



**TECHNIUM**  
**SOCIAL SCIENCES JOURNAL**

**Vol. 36, 2022**

**A new decade  
for social changes**

[www.techniumscience.com](http://www.techniumscience.com)

ISSN 2668-7798



9 772668 779000

## **Green Infrastructure Investment Governance: A Literature Review and Lesson for Indonesia**

**Naufal Azaki, Achmad Lutfi**

Faculty of Administrative Science, Universitas Indonesia, Indonesia

[azakinaufal9@gmail.com](mailto:azakinaufal9@gmail.com)

**Abstract.** Green and climate resilience infrastructure have received widespread attention because of their central role in climate change adaptation and mitigation. Many works of literature emphasize the importance of climate governance, primarily in terms of funding. On the other hand, the world faces a funding gap because government spending cannot fully support infrastructure needs. This underlies the need for private participation in infrastructure development, especially green infrastructure, to address climate change. This study uses a qualitative approach with a literature review method on various related literature and refers to the framework of Corfee-Morlot et al. (2012) and aims to analyze the policy dynamics, governance, and instruments needed as lessons for Indonesia. The green infrastructure investment policy framework can be developed through 5 (five) main approaches; alignment of policy goals and targets, policies that enable investment to grow through incentives, development of investment schemes/financial instruments, strengthening the alternative resources and institutional capacities, and promotion of the importance of green investment

**Keywords:** climate resilience; governance; green; infrastructure; investment.

### **1. Introduction**

The report of the Intergovernmental Panel on Climate Change (IPCC) in 2021 noted that the dangers of climate change are increasingly worrying, marked by an increase in the temperature of the earth's temperature, which, without any change, will reach an increase of 1.50 C in the next two decades. This increase is the result of human activities that produce emissions. The prevalence of natural disasters is increasing in the next few years, one of which is due to rising sea levels. Major catastrophic events (dangerous and destructive) due to climate must occur because climate warming has already entered the climate system. Therefore investment in climate resilience is very urgent (World Resource Institute (WRI), 2021).

Paris Agreement put concerns on climate issues. This agreement resulted in a framework of targets and efforts from all countries as well as cooperation to curb the global temperature increase of 1.50 C through socio-economic transformation. (UNFCCC, 2015). In 2015 the United Nations (UN) ratified the Sustainable Development Goals (SDGs). The SDGs framework has 17 Goals and 169 Target indicators that substantially emphasize environmental, social, and economic sustainability. Climate adaptation is also an important component of the SDGs and has become a priority in many countries (Berrang-Ford et al., 2014).

The impact of climate change touches many aspects and requires a serious response from the government at every level, international, national and regional (Clar, 2019). How the state can play the role to the city has been the topic of many researchers (Arndt et al., 2012; Berrang-Ford et al., 2014; Carter, 2011; Castán Broto, 2017) as well as with a particular focus such as conceptual governance of climate adaptation (Bauer et al., 2012), institution (Mathai & Kartikasari, 2015), funding and investment aspect (Carolina Rezende de Carvalho Ferreira et al., 2016; Clark, 2019; Cumming et al., 2017; Halimanjaya, 2017; Tauhid & Zawani, 2018), communication-coordination strategy (Casado-Asensio & Steurer, 2013), managing participation (Bauer et al., 2012) to the relationship with the SDGs (Berrang-Ford et al., 2014; Cumming et al., 2017). In essence, policymakers expected to facilitate, initiate and structure (institutionalize) climate adaptation governance (Clar, 2019).

The Indonesian government has issued a series of policies such as the ratification of the SDGs through Presidential Regulation no. 59 of 2019 concerning the Implementation of the Achievement of Sustainable Development Goals (TPB) to the Climate Resilience Development Policy (PBI) 2020-2045, which focuses on four main sectors (Kementerian PPN/Bappenas, 2021). The PBI consists of an institutional framework for climate resilience, the role of non-governmental actors, funding, and climate resilience priority sectors (Kementerian PPN/Bappenas, 2021). Indonesia also has a Sustainable Finance Roadmap issued by the Financial Services Authority (OJK) in 2014. In addition, Indonesia is the first country to issue US\$ 1.25 billion in green Sukuk/green bonds (Guild, 2020). That is why the topic of investment in green infrastructure is interesting for further review and its relation to the Indonesian context.

## **2. Research Method**

The research method used in this study is a literature review conducted by qualitatively analyzing secondary data from books, scientific journals, and research reports/studies previously related to green infrastructure and investment. Literature review can provide a comprehensive explanation of why a topic/research question is essential and the development of relevant research and theory related to the topic raised and outlines contextual debates that have been or are currently ongoing. (Yang, Kaifeng; Miller, 2008)

## **3. Result and Discussion**

### *3.1.1. Green Infrastructure.*

The impact of climate change cause an increase in the need for related infrastructures, such as flood control, clean/drinking water supply systems, sanitation, and coastal buildings. (OECD, 2018). Along with the insistence on adaptation and mitigation, the concept of green infrastructure emerged (Abramowicz & Stępniewska, 2020; Clar, 2019; Tauhid & Zawani, 2018), sustainable infrastructure (Baron, 2016; Cumming et al., 2017; IDB, 2017), to climate infrastructure (OECD, 2018).

Green infrastructure is a term that refers to a sustainable approach to water resources management to mitigate environmental impacts, low carbon and pollution infrastructure for climate resilience (Tukiainen, 2020) and infrastructure focused on environmental conservation (Mungkasa, 2020). Green infrastructure has a multifunctional role related to its ability to perform and contribute in many ways, such as environmental conservation, adaptation to climate change, meeting social needs (providing clean/drinking water, sanitation, and waste services), and economic functions through job creation. (European Commission, 2012). The relationship between infrastructure and climate change and sustainability has been widely discussed in various studies (Arndt et al., 2012; Carter, 2011; Cumming et al., 2017; Delanka-

Pedige et al., 2021; Fell & Mattsson, 2021; Tauhid & Zawani, 2018). The study reviews how cities in Europe are struggling with climate change and mitigating its impacts (Carter, 2011), and how the road infrastructure scenario in Mozambique responds to climate impacts (Arndt et al., 2012).

Green/sustainable infrastructure is the key to overcoming the 3 main global challenges today; accelerating economic growth, achieving the SDGs, and reducing climate risk in line with the Paris Agreement (The Global Commission on the Economy and Climate, n.d.). So it is not surprising that infrastructure is considered the keyword to achieve the SDGs targets and the Paris Agreement, where all priority sectors for achieving the SDGs targets require infrastructure support. (OECD, 2018; United Nations UNCTAD, 2015). Below is the mapping of how investment in ecological infrastructure contributes to the achievement of the SDGs targets (Cumming et al., 2017).



Figure 1. Investing in ecological infrastructure supporting the SDGs targets. Source: Cumming et al. (2017).

### 3.1.2. Private Participation.

The involvement of non-government actors is vital for two reasons; their knowledge and experiences to improve policy quality and participation are considered an effort to increase awareness and build capacity (Bauer et al., 2012). The government's limitations in restraining the rate of temperature increase to below 1.50C require contributions from non-government actors who can participate in mitigating it (Castán Broto, 2017). Usually in developing countries, investment in infrastructure provision is considered a public sector obligation. However, at the same time, the role of the private sector in economic growth is considered relatively important. (Unnikrishnan & Kattookaran, 2020). Research on the sustainability of water supply services (clean and drinking) in Somalia reveals that private investment through PPPs contributes very vitally to the provision of water services for the community. (Jama & Mourad, 2019). Another study in India found that private investment tends to boost economic growth (Unnikrishnan & Kattookaran, 2020). Another study conducted using data from 26 provinces in China concluded that investment in infrastructure has a positive and significant impact on improving the quality and sustainability of economic growth and efficiency as a result of high mobility of goods and services, market integration, and technology transfer (Zhou et al., 2021).

### 3.1.3. Closing the Funding Gap

In line with this, it needs to combine private and public investment to close the deep investment needs gap; expose the fact that the government cannot handle this responsibility alone (Unnikrishnan & Kattookaran, 2020). Low-income countries have financial obstacles in

achieving the targets set in the SDGs, especially those related to Goal 6 of clean water and sanitation (Delanka-Pedige et al., 2021). Then there will be a condition where public investment, in this case, government spending, will no longer be able to meet the growing infrastructure needs (Unnikrishnan & Kattookaran, 2020). Even the global investment gap reaches USD\$2.5-3.5 Trillion (Baron, 2016)

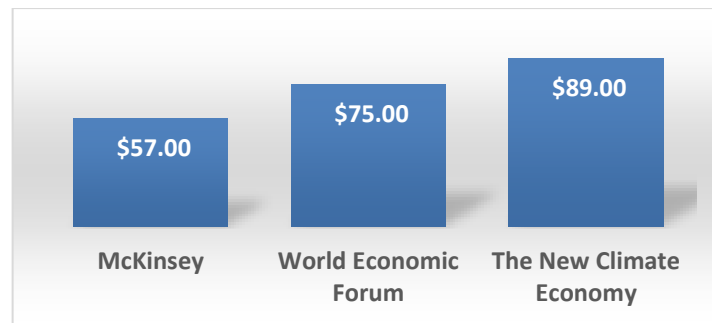


Figure 2. Estimated Infrastructure Needs Source: Baron (2016), processed by the author.

Indonesia also experiences a wide infrastructure funding gap. In the 2020-2024 National Medium-Term Development Plan (RPJMN), infrastructure development requires the funding of Rp. 6.445 Trillion, where the government budget (APBN/D) can only cover Rp. 2.385 Trillion (37%), and the rest requires the private investment of Rp. 2.707 Trillion (42 %) and SOEs amounting to Rp 1.353 trillion (21%). The Ministry of Public Works and Public Housing which plays a role in green infrastructures like the drinking water supply system, water resource buildings, and residential infrastructure, is also experiencing a funding gap as reflected in the PUPR Visium 2030 where it requires IDR 2.058 trillion, the government budget contribute only IDR 623 trillion (30%). The remaining IDR 1.435 trillion (70%) needs private support.

In terms of green infrastructure investment, a study conducted in 136 of the world's largest coastal cities projected an additional investment requirement of US\$50 billion per year in flood control infrastructure for the effects of climate change. (Hallegatte et al., 2013). Annual additional investment needs of US\$12-71 Billion by 2100 to build coastal flood-retaining infrastructure (Hinkel et al., 2014). This high demand creates a vast funding gap of US\$2.5-3.5 Trillion (Baron, 2016). Therefore, the need for alternative funding sources is unavoidable considering the need for infrastructure will still increase with the times.

#### *3.1.4. Infrastructure Financing/Investment Scheme*

The infrastructure financing/investment component consists of 3 (three) main things; forms, instruments, and capital costs (Putri & Wisudanto, 2017). The choice of how an infrastructure project is executed and financed consists of 2 forms; infrastructure project-based financing and financing to the company's balance sheet/finance. Instrument refers to the instrument used, usually in the form of equity, debt, and hybrid. Cost of capital is calculating project costs based on the source of funds used (debt or equity) (Putri & Wisudanto, 2017).

Tabel 2. Instrumen Investasi Infrastruktur.

Asset Category	Instrument	Project	Balance Sheet	Market Commodity/ Capital Source
<b>Fixed income</b>	Bonds	Project Bonds	Corporate bonds, Green bonds	Bond Index, Bond Fund, Exchange Traded Fund (ETF)
		Municipal Bonds, Sub-sovereign Bonds		
		Green Sukuk	Subordinated Bonds	
	Loans	Direct loan to project, Syndicated Project Loans	Direct loans to infrastructure companies	Debt Funds
Syndication credit, Securities Loan, CLOs			Loan Funds	
<b>Mix</b>	Hybrid	Subordinated liability, mezzanine capital	Subordinated bonds, convertible bonds, preferred stock	Mezzanine financing, hybrid debt funds)
<b>Equity</b>	Listed	YieldCos	Listed infrastructure, close-ends funding, infrastructure investment trust (IIT), real estate investment trust (REIT), master limited partnership (MLP)	Equity Funding for Listed Infrastructure, Trusts, Exchange Traded Funds (ETFs)
	Unlisted	Direct Investment in Infrastructure project equity, PPP	Direct Investment in Infrastructure project equity	Funding for Unlisted Infrastructure

Source: (OECD, 2015), conducted by authors.

Based on the type of issuer, green bonds consists of 2 (two) types; corporate bonds issued by the private sector (LJK, BUMN, real) and sovereign bonds issued by the government of a country (central or regional (Dirjen Pengelolaan Pembiayaan dan Risiko Kementerian Keuangan RI (DJPPR Kemenkeu RI), 2020). There are several types of bond instruments, such as green, social, sustainability, sustainability-linked, climate transition, and SDG bonds, each of which has different characteristics, frameworks, and approaches. (IFC, 2021). The emergence of the Green Climate Fund is expected to become an important source of climate adaptation funding, primarily for lower-middle income countries in the coming years (Berrang-Ford et al., 2014). Other mechanisms such as debt-for-nature-swaps, can be an alternative to

mobilizing funding through debt cancellation or restructuring, where creditors (states or financial institutions) can agree to cancel or restructure debt under certain conditions. For example, the debtor country invests a nominal amount equal to the debt borrowed for sustainable development (Cumming et al., 2017).

Indonesia already has various funding portfolios, mainly for green infrastructure and climate resilience. In 2020, Indonesia will issue green bonds for \$750 million. Cumulatively, from 2018-2020, the largest allocation was in sectors related to sustainable transportation (41%), followed by climate resilience and disaster risk reduction (36%), energy efficiency (11%), waste and waste management (6%), and new renewable energy/EBT (5%) (Finance, 2021). In addition, green infrastructure and climate resilience are also funded through the State Budget, Public Private Partnership (PPP) Cooperation, Non-Government Budget Investment Financing (PINA), to Mutual Funds in the Form of Limited Participation Collective Investment Contracts. (Kementerian PPN/Bappenas, 2021).

### 3.1.5. *Determinant Factors in Investment Decision*

The study's results using 444 articles from the period 1990-2020 using bibliometric and systematic analysis revealed a significant increase in green investment in the last 6 years. (Chițimiea et al., 2021). This study classifies various factors (internal and external) that influence decisions and the success/failure of a green investment from hundreds of research sources.

Table 3. Determinant Factors in Green Investment Decisions.

<i>Factors</i>	<i>Notes</i>
<b>β</b>	Consumers are more aware and concerned about the environmental impact of the products they buy/use. However, most companies tend not to switch because of the high costs and risks.
<b>Climate change</b>	The negative impact on the environment (causes of climate change) also affects the company's decision to transform.
<b>Legislation and regulations</b>	Most of the results of enforcing the law affect the increase in spending due to additional taxes.
<b>Target market</b>	Adaptation to market changes also has an effect. There are always looming risks, such as market dissatisfaction or a mismatch between supply and demand.
<b>Public funding &amp; incentives</b>	Financing schemes affect reducing financial risk as well as bank credit policies.
<b>Investor preferences</b>	Environmental impacts have influenced investors, and many companies have adapted to capture the preferences of these investors.
<b>Organizational culture</b>	In order to ensure the sustainability of the company, sustainability-based governance efforts (plans, structures, products) become an essential reference.
<b>Financial performance</b>	There is a close relationship between finance and sustainability, where the company needs to transform its business to ensure long-term survivability.

<b>Reputation considerations</b>	The more companies have a good precedent in ESG factors, the higher their brand value will be.
<b>Efficiency needs</b>	Companies prioritize competitive advantage through cost savings, risk mitigation, and resource efficiency.

Source: (Chițimiea et al., 2021), conducted by authors.

In addition, a study in Vietnam calculated data from 208 businesses concluding ten main factors that influence green investment; access to funding/capital sources, knowledge of green investment, government support, banking policies, and initiatives from the company itself (Tran et al., 2020).

### 3.1.6. Challenges

There are 3 (three) obstacles and challenges faced by investors in their desire to participate in green infrastructure development (Kaminker et al., 2013). First, infrastructure investments always have liquidity risks, long tender processes, high costs for transactions, operations, and teams, expensive due diligence, policy and political instability, obstacles to accounting rules, and the risk of default. Second, in green investment, there is still a risk of instability in returns due to market failures, inadequate incentives and carbon pricing policies. The government still favors fossil fuel subsidies compared to NRE, risks on technical requirements such as technology, volume, expertise, and resources to compete in accessing capital with traditional infrastructure. The third obstacle is the lack of investment design/scheme, limited liquidity, high churn/unsubscribe rate, and barriers to leverage (using debt funds to increase returns).

Institutional issues are fundamental. There are 4 (four) main challenges in the governance of climate change adaptation policies; 1) integrating cross-sectoral policies; 2) cross-jurisdictional vertical governance; 3) integrating knowledge and evidence; and 4) encouraging the involvement of non-governmental actors in policy formulation (Bauer et al., 2012). So it can be concluded that institutions are the most dominant factor in determining climate adaptation policies. These institutions include good governance, environmental sustainability index and environmental performance index. The study suggests that global adaptation, funding and investment progress is likely to be hampered due to low governance capacity. One study examines how the institutional water supply system in Somalia finds that it is still not well organized and institutionalized where there is overlapping authority causing the implementation of PPP to be less effective and optimal. (Jama & Mourad, 2019). Due to the demographic boom, developing countries have problems in the institutional aspects and the main policy framework in responding to infrastructure needs (Corfee-Morlot et al., 2012).

In the investment scheme, there are 5 (five) main challenges for green investment, including carbon pricing policies, fossil fuel subsidies, high upfront costs and long payback periods, technology risk, and revenue risk. (Baietti et al., 2011). Due to the high initial cost and long payback period, green investment requires a high rate of return and interest. Thus the profitability of the investment portfolio needs to be supported by the government through a price mechanism or special requirements like green certificates (Tran et al., 2020). Acceptance risk occurs due to technological uncertainty and acceptance that causes investors or banks to think twice about financing new technology; even in the field, they tend to have a low credit rating and need collateral to cover/support their financial needs. In addition, the lack of credit disbursement is seen as an obstacle in encouraging private investment in developing countries (Unnikrishnan & Kattookaran, 2020).

The World Bank report shows that 9 out of 10 respondents (investors) consider political stability, macroeconomics, and the policy environment to be the three primary considerations, even above tax considerations. Private investment tends to be more sensitive to developments in macroeconomic conditions (Bank, 2020). One way to see the investment quality and business climate quality is through the Ease of Doing Business (EoDB) index. In the last five years, Indonesia has made significant progress even though its performance is still below peer countries such as Thailand, Malaysia, and Singapore.

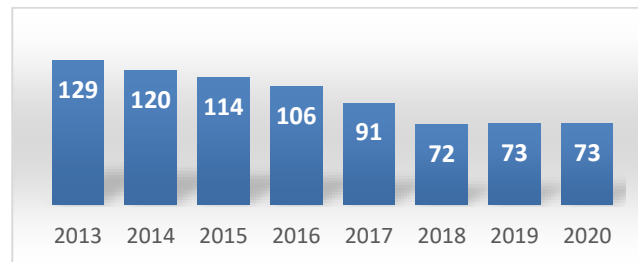


Figure 5. Achievements of EoDB Indonesia. Source: (World Bank Group, 2020), conducted by authors.

A study on the implementation of green finance in Indonesia reveals 2 (two) main obstacles (Guild, 2020). The first is the low quality of human resources and the lack of experience, so they are limited in properly analyzing potential and risks. Second, poor institutional barriers and incentives are not well targeted, one of which is the result of the government being dominated by fossil business people so that the space for renewable energy is limited.

### 3.1.7. Policy Framework for Promoting Green Infrastructure Investment

Several studies explain the importance of improving governance to encourage green infrastructure investment (Baietti et al., 2011; Baron, 2016; Bauer et al., 2012; Berrang-Ford et al., 2014; Jama & Mourad, 2019; Kaminker et al., 2013). The climate infrastructure investment framework is essential as a green economy and climate-based development catalyst. This paper adopts the framework developed by Corfee-Morlot et al. (2012) with the support of an analysis of various studies in several countries.



Figure 6. Climate Resilience Infrastructure Investment Policy Framework  
Source: (Corfee-Morlot et al., 2012).

### 1. Strategic goal setting and policy alignment

One crucial point that needs to execute is to develop an infrastructure development plan and communicate it to potential investors regularly to identify investment opportunities (OECD, 2018). This is because the need for investment in green infrastructure and climate resilience will increase. Bappenas projection concludes that the potential loss due to climate change in Indonesia in the period 2020-2024 could reach Rp 544 T with an economic loss of Rp 115 T if there is no intervention/effort to deal with it. However, if a precise climate resilience policy is implemented, the risk of economic loss will decrease to Rp. 57 T. Economic loss is due to sea level rise of 0.8-1.2 cm/year, which causes coastal flooding and damage to infrastructure, decreased water availability, and production rice to increase the potential for disease variants (Kementerian PPN/Bappenas, 2021).

Creating scenarios/models of how road infrastructure and its investment needs respond to climate change is needed to measure the impact of climate change on infrastructure and how investment can be directed as early as possible to reduce worsening vulnerabilities (Arndt et al., 2012).

In the context of strengthening and policy coherence, Indonesia has issued a series of climate adaptation & mitigation policies, starting from the 2014 National Action Plan for Climate Change Adaptation (RAN API) to the 2021 PBI Policy. The core activities in PBI are infrastructure, governance, and funding with supporting activities to increase technology and capacity building (Kementerian PPN/Bappenas, 2021). The Low Carbon Development (CRP) policy framework has also been adopted in the 2020-2024 RPJMN. In addition, there is also a National Green Growth Roadmap for 2016-2020 initiated by the Ministry of National Development Planning/Bappenas and the Global Green Growth Institute (GGGI).



Figure 7. Buku Kebijakan PBI Indonesia Sumber: Bappenas (2021).

Currently the climate adaptation-mitigation budget is carried out by marking the KRISNA system, and collectively in the last three years (2018-2020), it has reached Rp. 307.94 trillion, of which 83.7% (Rp.232,74 trillion) (Dirjen Pengelolaan Pembiayaan dan Risiko Kementerian Keuangan RI (DJPPR Kemenkeu RI), 2020). However, this report has not explained based on the source of funding, whether through government spending or private investment/other non-APBN funding sources. In addition, Indonesia does not yet have a road map specifically for green infrastructure. Making a green infrastructure investment plan is deemed necessary, especially in the medium and long-term infrastructure (Tran et al., 2020). This is important considering that political factors (political will) and financial considerations also influence the government's decision to use what source of financing for its infrastructure projects (Singla et al., 2021). Therefore, there is a need for policy alignment and coherence.

## **2. Enabling policies and incentives for LCR investment**

The tender process can play a role by comparing the cost of the bid with the projected life of the asset (including operational costs/OPEX and capital/CAPEX). The government can include it in the main procurement/auction requirements in the PPP/PPP scheme considering that it is very important to clarify the risk allocation for climate change in the planning and project management stages. (OECD, 2018). Utilizing the procurement of goods and services (PBJ) process to encourage green infrastructure investment has been carried out by several countries such as Norway, the Netherlands, Korea, China, and several European countries. (Baron, 2016).

Table 7. Best Practices.

Norwegia	The Ministry of Transport conducted a tender to develop an energy-efficient and low-emission ferry connecting two Sognefjord villages. The requirement is a minimum 15-20% increase in energy efficiency compared to diesel-powered ones. This tender produces the first electric-powered ferry that saves 60% energy, reduces 89% CO <sub>2</sub> , and creates a new market for low-carbon ferries.
Belanda	The Ministry of Infrastructure applies green infrastructure requirements in construction tenders. They provided DuboCalc (The Sustainable Building Calculator) to the auction committee to assess the environmental impact of using building materials. The results of this aggregate environmental impact calculation are converted in monetary terms, combined with the project's tender price. It succeeded in effectively promoting low-carbon raw materials for public infrastructure. A more integrated set of policy instruments is effective in achieving ambitious targets for reducing carbon footprints (Baron, 2016, p. 18).
Korea	Require the central/local government and public organizations to report on the implementation of the green procurement plan. The monitoring system is built so that more than 60% of green procurement data is automatically reported, and the Government can estimate carbon reductions while creating jobs.

*Source: Baron (2016), conducted by authors.*

In essence, the tender process does not need to specify what technology is required but focuses on the big goals/goals, labels and standards, from lowest cost to full cost, and a more flexible funding scheme. Another example is the implementation of green bonds in China which concludes that there are sectoral regulations that technically regulate the scheme, and financial needs, and clear guidelines from the sector can optimize the use of green bonds for green infrastructure. (Zhang, 2020). Various enabling policies, as above, can be used as references on how policies can work as a stimulant for green infrastructure investment.

## **3. Financial policies and instrument**

Clarity of concept and identification of the term "green" in green investment is also required (Tran et al., 2020). But that is not enough. A prerequisite for accelerating investment in green infrastructure is to ensure that investment is competitive based on risk-adjusted returns. Investors will not invest because it is "green"; their main concern remains on the financial aspect (Kaminker et al., 2013). It is therefore recommended to develop an attractive PPP/PPP scheme for all sectors and a tax policy that does not burden investors.

#### **4. *Harnessing resources and building capacity for an LCR economy***

Innovation in investment instruments such as the Masala Bond issued by the Kerala Infrastructure Investment Board (KIIFB) needs to be done (Unnikrishnan & Kattookaran, 2020). Barriers related to the low capacity of human resources, both policymakers and financial intermediaries, as described by the Guild (2020), need to be responded to with measurable programs that follow international standards and good practices. There is a need for a more massive public-private dialogue on green infrastructure investment and the need for transparency of markets, data, and infrastructure plans (Kaminker et al., 2013).

The need to increase FDI is also an alternative that requires the relaxation of several provisions. The Government of India is massively liberalizing FDI by allowing investment rates of up to 100% in all infrastructure sectors (Unnikrishnan & Kattookaran, 2020). Of course, this cannot be done by Indonesia considering the views and constitutional basis for the state's obligation to provide basic infrastructure and services that are different from India. Therefore, government authorities are expected to innovate within the PPP policy framework and model and ease the barriers in terms of requirements (Baron, 2016).

#### **5. *Promote green business and consumer behavior***

Raising public and business awareness (of the importance and benefits of green infrastructure) goes hand in hand with increased public participation, as green infrastructure is a decentralized system (Tauhid & Zawani, 2018). Private participation in infrastructure must be given the green light, and the government needs to create supporting facilities to facilitate it. Studies in Kiberai and Madurai show that thanks to the awareness and strong will of the community and organizations (businesses and non-governmental organizations/NGOs), non-governmental funding can be picked up, such as through grants or international assistance. The main point is not to tell what to do but to disseminate knowledge so that people are aware of decisions and the importance of paying attention to green infrastructure (Tauhid & Zawani, 2018). The importance of this socialization and education aims to prepare market interest in order to create a balanced supply and demand (OJK, 2016).

#### **Conclusion**

Green infrastructure is important in mitigating and adapting to climate change, so investment in it needs to be optimized to close the funding gap. Through the mixed research results and studies discussed, it is concluded that optimizing alternative sources of financing for infrastructure needs to be mainstreamed by the government, especially by encouraging the involvement of the private sector. Various challenges still arise in encouraging private participation, such as in the institutional aspect, investment/financial schemes, lack of policy support and low human resource capacity. Therefore, it needs a holistic and coherence policy framework both in terms of investment and climate (sectoral approach), sharpening financial instruments and incentives, campaigning for green investment, innovation in the procurement of goods & services, as well as eliminating various obstacles in the process (requirements, planning to operation) green infrastructure projects.

#### **References**

- [1] Abramowicz, D., & Stępniewska, M. (2020). Public Investment Policy as a Driver of Changes in the Ecosystem Services Delivery by an Urban Green Infrastructure. *Quaestiones Geographicae*, 39(1), 5–18. <https://doi.org/10.2478/quageo-2020-0001>

- [2] Arndt, C., Chinowsky, P., Strzepek, K., & Thurlow, J. (2012). Climate Change, Growth and Infrastructure Investment: The Case of Mozambique. *Review of Development Economics*, 16(3), 463–475. <https://doi.org/10.1111/j.1467-9361.2012.00674.x>
- [3] Baron, R. (2016). The role of public procurement in low-carbon innovation. *Round Table on Sustainable Development*, April, 12–13.
- [4] Bauer, A., Feichtinger, J., & Steurer, R. (2012). The Governance of Climate Change Adaptation in 10 OECD Countries: Challenges and Approaches. *Journal of Environmental Policy and Planning*, 14(3), 279–304. <https://doi.org/10.1080/1523908X.2012.707406>
- [5] Berrang-Ford, L., Ford, J. D., Lesnikowski, A., Poutiainen, C., Barrera, M., & Heymann, S. J. (2014). What drives national adaptation? A global assessment. *Climatic Change*, 124(1–2), 441–450. <https://doi.org/10.1007/s10584-014-1078-3>
- [6] Carolina Rezende de Carvalho Ferreira, M., Amorim Sobreiro, V., Kimura, H., & Luiz de Moraes Barboza, F. (2016). A systematic review of literature about finance and sustainability. *Journal of Sustainable Finance and Investment*, 6(2), 112–147. <https://doi.org/10.1080/20430795.2016.1177438>
- [7] Casado-Asensio, J., & Steurer, R. (2013). Integrated strategies on sustainable development, climate change mitigation and adaptation in Western Europe: Communication rather than coordination. *Journal of Public Policy*, 34(3), 437–473. <https://doi.org/10.1017/S0143814X13000287>
- [8] Castán Broto, V. (2017). Urban Governance and the Politics of Climate change. *World Development*, 93, 1–15. <https://doi.org/10.1016/j.worlddev.2016.12.031>
- [9] Chițimiea, A., Minciu, M., Manta, A. M., Ciocoiu, C. N., & Veith, C. (2021). The drivers of green investment: A bibliometric and systematic review. *Sustainability (Switzerland)*, 13(6). <https://doi.org/10.3390/su13063507>
- [10] Clar, C. (2019). Coordinating climate change adaptation across levels of government: the gap between theory and practice of integrated adaptation strategy processes. *Journal of Environmental Planning and Management*, 62(12), 2166–2185. <https://doi.org/10.1080/09640568.2018.1536604>
- [11] Clark, G. L. (2019). The allocation of risk and uncertainty in green infrastructure investment with implications for climate change policy. *Journal of Sustainable Finance and Investment*, 9(2), 116–137. <https://doi.org/10.1080/20430795.2018.1558043>
- [12] Cumming, T. L., Shackleton, R. T., Förster, J., Dini, J., Khan, A., Gumula, M., & Kubiszewski, I. (2017). Achieving the national development agenda and the Sustainable Development Goals (SDGs) through investment in ecological infrastructure: A case study of South Africa. *Ecosystem Services*, 27, 253–260. <https://doi.org/10.1016/j.ecoser.2017.05.005>
- [13] Delanka-Pedige, H. M. K., Munasinghe-Arachchige, S. P., Abeysirwardana-Arachchige, I. S. A., & Nirmalakhandan, N. (2021). Wastewater infrastructure for sustainable cities: assessment based on UN sustainable development goals (SDGs). *International Journal of Sustainable Development and World Ecology*, 28(3), 203–209. <https://doi.org/10.1080/13504509.2020.1795006>
- [14] Fell, T., & Mattsson, J. (2021). The role of public-private partnerships in housing as a potential contributor to sustainable cities and communities: A systematic review. *Sustainability (Switzerland)*, 13(14). <https://doi.org/10.3390/su13147783>
- [15] Guild, J. (2020). The political and institutional constraints on green finance in Indonesia. *Journal of Sustainable Finance and Investment*, 10(2), 157–170.

- <https://doi.org/10.1080/20430795.2019.1706312>
- [16] Halimanjaya, A. (2017). Climate mitigation finance in leveraging private investments in Indonesia. *Journal of Sustainable Finance and Investment*, 7(4), 335–359. <https://doi.org/10.1080/20430795.2017.1318461>
- [17] Hallegatte, S., Green, C., Nicholls, R. J., & Corfee-Morlot, J. (2013). Future flood losses in major coastal cities. *Nature Climate Change*, 3(9), 802–806. <https://doi.org/10.1038/nclimate1979>
- [18] Hinkel, J., Lincke, D., Vafeidis, A. T., Perrette, M., Nicholls, R. J., Tol, R. S. J., Marzeion, B., Fettweis, X., Ionescu, C., & Levermann, A. (2014). Coastal flood damage and adaptation costs under 21st century sea-level rise. *Proceedings of the National Academy of Sciences of the United States of America*, 111(9), 3292–3297. <https://doi.org/10.1073/pnas.1222469111>
- [19] Jama, A. A., & Mourad, K. A. (2019). Water services sustainability: Institutional arrangements and shared responsibilities. *Sustainability (Switzerland)*, 11(3), 1–16. <https://doi.org/10.3390/su11030916>
- [20] Kaminker, C., Kawanishi, O., Stewart, F., Caldecott, B., & Howarth, N. (2013). Institutional Investors and Green Infrastructure Investments: Selected Case Studies. In *OECD Publishing* (Issue 35). <https://doi.org/10.1787/5k3xr8k6jb0n-en>
- [21] Keuangan, K. (2021). Green Sukuk Allocation and Impact Report May 2021. In *Kementerian Keuangan*.
- [22] Mathai, M. V., & Kartikasari, K. (2015). Institutional Framework for Low-Carbon Urban Infrastructure Investment: Some Evidence and Lessons from DKI Jakarta, Indonesia. *Journal of Comparative Asian Development*, 14(2), 319–349. <https://doi.org/10.1080/15339114.2015.1059056>
- [23] Mungkasa, O. M. (2020). Green Infrastructure in Jakarta, Basic Understanding and Implementation Efforts in Indonesian Cities. *Applied Research on Civil Engineering and Environment (ARCEE)*, 2(01), 28–35. <https://doi.org/10.32722/arcee.v2i01.2921>
- [24] OECD. (2015). Infrastructure Financing Instruments and Incentives. In *OECD - Secretary-General*.
- [25] OJK. (2016). Laporan Kajian Pengembangan Green Bond Di Indonesia. In *Jakarta: Otoritas Jasa Keuangan* [https://www.ojk.go.id/sustainable-finance/id/publikasi/riset-dan-statistik/Documents/Pengembangan Green Bonds di Indonesia.pdf](https://www.ojk.go.id/sustainable-finance/id/publikasi/riset-dan-statistik/Documents/Pengembangan%20Green%20Bonds%20di%20Indonesia.pdf)
- [26] Putri, E. S., & Wisudanto, W. (2017). Struktur Pembiayaan Pembangunan Infrastruktur di Indonesia Penunjang Pertumbuhan Ekonomi. *IPTEK Journal of Proceedings Series*, 3(5), 222–228. <https://doi.org/10.12962/j23546026.y2017i5.3136>
- [27] Singla, A., Shumberger, J., & Swindell, D. (2021). Paying for infrastructure in the post-recession era: Exploring the use of alternative funding and financing tools. *Journal of Urban Affairs*, 43(4), 526–548. <https://doi.org/10.1080/07352166.2019.1660580>
- [28] Tauhid, F. A., & Zawani, H. (2018). Mitigating climate change related floods in urban poor areas: Green infrastructure approach. *Journal of Regional and City Planning*, 29(2), 98–112. <https://doi.org/10.5614/jrcp.2018.29.2.2>
- [29] Tran, T. T. T., Do, H. N., Vu, T. H., & Do, N. N. M. (2020). The factors affecting green investment for sustainable development. *Decision Science Letters*, 9(3), 365–386. <https://doi.org/10.5267/j.dsl.2020.4.002>
- [30] Tukiainen, K. (2020). Green Bond Market Summary Q3 2020. In *The Climate Bonds Initiative* (Issue November). [https://www.climatebonds.net/system/tfd/reports/cbi\\_q3\\_2020\\_report\\_01c.pdf?file=1&t](https://www.climatebonds.net/system/tfd/reports/cbi_q3_2020_report_01c.pdf?file=1&t)

- ype=node&id=54810&force=0
- [31] UNCTAD. (2015). Investment Policy Framework For Sustainable Development. In *United Nation's Conference on Trade and Development (UNCTAD)*. <https://investmentpolicy.unctad.org/investment-policy-framework>
- [32] Unnikrishnan, N., & Kattookaran, T. P. (2020). Impact of Public and Private Infrastructure Investment on Economic Growth: Evidence from India. *Journal of Infrastructure Development*, 12(2), 119–138. <https://doi.org/10.1177/0974930620961477>
- [33] Yang, Kaifeng; Miller, G. J. (2008). *Handbook of Research Methods in Public Administration*. CRC Press. [https://www.researchgate.net/publication/269107473\\_What\\_is\\_governance/link/548173090cf22525dcb61443/download%0Ahttp://www.econ.upf.edu/~reynal/Civilwars\\_12December2010.pdf%0Ahttps://think-asia.org/handle/11540/8282%0Ahttps://www.jstor.org/stable/41857625](https://www.researchgate.net/publication/269107473_What_is_governance/link/548173090cf22525dcb61443/download%0Ahttp://www.econ.upf.edu/~reynal/Civilwars_12December2010.pdf%0Ahttps://think-asia.org/handle/11540/8282%0Ahttps://www.jstor.org/stable/41857625)
- [34] Zhou, J., Raza, A., & Sui, H. (2021). Infrastructure investment and economic growth quality: empirical analysis of China's regional development. *Applied Economics*, 53(23), 2615–2630. <https://doi.org/10.1080/00036846.2020.1863325>