ICAT Case Study: Application of the ICAT Buildings Efficiency Guidance in Indonesia

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ICAT Initiative for Climate Action Transparency

Initiative for Climate Action Transparency - ICAT

Application of the ICAT Buildings Efficiency Guidance in Indonesia

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1. Background

Indonesia is the 4th most populous country with population of more than 280 million. It is characterized by rapid urbanization, growing energy demand, and increasing greenhouse gas (GHG) emissions from the building sector. Buildings—especially residential and commercial—now account for around 60% of the country's total electricity consumption[1]. As urban development accelerates, the number of buildings and associated energy needs continue to rise, contributing significantly to Indonesia's overall GHG emissions.

This trend has been exacerbated by climate change, which influences both energy consumption patterns and policy urgency. Higher ambient temperatures due to climate change have increased the demand for cooling, particularly in urban areas, thereby driving up electricity use—most of which is still generated from fossil fuels. This creates a vicious cycle, where increased energy use from buildings leads to higher emissions, which further intensify climate-related impacts.

In response to these challenges, the Indonesian government has committed to reducing GHG emissions by 31.89% unconditionally and up to 43.20% with international support by 2030, as part of its Enhanced Nationally Determined Contribution (e-NDC). As a serious step to achieve the e-NDC target, Indonesia has developed a long-term strategy, outlining broad pathways to mitigate emission across the Indonesian economy, with a vision to achieve net-zero emission by 2060 or sooner[2].

The building sector is recognized as a key area for mitigation, prompting the Ministry of Public Works and Housing (MPWH) to issue Regulation No. 21/2021 on green buildings, aimed at improving energy efficiency and integrating renewable energy. This regulation is supported by a national Green Building Roadmap, which sets strategic targets for emission reductions and capacity development.

Thus, the situation in Indonesia reflects a pressing need to address building-related emissions, which are being influenced both by structural economic development and by the growing impacts of climate change. The ICAT project seeks to assess and strengthen these policy efforts to ensure that buildings contribute effectively to Indonesia's climate resilience and mitigation goals.

The Application of the ICAT Buildings Efficiency Guidance in Indonesia project fits within the broader national and international landscape of climate action, emissions mitigation, and sustainable development. Within this framework, the building sector is identified as a critical contributor to GHG emissions, particularly due to increasing energy demand driven by urbanization, economic growth, and rising cooling needs influenced by climate change.

2. The Application of the ICAT Buildings Efficiency Guidance in Indonesia

The aims of the Application of the ICAT Buildings Efficiency Guidance in Indonesia were centered on evaluating and enhancing the country's efforts to reduce GHG emissions in the building sector through the application of standardized international methodologies. Specifically, the project aimed to (i) assess the impact of Indonesia's Green Building Regulation (Permen PUPR No. 21/2021) on GHG emissions by applying the ICAT Building Efficiency Guidance—a globally recognized tool for policy impact evaluation in climate action; (ii) Support the achievement of Indonesia's climate goals, particularly the targets set in the Enhanced Nationally Determined

[1] National electricity consumption by sector (IEC, 2024)

[2] Long-Term Strategy for Low Carbon and Climate Resilience 2050 (MEF, 2021)

Contribution (e-NDC) and the Long-Term Strategy for Low Carbon and Climate Resilience (LTS-LCCR 2050), by identifying the emission reduction potential in the building sector; (iii) provide an evidence-based ex-ante and ex-post analysis of energy efficiency measures and renewable energy adoption in residential, commercial, and government buildings; (iv) facilitate alignment with international best practices and improve transparency, consistency, and credibility in evaluating the effectiveness of building sector policies; and (v) deliver insights and recommendations to enhance the implementation and enforcement of green building policies, while also contributing to the refinement of ICAT methodologies based on real-world application in a developing country context.

These aims are directly relevant to the broader context described earlier. As Indonesia faces growing climate risks and rising emissions—particularly from its rapidly expanding building sector—this project provides the tools and insights necessary to translate national policies into measurable climate action outcomes. It addresses the gap between policy intention and actual implementation, supports Indonesia's climate reporting obligations, and helps build institutional capacity for long-term, data-driven decision-making in the pursuit of sustainable, low-carbon development.

The project applied ICAT's Buildings Efficiency Guidance to a real-world policy in a developing country context, testing the framework's effectiveness and generating valuable feedback for both Indonesia and the broader ICAT community. By conducting ex-ante and ex-post assessments, the project provides evidence-based insights into the actual and projected impacts of green building policies, enabling continuous learning and refinement of both national strategies and ICAT tools.

Overall, the project serves as a bridge between policy design and policy performance, helping Indonesia monitor progress, identify gaps, and refine actions to ensure its building sector contributes meaningfully to national and global climate goals.

To meet the aims of the ICAT Building Efficiency project in Indonesia, the project team carried out a structured series of tasks and processes guided by the ICAT Building Efficiency Guidance. These activities ensured a comprehensive evaluation of the national green building policy and its alignment with climate goals. The key tasks included:

1. Policy and Contextual Review
   - Reviewed Permen PUPR No. 21/2021
   - Analyzed Indonesia's climate policy landscape, including the e-NDC and LTS-LCCR 2050
   - Identified key performance indicators and strategic objectives for the building sector
2. Stakeholder Identification and Engagement
   - Mapped relevant stakeholders across government, private sector, utilities, and academia
   - Conducted consultations with institutions such as MPWH, MEMR, PLN, and GBCI
   - Collected both primary and secondary data from ministries, statistical bureaus, and building owners
3. Baseline GHG Emissions Estimation
   - Selected 2021 as the reference year
   - Collected data on building stock, energy use intensity (EUI), floor area, and energy carriers
   - Used construction and demolition rates to project building growth to 2024
   - Applied local emission factors (electricity and gas) to estimate total emissions

4. Ex-Ante Impact Assessment (2021–2030)
   - Developed energy simulation models for residential, government, and commercial buildings

- Simulated energy savings based on improvements in: Building envelope, HVAC systems, Lighting, Occupancy and automation
- Calculated GHG emissions reduction under optimistic and roadmap-aligned scenario

5. Ex-Post Impact Assessment (2021–2024)
   - Collected actual implementation data from the Green Building Secretariat
   - Identified number and type of green-certified buildings implemented per year
   - Compared actual emissions with baseline estimates to assess short-term policy impact
6. Application of ICAT Methodology
   - Defined GHG assessment boundaries (heating/cooling, lighting, electricity supply)
   - Created causal chains to map how policies lead to intermediate and final impacts
   - Assessed barriers to policy implementation (technical, institutional, financial)
   - Evaluated data availability and uncertainty in inputs and assumptions
7. Reporting and Recommendations
   - Synthesized findings into quantitative and qualitative policy insights
   - Developed recommendations for:
   - Enhancing implementation of Permen PUPR No. 21/2021
   - Improving ICAT tools based on local context
   - Increasing enforcement, capacity building, and public awareness

These tasks provided a comprehensive foundation to assess the effectiveness of Indonesia's green building regulation and to support more impactful climate action in the building sector.

The project produced a set of important results that demonstrated both the potential and current limitations of green building policy implementation, specifically regarding GHG emissions reduction in the residential, commercial, and government building sectors.
Key Results:

1. Baseline Emissions (2021–2024)
   - Total emissions from buildings were estimated at 312 $MtCO_2$ in 2021, rising to almost 342 $MtCO_2$ by 2024 under a business-as-usual scenario
   - The residential sector accounted for the largest share of emissions (~71%), driven by electricity use
2. Ex-Ante Assessment (2021–2030)
   - Simulations using improved energy performance measures showed potential reductions in energy use intensity (EUI) for residential, government and commercial buildings upto 47%, 68% and 58%, respectively.
   - Under the best-case scenario, emissions by 2030 could be reduced to 137 $MtCO_2$, a reduction of 271 $MtCO_2$ compared to the projected baseline of 408 $MtCO_2$.
   - The Green Building Roadmap scenario showed a reduction upto 109 $MtCO_2$, compared to the projected baseline of 408 $MtCO_2$
   - Both scenarios demonstrate strong mitigation potentials and meeting the sectoral target of 37 $MtCO_2$ reduction from the 2021 baseline
3. Ex-Post Assessment (2021–2024)

- Actual implementation of green building practices remained limited: only 2 government buildings were certified in 2021–2022; by 2024, a total of 1173 residential, 19 government, and 1 commercial building had adopted green building measures
- Result: Emissions is stagnant in the period from 2022 to 2024 compared to the baseline—showing that implementation is not yet widespread enough to drive down emissions.

The project successfully applied the ICAT Building Efficiency methodology to assess the GHG impact of Indonesia's Permen PUPR No. 21/2021. It demonstrated how energy efficiency improvements can significantly reduce emissions, thereby validating the relevance of the regulation. The results quantified the emissions reductions possible under various implementation scenarios, directly linking building sector improvements to Indonesia's climate commitments. The project carried out a robust dual-phase assessment, comparing both projected impacts (ex-ante) and actual outcomes (ex-post), as intended.

By using ICAT's internationally recognized framework, the project ensured methodological consistency and created a model that can be replicated or adapted by other countries. The results highlighted implementation gaps and areas for improvement in regulation enforcement, stakeholder capacity, and public awareness—supporting the aim of refining future policies and enabling climate action in the building sector.

In summary, the project not only met its intended goals but also provided a data-driven foundation for improving policy enforcement, scaling green building practices, and aligning Indonesia's building sector with its broader climate targets.

While the primary focus of the project was to evaluate the impact of Indonesia's green building regulation on GHG emissions, several additional results emerged during the process. These were not explicitly defined in the original objectives but provided valuable insights for future climate policy and project design:

1. Limited Policy Uptake Highlighted Systemic Barriers
   The ex-post analysis revealed that despite the existence of a national regulation, actual implementation was minimal (e.g., only a few hundred certified buildings by 2024). This result pointed to deeper institutional, technical, and financial barriers—including lack of awareness, insufficient enforcement, and limited incentives
2. ICAT Methodology Gaps Identified
   Applying the ICAT framework in Indonesia's real-world context exposed practical challenges, such as:
   - The need for more granular classifications of residential buildings (e.g., houses vs. apartments)
   - The necessity to account for varying electricity sources (e.g., grid vs. rooftop solar)
   - These findings provided constructive feedback for refining the ICAT guidance, going beyond its original use
3. Stakeholder Mapping Created a Strategic Engagement Resource
   The comprehensive stakeholder analysis evolved into a strategic reference for cross-sectoral coordination, offering clarity on roles, influence, and data access. This output, though not a

core project deliverable, will be highly useful for future green building initiatives and climate programs in Indonesia

4. Identification of Co-Benefits
   Although not an original objective, the project uncovered additional co-benefits of green building policies, such as:
   - Potential for cost savings for building owners through lower energy bills
   - Improved indoor air quality and comfort, especially relevant in a warming climate
   - Opportunities for green job creation in construction, design, and energy services sectors
5. Triggered Further Interest in Green Finance
   Discussions during stakeholder engagement and dissemination events revealed interest from financial institutions and developers in exploring green bonds, climate finance, and carbon credit mechanisms

These additional results added depth and relevance to the project, making it not just a policy evaluation tool but also a catalyst for broader climate action planning, capacity building, and policy refinement in Indonesia.

The ICAT Building Efficiency project in Indonesia primarily utilized the ICAT Building Efficiency Guidance, which was applied throughout the project to assess the GHG impacts of the national green building regulation (Permen PUPR No. 21/2021). This methodology guided the entire assessment process, including defining GHG assessment boundaries, selecting key parameters such as energy use intensity (EUI), energy carrier mix, and emission factors, and conducting both ex-ante (2030 projection) and ex-post (2021–2024 review) evaluations. Additionally, the ICAT Stakeholder Participation Guidance was used during the stakeholder mapping and consultation phase to identify key actors, assess their influence, and ensure inclusive engagement. While not used as a core tool, ICAT's principles on sustainable development were also reflected in the analysis of co-benefits, such as cost savings and health improvements, reinforcing the project's alignment with broader climate and development goals.

3. Conclusion

The results of the ICAT Building Efficiency project in Indonesia carry significant implications for national climate action, policy implementation, and sustainable development. First, the findings confirm that green building policies—if widely and effectively implemented—have strong potential to reduce greenhouse gas emissions in line with Indonesia's enhanced NDC and net-zero goals. The simulations showed that energy use intensity in buildings could be cut by over 50%, leading to substantial emissions reductions. However, the ex-post assessment revealed a major implementation gap, with limited uptake of green building practices, resulting in continued emissions growth. This suggests that current policies lack the enforcement, incentives, and capacity needed for widespread adoption. Consequently, there is an urgent need for stronger regulatory enforcement, increased stakeholder capacity, financial mechanisms, and public awareness to accelerate adoption of energy efficiency measures. The results also highlight areas where the ICAT methodology could be improved—such as better classification of residential building types and more nuanced treatment of energy sources—making the project not only a national assessment, but also a valuable contribution to enhancing global climate transparency tools. Overall, the results underscore that bridging the gap between policy design and on-the-

ground implementation is critical for achieving Indonesia's climate and development objectives.

These results fit within the broader context where Indonesia is facing rising energy demand and emissions from its rapidly growing building sector, exacerbated by climate change. The project directly supports national efforts to decarbonize the sector and achieve climate targets by demonstrating both the potential and the current gaps in implementing energy-efficient and low-emission building practices.