

Battery-Swapping as a Hidden Lease? An Imputed-Interest Analysis of E-Motorcycle Subscription Schemes in Indonesia

Ickhsanto Wahyudi^{*1}, Eka Bertuah², Agung Mulyo Widodo³

^{1,2} FEB Esa Unggul

³ Fasilkom Esa Unggul University

*Correspondence: Ickhsanto.wahyudi@esaunggul.ac.id

Abstract

This study analyzes the battery-swapping subscription model for electric motorcycles in Indonesia to identify hidden financing elements embedded within seemingly affordable daily payment structures. Using an imputed-interest analysis based on a 24-month cash-flow simulation, the study models the battery (not the vehicle) as the leased asset, valued at IDR 12,000,000, with daily payments of IDR 25,000 (equivalent to IDR 750,000 per month) and residual values between 0–15% to reflect realistic battery degradation. The simulation results indicate a monthly internal rate of return (IRR) ranging from 3.53% to 4.10%, equivalent to an effective Annual Percentage Rate (APR) of 51.7–62.0% per year—four to five times higher than conventional motorcycle financing rates (11–13%) and the Bank Indonesia reference rate of 5.25%. These findings reveal a substantial hidden cost of capital and confirm that the scheme economically qualifies as a finance lease under IFRS 16 and PSAK 73. The high effective rate and risk transfer indicate strong information asymmetry between service providers and users, particularly gig-economy drivers with low financial literacy. This study recommends that OJK and Bank Indonesia strengthen cost-transparency regulations by mandating disclosure of the effective APR in all subscription-based energy services to ensure that Indonesia's electric-mobility transition remains transparent, inclusive, and socially just.

Keywords: battery-swapping, imputed interest, finance lease, transparency, electric vehicle.

1. Introduction

Indonesia is currently undergoing a structural shift toward electric vehicle (EV) adoption as part of its national strategy for decarbonization and clean energy transition by 2030 (McKinsey, 2023; MEMR, 2023). Within this framework, the motorcycle segment—especially in the gig economy—plays a vital role in promoting widespread EV use due to its affordability, accessibility, and dominance in urban mobility patterns (IEA, 2023). Nevertheless, the main obstacle to mass adoption remains the high upfront cost of EV ownership, where the battery accounts for approximately 35%–53% of the total price (ADB, 2022). In response, several mobility platforms have introduced *battery-swapping subscription schemes* that allow riders to pay a daily fee of around IDR 25,000 to access a fully charged battery without purchasing the asset outright (Swap Energy, 2024). This model is promoted as a cost-effective solution compared to gasoline-powered vehicles.

However, despite its convenience, this subscription arrangement raises fundamental financial and accounting concerns. The recurring payments and right-of-use characteristics closely resemble the substance of a finance lease as defined by IFRS 16 (IASB, 2016) and PSAK 73 (IAI, 2019). From a financial perspective, such schemes may contain an **implicit cost of capital** or *imputed interest*—an element of hidden financing embedded within daily payment structures that appear small yet accumulate significantly over time. When analyzed through behavioral finance, this phenomenon aligns with the *peanut effect* (Prelec & Loewenstein, 1998), wherein individuals underestimate the cumulative impact of frequent small expenses. As a result, drivers—particularly those in the gig economy with limited financial literacy—face a financial illusion of affordability, unaware of the high effective interest rate they implicitly pay (OECD, 2022).

At the policy level, regulatory ambiguity exacerbates the issue. Existing financial regulations in Indonesia, including OJK Regulation No. 10/POJK.05/2022 on fintech lending and BI Circular No. 23/23/DKSP/2023 on payment transparency, do not explicitly govern subscription-based energy or battery services (BI, 2023; OJK, 2022). This omission creates an opportunity for *regulatory arbitrage*, allowing firms to operate quasi-financing schemes without disclosure obligations regarding effective annual interest rates (Sovacool & Griffiths, 2020). Consequently, users may unknowingly bear financing costs far higher than those of conventional motorbike loans, raising issues of fairness, transparency, and consumer protection.

Empirical and conceptual research on subscription-based EV financing remains notably limited and fragmented. Previous studies have predominantly examined household-level leasing for renewable energy systems, such as off-grid solar home financing (Hansen et al., 2021; Komatsu et al., 2020), which operates in a different economic and regulatory context. Crucially, these studies do not address the unique convergence of digital mobility platforms, behavioral finance, and implicit financing costs. Furthermore, while existing literature often focuses on a single perspective, a significant gap exists in research that integrates **financial simulation** to quantify implicit interest rates, **accounting classification** to determine the substantive nature of the transaction, and **regulatory analysis** to identify oversight gaps—all within a single, cohesive framework.

This study is positioned to address this critical research gap by presenting a pioneering analysis of the battery-swapping subscription model, reconceptualizing it as a concealed finance lease within Indonesia's burgeoning digital mobility ecosystem. Adopting a novel perspective, the study identifies the battery itself—rather than the vehicle—as the core leased asset. Through an imputed-interest analysis, the research rigorously quantifies the scheme's implicit financing cost by calculating its effective Annual Percentage Rate (APR). Furthermore, it evaluates the arrangement against the substantive criteria of a finance lease as defined by IFRS 16 and PSAK 73. By integrating financial simulation with insights from behavioral economics and a regulatory assessment, this paper ultimately contributes to the broader discourse on sustainable finance and energy justice, advocating for an electric vehicle transition in Indonesia that is not only technologically driven but also transparent and socially equitable (Sovacool & Griffiths, 2020).

2. Research method

This study adopts a **quantitative approach** using *imputed-interest analysis* to estimate the implicit cost of capital embedded in Indonesia's e-motorcycle **battery-swapping subscription schemes**. The objective is to determine the **Annual Percentage Rate (APR)** — the effective annual interest rate implicitly contained within the daily subscription payments — and to evaluate whether the scheme qualifies substantively as a **finance lease** under *IFRS 16* (IASB, 2016), and *PSAK 73* (IAI, 2019).

The analysis is conducted through a **24-month cash flow simulation**, representing the typical contractual period used by major battery-swapping operators in Indonesia (Greeny, 2024). The **initial asset value (P_0)** is set at **IDR 12,000,000**, corresponding to approximately **52% of the total electric-motorcycle cost (Team, 2025)**. This value represents the **economic worth of a new lithium-ion battery** at the start of the subscription. Users pay a **daily subscription fee of IDR 25,000**, equivalent to **IDR 750,000 per month**, in exchange for unlimited battery access throughout the contract duration (Kompas.com, 2023). Since the user does not obtain ownership of the battery, the residual value is assumed within the range of 0–15% of the initial price. This range reflects the severe degradation in energy capacity and resale value after two years of continuous, high-utilization use common in gig-economy services (Kong et al., 2025). The assumption aligns with industry observations that lithium-ion batteries for electric two-wheelers can lose over 20% of their capacity within 2–3 years, rendering their post-lease economic value minimal due to performance decline and technological obsolescence (Rahman & Alharbi, 2024).

The cash flow is modeled as a finance lease where the initial battery value (P_0) is the lessor's investment, the monthly payment (C_t) is the lease payment, and the residual value (RV) is the estimated value of the asset returned to the lessor

$$P_0 = \sum_{t=1}^{24} \frac{C_t}{(1+r)^t} + \frac{RV}{(1+r)^{24}}$$

where P_0 is the initial asset value (IDR 12,000,000), C_t represents the monthly payment (IDR 750,000), r is the implicit monthly return rate, and RV is the assumed residual value at the end of the 24-month term.

The resulting monthly IRR is then converted to an **effective Annual Percentage Rate (APR)** using the compounding formula:

$$APR = (1 + IRR_{monthly})^{12} - 1$$

A **sensitivity analysis** is performed under three realistic residual-value scenarios: **Zero 0% (no residual value)**, **10%**, and **15% of initial asset value**, with an additional **20% scenario** included for reference. This range captures variations in battery durability and provider policy, illustrating how changes in residual assumptions affect the effective cost of financing borne by users. Finally, the computed APR values are compared with benchmark market rates, including **conventional vehicle**

loans (11–13%) and the **Bank Indonesia 7-Day Reverse Repo Rate (5.25%)** (BI, 2023). The results are then evaluated conceptually within the accounting framework of *IFRS 16* and *PSAK 73* to assess whether the subscription’s economic substance reflects a **finance lease**. All calculations were performed using **Microsoft Excel**, ensuring transparency and reproducibility of the imputed-interest simulation.

3. Results and Discussion

The cash-flow simulation in this study focuses exclusively on the **battery** as the leased asset within Indonesia’s e-motorcycle subscription model. This approach reflects the actual ownership structure in the field: users purchase the electric-motorcycle body separately for approximately **IDR 23,000,000**, while paying a daily subscription fee of **IDR 25,000** for battery access. The battery is the economic asset consumed by the user throughout the subscription, yet ownership remains with the service provider. Consequently, the relevant financial transaction is not a vehicle lease but a **battery-financing arrangement** embedded in the subscription model. Based on industry data, the **battery accounts for about 52% of the total vehicle cost**, with an estimated new value of **IDR 12,000,000** (ADB, 2022). The user pays **IDR 750,000 per month** (30 days × IDR 25,000) for 24 months, without obtaining ownership at the end of the contract. The residual value of the battery is realistically assumed to range from **0% to 15%** of its original price, reflecting technological degradation and the absence of asset return rights to users. Under these parameters, the simulation produces a **monthly internal rate of return (IRR)** ranging from **3.53% to 4.10%**, corresponding to an **effective Annual Percentage Rate (APR)** between **51.7% and 62.0%** per year. These figures **unequivocally** reveal that the subscription model contains a **hidden financing cost** far exceeding both conventional loan rates (11–13%) and the **Bank Indonesia reference rate** of 5.25% (BI, 2023). This result confirms that the subscription structure economically functions as a **high-cost financing scheme**, rather than a simple energy service.

Table 1. Cash-Flow Simulation and Imputed Interest Rate

Description	Amount (IDR)	Notes
Initial battery value (P_0)	12,000,000	52% of total EV cost (ADB, 2022)
Daily subscription payment	25,000	Fixed daily fee
Monthly equivalent	750,000	$25,000 \times 30$ days
Contract duration	24 months	User holds right-of-use, not ownership
Total payment	18,000,000	Cumulative over contract period, exceeds asset cost without ownership
Residual value (provider’s asset)	0–1,800,000	0–15% of initial value
Monthly IRR	3.53–4.10%	Hidden monthly financing rate
Effective APR	51.7–62.0%	Equivalent annualized interest rate

Source: Author’s simulation (2025).

To test the robustness of the results, a **sensitivity analysis** was conducted by adjusting the residual value of the battery. The analysis demonstrates that even under optimistic residual-value assumptions, the effective APR remains significantly above standard market financing rates, confirming a strong **cost burden and risk transfer** to users.

Table 2. Sensitivity of Residual Value to Effective APR

Residual Value Scenario	Residual (IDR)	Monthly IRR (%)	Effective APR (%)
0% (no residual)	0	3.53	51.72
10%	1,200,000	3.92	58.72
15%	1,800,000	4.10	62.04
20% (reference)	2,400,000	4.27	65.24

Source: Author's recalculated simulation (2025).

The sensitivity results indicate that every 10–15% increase in residual value reduces the effective APR only marginally, yet the cost of capital remains well above **50%**. This pattern shows that the user effectively bears the full **residual risk** of battery value depreciation, while the service provider secures a fixed and predictable financial return. Such a structure aligns with the characteristics of a **finance lease** under *IFRS 16* and *PSAK 73*, where the **risks and rewards of ownership** are transferred substantially from the lessor to the lessee.

Overall, these findings confirm that Indonesia's **battery-swapping subscription system embeds a hidden financing structure**, characterized by high implicit interest rates, asymmetric information, and risk transfer (Fata Herzasha, 2023; Greeny, 2024). This creates a financial environment that appears affordable in daily terms but, in aggregate, imposes an **excessive cost of capital** on gig-economy users, raising both accounting and regulatory concerns (Mubarok & Kartini, 2025).

3.1. Discussion

3.1.1 Behavioral Finance Perspective: The Illusion of Affordability and the “Peanut Effect”

The results reveal that the **battery-swapping subscription model** for electric motorcycles in Indonesia operates not merely as an energy service but as an **implicit financing contract**. The imputed-interest simulation produces a **monthly IRR of 3.53–4.10%**, corresponding to an **effective APR of 51.7–62.0% per year**. These figures are substantially higher than both **conventional motorcycle loans (11–13%)** and the **Bank Indonesia reference rate (5.25%)** (BI, 2023). Although users perceive the daily fee of IDR 25,000 as affordable, the cumulative cost over 24 months represents a substantial financial burden. This phenomenon aligns with the **“peanut effect”** in behavioral finance, as proposed by Prelec & Loewenstein (1998), which describes how individuals tend to underestimate the cumulative impact of small, frequent payments because each transaction feels psychologically negligible.

In the context of Indonesia’s **gig economy**, this behavioral bias is amplified by **limited financial literacy** (Royono et al., 2025). Many drivers lack understanding of compound interest and effective annual rates (OECD, 2022), leading them to misjudge the true economic cost of subscription models (Zainudin & Rahayu, 2024). The resulting **financial illusion** creates a gap between perceived affordability and actual financing burden (CELIOS, 2024). This illusion benefits service providers, who frame daily fees as flexible and accessible while concealing the implicit interest rate that effectively converts the scheme into a hidden loan.

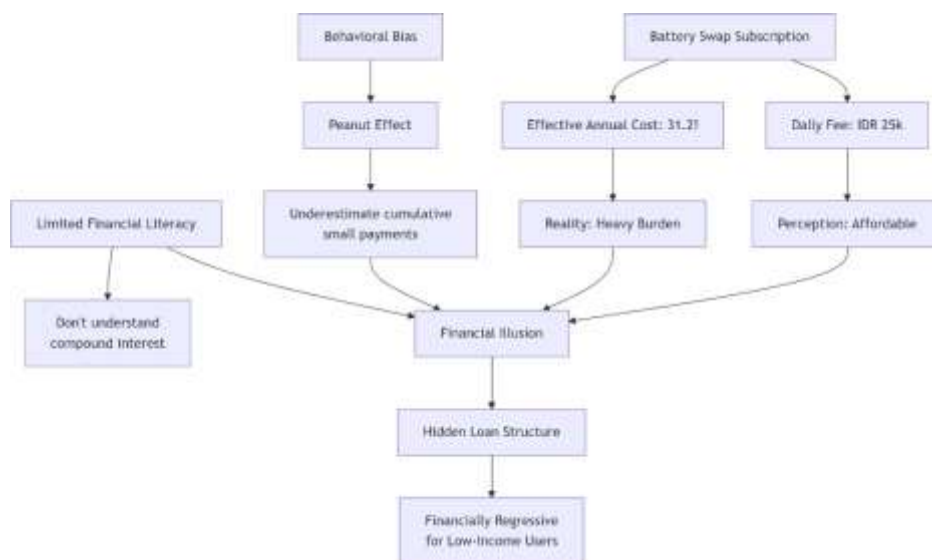


Figure 1. The Illusion of Affordability

Hence, the behavioral dimension of this study underscores that **financial innovation without transparency** can replicate predatory lending characteristics under the guise of convenience (IRENA, 2020; Agarwal et al., 2025). While marketed as a pay-as-you-go energy service, the underlying cost structure is financially regressive for low-income users (Global, 2024).

3.1.2 Accounting Perspective: Substantive Features of a Finance Lease

From an accounting standpoint, the findings indicate that the **battery-swapping subscription model** satisfies the **substantive criteria of a finance lease** under *IFRS 16* and *PSAK 73* (IAI, 2021; PwC, 2023). According to these standards, a lease is classified as “finance” when substantially all risks and rewards associated with ownership are transferred from the lessor to the lessee. In this case, users (drivers) exercise continuous control and derive full economic benefits from the battery during the contract term, while the service provider merely retains legal ownership without bearing depreciation or residual-value risk (KPMG, 2023).

The updated *imputed-interest analysis* confirms that users effectively absorb the **residual-value risk**, as the **effective Annual Percentage Rate (APR)** ranges from **51.7% to 62.0% per year** under realistic battery residuals of 0–15%. Even under more optimistic assumptions (20% residual), the APR remains above **65.24%**, far exceeding conventional loan benchmarks. This reinforces the presence of **risk and information asymmetry**, consistent with Akerlof (1970) theory—where users face uncertainty about the true cost of financing, while providers secure stable and predictable financial returns.

Therefore, although service providers classify the transaction as an “energy service,” its **economic substance aligns more closely with financial leasing** than service delivery. In practice, the provider functions as a **de facto lessor** earning fixed interest income, while users act as lessees with long-term financing obligations. Under the *substance over form* principle, such arrangements should be recognized transparently in financial statements—recording **lease receivables** and **interest income** on the provider’s side, and **right-of-use liabilities** on the user’s side—to reflect the true financing exposure. Misclassification of these transactions as service revenue could **overstate operational income** and **understate credit risk**, thereby distorting both the provider’s financial position and the regulatory assessment of financial stability.

3.1.3 Regulatory Perspective: Gaps, Arbitrage, and the Need for Cross-Sectoral Oversight

The study identifies a **regulatory grey area** in Indonesia’s current financial and energy oversight framework. Both *POJK No. 10/POJK.05/2022* on fintech lending and *BI Circular No. 23/23/DKSP/2023* on transparency of payment system costs focus on traditional financing and payment products, not on subscription-based energy services (BI, 2023; OJK, 2022). This omission enables **regulatory arbitrage**, allowing companies to operate quasi-financial schemes without disclosing effective interest rates (Sovacool & Griffiths, 2020). As a result, users lack access to essential financial information—particularly the *Annual Percentage Rate (APR)*—that would otherwise be mandatory in standard credit contracts under *truth-in-lending* principles. This regulatory gap undermines both **consumer protection** and **financial transparency**, especially in an era where financial technology and digital mobility converge.

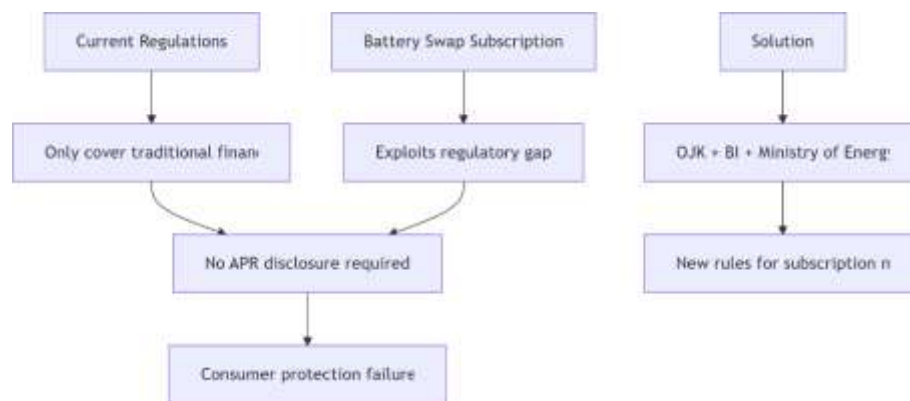


Figure 2. Regulatory Framework Gap

Cross-sectoral collaboration between **OJK, BI, and the Ministry of Energy and Mineral Resources (MEMR)** is therefore necessary to address these challenges (BI, 2024). A unified framework should require all subscription-based models that exhibit financing characteristics to disclose effective interest rates and associated risks. Such coordination aligns with the broader agenda of **sustainable finance** and **just energy transition**, ensuring that digital innovations in energy access do not inadvertently perpetuate economic inequality (UNDP, 2025).

3.1.4 Socioeconomic Perspective: Equity and the Just Energy Transition

The social implications of these findings extend beyond accounting classification. The daily subscription cost of IDR 25,000—equivalent to about 15% of the average monthly income of gig economy drivers—suggests a disproportionate burden on low-income workers (IEA, 2023). This undermines the goals of a **just and inclusive energy transition**, where economic accessibility is central to sustainability (MEMR, 2023).

When the total cost of ownership for electric motorcycles exceeds that of conventional ones, financial incentives for EV adoption weaken. The hidden financing embedded in subscription schemes not only affects individual financial stability but may also **slow down Indonesia’s green mobility agenda** (Afraah et al., 2021). Policymakers must thus balance innovation and social justice by ensuring transparent pricing and equitable financing mechanisms (Istiqomah et al., 2024). Possible solutions include integrating *green financing instruments* or *lease-to-own programs* that allow users to gradually acquire ownership through subscription payments. These alternatives align financial inclusion with environmental sustainability, addressing both economic and ethical dimensions of the transition (BI, 2025; InvestinAsia, 2025).

4. Conclusion and Recommendations

This study concludes that Indonesia’s battery-swapping subscription scheme for electric motorcycles embeds a concealed financing mechanism that, in substance, functions as a finance lease—not a pure energy service. Imputed-interest analysis reveals an implicit cost of capital equivalent to an effective annual percentage rate far exceeding conventional loan and central bank rates. This reflects significant information asymmetry: providers fully grasp the financing structure,

while gig workers—often with limited financial literacy—perceive affordability due to the “peanut effect,” underestimating the cumulative burden of small daily payments. Users receive most economic benefits of the battery and bear its residual-value risk, satisfying core criteria for a finance lease under both international and national accounting standards. The resulting financial illusion places users at a structural disadvantage, contradicting principles of fairness, transparency, and sustainable finance, and underscoring the need for regulators to treat such subscriptions as financial intermediation requiring mandatory disclosure of effective interest rates.

The findings reveal a critical regulatory gap in Indonesia: existing rules like POJK No. 10/POJK.05/2022 and BI Circular No. 23/23/DKSP/2023 do not cover subscription-based energy services, enabling regulatory arbitrage and allowing providers to conceal high effective interest rates—undermining consumer protection and transparency. Closing this gap requires cross-sectoral coordination among OJK, Bank Indonesia, and MEMR to mandate disclosure of the effective APR, apply truth-in-lending principles, and classify qualifying arrangements as finance leases. To ensure a just energy transition, policymakers should also boost financial literacy among gig workers and promote inclusive green-financing models—such as lease-to-own or subsidized loans—that align innovation with equity. True sustainability demands not only clean energy but also fair, transparent financial systems that empower, not exploit, users.

While this study offers a robust imputed-interest analysis, it relies on estimated parameters—such as battery cost, daily fees, and residual values—drawn from public sources rather than actual provider data or contracts. Although these assumptions are credible, they may not reflect operational or regional variations in usage and battery degradation. Future research should validate findings through primary data (e.g., user surveys, transaction records) and compare alternative models—like lease-to-own, microloans, or subsidized green financing—to identify the most equitable and transparent pathways. Expanding the analysis to include Islamic finance or gender-disaggregated impacts could further advance inclusive electric mobility in Indonesia.

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Appendix: Detailed Calculation of Imputed Interest and Effective APR

This appendix provides the detailed cash flow calculations and the derivation of the Internal Rate of Return (IRR) that underpin the imputed-interest analysis in the main body of the paper.

A1. Base Assumptions and Inputs

- Initial Battery Value (P_0): IDR 12,000,000
- Daily Subscription Fee: IDR 25,000
- Monthly Subscription Payment (C_t): IDR 25,000 $\times$ 30 = IDR 750,000
- Contract Duration (n): 24 months

A2. Cash Flow Structure and IRR Calculation

The cash flows are modeled from the perspective of the service provider (the lessor):

- At time $t=0$: A cash *outflow* equal to the initial cost of the battery, **-IDR 12,000,000**.
- For periods $t=1$ to $t=24$: A cash *inflow* of the monthly subscription fee, **+IDR 750,000**.
- At time $t=24$: A cash *inflow* equal to the residual value of the battery at the end of the contract.

The Internal Rate of Return (IRR) is the discount rate (r) that sets the Net Present Value (NPV) of this cash flow stream to zero, as defined by the formula:

$$P_0 = \sum_{t=1}^{24} \frac{C_t}{(1+r)^t} + \frac{RV}{(1+r)^{24}}$$

The monthly IRR (r) is calculated for each residual value (RV) scenario using the IRR function in Microsoft Excel. The effective Annual Percentage Rate (APR) is then annualized using the formula:

$$APR = (1 + IRR_{monthly})^{12} - 1$$

A3. Detailed Cash Flow Tables and Results per Scenario

Table A1. Cash Flow Simulation for 0% Residual Value Scenario

Period	Cash Flow (IDR)	Description
0	(12,000,000)	Initial Investment in Battery
1	750,000	Monthly Subscription Payment
2	750,000	Monthly Subscription Payment
...	...	...
23	750,000	Monthly Subscription Payment

Period	Cash Flow (IDR)	Description
24	750,000	Final Monthly Payment + IDR 0 Residual Value
Monthly IRR	3.53%	= IRR (All Cash Flows)
Effective APR	51.72%	=$(1+3.53\%)^{12}-1$

Table A2. Cash Flow Simulation for 10% Residual Value Scenario (RV = IDR 1,200,000)

Period	Cash Flow (IDR)	Description
0	(12,000,000)	Initial Investment in Battery
1	750,000	Monthly Subscription Payment
2	750,000	Monthly Subscription Payment
...	...	...
23	750,000	Monthly Subscription Payment
24	1,950,000	Final Monthly Payment (750,000) + Residual (1,200,000)
Monthly IRR	3.92%	=IRR(All Cash Flows)
Effective APR	58.72%	=$(1+3.92\%)^{12}-1$

Table A3. Cash Flow Simulation for 15% Residual Value Scenario (RV = IDR 1,800,000)

Period	Cash Flow (IDR)	Description
0	(12,000,000)	Initial Investment in Battery
1	750,000	Monthly Subscription Payment
2	750,000	Monthly Subscription Payment
...	...	...

Period	Cash Flow (IDR)	Description
23	750,000	Monthly Subscription Payment
24	2,550,000	Final Monthly Payment (750,000) + Residual (1,800,000)
Monthly IRR	4.10%	=IRR(All Cash Flows)
Effective APR	62.04%	=(1+4.10%)^12-1

Table A4. Cash Flow Simulation for 20% Residual Value Scenario (RV = IDR 2,400,000)

Period	Cash Flow (IDR)	Description
0	(12,000,000)	Initial Investment in Battery
1	750,000	Monthly Subscription Payment
2	750,000	Monthly Subscription Payment
...	...	...
23	750,000	Monthly Subscription Payment
24	3,150,000	Final Monthly Payment (750,000) + Residual (2,400,000)
Monthly IRR	4.27%	=IRR(All Cash Flows)
Effective APR	65.24%	=(1+4.27%)^12-1

A4. Sensitivity Analysis Summary

The following table consolidates the results from all scenarios, demonstrating the high effective APR across a realistic range of residual values.

Table A5. Sensitivity of Effective APR to Residual Value Assumptions

Residual Value Scenario	Residual Value (IDR)	Monthly IRR	Effective APR
0%	0	3.53%	51.72%
10%	1,200,000	3.92%	58.72%
15%	1,800,000	4.10%	62.04%
20% (Reference)	2,400,000	4.27%	65.24%

Source: Author's calculations based on cash flow simulation (2025).