacle faced is that most of the street lighting lamps do not use the meter system. Therefore, this is one of the conditions that are difficult to convince the Regional Government how far the level of savings can be made by using LED street lighting. The second obstacle is that LED street lighting on the market does not yet have an SNI (Indonesian National Standard) number, so the product is not standardized. If these two problems can be overcome by installing a meter system at the same time when replacing conventional street lighting with LED street lighting, then replacing conventional street lighting with LED street lighting will be easier.

g) CO2 emissions from LED lamps compared to other lamps show that the emission of LED lamps is only about 10% of the CO2 emissions of incandescent lamps or 42% of the emissions of CFL lamps. LED lamps also show extraordinary savings, which are about 2 times more efficient than CFL lamps, but require a larger investment fund of about 4 times.

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