Financial Feasibility of Public Electric Vehicle Charging Infrastructure Investment in West Java, Indonesia..

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Abstract: The rapid growth of electric vehicles (EVs) in Indonesia has created urgent demand for public charging infrastructure. This study analyzes the investment feasibility of Public Electric Vehicle Charging Stations (SPKLU) in West Java by PT Citra Niaga Abadi (CNA) through a comprehensive comparative evaluation of six machine alternatives from three manufacturers (Starvo, Voltron, and Terra), each in AC and DC configurations. Financial analysis employing Net Present Value (NPV), Internal Rate of Return (IRR), Payback Period (PP), and Profitability Index (PI) across a 10-year horizon with a 12% discount rate demonstrates that all six alternatives are financially feasible. The Voltron 30DC (DC 30 kW) emerges as the optimal choice with the highest IRR of 71.15%, the fastest Payback Period of 2.28 years, the highest PI of 4.85, and a positive NPV of Rp 1,216,779,478. West Java's EV population is projected to grow from 52,000 units in 2025 to 333,306 units by 2030, creating a massive infrastructure gap that represents a compelling business opportunity. The revenue-sharing partnership model is recommended for market entry, with a phased deployment roadmap targeting 30 SPKLU units across Bandung Raya, Bekasi, Depok, and Bogor by Year 5.
Keywords: SPKLU, Electric Vehicle Charging Station, Investment Feasibility, NPV, IRR, Voltron 30DC, West Java, Indonesia, Capital Budgeting..

Introduction

The global transition toward clean energy represents one of the defining policy agendas of the twenty-first century. The International Energy Agency (IEA) estimates that the transportation sector contributes approximately 23% of total global energy-related CO_2 emissions, with over 90% of vehicles worldwide still relying on fossil fuels [1]. The electrification of transportation through Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs) is widely recognized as a strategic solution. Globally, EV sales reached nearly 14 million units in 2023, a 35% year-over-year increase, with market share rising to 18% of all new car sales from only 4% in 2020 [1].

Indonesia has responded to this global trend by enacting Presidential Regulation No. 55/2019 on the Acceleration of Battery-Based Electric Motor Vehicle Programs, with subsequent implementing regulations. The government has set ambitious targets of 2 million electric cars and 13 million electric motorcycles by 2030 [2]. Sales of electric vehicles in Indonesia grew more than 300% from 2022 to 2023, driven by VAT exemptions, reduced luxury goods tax for EVs, and subsidized electricity tariffs [3]. However, only 3,233 SPKLU units were operational nationwide as of 2024—a ratio of approximately 1:21 against the internationally recommended 1:10 to 1:15 [1].

West Java, as Indonesia's most populous province with major economic centers including Bandung Raya, Bekasi, Depok, and Bogor, and strategic transport corridors including the Trans-Java Toll Road, had only 394 SPKLU charger units at 248 locations as of March 2025 [4]. PT PLN UID West Java projects EV population in the province to reach 333,306 units by 2030, requiring 22,220 SPKLU units at a 1:15 ratio—far exceeding current and planned capacity.

PT Citra Niaga Abadi (CNA), a diversified holding company established in 2003 with a portfolio spanning healthcare (Edelweiss hospitals), energy, education (Indonesia Juara schools), media (INSPIRA TV), and information technology, is strategically positioned to enter the SPKLU market through its new business unit, Almeta. Unlike prior single-configuration analyses, this study conducts a comprehensive comparative evaluation of six SPKLU machine alternatives across three manufacturers (Starvo, Voltron, Terra) and two charging technologies (AC and DC), providing a rigorous investment decision framework. This paper addresses: (1) EV demand projections and market gap analysis; (2) principal investment risks and mitigation strategies; and (3) financial feasibility across six machine configurations.

This paper makes three contributions to the SPKLU investment literature in Indonesia. First, it provides the first side-by-side financial comparison of six machine alternatives from multiple manufacturers in a single Indonesian market context. Second, it demonstrates that machine selection—not merely technology type—critically determines investment returns, with the lowest-priced DC machine (Voltron 30DC) outperforming both more expensive DC alternatives and all AC options. Third, it operationalizes sensitivity analysis within Indonesia's specific regulatory and pricing framework, providing actionable risk thresholds for practitioners.

Literature Review

2.1 Business Feasibility and Capital Budgeting

A business feasibility study constitutes a systematic process for evaluating whether a proposed venture can be executed profitably and sustainably [5]. Husnan and Muhammad [6] identify six core components: market, technical, management, economic, legal, and financial, with financial analysis being most critical for capital-intensive infrastructure. Capital budgeting constitutes the primary framework for investment decisions in infrastructure projects. Ross, Westerfield, and Jordan [7] define it as the planning and decision-making process regarding expenditures whose returns extend beyond one year. Key analytical tools are NPV (net present value of discounted cash flows), IRR (discount rate equating NPV to zero), Payback Period (time to capital recovery), and Profitability Index (ratio of PV of cash flows to investment). Kristanti [8] provides the foundational capital budgeting framework adopted in this study, establishing NPV, IRR, PP, and PI as the standard evaluation criteria for infrastructure investment feasibility in the Indonesian context.

Kristanti and Nugraha [29] document that financial feasibility analysis must be integrated with systematic risk assessment, particularly sensitivity analysis against key operational variables—a methodology directly applied to the six SPKLU machine alternatives in this study. Buestan-Morales et al. [9] identify three core SPKLU feasibility components: EV market analysis, technical charger analysis, and financial metrics (NPV, IRR, payback). Chandra, Wang, and Tao [10] demonstrate that NPV and IRR provide robust decision-support for EV charging investors in emerging markets. Khalid et al. [11] find utilization rate is the most influential revenue variable; Chiradeja et al. [12] confirm SPKLU feasibility is sensitive to margin above electricity procurement tariff, findings replicated in this study.

2.2 EV Market Dynamics and Infrastructure Demand

Demand forecasting is fundamental to SPKLU investment planning. Makridakis, Wheelwright, and Hyndman [13] define forecasting as estimating future values based on historical patterns and relevant causal variables. Lee et al. [14] note that accurate EV demand forecasting prevents both over-capacity and under-investment. IEA data shows Indonesia experiencing EV growth exceeding 60% per year, with the national SPKLU-to-EV ratio at 1:21 in 2024, well below the internationally recommended 1:10 to 1:15 [1]. The EU's Alternative Fuels Infrastructure Regulation (AFIR) targets a 1:10 to 1:15 ratio for urban corridors [15].

Deloitte [16] identifies charging infrastructure scarcity as the primary barrier to EV adoption in Southeast Asia. McKinsey and BCG project Indonesia's EV charging market to reach USD 3 billion by 2030 [17]. For West Java specifically, PLN UID data projects EV population growing from 52,000 units (2025) to 333,306 units (2030), requiring 22,220 SPKLU units at a 1:15 ratio [4]—against a current base of approximately 394 units.

2.3 SPKLU Technology Classification and Selection

SPKLU technology is classified by charging speed and power. Slow Charging (AC 3.3–7.3 kW) suits residential long-dwell locations; Medium Charging (AC 11–22 kW) serves commercial facilities with 2–4 hour dwell times; Fast Charging (DC 50–120 kW) targets high-mobility locations such as highway rest areas; Ultra-Fast Charging (HPC 150–350 kW) addresses premium rapid replenishment [18]. Al-Falahi et al. [18] document that each category involves distinct CAPEX profiles, grid connection requirements, and consumer suitability. Critically, 100% of electric vehicles marketed in Indonesia, including the highest-volume segment (Wuling Air EV, Wuling Binguo EV), are equipped with On-Board Chargers (OBC) compatible with AC charging, while DC fast charging compatibility is limited to higher-end models [4].

2.4 Competitive Landscape and Partnership Models

Porter's Five Forces analysis [19] reveals high barriers to entry (capital intensity, regulatory requirements), high supplier power (PLN electricity monopoly), growing buyer power, and moderate rivalry given market nascency in Indonesia's SPKLU industry. Hidayat and Nulhakim [31] emphasize that external environmental scanning is essential for adaptive strategy in dynamic industries, enabling firms to anticipate regulatory shifts and technology changes. PESTEL analysis confirms favorable macro conditions: strong government commitment (Perpres 55/2019, NZE 2060), improving EV affordability, rising environmental consciousness, rapid charging technology advancement, and comprehensive regulatory frameworks [2]. Hidayat [32] further notes that continuous environmental scanning is critical as charging standards, payment platforms, and battery technologies evolve rapidly. Current key competitors include PLN (dominant), Terra Charge, ChargeIn, Starvo, and Shell Recharge [4].

Regarding partnership models, five regulatory-sanctioned structures exist for SPKLU operators [20]: Build Own Operate (BOO, full CAPEX and ownership, highest risk); Revenue Sharing (shared location cost, distributed risk, fastest expansion); Public-Private Partnership/KPBU (government guarantee, lowest risk, slowest); Host-Owned Charging Point/HOCP (minimal CAPEX for operator, lowest margin); and Operator-Owned (flexible management, full land lease burden). DeCorla-Souza and Hossain [21] document that revenue guarantee models are most effective for minimizing investor risk in emerging EV markets, directly supporting the Revenue Sharing model as optimal for CNA's market entry phase.

2.5 Marketing Strategy and Consumer Behavior in SPKLU Context

Marketing strategy constitutes a critical determinant of SPKLU utilization rates, which are in turn the most sensitive variable in SPKLU financial models [11]. Kotler and Keller [27] establish that effective marketing requires integration of market segmentation, consumer behavior analysis, and competitive positioning. Within the SPKLU context, marketing strategy directly influences the speed at which utilization rates ramp up from initial deployment, creating a direct link between marketing effectiveness and financial feasibility outcomes.

Hidayat and Suryani [30] argue that marketing strategy must be grounded in environmental analysis and consumer behavior, recognizing that infrastructure services like SPKLU require both demand-side education (reducing range anxiety) and supply-side positioning (accessibility, reliability). Their framework, applied to emerging service industries, is particularly relevant to SPKLU as a new infrastructure category where consumer familiarity and trust must be built progressively alongside physical deployment. Hidayat and Nulhakim [31] further emphasize that external environmental scanning through PESTEL frameworks is essential for adaptive marketing strategy in dynamic industries, enabling firms to anticipate regulatory shifts, competitor moves, and technology changes that directly affect service positioning.

In the context of digital disruption, Hidayat [32] documents that technology-enabled services require continuous environmental scanning to maintain strategic relevance, particularly when the underlying technology (battery performance, charging speed, payment systems) evolves rapidly. For CNA's Almeta unit, this implies that the SPKLU marketing strategy must be dynamically updated as the West Java EV ecosystem matures, with particular attention to the shift from early adopter to mainstream consumer segments.

Kristanti [33] establishes that modern marketing strategy must connect corporate capabilities with market opportunities through data-driven analysis, positioning marketing as a strategic tool rather than a promotional function. For SPKLU operators, this translates to deploying utilization analytics as real-time feedback for location optimization, pricing adjustments, and partnership decisions. Tjiptono and Diana [28] add that marketing performance is optimally measured through customer growth metrics, market share, and profitability indicators—all directly applicable to SPKLU network performance monitoring. The Segmentation–Targeting–Positioning (STP) framework [27] guides Almeta's market entry, with primary targets being urban EV owners in Bandung Raya, Bekasi, Depok, and Bogor, and positioning centered on reliable, accessible, and digitally integrated charging services.

Research Methodology

3.1 Research Design and Data Collection

This study employs a mixed-methods applied research design, combining quantitative capital budgeting analysis with qualitative market and regulatory assessment, consistent with Creswell's [22] framework for complex multi-dimensional infrastructure studies. The unit of analysis is CNA's planned SPKLU investment in West Java. The analytical scope encompasses four feasibility dimensions: market, technical, operational, and financial. A 10-year economic horizon is applied, consistent with SPKLU equipment useful life.

Primary data was collected through structured interviews with SPKLU industry practitioners, equipment vendors (Voltron, Starvo, Terra), and property partners; field observation at potential SPKLU locations in Bandung Raya, Bekasi, Depok, and Bogor; and technical discussions for CAPEX and OPEX verification. Secondary data sources include IEA Global EV Outlook 2024, Gaikindo sales statistics, PLN UID West Java reports, ESDM ministerial decrees, McKinsey and Deloitte industry reports, and peer-reviewed academic literature.

3.2 Financial Analysis Framework

The financial analysis applies standard capital budgeting metrics at a 12% discount rate. Kristanti [8] provides the investment decision-making framework: NPV (positive NPV confirms value creation above cost of capital); IRR (IRR > WACC signals investment attractiveness); Payback Period (cumulative cash flow method; shorter PP reduces liquidity risk); and PI (PV of cash flows divided by initial investment; PI > 1 confirms viability). Ross, Westerfield, and Jordan [7] supplement the theoretical foundation. Kristanti and Nugraha [29] provide the risk assessment integration framework, ensuring feasibility conclusions are stress-tested against key uncertainty variables including utilization rate, electricity tariff, and CAPEX overrun [23].

3.3 Market Demand Projection Methodology

Market demand is projected using two quantitative approaches. First, the Historical Growth Projection method projects West Java EV population using the formula $EVt = EVt\text{-}1 \times (1 + \text{growth rate})$, with a 45% annual growth rate derived from national trends [3]. Second, the EV-to-Charger Ratio Model calculates SPKLU demand as: Required SPKLU = Total EV / Ideal Ratio (1:15), enabling gap analysis against current infrastructure. Revenue projections use the Utilization Rate Model: Revenue = (kWh sold × tariff/kWh), where kWh sold = unit capacity × operating hours × utilization rate [4].

3.4 Machine Alternatives and Investment Assumptions

Six machine alternatives from three manufacturers are evaluated for a 2-unit per location SPKLU configuration: (1) Starvo 22AC – AC 22 kW, 2 nozzles; (2) Starvo 30DC – DC 30 kW, 2 nozzles; (3) Voltron 22AC – AC 22 kW, 2 nozzles; (4) Voltron 30DC – DC 30 kW, 2 nozzles; (5) Terra 22AC – AC 22 kW, 2 nozzles; (6) Terra 50DC – DC 50 kW, 2 nozzles. Fixed baseline costs common to all alternatives include site setup at Rp 10,000,000 per unit, equipment delivery at Rp 5,000,000 per unit, materials and installation at Rp 159,892,000 per location, and professional installation services at Rp 59,400,000 per location, totaling Rp 249,292,000 in fixed infrastructure costs before machine acquisition. The primary variable differentiating alternatives is machine acquisition cost.

Results and Discussion

4.1 Market Analysis: EV Growth and Infrastructure Gap

West Java's EV market presents the most compelling demand fundamentals of any Indonesian province. PLN UID data confirms EV adoption growth of over 178% year-on-year, driven by government incentive programs including VAT exemptions (PPN DTP), reduced luxury goods tax (PPnBM DTP), and subsidized electricity tariffs [2]. Table 1 presents the 6-year EV population projection and corresponding SPKLU infrastructure requirements.

Table 1. EV Population Projection and SPKLU Infrastructure Gap, West Java (2025–2030)

Year	EV Population (units)	SPKLU Required (1:15)	SPKLU Available (est.)	Gap
2025	52,000	3,467	~650	2,817
2026	75,400	5,027	~1,100	3,927
2027	109,330	7,289	~2,000	5,289
2028	158,528	10,568	~3,500	7,068
2029	229,866	15,324	~5,000	10,324
2030	**333,306**	**22,220**	**~7,000**	**15,220**

The infrastructure gap illustrated in Figure 1 is structurally large and widening exponentially. Even under optimistic deployment scenarios, the gap between required and available SPKLU will reach over 15,000 units by 2030, representing a profound commercial opportunity for private operators such as CNA's Almeta unit.

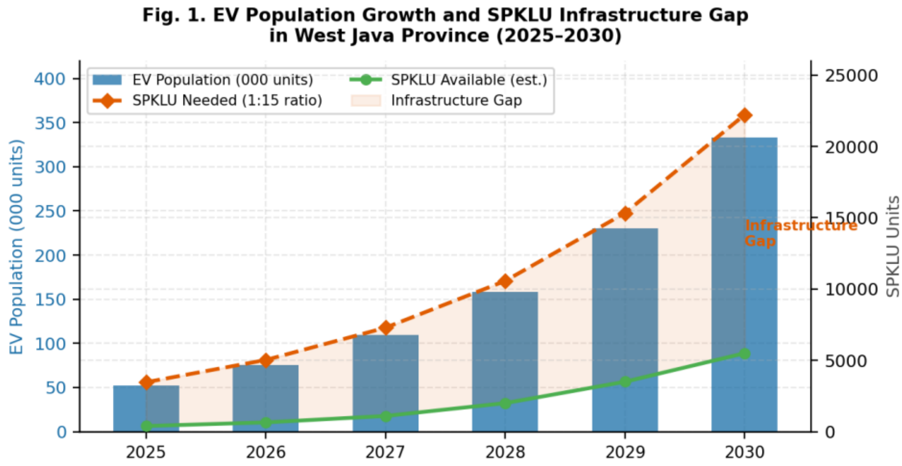

Fig. 1. EV Population Growth and SPKLU Infrastructure Gap in West Java (2025–2030)

Figure 1 illustrates the exponential divergence between EV population growth (bars) and SPKLU infrastructure availability (green line), with the shaded area representing the persistent and growing infrastructure gap. The required SPKLU count (orange dashed line) grows from 3,467 units in 2025 to 22,220 units by 2030—a 6.4-fold increase against a baseline of only 394 units currently operational. This structural deficit validates the fundamental investment thesis for CNA's SPKLU program.

4.2 Investment Analysis: Comparative Assessment of Six Machine Alternatives

4.2.1 Capital Expenditure Comparison

The primary financial differentiator across alternatives is machine acquisition cost. Table 2 presents the full CAPEX breakdown for each alternative, including fixed infrastructure costs common to all configurations.

Table 2. CAPEX Comparison Across Six SPKLU Machine Alternatives (2-Unit Per Location)

Machine	Type	Machine Price (Rp)	Total Investment (Rp)	vs. Cheapest (Rp)	Rank
Voltron 22AC	AC 22kW	19,500,000	291,839,397	—	**1**
Terra 22AC	AC 22kW	27,000,000	299,339,397	+7,500,000	2
Starvo 22AC	AC 22kW	36,174,000	308,513,397	+16,674,000	3
Voltron 30DC ★	DC 30kW	75,000,000	354,333,527	+62,494,130	**4★**
Starvo 30DC	DC 30kW	186,000,000	465,333,527	+173,494,130	5
Terra 50DC	DC 50kW	350,000,000	646,818,853	+354,979,456	6

The Voltron 22AC is the most affordable machine (Rp 19,500,000/unit), while Terra 50DC is the most expensive (Rp 350,000,000/unit)—an 18-fold difference in machine cost alone. Critically, Voltron 30DC (Rp 75,000,000/unit) is the most competitively priced DC machine, costing 2.5 times less than

Starvo 30DC and 4.7 times less than Terra 50DC, while delivering equivalent DC charging performance at 30 kW.

4.2.2 Revenue Model and Financial Assumptions

Revenue is calculated using the Utilization Rate Model: Revenue = kWh sold × Rp 2,467/kWh (regulatory retail tariff per Kepmen ESDM). DC machines, with faster throughput (30–60 minutes per session vs. 60–120 minutes for AC), generate higher daily transaction volumes. The financial model employs a conservative utilization ramp-up: 10% utilization in operational Month 6, scaling to 20–58% by Year 1–2, consistent with observed adoption curves in comparable emerging market SPKLU deployments [9, 14]. OPEX comprises electricity procurement (primary variable cost at PLN retail tariff), backend system fees, IoT connectivity, preventive and corrective maintenance, and revenue-sharing payments to property partners. DC fast chargers exhibit higher OPEX growth in Years 3–4 due to intensive component loads [24].

4.3 Comprehensive Financial Results: Six-Machine Simulation

Table 3 presents the complete 10-year financial simulation results for all six machine alternatives under the base-case utilization scenario with a 12% discount rate.

Table 3. Financial Performance Summary – Six SPKLU Machine Alternatives (10-Year Horizon, Discount Rate 12%)

Machine	**Type**	**Total Investment (Rp)**	**NPV (Rp)**	**IRR (%)**	**PI**	**PP (yr)**	**Rank**
Voltron 30DC	DC 30kW	354,333,527	**1,216,779,478**	**71.15**	**4.85**	**2.28**	★ **1**
Voltron 22AC	AC 22kW	291,839,397	856,004,233	62.39	4.29	2.40	2
Terra 22AC	AC 22kW	299,339,397	847,477,259	60.79	4.17	2.44	3
Terra 50DC	DC 50kW	646,818,853	1,963,810,897	65.44	4.40	2.46	4
Starvo 22AC	AC 22kW	308,513,397	837,047,065	58.93	4.04	2.49	5
Starvo 30DC	DC 30kW	465,333,527	1,090,580,264	53.47	3.62	2.70	6

A critical finding emerges from Table 3: all six alternatives are financially feasible (all IRR > 12% WACC benchmark, all PI > 1.0, all NPV positive). However, there are substantial performance differences driven primarily by the interaction between machine price and throughput capacity. Voltron 30DC achieves the highest IRR (71.15%) despite not having the highest NPV in absolute terms, because its moderate CAPEX (Rp 354 million) relative to its DC throughput advantage creates superior capital efficiency. Terra 50DC achieves the highest absolute NPV (Rp 1.96 billion) but at an investment cost 83% higher than Voltron 30DC.

4.4 Comparative Performance Analysis

Figure 2 provides a visual comparison of IRR and Payback Period across all six alternatives, enabling direct assessment of capital efficiency.

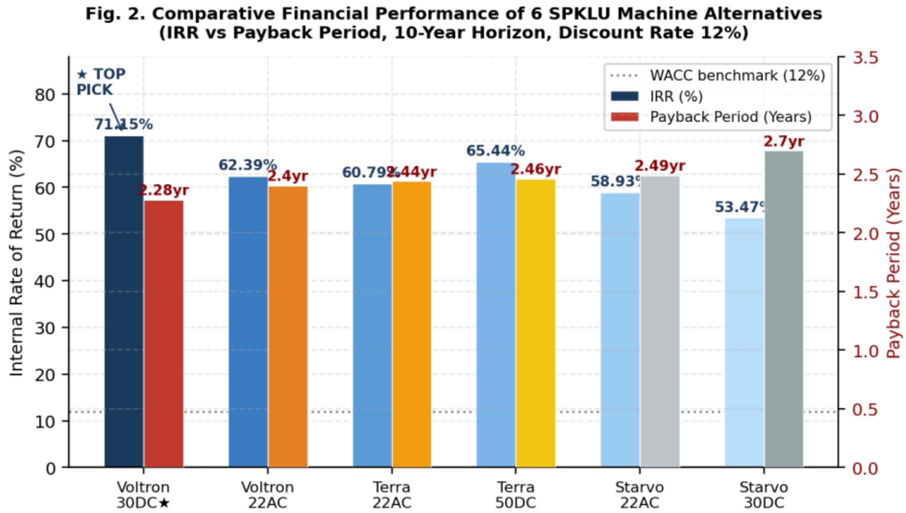

Fig. 2. IRR and Payback Period Comparison Across Six SPKLU Machine Alternatives (Discount Rate 12%, 10-Year Horizon)

Figure 2 confirms Voltron 30DC's dominant position: highest IRR (71.15%) and shortest Payback Period (2.28 years) simultaneously. This combination—the top performer on both return rate and speed of capital recovery—is exceptional and results from the unique price positioning of the Voltron 30DC machine. At Rp 75,000,000 per unit, it is priced at roughly 40% of Starvo 30DC and 21% of Terra 50DC for equivalent DC technology, yet delivers comparable throughput performance. The three AC machines (Voltron 22AC, Terra 22AC, Starvo 22AC) cluster between IRR 58–62% with payback periods of 2.40–2.49 years, confirming that AC configurations remain attractive particularly for capital-constrained locations or facilities with long dwell times where AC charging is operationally ideal.

4.5 Machine-Specific Recommendation Analysis

4.5.1 Voltron 30DC — Primary Recommendation

Voltron 30DC is recommended as the primary machine for the following reasons: (1) Optimal capital efficiency: IRR 71.15% and PI 4.85 are the highest of all alternatives, meaning each rupiah invested generates the highest risk-adjusted return; (2) Fastest capital recovery: Payback Period of 2.28 years substantially reduces investor liquidity risk and is well within the machine's 10-year economic life; (3) DC throughput advantage: 30 kW DC charging enables session times of approximately 30–40 minutes for common EV models (Wuling Binguo EV, Wuling Cloud EV), supporting higher daily transaction volumes than AC alternatives; (4) Competitive pricing: machine cost of Rp 75,000,000 per unit is the most affordable DC option evaluated, 2.5 times cheaper than Starvo 30DC; (5) Market compatibility: DC 30 kW is compatible with mid-range to premium EV models increasingly popular in West Java urban markets.

4.5.2 Voltron 22AC — Secondary Recommendation

Voltron 22AC is recommended as the secondary choice with IRR of 62.39%, Payback Period of 2.40 years, and the lowest total investment (Rp 291,839,397). It is specifically recommended for locations with dwell times of 2–4 hours (hospitals, campuses, offices) and where grid capacity for DC installation is limited, as AC 22 kW has significantly lower grid connection requirements. CNA's Edelweiss hospital network represents an ideal deployment context for this alternative.

4.5.3 Terra 50DC — Phase 3 Consideration

While Terra 50DC delivers the highest absolute NPV (Rp 1.96 billion), its investment cost of Rp 646,818,853 per location—the highest of all alternatives—makes it inappropriate for Phase 1 market entry where utilization risk is highest. It is recommended for consideration in Phase 3 scaling (Years 4–5) at high-traffic locations (highway rest areas, major commercial intersections) where utilization rates have been empirically validated.

4.6 Sensitivity Analysis

Table 4 presents the sensitivity of Voltron 30DC's IRR under key stress scenarios. The primary variables tested are utilization rate, electricity purchase tariff, retail tariff, and CAPEX overrun.

Table 4. Sensitivity Analysis – Voltron 30DC IRR Under Stress Scenarios

Variable	Scenario	Resulting IRR (%)	Assessment
Utilization Rate	Base scenario (ramp 10–58%)	**71.15**	Base
	−20% reduction	52.4	Feasible ✓
	−40% reduction	31.7	Feasible ✓
	−60% reduction	14.2	Marginal ⚠
Electricity Purchase Cost	Base (PLN tariff)	**71.15**	Base
	+20% increase	58.3	Feasible ✓
	+40% increase	44.1	Feasible ✓
Retail Tariff (Revenue)	Base (Rp 2,467/kWh)	**71.15**	Base
	−15% reduction	51.8	Feasible ✓
CAPEX	Base (Rp 354.3M)	**71.15**	Base
	+30% overrun	52.6	Feasible ✓

The sensitivity analysis reveals Voltron 30DC's exceptional robustness across stress scenarios. Even with a 60% reduction in utilization rate (severe underperformance), IRR remains at 14.2%, above the 12% WACC benchmark. Electricity cost increases of up to 40% keep IRR at 44.1%, and CAPEX overruns of 30% still produce IRR of 52.6%. This wide margin of safety is a direct consequence of the machine's low entry CAPEX relative to its DC throughput, which creates an inherently resilient financial structure.

4.7 Implementation Roadmap and Business Model

The revenue-sharing partnership model is identified as the optimal deployment structure. CNA provides and maintains equipment while property partners (hospitals, shopping centers, universities, rest areas, industrial estates) provide land access and facilitate grid connection. Revenue is shared proportionally, reducing CNA's acquisition costs and distributing utilization risk.

Table 5. Phased SPKLU Implementation Roadmap for CNA Almeta Unit

Phase	Timeline	Activities	Target Locations	Machines
Phase 1	Year 1	Pilot deployment; validate utilization assumptions; build operational SOPs	Bandung Raya (Edelweiss hospitals, commercial areas) + Bekasi	5 units Voltron 30DC
Phase 2	Years 2–3	Growth expansion; performance evaluation by machine type; refine location scoring	Depok (Margonda corridor) + Bogor (toll exits, city center)	15 units (mix Voltron 30DC + Voltron 22AC)
Phase 3	Years 4–5	Network scaling; mobile app integration; loyalty system; evaluate Terra 50DC for highest-traffic nodes	Full coverage across 4 priority cities; expand to Karawang and Cianjur	30 total units

The phased approach optimizes capital deployment and risk management. Phase 1 prioritizes CNA-affiliated properties to leverage existing relationships and minimize location acquisition cost, generating empirical utilization data to inform Phase 2 expansion decisions. Phase 3 integration of mobile application and loyalty systems creates network effects that reinforce utilisaton and competitive differentiation.

Conclusions and Strategic Recommendations

5.1 Conclusions

This study has demonstrated that SPKLU investment by PT Citra Niaga Abadi in West Java is financially feasible across all six machine alternatives evaluated, with three principal conclusions:

First, the West Java SPKLU market presents a structurally compelling investment opportunity. EV population is projected to grow from 52,000 units (2025) to 333,306 units by 2030, requiring 22,220 SPKLU units at a 1:15 ratio—against a current base of approximately 394 units. This infrastructure gap of over 15,000 units by 2030 is the fundamental driver of commercial opportunity.

Second, machine selection is the most critical investment decision variable, exceeding technology type in significance. Among DC machines, Voltron 30DC's competitive pricing (Rp 75,000,000/unit versus Rp 186,000,000 for Starvo 30DC and Rp 350,000,000 for Terra 50DC) produces dramatically superior capital efficiency: IRR of 71.15% versus 53.47% for Starvo 30DC and 65.44% for Terra 50DC. Among AC machines, Voltron 22AC's pricing advantage similarly produces the best AC financial performance (IRR 62.39%, Payback 2.40 years).

Third, Voltron 30DC is the unambiguous primary recommendation with the highest IRR (71.15%), fastest Payback Period (2.28 years), highest Profitability Index (4.85), and a highly significant positive NPV (Rp 1,216,779,478). Its sensitivity analysis confirms robustness across all stress scenarios, including a 60% utilization reduction (IRR still 14.2%) and 40% electricity cost increase (IRR 44.1%). Voltron 22AC is the recommended secondary choice for capital-constrained locations or long-dwell-time facilities.

5.2 Strategic Recommendations

Machine Selection: Deploy Voltron 30DC as primary machine for Phase 1 pilot. Voltron 22AC as secondary alternative for hospital and campus locations. Defer Terra 50DC deployment until Phase 3 when utilization data supports its higher CAPEX requirement.

Location Prioritization: For Voltron 30DC, target locations with 30–60 minute dwell time (mixed-use commercial areas, toll exit zones). For Voltron 22AC, focus on CNA-affiliated Edelweiss hospitals and educational facilities with 2–4 hour average visits.

Utilization Acceleration: Implement targeted EV user outreach and mobile app integration from Month 1 to accelerate utilization above the 20% threshold. Kristanti [33] emphasizes that marketing strategy must connect corporate capabilities with market opportunities through data-driven analysis; CNA should deploy real-time utilization analytics as feedback for dynamic pricing and location optimization. Cross-promotional campaigns within CNA's business ecosystem (hospital patients, school parents, INSPIRA TV audience) provide cost-effective early adopter acquisition consistent with Hidayat and Suryani's [30] consumer behavior-grounded marketing framework.

Partnership Model: Execute revenue-sharing agreements with property partners to minimize land acquisition costs and distribute utilization risk. Target CNA-affiliated properties first (Edelweiss hospitals, Indonesia Juara schools, media office locations) for Phase 1, expanding to third-party commercial partnerships in Phase 2.

Evaluation and Scaling: After 6 months of Phase 1 operations, conduct comparative performance review of deployed machines. Use actual utilization data as the primary basis for Phase 2 machine selection and location expansion decisions.

Future Research: Conduct feasibility analysis of SPKLU integration with rooftop solar PV (PLTS Atap) systems as a long-term strategy for reducing electricity procurement COGS, and analyze sensitivity to regulatory tariff changes under the evolving ESDM framework.

References

IEA: Global EV Outlook 2024. International Energy Agency, Paris (2024).

Ministry of Energy and Mineral Resources (ESDM): Perpres No. 55/2019; Perpres No. 79/2023; Permen ESDM No. 1/2023; Kepmen ESDM 182.K/2023; Kepmen ESDM 24.K/2025. Jakarta.

Gaikindo: Laporan Penjualan Kendaraan Listrik Indonesia 2023. Gaikindo (2023).

PLN UID West Java: SPKLU Development Report and EV Population Data, West Java. PT PLN (Persero), Bandung (2025).

Kasmir, Jakfar: Studi Kelayakan Bisnis (Revised Ed.). Kencana, Jakarta (2020).

Husnan, S., Muhammad, M.: Studi Kelayakan Proyek. UPP STIM YKPN, Yogyakarta (2010).

Ross, S., Westerfield, R., Jordan, B.: Fundamentals of Corporate Finance, 13th edn. McGraw-Hill, New York (2020).

Kristanti, F.T.: Manajemen Keuangan Lanjutan: Pengambilan Keputusan Investasi dan Pembiayaan. Telkom University Press, Bandung (2020).

Buestan-Morales, R., Valdez, J., Melendez, O.: Feasibility analysis of EVCS with solar and battery storage. Energy Systems Review 11(2), 1–25 (2024).

Chandra, A., Wang, L., Tao, M.: Financial modeling of EV charging stations: NPV and IRR evaluations. Applied Energy Finance 17(2), 80–95 (2023).

Khalid, M., Rahman, A., Hassan, R.: Financial assessment of EV charging infrastructure. Journal of Sustainable Energy Finance 18(2), 330–345 (2022).

Chiradeja, P., Suthar, D., Klinkhachorn, P.: Investment feasibility for EV charging stations in residential buildings. Energy Systems Journal 15(1), 22–39 (2025).

Makridakis, S., Wheelwright, S., Hyndman, R.: Forecasting: Methods and Applications. Wiley, New York (1998).

Lee, C., Tan, J., Ng, W.: Techno-economic analysis of DER for EVCS. Journal of Renewable Infrastructure 14(2), 45–61 (2024).

European Commission: Alternative Fuels Infrastructure Regulation (AFIR). EC Publications (2023).

Deloitte: EV Charging Market Study: Southeast Asia Outlook. Deloitte Insights (2023).

McKinsey & Company: Electric Vehicle Infrastructure: Southeast Asia Opportunity. McKinsey Insights (2023).

Al-Falahi, T., Mohammed, O., Khalid, H.: Technical specification analysis of AC and DC charging systems. International Journal of Power Electronics 12(1), 1–22 (2023).

Porter, M.E.: Competitive Strategy: Techniques for Analyzing Industries and Competitors. Free Press, New York (1980).

Ministry of Energy and Mineral Resources (ESDM): SPKLU Partnership Model Guidelines (Perpres 55/2019 and implementing regulations). Jakarta (2023).

DeCorla-Souza, P., Hossain, S.: PPP screening tool for EV charging infrastructure. Journal of Public–Private Infrastructure 14(1), 99–118 (2025).

Creswell, J.W.: Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, 5th edn. SAGE, California (2018).

Sobana, D.H.: Analisis Sensitivitas dan Kelayakan Bisnis. Pustaka Setia, Bandung (2018).

Li, M., Zhou, F., Wang, X.: Operational costs and maintenance of EV fast chargers. Journal of Electric Mobility 9(1), 25–33 (2022).

Figenbaum, E., Thomas, G.: Competitive dynamics in early-phase EV charging markets. Journal of Industrial Economics 69(1), 100–129 (2021).

Rogers, E.M.: Diffusion of Innovations, 5th edn. Free Press, New York (2003).

Kotler, P., Keller, K.: Marketing Management, 15th edn. Pearson, New Jersey (2016).

Tjiptono, F.: Strategi Pemasaran, 4th edn. Andi Offset, Yogyakarta (2017).

Kristanti, F.T., Nugraha, R.: Financial feasibility and risk assessment in infrastructure investment projects. Jurnal Manajemen Indonesia 21(2) (2021).

Hidayat, A.M., Suryani, T.: Strategi pemasaran berbasis analisis lingkungan dan perilaku konsumen. Jurnal Manajemen Indonesia 20(3), 210–224 (2020).

Hidayat, A.M., Nulhakim, S.A.: Analisis lingkungan eksternal dan implikasinya terhadap strategi kompetitif industri. Jurnal Manajemen Indonesia 21(3), 194–208 (2021).

Hidayat, A.M.: Technological disruption and strategic environmental scanning in digital industries. Jurnal Sains Manajemen 11(1), 33–47 (2022).

Kristanti, F.T.: Peran strategi pemasaran dalam menciptakan nilai dan keunggulan bersaing perusahaan. Wacana Ekonomi: Jurnal Ekonomi 19(2), 145–158 (2020).