Financing Green Buildings in Indonesian Cities

An Analysis of Key Instruments for Climate Impact

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CITIES CLIMATE FINANCE LEADERSHIP ALLIANCE

CLIMATE POLICY INITIATIVE

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ABOUT THE CITIES CLIMATE FINANCE LEADERSHIP ALLIANCE

The CCFLA is a coalition of leaders committed to deploying finance for city-level climate action at scale by 2030. Trillions of dollars will be required to help cities build the low-emissions, resilient infrastructure necessary to combat and react to climate change. The CCFLA is the only multi-level and multi-stakeholder coalition aimed at closing the investment gap for urban subnational climate projects and infrastructure worldwide.

ABOUT CPI

CPI is an analysis and advisory organization with deep expertise in finance and policy. Our mission is to help governments, businesses, and financial institutions drive economic growth while addressing climate change. CPI has six offices around the world in Brazil, India, Indonesia, the United Kingdom, and the United States.

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EXECUTIVE SUMMARY

The building and construction sector plays a key role in Indonesia's economic and sustainable development. However, it is also a key contributor of GHG emissions. The country's buildings sector accounted for 23% of total energy consumption in 2021 and is expected to contribute 40% by 2030.

This is partly due to an annual construction growth rate of 5-6%, as well as urban population growth of 65% expected by 2050. Growth in the building sector will be concentrated in cities, especially those on the islands of Java and Sumatra, which are among the most populated in the Indonesian archipelago.

Indonesia's tropical climate makes cooling an important aspect of green buildings. Between 2022 and 2060, an estimated 550 million air conditioning (AC) units will be sold in Indonesia. Efficient cooling will be critical to reducing electricity consumption, including through the use of efficient AC systems and building materials.

This report is the third of a three-part series by CCFLA to promote a better understanding of the financing barriers and solutions for implementing net zero carbon buildings. It assesses the current use of financial instruments that can promote the development of Indonesia's green buildings sector. It also explores how national and subnational regulatory frameworks can address the identified barriers to private and public investment.

We used CCFLA's recently developed taxonomy of 75 financial and policy instruments to help address the barriers to achieving green buildings (CCFLA 2023a). We have adapted this model to the Indonesian context, based on desk research and interviews with green buildings experts. Barriers to green buildings were assessed in terms of severity in Indonesia, and financial and policy instruments were evaluated for availability and potential to scale the Indonesian green buildings sector.

A deep dive was also conducted in the city of Semarang, which is one of only six subnational administrations in Indonesia to have adopted a local regulation on green buildings. The study analyzed energy consumption in apartment, office, commercial, and public buildings and estimated potential energy improvements from implementing existing green building regulations and the cost of investing in green buildings.

KEY FINDINGS

Financial barriers are perceived as the most severe challenge to implementing green buildings in Indonesia. Three other types of barriers were found to have moderate to low severity, based on research and expert interviews, as shown in Table ES1.

Table ES1. Barrier categories and their perceived severity

Barrier	Barriers to green buildings in Indonesia	Perceived severity
Financial Barriers that limit cities' ability to source funding for net zero carbon buildings.	Rated as the most severe due to an absence of dedicated financing instruments and high interest rates for conventional corporate loans.	High
Regulatory Barriers that make current regulations unsuited to achieving the transition, due to lack of support for and/or adaptability to green building specificities	Perceived as being of medium severity, given the existence of national regulations that regulate mandatory green building codes. However, increased enforcement is needed to achieve net zero carbon emissions, and challenges remain for city-level implementation of regulations.	Medium
Market readiness Barriers that slow down green buildings deployment due to the low maturity or limited availability/supply of required technical solutions, and the lack of experience of actors involved in their deployment, including municipal capacities and human resources	Considered to be of medium severity as the technical and mechanical products required for green buildings have limited availability and are mostly imported. This includes a lack of supply of low embodied carbon and eco-labeled construction materials in the market.	Medium
Investment risk/opportunity Barriers that deprioritize investment in green buildings because of the perceived risk profile of projects, or because they hinder opportunity identification	Viewed as least severe, with barriers most commonly related to retrofitting of existing buildings rather than construction of new ones. Current mandatory green building codes apply to buildings with relatively large floor areas, ensuring a certain level of demand. Reasonable payback periods and significantly lower operational costs make these favorable for investment. However, uncertainty remains about how investment in green buildings may scale, as regulation requirements apply only to a limited subset of buildings.	Medium-Low

None of the fiscal instruments in CCFLA's taxonomy have been implemented in Indonesia's green buildings or renewable energy sector. These instruments – including capital cost subsidies, carbon credits, and property-assessed clean energy mechanisms – have helped to advance green buildings in other countries. Currently available financing instruments in Indonesia – including grants, debts, bonds, and public and private equity financing – tend to be traditional rather than innovative; more dedicated financing instruments are needed to scale investment in green buildings.

Indonesian green buildings regulations are improving but are still insufficient to achieve widespread implementation in cities. The national-level developments include a dedicated section on green buildings in the national government regulation (GR) on

buildings released in February 2021 (GR 16/2021), followed a month later by a regulation requiring performance assessments for green buildings.

Existing regulations fall short of ambition in terms of achieving net zero carbon buildings and scale. The residential sector, which accounts for 83% of energy demand from buildings in Indonesia, is not mandated to follow green buildings standards. GR 16/2021 lays out a suite of green building standards but is only mandatory for very large buildings (those with a floor area of above 5,000 m^2). This limits the drive to scale up green building development, thereby slowing the pace of emissions reduction for buildings.

In addition, the current regulations do not include sufficient detail to facilitate city-level implementation. GR 16/2021 does not include requirements on renewable energy, which are needed to achieve net zero carbon buildings. Some subnational governments had more ambitious standards in place – for example, Jakarta had mandated that solar systems be installed on rooftops of local government buildings and some apartments. However, this regulation was revoked in December 2023 to align with the national regulation.

Our case study of Semarang found that energy efficiency improvements for AC systems and building materials through retrofits can yield significant energy savings. Our simulation found that improved cooling systems and building materials can reduce energy use by between 32% and 44%, depending on the building type, resulting in energy cost savings of around USD 3.19 million (IDR 50.56 billion) a year.

Meeting Semarang's green building mandates in the next ten years will require large investment.[1] The total investment needed to meet these is estimated to be USD 223.7 million. Even after accounting for the reduced energy costs of green buildings, more financing is needed for Semarang and comparable cities to reach these targets.

RECOMMENDATIONS

Our recommendations aim to help central and local governments as key actors in green building financing and implementation. Governments can help to create a better enabling environment for green buildings through the following actions:

1. Supporting financial institutions and project developers through capacity building and exploring innovative financing instruments for the construction and retrofit of green buildings in Indonesia. This can include efforts to raise awareness among financial institutions of opportunities for energy-saving financial instruments.

1 Semarang City's masterplan specifies the expected projected building construction, local Semarang regulations specify the unit cost of construction, and national building regulations specify the requirements for green buildings based on building type and floor area.

2. Developing fiscal instruments to enhance the attractiveness of investing in green buildings through energy and cost savings. Government incentives or credit enhancements provided to financial institutions can help spur innovation in this space. The government can also facilitate exchange between financial institutions, project developers, and building owners. Current national green building regulations need to be:
    a. Made mandatory for residential buildings of over a certain floor area, given that residential buildings account for 83% of total energy demand from buildings in Indonesia.
    b. Adopted and implemented at the local (city or province) level.
    c. Expanded to include renewable energy requirements (either on-site, off-site, or purchasing of renewable energy certificates) to help Indonesia move towards net zero carbon buildings.

CONTENTS

ABBREVIATIONS

AC	Air Conditioner
BMR	Building Material Retrofit
CCFLA	Cities Climate Finance Leadership Alliance
COP	Coefficient of Performance (of AC)
CPI	Climate Policy Initiative
ENDC	Enhanced Nationally Determined Contribution
ESCO	Energy Service Company
GHG	Green House Gas
GR	Government Regulation
IDR	Indonesian Rupiah, currency
MEMR	Ministry of Energy and Mineral Resources
MPWH	Ministry of Public Works and Housing
NDC	Nationally Determined Contribution
OJK	Financial Services Authority (*Otoritas Jasa Keuangan*)
TOE	Ton of Oil Equivalent, unit of energy
USD	United States Dollar, currency

1. INTRODUCTION

Globally, buildings are responsible for 37% of energy-related greenhouse gas (GHG) emissions, making decarbonization of the building and construction sector essential to meeting global climate targets (UNEP 2023). With nearly 70% of the world's population expected to live in urban areas by 2050, city governments are the cornerstone of achieving a net zero transition for the built sector (UNDESA 2019).

While robust work has already been done on green building policy options, the interdependencies between the various fiscal and policy instruments in this complex sector remain underexplored. Understanding the interplay between such instruments can help city governments to prioritize action to decarbonize buildings. A report by Cities Climate Finance Leadership Alliance (CCFLA) published in December 2023 bridged this theory-to-practice gap (CCFLA 2023a). The report, titled "Net Zero Carbon Buildings in Cities: Interdependencies between Policy and Finance", used network analysis to explore policy and financial instruments that can promote the adoption of net zero carbon buildings, as well as the barriers to their adoption (see Annex 1). The current report builds on this work, but refers to green buildings, rather than net zero carbon buildings, to better suit the Indonesian regulatory and policy context (see Box 1).

Box 1. Definitions: Net Zero Carbon Buildings vs. Green Buildings

CCFLA's work distinguishes between net zero carbon buildings and green buildings as follows:

An adequate **net zero carbon building** definition must take whole-life carbon into account, including energy use and other operating emissions, manufacturing and embodied carbon of materials, the construction process, and demolition. CCFLA's 2023 Net Zero Carbon Buildings in Cities report defines a net zero carbon building as one that is powered by on-site or off-site carbon-free energy and whose materials have net zero life cycle emissions and/or use carbon removal to offset residual life cycle emissions.

The term **green building** refers to buildings that do not meet the above net zero bar but include significant measurable performance in saving energy, water, and other resources through the application of green building principles in accordance with the function and classification at each stage of implementation. This term is widely used in national regulations and by professional associations, including in Indonesia.

In Indonesia, the sustainable buildings agenda is still generally focused on improving energy efficiency, rather than achieving net zero emissions. Thus, we refer to green buildings in this report to align with this context.

This report undertakes an in-depth examination of the Indonesian green building market, employing a comprehensive approach to assessing barriers and applying CCFLA's taxonomy to the context of achieving green buildings in Indonesia. By identifying and understanding barriers, the report aims to shed light on opportunities to enhance the national and local policy framework, facilitating increased private and public investment in green building initiatives across cities.

Additionally, the report delves into the interplay between 75 financial and policy instruments, policy implementation pathways, and barriers to the adoption of net zero carbon building practices. Focusing on Semarang as a representative city in Indonesia, the study estimates the potential energy savings from implementing green building regulations. It also assesses future investment that would be needed for related new green construction amid growing demand for cooling of buildings in the city.

Buildings and construction play a key strategic role in Indonesia's economic and sustainable development. These sectors are key to creating the necessary infrastructure and providing jobs; the country had around 1.2 million permanent and contract construction workers in 2022 (BPS-Statistics Indonesia, 2023). Indonesia's building stock is expected to grow significantly in the coming decades, especially in cities. The urban population is expected to grow by 65% between 2020 and 2050 and the national government has recognized the need for better urban planning and infrastructure. In 2021, estimated new housing needs across the country reached 1.4 million units per year, and the annual construction growth rate of residential and commercial buildings is about 5-6% with the highest increase estimated to be in residential buildings (CCFLA 2022; DEA 2022).

As well as being vital to development, buildings contribute significantly to GHG emissions. In 2021, the buildings sector represented 23% of Indonesia's final energy consumption and this figure is expected to reach 40% by 2030 (IEA 2022a). The residential sector dominates 83% of buildings' total energy demand in the country (IEA 2022a).

In particular, air conditioning (AC) is predicted to become the biggest energy end-use in Indonesian buildings in the coming decade. Given the country's high temperatures and humidity, Indonesia has among the highest space cooling needs in the world, with population and economic growth spurring demand. The International Energy Agency's Announced Pledges Scenario estimates around 550 million AC units will be sold in Indonesia between 2022 and 2060.[2] This paper therefore focuses on cooling as a high-impact area for green buildings, presenting great opportunities to develop solutions that help to mitigate, as well as adapt to, climate change.

We use Semarang as a city-level deep dive for our analysis, given its commonalities with other Indonesian cities in terms of scale and its readiness to apply green building regulations. Semarang was among the first cities to pioneer green building standards, with its Mayor Regulation No. 24/2019. We have estimated the potential energy savings from implementing these and national green building regulations with a focus on cooling and the investment needed for new green building construction in Semarang.

2 The International Energy Agency developed the Announced Pledges Scenario, under which Indonesia reaches net zero emissions on an economy-wide basis by 2060, with deep cuts in energy sector emissions.

HIGH-IMPACT AREA OF FOCUS: COOLING

Electric fans and air conditioners are the most commonly used space cooling technologies in Southeast Asia (IEA 2022b). These are required to feature energy-efficiency labels under the Indonesian Ministry of Energy and Mineral Resources' Minimum Energy Performance Standards, enabling property developers to choose efficient options.

AC systems with high coefficient of performance (COP) use less energy than conventional units and are available in both split and centralized formats. However, high-COP systems may have higher initial costs than less efficient systems.

Box 2. Commonly used cooling solutions in Indonesia

AC is increasingly used in Indonesian buildings due to the demand for more comfortable indoor air temperatures in a tropical climate. High-COP systems are more energy-efficient and can significantly reduce energy consumption for cooling. Efficient AC systems are easier to implement than many other energy-efficiency measures, such as changing building or material designs.

Electric fans are an affordable and low-energy cooling alternative to AC. While they do not reduce air temperature, they can deliver considerable comfort in well-designed buildings with energy-efficient envelopes.

2. THE GREEN BUILDINGS POLICY CONTEXT IN INDONESIA

Indonesia has made an unconditional commitment in its Enhanced Nationally Determined Contribution (ENDC)[3] to reduce its GHG emissions by 31.89% by 2030, and by 43.2% if receiving international assistance (Government of Indonesia, 2022). It aims to do so through various actions including energy conservation and the promotion of clean and renewable energy sources.

None of the country's Nationally Determined Contributions to date include specific emissions reduction targets for the buildings sector or related subsectors. However, in practice, buildings have been addressed under the residential and commercial subsectors of the energy sector.

Given that buildings account for two thirds of Indonesia's current electricity demand, 80% of which is generated from unabated fossil fuels, this sector will be central to achieving Indonesia's ENDC emissions targets by 2030, as well as to net zero emissions by 2060.

This decarbonization imperative will only strengthen amid rapidly growing demand for buildings in the coming decades, creating a need for the development of the green buildings sector at speed and scale.

2.1 KEY GREEN BUILDINGS STAKEHOLDERS

Several stakeholders have key roles in supporting Indonesia's green building sector.

Table 1. Key stakeholders in Indonesia's green building sector

Stakeholder Category	Role in Green Buildings	Stakeholder Examples
Central Government	Formulating policy, regulations, and green building standards	Ministry of Public Works and Housing (MPWH) Ministry of Energy and Mineral Resources (MEMR)
Subnational Governments (Provincial and Municipal)	Establishing local regulations to support technical aspects of green buildings, adapting national regulations to local contexts	Provincial Government of Central Java City Government of Semarang

3 Indonesia set its first as a prompt response to the Paris Agreement. It updated this NDC in 2021 and published its ENDC in 2022.

Stakeholder Category	Role in Green Buildings	Stakeholder Examples
Financial and Monetary Authorities	Encouraging and providing regulatory support for financial institutions to incorporate green building principles into their business operations and catalyze green building financing	Indonesian Financial Services Authority (*Otoritas Jasa Keuangan*, or OJK) Central Bank of Indonesia
Non-Governmental Organizations (NGOs)	Enhancing awareness of green buildings and materials by conducting research, capacity building, and collaboration among the private and public sectors, may provide labels or certifications (e.g. green labels by the Green Product Council Indonesia, GREENSHIP by the Green Building Council of Indonesia)	Green Building Performance Network Green Building Council Indonesia Green Product Council Indonesia
Private Sector Entities	Businesses: providing construction materials and services to implement green buildings. Financiers (e.g., commercial banks or capital markets): Channeling finance for green building projects	Commercial banks PT Sarana Multi Infrastruktur Construction Services Cement Industry

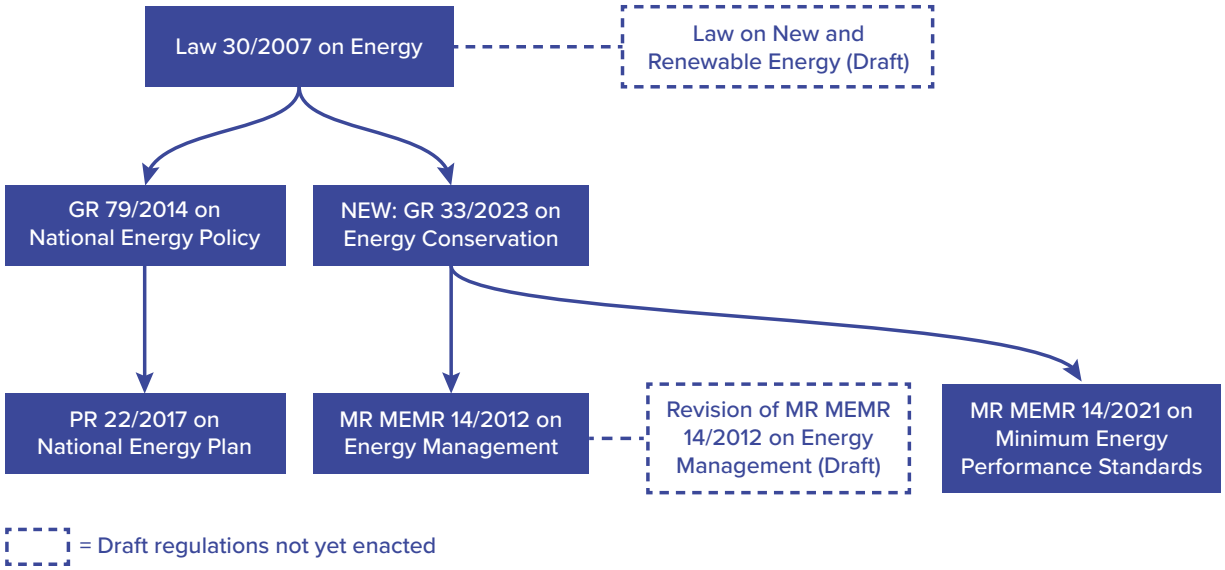
Together, the above stakeholders all play important roles in advancing green buildings implementation. On the policy development side, the national government can engage with NGOs to develop new codes and standardize construction for green buildings. Policymakers can also collaborate with the private sector and NGOs to identify effective incentives and enforcement strategies to help strengthen green buildings regulations. Ultimately, the central government has a critical role in providing a strong foundation to mobilize investment in green buildings.

2.2 ENERGY-EFFICIENCY POLICIES FOR BUILDINGS

Since 2007, the Indonesian government has built a regulatory foundation for energy conservation and management through Law 30/2007 on Energy and subsequent subsidiary technical regulations. However, legislation remains concentrated at the national level, leaving cities and municipalities to consider subnational mandates to address the local aspects of implementing energy conservation.

Figure 1 summarizes some of the most relevant regulations on energy and energy efficiency. Further details on Indonesia's national policy and regulations related to energy conservation are also available in Annex 2.

Figure 1. Overview of national policies and regulations on energy



Law 30/2007, Indonesia's overarching regulation on energy, governs general principles for the management of energy resources and lays out targets for future development of the energy mix. It stresses the importance of sustainable development, environmental preservation, and energy resilience in national energy management, laying the groundwork for further regulations on the development of renewable energy and energy conservation.

Indonesia also strongly promotes energy efficiency in existing green building performance standards.

The recent Government Regulation (GR) on Energy Conservation (GR 33/2023) includes energy efficiency as part of local governments' key performance indicators and mandates them to earmark energy-efficiency financing in their annual budgets. Energy conservation measures are therefore compulsory for public buildings in cities, the MEMR carries out monitoring and evaluation based on energy conservation performance reports.

GR 33/2023 significantly decreases the permitted threshold for energy consumption for sectors including industry, transportation, and buildings.[4] Each building must now limit annual emissions from energy use to less than 500 tons of oil equivalent (TOE) and may make further reductions voluntarily. In addition, government-owned buildings (at both the central and local levels) are required to implement energy management measures regardless of their levels of energy consumption.

GR 33/2023 also provides standards on energy performance and energy savings labels, energy conservation financing, energy conservation services business development, capacity building, research and innovation, and stakeholder partnership programs. In the building sector alone, this new regulation is projected by the MEMR's Directorate General of New, Renewable Energy and Energy Conservation (MEMR 2023) to:

4 The former GR 70/2009 on energy conservation regulates energy consumers, without specifying sector, with an annual consumption of 6,000 TOE or above to implement energy conservation through energy management practices.

- Increase in energy-saving potential by 77,700 TOE/year,
- Decrease in CO_2 emissions by 767,000 tons/year, and
- Decrease of energy spending by USD 87 million/year.

GR 33/2023 also regulates energy service companies (ESCOs), covering the implementation of investment-grade energy audits, financing of energy-efficiency projects, installation and/or construction work, and monitoring and supervision of energy-efficiency projects, operation, maintenance, and repair of energy installations, and/or energy performance measurement and verification.

A New and Renewable Energy Bill is also being drafted by Indonesia's House of Representatives and is expected to include ambitious measures to achieve Indonesia's Nationally Determined Contribution and reach net zero by 2060 or sooner. Details of the bill were not available at the time of writing.

2.3 GREEN BUILDINGS POLICY

Current green building regulations in Indonesia have limited scope and enforcement, and enabling policy instruments are not widely deployed to support them. Existing laws do not institute strong enough requirements or penalties to ensure green performance compliance.

The new GR 16/2021, brought into force in 2021, serves as the national overarching regulation on buildings. Superseding the previous building regulation GR 36/2005, the new GR regulates and codifies green buildings at the national level for the first time. It also outlines the types of building mandated to follow the green building guidelines. The regulation lays out provisions for green buildings on the following topics:

- **Green building technical planning stage** (Article 112): Site management, energy efficiency, water efficiency, indoor air quality, use of environmentally friendly materials, waste management, and wastewater management. In terms of energy efficiency, the provisions cover the building envelope, as well as electricity, ventilation, AC, lighting, and in-building transportation systems.
- **Incentives for green building owners and management** (Article 122): Tax incentives for building permits, additional floor area ratio,[5] awards/tokens of appreciation[6], and other incentives in the form of publicity and/or promotion. It is noted that the provisions do not include financing incentives.

In addition, Ministry of Public Works and Housing Regulation (MPWHR) No. 21/2021 was enacted after GR 16/2021 to cover performance assessments of green buildings. This regulation specifies the types of building that are required to comply with GR 16/202. It also includes provisions on energy performance assessment, as well as measurement, reporting, and verification related to green buildings, and sets out the assessment

5 Floor area ratio (referred to in the regulation as "building floor coefficient) is the ratio of a building's total floor area to the size of the land plot upon which it is built. This is regulated to limit the construction of high-rise buildings because it is related to building height.
6 Awards can take the form of certificates, placards, and/or a sign of appreciation to building owners and management officials who meet the criteria.

parameters for obtaining green building certification. Table 2 outlines the building classification and floor area requirements to comply with green building technical standards for new and existing buildings, as described in MPWHR 21/2021.

Table 2. Criteria triggering mandatory compliance with green building standards

Building Class	Description	Criteria Triggering Mandatory Compliance
1	Residential buildings (single house, duplex, small dormitory, small hostel)	No mandatory compliance, only recommended
2	Residential buildings (multi-family residential)	
3	Residential buildings (houses that do not fall under class 1 or 2)	
4	Mixed-use residential buildings (apartments combined with other purposes such as commercial)	≥ four stories, and ≥ 50,000 m^2 floor area
5	Buildings for professional, administrative, and commercial use (including office buildings)	
6	Commercial buildings (stores, shops)	≥ four stories, and ≥ 50,000 m^2 floor area
7	Buildings for storage (warehouse)	
8	Laboratories and buildings used to process products (workshop)	
9a	Public buildings related to healthcare	>20,000 m^2 floor area
9b	Other public buildings	> 10,000 m^2 floor area
10	Facility buildings built separately from the main building	No mandatory compliance, only recommended

Source: MPWHR 21/2021 Article 2 and Annex 1

Further details on the national regulations supporting green buildings in Indonesia are provided in Annex 2.

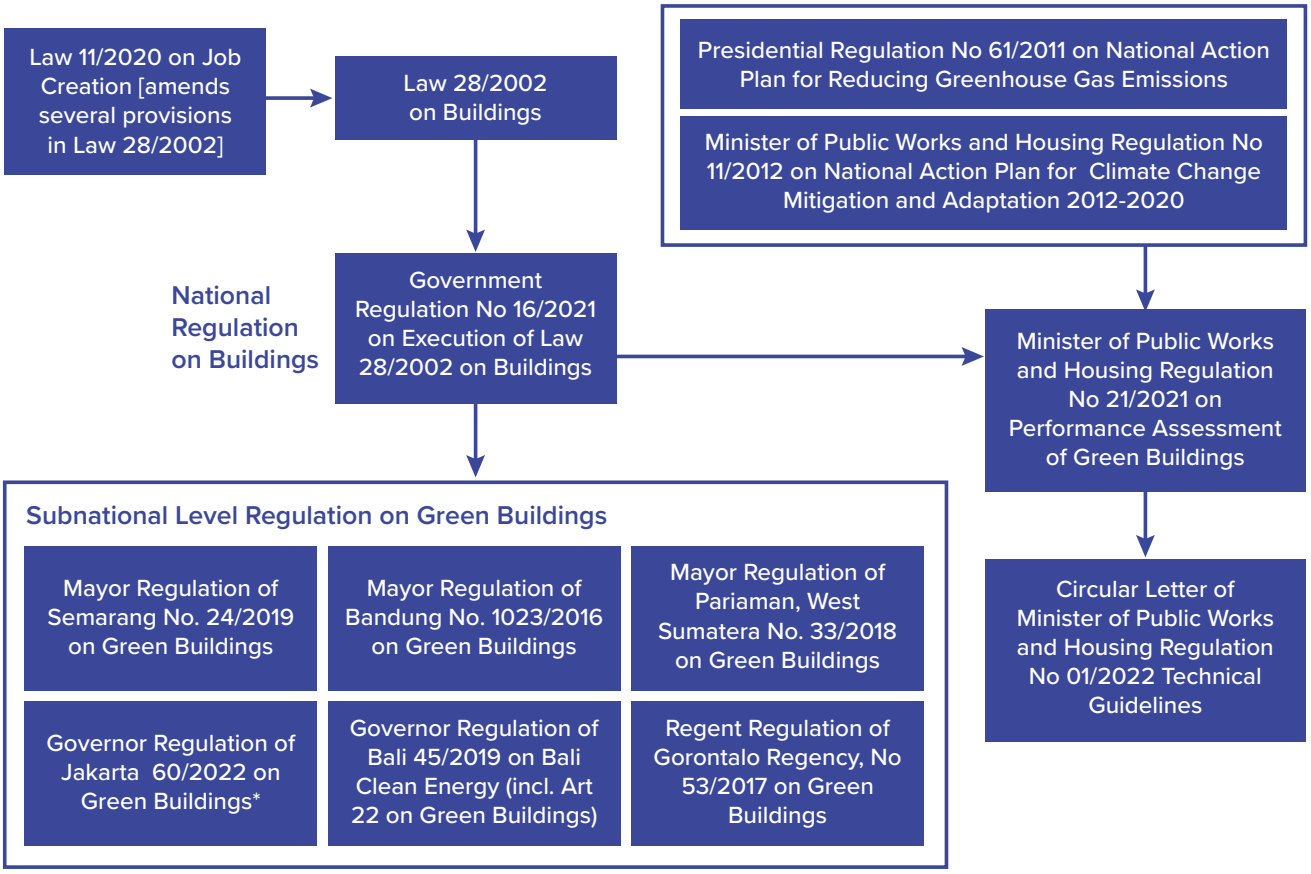
There are some subnational regulations on green buildings in Indonesia, which predate GR 16/2021 and MPWHR 21/2021. Semarang was among the first cities to pioneer green building standards, with its Mayor Regulation No. 24/2019. Jakarta, Indonesia's capital, mandated in 2022 that solar systems be installed on rooftops of local government buildings and apartments with certain terms and conditions related to floor and roof area. However, this local regulation was revoked in 2023 to align with the national regulation.[7] Other subnational regulations pertaining to green buildings are also in

7 Governor Regulation of Jakarta No. 44/2023 revoked the Governor Regulation of Jakarta No. 60/2022 on Green Buildings.

place in Gorontalo regency in Gorontalo province, Sulawesi; Pariaman city in West Sumatra; Bandung city in West Java; and Bali province.[8] In the regulatory hierarchy, these subnational regulations derive from the now-revoked GR 36/2005 building code and would therefore benefit from being updated to align with GR 16/2021. However, any provisions that do not contradict the current GR 16/2021 national building regulation remain valid.

Figure 2 maps the regulations on buildings and green buildings in Indonesia.

Figure 2. Mapping of building regulations in Indonesia



*recently revoked by Governor Regulation of Jakarta No. 44/2023

Implementation of GR 16/2021 and MPWHR 21/2021 is the responsibility of municipalities. The success of these regulations will depend on cities having sufficient implementation capacity and on educating the construction sector on how to increase investment in green buildings.

While GR 16/2021 represents significant progress on green building regulations, its effectiveness is compromised by several omissions. Firstly, it lacks provisions for subnational implementation, leaving an enforcement gap at the city and provincial levels where building regulations are often tailored to local contexts. Secondly, the regulation fails to address renewable energy targets, hindering progress towards net

8 Bali's regulation is included in included in the Governor Regulation of Bali Clean Energy, with a specific Article on Green Buildings.

zero emissions. Lastly, it does not mandate residential buildings to implement green standards. This is a missed opportunity, given that residential buildings constitute the majority of energy consumption among all building types. Addressing these deficiencies is crucial for ensuring comprehensive and impactful regulation of Indonesia's building sector, facilitating a transition towards a more sustainable built environment.

Box 3. Sustainable finance roadmaps

The Indonesian Financial Services Authority (OJK) and The Central Bank of Indonesia have created a sustainable finance roadmap aimed at increasing green finance portfolios, including for buildings. This is designed to support banks in financing green buildings in their portfolios and also greening their own operations, including their office buildings. This regulation can support the development of the green buildings sector in major cities like Jakarta, where large commercial banks have started applying green standards in their office buildings.

The OJK Sustainable Finance Roadmap, first adopted in 2021 contains guidance and policy directions for sustainable finance development in Indonesia and is a realization of cooperation between the OJK and the government, particularly the Ministry of Environment and Forestry (OJK 2021).

1. Ensuring financial institutions operate sustainably, by obligating them to report emissions reductions pertaining to energy consumption as part of their annual mandatory sustainability reporting. This mandate, enforced under POJK 51/2017, has triggered major banks to invest in green building retrofit projects and invest in energy efficiency.
2. Encouraging capital market participants to raise funds through green-labeled instruments, regulated under POJK 60/2017. The OJK includes green buildings as among the projects eligible to access funds from green bond issuance. Moreover, the OJK also provides clear regulations for local governments to issue municipal bonds.

3. BARRIER ANALYSIS

Building stocks are formed of scattered, often unique, assets that each have distinct uses and constraints. A wide range of actors including individuals, the private sector, to large corporations can variously take the roles of building developers, owners, and occupiers. It is important to identify the barriers to implementing green buildings, which apply to different actor types and often reflect the limitations of uncoordinated action.

Our barrier assessment draws on CCFLA's global study on Net Zero Carbon Buildings in Cities (CCFLA 2023a), desk research, and expert consultation with stakeholders in Indonesia's building sector. Financial barriers were identified as the most severe, followed by regulatory and market readiness barriers. Opportunity barriers were considered the least severe. The CCFLA global analysis shows that financial barriers are more effectively addressed after underlying market readiness and regulatory barriers are addressed. While Section 4 of this report emphasizes addressing financial barriers and implementing new fiscal instruments, the overall recommendations of this paper try to align with the underlying barrier dependency. See Table 3 for detailed barrier assessment results.

- **Financial barriers relate to a lack of access to affordable finance and a limited supply of dedicated financing instruments for green buildings.** Due to this lack of funding options, and a lack of awareness of those that do exist, commercial building developers must often use conventional options such as corporate loans to fund green buildings. However, the high interest rates of such loans may not be suited to such projects, given that they require significant upfront investment in energy-efficient technologies, as well as sustainable materials and construction methods. Expert interviewees from the Green Building Council of Indonesia assess that green building projects have 10-15% higher costs on average than those for conventional buildings.
- **Regulatory barriers exist when current regulations are unsuited to support the transition to net zero carbon buildings, due to a lack of specificity or adaptability to green buildings.** Regulatory barriers are seen as moderately severe in the Indonesia green buildings context. Current regulations are perceived as lacking ambition and do not adequately demonstrate a pathway to net zero to encourage investment.
- **Market readiness barriers** can hinder the deployment of green buildings due to a lack of maturity or limited availability of technical solutions, and the lack of experience of actors involved in their deployment. These are seen as among the least severe barriers in Indonesia, though challenges with technical product supply remain, as local products are limited.
- **Investment risk or opportunity barriers** relate to perceived risk profiles or a lack of opportunity identification, which can deprioritize investment in green buildings. These are seen as among the least severe barriers in Indonesia, though low

priority placed on green building investment hinders growth and scale. As only commercial buildings with large floor areas are mandated to comply with green building standards (see Table 2), and owners and developers are unlikely to comply voluntarily, there may not be sufficient demand for investments at scale.

Table 3. Barriers to financing and adopting green buildings in Indonesia

Barrier	Context in Indonesia	Severity Level
Financial barriers		
Lack of access to affordable finance	High interest rates in Indonesia limit access to finance in general, increasing the overall cost of projects and deterring individuals and companies from pursuing them.	High
Lack of awareness of funding options	Private sector actors lack information on available funding options, causing building developers to seek conventional options such as corporate loans, which may not be suited to green projects. Retrofitting is usually done by ESCOs, which often have limited access to finance.	Medium
Limited supply of dedicated financing instruments	The limited number of dedicated financing instruments for the construction and retrofitting of green buildings obliges commercial developers to use conventional instruments.	High
Inability to pay for upfront costs	Difficulties in securing cash flow for construction hinder the development of green building projects in particular, given their typically higher upfront costs compared to traditional construction.	Medium-Low
Regulatory barriers		
Lack of building regulation support	Despite updates to the national regulation on buildings to cover green buildings and a subsequent minister's regulation on the performance assessment of green buildings, current standards are perceived as lacking ambition, including a lack of renewable energy requirements. While the MEMR shows alignment with Indonesia's Roadmap to Net Zero Emissions, the MPWH does not, and still only focuses on green buildings and energy efficiency.	Medium
Lack of technology standards	There is a lack of technologies that meet the Indonesian National Standard, and more research and development is needed.	Medium-Low
Long processes for permitting / access to land	Although the building construction permitting process has been simplified in the 2021 building regulation, access to land is still a common barrier to building expansion in Indonesia due to land scarcity and competing land use. Rapid urbanization and economic growth have intensified competition for land, particularly in desirable urban and peri-urban areas.	Medium-Low

Barrier	Context in Indonesia	Severity Level
Social risk / community opposition	Pressing social issues such as land issues may be deemed more important than carbon emissions reduction due to limited awareness of sustainability benefits. In addition, the general public is wary of the increased investment costs and potential disruption during construction (for green retrofits, for example). With proper socialization and education, local communities' resistance to green buildings projects can be reduced.	Medium-Low
Market readiness barrier		
Limited experience with technical solutions	Technical solutions are common for efficient AC and building envelope materials, but there is insufficient knowledge and experience among stakeholders on passive design and eco-labeled solutions.	Medium-Low
Lack of expertise / skills	There is inadequate green buildings knowledge among built environment professionals and a lack of qualified green building certification assessors.	Medium-Low
Limited technical product supply	There are limited local products available, hence most electrical and mechanical equipment is imported. There is also a lack of low embodied-carbon materials and eco-labeled materials that are well-known in the market.	Medium
Investment risk/ opportunity barriers		
Asset class has insufficient project scale	New buildings provide opportunities for achieving green buildings at scale, but few new builds are currently mandated to follow related standards based on their floor area and use. On the other hand, the smaller ticket sizes of retrofitting activities may not meet the investment appetite of all financial institutions.	Medium
High investment costs compared to alternatives	Energy efficient technologies and equipment are more expensive to install. According to an expert from the Green Building Council of Indonesia, green buildings have 10-15% higher costs than conventional buildings. Net zero carbon buildings with the addition of renewable energy (e.g., rooftop solar systems), will also have higher CAPEX needs.	Medium-Low
Long payback on investment	Even with higher investment costs, the payback period for green buildings can still be similar to conventional buildings (within 5 years).	Low
Perceived technical performance risk	Energy-efficiency performance is well established for technical solutions such as AC and building envelope materials. However, the "eco-labeling" of construction materials, as required by the new building regulation, is less known, leading to higher perceived risk among stakeholders.	Medium-Low
Split incentive between landlords and tenants	Tenants are responsible for paying utility bills, in many leasing agreements, especially for commercial real estate. This means that they directly bear the costs of electricity, heating, and cooling. However, building owners are generally responsible for building improvements and upgrades. If landlords invest in technologies to reduce energy consumption, tenants benefit from lower utility bills. Building owners may compensate for this by increasing lease prices. Thus, this barrier is of low severity.	Low

Barrier	Context in Indonesia	Severity Level
Low priority investment	Investment in green buildings is still a low priority for developers, owners, and landlords due to low awareness of the related opportunities (e.g., cost savings from energy consumption), beyond complying with the currently limited regulations.	Medium
Lack of awareness / appropriate information on opportunity	There is a lack of awareness among stakeholders on the definition of green buildings and their positive environmental impacts and other benefits, with few green buildings available as examples of success.	Medium-Low
Lack of performance data	Performance data are often difficult to obtain from building owners and managers, making it difficult to assess the performance improvements of green buildings.	Medium-Low
High or uncertain maintenance/ operation costs	Operational costs are usually lower, given that energy-efficient equipment leads to lower electricity bills. Materials and technologies have also improved, reducing maintenance costs.	Low

Note: *We used the following approach to identify barriers to green buildings in Indonesia: (1) Adopt the list of barriers from CCFLA's global study and align the barriers' relevance with the Indonesian context; (2) Receive expert inputs via interviews of selected experts to understand the impact of the barriers to financing green buildings in Indonesia; and (3) Develop a heatmap based on the expert inputs to categorize the barriers according to their perceived severity. Experts interviewed include green building consultants, Green Building Council Indonesia, and the Global Building Performance Network.*

4. INSTRUMENT ANALYSIS

This section delves into policies and financial instruments that are relevant to Indonesia's green buildings sector and analyzes the interdependencies between them. Our analysis is based on CCFLA's 75 financial and policy instruments for net zero carbon buildings, as outlined in Annex 1.

Financial barriers, which are of high priority from a demand-side perspective, can be significantly mitigated by addressing other regulatory, market, and investment risk/opportunity barriers. For example, creating dedicated financial instruments for net zero carbon building technologies (i.e., overcoming financial barriers) requires new technologies and related know-how (market readiness), as well as clear technology standards (regulations).

Policy instruments including audits, tune-ups, commissioning of retrofits, building energy performance standards, and energy-efficiency standards have been embedded in national and some subnational government policies (see Section 2 and Annex 1). However, those instruments are still at a nascent stage and are not widely implemented. Meanwhile, standards and codes pertaining to net zero carbon buildings are not yet active, since Indonesia's regulations on green buildings do not mandate offsetting all emissions to achieve net zero. The analysis in this report focuses on financial instruments as these have the greatest potential to drive the decarbonization of Indonesia's buildings sector.

While financial instruments such as concessional loans, market-rate debts, green mortgages, and technical assistance grants are well established in Indonesia, fiscal instruments covered by the CCFLA taxonomy are not in use. Potentially impactful fiscal instruments include capital cost subsidies, carbon credits and markets, energy/carbon taxes, feed-in tariffs, financial penalties, Property Assessed Clean Energy (PACE) mechanisms, service subsidies, tax incentives, and tax- or fee-based land-value capture (LVC).

4.1 CURRENT STATE OF FINANCIAL INSTRUMENTS

This section outlines which financial instruments from the CCFLA taxonomy are available in Indonesia for green buildings and other related sectors.

4.1.1 GRANTS

Table 4. Use of grant-based instruments in Indonesia

Instrument	Description	Use in Green Buildings	Use in Other Sectors
Result-based grants	An instrument that awards a portion of the grant only upon achieving and verifying pre-defined results. Rewarding individuals or institutions after agreed-upon results are verified helps to shift focus to outcomes while strengthening ownership and incentivizing performance. Results-based funds are often used as add-ons to accelerate the pace of other programs and can be implemented in conjunction with additional capacity-building activities or technical assistance.	Yes	Yes
Technical assistance grants	Technical assistance grants provide funding to access expert opinions and guidance to design, develop, and implement green buildings projects.	Yes	Yes

Grants have been important for financing climate adaptation and mitigation projects related to buildings in Indonesia. Results-based grants have been used to reimburse solar rooftop installations for residential and commercial buildings, initiated by the United Nations Development Program and the Indonesian Environment Fund. Technical assistance grants are also well-used to support public policy enhancement at both national and local levels (see Box 4).

Box 4. Case study: Indonesia Green and Affordable Housing Program

Supported by the International Finance Corporation (IFC), the Ministry of Housing and Public Works aims for 10,000 new houses to be built with green certification across Sumatra, Java, and Sulawesi (Indonesia's most populous islands) by 2024. This is part of the IFC's Excellence in Design for Greater Efficiencies (EDGE) initiative, focusing on renewable energy and waste management for buildings. The initiative provides grants for assessment based on climatic conditions, usage patterns, technology, and typical buildings in a given area to demonstrate the amount of energy and water savings achievable by implementing sustainable technologies. The grants fund the assessment costs to calculate the savings and financing needs for green buildings.

However, there is room to improve the deployment of grant-based instruments. First, data accuracy in relation to results-based grants remains a challenge, especially in generating evidence-based energy performance. Second, there is a lack of awareness of available grant facilities for green buildings, and a lack of understanding of the best options to use such grants.

4.1.2 DEBT

Table 5. Use of debt instruments in Indonesia

Instrument	Description	Use in Green Buildings	Use in Other sectors
Concessional loans	Loans made on more favorable terms than the borrower could obtain in the market. Concessional terms may include below-market interest rates, deferred repayments, or income-contingent repayments.	Yes	Yes
Credit lines	Flexible loans for a defined amount of money that can be accessed as needed and repaid either immediately or over time.	Yes	Yes
Market-rate debt	Referring to the market price investors would be willing to buy a company's debt for, which differs from the book value on the balance sheet.	Yes	Yes
Results-based loans	An instrument that awards the loan only upon achieving and verifying pre-defined results. Development agencies have started using results-based financing as a tool to improve the effectiveness of their aid to developing countries.	No	Yes
Revolving funds	Funds that are continually replenished as withdrawals are made.	No	Yes
Syndicated loans	Loans that are provided by a group of lenders and structured, arranged, and administered by one or several commercial banks or investment banks (known as lead arrangers).	Yes	Yes
Green mortgages	Mortgages targeted at green buildings offer incentives such as lower interest rates or increased loan amounts to encourage borrowers to either buy a green building or renovate an existing one to make it greener.	Yes	Not applicable

Since little to no data is available on concessional, results-based, and syndicated loans for green buildings in Indonesia, we focused our analysis on market debt instruments and credit lines, which are commonly used to finance green buildings construction and retrofitting. Market debt is common, due to the real estate business in Indonesia being driven by a large group of companies with strong financial capabilities. Although market-rate debt might be considered as high-cost financing, large corporations may still use it to finance green buildings as they perceive this as a good public relations opportunity to harness environmental, social, and governance principles in their operations.

To develop green public buildings, provincial and municipal governments can access debt from national/other subnational governments, financial institutions, and the bonds

market. Subnational governments are prohibited from borrowing from foreign sources but can access any debt instrument from domestic sources.

GR 56/2018 on Regional Loans sets the terms for short-, medium- and long-term regional loans (see Annex 3). Medium-term loans are used to finance infrastructure and/or public services in areas that do not generate local revenue. Long-term loans are used to finance infrastructure and/or public service facilities that aim to generate direct local revenues, or indirect local revenues from savings. As such, green building developments, which generate energy cost savings, are eligible for regional loans.

In 2015, the OJK issued a guideline on high-level principles for green buildings loans, and the Central Bank of Indonesia has waived the upfront cost requirement for green mortgages to enable market-rate debt financing (OJK 2015). These guidelines cover the foundation for green building financing criteria and potential financing instruments. **However, financiers need to adopt more detailed and technical guidance in their internal credit risk standards. Banks may face difficulties in accurately assessing long-term value, marketability, and potential risks associated with green buildings, impacting their willingness to finance such projects.** The MPWH's recently launched Indonesia Green and Affordable Housing Program will increase the market for green mortgages as the supply of qualifying housing increases (PUPR 2021). The Central Bank's green mortgage incentives can help to meet this growing demand.

Financiers generally opt to invest in projects that they are more familiar with. Thus, increased awareness of green buildings among market stakeholders is needed**. To strengthen the enabling environment, governments can develop clear and supportive policies that are practical for financiers to adopt in their internal standards.** This can include green building standards, tax incentives, climate risk-adjusted return principles, and preferential treatment for green buildings in public procurement. Providing training and educational programs to lenders, investors, and project developers can enhance their understanding of green building financing and risk evaluation. This can also enable financial institutions to better assess the environmental and financial aspects of green building projects, which is critical to scale up Indonesia's green buildings loans.

4.1.3 BONDS

Table 6. Use of bonds/sukuk in Indonesia

Instrument	Description	Use in Green Buildings	Use in Other sectors
Catastrophe bonds/ Insurance pools	Risk-linked securities that transfer a specified set of risks from a sponsor to investors.	No	No
Green corporate bonds/sukuk	The green bond label signifies commitment to exclusively use the funds raised to finance or refinance "green" projects, assets, or business activities. For green sukuk, Sharia Law compliance is also assessed alongside the green criteria.	Yes	Yes

Instrument	Description	Use in Green Buildings	Use in Other sectors
Green municipal bonds/sukuk	Bonds/sukuk issued by a municipal government where proceeds will be exclusively applied to finance or refinance projects that provide clear environmental benefits – assessed and quantified by the issuer where feasible.	No	No
Green sovereign bonds/sukuk	Bonds/sukuk issued by the national government where proceeds are used to finance climate change mitigation, climate change adaptation, and environmental projects.	Yes	Yes

While catastrophe bond/insurance pools are neither regulated nor used in Indonesia, green corporate bonds and sukuk are well established and commonly applied by large commercial banks to expand their green lending portfolios.

Domestic corporate green bonds/sukuk have been issued by larger banks, but there is still a need to develop the market for smaller banks. The demand for green bonds, including for financing green buildings, may be limited compared to conventional bonds. Investors may still exhibit a preference for conventional bonds due to familiarity and perceived lower risks.

According to a green bond market survey conducted by the Asian Development Bank in 2021, most investors value green bonds from the commercial side (i.e., coupon rate), yet there is no coupon on the “green” label (ADB 2022). Additionally, given the less developed secondary green bond market in Indonesia, there is a liquidity risk if investors aim to resell before the bond maturity. In particular, there is also a lack of awareness of the benefits and potential returns associated with green building investments.

In 2018, the central government issued the world’s first sovereign green sukuk, valued at USD 1.2 billion. Green buildings finance is among the eligible uses of proceeds of this sukuk. The Ministry of Finance and the OJK have enacted regulations on municipal bonds aiming to open alternative sources of debt finance from capital markets for local governments.

However, no green municipal bonds/sukuk have been issued to date, as eligibility requirements and procedures are challenging. Local governments must achieve high fiscal capacity indicators to be eligible to issue municipal bonds/sukuk. Moreover, these instruments can only be listed on the domestic market and are not guaranteed by the central government. Therefore, municipal bonds/sukuk are only suitable for cities with strong fiscal capacity and credentials.

Additionally, local governments must have feasible project pipelines before municipal bonds/sukuk issuance as well as commitments to report the proceeds until the maturity of the bonds/sukuk. As green building certification emphasizes energy efficiency, local governments need to highlight the saving potential of selected project pipelines to capture the projected cash flow of potential savings to meet the financial feasibility criteria.

4.1.4 EQUITY

Table 7. Equity instrument usage in Indonesia

Instrument	Description	Use in green buildings	Use in other sectors
Private equity	Investment partnerships that buy and manage assets before selling them. They operate investment funds on behalf of institutional and accredited investors.	No	Yes
Public equity	Ownership of assets in the form of stock, bonds, or cash as a 'shareholding'. For building properties, it is a measure of the difference between the market value of a property minus what the owner must pay on the mortgage.	No	Yes
Crowdfunding	The practice of funding a project or venture by raising money from many people who each contribute a relatively small amount, typically via the internet.	No	Yes

Public and private equity are relatively mainstream forms of building finance, though investors and building owners have not clearly distinguished finance channeled to green versus conventional buildings. Tracking the number of green buildings financed by private and public equity is therefore challenging, limiting our ability to analyze the related market barriers and drivers. Equity instruments face some impediments as the higher upfront costs commanded by the construction of green buildings compared to conventional ones may be perceived as a barrier to investment. The resulting longer payback periods for green buildings may increase uncertainty about the market demand and value appreciation of green buildings.

We found no data indicating that crowdfunding has been used to finance green buildings in Indonesia.

4.1.5 FISCAL INSTRUMENTS

Table 8. Use of fiscal Instruments in Indonesia

Instrument	Description	Use in Green Buildings	Use in Other sectors
Capital cost subsidy	A subsidy that covers a share of the upfront capital cost of an asset (e.g., a solar water heater).	No	No
Carbon credits & markets	A mechanism to reduce GHG emissions by creating a market in which companies can trade emissions permits.	No	No

Instrument	Description	Use in Green Buildings	Use in Other sectors
Energy / carbon taxes	A type of penalty that businesses must pay for excessive energy use or GHG emissions.	No	No
Feed-in-tariff	A payment made to households or businesses generating their own electricity using methods that do not contribute to the depletion of natural resources, proportional to the amount of power generated.	No	No
Financial penalties	The obligation to pay a sum of money on conviction of a criminal or administrative offense.	No	No
Property Assessed Clean Energy (PACE) initiatives	PACE initiatives allow local governments to support building owners carrying out energy-efficiency retrofits or installing renewable energy in their properties. This entails conducting special assessments for eligibility and providing upfront funding for the improvement, which is paid back through property tax bills.	No	No
Service subsidies	Subsidies including payments, tax breaks, and other economic support to promote infant industries, secure the achievement of universal access objectives (health, education, and sanitation), and encourage sustainable production and consumption (energy and transport), as well as to respond to market failures and their potentially undesirable developmental consequences.	No	No
Tax incentives	Tax credits, rebates, reductions, and exemptions that are designed to incentivize property owners to install energy-efficient equipment, and renewable energy systems and meet green building certification standards. Tax incentives can be based on low embodied-carbon criteria such as energy efficiency building codes or green building certification standards.	No	No

None of the fiscal instruments mentioned in Table 8 are currently in use in either Indonesia's green buildings or the renewable energy sector. The lack of legal frameworks to support them means that there are many steps to be taken before they can be used to facilitate green buildings in cities.

Although Indonesia implemented feed-in-tariff regulations in 2020, the government removed the option to use these for rooftop solar systems in 2022, due to electricity oversupply from fossil-based sources and grid stability issues. Funding renewable energy development projects has been limited ever since. Maintaining policy stability to support renewable energy and energy efficiency will be challenging given the grid issues, despite the country's target to achieve a 23% renewable energy mix by 2025.

Local governments can also explore fiscal incentives such as land and building tax waivers for green buildings. Learning from existing initiatives used to promote electric vehicle adoption, such incentives could significantly increase appetites for green mortgages promoted by banks and housing developers.

Furthermore, Indonesia has not yet implemented a carbon tax or carbon market. While the legal framework for these has been established, Indonesia is still working

on institutional governance and capacity-building measures. As carbon markets and carbon taxes will be first implemented in the power generation sector, it will take time before they can be sufficiently deployed in the buildings sector, especially as regulations currently focus on green buildings rather than net zero carbon buildings.

DEVELOPMENT STRATEGIES FOR INVESTMENT

A main driver of investment appetite is regulatory certainty. Local governments should work to develop capacities and enforce green building regulatory frameworks to enhance the city-level enabling environment. City-level regulations, alongside capacity building for government officials, can help to attract finance for green buildings in forms such as debt and equity.

Regulatory adjustments: Currently, green buildings and energy-efficiency regulations only cover the national context. Subnational governments need to enact local legislation to apply current national law to their local contexts. In addition to regulations, subnational governments can deepen their green building initiatives through regional development plans, incentives, and local government budgets promoting fiscal instruments for green buildings finance.

Mapping of buildings and creating project pipelines: Local governments need to survey and map their existing public infrastructure to identify which buildings can be retrofitted as green. Eligible buildings can be categorized and added to project pipelines. To attract financiers, local governments can pool green buildings projects to widen project scopes, increase their economic scale, and reduce transaction costs.[9] As project pipelines are deepened, local governments can match projects with suitable financial instruments (e.g., loans, bonds, and grants). Finally, local governments can embed project pipelines in regional development plans when applying for loans from financial institutions, fiscal transfers from the central government, and issuing municipal bonds/sukuk.

Grants for obtaining green building certification: Local governments, facilitated by the central government, can also partner with philanthropic organizations and development agencies to provide subsidies for private building owners to work towards green building certification. This can help private sector actors to plan, implement, and evaluate green performance on their buildings, which is particularly helpful for price-sensitive enterprises like small- and medium-sized enterprises.

9 Further insights on subnational climate finance aggregation can be found at https://citiesclimatefinance.org/publications/financial-aggregation-blueprints-for-urban-climate-infrastructure.

5. CITY DEEP DIVE IN SEMARANG

This deep dive aims to estimate the city-level potential energy savings and investment costs associated with expanding green building regulations to other Indonesian cities.

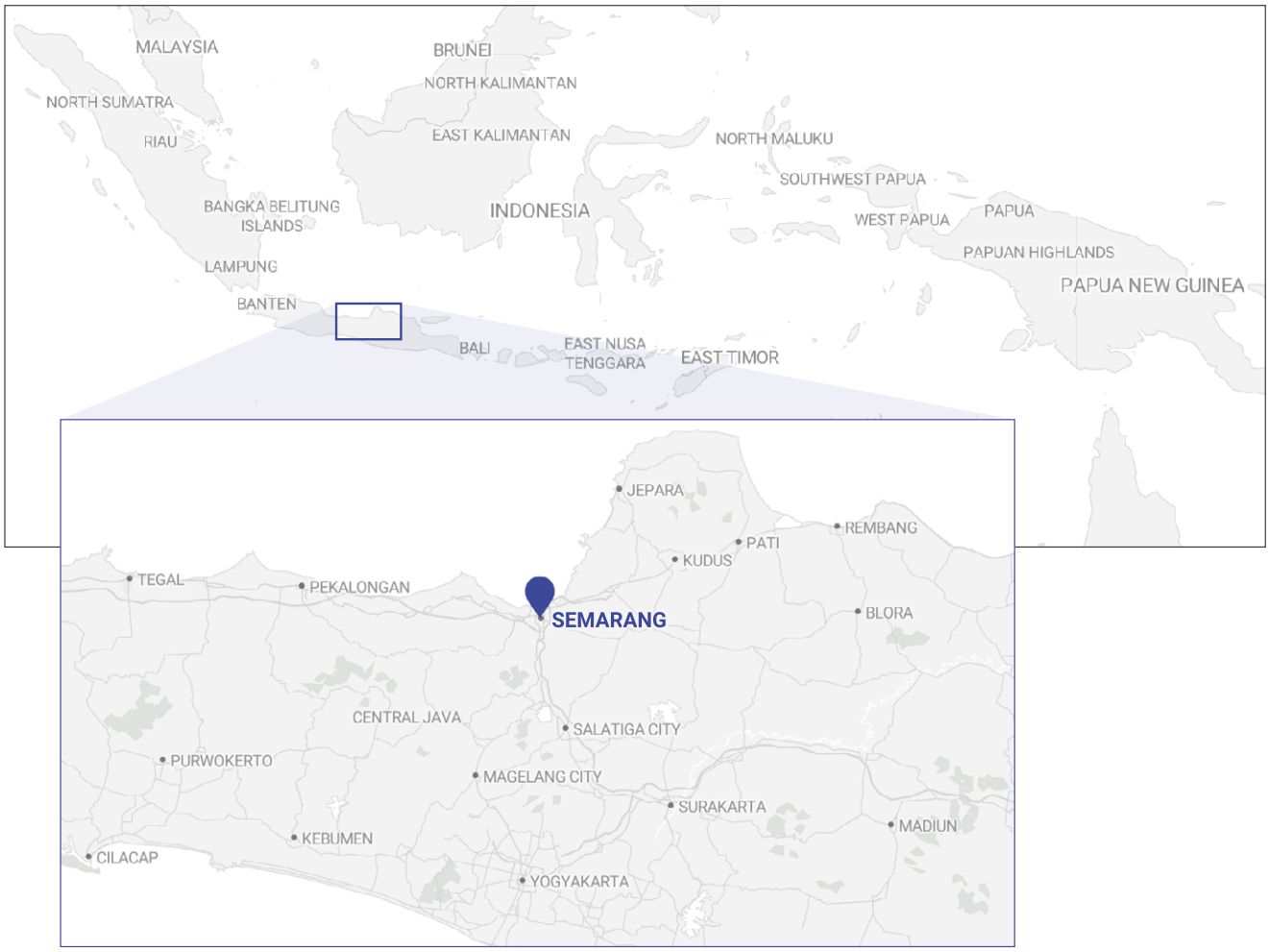
CCFLA commissioned a team of consultants to study the energy consumption patterns of buildings in Semarang to estimate the potential energy savings from the implementation of the green building regulations, with a focus on cooling. This work included collecting data from a representative sample of buildings, estimating energy efficiency improvements from implementing green building regulations for mandatory and recommended buildings, and projecting future investment costs.

Estimations of energy savings and future projections can help investors assess the financial feasibility of green building projects, making it easier to secure funding. These projections also influence policies and financial instruments, allowing governments to design incentives that encourage sustainable construction. Ultimately, they can bridge the gap between the financial needs of green building initiatives and the policies and financing mechanisms that support them.

Semarang, in Central Java (see Figure 3), is one of the ten most populous cities in Indonesia, with a population of 1.7 million. A major port during the 17th century, it is a preserved colonial city with a mixed stock of old and new buildings that is now undergoing rapid development. Green building standards will therefore have to account for retrofits of existing buildings as well as the construction of new ones.

Semarang is representative of other big cities in Indonesia as it mostly consists of low- and mid-rise buildings, similar to Bandung, Bali, Surabaya, Padang, and Medan. Semarang's average air temperature is 26.5°C to 28.9°C, with relative humidity of 70% to 92%. Most Indonesians live in a similar climate, with average daily temperatures exceeding 25°C; even when temperatures are lower, high humidity levels increase perceived temperatures, creating cooling needs.

Figure 3. Location of Semarang city



Semarang was recognized as the most sustainable city in Indonesia in 2022 by the University of Indonesia Green City Metrics. Semarang's 2019 city-level green building code made it one of only six subnational governments in Indonesia to have enacted local green building regulations before national ones were established in 2021.[10] This provides an interesting opportunity to study the potential benefits and costs of decarbonizing buildings in a real-world context.

5.1 ASSESSMENT METHODOLOGY

The assessment included two main activities: (1) mapping and determining green building investment needs for public and private sectors in Semarang, and (2) projection of the financial impacts of the green buildings scenarios into the future, using Semarang's 2045 Master Plan.

The mapping consisted of desk research and a field survey of buildings' energy consumption. Building stock data was obtained from the municipal government.[11]

10 The others are Jakarta, Bandung, Bali, Pariaman, and Gorontalo.
11 Available at: data.semarangkota.go.id

We also conducted field surveys to collect basic information including on building function; year of establishment; energy systems; cooling systems; lighting; heating, ventilation, and AC systems; electrical appliances; and electrical bills.

Semarang's building stock is mostly residential (78%), which is not subject to mandatory green buildings regulations. Our assessment covered only those building classes mandated to comply with green building regulations, as shown in Table 2. This included four types of buildings, which represented just 2% of Semarang's total building stock. See Annex 4 for more details on Semarang's building stock.

The analysis considered two different types of energy-efficiency improvements that could satisfy the green building regulations, to determine the energy-efficiency improvements possible: (i) Building Material Retrofit (BMR), (ii) Improved AC, and (iii) a combination of BMR and improved AC. Scenarios were modeled using EnergyPlus software to simulate the energy consumption under different conditions and compared with a baseline scenario. See Box 5 for an outline of the scenarios and Annex 4 for further details.

Box 5. Energy efficiency improvements considered for simulation

Building Material Retrofit (BMR) aims to minimize heat transfer between the environment and a building's interior. Wall and window surfaces typically dominate building envelopes. Poorly insulated walls and windows allow for a high rate of heat transfer from the outside requiring AC systems to consume more energy to maintain a comfortable temperature. Retrofitting walls and windows with better insulating materials such as rock wool and low emissivity glass can reduce air exchange, thereby reducing cooling energy consumption.

Improved AC Coefficient of Performance (COP) allows AC systems to produce the same amount of cooling using less electricity. COP represents the ratio of cooling output to energy input, a primary measure of AC energy efficiency. Although higher-COP AC units may have higher capital costs, energy savings over time can often offset the initial investment. Shopping malls use centralized AC systems, for which the highest available COP is 6.3, while all other building classifications mostly use split AC systems, for which the highest available COP is 5.7.

5.2 POTENTIAL ENERGY EFFICIENCY IMPROVEMENTS IN SEMARANG

The simulation results provide indicative findings for the energy efficiency improvements from implementing green cooling interventions. The results show a range of potential energy reductions for cooling and how they translate into overall energy reductions. Combining multiple interventions (through BMR and improved AC COP) can lead to energy-efficiency gains.

Table 9. Potential energy-efficiency improvements in Semarang

Scenario	Scenario Detail	Cooling Energy Consumption Reduction (range depending on building type)	Estimated Total Energy Reduction (range depending on building type)
BMR	Improved building envelope by installing insulating materials	3-13%	2-8%
Improved AC COP: Simulated four different COPs available on the Indonesian market. The baseline COP on the market is 3.0 for centralized AC and 3.45 for split AC.	COP 4.0	12 – 14%	6 – 9%
	COP 4.5	18 – 19%	9 – 12%
	COP 5.0	23 – 27%	14 – 17%
	COP 5.7	30% (results are the same for all building types)	16 – 19%
Combined (BMR + High COP)	BMR + COP 5.7 for split AC and 6.3 for centralized AC	32-44%	21-27%

Assuming that no significant air gaps are found in the building envelope, the BMR scenario alone does not bring significant energy savings for cooling.[12] For improved AC COP and combined scenarios, ranges of energy savings depend on several factors such as building type and type of AC system installed (centralized vs. split).

Under the combined BMR and high-COP scenario, energy savings from cooling ranged from 32% (for commercial malls with centralized AC systems) to 44% (for apartments, offices, and public building using split AC systems). This means that combining BMR and updating the AC systems with the highest COP in the market could bring dramatic savings in energy consumption, although building type matters. For example, the thermal mass effect in large commercial buildings (e.g., shopping malls) increases cooling demand and increases the potential for energy savings.

This integrated approach demonstrates the potential to reduce operational costs, helping to make green building projects more attractive to investors and lenders due to the demonstrable energy savings and potential for higher property values. Dedicated financial instruments are needed to support the various efficiency measures in combination since isolated technical solutions might not be cost effective.

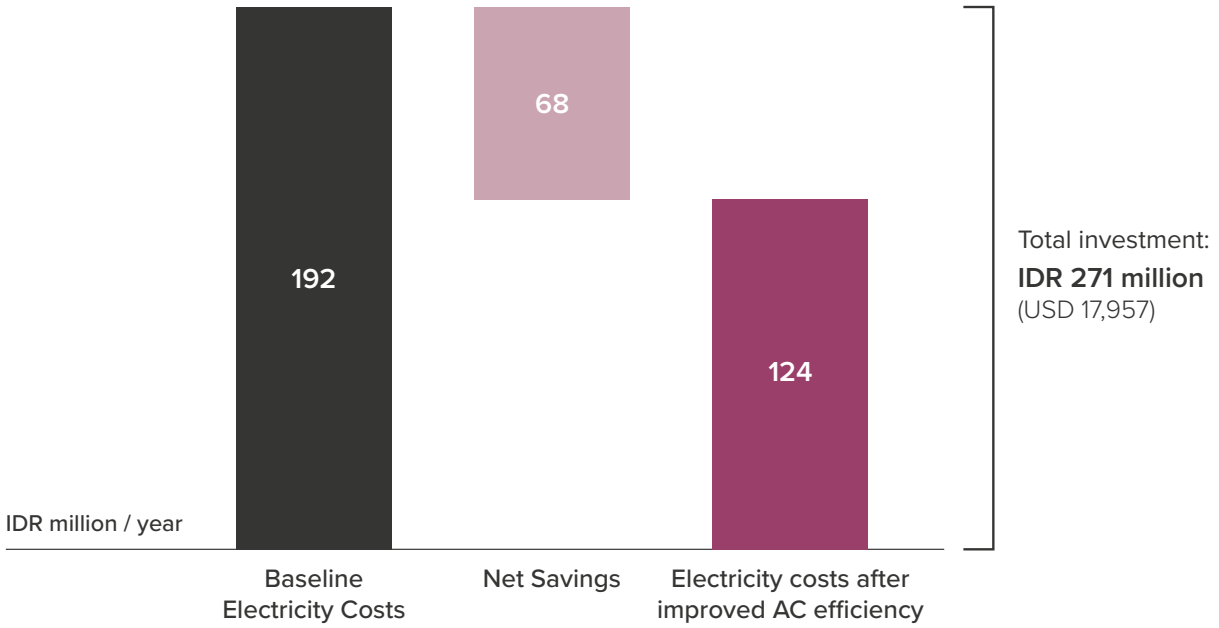
12 This simulation does not include passive cooling, which also results in energy savings. The BMR scenario is not effective for certain types of buildings, such as shopping malls, due to smaller window areas and high volume of thermal mass inside. However, even a modest reduction in cooling demand for a large building like a mall can produce significant cost savings.

5.3 ANNUAL ELECTRICITY SAVINGS

Translating the above energy-efficiency improvements into cost savings on electricity bills reveals the potential payback periods for green buildings. Using the combined BMR with the highest COP scenario, we project energy savings of USD 3.19 million (IDR 50.56 billion) per year for mixed-use residential buildings, office buildings, and public buildings combined.

Energy savings can reduce the payback period significantly for green buildings. The potential energy consumption savings from improving the AC systems in a sample public building are presented in Figure 4. The simulated electricity bill savings would reach USD 4,506 (IDR 68 million) annually, reducing the average electricity bill from USD 12,723 (IDR 192 million) to USD 8,217 (IDR 124 million) – a saving of 35%. Assuming that the total investment required to implement more efficient cooling is USD 17,957 (IDR 271 million), this will create a payback period of four years.

Figure 4. Simulation of annual savings on electricity costs for cooling in a public building



5.4 INVESTMENT NEEDS ESTIMATION FOR SEMARANG

The total investment needed to ensure energy-efficient BMR and ACs for new buildings can be estimated based on the projections of future floor area and by taking the unit cost of construction per unit of floor area from the Mayor Regulation No. 53/2021 concerning Standardization of Unit Prices for Building Materials, Wages and Job Analysis for the Development of Semarang for Fiscal Year 2022.

However, commercial buildings often use non-standard, upscale designs, and less common materials than apartment, office, and public buildings. This makes it difficult to accurately predict the investment requirements for commercial buildings to account for unique design choices.

Figure 5. Unit cost of construction for conventional and green buildings

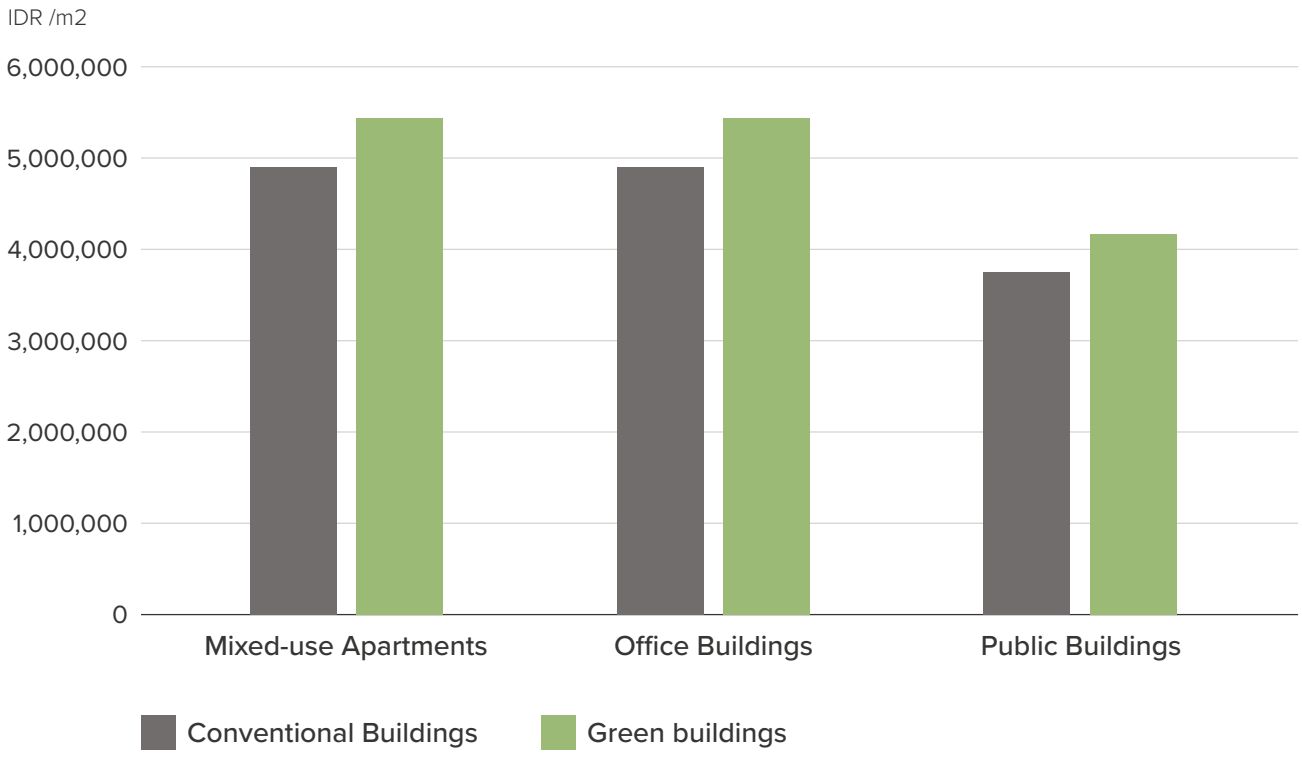
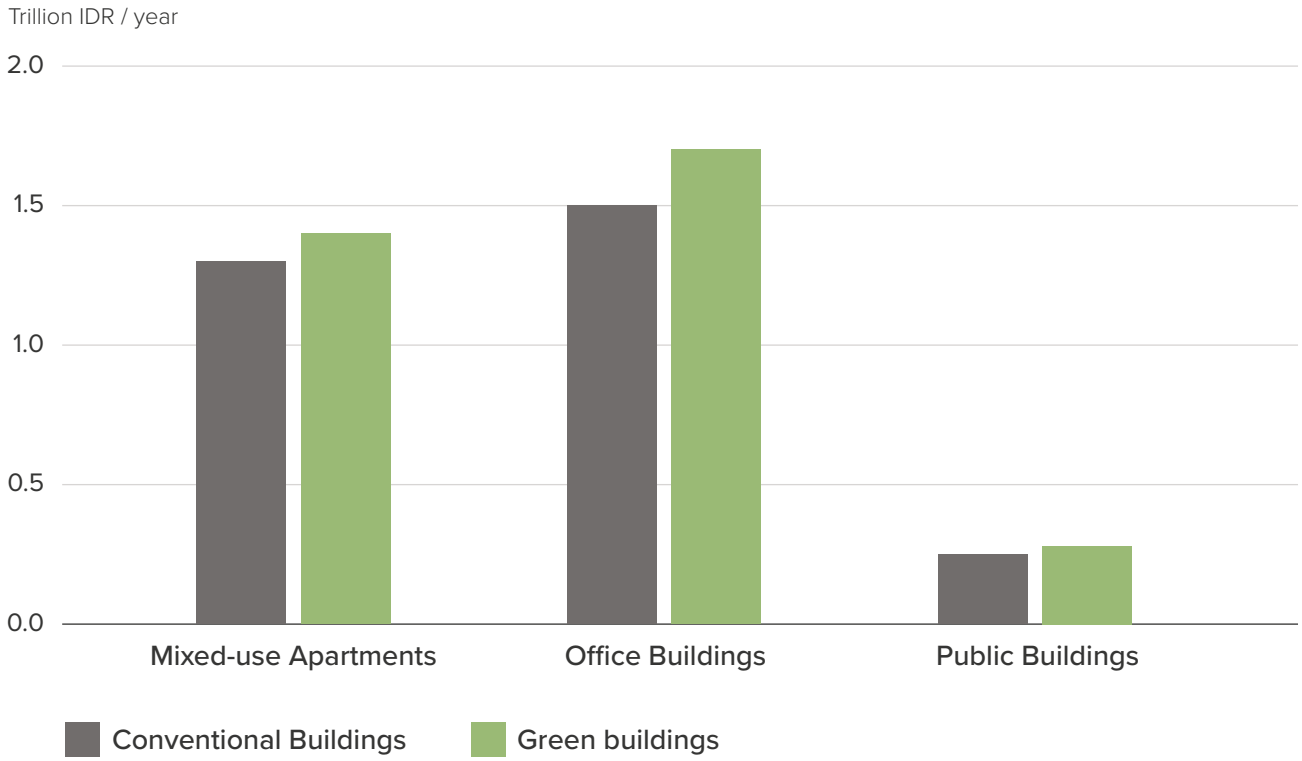


Figure 6. Total investment needed for new buildings in Semarang



The unit cost of construction of a conventional building per square meter for each building class is calculated based on the highest standard unit price provided by the Central Java Public Works Department. Apartment and office buildings have a construction cost of USD 325 (IDR 4.9 million)[13] per square meter, while public buildings cost USD 248 (IDR 3.75 million) per square meter.

Interviews with the contractors of the MPWH, found that green buildings are estimated to have an 11% higher cost than conventional buildings, at USD 360 (IDR 5.44 million) per square meter for private buildings, while public green buildings cost USD 276 (IDR 4,16 million) per square meter. This is similar to estimates from Green Building Council of Indonesia that placed the cost of investment for new green buildings at 10-15% higher than conventional buildings.

Based on the unit cost of construction, it can be estimated that the total investment needed for the construction of new conventional apartment buildings from 2021 to 2031 is USD 86.1 million (IDR 1.3 trillion), office buildings USD 99.4 million (IDR1.5 trillion) and public buildings USD 16.4 million (IDR 248 billion). Meanwhile, the total investment in new green buildings for these buildings is USD 92.8 million (IDR 1.4 trillion), USD 112.6 million (IDR 1.7 trillion), and USD 18.3 million (IDR 276 billion), respectively. **This means that the total investment needed over 10 years for most of the mandatory green buildings in Semarang is USD 223.7 million (IDR 3.38 trillion).**

13 All conversions in this report have been done using Central Bank of Indonesia's average conversion rate from January to August 2023, where 1 USD = IDR 15,091, www.bi.go.id

6. CONCLUSION AND RECOMMENDATIONS

The buildings sector is vital to lowering emissions in Indonesia. Adequate regulations, supported by fitting financial instruments will spur the country's path towards sustainability for the sector. Below are the main conclusions from this report as well as other key findings on regulatory and financing gaps in this sector.

1. Current green building regulations are not mandatory for residential buildings, which take the highest portion of floor area both nationally (78%) and within cities (89% in Semarang). This points to an opportunity to promote green buildings through increased regulation.
2. Subnational implementation of these regulations is also lacking; only six subnational governments have adopted national building codes in local legislation. In addition, existing local regulations require updating to derive from the new national regulation.
3. The new national regulation on energy conservation (GR 33/2023) requires more buildings to implement energy management by lowering the energy consumption bar from 6,000 TOE to 500 TOE for the buildings sector compared to the preceding regulation.
4. Financial regulations supporting sustainability activities already exist, but there are limited dedicated instruments to finance green buildings. None of the fiscal instruments identified in the CCFLA taxonomy have been implemented yet in Indonesia.
5. Cooling is the highest energy consumption factor in buildings in Indonesia. Installing more efficient ACs can save significantly on electricity bills, while using building materials can reduce heat gain, thus enabling cooling systems to become even more efficient.
6. New green buildings have 10-15% higher upfront costs than conventional ones. However, our case study in Semarang indicates that the operational costs are 32-44% lower, bringing significant savings from electricity bills and making green building investment more cost-efficient in the long run.
7. It is possible to estimate future investment needs to meet green building requirements for new buildings, but not for retrofitting of existing properties, as the conditions of such buildings need to be assessed case-by-case. Moreover, retrofitting often uses the ESCO business model, under which building owners prioritize revenue generation over savings.

6.1 RECOMMENDATIONS

Central and local governments are key actors in green buildings finance mobilization. They can help to create enabling environments in their regions to develop green buildings at scale through the following actions:

1. Supporting financial institutions and project developers through capacity building and other measures to explore innovative financing instruments for the construction and retrofit of green buildings in Indonesia. This can include efforts to raise awareness among financial institutions of opportunities for energy-saving financial instruments.
2. Developing fiscal instruments to enhance the attractiveness of investing in green buildings through energy and cost savings. Government incentives or credit enhancements provided to financial institutions can help spur innovation in this space. The government can also facilitate exchange between financial institutions, project developers, and building owners.
3. Expanding regulations to the residential building class and including mandatory requirements, considering that the residential sector accounts for 83% of the total energy demand from buildings.
4. Adapting and enforcing green building regulations at the city and province level in order to advance the implementation of national regulations and accelerate the growth of this sector in cities.
5. Increasing ambition on enforcement to achieve net zero carbon emissions in the built sector, with the addition of renewable energy to help the building sector move towards net zero carbon buildings and thus align with the national goal of reaching net zero by 2060 or sooner.

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ANNEXES

ANNEX 1. CCFLA WORK ON NET ZERO CARBON BUILDINGS TAXONOMY OF FINANCIAL INSTRUMENTS

The current report is part of CCFLA's net zero carbon buildings workstream. This started in 2022, with a scoping paper laying out a structured approach to analyzing the challenges and priorities relevant to cities in decarbonizing the built sector. This built in-house and member knowledge and guided subsequent CCFLA work.

CCFLA has since published: Net Zero Carbon Buildings in Cities: Interdependencies between Policy and Finance as well as a deep dive into green buildings in Nigeria, both in 2023.

This work aims to bridge the theory-to-practice gap using network analysis to reflect the interdependency between policy and financing instruments, and barriers to implementation. Understanding such relations allows policymakers and other stakeholders to identify what levers cities can more effectively use to support the sector's transition.

Table A1 below outlines CCFLA's taxonomy of financial instruments to support net zero buildings, and Table A2 outlines policy instruments.

Table A1. Summary of the CCFLA Taxonomy financial instruments for net zero carbon buildings global study with 75 instruments taxonomy

Instrument	Instrument Category	Description
Result-based grants	Grants	Intervention that provides rewards to individuals or institutions after agreed-upon results are achieved and verified. It helps to shift the focus towards outcomes and aims to strengthen ownership and provide incentives to perform. Results-based funded programs serve to accelerate the pace of existing programs are often add-ons to other programs and can include or be implemented in complementarity to additional capacity-building activities or technical assistance.
Technical assistance grants	Grants	A technical assistance grant helps communities participate in Superfund cleanup decision-making. It provides funding to community groups to contract their own technical advisor to interpret and explain technical reports, site conditions, and Environmental Protection Agencies proposed cleanup proposals and decisions.

Instrument	Instrument Category	Description
Concessional loans	Debt Financing	A loan made on more favorable terms than the borrower could obtain in the marketplace. The concessional terms may be one or more of the following: a lower interest rate below (the most common) deferred repayments. income-contingent repayments.
Credit lines	Debt Financing	A line of credit is a flexible loan from a financial institution that consists of a defined amount of money that you can access as needed and repay either immediately or over time.
Market-rate debt	Debt Financing	The Market Value of Debt refers to the market price investors would be willing to buy a company's debt for, which differs from the book value on the balance sheet.
Results-based loans	Debt Financing	An umbrella term referring to any program or intervention that provides rewards to individuals or institutions after agreed-upon results are achieved and verified. Development agencies have started using results-based financing as a tool to improve the effectiveness of their aid to developing countries.
Revolving funds	Debt Financing	A fund that is continually replenished as withdrawals are made.
Syndicated loans	Debt Financing	Syndicated loans are provided by a group of lenders and structured, arranged, and administered by one or several commercial banks or investment banks known as lead arrangers.
Green mortgage	Debt Financing	A mortgage specifically targeted at green buildings. As an incentive for the borrower to either buy a green building or renovate an existing one to make it greener, the bank would offer them either a lower interest rate or an increased loan amount.
Catastrophe bond / Insurance pool	Debt Bonds	Risk-linked securities that transfer a specified set of risks from a sponsor to investors.
Green corporate / obligation bond	Debt Bonds	A green bond is differentiated from a regular bond by this label, which signifies a commitment to exclusively use the funds raised to finance or refinance "green" projects, assets, or business activities.
Green project / municipal bond	Debt Bonds	Any type of bond instrument where the proceeds will be exclusively applied to finance or refinance in part or in full new and/or existing eligible projects that provide clear environmental benefits - assessed and quantified by the issuer where feasible.
Green Sukuk	Debt Bonds	The "Green" label means that sukuk is compliant with green bond standards (also called principles and framework). Proceeds of green bonds are used to finance climate change mitigation, climate change adaptation, and environmental projects.
Crowdfunding	Equity	The practice of funding a project or venture by raising money from many people who each contribute a relatively small amount, typically via the internet.

Instrument	Instrument Category	Description
Private equity	Equity	Investment partnerships that buy and manage assets before selling them. They operate investment funds on behalf of institutional and accredited investors.
Public equity	Equity	Ownership of assets in the form of stock, bonds, or cash as a 'shareholding'. For building properties, it is a measure of the difference between the market value of a property minus what the owner must pay on the mortgage.
Aggregation platforms	Structured Finance	Platform for a group of companies or local institutions to partner together to buy energy from a single developer, or multiple developers, at smaller volumes while retaining the economic advantages of a high-volume purchase.
Land banking / land readjustment	Structured Finance	Land readjustment is an effective tool in allowing local governments to take on regeneration projects through increased land values while engaging and involving the original residents and landowners as stakeholders.
Pooled procurement for green financial products or buildings	Structured Finance	Pooled procurement cooperatively combines the financial and other resources of purchasing authorities to improve efficiency and create greater purchasing power for green financial products or buildings.
Securitization / Asset-backed securities (ABS)	Structured Finance	An ABS is a type of financial investment that is collateralized by an underlying pool of assets—usually ones that generate a cash flow from debt, such as loans, leases, credit card balances, or receivables.
Capital cost subsidy	Fiscal Instruments	A subsidy that covers a share of the upfront capital cost of an asset (for example, a solar water heater).
Carbon credits & markets	Fiscal Instruments	A mechanism to reduce GHG emissions by creating a market in which companies can trade in emissions permits.
Energy / carbon taxes	Fiscal Instruments	A carbon tax is a type of penalty that businesses must pay for excessive GHG emissions.
Feed-in-tariff	Fiscal Instruments	A payment made to households or businesses generating their own electricity using methods that do not contribute to the depletion of natural resources, proportional to the amount of power generated.
Financial penalties	Fiscal Instruments	The obligation to pay a sum of money on conviction of a criminal or administrative offense.
Property Assessed Clean Energy (PACE)	Fiscal Instruments	PACE initiatives allow local governments to support building owners carrying out energy-efficiency retrofits or installing renewable energy in their properties. This entails conducting special assessments for eligibility and providing upfront funding for the improvement, which is paid back through property tax bills.

Instrument	Instrument Category	Description
Service subsidy	Fiscal Instruments	Service subsidies include payments, tax breaks, or other forms of economic support given to individuals and industries. This subsidy is designed to promote infant industries, secure the achievement of universal access objectives (health, education, and sanitation), and encourage more sustainable patterns of production and consumption (energy and transport) as well as the need to respond to market failures and their potentially undesirable social and developmental consequences.
Tax incentives	Fiscal Instruments	Tax incentives (credits, rebates, reductions, exemptions) are designed to offer financial incentives to property owners to install energy-saving equipment, and renewable energy systems and meet green building certification standards. Tax incentives can be based on specific low embodied-carbon criteria such as energy efficiency building codes or green building certification standards.
Tax or fee-based land-value capture (LVC)	Fiscal Instruments	The value of privately held land often increases due to public investments in the area. LVC methods usually seek to harness a portion of these unearned rents to help finance public infrastructure or improvement projects. Betterment taxes can be implemented to levy tax on total land value or on the incremental value in the neighborhood of the public investment.
Collaterals	Risk Mitigation	Pledge to offer security for a loan repayment or credit line. (Energy collateral is the money grid operators require energy suppliers to post in order to actively supply electricity or natural gas to customers on that grid).
Currency exchange funds (TCX)	Risk Mitigation	A Currency Exchange Fund is designed to mitigate currency and interest rate risks to attract and lock in long-term private equity and private debt in local currency. TCX acts as an intermediary between borrowers and investors by giving borrowers in developing and emerging countries access to long-term financing in their own currencies and risk management products that help manage exchange rate risks thereby reducing the market risk associated with currency mismatches.
Full or partial credit guarantees	Risk Mitigation	Guarantees are credit-enhancement tools that can provide investors with the ability to leverage more capital to address social and environmental challenges. Credit guarantees could come in the form of a partial guarantee where a third party covers a part or percentage of a loss/default or a full guarantee where a third party covers the entire amount of the loss/default.
Risk insurance products	Risk Mitigation	Risk insurance refers to the risk or chance of occurrence of something harmful or unexpected that might include loss or damage of valuable assets.
Development-based land-value capture (LVC)	Asset Finance Models	LVC mechanisms seek to absorb increases in the value of private land due to public infrastructure projects to fund those projects [for more general information on LVC see the instrument card *tax or fee-based LVC*]. Development-based LVC mechanisms differ from tax-based in that cities do not levy taxes on land value increments.

Instrument	Instrument Category	Description
Hybrid models of build / purchase / operate / transfer and lease of assets	Asset Finance Models	A project funding model based on a financial agreement between a private contractor and a public organization.
Low-carbon/ efficient equipment capital lease finance	Asset Finance Models	A simple financing structure that allows a customer to use energy efficiency, renewable energy, or other generation equipment without purchasing it outright.
Low-carbon/ efficient equipment operating lease finance	Asset Finance Models	A contract that permits the use of an energy-efficient asset without transferring the ownership rights of said asset.
As-a-service models	Other Innovative Instruments	Customers pay for an energy service without having to make any upfront capital investment.
Energy performance contracts (EPC) and ESCOs	Other Innovative Instruments	EPCs are innovative financing schemes offered by contractor energy service companies (usually ESCOs) to clients (e.g., a municipality), who need energy-efficiency improvements but have limited financial means or technical capacities to implement such projects on their own.
Energy service agreements (ESA)	Other Innovative Instruments	An ESA is a pay-for-performance, off-balance sheet financing solution that allows customers to implement energy-efficiency projects with zero upfront capital expenditure.
On-bill financing (OBF) & repayment (OBR)	Other Innovative Instruments	A method of financing energy-efficiency improvements through a customer's utility bill. The customer receives an upfront loan to make energy efficiency or renewable energy improvements to his or her property, then repays that loan through a surcharge on his or her utility bill.
Pay-as-you-save (PAYS)	Other Innovative Instruments	Enables building owners or tenants to purchase and install money-saving resource-efficient measures with no upfront payment and no debt obligation.
Payment for ecosystem services (PES)	Other Innovative Instruments	PES policies compensate individuals or communities for undertaking actions that increase the provision of ecosystem services such as water purification, flood mitigation, or carbon sequestration.
Power purchase agreements for clean energy	Other Innovative Instruments	A power purchase agreement is a long-term contract under which a business agrees to purchase electricity directly from a renewable energy generator.

Table A2. Summary of the CCFLA Taxonomy policy instruments for net zero carbon buildings

Instrument	Instrument Category	Description
Mandatory construction waste landfill diversion	Mandates: Standards and Codes: Process	Waste diversion is the process of diverting waste from the landfill. In order to divert waste, all construction materials are separated by type and disposed accordingly. Materials that are recyclable are separated from materials that are not recyclable.
Mandatory pre-demolition audits and landfill diversion	Mandates: Standards and Codes: Process	A pre-demolition audit is an inventory of materials and components arising from future demolition or renovation projects and their management and recovery options.
Net zero carbon construction site	Mandates: Standards and Codes: Process	A construction site with net zero carbon building protocols for highly energy efficient construction powered from on-site and/ or off-site renewable energy sources, with any remaining carbon balance offset.
Audit, tune-ups, and retro-commissioning	Mandates: Standards and Codes: Buildings	Assessment of the current state of building's energy system to help owners identify specific strategies and investments that can improve the energy performance of their buildings.
Building energy performance standards	Mandates: Standards and Codes: Buildings	Policies that establish performance levels for buildings and drive all buildings that BEPS covers to achieve these levels in the long-term with required progress at regular intervals in the interim.
Embodied carbon building codes	Mandates: Standards and Codes: Buildings	Embodied carbon building code is aimed at quantifying, evaluating, and achieving practical reductions in climate impact by selecting lower embodied carbon materials. According to International Energy Agency, embodied carbons contribute to 11% of the global emission, and as urbanization increases embodied carbon from new buildings, renovations, and infrastructure until 2060 may exceed 230 gigatons.
Energy efficient building codes	Mandates: Standards and Codes: Buildings	Energy codes are a subset of building codes, which establish baseline requirements and govern building construction.
Hazard specific building code amendments	Mandates: Standards and Codes: Buildings	Design and construction requirements to ensure safe and resilient structures.
Mandatory material take-back program	Mandates: Standards and Codes: Buildings	A mandatory material take-back program looks to increase material reuse by forcing suppliers to take back unused construction materials. This has a significant benefit over policies such as landfill diversion, as take-back materials require much less processing compared to recycled products to be given new use, and often characterizes a large portion of construction waste.

Instrument	Instrument Category	Description
Require RE generation or off-site purchase	Mandates: Standards and Codes: Buildings	Renewable energy generation/purchasing requirements seek to encourage greater use of renewable energy sources by requiring buildings to comply with a minimum percentage of renewable energy in its energy mix. This can be achieved either by energy generation on-site, via solar panels or wind turbines, or off-site through energy providers.
Risk informed spatial plans, land use plans, and zoning	Mandates: Standards and Codes: Buildings	Cities can change zoning regulations or planning requirements to incorporate physical risk factors. Changes in zoning regulations could work in tandem with amending building codes to reflect hazards.
Advanced metering infrastructure (AMI)	Mandates: Standards and Codes: Components	An integrated system of equipment, communications, and information management systems for utilities to remotely collect customer energy usage data in real time.
Minimum energy performance standards	Mandates: Standards and Codes: Components	A specification, containing several performance requirements for an energy-using device, that effectively limits the maximum amount of energy that may be consumed by a product in performing a specified task.
Phase out fossil fuel-based appliances and equipment	Mandates: Standards and Codes: Components	Replacing fossil fuels with sustainable energy sources in sectors such as transport and heating.
Prohibiting extremely high emitting materials	Mandates: Standards and Codes: Components	Setting a near-zero-emission requirement for the production and use of certain products.
Benchmarking and labels for equipment	Mandates: Informational	A marker used to discover what is the best performance being achieved in terms of energy efficiency for equipment.
Benchmarking and labels for whole building	Mandates: Informational	A marker used to discover what is the best performance being achieved in terms of energy efficiency for a whole building.
Building passports	Mandates: Informational	A building passport is a digital or physical record of information about a building, including basic characteristics, construction materials, systems, energy use, renovations, and other building information. A building passport makes the information needed by building owners and users to track and maintain building performance available in a centralized location.
Construction materials efficiency declaration	Mandates: Informational	Declaration for efficient use of energy, natural resources, and materials to use construction materials with less impact on the environment and natural resources.
Lifecycle carbon calculation and reporting	Mandates: Informational	A total product carbon footprint is a measure of the direct and indirect GHG emissions associated with all activities in the product's life.

Instrument	Instrument Category	Description
Risk disclosure requirements	Mandates: Informational	Requirements to disclose “material” risks, those to which reasonable investors would attach importance in making investment or voting decisions.
Awards and publicity	Non-Financial Incentives	Act or device designed to attract public service to gain public attention and support.
Density bonus for carbon efficiency	Non-Financial Incentives	In cities that have limits on how large a building can be on a certain plot of land, a density bonus for carbon efficiency allows developers to increase the size of their planned building if they reduce the embodied carbon in construction.
Expedited permitting	Non-Financial Incentives	Expedited license means a full and unrestricted medical license granted by a member state to an eligible physician through the process set forth in the compact.
Zoning use exemptions	Non-Financial Incentives	Zoning use exemptions provide a non-financial incentive to investors and project developers by proving special zoning exemptions to projects which include carbon mitigation or resilience solutions in their building design.
Ensure compliance through comprehensive enforcement	Capacity Development	State of being in accordance with established guidelines or specifications, or the process of becoming so.
Promote pilot projects	Capacity Development	Pilot projects work by taking cutting edge technology or practices and incorporating them into a real development project to showcase their success. Sometimes pilot projects are differentiated from demonstration projects. Pilot projects focus on testing new technologies whereas demonstration projects focus on engaging stakeholders to demonstrate these technologies.
Provide information on design and construction best practice	Capacity Development	Adoption of policy, self-assessment and/or benchmarking for design and construction best practices for net zero buildings.
Publish hazard and risk open data	Capacity Development	Publishing data on hazard and risk that can be freely used, re-used, and redistributed by anyone.
Soil and materials coordination for mass storage and reuse	Capacity Development	Cities can help coordinate mass transit of soil and other materials from sites to storage locations. They can also provide land for storage sites of materials and keep inventories of soils and materials and forecast supply and demand.
Workforce training	Capacity Development	Postsecondary activities (seminar, workshop, course, customized training, etc.) that develop or enhance the skills of existing employees or members of any business or industry.

ANNEX 2. NATIONAL POLICY AND REGULATION IN INDONESIA ON ENERGY AND ENERGY EFFICIENCY

Table A3. Summary of national government policy and regulation in Indonesia related to energy

Law/Policy, year	Key Aspects of Energy and Energy Efficiency
Energy Law (Law 30/2007)	Law 30/2007 on Energy is the overarching regulation on energy and governs general principles for the management of energy resources and the basic targets for future development of the energy mix. This law stresses the importance of sustainable development, environmental preservation, and energy resilience in national energy management; it sets the foundation for regulations on the development of renewable energy and energy conservation. According to the Energy Law, energy conservation is a systematic, planned, and integrated effort to conserve domestic energy resources and improve the efficiency of energy resource utilization. The mandate aims to carry out energy conservation at all stages of the supply chain, including the sectors of energy distribution, production, consumption, and technology and conservation measures. Currently, a New and Renewable Energy Bill is being drafted by the House of Representatives and the draft is expected to include ambitious measures to reach net zero by 2060 or sooner and to achieve Indonesia's Nationally Determined Contribution.

Law/Policy, year	Key Aspects of Energy and Energy Efficiency
Energy Conservation Regulation (GR 33/2023)	**GR 33/2023 has recently been enacted to replace GR 70/2009 on Energy Conservation.** While GR 70/2009 puts a generic threshold on energy consumption limit (without sectoral classification), GR 33/2023 divides the threshold according to different types of sectors including industrial, transportation, and buildings. This regulation mandates buildings that exceed 500 TOE of energy consumption per year shall implement energy conservation through energy management. Meanwhile, buildings that consume energy less than 500 TOE can voluntarily conduct energy management. All public buildings owned by central and local government are required to conduct energy management regardless of their energy consumption level. However, ministerial-level regulation that governs the technical implementation has not been issued yet. Furthermore, GR 33/2023 also governs investment-standard energy audits and ESCOs, a new addition since GR 70/2009. There are seven key aspects of GR 33/2023: **Energy Management:** mandates and recommendations to implement energy management systems to identify, measure, and control energy consumption. **Standards on Energy Performance and Energy-Saving Label:** to assist energy consumers in selecting products with energy-efficiency benefits through standardized products and services. **Energy Conservation Financing:** to stimulate investment and implementation of energy-efficiency projects through interesting financing schemes. **Energy Conservation Services Business Development:** The government supports the energy conservation sector to constantly develop expertise and services in the private sector. **Capacity Building:** education and training programs for energy conservation professionals. **Research and Innovation:** the government will support R&D to create innovative solutions for energy conservation. **Partnerships on energy conservation:** knowledge, experience, and resources exchanges to facilitate collaboration across different stakeholders.
Energy Management, Regulation (MEMRR 14/2012)	MEMR Regulation (Permen ESDM) No. 14/2012 on Energy Management, derived from the old energy conservation regulation (GR 70/2009), requires those who consume more than 6,000 TOE per year to implement energy management measures. This includes the appointment of an energy manager, developing short-, medium-, and long-term energy conservation programs, conducting regular energy audits, and implementing recommendations from energy audits. The MEMR regulation only governs technical aspects of energy management in the national context. As the regulation of energy conservation has changed in June 2023, this regulation on energy management is expected to change accordingly.

Law/Policy, year	Key Aspects of Energy and Energy Efficiency
The Application of Minimum Energy Performance Standards (MEPS) for Energy Consuming Appliances and Equipment (MEMRR 14/2021)	MEMR Regulation (Permen ESDM) No.14/2021 is a technical regulation for the Application of MEPS for Energy Consuming Appliances and Equipment. Under this regulation, several MEMR Decrees were derived to regulate MEPS and labeling for appliances such as AC (MEMR Decision No.07/2015, No.57/2017, No. 103/2021), Fans (MEMR Decision No. 114/2021), Refrigerators (MEMR Decision No. 113/2021). MEMR Regulation only governs Energy Management in the national context. Similar to the latest Energy Management Regulation (MEMR Regulation 14/2012), we also expect changes as the new energy conservation regulation comes into force.

Table A4. Summary of national government policy and regulation in Indonesia related to green buildings

Law/Policy, Year	Key Aspects of Buildings and Green Buildings
Buildings Regulation **(GR 16/2021)**	**GR 16/2021 on Buildings is currently the overarching regulation on buildings, with a specific section on green buildings.** Under GR 16/2021, new and existing buildings of certain classes and floor areas must implement green building measures in order to obtain a building permit (*Persetujuan Bangunan Gedung*), which replaced the former building permit (*Izin Mendirikan Bangunan*). The mandatory building classes include mixed-use residential buildings, office buildings, commercial buildings, storage buildings, laboratory/industrial/factory buildings, public healthcare buildings, public halls, and convention buildings. Only residential buildings do not need to meet mandatory standards but are recommended. With this new regulation, the former GR 36/2005 is canceled, however, as stated in the closing provisions, implementing regulations derived from the former GR can still be valid as long as it does not contradict or is not yet replaced with a new regulation under the new GR.
Performance Assessment of Green Buildings Regulation (MPWHR 21/2021)	MPWHR 21/2021 on Performance Assessment of Green Buildings covers performance assessment, green buildings measurement, reporting, and verification. To assess the performance of green buildings, this regulation sets seven parameters including: • Site development • Energy efficiency • Water efficiency • Indoor air quality • Materials • Waste management • Wastewater management **Certification** Using these seven parameters, one of three types of green building certificate can be obtained by the building owner depending on the level of implementation: Pratama (Basic), Madya (Intermediate), or Utama (Advanced). Among the abovementioned parameters, energy efficiency takes the largest portion of the assessment.

ANNEX 3. INSTRUMENTS APPLICABLE FOR GREEN BUILDING FINANCING IN CITIES

Table A5. Policy instruments in place to support green building financing in cities

Policy Instruments	Key aspects of the regulation
Job Creation, Law 6/2023 on amendments to Law 11/2020	Simplifies the process for local government by waiving requirements on obtaining local parliament approval before municipal bond issuance.
Fiscal Relationship between Central Government and Local Government, Law 1/2022	Gives authority for local government to allocate funds as the fulfillment of decentralization duties including raising funds, collecting taxes, allocating local government budget and spending, as well as fiscal transfers.
Regional Debt, Government Regulation 56/2018	GR 56/2018 on Regional Loans sets the terms for short-, medium-—and long-term regional loans. Medium-term loans are used to finance infrastructure activities and/or public service facilities in areas that do not generate local revenue. Long-term loans are also used to finance infrastructure and/or public service facilities that aim to generate direct local revenues, or **indirect local revenues from savings** if such activity does not provide economic and social benefits.
Public Private Partnership (PPP), Government Regulation 38/2015	To fill up the funding gap in infrastructure financing, local governments can utilize the PPP scheme. Under a PPP contract, the local government can share risks and shares to meet the financial feasibilities of infrastructure projects. According to Presidential Regulation No 38/2015 on Public Private Partnership, Local government can act in the form of government guarantee, Payment of Services, and fiscal incentives. Local government can also provide a Viability Gap Fund as agreed in the PPP contract. Recently, the City of Banyuwangi used the PPP scheme to develop a green building concept for Banyuwangi Airport.
Municipal Bond and Municipal Sukuk, POJK 61/2017	POJK 61/2017 on Municipal Bond and/or Sharia Bond Registration describes technical requirements to issue municipal bonds. CPI conducted research on the potential of municipal green bonds based on criteria set by the Ministry of Finance, analyzing both the supply and demand sides.

ANNEX 4. SEMARANG BUILDING STOCK ANALYSIS

The status of the built environment in Semarang was obtained by external consultants from various sources, mainly from the Semarang government website (data.semarangkota.go.id). There are more than 14,477 settlement areas, with a total of 470,495 buildings in Semarang. Among them, 444,207 buildings (94.4%) have already obtained a building permit (*Izin Mendirikan Bangunan*/IMB). Most of the city's buildings are residential (367,766 units or 78.17%).

Table A6. Summary of the building classes in Semarang City

Building classes	Description	Number (unit)	Percentage
Class 1-3	Residential buildings	367,766	78.17
Class 4	Mix-used residential buildings	510	0.11
Class 5	Office buildings	416	0.09
Class 6	Commerce buildings	3,078	0.65
Class 7	Storage buildings	8	0.00
Class 8	Laboratory buildings or industrial buildings or factory buildings	3,601	0.77
Class 9a	Public buildings: health care buildings	419	0.09
Class 9b	Public buildings: hall or convention buildings	4,847	1.03

The consultants classified buildings in Semarang into types and determined if the buildings were mandated to implement green building measures, based on function and coverage area, as per GR 16/2021 and MPWHR 21/2021. For Semarang, the criteria for sampling set by the external consultant team are:

- Building class has a mandatory requirement to implement green building standards,
- Building has high energy consumption for cooling, and
- Permits and data are available for the visited buildings.

These criteria resulted in some exclusions, as shown in Table A7.

Table A7. Building classifications and compliance

Building Class	Building Type	Percentage of Building Stock[14]	Included in Assessment	Reason for In/Exclusion
1-3	Residential Houses	78.17%	No	Green building standards not mandated
4	Mixed-use Apartments	0.11%	Yes	Green building standards mandated for >50,000 m^2; the energy needed for cooling is a significant portion
5	Office Buildings	0.09%	Yes	
6	Commercial Buildings	0.65%	Yes	
7	Warehouses	0.00%	No	Consume relatively low amounts of energy
8	Laboratories and Factory Buildings	0.77%	No	Use specialized equipment and machines hence does not give a general overview of buildings
9a	Hospitals and Healthcare Buildings	0.09%	No	Use specialized equipment and do not give a general overview of buildings
9b	Public Buildings	1.03%	Yes	Green building standards mandated from >10,000 m^2; energy needed for cooling is a significant portion
10	Facility Buildings		No	Not mandatory to implement green building standards

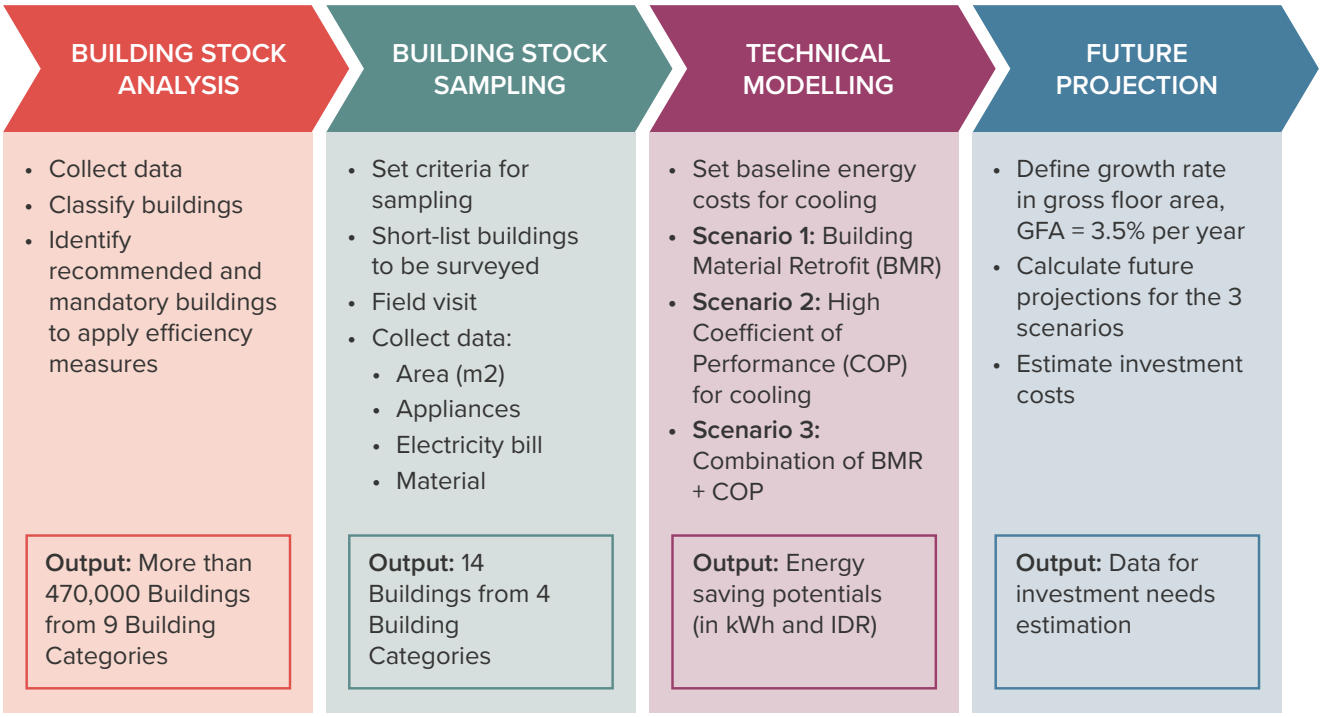
SIMULATION OF BUILDINGS

The information gathered from building stock data and field surveys was used to simulate three scenarios from the present to 2045:

1. Baseline scenario, existing conditions
2. Projection of business as usual without green building interventions
3. Projection of green building scenarios with mandatory building implementation of green building interventions. Within this scenario, three types of green building energy improvements were considered:
    a. Building material retrofit (BMR)
    b. Improved AC COP
    c. Combined BMR + Improved AC COP

14 Approximately 17% of the building stock is of unknown classification, so percentages do not sum to 100%.

Figure A1. Buildings sampling approach in Semarang



METHODOLOGY / SAMPLING APPROACH IN SEMARANG

First, building data was gathered directly from local government agencies and other publicly available sources. Buildings were then classified according to whether they were mandated to green building efficiency measures, based on gross floor area. From this step, more than 470,000 buildings were identified from nine building categories.

To determine which buildings will be surveyed, the consultant team first determines which category to include, and which to exclude. Categories that do not have any mandatory requirements to incorporate green building measures are excluded from the shortlist, as well as buildings where cooling is not the main energy consumer. The data gathered on site are physical data, observation, and utility bills. Despite limited permits obtained from building owners, the consultant team collected data from 14 buildings that represent four building categories.

A software-based technical modeling is then made using BMR high COP for cooling, and a combination of both. This step aims to calculate the energy savings potential.

The last work undertaken by the consultant team is the future projection of buildings in Semarang using assumptions taken from the city's roadmap, which will then be used to estimate future investment needs for the city.

SURVEYED BUILDINGS

A total of 14 buildings from 4 categories were surveyed and the consultant team collected their energy consumption profile and energy use intensity.

Two high-rise apartment buildings that were recently developed in two districts of Semarang (in 2016 and 2020) were surveyed. Split AC systems are commonly used in tenant-occupied apartments, while public areas use central systems. Other common equipment and appliances include water pumps, elevators, TVs, refrigerators, and various kitchen appliances.

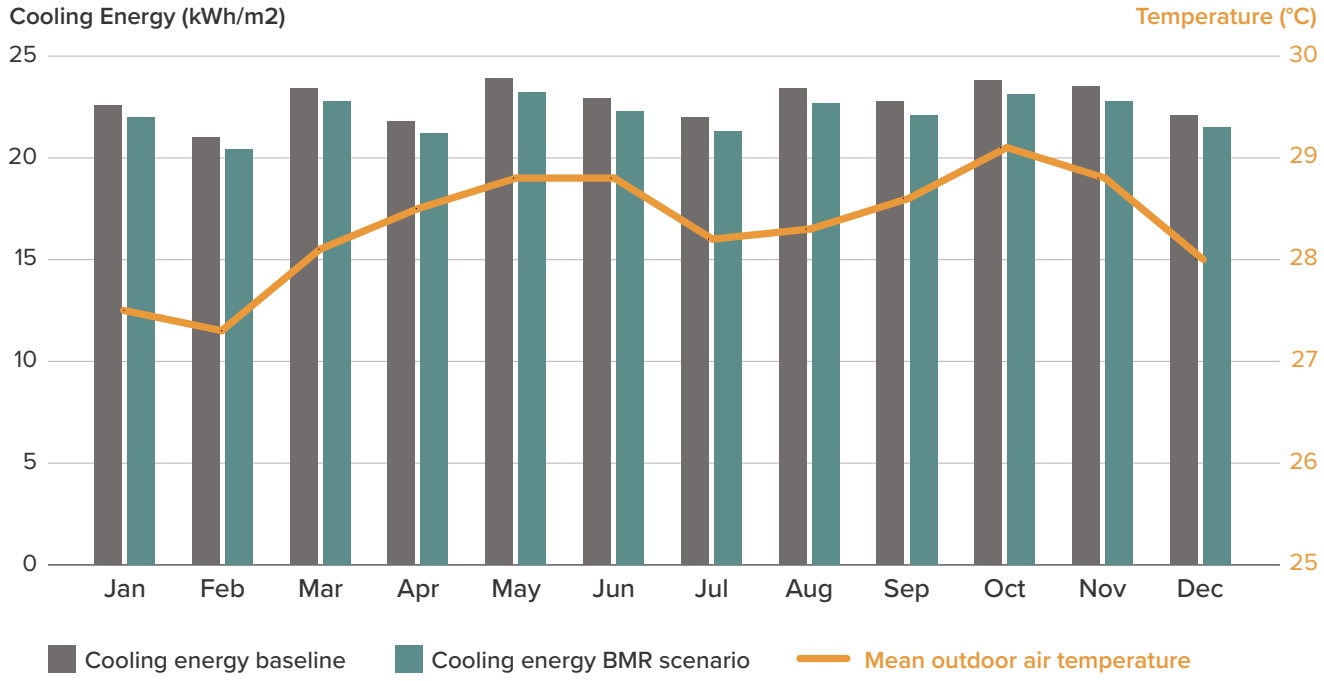
Five office buildings were surveyed in different districts: three government offices and two state-owned enterprise buildings. Besides AC and lighting, the most common appliances found in offices that are energy-intensive are computers, monitors, printers, and projectors.

The two commercial buildings surveyed are both large shopping malls, which consume a high amount of electricity for central AC systems and water pumps. Both buildings use reinforced concrete as the structure material and glazing with aluminum frames for their windows. The building materials differ in the walls, where one uses clay brick and the other aerated lightweight concrete.

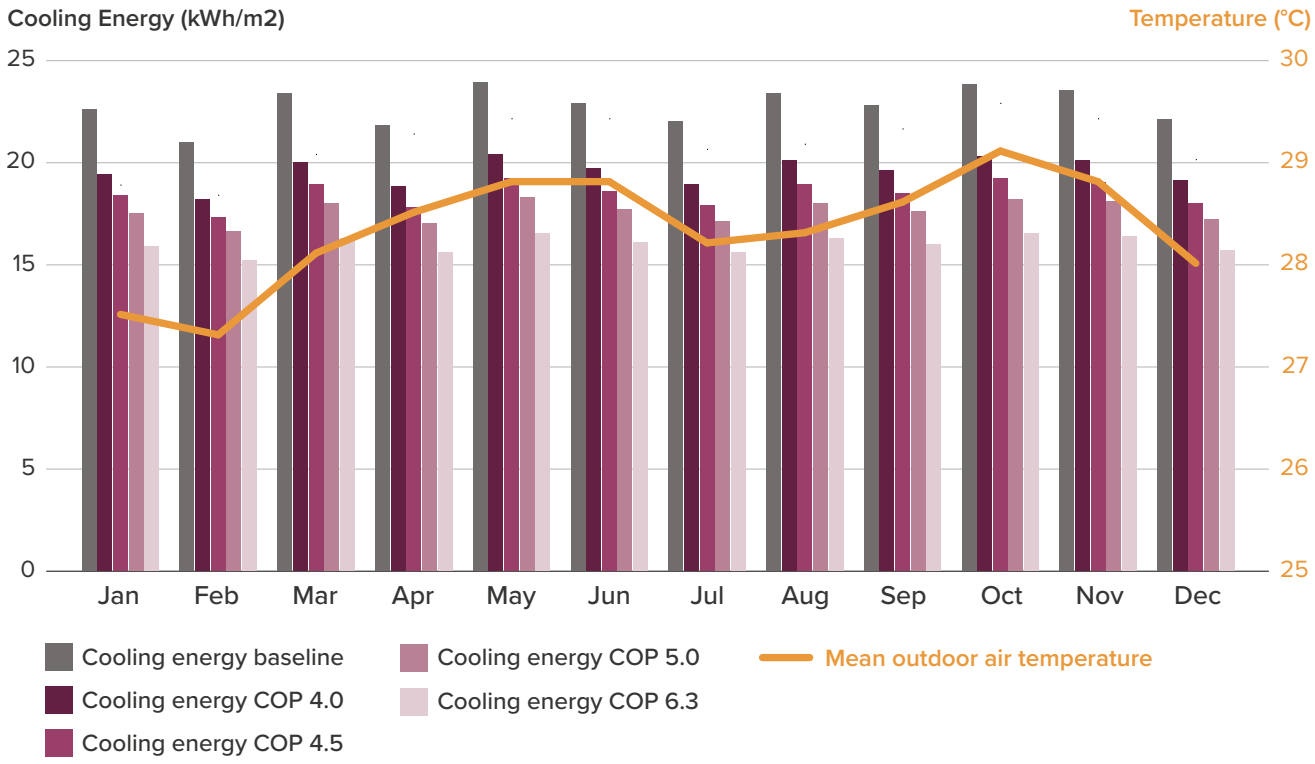
Five public buildings were surveyed, including three schools, one university, and one library. Most schools only use fans in the classrooms and split AC units for the office rooms and laboratories. Both the university and public library use split AC systems. The library was built around 60 years ago and uses more conventional materials, such as plastered clay brick and single glazing with wooden frames in the building envelope. No shading devices were observed, which means the library gains more heat on hot days and makes the energy consumption for cooling higher.

SIMULATION RESULTS

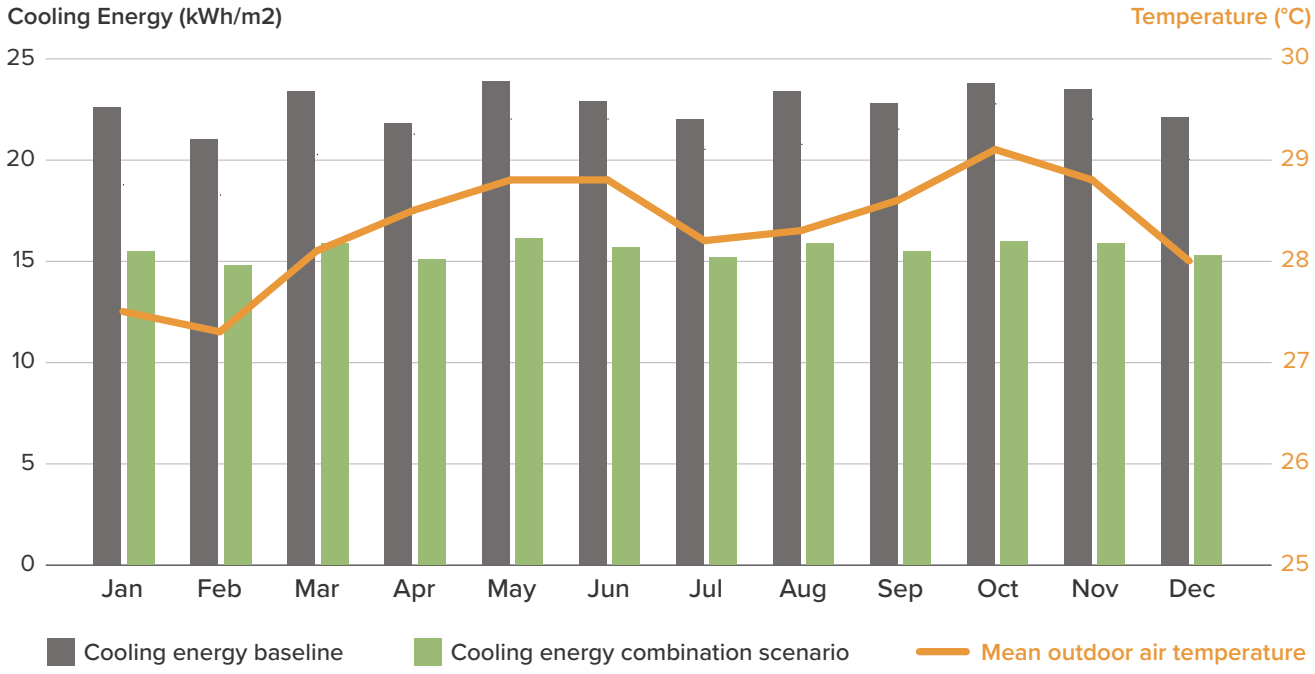
Scenario 1: Cooling energy consumption of the buildings with split AC system under BMR scenario condition.



Scenario 2: Cooling energy consumption under different COPs of the split AC system.



Scenario 3: Cooling energy consumption under combination BMR + COP scenario with split AC system.



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